



THE BURNING QUESTION: How to Fix Flaring

ESG BY EDF: INVESTOR INSIGHTS FOR A LOW-CARBON WORLD

ESG By EDF is a suite of investor-oriented research products providing insights on transition issues in carbon-intensive sectors informed by EDF expertise in science, policy and industry.



Quick Take

- **Flaring by the oil and gas industry is a major source of climate pollution.** Reducing flaring is among the fastest and most impactful ways to cut global greenhouse gas emissions.
- **Addressing flaring is in industry's interest.** The practice is a “black eye” for oil and gas - a visible display of pollution and waste that erodes public support for the industry.
- **Flaring is affordable to fix.** In many cases, flaring can be reduced or eliminated at reasonable cost by integrating flaring abatement into management strategy and processes.
- **Companies should eliminate routine flaring.** We propose commitments for all operators, including zero routine flaring by 2030 at the latest, overall flaring reduction, zero tolerance for unlit flares, and transparent planning and policy advocacy.
- **Disclosure supports accountability.** Company-level information on absolute flaring volumes, flaring intensity, and routine flaring levels is necessary to track progress.
- **Twenty companies in review.** We discuss the commitments, disclosures and flaring performances of 20 large oil and gas companies.
- **Leaders:** bp, Devon, EOG, Equinor, Occidental, PetroChina, Pioneer, Saudi Aramco and Shell
- **Laggards:** ExxonMobil, Hess, CNOOC

EDF AUTHORS:

Andrew Howell, CFA
ahowell@edf.org

Dominic Watson
Andrew Baxter
Gabriel Malek

EDF CONTRIBUTORS:

Colin Leyden
Nichole Saunders
David Lyon
Ben Hmiel
Mark Omara

NON-EDF CONTRIBUTORS:

Clare Staib-Kaufman

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Definitions

NOCs: National Oil Companies

Flaring intensity: EDF's assessment of each company's flaring intensity within its peer group, based on satellite data sourced from Wood Mackenzie and Flaring Monitor, as well as company-reported flaring intensity

WB ZRF30: The World Bank's Zero Routine Flaring by 2030 initiative

WB GGFR: The World Bank Global Gas Flaring Roundtable

ZRF30 Global: Commitment to eliminate routine flaring by 2030

ZRF25 Permian: Commitment to end routine flaring in the Permian Basin by 2025

Flaring intensity: Commitment to a specific flaring intensity target

Key "ask": EDF's assessment of the most impactful next step a company can take to address flaring

Executive Summary

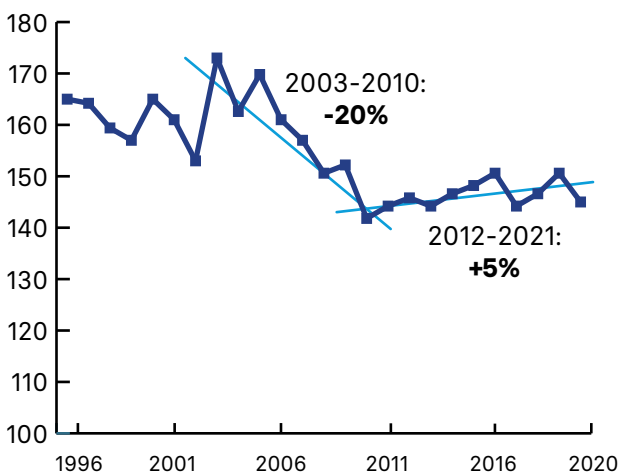
Natural gas flaring is a long-standing oil and gas industry practice with damaging climate, air pollution, and health effects. It is also a source of social and regulatory risk to companies -- and is mostly avoidable through sound planning and management. In this report we look at how investors can manage flaring risk exposure and assess major oil and gas companies on their performance.

Flaring, in which excess natural gas is burned as a waste stream, typically occurs during the production, transportation and processing of oil and gas due to a lack of gas take-away capacity or for safety reasons. Natural gas flares emit carbon dioxide, smog-forming nitrogen oxides, and other pollutants that are damaging to human health. When natural gas is released without burning, for example due to a flare malfunction, large quantities of climate-warming methane can be released directly into the atmosphere.

Flaring and venting are highly visible evidence of pollution and waste by oil and gas operators. In the words of one executive, flaring is a “black eye” for the industry. Pervasive flaring can erode operators’ social license to operate and has spurred campaigns to regulate such emissions through oversight, penalties, and taxes on flaring. Methane emissions have also emerged as a concern among some energy customers, as seen in the abandonment of plans by France’s Engie to import US liquefied natural gas, due to its climate footprint.

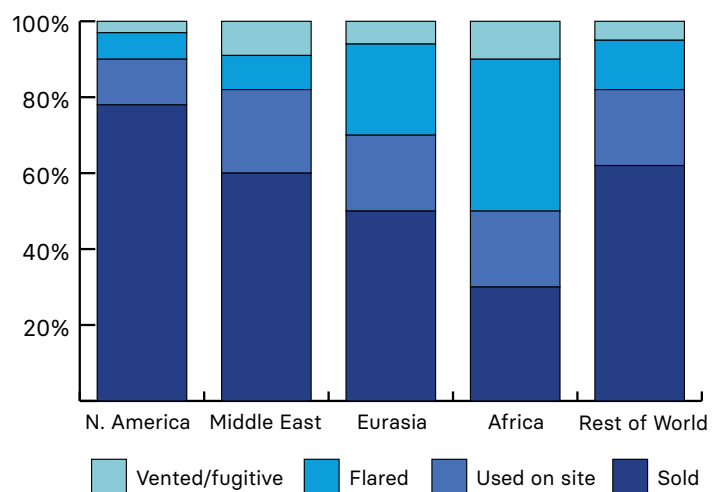
Steps that oil and gas companies take to minimize flaring not only reduce the associated climate and public health impacts, but also represent best practice from a risk management and governance perspective. Investors have good reason to press companies for better performance and transparency on flaring.

Figure 1:
Annual flared volumes (BCM)



Source: World Bank

Figure 2:
Use of associated gas by region, 2019



Source: International Energy Agency

Excessive flaring

Flaring is the disposal of a valuable product as waste. Still, the practice is commonplace: 142 billion cubic meters (BCM) of gas was flared last year, or about 4% of global gas production, representing \$15 billion in value if the gas had been sold. Much of this flaring could be eliminated at minimal cost to operators with better planning and improvements in how gas is used and transported.

The benefits of cutting back on flaring are well understood. Progress, however, has been mixed. Global flaring fell from 2000-2010, but flare volumes have risen modestly over the past decade (see Figure 1). As of 2019, regional flaring rates ranged from 7% in the U.S. to 34% in Africa, according to IEA data (see Figure 2). All major flaring countries have seen an increase over that period, with the sharpest increase in the United States, where flaring surged in 2017-19 amid a rise in tight oil production that was not matched by gas infrastructure.

New commitments and disclosures are needed

We reviewed the flaring intensities, commitments and disclosures of 20 large oil and gas producers, and found they vary considerably across the industry. Many companies have endorsed the World Bank's Zero Routine Flaring by 2030 initiative (ZRF30), or else made a similar pledge. However, in many cases these commitments are not backed by concrete plans to achieve them, nor by disclosures allowing investors to judge progress. Moreover, few have gone beyond ZRF30 to set a more ambitious target, even where that would be relatively easy to achieve and few companies have committed to reduce overall flaring.

We call for all oil and gas operators to make four commitments on flaring:

1. Join the World Bank's Zero Routine Flaring By 2030 initiative, or make an equivalent commitment, and commit to this by 2025 for operations in the US Permian Basin;
2. Adopt a target for overall flaring intensity;
3. Adopt a zero tolerance policy for unlit flares, which are major sources of methane pollution; and
4. Advocate for government policies to reduce flaring and minimize flare malfunctions.

We also call for improvement to flaring disclosures. Few companies report both absolute flaring volumes and flaring intensity, and even fewer report routine flaring, despite commitments to eliminate it. We think all three measures are useful for investors to evaluate company performance.

As Figure 3 makes clear, all the companies we evaluated have room for improvement. We highlight the top "ask" that investors should make to each company. **These commitments and disclosures are achievable, would incur modest cost or result in savings, and with industrywide adoption they would significantly reduce sectoral greenhouse gas emissions.**

In this report we summarize what investors should ask companies to do on flaring; provide background on the technical aspects of flaring; review the performance of 20 companies on flaring intensity, alliances, commitments and disclosures; survey how flaring is regulated around the world; and discuss common and emerging solutions to flaring. In the Appendix we provide additional detail on the flaring performance of the 20 companies we reviewed.

Figure 3.

Summary of flaring performance and key “asks”

		Flaring Intensity	Commitments				Disclosures			Key “Ask”
			ZRF30 Global	ZRF25 Permian	Has flaring intensity target	Zero unlit flare target	Flaring volumes	Flaring intensity	Routine volumes	
Majors	bp	🔥	✓	✓			✓		✓	Set flaring intensity target
	Chevron	🔥🔥	✓		✓		✓	✓		Commit to ZRF25 Permian
	ConocoPhillips	🔥🔥🔥	✓				✓	✓		Commit to ZRF25 Permian
	Eni	🔥🔥	✓	✓			✓		✓	Set flaring intensity target
	Equinor	🔥	✓					✓	✓	Set flaring intensity target
	ExxonMobil	🔥🔥🔥	✓				✓			Endorse WB ZRF30
	Repsol	🔥🔥	✓				✓		✓	Set flaring intensity target
	Shell	🔥	✓				✓		✓	Commit to ZRF25 Permian
	Total	🔥🔥	✓				✓		✓	Set flaring intensity target
Independents	Apache	🔥🔥	✓	✓	✓		✓			Endorse WB ZRF30
	Devon Energy	🔥	✓		✓		✓	✓		Commit to ZRF25 Permian
	EOG Resources	🔥	✓				✓	✓		Commit to ZRF25 Permian
	Hess	🔥🔥🔥			✓		✓	✓		Endorse WB ZRF30
	Occidental	🔥🔥	✓				✓	✓		Commit to ZRF25 Permian
	Pioneer	🔥	✓		✓		✓			Commit to ZRF25 Permian
NOCs	CNOOC Ltd	🔥🔥🔥								Endorse WB ZRF30
	Petrobras	🔥🔥	✓				✓			Set flaring intensity target
	PetroChina	🔥								Endorse WB ZRF30
	Rosneft	🔥🔥🔥					✓	✓		Endorse WB ZRF30
	Saudi Aramco	🔥	✓					✓		Disclose flaring volumes

Flaring Intensity Key: 🔥 Low 🔥🔥 Medium 🔥🔥🔥 High

Source: Company reports and EDF

Leaders & Laggards

Companies that stand out for having low flaring intensities: bp, Equinor and Shell (among majors); Devon, EOG, Occidental and Pioneer (among U.S. independents); and PetroChina and Saudi Aramco (among NOCs).

At the other end of the spectrum, one company in each group stands out for high flaring intensity: ExxonMobil (among majors), Hess (among independents) and CNOOC (among NOCs).

What investors should ask for on flaring

Investors can play an important role in encouraging companies to take stronger action on flaring. As they engage with management teams on climate, investors should give flaring — alongside the related and important issue of overall methane emissions — the focus it deserves as a powerful near-term lever to reduce a company's operational emissions and, in turn, reduce portfolio-wide climate risk.

Commitments

Companies should set more ambitious and concrete targets around flaring reduction goals. A logical starting point is routine flaring (see definition on p. 11), which is usually avoidable with proper planning and infrastructure. Eliminating routine flaring of associated gas should be an explicit goal of every operator. However, ambition should extend beyond zero routine flaring to include minimizing all flaring. By pushing companies to raise their ambition on flaring, investors can secure relatively quick and cost-effective wins to support their net zero transitions. We recommend that investors ask for the following:

- 1. Zero Routine Flaring by 2030: a start.** Twelve out of the 20 companies we reviewed have endorsed the World Bank's ZRF30 initiative, and a further four have made a similar pledge. The remainder should make this commitment, which also includes a "no new routine flaring" pledge i.e., not to bring on new production without a destination or use for the associated gas already in place. In addition, as part of a commitment to ZRF30, each company should disclose concrete plans for getting there.
Greater ambition in the Permian: ZRF25. Companies operating in the Permian Basin, where the necessary infrastructure is generally in place to offtake associated gas, should go beyond ZRF30 and pledge for faster progress. Companies that aspire to climate leadership should consider such a ZRF25 pledge for broader geographies.
- 2. A strong overall flaring intensity target.** Routine flaring only accounts for part of total flaring volumes, and companies should also set targets for reducing their overall flaring footprint. We think a gas flaring intensity target of 1% of gas produced (in line with what Apache and Pioneer have adopted; Devon has gone beyond this to 0.5%), or a flaring emissions total production target of 3kg CO₂/BOE (as Chevron has adopted) are good starting points.
- 3. Zero tolerance for unlit flares.** Given the harmful effects of unlit flares, which vent methane directly into the atmosphere, it is particularly important for companies to be vigilant in ensuring that flares remain lit and function as designed. Steps to ensure optimal flare performance should include frequent monitoring of flares as well as better design, installation, and maintenance. An effective flare minimization and management policy is crucial.
- 4. Policy advocacy.** Companies should advocate for government policies consistent with a significant reduction in flaring activity and associated emissions. In the United States, this advocacy should take place on both a federal and state level. The ongoing development of new US EPA methane regulations provides an opportunity for industry engagement reflective of these commitments.

Disclosures

Too many companies disclose incomplete or unclear flaring information, making it difficult for investors to assess a company's performance or compare one company's activity to another. We call on all companies to disclose at minimum the following three flaring performance metrics, to help investors and other stakeholders evaluate progress.

1. **Absolute flaring volume.** We recommend disclosing both the quantity of gas flared and the CO₂ equivalent and to report flaring volumes both on a gross operated and net equity basis, or at a minimum to clarify the basis of the volumes disclosed.
2. **Flaring intensity.** Since calculating flaring intensity requires additional data and assumptions, companies should report this as well, along with the basis for the calculation, helping stakeholders make comparisons with other producers. Two types of flaring intensity metrics are helpful: volume of gas flared/volume of gas produced and CO₂e emitted/BOE produced. While the former is easier to understand, the latter metric may be more comparable, putting flaring activity into the context of overall oil and gas production.¹ Nine of the 20 companies we reviewed disclose a flaring intensity metric.
3. **Routine flaring volume.** While most companies have a zero routine flaring target, few actually disclose their level of routine flaring in their sustainability reporting.² All companies with such a ZRF commitment should disclose this, allowing investors to gauge progress toward eliminating routine flaring.

As a final note, we encourage companies to provide more detail and granularity on flaring trends and their flaring reduction actions and strategy in their sustainability reporting. In a survey of sustainability reports, we noted a range in the depth and detail of discussions of flaring, ranging from a high of 53 mentions of the word “flaring” by Pioneer, to a low of six by Equinor. By pressing for more specific and comparable flaring information from companies, as well as for clear roadmaps for how companies plan to achieve their goals, investors can better manage the transition risks associated with shifting market conditions and emissions regulations.

Questions to ask management about flaring

When engaging with oil and gas companies on climate policies, the following are questions that investors can pose to management teams to better understand their flaring action and ambitions:

1. Help us understand recent flaring trends. What explains recent increases/decreases, and what are the obstacles preventing you from reducing flaring even more quickly?
2. How is your flaring split between routine and event-driven? Do you have wells without access to gas takeaway infrastructure, and what are the most viable alternative uses for associated gas?
3. How are you reducing event-driven flaring? How do you manage coordination with midstream partners to avoid bottlenecks that cause flaring? What technological solutions do you find most effective to reduce flaring intensity and improve flare performance?
4. What are your flaring reduction targets? If you have committed to eliminate routine flaring, what is your plan to achieve this? Would you be willing to go beyond a ZRF30 commitment to achieve ZRF25, in the Permian or more broadly, or to set a flaring intensity target?
5. How do you disclose flaring performance in your sustainability reporting? Are you willing to commit to reporting total flaring volumes, routine flaring volumes and flaring intensity?
6. What public policies do you advocate to discourage flaring and improve flare performance wherever you operate? In the United States, what is your position on flaring limits at the federal and/or state level, and what steps have you taken to communicate that support publicly and engage policymakers on this issue?

¹A company's flaring intensity can be influenced both by its ratio of associated to non-associated gas production as well as by its overall gas to oil production ratio (GOR). Companies with higher amounts of non-associated gas production will have lower flaring intensity metrics, all else being equal.

²A few companies disclose this information to the World Bank, where it can be viewed on the ZRF30 website.

Flaring 101: What is gas flaring?

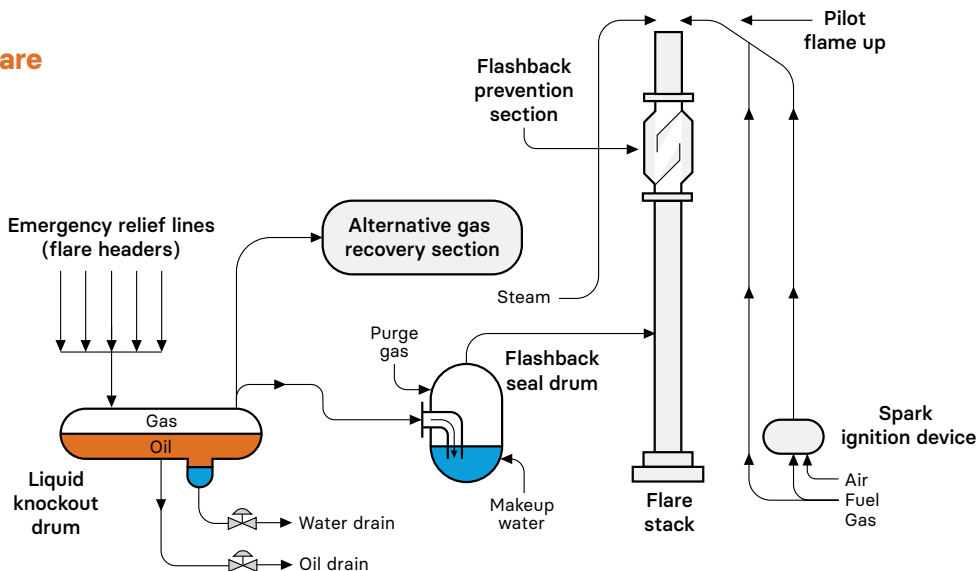
Gas flaring is the combustion of natural gas as waste. While flaring occurs in a number of industrial processes including petrochemical production and landfill operation, in this report we focus on the largest source of flaring: oil production, for which the combustion of associated gas represents the majority of flared gas volumes.

Natural gas is often produced as a by-product during oil extraction where it is known as associated gas. Despite being a valuable resource in its own right, natural gas can be flared for numerous reasons:

- Lack of gas capture and transportation infrastructure. Companies may produce oil without the infrastructure to transport away the associated gas. This might occur when the amount of associated gas is small, when there is a lack of a viable market for the captured gas, or where the operator has initiated oil production in advance of completing the necessary gas infrastructure.
- Lack of on-site uses. Associated gas can be utilized in several ways such as re-injection into the hydrocarbon-bearing geology to provide pressure support, or conversion to compressed natural gas (CNG) or liquified natural gas (LNG) for offtake by truck or other modalities. When none of those are in place, the gas must be flared.
- Midstream bottlenecks. In some cases, gas transportation infrastructure may be in place, but capacity constraints, maintenance or other factors may prevent the offtake of the gas. This is more likely when the gas network is not under the control of the oil producer.
- Safety. A build-up of pressure, which may result from an increase in gas flow as well as downstream bottlenecks may require flaring. Equipment malfunctions that shut down sections of the gas handling process may also cause situations where safety-related flaring is required.

If a producer cannot transport gas away for any of these reasons, the gas must be flared, given that flaring is preferable to venting natural gas directly into the atmosphere. Natural gas, consisting primarily of methane, has a much higher warming potential than CO₂ when vented. Methane venting poses other problems, including the risk of sudden combustion and the release of other hazardous air pollutants contained in the produced gas that have negative health effects on people living close to these sites, as well as on workers involved in oilfield production.

Figure 4:
Typical gas flare



Historically, many oil producers have not taken into account the costs of avoiding flaring in modelling the economics of production in the way that other environmental costs, such as water disposal, are normally included. As a result, true lifting costs of production are often underestimated, and returns exaggerated.

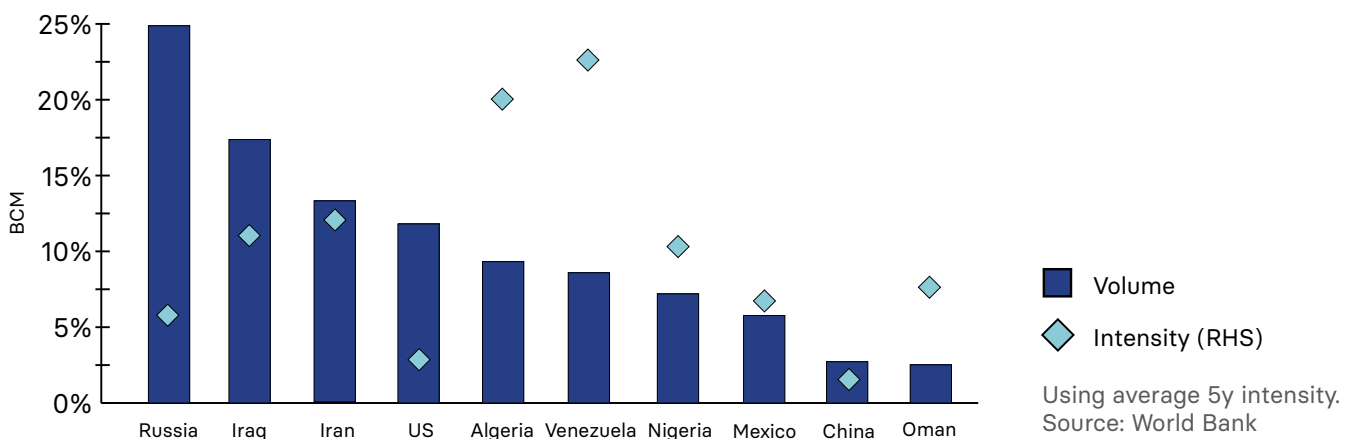
How much gas is being flared?

According to the World Bank’s latest Global Gas Flaring Tracker Report, which reports gas flaring using satellite data (see Box 3), 142 BCM of gas was flared in 2020, which is around 4% of the 4,000 BCM of gas produced globally.³ This gas would have a market value of around \$15 billion in the United States had it been captured and sold at current spot prices (\$3/MMBtu Henry Hub).

The amount of gas flared in 2020 was slightly less than in 2019 — likely due at least partly to a Covid-related slowdown — and similar to 2018. Indeed, flaring volumes have trended in a fairly tight range over the past decade. By country, Russia flares the most (25BCM), followed by Iraq, Iran and the U.S. In terms of flaring intensity (gas flared/gas produced), the highest intensity countries are Venezuela, Algeria, Iran, Iraq and Nigeria (using 5y average intensity). Despite some year-to-year volatility of flaring volumes in individual countries, the course of flaring for most countries has ended up in a relatively tight range over the past five years.

Figure 5:

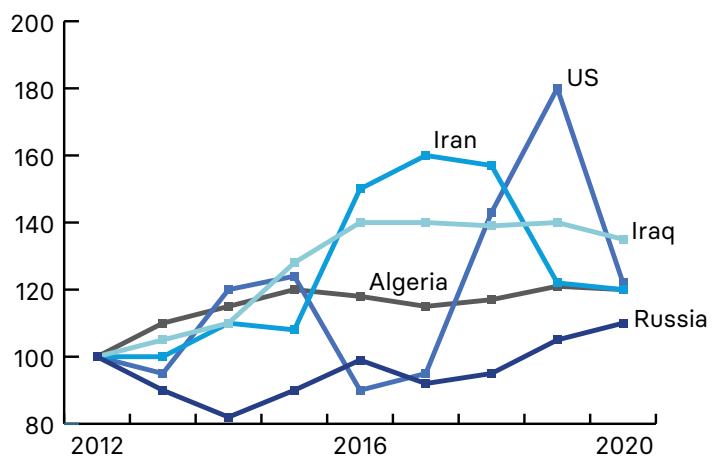
2020 flared volumes and intensity, by highest flaring countries



The U.S. has followed a more volatile trajectory over the past few years, following the rapid increase in oil production in the Permian Basin, where the rush to bring oil production online outpaced investment in gas infrastructure. Natural gas pipeline capacity began to meet demand in late 2019 after Kinder Morgan’s Gulf Coast Express pipeline came online, resulting in much lower flaring volumes in 2020. Looking forward, further pipeline capacity shortages could again become an issue unless operators are more proactive in integrating planning for associated gas into development and production.

Figure 6:

10y flaring volumes, rebased



³ <https://www.iea.org/reports/natural-gas-information-overview>

Source: World Bank

Routine versus event-driven flaring

Most flaring can be classified as being either routine or event-driven, reflecting the reasons that the flaring is taking place.⁴

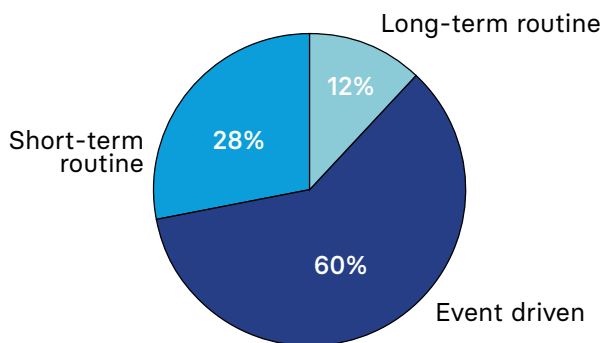
1. **Routine flaring.** This occurs when gas is flared due to a lack of infrastructure to offtake the gas or use it onsite. In some cases, oil production is started before necessary infrastructure to transport the associated gas is put in place. If this takes place in less than a year, the flaring is considered temporary routine flaring; otherwise it is called long-term routine flaring.
2. By contrast, **event-driven flaring** is episodic in nature and occurs when operators flare for safety or maintenance. This can be caused by infrastructure events such as outages and accidents, and midstream takeaway constraints, primarily insufficient pipeline capacity.

In a 2020 study for EDF on flaring in the Permian Basin based on 2019 data, Rystad Energy estimated that two-thirds of flaring was event-driven, and of routine flaring, a considerably higher share was short-term in nature (see Figure 7)⁵. This estimate, it should be noted, took place at a time when Permian operators failed to bring associated gas infrastructure as fast as surging oil production, resulting in significant midstream flaring. In other geographies, the ratio of routine to event-driven flaring may be higher.

Routine flaring generally takes place at production sites, while event-driven flaring can occur at a variety of locations, from the wellhead to midstream operations. In its estimates of flaring-related emissions, the EPA estimates that slightly more overall flaring activity takes place mid-stream than upstream (see Figure 8), while the GHG Inventory indicates that 60% of U.S. oil and gas flaring methane emissions are from upstream, resulting in part from a higher malfunction rate from upstream flares.

Figure 7:

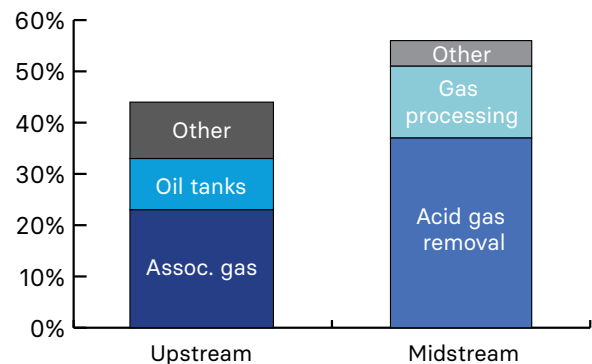
Observed flaring volumes, by type, Permian Basin 2020



Source: Rystad Energy

Figure 8:

CO₂ emissions from flaring in oil and gas inventories



Source: EPA Greenhouse Gas Inventories

Although routine and event-driven flaring often occur for different reasons, lower levels of routine flaring tend to be associated with less event-driven flaring. In its study, Rystad noted that elimination of routine flaring was associated with a 25% reduction in event-driven flaring as well. The reason for this decline is that better upstream gas capture and gathering systems tend to be accompanied by greater investment in midstream infrastructure. Upstream and midstream alignment improve as upstream operators plan for the associated gas in the design process, bringing down flaring overall. This further highlights the importance of reducing routine flaring.

⁴ Some analysts also include a third category of "operational" flaring, which mostly includes intermittent flares that handle small volumes generated from separators on tank batteries or higher MW flash gas. The World Bank classifies flaring into routine, safety or non-routine; both safety and non-routine flaring fit our definition of event-driven flaring.

⁵ Rystad Energy/EDF Permian Basin Flaring Outlook (January 2021)

Climate impact of flaring

Flaring contributes to climate change in two ways. Firstly, through emitted carbon dioxide: 1 cubic meter of combusted natural gas produces about 1.9kg of CO₂.⁶ Last year's 142BCM of flared gas, if fully combusted, would have produced about 270mt of CO₂e.

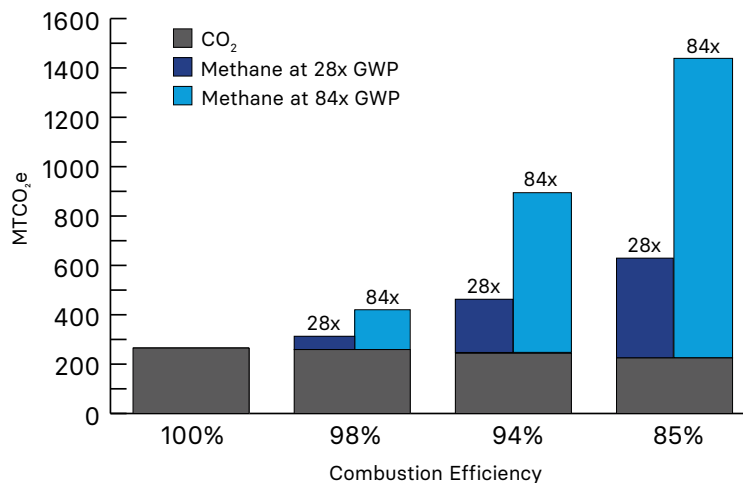
Secondly, methane is also released, because not all natural gas is fully combusted by a flare. This is a problem, because methane has a much more potent warming effect than CO₂ — 28x more over 100 years and 84x over 20 years.⁷ How much methane escapes into the atmosphere is a function of numerous factors including the flow of natural gas to the flare, the composition of that gas and the “destruction efficiency” of the flare. Most emissions inventories such as the U.S. EPA, as well as the World Bank GGFR program, assume that 98% of flared gas is combusted and 2% is vented, primarily as methane. This would raise flaring's implied GHG footprint to 300-400MT CO₂e.

However, there is strong evidence that the actual combustion efficiency of flaring under real life conditions is well below well below 98%.⁸ EDF's PermianMAP work (see Box 1) has shown that many flares do not perform optimally much of the time, resulting in higher levels of vented methane. In the Permian Basin, our team assumes that basin-wide flare combustion efficiency is unlikely to exceed 94% and may be even lower. This is why we argue for strong commitments from all the operators to eliminate flare malfunctions.

Different assumptions for the global combustion efficiency of flares can result in much higher implied GHG footprint from flaring, particularly using a higher global warming potential of 84x for methane (see Figure 9). Under a scenario of a lower combustion efficiency (85%) and high warming potential of methane (84x), flaring's footprint exceeds 1GT CO₂e, which is nearly 2% of global GHG emissions. While flaring's true footprint cannot be known with certainty, it appears that flaring is a greater source of greenhouse gas emissions than widely acknowledged, largely as a result of the methane that escapes the plumes and vents directly to the atmosphere. This is driven home by the recently-released 6th Assessment Report from the International Panel on Climate Change (IPCC), which further emphasized the importance of methane mitigation in slowing near-term climate change.

Reducing the volumes of gas sent to flares by changes in operational practices is the only reliable mechanism to abate emissions from flaring in the natural gas value chain. Moreover, all companies with flares need to take steps to ensure optimal equipment function and develop systems to check facilities for equipment failures, particularly in marginal locations.

Figure 9: **Flaring-related emissions under different assumptions for combustion and methane warming potential**



Source: EDF

⁶ This is equal to 14.5 kg carbon per mmbtu, fully combusted.

<https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references>

⁷ See IPCC, “Anthropogenic and Natural Radiative Forcing” (2018).

⁸ “Methane, Black Carbon, and Ethane Emissions from Natural Gas Flares in the Bakken Shale, North Dakota”, Environ. Sci. Technol. 2017, 51, 9, 5317–532 and “Methane Destruction Efficiency of Natural Gas Flares Associated with Shale Formation Wells”, Environ. Sci. Technol. 2014, 48, 16, 9548–9554

Flaring and Community Health

The impact of flaring extends beyond climate. Wherever flaring occurs, particulate emissions from flaring create a health risk for nearby communities. In the United States, over 500,000 people live within 5km of flaring activities in the Permian, Western Gulf (Eagle Ford) and Williston (Bakken) basins, which together account for 80% of US flaring activities.⁹ In Nigeria's Niger Delta, more than 2m people live within 4km of a flare, while Southern Iraq is another area with a high degree of flaring in proximity to local populations. Thousands of oil sector workers are exposed to flare-related health risks as well.

A number of adverse health impacts derive from flaring¹⁰:

- Flaring is a significant source of nitrogen oxides (NOx) as volatile organic compounds (VOCs) including formaldehyde, acetaldehyde and ethene. NOx and VOCs contribute to the development and exacerbation of asthma as well as the formation of ground-level ozone, which in turn is linked with effects on the respiratory, cardiovascular, and nervous systems and with reproductive effects and mortality.
- Flaring also emits hazardous air pollutants—including benzene and polycyclic aromatic hydrocarbons (PAHs)—as well as particulate matter in the form of black carbon. Benzene and some PAHs are well established carcinogens and have also been linked to birth defects, while exposure to black carbon is associated with higher rates of mortality as well as cardiopulmonary hospital admissions.

These concerns are more than hypothetical: recent research in the United States has found a substantial increase in preterm births associated with residence within 5 km of 10 or more flares during pregnancy¹¹.

Flaring is an environmental justice issue as well. In the Permian and Western Gulf regions of the U.S., populations living in proximity to flaring in several basins are predominantly made up of people of color. Native Americans -- particularly members of the Mandan, Hidatsa, and Arikara Nation -- make up a significant proportion of the population living in proximity to the Williston Basin, where a high volume of flaring takes place.

Why flaring is an ESG issue

The flaring issue touches on all of the core pillars of ESG. The adverse environmental impact results from avoidable emissions of CO₂ and methane. The social impact is driven by the harmful effects of associated air pollution on workers and communities as well as the health risks stemming from inadvertent combustion of leaked methane. Another impact stems from the missed revenues to states and landowners when gas is flared rather than delivered to market. Finally, flaring is clearly a governance issue, as this problem can be almost entirely avoided when integrated into management planning and decisions.



E

Environmental

Flaring emits climate-warming CO₂, methane, & other air pollutants



S

Social

Pollution impacts communities & workers



G

Governance

Excess flaring reflects a lack of management focus

⁹ "Up in smoke: characterizing the population exposed to flaring from unconventional oil and gas development in the contiguous US", Lara J Cushing et al 2021 Environ. Res. Lett. 16 034032 Ibid.

¹⁰ "Flaring from Unconventional Oil and Gas Development and Birth Outcomes in the Eagle Ford Shale in South Texas", Lara J Cushing et al 2020 Environ. Health Perspectives

¹¹ "Flaring from Unconventional Oil and Gas Development and Birth Outcomes in the Eagle Ford Shale in South Texas", Lara J Cushing et al 2020 Environ. Health Perspectives

BOX 1: PermianMAP flaring project

EDF's Permian Methane Analysis Project (PermianMAP) is a methane monitoring and research project aiming to provide transparent and accessible methane emissions data from one of the world's largest oil fields. Starting in early 2020, EDF's PermianMAP team has been conducting advanced emissions monitoring in high producing areas of the Permian Basin using tower-based monitors, frequent aircraft and helicopter surveys, as well as ground-based measurements. A full methodology from the project is available [here](#).

To examine methane emissions from flaring, PermianMAP researchers performed flyovers of flares with a custom infrared camera deployed in an R44 helicopter. Through four randomized helicopter flaring surveys, covering more than 1,000 high-producing well sites over the course of 2020, EDF found a consistent rate of around 5% of flares that were malfunctioning and only partially lit, and another additional 5% that were entirely unlit and venting methane directly to the atmosphere. During a smaller study observing >200 flares multiple times over the course of a week, over half of the malfunctioning flares had recurring malfunctions and about a quarter never operated properly during that week.

In EDF's most recent helicopter flaring survey from Spring 2021, the survey protocol was expanded to include marginal sites, as well as high-producing sites.¹² As a result, the rate of malfunctioning flares observed tripled from 10% to around 30%. These new findings highlight significant concerns about rates of methane emissions from low-producing and marginal well sites, from flaring as well as other sources. It is thought that a combination of older equipment, less frequent maintenance and reduced production, and therefore intermittency in which these sites need to flare gas, all may be contributing to a higher rate of malfunctions at those locations.

Despite the fact that marginal wells make up the vast majority of wells across the country, operators often seek to have them exempted from state and federal emissions standards. Protocols to regularly check these marginal facilities for equipment failures could help to substantially reduce the rate of flare malfunctions.

Lit flare (L) and unlit flare (R) as seen from an R44 helicopter via infrared camera.

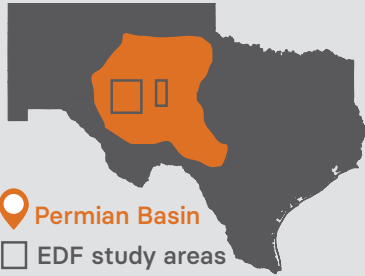


Still taken from video footage.
Photo credit: PermianMAP

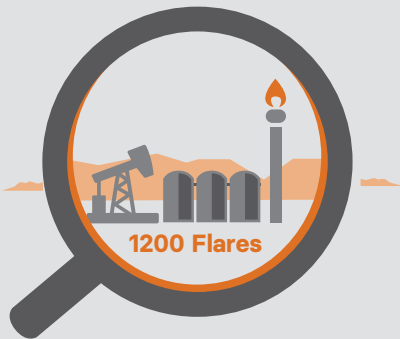
¹² See EDF Blog, "What new Permian research means for U.S. methane policy"

Permian oil & gas flaring emissions

Where we studied



What we studied



How we did it

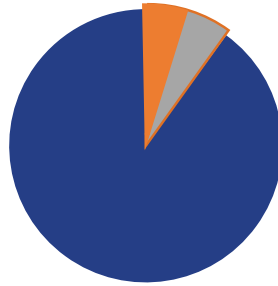


Periodic, covers flares in various areas
Feb. | March | June | Nov.

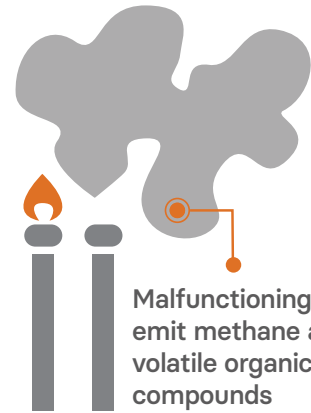


Consecutive, covers all flares in one area
Nov. 2 | Nov. 4 | Nov. 6

What we found

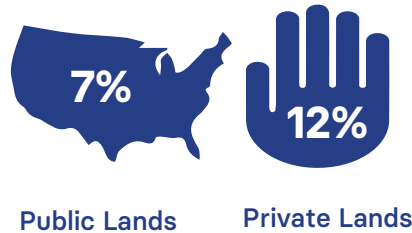


10% Flares are malfunctioning
5% Are unlit and venting

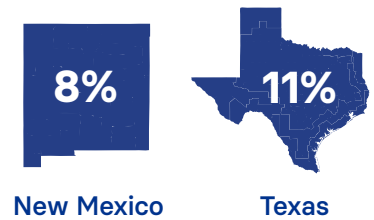


Where it's worst

Malfunction rate by land owner



Malfunction rate by location

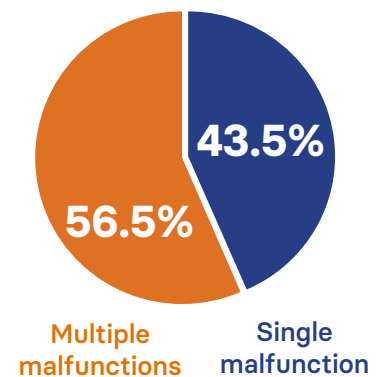


Why flares fail



Repeat offenders

More than half of flares malfunction repeatedly



Data as of February 10, 2021
Learn more at PermianMAP.org

Flaring by 20 oil and gas companies

We have reviewed the flaring performance, commitments and disclosures by 20 listed oil companies: Nine majors (bp, Chevron, ConocoPhillips, Eni, Equinor, ExxonMobil, Repsol, Shell and TotalEnergies), six U.S. independents (Apache, Devon, EOG, Hess, Occidental and Pioneer) and five National Oil Companies (CNOOC, Petrobras, PetroChina, Rosneft and Saudi Aramco). These firms are generally the oil companies with the largest flaring volumes in their category.

To assess each company's flaring intensity, we considered both company-reported data and a dataset of satellite-measured flaring from Wood Mackenzie and Flaring Monitor. To assess commitments and disclosures, we have reviewed sustainability reports and CDP questionnaire responses¹³ as well as reaching out to company management teams directly.

While the data reveals a range of performances on flaring, the conclusion is clear: The majority of companies we reviewed can do more to reduce flaring and to improve flaring-related disclosure. These results showcase the need for heightened investor engagement to raise the bar on flaring as well as a need for improved public policy. We summarize the overall findings here; in the Appendix we discuss individual operator performance.

Flaring intensity

We reviewed the disclosed flaring volumes and intensities for the 20 companies and compared this with satellite-based data from Flaring Monitor for U.S. production and from Wood Mackenzie for other locations. While companies tend to measure flaring volumes using a mix of direct measurement and estimation, the satellite data uses sensor readings of heat signatures from natural gas flares (see Box 2). The global dataset we reviewed ran through 2019, while the U.S. data was available through 2020.

Figure 10 displays flaring intensity for each company in 2019 based on satellite-measurements and self-reported flaring intensity, while Figure 11 shows U.S.-only flaring data for 2019 and 2020.

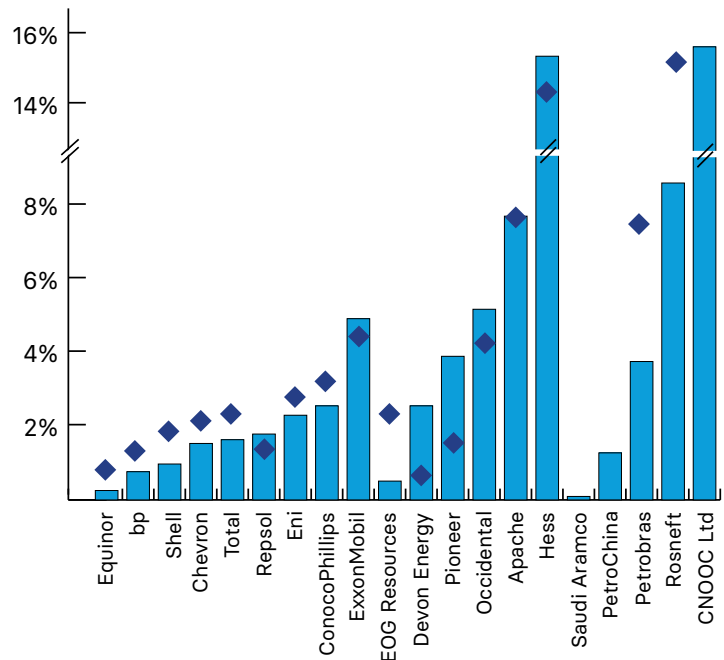
Figure 10:

Global gas flaring intensity, 20 companies, 2019

- ◆ Company reported
- Satellite estimated

Gas flaring intensity = flared gas / produced gas.

Source: Wood Mackenzie, Flaring Monitor and company reports



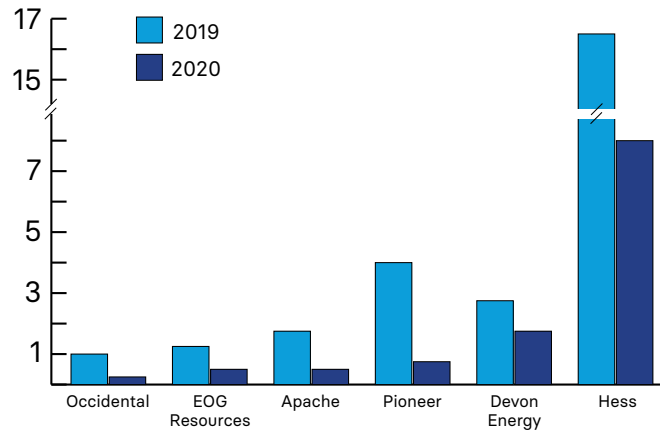
¹³ Especially question C-OG4.8: "If flaring is relevant to your oil and gas production activities, describe your organization's efforts to reduce flaring, including any flaring reduction targets."

Some observations regarding Figures 10 and 11 include:

- A wide range of flaring rates.** Within each group, flaring intensity ranges widely. This is most striking among the national oil companies (where 2019 intensity ranges from below 0.5% at Saudi Aramco to over 16% at CNOOC). Companies with flaring intensities on the lower end of the range are Equinor, Shell and bp (among the majors); EOG and Occidental (independents); and PetroChina and Saudi Aramco (NOCs). One firm in each group stood out for a higher flaring intensity: ExxonMobil (majors), Hess (independents) and CNOOC (NOCs).
- Differences between satellite measurements and company-reported flaring.** In many cases the satellite data collected by Wood Mackenzie and Flaring Monitor matches fairly closely with what the companies reported, but in a few cases there are significant differences. This divergence may be due to a number of factors discussed in Box 2. That said, both sources of data generally give a consistent signal as to the relative flaring intensity (low, moderate or high) of a company within its peer group.
- A sharp decline in intensity in the U.S. in 2020.** Following a surge in 2017-2019 driven by rising production, particularly in the Permian Basin, all of the U.S. operators saw declines in flaring intensity due to a combination of better gas takeaway capacity and Covid-related decreases in activity.

Figure 11:

U.S.-only gas flaring intensity, six companies, 2019 and 2020



Source: Flaring Monitor

BOX 2: Detecting flares by satellite

Unlike other sources of oil and gas emissions such as methane, gas flares are observable by the naked eye and can be measured from space, with their brightness directly related to the volume of gas being combusted.

For nearly a decade the U.S. National Oceanic and Atmospheric Administration (NOAA) Joint Polar Satellite System (JPSS) has been observing global flaring activity. The JPSS's Visible Infrared Imaging Radiometer Suite of detectors (VIIRS), mounted on the Suomi-NPP and NOAA-20 polar-orbiting satellites, gather readings of flaring activity, with each satellite measuring the intensity of flares worldwide once per 24 hours at a spatial resolution of 1 km². The VIIRS sensors respond to heat emissions at wavelengths where emissions from flares are at a maximum, allowing them to be distinguished from other heat sources.

The Earth Observation Group (EOG), part of the Payne Institute at the Colorado School of Mines, receives, processes and makes available the VIIRS data through a product called VIIRS Nightfire (VNF). EOG also provides an annual estimate of gas flared volumes at individual flaring sites globally, including flaring sites in the upstream (production sites), midstream (e.g., compressor stations, processing plants, LNG) and downstream (e.g., crude oil refineries) facilities. This estimate is based on previously-derived correlations between satellite-derived flare brightness and gas flared volumes.¹⁴

¹⁴ <https://www.mdpi.com/1996-1073/9/1/14>

Several factors can impede the ability of the VIIRS sensors to measure flaring activity accurately. Foremost among these is the periodic nature of event-driven flaring: each VIIRS instrument measures each flare site once every 24 hours, and only at night. If an intermittent flare is not active at that time, it will not be measured. Cloud cover can also obstruct visibility, although VNF algorithms make some adjustment for these effects.

With the support of the Oil and Gas Climate Initiative (OGCI), a new web-based application will expand the variety and quality of the Earth Observation Group's VIIRS flaring data starting in 2022.

Figure 12:

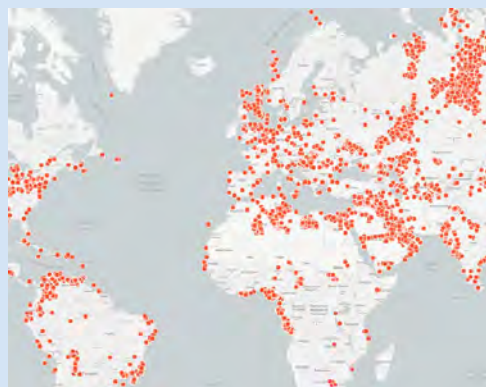
Suomi NPP satellite containing VIIRS sensors



Source: Nasa https://www.nasa.gov/mission_pages/NPP/mission_overview/index.html

Figure 13:

Annual Flaring Volume Estimates from Earth Observation Group (2012-2020)



Source: SkyTruth

In order to attribute satellite-derived flaring estimates to individual companies, the VNF data needs to be mapped to a given operator based on geographic coordinates. Because the VIIRS instrument detects flaring radiances within each $\sim 1 \text{ km}^2$, this mapping can be uncertain, particularly in basins with high density of flaring sites and multiple operators. The satellite flaring data reviewed for this report is sourced from Flaring Monitor and Wood Mackenzie, which have mapped the VNF data to operators. In the U.S., where many operators work in close proximity, Flaring Monitor has developed an approach based on well pad matching.

Comparing satellite-measured flaring data with company-reported data is subject to a number of uncertainties that make strict comparisons difficult. Companies use a range of measurement and estimation techniques that may be subject to error. In some cases, measurement is limited to production sites, meaning flaring at compressor stations/processing plants/refineries may not be disclosed. In others, the company-reported flaring data may include vented gas which is not measured by the satellites. There is also a question of reporting basis; often, companies report flaring on an operated basis but total gas production on a net equity basis, complicating efforts to calculate a meaningful flaring intensity ratio.¹⁵

In this analysis, the satellite-measured flaring volumes and intensities were often lower than the company-reported flaring data. By contrast, in its PermianMap research EDF has found that company-reported upstream flare volumes in the Permian Basin were often lower than satellite readings.

¹⁵ Some jurisdictions, e.g., the Texas Railroad Commission, make no distinction between flared gas and vented gas, requiring operators to combine the two in their reports.

Flaring commitments

Nearly all the companies we reviewed can do more to reduce flaring. A key step in evaluating a company's commitment to flaring reduction is an assessment of flaring reduction targets. We highlight four commitments that we believe each company should make on flaring:

- 1. Zero Routine Flaring by 2030: a start.** Twelve out of the 20 companies we reviewed have endorsed the World Bank's ZRF30 initiative, and a further four have made a similar pledge. The remainder should make this commitment, which also includes a "no new routine flaring" pledge i.e., not to bring on new production without a destination or use for the associated gas already in place. In addition, as part of a commitment to ZRF30, each company should disclose concrete plans for getting there.
Greater ambition in the Permian: ZRF25. Companies operating in the Permian Basin, where the necessary infrastructure is generally in place to offtake associated gas, should go beyond ZRF30 and pledge for faster progress. Companies that aspire to climate leadership should consider such a ZRF25 pledge for broader geographies.
- 2. A strong overall flaring intensity target.** Routine flaring only accounts for part of total flaring volumes, and companies should also set targets for reducing their overall flaring footprint. We think a gas flaring intensity target of 1% of gas produced (in line with what Apache and Pioneer have adopted; Devon has gone beyond this to 0.5%), or a flaring emissions total production target of 3kg CO₂/BOE (as Chevron has adopted) are good starting points.
- 3. Zero tolerance for unlit flares.** Given the harmful effects of unlit flares, which vent methane directly into the atmosphere, it is particularly important for companies to be vigilant in ensuring that flares remain lit and function as designed. Steps to ensure optimal flare performance should include frequent monitoring of flares as well as better design, installation, and maintenance. An effective flare minimization and management policy is crucial.
- 4. Policy advocacy.** Companies should advocate for government policies consistent with a significant reduction in flaring activity and associated emissions. In the United States, this advocacy should take place on both a federal and state level. The ongoing development of new US EPA methane regulations provides an opportunity for industry engagement reflective of these commitments.

Disclosures

Too many companies disclose incomplete or unclear flaring information, making it difficult for investors to assess a company's performance or compare one company's activity to another. We call on all companies to disclose at minimum the following three flaring performance metrics, to help investors and other stakeholders evaluate progress.

- 1. Absolute flaring volume.** We recommend disclosing both the quantity of gas flared and the CO₂ equivalent and to report flaring volumes both on a gross operated and net equity basis, or at a minimum to clarify the basis of the volumes disclosed.
- 2. Flaring intensity.** Since calculating flaring intensity requires additional data and assumptions, companies should report this as well, along with the basis for the calculation, helping stakeholders make comparisons with other producers. Two types of flaring intensity metrics are helpful: volume of gas flared/volume of gas produced and CO₂e emitted/BOE produced. While the former is easier to understand, the latter metric may be more comparable, putting flaring activity into the context of overall oil and gas production.¹ Nine of the 20 companies we reviewed disclose a flaring intensity metric.

3. Routine flaring volume. While most companies have a zero routine flaring target, few actually disclose their level of routine flaring in their sustainability reporting.² All companies with such a ZRF commitment should disclose this, allowing investors to gauge progress toward eliminating routine flaring.

As a final note, we encourage companies to provide more detail and granularity on flaring trends and their flaring reduction actions and strategy in their sustainability reporting. In a survey of sustainability reports, we noted a range in the depth and detail of discussions of flaring, ranging from a high of 53 mentions of the word “flaring” by Pioneer, to a low of six by Equinor. By pressing for more specific and comparable flaring information from companies, as well as for clear roadmaps for how companies plan to achieve their goals, investors can better manage the transition risks associated with shifting market conditions and emissions regulations.

Figure 14 summarizes the flaring intensity performance, targets and disclosures of the companies we reviewed. We also indicate what we see as the key “ask” i.e, the next logical step we have identified for each company on the road to better flaring performance.

Figure 14.

Summary of flaring performance and key “asks”

		Flaring Intensity	Alliances		Commitments				Disclosures			Key “Ask”
			WB ZRF30 endorser	WB GGFR partner	ZRF30 Global	ZRF25 Permian	Has flaring intensity target	Zero unlit flare target	Flaring volumes	Flaring intensity	Routine volumes	
Majors	bp	🔥	✓	✓	✓	✓			✓		✓	Set flaring intensity target
	Chevron	🔥🔥	✓	✓	✓		✓		✓	✓		Commit to ZRF25 Permian
	ConocoPhillips	🔥🔥🔥	✓		✓				✓	✓		Commit to ZRF25 Permian
	Eni	🔥🔥	✓	✓	✓	✓			✓		✓	Set flaring intensity target
	Equinor	🔥	✓	✓	✓					✓	✓	Set flaring intensity target
	ExxonMobil	🔥🔥🔥		✓	✓				✓			Endorse WB ZRF30
	Repsol	🔥🔥	✓		✓				✓		✓	Set flaring intensity target
	Shell	🔥	✓	✓	✓				✓		✓	Commit to ZRF25 Permian
	Total	🔥🔥	✓	✓	✓				✓		✓	Set flaring intensity target
Independents	Apache	🔥🔥			✓	✓	✓		✓			Endorse WB ZRF30
	Devon Energy	🔥			✓		✓		✓	✓		Commit to ZRF25 Permian
	EOG Resources	🔥	✓		✓				✓	✓		Commit to ZRF25 Permian
	Hess	🔥🔥🔥					✓		✓	✓		Endorse WB ZRF30
	Occidental	🔥🔥	✓		✓				✓	✓		Commit to ZRF25 Permian
	Pioneer	🔥			✓		✓		✓			Commit to ZRF25 Permian
NOCs	CNOOC Ltd	🔥🔥🔥										Endorse WB ZRF30
	Petrobras	🔥🔥	✓		✓				✓			Set flaring intensity target
	PetroChina	🔥										Endorse WB ZRF30
	Rosneft	🔥🔥🔥							✓	✓		Endorse WB ZRF30
	Saudi Aramco	🔥	✓		✓					✓		Disclose flaring volumes

Flaring Intensity Key: 🔥 Low 🔥🔥 Medium 🔥🔥🔥 High

Source: Company reports and EDF

BOX 3: Disclosure frameworks around flaring

Mainstream ESG disclosure frameworks all encourage oil and gas companies to report at least some information on flaring emissions. These frameworks provide investors with a foundation to engage companies on flaring. Companies across the oil and gas sector often include absolute flaring data in their sustainability reporting, but not flaring intensity or routine flaring volume. Investors can strengthen their flaring engagements by encouraging SASB, CDP, GRI and TCFD to add language on flaring intensity and routine flaring to their reporting frameworks.

SASB: SASB addresses flaring explicitly in its disclosure recommendations for oil and gas exploration and production companies. Metric EM-EP-110a.2 asks companies to report gross global Scope 1 emissions from “(1) flared hydrocarbons, (2) other combustion, (3) process emissions, (4) other vented emissions, and (5) fugitive emissions.”¹⁶ The metric specifies that flared hydrocarbons include “all emissions emitted from flares and which are associated with the management and disposal of unrecoverable natural gas via combustion of hydrocarbon products and routine operations, upsets, or emergencies.” Additionally, metric EM-EP-110a.3, which asks companies to discuss their long- and short-term approaches to mitigate Scope 1 emissions, calls out flaring as one source of emissions that may require specific attention. In practice, companies often link their absolute flaring volume data to SASB metric EM-EP-110a.2 and tie their flaring reduction strategies to metric EM-EP-110a.3.

CDP: CDP’s questionnaire for oil and gas companies features a stronger flaring focus than its peer disclosure frameworks. For metric C-OG42.c, which asks companies whether they have methane-specific emissions reduction targets, CDP notes that common methane reduction targets involve flaring curtailment. CDP also devotes an entire section (C-OG4.8) to “flaring reduction efforts.” The section asks companies to describe company-specific flaring reduction plans and asks companies without flaring reduction initiatives to explain why flaring is not relevant to their operations. Finally, in C-OG7.1 on Scope 1 emissions, CDP, like SASB and TCFD, recommends that companies disclose absolute methane and CO₂ emissions from flaring. Companies that release CDP reports tend to respond to all three of these flaring-related sections.

GRI: Intended to apply to companies across all sectors, GRI provides the least guidance to oil and gas companies on flaring disclosure. In its recommended disclosure 305-1 on Scope 1 emissions, GRI lists flaring as a “type of activity” that may lead to greenhouse gas emissions. Otherwise, GRI does not discuss flaring. GRI is in the process of developing sector-specific standards for oil and gas that are set to be released in Q4 of 2021.

TCFD: Because it is sector-agnostic, the general TCFD framework does not explicitly mention flaring. However, in its supplemental guide for the energy sector, TCFD has one metric that addresses flaring. TCFD urges companies to disclose in MT of CO₂e their amount of gross global Scope 1 emissions from “(1) combustion, (2) flared hydrocarbons, (3) process emissions, (4) directly vented releases, and (5) fugitive emissions/leaks.”¹⁷ This recommendation is almost identical to SASB metric EM-EP-110a.2. Given these similarities, most companies map their absolute flaring emissions onto the SASB framework, especially because most firms consult the general TCFD framework rather than the supplementary energy sector materials.

¹⁶ Oil & Gas - Exploration & Production – Sustainability Accounting Standard, SASB (2018)

¹⁷ Implementing the Recommendations of the Task Force on Climate-related Financial Disclosures, TCFD (2017)

Flaring regulation

Investors have good reason to engage companies to encourage action on flaring: regulatory risk. While regulators have taken a permissive view of flaring in the past, resulting in fairly ineffectual regulation and/or lax enforcement in many jurisdictions, regulatory scrutiny is likely to increase in the future. As the malign impacts of flaring on the environment and human health become better understood, the highly visible flare is an appealing target.

Indeed, flaring is a strong candidate for regulation, being a classic example of an environmental market failure where the actions of individuals have unintentional and uncompensated harmful effects on others.¹⁸ While select members of industry have demonstrated leadership on reducing flaring, industry action on the whole has proven far from sufficient to address the issue. Mitigating climate-related financial risks and achieving net zero investing goals thus depends on improved public policy on flaring.

As calls for policy action and competition from cleaner energy sources intensify, investors should consider opportunities to work with both companies and policy makers to support the development of sensible yet ambitious action to address flaring and associated pollution.¹⁹

Global flaring policy

While the economic, environmental and health impacts of flaring have been widely acknowledged by governments of oil producing countries around the world, regulatory policies to address the issue remain limited. Seven countries — Russia, Iraq, Iran, the United States, Algeria, Venezuela and Nigeria — contribute to around 65% of global flaring, yet none have comprehensive policies to reduce flaring aggressively.²⁰

Even in countries where some flaring policies are in place, in Algeria or Nigeria for example, enforcement remains lax. The considerable influence of national oil companies in these countries as well as these nations' economic reliance on the oil and gas industry often means regulatory bodies will offer companies virtually unlimited exemptions for flaring without consequence or overlook company flaring entirely.

Flaring and venting are often covered by more than one regulatory body or institution. As venting and flaring touches on both the efficient use of a country's natural resources as well as air pollution issues, in many countries both the ministry of petroleum or energy as well the ministry of the environment will each have overlapping authority to address flaring.

¹⁸ Keohane N.O., Olmstead S.M. (2016) Market Failures in the Environmental Realm. In: Markets and the Environment. Island Press, Washington, DC. https://doi.org/10.5822/978-1-61091-608-0_5

¹⁹ "The Inevitable Policy Response 2021: Policy Forecasts." UN Principles for Responsible Investment, March 17, 2021.

²⁰ "Global Gas Flaring Tracker Report." World Bank GGFR, April 2021

Figure 15:

Summary of international regulatory frameworks around flaring

Country	ZRF30	Flaring Intensity ²¹	Main Regulatory Authority	Overall Targets	When is Flaring Allowed	Permits and Penalties	Comments
Russia	✓	6.9%	Ministry of Natural Resources; Regional authorities	National GHG emissions 70%-75% below 1990 levels by 2030	Russia officially requires an associated petroleum gas utilization rate of 95% for all major fields. Associated petroleum gas is also given priority pipeline access. ²²	Russia officially has substantial penalties in place for noncompliance for both routine and emergency flaring, potentially including up to a license withdrawal.	Despite official rules, a lack of monitoring and enforcement, particularly for Russian operators, means limited compliance with the requirements.
Iraq ²³	✓	11.6%	Environment Ministry; Ministry of Oil	No official flaring target, but statements that flaring would be eliminated by 2025	It is not clear whether there are any official limits on flaring, however, in recent years the Iraqi government and NOCs have looked to partner with foreign companies to build gas capture and utilization infrastructure. ^{24, 25, 26}	The Environment Ministry has reportedly levied fines against Basra Oil for flaring, but it is often cheaper to pay the fines than reduce flaring. ²⁷	Given that it currently imports gas from Iran, Iraq has clear economic and geopolitical incentives to mitigate flaring. But a lack of investment has historically limited buildout of gas capture infrastructure.
Iran ²⁸		13.6%	Ministry of Petroleum	National GHG emissions reduced 4% by 2030 vs. BAU	A 2017 law directed the Iranian Government to limit flaring to 10% of associated petroleum gas production by 2021. ²⁹	Unclear	Significant investment in gas capture infrastructure is needed to mitigate flaring in Iran. However, U.S. sanctions may limit foreign funding.

²¹ Flaring intensity = Natural gas flared divided by barrel of oil produced. Source: World Bank GGFR

²² Hines, Jon et al., "Oil and gas regulation in the Russian Federation: overview." Thomson Reuters Practical Law, April 1, 2021

²³ Based on best publicly available information, access to reliable sources on up-to-date flaring policy for the country is limited.

²⁴ Hasan, Hadeel A. and Slava Kiryushin. "First-step analysis: the oil market and regulation in Iraq." DWF Group, May 29, 2021

²⁵ "Amid ongoing conflict, Iraq to Begin Snuffing Out Flares." World Bank GGFR, May 9, 2017

²⁶ Al Ansary, Khalid. "Iraq Discussing \$7 Billion Energy Deal With Total, Minister Says." Bloomberg, March 27, 2021

²⁷ Rubin, Alissa J. and Clifford Krauss. "Southern Iraq's Toxic Twilight." New York Times, July 16, 2020

²⁸ Based on best publicly available information, access to reliable sources on up-to-date flaring policy for the country is limited.

²⁹ "Iran Passes Law to Curtail Gas Flaring." Financial Tribune, January 2, 2017

Country	ZRF30	Flaring Intensity ²¹	Main Regulatory Authority	Overall Targets	When is Flaring Allowed	Permits and Penalties	Comments
Algeria		22.7%	Ministry of Energy and Mines; National Agency for the Valorization of Hydrocarbon Reserves	Algeria's NDC commits to no more than 1% flaring by 2030	Routine flaring is officially prohibited in Algeria, but there appear to be significant gaps in monitoring and enforcement. ³⁰	Flaring on new fields, often operated by private oil companies, appears to be limited. Almost all flaring occurs in older fields operated by Sonatrach.	Due to Sonatrach's considerable political and economic influence in Algeria, it appears the company is largely exempt from government restrictions on flaring.
Venezuela		44.5%	Ministry of Environment and Renewable Natural Resources	National GHG emissions reduced 20% by 2030 vs. BAU	Venezuela does not limit venting and flaring, but instead sets air quality and maximum emissions limits for pollutants. MARNR sets standards on a case-by-case basis, but it is understood the oil industry follows its own guidelines. ³¹	Permits to flare are granted by MARNR on a case-by-case basis. The government also has the legal right to take associated gas that an operator does not use, often for free or at a discounted price.	Severe political conflict has been associated with an increase in gas flaring in oil-producing countries. In Venezuela over the last two years, flaring has increased sharply while production has declined following similar trends seen in Syria and Yemen. ³²
Nigeria	✓	11%	Ministry of Petroleum Resources	National GHG emissions 20% below 2010-14 levels by 2030	Since 2008, all non-operational gas venting and flaring has been officially prohibited in Nigeria, except in limited circumstances. ³³	The Department of Petroleum Resources grants permits to flare gas and levies flaring penalties. ³⁴	Though Nigeria remains the seventh-largest flaring country in the world, Nigeria has achieved significant progress on flaring over the past 15 years, decreasing flaring by 70% since 2000. ³⁵

³⁰ "Study on Possible Reductions of Gas Flaring in Algeria." Carbon Limits (Nigeria), July 1, 2019

³¹ "Regulation of Associated Gas Flaring and Venting." World Bank GGFR, August 2004

³² "Increased Shale Oil Production and Political Conflict Contribute to Increase in Global Gas Flaring." World Bank Global Gas Flaring Reduction Partnership, June 12, 2019

³³ "Assessing the Impact of Gas Flaring on the Nigerian Economy." PWC, 2018

³⁴ "The Flare Gas (Prevention of Waste and Pollution) Regulations 2018." Nigerian Gas Flare Commercialization Programme, July 2018

³⁵ "Global Gas Flaring Tracker Report." World Bank GGFR, April 2021

United States

In the U.S., major oil basins, including the Permian and the Bakken, have seen high levels of flaring in recent years. At the federal level, no rules are currently in place to limit flaring, and action by Congress on this issue appears unlikely. However, the Biden administration is currently considering revising and reinstating Obama-era regulations from the Bureau of Land Management, recently vacated by a district court, that would limit venting and flaring on federal and tribal lands. Additionally, via forthcoming methane rules currently under consideration by the EPA, the Biden administration now has an opportunity to put in place regulations covering all U.S. oil and gas operations that would eliminate routine venting and flaring of associated gas and ensure that flares are operating efficiently where flaring persists.

By and large, flaring is thus regulated on a state level. Colorado and New Mexico have adopted comprehensive regulations to limit flaring, with buy-in from both industry and environmental stakeholders. This example demonstrates that effective rules can be implemented with a broad base of support.

Concerted regulatory action from other producing states has been more limited. In September 2020, large institutional investors representing more than \$2 trillion called on the Texas Railroad Commission to take steps to eliminate routine flaring by 2025.³⁶ However, the regulator has yet to show a willingness to adopt a firm regulatory pathway to ending routine flaring in the state.

³⁶ [Investment Giants Urge Texas to End Most Natural Gas Flaring](#), Bloomberg News, September 2020

Figure 16:

Summary of U.S. state regulatory frameworks around flaring

State	Flaring Intensity 2019 ³⁷	Main Regulatory Authority	Overall Targets	When is Routine Flaring Allowed	Permits and penalties	Comments
North Dakota	19.3% ³⁸	North Dakota Industrial Commission (NDIC)	None	NDIC allows flaring up to one year after completion outside of major basins and 90 days in Bakken and Three Forks. After, operators must meet a 91% gas capture target. ^{39, 40, 41}	If connection to a gas gathering system can be shown to not be economically feasible, operators can seek a permitted exemption.	Though North Dakota has made relative progress in bringing down flaring in recent years, the state's economic reliance on oil makes it unlikely to limit production to address flaring.
Texas	2% ⁴²	Texas Railroad Commission (RRC)	None	RRC allows operators to flare during drilling and in the first 10 days after completion, after which a flare exception is required, which staff can administratively approve for a maximum of 180 days.	Recent form changes indicate that extension beyond 45 days requires documentation of progress towards infrastructure access, while extension beyond 180 days is granted through a Final Order.	Despite recent form improvements, in practice, Texas' current regulations allow companies nearly unlimited permits to flare. Since 2013, operators have obtained >35,000 short-term flaring permits without a single wholesale denial. ⁴³
New Mexico	2%	Oil Conservation Division (OCD)	Statewide GHG emissions 45% below 2005 levels by 2030.	OCD has banned routine venting and flaring and requires 98% capture of produced gas by 2026. ^{44, 45}	Venting and flaring can be authorized during emergencies, maintenance, well unloading, tank gauging, and for up to one year at exploratory wells.	New Mexico's elimination of routine flaring is exemplary. Its 98% gas capture target by 2026 further provides a stronger baseline than most states.

³⁷ Flaring intensity = Gas flared / Total gas produced

³⁸ Most recent available [reported data](#) from the North Dakota Pipeline Authority shows flaring down from nearly 20% to around 7% in April.

³⁹ "[Order No. 24665.](#)" North Dakota Industrial Commission, April 22, 2014

⁴⁰ "[North Dakota Industrial Commission Order 24665 Policy/Guidance.](#)" North Dakota Industrial Commission. [Version 041718.](#)

⁴¹ "[North Dakota Natural Gas Flaring and Venting Regulations.](#)" U.S. Department of Energy, Office of Oil & Natural Gas, June 2020

⁴² Flaring rates in the Permian Basin, Texas' most active and productive oil field, were over 5% in 2019. However, flaring rates for the state as a whole, including older fields, were around 2% in 2019.

⁴³ Leyden, Colin. "[Texas oil and gas regulators offer a weak fix to flaring.](#)" Environmental Defense Fund, August 26, 2020

⁴⁴ "[Part 28 – Final Rule.](#)" New Mexico Energy, Minerals and Natural Resources Department, Oil Conservation Division, March 25, 2021

⁴⁵ Goldstein, Jon. "[New Mexico Steps Up to End Routine Venting and Flaring.](#)" Environmental Defense Fund, March 25, 2021

State	Flaring Intensity 2019 ³⁷	Main Regulatory Authority	Overall Targets	When is Routine Flaring Allowed	Permits and penalties	Comments
Wyoming	0.5%	Wyoming Oil and Gas Conservation Commission (WOGCC)	None	Venting and flaring is prohibited except for emergency or upset conditions, purging operations, production tests and casing head gas <60,000 cubic feet/day.	Operators are required to apply for authorization to vent or flare in any other situation, but no economic justification is required.	With a permitting threshold of 60,000 cubic feet/day Wyoming's rule allows for significant venting and flaring without a permit.
Colorado	0.2%	Colorado Oil and Gas Conservation Commission (COGCC)	Statewide GHG emissions 90% below by 2050	COGCC prohibits "unnecessary or excessive" venting and flaring. ^{46, 47}	Venting or flaring may only occur with COGCC approval, except during emergencies, maintenance, liquids unloading and bradenhead testing.	Colorado was the first lower 48 state to eliminate routine flaring and is a model for jurisdictions looking to address flaring.
Federal	2.8%	Bureau of Land Management (BLM)	Net zero emissions economy-wide by 2050	In 2016 BLM issued regulation limiting venting and flaring of associated gas on tribal and federal lands to emergencies, requiring operators to capture an increasing share of produced gas as well as to inspect and repair leaks. ⁴⁸	The BLM rule required operators to pay royalties on wasted gas (whose loss was avoidable).	In October 2020, the rule was vacated by the District Court of Wyoming and is currently not in effect. This decision has since been appealed. The Biden administration is also reportedly considering a revised BLM rule.

⁴⁶ "2 CCR 404-." Colorado Department of Natural Resources, Oil and Gas Conservation Commission, November 2020

⁴⁷ Grossman, Dan. "In Groundbreaking Move, Colorado Ends Routine Flaring." Environmental Defense Fund, November 5, 2020

⁴⁸ "Methane and Waste Prevention Rule." U.S. Department of the Interior, Bureau of Land Management.

Policy approaches to address flaring

Fortunately, with numerous solutions available, well-placed government intervention can play a key role in mitigating the societal and economic costs of flaring, setting a minimum standard that makes net zero investing financially viable. Marianne Kah of Columbia University's Center on Global Energy Policy has indicated five categories of policy options for regulators to consider, as well as some of the benefits and drawbacks of each approach:^{49,50}

- **Performance or gas capture standard.** This allows flexibility in operational decisions but could incentivize drilling low-value wells close to infrastructure in order to generate credits to drill high flaring wells.
- **Prohibition of routine flaring.** Such a rule would target flaring that occurs for economic reasons. However, this rule would not address event-driven flaring. Challenges could include that producers would need to commit to building out gas infrastructure before understanding scale of production. This could give midstream firms leverage over operators.
- **Equal royalty treatment of flared and captured gas.** This would reduce incentives to waste gas and compensate royalty owners. Challenges are in determining the cost of flared gas, which is often considered to have a low value, potentially limiting the incentive to minimize flaring.
- **Flared gas tax.** This incorporates the cost of flaring in individual operational and capital decisions. Easier to administer than cap-and-trade, but unpopular politically and with no guarantee of achieving the desired cap. Determining the appropriate taxation level could be difficult.
- **Flaring cap-and-trade.** This would facilitate lowest cost flaring reductions first and could be designed to achieve a flaring cap with some certainty. However, it can be difficult to administer and permit prices can be volatile.

⁴⁹Kah, Marianne. "Policy Options to Reduce Gas Flaring." Environmental Defense Fund, Ceres and Columbia Center on Global Energy Policy Investor Roundtable, April 29, 2021

⁵⁰Agerton, Mark, Gilbert, Ben and Gregory Upton. "The Economics of Natural Gas Flaring: An Agenda for Research and Policy," May 10, 2021

Solutions to flaring

When engaging with oil and gas operators on flaring, investors should emphasize that companies have a range of options to reduce flaring using existing technologies and processes, and in many cases, this can be done at reasonable cost. Below we review some of the leading solutions that top performers have implemented to reduce flaring.

For a more detailed discussion of administrative, technological and organizational flaring solutions, refer to GaffneyCline's 2020 report, prepared on behalf of EDF, [Tackling Flaring: Learnings from Leading Permian Operators](#).

Administrative: Better coordination between upstream and midstream

Much of the flaring seen today is a result of a mismatch in capacity and throughput expectations between upstream producers and midstream gathering and distribution operators. There are steps that can be taken at the interface between upstream and midstream to reduce flaring, at little cost.

- Plan, communicate and coordinate to ensure takeaway capacity for gas from new and existing wells.
- Provide timing and location of well development and projected production volumes far enough in advance to enable midstream companies to respond with adequate gathering and processing capacity.
- Share existing and planned future capacity additions and constraints to enable upstream companies to better align drilling schedules.
- Maintain communication channels between upstream and midstream parties so that teams are prepared to respond in the event of operational upsets to prevent excessive flaring in those scenarios. These unplanned upsets may occur due to malfunctions at gas gathering or processing facilities and failure of equipment in the midstream sector, such as a compressor, can cascade to upstream facilities.

In addition, steps to ensure the proper functioning of flares are critical to minimize flaring's climate and health impact. These include continuous/frequent monitoring of flares plus better design, installation and maintenance.

Technological: infrastructure and productive uses

Where routine flaring is taking place, the optimal solution in most cases is to connect these upstream facilities to gas gathering and distribution infrastructure. The difficulty of doing so depends on a range of factors, most importantly proximity to existing gathering and compression infrastructure.

Where connection to a gas network is not feasible, there are several alternatives for associated gas to avoid flaring it.

- The gas can be injected back into the reservoirs it was produced from, or other reservoirs, to provide pressure support that can increase oil production. Operations around the world take advantage of this production efficiency: in 2015, three times as much natural gas was reinjected as was flared worldwide, according to the U.S. EIA. The effectiveness of gas

reinjection in a specific operation depends on the characteristics of the reservoir, not all of which are suitable for reinjection.

- The gas can be treated to remove water, sulfur and carbon dioxide, then compressed on-site to produce compressed natural gas (CNG). Transporting CNG to a gas-processing facility can be economically viable for single-well, on-shore sites that are within 30km to 40km of the facility.
- Another option is producing on-site liquified natural gas (LNG). Establishing a micro-LNG facility is typically quite capital intensive, and a facility can require up to ~\$20MM in capital expenditure. The endeavor may be commercially feasible, though, if offtake is available and consistent — for example, the surrounding region may wish to use LNG in place of diesel fuel.
- Gas turbines and “reciprocating engines” can convert gases into electricity. The electricity can be used on-site to power other equipment or can be sold to the grid. Burning waste gas in a turbine, rather than flaring it, still creates emissions. However, the electricity that is generated may reduce the need for other activities that cause emissions (such as pneumatic controllers and pumps powered by electricity rather than pressurized natural gas).
- There is a growing potential for technologies that enable wells to be throttled back or shut in to respond to gas midstream congestion. Although oil companies have traditionally been averse to restricting production to avert flaring, this appears to be changing with several operators mentioning this approach. It is important that leadership and staff are aligned with a culture and process that allows for these technologies (see next point).

Figure 17:

Natural gas compressor station



Photo credit: Getty Images

Figure 18:

Vapor recovery unit



Photo credit: Getty Images

Figure 19:

Gas turbine engine



Photo credit: Shutterstock

Organizational

Companies that are effective at minimizing flaring have targets, internal policies, processes and cultures that enable their frontline to do so.

Companies seeking to position their organization to reduce flaring should:

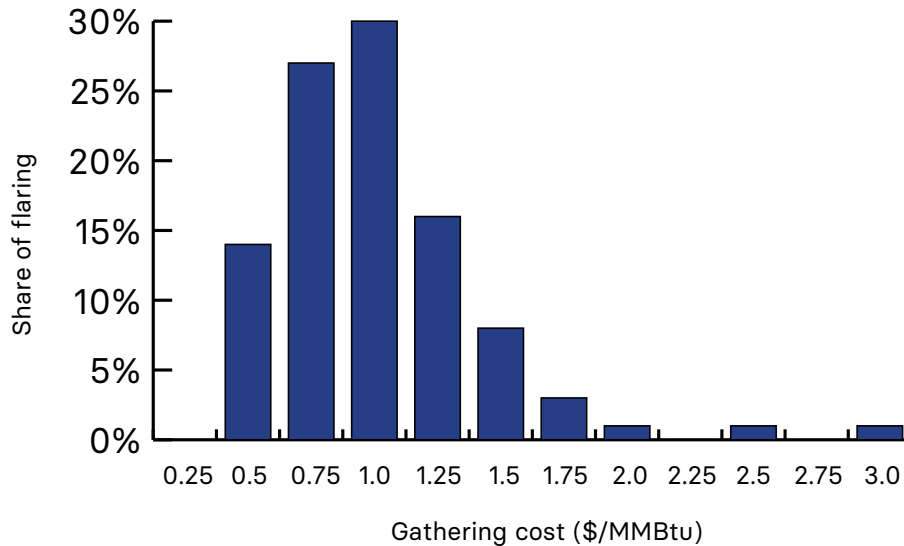
- Set aggressive flare reduction and flare intensity goals, providing staff a target to aim for and creating accountability from the Board of Directors down to operations engineers.
- Tie compensation metrics to flaring performance goals.
- Make flared volumes, flaring intensity and progress towards targets transparent and visible to employees.

- Institute stricter operating procedures to reduce event-driven flaring (e.g., empowering production staff to shut in wells and stop production when there is no takeaway capacity).
- Increase the reliability of infrastructure — enhanced maintenance schedules and upgrades to equipment can decrease process upsets that trigger event-driven flaring.
- Share best practices with other producers through industry collectives and associations.

How much does it cost to remove a flare?

When encouraging companies to seek out flaring solutions, investors should emphasize that, in many cases, abatement can be achieved at reasonable costs. In an analysis prepared for EDF, Rystad Energy surveyed hundreds of routine flares in the Permian Basin and estimated the cost of creating the necessary offtake infrastructure to eliminate routine flaring, finding that the most common cost of abatement in the Permian was in the \$0.75-1.25/MMBtu range (Figure 20). In less mature basins lacking takeaway infrastructure, or in geographies with remote production that is far from gas markets, abatement may be more challenging.

Figure 20:
% of flaring that could be abated at different costs (\$/MMBtu)




Source: Rystad Energy

Appendix 1: Details of company flaring performance and disclosure

To assess company flaring performance we reviewed both company disclosures on total flaring and satellite data on flaring from Flaring Monitor (for the U.S.) and Wood Mackenzie (for elsewhere). To calculate flaring intensity, we compared flared volumes to gas production (both in terms of cubic meters of gas). Based on this data we rated each company's flaring intensity as low, moderate or high within its peer group (majors, independents or NOCs).


While in many cases the satellite- and company-reported flaring intensities were similar, in some cases there were significant differences, likely resulting from factors discussed in Box 2. Despite this, for most companies we reviewed, both sources gave a consistent signal as to whether a company is flaring at a low, moderate or high intensity relative to peers.

Majors

		Alliances		Commitments				Disclosures			
	Flaring Intensity	WB ZRF30 endorser	WB GGFR partner	ZRF30 Global	ZRF25 Permian	Has flaring intensity target	Zero unlit flare target	Flaring volumes	Flaring intensity	Routine volumes	Key "Ask"
bp		✓	✓	✓	✓			✓		✓	Set flaring intensity target


bp

- bp reports flaring activity in terms of "total hydrocarbons flared", of which it reported 831 kt in 2020, down more than 50% from 1896 kt flared in 2016. The company does not report flaring intensity, but we estimate the company's flaring intensity to be among the lowest of the majors, at 1.4% in 2019 and 1% in 2020, based on flaring volumes and gas production reported by the company (0.8% in 2019, according to satellite data).
- In addition to its endorsement of the World Bank ZRF30, the company has committed to zero routine flaring by 2025 in its U.S. onshore operations and has engaged in policy advocacy with key public stakeholders, signing a [letter](#) to the Texas Railroad Commission in 2020, supporting policies to eliminate routine flaring and conducting peer to peer advocacy encouraging others to join the effort.
- Outside the U.S., bp notes progress in reducing flaring in Angola and Oman.
- As part of bp's Net Zero Ambition delivery, the company is implementing a variety of technologies to improve flare monitoring and performance, for example improved procedures for flare ignition, use of predictive combustion analytics and spectrometry.

		Alliances		Commitments				Disclosures			
	Flaring Intensity	WB ZRF30 endorser	WB GGFR partner	ZRF30 Global	ZRF25 Permian	Has flaring intensity target	Zero unlit flare target	Flaring volumes	Flaring intensity	Routine volumes	Key "Ask"
Chevron		✓	✓	✓		✓		✓	✓		Commit to ZRF25 Permian

Chevron

- Chevron ranks as a moderate performer in terms of flaring intensity; the company's own reporting puts it at 2.2% in 2019, around average for the majors, falling to 1.8% in 2020 (satellite data puts it lower for 2019, at 1.5%).
- The company has endorsed all the major flaring alliances and stands out for being the only major to have set a target for overall flaring intensity (3 kgCO₂e/BOE; this ratio was at 3.6 in 1H20 according to its 2020 sustainability report).
- In the U.S., the company's flaring intensity was 0.5%, below peers. This was achieved thanks to a 2015 pledge not to connect any new wells in the Permian Basin without gas offtake capacity, as well as significant investments in gathering and compression. Management also notes a focus on "root cause analysis" — identifying and remediating causes of high frequency flare events.
- Internationally, flaring reduction in countries with limited domestic gas markets, including Iraq and Nigeria, remains a challenge. Management highlights the Angola LNG facility, fed entirely by associated gas, as responsible for a dramatic reduction of flaring in the country.
- The company has budgeted \$2 billion over five years to invest in attractive emissions abatement based on the company's annually updated marginal abatement cost curve (MACC), some of which include flaring reduction.

		Alliances		Commitments				Disclosures			
	Flaring Intensity	WB ZRF30 endorser	WB GGFR partner	ZRF30 Global	ZRF25 Permian	Has flaring intensity target	Zero unlit flare target	Flaring volumes	Flaring intensity	Routine volumes	Key "Ask"
ConocoPhillips		✓		✓				✓	✓		Commit to ZRF25 Permian

ConocoPhillips

- ConocoPhillips has a higher than average flaring rate relative to its peers, with a gas flaring intensity of 3.1% in 2019, falling to 2.1% in 2020 according to the company (2.7% in 2019, according to satellite data). In the U.S., flaring intensity was relatively high at 2.4% in 2019, per Flaring Monitor, but fell sharply in 2020 to 1.1%.
- The company endorses the World Bank's ZRF30 initiative but is one of the few majors that is not a partner in the World Bank's GGFR partnership.
- Management has stated that flaring increases in 2019 were a result of gas infrastructure constraints in the Bakken, with production growth exceeding midstream pipeline and processing capacity. The company cites progress towards reducing flaring in the Permian Basin, where it built and now operates a gathering system, which enables more flexibility and connections to multiple third-party processors. Other actions include facility design changes to reduce/eliminate flaring from tanks.

		Alliances		Commitments				Disclosures			
	Flaring Intensity	WB ZRF30 endorser	WB GGFR partner	ZRF30 Global	ZRF25 Permian	Has flaring intensity target	Zero unlit flare target	Flaring volumes	Flaring intensity	Routine volumes	Key "Ask"
Eni	🔥🔥	✓	✓	✓	✓			✓		✓	Set flaring intensity target

Eni

- Eni performs about average for the majors on flaring intensity (2.8% company-reported in 2019, 2.4% satellite-reported).
- The company stands out for having the most ambitious routine flaring reduction target among the majors, having committed to zero routine flaring by 2025 globally. However, the target, which was made in 2016, remains some way off: routine flaring likely exceeded 500MCM in 2020.⁵¹
- In its Eni for 2020 carbon neutrality report, the company notes flaring reduction projects in Angola, as well as lower overall production as the key drivers behind the 18% drop in flared volumes in 2020. However, details on specific steps needed to reach the ambitious ZRF25 goal are not provided. As with all companies that have put forward a zero routine flaring target, we would urge the company to disclose concrete steps it plans to take in order to achieve the target.

		Alliances		Commitments				Disclosures			
	Flaring Intensity	WB ZRF30 endorser	WB GGFR partner	ZRF30 Global	ZRF25 Permian	Has flaring intensity target	Zero unlit flare target	Flaring volumes	Flaring intensity	Routine volumes	Key "Ask"
Equinor	🔥	✓	✓	✓					✓	✓	Set flaring intensity target

Equinor

- Equinor achieved the lowest flaring intensity among the majors in 2019-20 (0.8% self-reported, 0.2% satellite-reported). The company does not flare routinely in most of its operations — including Norway, Brazil or offshore U.S. Some flaring issues are noted for specific assets such as the Mariner field and the Bakken shale asset in the U.S., where limited midstream pipeline capacity remains a challenge.


		Alliances		Commitments				Disclosures			
	Flaring Intensity	WB ZRF30 endorser	WB GGFR partner	ZRF30 Global	ZRF25 Permian	Has flaring intensity target	Zero unlit flare target	Flaring volumes	Flaring intensity	Routine volumes	Key "Ask"
ExxonMobil	🔥🔥🔥		✓	✓				✓			Endorse WB ZRF30

ExxonMobil

- ExxonMobil's flaring intensity is the highest among the majors, at 4.6% in 2019 based on both company reporting and satellite readings.


⁵¹ Based on overall reported flaring of 1BCM, 65% of which was routine in 2019 based on data reported to the World Bank.

- The company is slower to report on carbon performance data than most peers, and only plans to disclose 2020 data at the beginning of 2022.
- Although ExxonMobil is a founding partner of the World Bank's GGFR, it has not formally endorsed the ZRF30 initiative (the only major we reviewed not to have done so); however, its 2019 Sustainability Report states that "upstream operations also plan to align with the World Bank's initiative to eliminate routine flaring by 2030."
- The company has set a flaring intensity target — "50% improvement in flaring intensity from 2016 to 2025" — however, the lack of specificity around the intensity goal make it difficult to evaluate progress towards this goal.
- Management notes mixed trends in flaring abatement: progress in the Permian Basin but challenges in the Bakken and West Africa, where a lack of infrastructure remains an obstacle.
- Investors should urge the company to commit to ZRF30 as well as, in the Permian Basin, ZRF25.

		Alliances		Commitments				Disclosures			
	Flaring Intensity	WB ZRF30 endorser	WB GGFR partner	ZRF30 Global	ZRF25 Permian	Has flaring intensity target	Zero unlit flare target	Flaring volumes	Flaring intensity	Routine volumes	Key "Ask"
Repsol		✓		✓				✓		✓	Set flaring intensity target

Repsol


- Repsol ranks as a moderate intensity flarer, with a slightly better than average flaring intensity relative to the majors, 1.4% in 2019 and 1.7% in 2020, according to both company reports and satellite data.
- In contrast with many companies we reviewed, Repsol reported an increase in flaring volumes in 2020 (+15%), which management attributed to "increased production at the most flaring intensive assets and the improvements made to make the measurement methodology more precise."
- The company is one of two majors we reviewed that is not a member of the World Bank's GGFR partnership. It has signed the ZRF30 initiative and has also pledged to mitigate routine flaring by 50% by 2025; however, this pledge is difficult to evaluate given that it has not specified relative to what baseline year that would be achieved.

		Alliances		Commitments				Disclosures			
	Flaring Intensity	WB ZRF30 endorser	WB GGFR partner	ZRF30 Global	ZRF25 Permian	Has flaring intensity target	Zero unlit flare target	Flaring volumes	Flaring intensity	Routine volumes	Key "Ask"
Shell		✓	✓	✓				✓		✓	Commit to ZRF25 Permian

Shell

- Shell ranks better than average on flaring in this group, with a flaring intensity of 2% in 2019 and 1.4% in 2020, according to the company (0.9% according to satellite data). The company has taken a prominent role in many institutional initiatives around methane and flaring reduction.


- The company provides a more detailed discussion around flaring issues in its 2020 [sustainability report](#) than many majors, noting progress in Australia, the U.S. Permian, Qatar and Nigeria.
- The report also describes steps to upgrade Permian Basin's older facilities with equipment to automatically shut down production, instead of flaring gas, to relieve high pressure from certain high-demand pipelines; to replace flare stacks with improved gas processing infrastructure; and to install better control devices. Management notes that since 2017, these efforts have reduced flaring by more than 80% across the Permian facilities. In September 2021, the company announced the sale of its Permian business to ConocoPhillips.

		Alliances		Commitments				Disclosures			
	Flaring Intensity	WB ZRF30 endorser	WB GGFR partner	ZRF30 Global	ZRF25 Permian	Has flaring intensity target	Zero unlit flare target	Flaring volumes	Flaring intensity	Routine volumes	Key "Ask"
TotalEnergies		✓	✓	✓				✓		✓	Set flaring intensity target

TotalEnergies

- TotalEnergies ranks around average among the majors in flaring intensity, with 4.2 MCM of company-reported flaring in 2020, down from 5.7 in 2019, equating to a 2% flaring intensity in 2020 (1.6% according to satellite measurements).
- Management notes several steps taken to retrofit its existing sites to limit or eliminate the need for flaring. In Nigeria, flaring has been reduced and the company aims to eliminate routine flaring in Nigeria completely by 2025. An example of this is the Ofon field off the Nigerian coast, where associated gas is now compressed and exported to the onshore Nigeria LNG plant instead of being flared. Elsewhere, production has been optimized to eliminate the need for flaring during compressor shutdowns.


U.S. Independents

		Alliances		Commitments				Disclosures			
	Flaring Intensity	WB ZRF30 endorser	WB GGFR partner	ZRF30 Global	ZRF25 Permian	Has flaring intensity target	Zero unlit flare target	Flaring volumes	Flaring intensity	Routine volumes	Key "Ask"
Apache				✓	✓	✓		✓			Endorse WB ZRF30

Apache


- Apache ranks as a moderate performer in terms of flaring intensity, with a satellite- and self-reported intensity of 7.9% in 2019. However, this rate is heavily influenced by the company's high-flaring Egyptian operations. By contrast, in the Permian basin the company has reduced its flaring intensity from 1.6% in 2019 to 0.5%, according to Flaring Monitor, among the best of the U.S. independents we reviewed.
- Earlier this year, the company made two industry-leading flaring commitments for its U.S. onshore operations: to eliminate routine flaring by the end of 2021 and to keep overall flaring intensity below 1%. The company highlighted its control of midstream assets as giving it much greater visibility over the transportation and processing of the captured gas, allowing it to manage flaring to low levels.

- We see the potential for Apache to further enhance transparency by disclosing routine flaring volumes as well as its strategy to address flaring in its Egyptian operations where flaring intensity remains high.

		Alliances		Commitments				Disclosures			
	Flaring Intensity	WB ZRF30 endorser	WB GGFR partner	ZRF30 Global	ZRF25 Permian	Has flaring intensity target	Zero unlit flare target	Flaring volumes	Flaring intensity	Routine volumes	Key "Ask"
Devon Energy				✓		✓		✓	✓		Commit to ZRF25 Permian

Devon Energy

- Devon Energy reports a 2019 flaring intensity of 0.8%, which would rank it as among the better performers among the independents. However Flaring Monitor data based on satellite observations suggests a higher intensity of 2.5% in 2019 and 1.8% in 2020. We assign a "low" flaring intensity to Devon, reflecting progress and commitments on flaring, but would look to satellite data for confirmation of this strong self-reported performance.
- In June 2021, the company announced new environmental performance targets that included a flaring intensity target of an industry-leading 0.5% by 2025 and eliminating routine flaring by 2030.
- Devon is most active in New Mexico's Delaware Basin, where midstream infrastructure constraints led to rising flaring volumes in 2017-19. However, management notes that the company took ownership of an associated midstream gas compression equipment company in 2019 and has since addressed conditions that caused much of the flaring in the Delaware Basin. These actions resulted in a decline in Delaware intensity from 4% to below 1% by the end of 2019, according to management, with flared volumes down 70% versus a year earlier in 1H20.
- Management notes that flaring is not broadly distributed; much of the company's flaring is derived from a small number of sites, where investments in compression and gathering capacity allowed the company to make rapid progress. In addition to upgraded compressors, management notes positive results from adjusting flow rates of some wells and shutting in some wells where necessary.
- In 2021 Devon completed its merger with WPX Energy, which is likely to result in higher flaring intensity due to the latter company's exposure to North Dakota's Williston Basin, where a shortage of gas infrastructure is likely to result in high flaring intensities for some time.

		Alliances		Commitments				Disclosures			
	Flaring Intensity	WB ZRF30 endorser	WB GGFR partner	ZRF30 Global	ZRF25 Permian	Has flaring intensity target	Zero unlit flare target	Flaring volumes	Flaring intensity	Routine volumes	Key "Ask"
EOG Resources		✓		✓				✓	✓		Commit to ZRF25 Permian

EOG Resources

- Using satellite data, EOG Resources ranks as better than average on flaring intensity among the U.S. independents that we reviewed, with a satellite-observed flaring intensity of 1.3% in

2019 and 0.5% in 2020, according to Flaring Monitor. The company's own reporting suggests a higher intensity of 2.8% in 2019, still below the average for U.S. independents.

- The company is one of just two U.S. independents (along with Occidental) to have endorsed the World Bank's ZRF30 initiative.
- Management notes a number of steps taken to mitigate flaring. These include installing natural gas gathering pipelines early in the life of an asset, while contracting sufficient pipeline takeaway capacity to provide flow assurance. Other techniques include the use of multi-well pads and technologies including low-bleed controllers, instrument air systems, compressors equipped with emissions control technology, and electric and solar-powered pumps. Management also notes progress implementing closed-loop gas capture, an automated process that the company developed in-house to re-route natural gas back into existing wells when a downstream interruption occurs, now in pilot testing stage. Management cites Texas Railroad Commission reports finding the company's gas capture rate is among the best in the industry.

		Alliances		Commitments				Disclosures			
	Flaring Intensity	WB ZRF30 endorser	WB GGFR partner	ZRF30 Global	ZRF25 Permian	Has flaring intensity target	Zero unlit flare target	Flaring volumes	Flaring intensity	Routine volumes	Key "Ask"
Hess	🔥🔥🔥					✓		✓	✓		Endorse WB ZRF30

Hess

- Hess has the highest flaring intensity of the U.S. independents that we reviewed, driven by its production in North Dakota. U.S. flaring intensity was 16% in 2019 and 8% in 2020, according to Flaring Monitor, while the company reported a 15.5% intensity in 2019.
- The company is the only U.S. independent not to have committed to eliminate routine flaring.
- Management notes that production growth in the Bakken, launched before gas infrastructure was put in place, as well as delays in the construction and commissioning of a gas plant, the Little Missouri Four, all supported high flaring rates. More than \$3 billion has been spent on midstream infrastructure in North Dakota over the past eight years; despite this, production has still outpaced the company's ability to process the significant increase in gas production.
- Hess relies on third parties to provide gas gathering and processing infrastructure, and reported that gas capture by third-party gathering and processing facilities was less than expected in 2019. The company plans to continue to pursue additional natural gas processing and compression capacity, which will help to alleviate flaring intensity in the region.
- The company reports investments in natural gas capture and NGL extraction equipment to recover Bakken's raw, wet natural gas using modular, mobile, unmanned capture technologies.
- Investors should urge the company to raise its ambition on flaring reduction by improving its commitment and disclosure and announcing a specific flaring abatement plan.

		Alliances		Commitments				Disclosures			
	Flaring Intensity	WB ZRF30 endorser	WB GGFR partner	ZRF30 Global	ZRF25 Permian	Has flaring intensity target	Zero unlit flare target	Flaring volumes	Flaring intensity	Routine volumes	Key "Ask"
Occidental	🔥🔥	✓		✓				✓	✓		Commit to ZRF25 Permian

Occidental

- Occidental ranks as a moderate flaring intensity company. While it boasts the lowest U.S.-based intensity among all the U.S. independents we reviewed, 0.3% in 2020, according to Flaring Monitor, higher-intensity international operations (Oman) brought the company's overall flaring intensity to 5.3% in 2019, according to satellite data, or 4.4% according to the company.
- The company endorses the World Bank's ZRF30 initiative, but in our view is in a position to commit to a more ambitious ZRF25 timeline in the Permian Basin, given its strong performance on domestic flaring in recent years.
- The company reports that a new gas gathering system in New Mexico has further reduced volumes of flared gas by facilitating the transfer of sales gas to multiple third party midstream companies. The system design includes a closed loop flowback system that captures vapors released from flowback fluids, as well as enhanced investments in production systems. Occidental also secured extra capacity within the different third parties' systems to provide additional natural gas capacity should interruptions from one party occur.
- We would welcome greater clarity on steps to reduce flaring intensity in the company's Oman operations.

		Alliances		Commitments				Disclosures			
	Flaring Intensity	WB ZRF30 endorser	WB GGFR partner	ZRF30 Global	ZRF25 Permian	Has flaring intensity target	Zero unlit flare target	Flaring volumes	Flaring intensity	Routine volumes	Key "Ask"
Pioneer	🔥			✓		✓		✓			Commit to ZRF25 Permian

Pioneer

- We assess Pioneer's flaring intensity as low, despite some uncertainty over its level: the company reported a flaring intensity of 1.7% for 2019, among the lowest in the Permian Basin, citing Rystad Energy data to confirm this. However, Flaring Monitor observations put the company's flaring intensity considerably higher, at 3.8% in 2019, falling to 1.4% in 2020.
- The company has not endorsed the World Bank's ZRF30 initiative but has made a similar commitment, as well as "aspiring" to eliminate routine flaring by 2025. The company also has set a 1% flaring intensity target.
- In its 2020 sustainability report, the company provides a particularly in-depth discussion on the topic, with 53 mentions of the word "flaring" (the most of any report we reviewed). This included descriptions of recent investments in flaring technology, including the implementation of dual tip flares sized for efficient operation in a range of flow rates, as well as automatic back-pressure valves to activate the flare in case of third party pipeline high-pressure issues.

- The company remotely monitors flaring through a supervisory control and data acquisition (SCADA) system and utilizes alarms that are directed to a technician for quick response. According to management, these remote monitoring and tracking programs led to significant improvement in flare performance.

National Oil Companies

	Flaring Intensity	Alliances		Commitments				Disclosures			Key "Ask"
		WB ZRF30 endorser	WB GGFR partner	ZRF30 Global	ZRF25 Permian	Has flaring intensity target	Zero unlit flare target	Flaring volumes	Flaring intensity	Routine volumes	
CNOOC Ltd	🔥🔥🔥										Endorse WB ZRF30

CNOOC Ltd

- CNOOC has the highest flaring intensity of any company we reviewed for this report, with an intensity of 17% according to satellite data. As an offshore producer, CNOOC has limited options for disposing of associated gas.
- Earlier this year, three of China's largest oil companies, CNPC, Sinopec and CNOOC, established a methane control alliance with three domestic gas companies. Among their priority actions are enhancing gas capture and reducing flaring.
- The company does not provide any disclosures or commitments on flaring.

	Flaring Intensity	Alliances		Commitments				Disclosures			Key "Ask"
		WB ZRF30 endorser	WB GGFR partner	ZRF30 Global	ZRF25 Permian	Has flaring intensity target	Zero unlit flare target	Flaring volumes	Flaring intensity	Routine volumes	
Petrobras	🔥🔥	✓		✓				✓			Set flaring intensity target

Petrobras

- Petrobras has a level of flaring intensity that is around the middle of the wide range that characterizes the National Oil Companies: intensity was 4% in 2019, according to satellite data, and 7.7% according to the company.
- Petrobras has endorsed the World Bank's ZRF30 initiative but is not a GGFR partner.

	Flaring Intensity	Alliances		Commitments				Disclosures			Key "Ask"
		WB ZRF30 endorser	WB GGFR partner	ZRF30 Global	ZRF25 Permian	Has flaring intensity target	Zero unlit flare target	Flaring volumes	Flaring intensity	Routine volumes	
PetroChina	🔥										Endorse WB ZRF30

PetroChina

- PetroChina has a very low flaring intensity of just 1%, according to satellite data, one of the

lowest of the national oil companies.

- Unlike CNOOC, PetroChina operates onshore and benefits from significant investments in associated gas takeaway infrastructure that results in almost no routine flaring and limited overall flaring.
- Like CNOOC, Petrochina does not participate in flaring institutions, nor does it provide disclosures on flaring activity.

	Flaring Intensity	Alliances		Commitments				Disclosures			Key "Ask"
		WB ZRF30 endorser	WB GGFR partner	ZRF30 Global	ZRF25 Permian	Has flaring intensity target	Zero unlit flare target	Flaring volumes	Flaring intensity	Routine volumes	
Rosneft	🔥🔥🔥							✓	✓		Endorse WB ZRF30

Rosneft

- Russia is the country with the highest flaring activity, according to the World Bank, and Rosneft is a significant source of gas flaring. On an equity basis, which is how the company should be measured due to the ownership structure of its production entities, the company flared 5.7 BCM in 2019 according to satellite data, the most of any company we reviewed, for a flaring intensity rate of 9%.
- Rosneft is not a signatory to ZRF30 or other initiatives nor has it made specific targets related to flaring. However in its Carbon Management Plan of December 2020 it has targeted zero routine flaring by 2035.
- In its sustainability report, the company mentions its gas investment program which includes strategies to reduce flaring and find uses for associated petroleum gas (APG); however, few details are provided.
- We call on bp, as holder of a 19.75% equity stake in Rosneft, to push for more aggressive action on flaring mitigation at Rosneft.

	Flaring Intensity	Alliances		Commitments				Disclosures			Key "Ask"
		WB ZRF30 endorser	WB GGFR partner	ZRF30 Global	ZRF25 Permian	Has flaring intensity target	Zero unlit flare target	Flaring volumes	Flaring intensity	Routine volumes	
Saudi Aramco	🔥	✓		✓					✓		Disclose flaring volumes

Saudi Aramco

- Saudi Aramco has the lowest flaring intensity of any company we reviewed, with minimal flared volumes. This is due to a very well-developed gas capture and takeaway system, which is used to feed Saudi Arabia's petrochemical industry.

Appendix 2: Organizations that address flaring

Myriad industry groups and international organizations address flaring in the oil and gas sector. These institutions can provide investors with guidance on flaring measurement and management best practices and offer investors additional support in holding companies accountable for robust flaring reduction. Below we note some of the key institutions that have addressed the flaring issue.

- The World Bank's Global Gas Flaring Reduction Partnership (GGFR): This public-private partnership, which includes 17 countries and 13 companies, works to identify technical and regulatory solutions to flaring through collaborative research and enhanced measurement and reporting. GGFR refines and promotes tangible flaring reduction strategies to help achieve the 2030 zero routine flaring goal. It also produces the annual Global Gas Flaring Tracker Report, which provides country-level flaring volume and intensity data using satellite.
- Zero Routine Flaring by 2030 Initiative (ZRF30): In 2015, the World Bank, together with the United Nations Environmental Programme (UNEP), launched the Zero Routine Flaring by 2030 Initiative as a new global standard for oil and gas companies and governments. By endorsing the initiative, companies agree to establish "an operating environment conducive to flaring reduction" and avoid routine flaring in both new and existing oil fields. Companies also pledge to adhere to specific reporting requirements. The World Bank requires companies to disclose their overall annual operated flaring (flaring from all oil fields the company operates) and "the share of that flaring that is routine." For companies that have developed new oil fields, the World Bank also asks whether the firm has devised specific plans to address routine flaring at emerging sites. Currently, 34 governments, 44 companies, and 15 development institutions have endorsed the initiative.

Each signatory is obligated both to take measures to eliminate existing routine flares by 2030 and to refrain from developing new wells without the necessary infrastructure to avoid routine flaring from the start. Of the 20 companies we have reviewed, 12 have endorsed the ZRF30 initiative. This includes eight out of nine majors (ExxonMobil has written that "its upstream operations also plan to align with the World Bank's initiative to eliminate routine flaring by 2030"). Two U.S. independents (EOG and Occidental) and two NOCs (Petrobras and Aramco) have also endorsed ZRF30. It is not always clear whether endorsement leads to follow through. We also note a mixed compliance with the reporting mandate: fewer than half of the endorsers are supplying information about total and routine flaring volumes to the Initiative.

- Oil and Gas Methane Partnership (OGMP) 2.0: Co-developed by the United Nations Environmental Programme, Environmental Defense Fund and the European Commission, the OGMP 2.0 framework offers companies guidance on high quality methane emissions measurement. The framework helps increase transparency in methane emissions mitigation by setting the "gold standard" for methane reporting. Given its coverage of all sources for methane emissions, OGMP 2.0 necessarily touches on flaring. The framework considers upstream flaring emissions a Level 2 disclosure in its five level structure, with Level 1 being the least rigorous reporting and Level 5 being the most rigorous. The OGMP 2.0 steering group recently published a technical guidance document for flaring measurement.
- Methane Guiding Principles (MGP): Launched in 2017, Methane Guiding Principles is an international, multi-stakeholder partnership between industry and civil society organizations focused on methane emissions reduction across the natural gas supply chain. MGP now has 24

corporate signatories that have committed to continually reduce methane emissions; advance strong performance across the natural gas supply chain; improve accuracy of methane emissions data; advocate for sound policy and regulations on methane emissions; and increase transparency. MGP offers signatories master classes on methane management and produces publicly available best practices toolkits to catalyze industry emissions reduction. In 2019, MGP released a flaring best practices guide.

- Oil and Gas Climate Initiative (OGCI): Comprised of twelve companies, OGCI works to catalyze the oil and gas industry's response to climate change through Paris-aligned research, policy advocacy and investing. OGCI members invest over \$7 billion annually in low carbon solutions, a portion of which supports OGCI Climate Investments, a venture fund that backs emerging technologies to reduce methane and CO2 emissions and develop carbon capture and storage. All OGCI members support Zero Routine Flaring by 2030 and have establishing methane and carbon intensity targets that incorporate flaring emissions reduction. Additionally, in July 2020, OGCI launched a \$1 million partnership with the Payne Institute for Public Policy at the Colorado School of Mines to create a web platform to map real-time global gas flaring. OGCI Investments has also backed Andium, an early-stage company delivering remote flare monitoring.
- International Petroleum Industry Environmental Conservation Association (IPIECA): Since 1974, this association has convened both upstream and downstream oil and gas companies to discuss pressing environmental and social issues facing the industry. The organization has 13 working groups that focus on topics ranging from biodiversity to human rights. IPIECA's climate vertical, which facilitates dialogue between the oil and gas industry and the UNFCCC, devotes specific attention to "emissions management," including flaring. In January 2019, the organization publicly announced its support for the World Bank's Zero Routine Flaring by 2030 and pledged to use its convening power to convey the benefits of flaring mitigation to industry stakeholders. In 2011, the organization released a white paper on effective flare management planning.
- The Environmental Partnership: This initiative consists of 89 U.S. oil and gas companies working together to establish industry-wide best practices in methane and CO2 emissions reduction. The Environmental Partnership has a distinct flare management program that helps companies slash flare volumes, bolster flare reliability and more accurately calculate flaring intensity. The partnership has pledged to report its actions taken on flaring annually.
- The Texas Methane and Flaring Coalition (TMFC): The coalition is made up of seven trade associations and over 40 Texas oil and natural gas companies, and targets the end of routine natural gas flaring in Texas by 2030. We are critical of this policy and see the TMFC goal as falling short of what is achievable in mature and well-developed Texas basins like the Permian.⁵² TMFC's goal lacks ambition and urgency and fails to mention any of the policy measures needed to end routine flaring in Texas, raising the possibility that this target is intended to deflect scrutiny and maintain a status quo of inaction by policymakers like the Texas Railroad Commission.

Investors engaging portfolio companies on methane emissions reduction should look to these entities (with the exception of the TMFC) to gauge the latest industry progress on flaring research reduction. As an immediate first step towards net zero alignment, investors can encourage oil and gas companies to join OGMP, which can help upstream producers go from unreliable flaring estimates to accurate flaring measurements.

⁵² "Texas Methane and Flaring Coalition proposes a weak goal for ending routine flaring," EDF + Business Climate Authenticity Meter

Further reading

Reports

U.S. Department of Energy, [Natural Gas Flaring and Venting: State and Federal Regulatory Overview, Trends, and Impacts](#) (2019)

World Bank [Global Gas Flaring Tracker Report](#), April 2021

International Energy Agency, [Flaring Emissions report](#)

Methane Guiding Principles [Reducing Methane Emissions: Best Practice Guide, Flaring](#) (2019)

Rystad Energy/EDF [Permian Basin Flaring Outlook](#) (January 2021)

IEA, [Putting gas flaring in the spotlight](#) (December 2020)

Commentary

[Columbia Global Energy Dialogue: Natural Gas Flaring Workshop Summary](#)

[BP, Shell and investment giants call for Texas zero flaring regulations. Will others follow?](#) (EDF Blog: September 2020)

[A zero flaring policy is long overdue, and investors can help make it reality](#) (EDF Blog: May 2020)

[5 questions on flaring for investors to ask oil and gas companies](#) (EDF Blog: July 2020)

[A year of data and one clear message: Permian flaring remains a major problem](#) (EDF Blog: February 2021)

[Satellite data confirms Permian gas flaring is double what companies report](#) (EDF Blog: January 2019)

[Through Turbulent Year, EDF Data Show Permian Oil and Gas Operators Consistently Failed to Keep Flares Lit](#) (EDF: February 2021)