Global Gas Flaring Tracker Report

APRIL 2021

Photo: © Ed Kashi

GGFR
Global Gas Flaring Reduction Partnership

THE WORLD BANK
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April 2021

Foreword

2020 was an unprecedented year for the oil and gas industry and a historic time for the world. The COVID-19 pandemic dampened oil demand, prices and production, while oil-dependent countries experienced negative impacts on their revenues and national budgets. As countries imposed strict lockdowns, international travel came to a grinding halt and demand for oil fell, humanity became increasingly aware that something was changing. The World Bank and others increasingly called on governments to "build back better" and make our recovery from this pandemic a green and resilient one. At the same time, we saw international oil companies double down on their net-zero plans, outlining new strategies to decarbonize their operations, with several moving towards clean energy. The COVID-19 pandemic accelerated the speed of the global energy transition. In the global race to reduce emissions and build a low-carbon world, we quickened our pace.

Against the backdrop of this unusual year, we were interested to see what happened with global gas flaring in 2020. The 160-year-old practice releases about 400 million tons of CO_2 equivalent emissions, including un-combusted methane and black carbon (soot). Routine gas flaring also represents a lost opportunity to provide hundreds of millions of people with a valuable energy source – indeed, over 700 million people still lack access to energy, while an estimated 620 million people could still lack access in 2030, 85 percent of them in Sub-Saharan Africa.

The World Bank's 2020 Global Gas Flaring Tracker, a leading global and independent indicator of gas flaring, found that from 2019 to 2020, oil production declined by 8 percent, while gas flaring dropped by 5 percent. The raw data is obtained from two satellites operated by the U.S. National Oceanic and Atmospheric Administration (NOAA) that scan the globe each day, interpreted with the assistance of The Payne Institute for Public Policy at the Colorado School of Mines, to estimate global flare volumes. The Tracker is thus one of the best tools to raise awareness, track progress, rally support and drive collective action, including commitments from governments and industry to end routine flaring.

Seven countries continue to light up the global map, year after year: Russia, Iraq, Iran, the United States, Algeria, Venezuela and Nigeria have been the largest flaring countries for nine years running, since the first satellite was launched in 2012. While these seven countries have together produced some 40 percent of the world's oil each year, they have also accounted for roughly two-thirds (65 percent) of global gas flaring. There is no doubt that these countries face significant barriers and challenges to addressing flaring, but we are nonetheless determined to address this critical climate and resource management issue head on, expanding our engagements beyond the 7 of the top 15 gas flaring countries where we currently work.

We do see some marked improvements in a variety of regions and contexts. The United States performed particularly well in 2020, with gas flaring falling by 32 percent from 2019 to 2020, partly due to an 8 percent drop in oil production, but also through the construction of infrastructure to use gas that would otherwise be flared. The United States' reduction accounted for 70 percent or 5.5 billion cubic meters (bcm) of the global decline. Meanwhile, Nigeria and the greater Khanty-Mansiysk Autonomous Okrug (KMAO) region of Russia have both achieved significant progress over the past 15 years, with Nigeria reducing its gas flaring by 70 percent to just 7 bcm in 2020, and KMAO reducing its gas flaring volumes by nearly 80 percent, to just over 4 bcm.

These silver linings, against the backdrop of a dark year, give us hope that progress on gas flaring reduction will accelerate, particularly for those with the appropriate infrastructure, regulation and political will in place. For our part, we will redouble our efforts to collaborate with high gas flaring countries, particularly in developing countries, and work closely with governments and oil companies to address the most common challenges to gas flaring reduction.

Zubin Bamji
Program Manager
Global Gas Flaring Reduction Partnership
World Bank

Key findings

- In 2020, oil production declined by 8 percent (from 82 million barrels per day (b/d) in 2019 to 76 million b/d in 2020), while global gas flaring dropped by 5 percent (from 150 bcm in 2019 to 142 bcm in 2020).
- The United States accounted for 70 percent of the global decline, with gas flaring falling by 32 percent from 2019 to 2020, due to an 8 percent drop in oil production, combined with new infrastructure to use gas that would otherwise be flared.
- Russia, Iraq, Iran, the United States, Algeria, Venezuela and Nigeria remain the top seven gas flaring countries for nine years running, since the first of two satellites was launched in 2012. These seven countries produce 40 percent of the world's oil each year, but account for roughly two-thirds (65 percent) of global gas flaring.
- This trend is indicative of ongoing, though differing, challenges facing these countries. For example, the United States has thousands of individual flare sites, difficult to connect quickly to a market, while a few high flaring oil fields in East Siberia in Russia are extremely remote, lacking the infrastructure to capture and transport the associated gas.
- While the United States saw a 32 percent drop in gas flaring, the country's main three shale oil-producing regions – the Permian and Eagleford in Texas, and the Bakken in North Dakota – continued to account for over 90 percent of the gas flaring in 2020. However, combined flaring from these three regions declined by over 5 bcm in 2020, partly due to a reduction in oil production and the drilling of new wells, but also as a result of increasing volumes of flare gas being connected to existing and new gas pipeline networks.
- Russia tops the list of global gas flaring countries in 2020, contributing to 15 percent of global gas flaring. Mixed performance is seen across Russia: with a significant increase in flaring at oil production sites in East Siberia, alongside significant improvements in flaring reduction in the KMAO region in West Siberia.
- Gas flaring per barrel of oil produced, or "flaring intensity," increased significantly in fragile or conflict-affected countries: in Venezuela by 50 percent and in Libya by 38 percent, indicating an inability and lack of capacity to deal with the issue of gas flaring.
- Gas flaring in China increased by 35 percent; China was the ninth highest flaring country globally in 2020. Most of this increase was from new field developments in the West of China.
- There are a small number of large flaring sites which contribute the most to global flaring. In 2020, 12 percent of flare sites contributed to 75 percent of total flaring volume globally.
- GGFR's new metric, the Imported Flare Gas (IFG) Index, identifies how countries importing crude oil are exposed to gas flaring, a significant global climate issue. Preliminary results from the IFG Index show that many large crude oil-importing developed countries, such as Germany, Netherlands, Spain, France, and Italy are exposed to gas flaring, since they are importing crude oil from countries that flare large volumes of associated gas, such as Russia, Nigeria, Algeria, Iraq and Libya. The IFG Index also tells the story of shared responsibility – countries that import oil also have a role to play in ending this industry practice.

Photo: © Gribov Andrei Aleksandrovich

A spotlight on key trends

Differing challenges for top oil-producers

The top seven gas flaring countries represent some of the world's largest producers of oil, producing at least 1 million barrels of oil a day, but they face differing challenges to addressing the problem of gas flaring. For example, countries like Iraq, Iran, Venezuela and Algeria have a few large flaring fields. Economic, regulatory or technical barriers to the development of gas markets and gas infrastructure prevent associated gas from being used. In other countries, such as the United States, there are thousands of small flare sites that can be challenging to connect to a market. In Russia, there is a continued expansion of production at oil fields in East Siberia. These sites are extremely remote, lacking the infrastructure to capture and transport the associated gas.

These wide-ranging challenges mean there is no one-size-fits-all solution suitable for every country, context or region. Instead, gas flaring reduction programs and projects must be adapted and customized for a unique set of issues and circumstances.

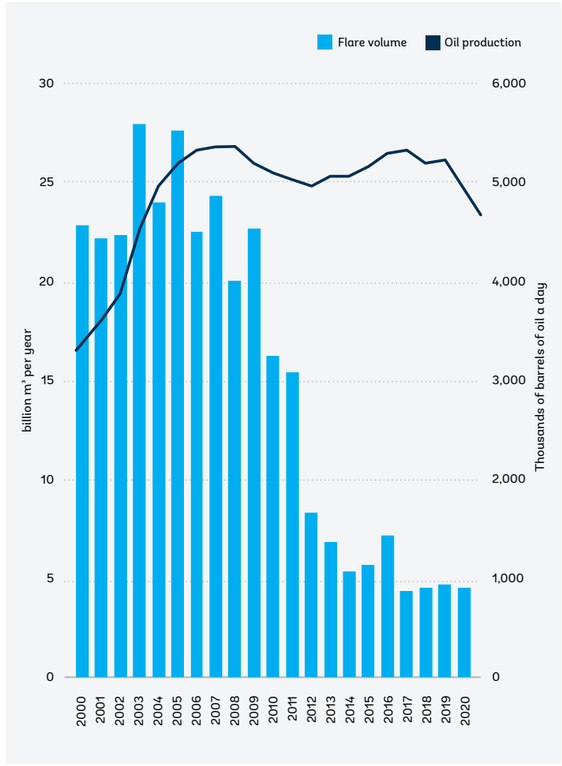
Flaring ticks upwards in parts of Russia and China

In Russia, the country flaring the largest volumes of gas since our data first began, gas flaring increased by 8 percent from 2019 to 24.6 bcm in 2020. KMAO, historically the largest oil-producing and gas-flaring region, however, has steadily expanded its gas utilization infrastructure over the last several years and now contributes just 20 percent of Russia's total flaring. Flaring in KMAO has declined from over 20 bcm in the mid-2000s to under 5 bcm in 2020.

A different story presents itself in East Siberia, where oil production from a small number of fields has continued to increase. In this remote and vast region, gas flaring has increased from 23 percent (4.8 bcm) of total flaring in the country in 2018 to 33 percent (8.2 bcm) in 2020. East Siberia would informally be known as "the middle of nowhere:" while it has huge oil reserves, it is an extremely sparsely populated region with little gas infrastructure and very little local demand for gas or gas products. Here, reducing gas flaring will require major investment in new gas infrastructure, or conservation by re-injecting the gas back into the earth, if this is geologically viable.

In China, which has risen in 2020 to become the ninth-largest flaring country, flaring increased by 35 percent, despite oil production staying essentially flat from 2019. Over half (nearly 55 percent) of the increase was from new flares in the remote northwest of the country. It is expected that future flaring at both these locations may be significantly reduced or eliminated as the "Central Asia Gas Pipeline" from Turkmenistan via Kazakhstan enters China past these fields, and a local gas gathering system is already in operation.

Khanty Mansiysk, Russia: Flare volumes and oil production, 2000 - 2020



Source: NOAA, Payne Institute and Colorado School of Mines, GGFR, EIA

Insecure, conflict-affected countries struggle to address gas flaring

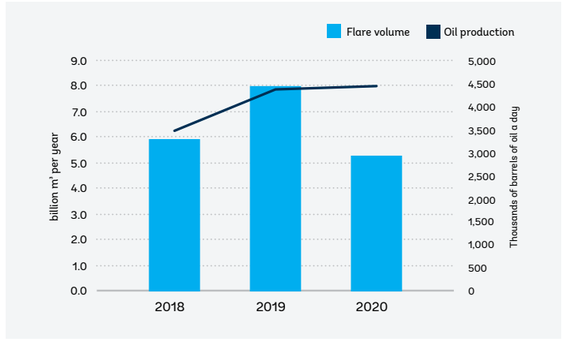
Fragile, conflict-affected and insecure countries flared more gas per barrel of oil in 2020 than other countries, indicating an inability and lack of capacity to operate facilities effectively and to deal with the issue of gas flaring. In Venezuela, the sixth-largest flaring country in 2020, oil production collapsed by 41 percent from 2018 to 2019, and then another 40 percent the next year. Despite this dramatic decline, gas flaring has increased by over 4 percent since 2018. Meanwhile, gas flaring intensity in Libya increased by 38 percent from 2019 to 2020. Another conflict-affected country, Syria, has the highest flaring intensity among all of the significant oil-producing countries, with approximately 76 cubic meters of gas flared per barrel of oil produced. These countries often do not have the ability, capacity and resources to address gas flaring, typically because they are in states of crisis.

Silver linings in three important countries

The United States reduced its gas flaring by 32 percent from 2019 to 2020 and accounted for 5.5 bcm or 70 percent of the overall global decline in gas flaring. The country's three main shale oil-producing regions – the Permian and Eagleford in Texas and the Bakken in North Dakota – contributed to 90 percent of the gas flaring in 2020. The shale oil developments consist of thousands of individual production units and individual gas flares. Combined gas flaring from these three regions declined by over 5 bcm in 2020, partly as a result of a decline in completion activity due to plunging oil prices in the wake of the outbreak of COVID-19, but also due to a large increase in takeaway capacity, including from the Gulf Coast Express Pipeline (GCX). Further flaring reduction in these regions will require continued connections from existing and new shale oil developments to the extensive gas infrastructure in Texas, in order to transport associated gas to market.

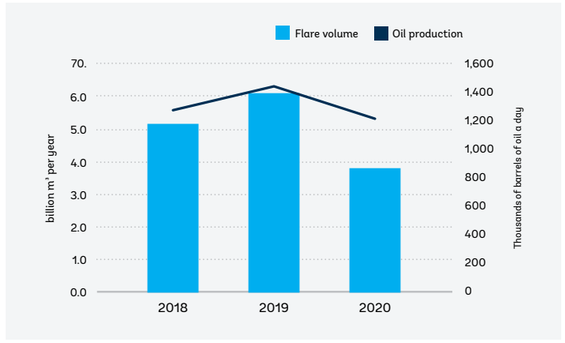
Gas infrastructure capacity in the Bakken area also increased in late 2019, with an additional 23 percent of gas processing capacity coming on stream, enabling increased utilization of otherwise flared gas.

Permian



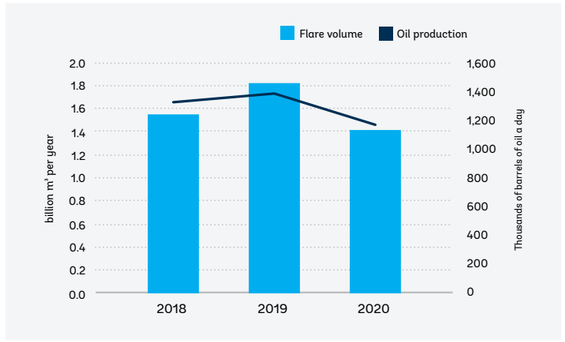
Source: NOAA, Payne Institute and Colorado School of Mines, GGFR, EIA

Bakken



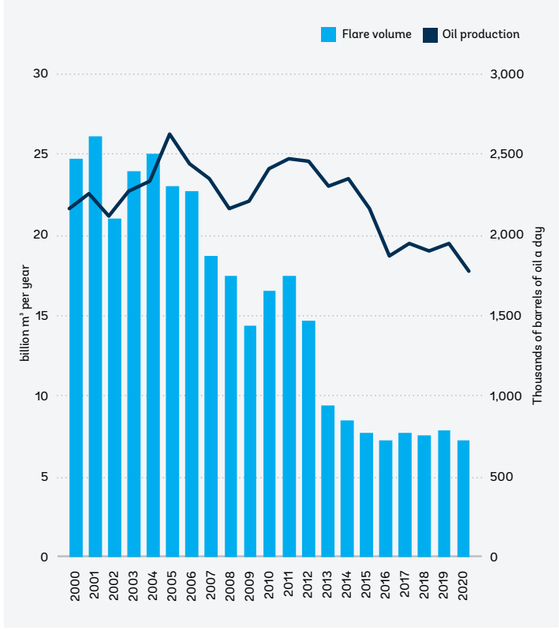
Source: NOAA, Payne Institute and Colorado School of Mines, GGFR, EIA

Eagleford



Source: NOAA, Payne Institute and Colorado School of Mines, GGFR, EIA

Nigeria: Flare volumes and oil production, 2000 - 2020



Source: NOAA, Payne Institute and Colorado School of Mines, GGFR, EIA

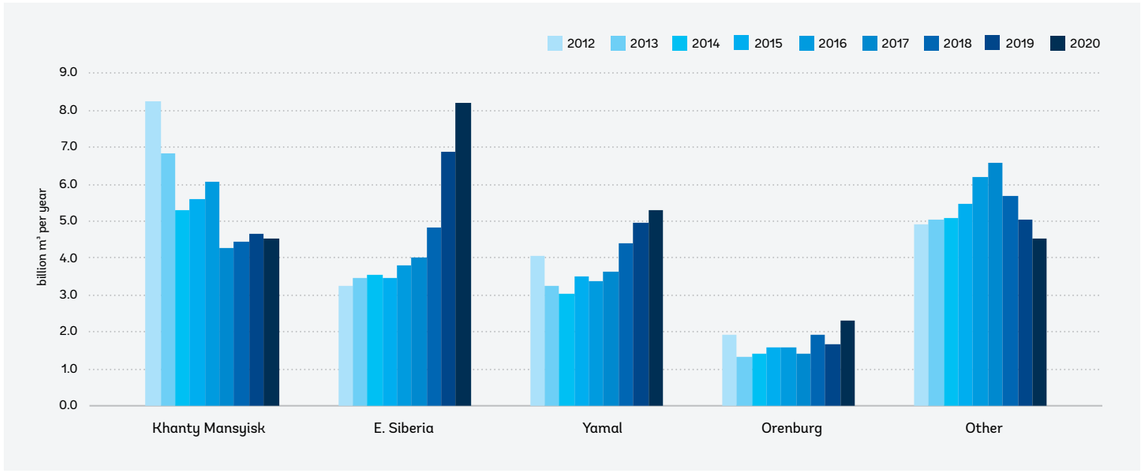
Nigeria: 15 years of progress

Another bright spot can be found in Nigeria, the seventh-largest flaring country in 2020. Although the country has remained in the top seven flaring countries, it has nonetheless steadily reduced its flaring by some 70 percent over the past 15 years. Flaring has declined from over 25 bcm in 2000 to close to 7 bcm in 2020, while oil production has remained essentially flat at around 2 million barrels a day.

KMAO: a major oil-producing region gets serious about gas flaring

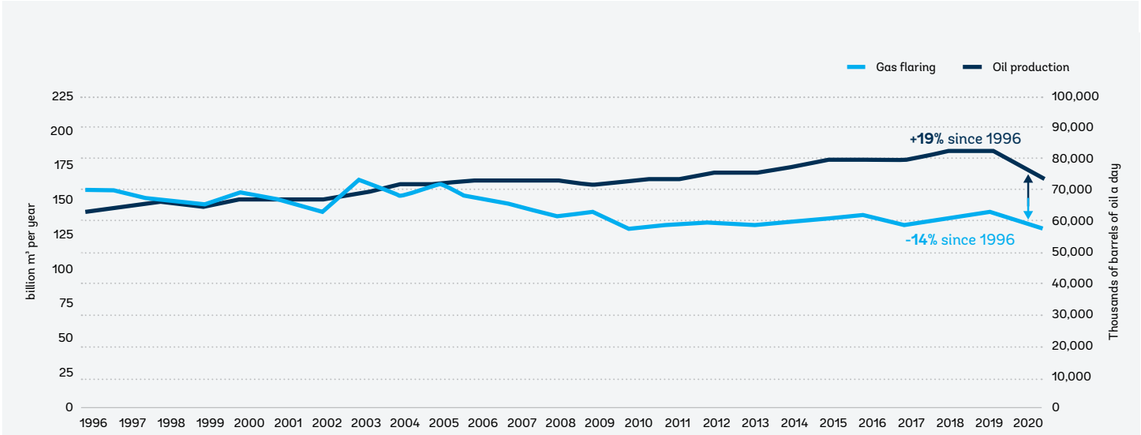
KMAO is a third success story. Accounting for 70 percent of Russia's oil reserves, including the largest oil field in the country, the region has made huge progress in reducing gas flaring by 80 percent since the mid-2000s. Indeed, in 2012, Russia's annual economic losses related to associated gas flaring were estimated to be more than $5 billion per year. KMAO was the first oil- and gas-producing region to announce it had met the federal requirement to use 95 percent of associated gas, that would otherwise be flared, by the end of 2014.

2012 - 2020 Flare volumes, Russian regions



Source: NOAA, Payne Institute and Colorado School of Mines, GGFR

Global Gas Flaring and Oil Production: 1996 to 2020 (flaring only at upstream oil & gas and LNG liquefaction plants)

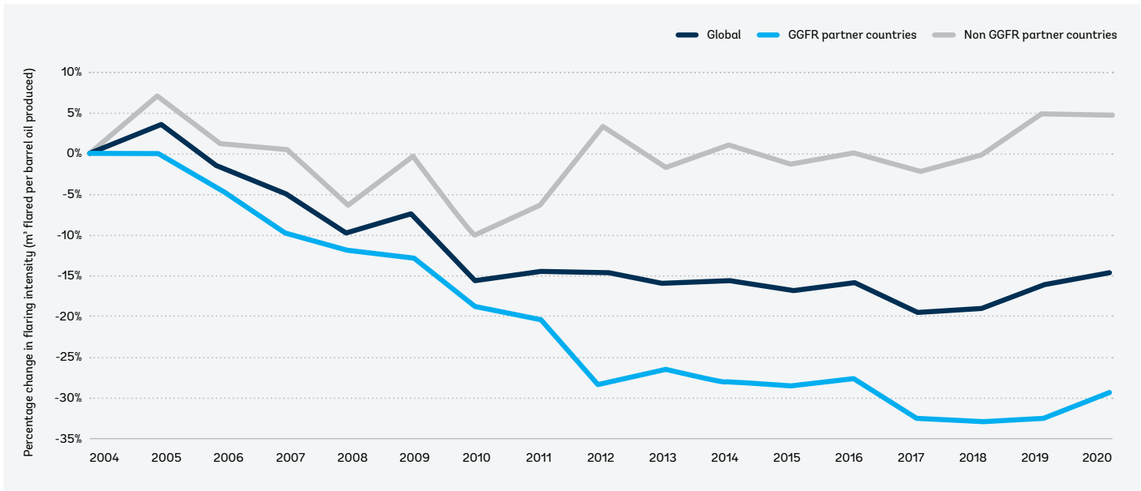


Source: NOAA, Payne Institute and Colorado School of Mines, GGFR, BP, EIA

Flare Volumes for the top 30 flaring countries from 2016-2020 (Sorted by 2020 flare volume)

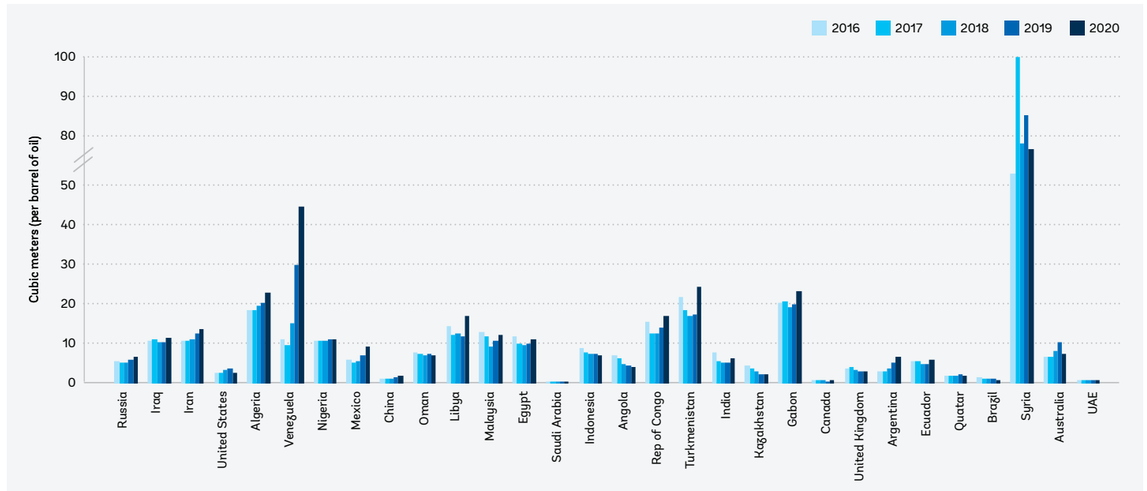
Source: NOAA, Payne Institute and Colorado School of Mines, GGFR

GGFR Partners have reduced flaring intensity by around 30 percent from 2004 to 2020



Source: NOAA, Payne Institute and Colorado School of Mines, GGFR

Flaring intensity for the top 30 flaring countries from 2016 to 2020 (Sorted by 2020 flare volume)"



Source: NOAA, Payne Institute and Colorado School of Mines, GGFR

Gas flaring volumes 2016-20 (billion cubic meters)

	2016	2017	2018	2019	2020	Change 2020-2019
Russia	22.37	19.92	21.28	23.21	24.88	1.66
Iraq	17.73	17.84	17.82	17.91	17.37	-0.54
Iran	16.41	17.67	17.28	13.78	13.26	-0.52
United States	8.86	9.48	14.07	17.29	11.81	-5.49
Algeria	9.10	8.80	9.01	9.34	9.32	-0.02
Venezuela	9.35	7.00	8.22	9.54	8.59	-0.95
Nigeria	7.31	7.65	7.44	7.83	7.20	-0.63
Libya	2.35	3.91	4.67	5.12	2.47	-2.65
Mexico	4.78	3.79	3.89	4.48	5.77	1.28
Angola	4.49	3.80	2.79	2.33	1.87	-0.46
Oman	2.82	2.60	2.54	2.63	2.52	-0.11
Saudi Arabia	2.38	2.32	2.29	2.10	2.26	0.16
Egypt	2.83	2.34	2.26	2.34	2.36	0.02
Malaysia	3.16	2.83	2.25	2.37	2.41	0.04
Indonesia	2.77	2.33	2.06	2.00	1.88	-0.12
Kazakhstan	2.67	2.42	2.05	1.57	1.48	-0.09
China	1.96	1.56	1.82	2.02	2.72	0.70
Rep of the Congo	1.14	1.14	1.58	1.67	1.79	0.11
Turkmenistan	1.84	1.67	1.50	1.34	1.67	0.33
Gabon	1.56	1.50	1.38	1.46	1.47	0.01
India	2.06	1.50	1.34	1.31	1.49	0.19
Canada	1.30	1.34	1.33	1.05	1.08	0.03
United Kingdom	1.34	1.35	1.21	1.11	1.06	-0.05
UAE	0.84	0.98	1.15	0.90	0.96	0.06
Cameroon	1.10	1.04	1.06	1.04	0.90	-0.14
Brazil	1.44	1.10	1.00	1.14	0.99	-0.14
Qatar	1.08	1.03	1.00	1.34	1.01	-0.34
Ecuador	1.15	1.07	0.90	0.92	1.04	0.12
Kuwait	1.14	0.79	0.87	0.73	0.74	0.01
Australia	0.73	0.66	0.86	1.39	0.98	-0.41
Rest of the world	9.58	9.15	8.08	8.73	8.81	0.08
Total	**148**	**141**	**145**	**150**	**142**	**-7.9**

Source: NOAA, Payne Institute and Colorado School of Mines, GGFR

Introducing a new metric: Imported Flare Gas Index

Photo: © gouatsight

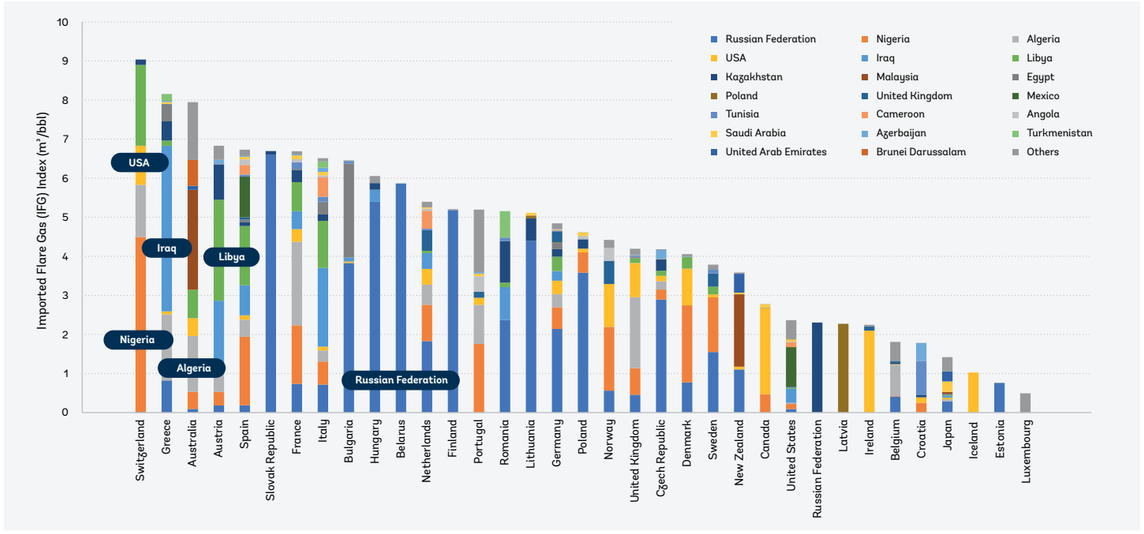
The World Bank's GGFR recognizes that oil-producing countries have historically borne the brunt of criticism for gas flaring practices. We rank the top 20 or 30 countries by gas flaring volume – based upon where the crude oil is produced, and the gas flaring occurs. However, when most of the crude oil is consumed in other countries, the burden of responsibility to reduce flaring emissions should be shared with those countries that import and use the oil. For example, the European Union (EU) is one of the largest importers of crude oil. As a globally recognized leader for climate action, it could have a strong role to play in driving change. Although the EU accounts for only 0.17 percent of global routine gas flaring (as of 2019), it can use its position as a global consumer of oil to mobilize action in the countries where this practice persists.

Acknowledging this, GGFR has created a new metric, the Imported Flare Gas (IFG) Index, which identifies how countries that import crude oil are exposed to the climate issue of gas flaring. The IFG Index represents a consumer-oriented indicator that helps importing countries recognize they have an influential role to play in decarbonizing energy systems globally. The Index can also help oil-importing countries assess where the flaring hotspots are in their fossil fuel supply chain; engage in a dialogue with countries from which they buy oil; assist them in implementing flaring reduction initiatives, and significantly improve the carbon emissions-intensity of the oil they consume.

The IFG index aims to quantify the concept that if a country is importing crude oil from producing countries then it is also importing the flaring intensity of these producing countries in proportion to the amount of crude oil imported.

Preliminary results from the IFG Index show that many large crude oil-importing developed countries, such as Germany, Netherlands, Spain, France, and Italy are exposed to gas flaring, since they are importing crude oil from countries that flare large volumes of associated gas, such as Russia, Nigeria, Algeria, Iraq and Libya. GGFR hopes the IFG Index will spark a new and collaborative discussion about how best to address gas flaring; we welcome the opportunity to support countries in this effort.

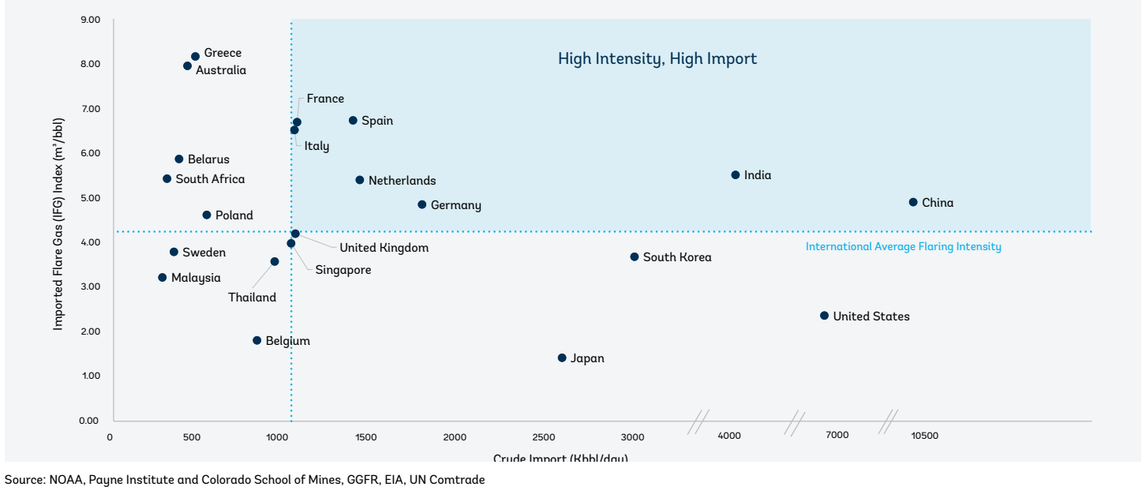
2020 IFG Index Results – Annex I* countries



Source: NOAA, Payne Institute and Colorado School of Mines, GGFR, EIA, UN Comtrade

* Annex I countries are defined by The United Nations Framework Convention on Climate Change (UNFCCC) and includes the industrialized countries that were members of the OECD (Organisation for Economic Co-operation and Development) in 1992, plus countries with economies in transition (the EIT Parties), including the Russian Federation, the Baltic States, and several Central and Eastern European States. UNFCCC identified the common but differentiated responsibilities and respective capabilities of different parties under Kyoto Protocol where Annex I countries committed to absolute emission reduction or limitation targets, whereas all other (non-Annex I) countries had no such obligations.

IFG Index of Largest Crude Importing Countries (> 250 K bbl/day)



Source: NOAA, Payne Institute and Colorado School of Mines, GGFR, EIA, UN Comtrade

Photo: © think4photop

Concluding reflections: the road to zero: from COP26 to Zero Routine Flaring by 2030

As we reflect on more than a full year of a global pandemic, we also look forward to the important UN Climate Change conference in Glasgow. Ahead of this important milestone, we are calling upon governments to put gas flaring reduction front and center in their Nationally Determined Contributions, and for oil-producing countries to position it at the heart of their "net-zero" and energy transition plans.

Eliminating routine gas flaring is common sense because any action to reduce flaring profoundly reduces the direct or Scope 1 emissions of the oil and gas sector. In this sense, it is what we call a "low-hanging fruit," alongside other climate actions, like preventing and minimizing methane leaks, and eliminating routine venting. While there are certainly barriers and constraints, ending routine gas flaring represents a big "win" for climate action. To minimize COVID-19 impacts, reduce emissions and accelerate the energy transition, the commitment of governments and companies to end routine gas flaring is now more important than ever.

Technology and innovation can help. Over the past decade, there is an accelerating trend from world-scale to small-scale Gas-to-Liquid (GTL) technologies, as smaller plants have become a viable option for the monetization of flares, with the same or lower unit capital costs as world-scale plants. There are now leading GTL solutions available, suitable for the monetization of small gas streams such as in gas flares, where the whole range of gas flare volumes from about 0.3 million standard cubic feet per day (MMscfd) to 25MMscfd and more can be processed.

2020 saw increasing interest from the renewable energy sector in the deployment of these small-scale GTL technologies. The conversion of biogas, landfill gas, agricultural waste, food waste, municipal solid waste (MSW) and even CO2 itself into clean, renewable drop-in fuels brings a variety of attractive carbon credits. Meanwhile, potential solutions, including the utilization of associated gas to feed fuel cells, or conversion into electricity for energy-intensive computing at the well site, are examples of innovative ways in which flare gas might be used. These relatively new solutions are starting to be investigated, and we are hopeful they may provide new insights and opportunities for gas flaring reduction.

Investment must start now. Gas flaring reduction programs and projects can take years to see results, so plans put in place now will not bear fruit until close to 2030. It's time for action: awareness is no longer enough. We must see movement from the top seven flaring countries in order to see dramatic change. Beyond this, national oil companies must also raise their ambition and efforts, as international oil companies have done in recent years. Our data finds that some national oil companies are lagging behind and may struggle with the capital expenditure and investment required to address gas flaring.

We hope that this report, tracking progress towards our shared goal of ending routine flaring, serves as a reminder and catalyst to governments and companies to kickstart projects, making investment in gas flaring reduction a key priority and contribution to the critical climate agenda.

The World Bank's role in gas flaring reduction

The World Bank's GGFR works closely with governments and oil companies to help assess technologies, develop policies and regulations, and build capacity to end routine flaring by 2030. We are also continuing to secure commitments for the Zero Routine Flaring by 2030 initiative, building upon the 78 government and oil company endorsers that, together, account for close to 60 percent of global flaring. Ending routine gas flaring is critical if governments and companies are to deliver their products in the cleanest manner possible, meet "zero emissions" targets, and maintain their license to operate, especially in developing countries where millions lack access to energy.

To do this, we must test and scale innovative approaches, while considering new solutions that treat associated gas as an asset, not a waste product. Such approaches must also be tailored to the unique circumstances and context of a particular country, or even a specific oil production site. We need to work collaboratively with governments and oil companies to develop holistic policies, considering a range of carrots and sticks, incentives and penalties, to finally put an end to this practice.

Methodology

The Global Gas Flaring Tracker is produced on an annual basis by the World Bank's GGFR, comprised of governments, oil companies, and international institutions working to end routine gas flaring at oil production sites around the world. GGFR, in partnership with the U.S. NOAA and The Payne Institute for Public Policy at the Colorado School of Mines, has developed global gas flaring estimates based upon observations from satellites launched in 2012 and 2017. The advanced sensors of this satellite detect the heat emitted by gas flares as infrared emissions at global upstream oil and gas facilities. The Colorado School of Mines and GGFR quantify these infrared emissions and calibrate them using country-level data collected by a third-party data supplier, Cedigaz, to produce robust estimates of global gas flaring volumes.

The satellite data for estimating flare gas volumes is collected by NOAA's satellite mounted Visual and Infrared Radiometer Suite of detectors (VIIRS). VIIRS has a set of high-resolution detectors which:

- respond only to heat emissions and hence are not affected by sunlight, moonlight or other light sources;
- respond to wavelengths where emissions from flares are at a maximum; and
- have excellent areal resolution.

The ability of VIIRS to detect only hot sources, such as gas flares, enables flares to be detected automatically with minimal manual intervention. Emissions from non-flare hot sources (e.g., biomass burning) can be removed from the data easily by selecting only emissions with temperatures above 1100 deg C as other hot sources burn at lower temperatures. Indeed, flares burn hotter than any other terrestrial hot sources, including volcanos. Over the past seven years of operation, VIIRS has automatically detected ~10,000 flares annually around the globe.

A new and improved web-based application will map global gas flaring data and will be publicly available in 2022, with the support of the Oil and Gas Climate Initiative (OGCI) and the Payne Institute for Public Policy at the Colorado School of Mines.

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