

FLARING UP:

North Dakota Natural Gas Flaring More Than Doubles in Two Years

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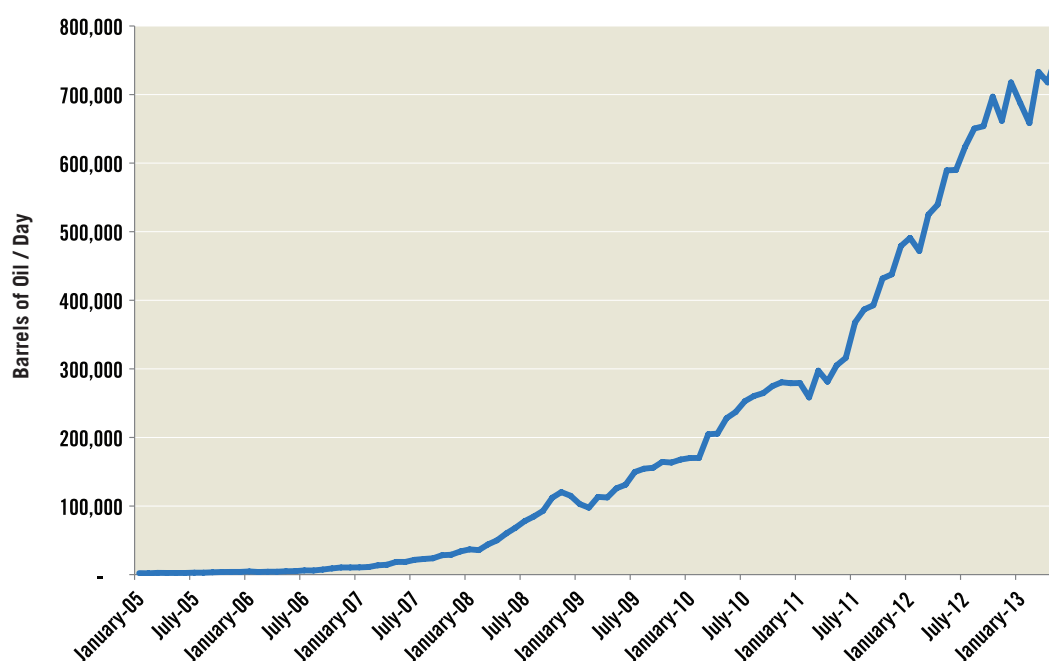


Executive Summary

In its *World Energy Outlook 2012*, the International Energy Agency projected that the United States would become the world's largest oil producer by 2020, a position the U.S. last held in the 1970s.¹ This dramatic resurgence is being driven by technological advances like directional drilling and hydraulic fracturing, which are unlocking shale gas and tight oil resources that were previously uneconomic to recover.

This recent boom has been perhaps most evident in North Dakota, where oil production from the state's Bakken formation increased 40 fold between 2007 and mid-2013, from 18,500 to 760,000 barrels per day (bpd).² In May 2012, North Dakota surpassed Alaska to become the second-largest oil producing state in the U.S. after Texas.³

FIGURE 1: BAKKEN OIL PRODUCTION IN NORTH DAKOTA



Source: North Dakota Industrial Commission

The tremendous growth of unconventional oil production in North Dakota has also led to a rapid rise in the production of associated natural gas. However, state authorities report that a large percentage of this gas does not ultimately go to market. Nearly 30 percent of North Dakota gas is currently being burned off, or flared, each month as a byproduct of oil production.⁴ Although flaring natural gas produces less potent greenhouse gas (GHG) emissions than venting it directly to the atmosphere, the practice is environmentally damaging, economically wasteful and a potential threat to the industry's long-term license to operate.

1 Fatih Birol, "World Energy Outlook," International Energy Agency, 12 November 2012, <http://www.worldenergyoutlook.org/publications/weo-2012/> (accessed July 2013)

2 North Dakota Industrial Commission Department of Mineral Resources, "ND Monthly Oil Production Statistics" <https://www.dmr.nd.gov/oilgas/stats/historicaloilprodstats.pdf> (accessed July 2013)

3 Stephen J. Lee, "North Dakota tops Alaska in oil production, trailing only Texas," Grand Forks Herald, 14 May 2013, <http://www.inforum.com/event/article/id/360831/> (accessed July 2013)

4 Helms, Lynn, "Director's Cut [Report on May 2013 Production]," NDIC Department of Mineral Resources, 15 July 2013, (accessed July 2013)

Absolute volumes of flared gas have more than doubled between May 2011 and May 2013. In 2012 alone, flaring resulted in the loss of approximately \$1 billion in fuel and the GHG emissions equivalent of adding one million cars to the road.

As U.S. unconventional oil and gas production has grown, investors and community members have raised concerns over flaring, citing both environmental and economic issues.⁵ Because the natural gas from the Bakken formation contains high volumes of valuable natural gas liquids (NGLs), such as propane and natural gasoline, in addition to dry gas consisting mostly of methane, it is potentially worth roughly four times that of the dry gas produced elsewhere in the U.S.

Some individual companies have shown leadership in curbing flaring, legislators have introduced incentives to limit flaring,⁶ and several billion dollars have already been invested in additional gas pipeline and processing infrastructure. In addition, the state has set a goal to limit flaring to no more than 10 percent of produced gas.

However, Ceres' analysis of North Dakota oil and gas production data indicates that absolute volumes of flared gas have more than doubled between May 2011 and May 2013. In 2012 alone, flaring resulted in the loss of approximately \$1 billion in fuel and the GHG emissions equivalent of adding one million cars to the road. In addition, Ceres' projections indicate that total flaring volumes will continue to rise above 2012 levels through 2020 unless the percentage of flaring is reduced from its current level to below 21 percent. Furthermore, even if the state's goal of 10 percent flaring were achieved, total volumes of flared gas in 2020 would still exceed the amount flared in 2010. These findings underscore the importance of solving the problem of flaring in order to limit both environmental impacts and economic waste.

Why Flaring is on the Rise in North Dakota

While the Bakken formation has been developed primarily as an oil play, a proportion of the overall production is natural gas and NGLs.⁷ The majority of North Dakota gas (roughly 70 percent) is ultimately marketed; however, a significant percentage of the state's natural gas production is burned off in flares due to a lack of pipelines, processing and compression infrastructure.

According to the North Dakota Pipeline Authority flaring occurs "when natural gas is burned on location due to a lack of gathering pipeline infrastructure or economic alternatives."⁸ In addition, although 55 percent of flaring occurs at wells that are unconnected to the gas gathering system where production has outpaced infrastructure investment, 45 percent occurs at wells that are already connected due to pipeline capacity and compression challenges.⁹ Presently, the full collection and marketing of North Dakota natural gas faces two primary challenges.

First, natural gas has a much lower relative value than oil. For production occurring in May 2013, the North Dakota Industrial Commission reported that the oil to gas price ratio was 30 to 1, reflecting the relatively high market price of oil and correspondingly low price of natural gas.¹⁰ A large differential between the prices for oil and gas acts as a deterrent for developers to invest capital in natural gas utilization.

5 Ceres, "Major Investors Warn Energy Companies of Business Risks in Flaring Gas at Shale Oil Wells" 29 March 2012, <http://www.ceres.org/press/press-releases/major-investors-warn-energy-companies-of-business-risks-in-flaring-gas-at-shale-oil-wells-1> (Accessed July 2013)

6 Associated Press, "ND drillers to get tax breaks natural gas usage," 1 July 2013, <http://fuelfix.com/blog/2013/07/01/nd-drillers-to-get-tax-breaks-natural-gas-usage/> (accessed July 2013)

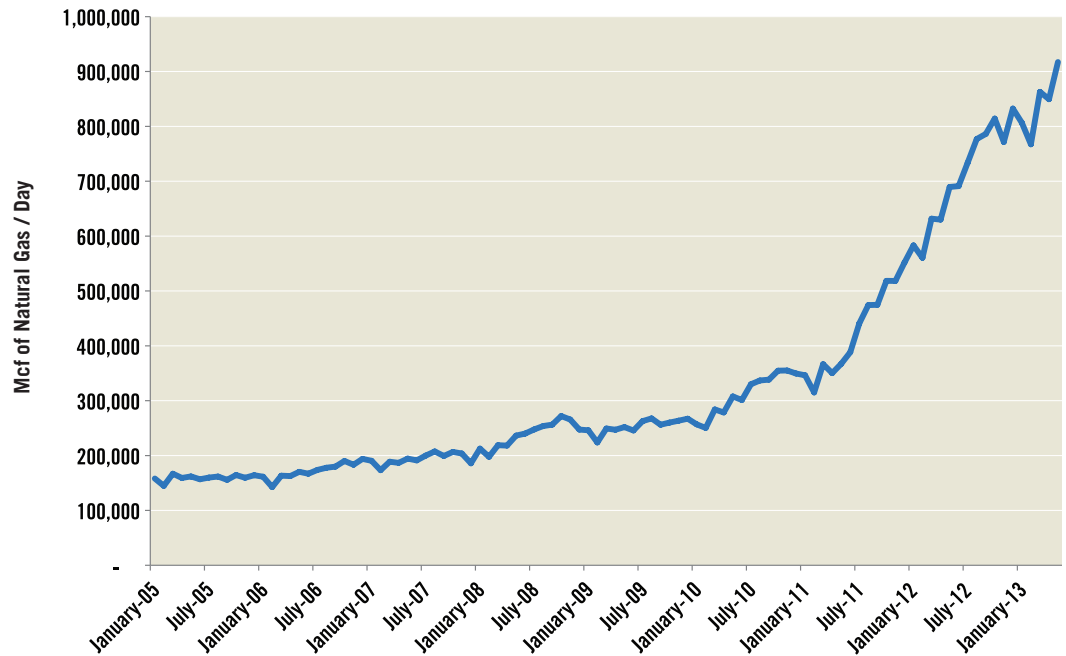
7 Helms, "Directors Cut"

8 North Dakota Pipeline Authority, "Facts on Natural Gas and Flaring in North Dakota" <http://northdakotapipelines.com/natgasfacts/> (accessed July 2013)

9 Fielden, Sandy "Set Fire To The Gas – The Fight to Limit Bakken Flaring" 6 May 2013, <http://www.rbenergy.com/set-fire-to-the-gas-the-fight-to-limit-bakken-flaring> (accessed July 2013)

10 Helms, "Director's Cut."

FIGURE 2: NORTH DAKOTA NATURAL GAS PRODUCTION



Source: North Dakota Industrial Commission

Secondly, natural gas requires its own infrastructure to be collected and marketed, necessitating further investment. In the absence of a strong regulatory framework that prohibits flaring, companies working with a limited amount of capital (which is to say all companies) have a strong incentive to put their capital toward oil production, given its higher return relative to natural gas. As a result, Bakken producers have often chosen to flare off associated natural gas, even as state authorities report that its high proportion of NGLs “makes gathering and processing of Bakken gas economic.”¹¹

The percentage of flared natural gas in North Dakota peaked in September 2011 at 36 percent.¹² That percentage has since fallen to 29 percent as of May 2013;¹³ however, the absolute volume of flared gas has continued to grow, outpacing investments in additional gathering and processing infrastructure. Between May 2011 and May 2013, the amount of natural gas flared in North Dakota grew 2.5 times, from approximately 106,000 to 266,000 Mcf per day,¹⁴ propelling the U.S. to join Russia, Nigeria and Iraq among the world’s top 10 flaring countries.¹⁵

11 Ibid.

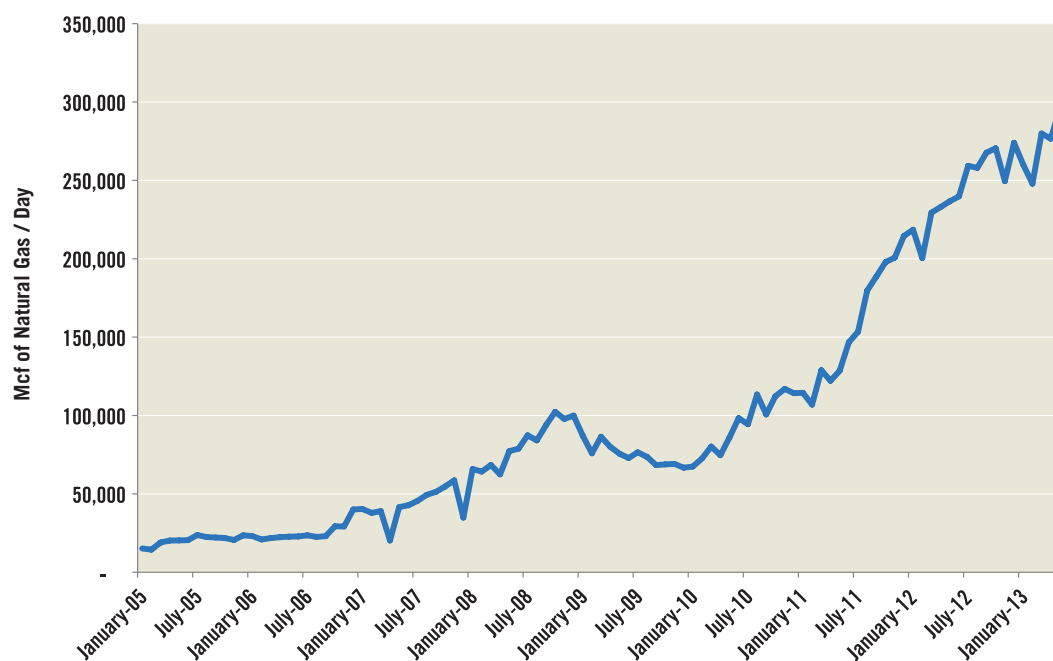
12 Ibid.

13 Ibid.

14 North Dakota Industrial Commission Department of Mineral Resources, “North Dakota Monthly Gas Production and Sales,” <https://www.dmr.nd.gov/oilgas/stats/Gas1990ToPresent.pdf> (accessed July 2013)

15 Global Gas Flaring Reduction “Estimated Flared Volumes from Satellite Data, 2007-2011” <http://go.worldbank.org/D03ET1BVDO> (accessed July 2013)

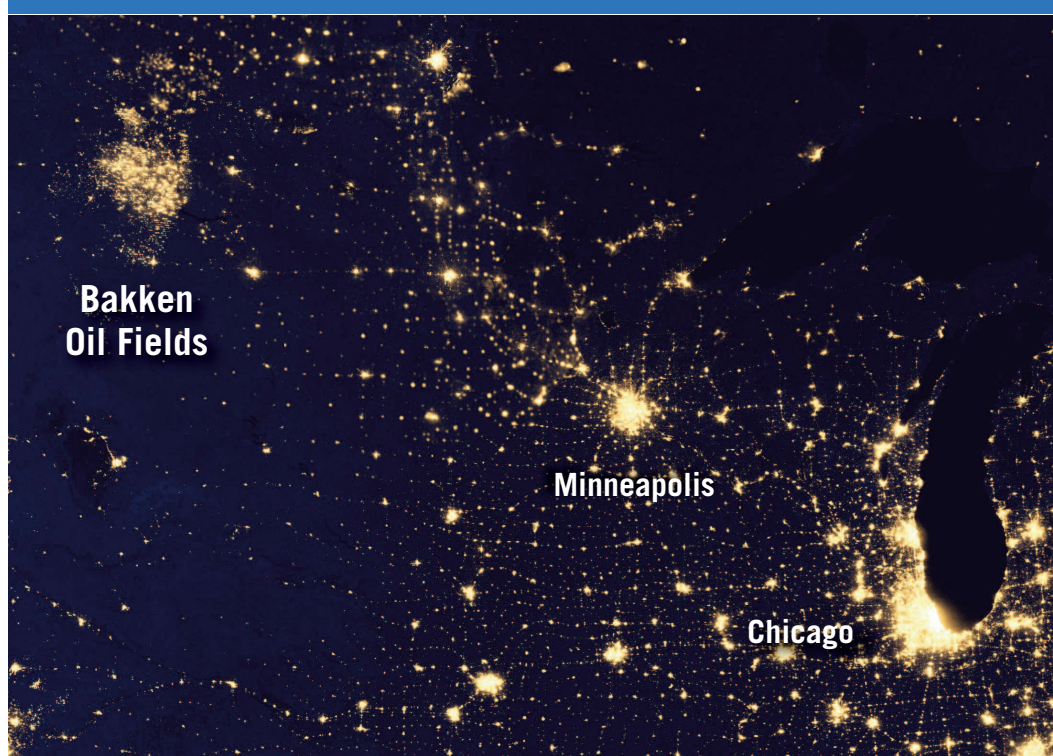
FIGURE 3: NORTH DAKOTA FLARED OR UNMARKETED NATURAL GAS¹⁶



Source: North Dakota Industrial Commission

The absolute volume of flared natural gas in North Dakota has continued to rise along with oil production.

NORTH DAKOTA GAS FLARES CAN BE SEEN FROM SPACE



Credit: NASA Earth Observatory/NOAA NGDC © 2012

Satellite images from NASA's "Earth at Night" project reveal that North Dakota's natural gas flares are now visible from space, burning nearly as brightly as city lights in Minneapolis and Chicago.

¹⁶ The North Dakota Oil and Gas Division provides historical data on the volume of natural gas produced and the volume marketed in the document cited here as "North Dakota Monthly Gas Production and Sales." The volume of historical flaring was estimated by subtracting the volume of marketed gas from the volume produced. A small portion of the difference is natural gas that is unmarketed, but not flared. Since January 2011, the North Dakota Oil and Gas Division has also provided the actual percentage of flared natural gas. Unless indicated as "flared or unmarketed" gas, all other figures in this report were derived from the actual percent of flaring.

Over the course of 2012, natural gas flaring in North Dakota emitted 4.5 million metric tons of carbon dioxide, equivalent to the annual emissions of approximately one million cars.

NASA satellite images reveal that North Dakota's gas flares are now visible from space, yet flared gas produces more than light pollution.¹⁷ Over the course of 2012, natural gas flaring in North Dakota emitted 4.5 million metric tons of carbon dioxide, equivalent to the annual emissions of approximately one million cars.¹⁸ Although flaring produces less potent GHG emissions than venting the gas directly to the atmosphere, these emissions increase the carbon footprint of Bakken oil. In addition, because the flares used tend to only partially combust the natural gas, a variety of other hazardous pollutants are generated by the process, including black carbon, another potent driver of climate change¹⁹ with adverse health effects.²⁰

The Cost of Flaring

The environmental impact of flaring is not its sole cost. The combustion of natural gas during production represents a significant economic cost for oil and gas producers, especially when the valuable characteristics of North Dakota gas are taken into account.

More than 95 percent of flaring extensions requested over the past two years were granted by North Dakota regulators.

Under current North Dakota regulation, companies are allowed to flare natural gas for the first year of a well's production. The high decline curve associated with unconventional oil and gas wells means that a large percentage of the well's total natural gas production occurs during that first year. After the first year, producers can apply for a further flaring exemption if they can demonstrate that capturing the natural gas is economically unfeasible.²¹ Because many wells are located in remote areas with rough terrain, installing the necessary pipelines can be expensive. Given the wide price differential between oil and gas, companies can easily make the case that the potential profit margin for the natural gas is too small to justify the costs of installing the pipelines. As a result, more than 95 percent of the extensions requested over the past two years were granted by North Dakota regulators.²²

If the value of natural gas liquids is added, capturing Bakken gas is more economic.

However, according to the North Dakota Pipeline Authority, Bakken natural gas contains roughly eight to 12 gallons of higher-priced natural gas liquids (NGLs)—including propane, butane, isobutane and natural gasoline—per Mcf of natural gas produced.²³ The value of 10 gallons, the midpoint of that range, for an average mix of NGLs is \$10.33, as illustrated in Table 1.²⁴ Therefore, if the value of the NGLs is added to the price of the dry gas (\$3.20/Mcf as of May 2013), Bakken natural gas could be worth about \$13.50 per Mcf, making capturing the natural gas more economic. The price producers ultimately receive is lower due to the costs associated with getting the gas to market. This figure represents the market value of Bakken gas, some of which producers pay out in transport fees, royalties, taxes and other costs.

17 Ajay Makan and Ed Crooks, "Shale gas boom now visible from space," Financial Times, 27 January 2013, <http://www.ft.com/intl/cms/s/0/d2d2e83c-6721-11e2-a805-00144feab49a.html> (accessed July 2013)

18 Based on: 56.14 kg CO₂/Mcf, as calculated in "2012 Climate Registry Default Emission Factors" <http://www.theclimaterestory.org/downloads/2012/01/2012-Climate-Registry-Default-Emissions-Factors.pdf> and 1 kg CO₂e = 0.00021 cars' annual emissions, as calculated by U.S. Environmental Protection Agency, "Greenhouse Gas Equivalencies Calculator" <http://www.epa.gov/cleanenergy/energy-resources/calculator.html#results> (both accessed July 2013)

19 Eilperin, Juliet "Black carbon ranks as second-biggest human cause of global warming," Washington Post, 15 January 2013, http://articles.washingtonpost.com/2013-01-15/national/36385685_1_black-carbon-impact-of-carbon-dioxide-soot (accessed July 2013)

20 U.S. Environmental Protection Agency, "Effects of Black Carbon?" <http://epa.gov/blackcarbon/effects.html> (accessed July 2013)

21 North Dakota Industrial Commission, Department of Mineral Resources, Oil and Gas Division, "Rules and Regulations," p. I-10, <https://www.dmr.nd.gov/oilgas/rules/rulebook.pdf> (accessed July 2013)

22 MacPherson, James "ND bill cuts exemption for wasting natural gas" Associated Press, 2 February 2013, <http://www.thedickinsonpress.com/event/article/id/65518/> (accessed July 2013)

23 North Dakota Pipeline Authority, "Facts on Natural Gas and Flaring in North Dakota" <http://northdakotapipelines.com/natgasfacts/> (accessed July 2013)

24 Calculated using mix assumption in RBN Energy Frac Spread model described in Sandy Fielden, "Set Fire To The Gas – The Fight to Limit Bakken Flaring" 6 May 2013, <http://www.rbnenergy.com/set-fire-to-the-gas-the-fight-to-limit-bakken-flaring> (accessed July 2013)

Over the course of 2012, North Dakota oil and gas producers flared more than \$1 billion of natural gas.

TABLE 1: VALUE OF NATURAL GAS LIQUIDS PER MCF OF NORTH DAKOTA GAS				
Mix	Product	\$/Gal	Weighted average	\$ per Mcf (@ 10 gal/Mcf)
49%	Propane	\$0.68	\$0.33	\$3.33
16%	Normal butane	\$0.97	\$0.16	\$1.55
12%	Isobutane	\$0.95	\$0.11	\$1.14
23%	Natural gasoline	\$1.87	\$0.43	\$4.30
100%	Total			\$10.33

Multiplying the amount of flared natural gas by the combined price of the dry gas and natural gas liquids puts the amount of economic waste generated by flaring into stark perspective. Over the course of 2012, North Dakota oil and gas producers flared more than \$1 billion of natural gas. Again, this figure represents the market value of Bakken gas, some of which is not ultimately retained by producers.

In May 2013 alone, producers flared 266,000 Mcf of natural gas each day, which represents roughly \$3.6 million in lost revenue per day at market rates. That is approximately five percent of the total value of the oil produced in North Dakota each day in May 2013, which, at a reported price of \$87.94 per barrel, is estimated at \$72.6 million.

These figures underscore that, though the decision to flare may seem a rational one in the short-term, it carries with it real and significant economic costs for producers, landowners and the state as a whole.

Industry Efforts to Curb Flaring

Some North Dakota oil and gas producers have taken important steps to curb the routine use of flaring in their operations. For example, Hess Corporation reports that it is investing “\$1.2 billion in oil and gas infrastructure between 2011 and 2013...[including] oil and gas gathering lines, compression stations, grouped production facilities and gas processing operations.”²⁵ Service companies are also offering operators a range of other solutions such as onsite natural gas-powered electric generators.

North Dakota regulators have set a public goal to reduce flaring to 10 percent or below by an unspecified future date.²⁶ In addition, new legislation passed by the North Dakota legislature will offer tax incentives for producers that capture and use gas, rather than flare it. Meanwhile, investors in the state’s oil and gas industry have continued to be outspoken proponents of flaring reduction,²⁷ and leading companies also have set flaring reduction goals. Examples include:

North Dakota regulators have set a public goal to reduce flaring to 10 percent or below by an unspecified future date.

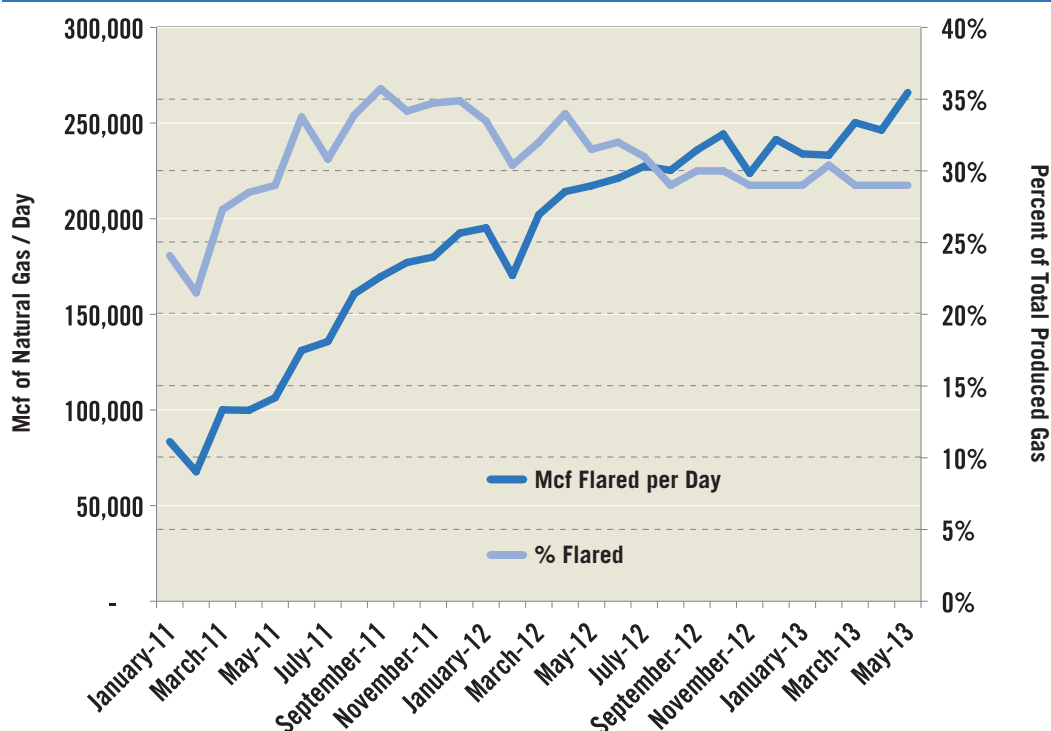
25 Hess Corporation, “How We Operate” http://www.hesscorporation.com/media/csr_2011/2011site/operate_24.html (accessed July 2013)

26 North Dakota Pipeline Authority, “Facts on Natural Gas and Flaring in North Dakota” <http://northdakotapipelines.com/natgasfacts/> (accessed July 2013)

27 Saqib Rahim, “Bakken’s top producer wants to snuff out natural gas flaring,” EnergyWire, 4 March 2013, re-printed at <http://www.midwestenergynews.com/2013/03/04/bakkens-top-producer-wants-to-snuff-out-flaring/> (accessed July 2013)

- **Whiting Petroleum:** “Our goal [is] to have zero [flaring] emissions.”²⁸
- **Hess Corporation:** “We expect to reduce our flaring rate beginning in 2013 to a point below the state’s goal of 10 percent flaring for the Bakken region by 2014.”²⁹
- **Continental Resources:** “Our ultimate goal is to reduce natural gas flaring from our operated well sites to as close to zero percent flaring as possible.”³⁰

FIGURE 4: NORTH DAKOTA FLARED NATURAL GAS (TOTAL VOLUME & PERCENTAGE)³¹



Unless regulators and companies take more aggressive action, the total amount of flaring in North Dakota could continue to rise along with the projected growth in overall production, even if the percentage of flared natural gas continues to fall.

29 Hess Corporation, "How We Operate" http://www.hesscorporation.com/media/csr_2011/2011site/operate_24.html (accessed July 2013)

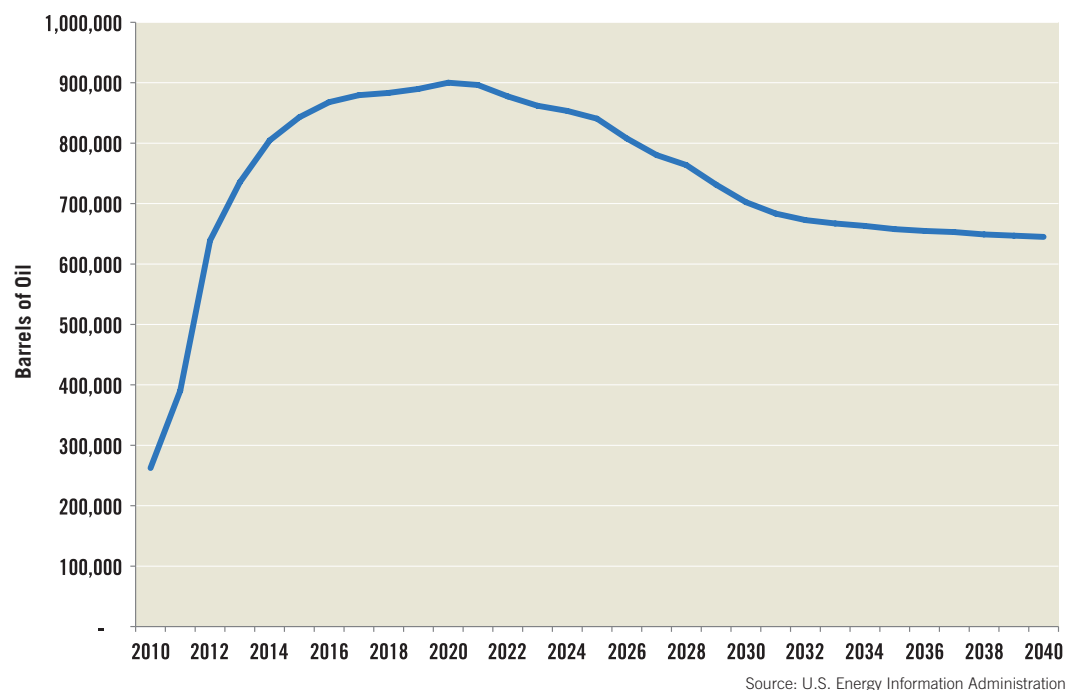
31 Percent flaring is currently reported by the North Dakota Industrial Commission. Prior to January 2011, the Commission did not report the actual percentage of flared gas. In addition, for several months including the summer months of 2011 and between October and January 2012, there are gaps in the Commission's reporting of the actual percentages of flared gas. During these months, flaring percentages are estimated using methodology outlined in note 15. All other percentages are actual flaring reported by the Commission.

Will Flaring Continue to Rise?

Existing studies have projected the long-term expected productivity of North Dakota oil production. Given that the flaring of natural gas is directly tied to the level of oil production, it is possible to project future volumes of flared gas based upon the estimated productivity of the state's unconventional oil plays.

In its 2013 *Annual Energy Outlook*, the U.S. Energy Information Administration (EIA) projected that oil production from the Bakken formation would increase by an additional 40 percent between 2012 and 2020, from 640,000 to 900,000 bpd, ultimately accounting for 32 percent of U.S. tight oil production.³² (By comparison, the next two largest tight oil plays, the Eagle Ford and Permian, are projected to account for 24 percent and 22 percent of U.S. tight oil production, respectively.)

FIGURE 5: PROJECTED OIL PRODUCTION FROM BAKKEN FORMATION



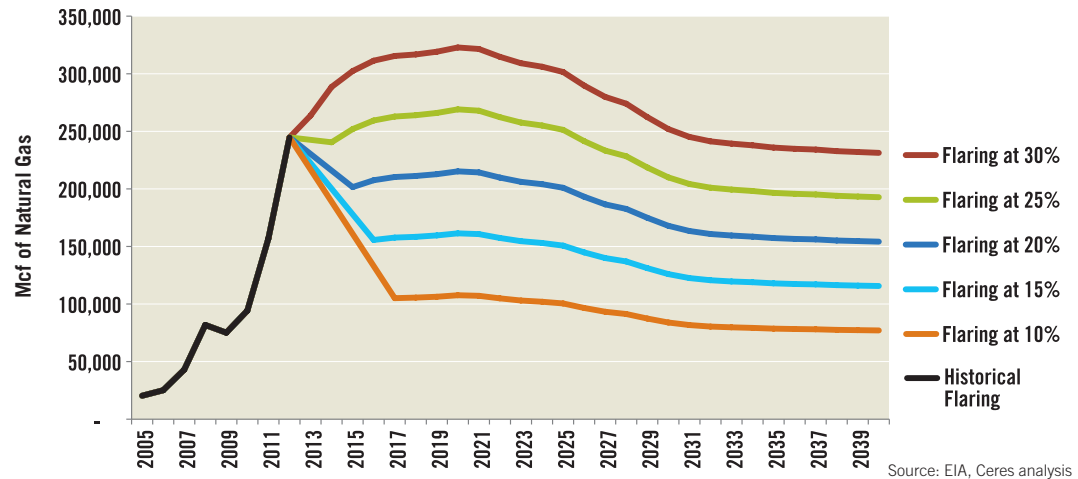
This projection of Bakken oil production can be used to estimate the amount of total natural gas flaring that may occur in the future at various percentages of flaring. For the purposes of these projections, the ratio of gas to oil production is held constant at 1.2 Mcf of gas per one barrel of oil, which was the average ratio for production recorded from 2011 through 2012.³³ In addition, flaring percentages below the current level of approximately 30 percent are assumed to decrease at five percent per year. This assumption accounts for the likelihood that reductions of flared gas would take several years to achieve.

³² U.S. Energy Information Administration, "Annual Energy Outlook 2013," p. 82, [http://www.eia.gov/forecasts/aeo/pdf/0383\(2013\).pdf](http://www.eia.gov/forecasts/aeo/pdf/0383(2013).pdf) (accessed July 2013)

³³ Derived from "North Dakota Monthly Gas Production and Sales" and "ND Monthly Oil Production Statistics"

Figure 6 depicts five projections, one in which flaring remains relatively constant at today's level of 30 percent, and others in which flaring levels are reduced to 25 percent, 20 percent, 15 percent and North Dakota's stated goal of 10 percent. Under these projections, total flaring volumes will continue to rise above 2012 levels through 2020 unless the percentage of flaring is reduced from its current level to below 21 percent.

FIGURE 6: CERES PROJECTIONS FOR MCF PER DAY FLARED



Under these projections, total flaring volumes will continue to rise above 2012 levels through 2020 unless the percentage of flaring is reduced from its current level to below 21 percent.

Even if the state's goal of 10 percent flaring were achieved, total volumes of flared gas in 2020 would still exceed the amount flared in 2010.

In addition, even if the state's goal of 10 percent flaring were achieved, total volumes of flared gas in 2020 would still exceed the amount flared in 2010. This projection highlights the importance of monitoring the total amount of natural gas flaring in addition to the percentage of gas flared to measure progress. The percentage of flared gas could fall incrementally over the next several years, but total volumes of flared gas could still be expected to continue to grow. Indeed, a Bentek Energy study commissioned by the North Dakota Pipeline Authority and North Dakota Industrial Commission shows that gas to oil production ratios tend to increase as wells age.³⁴

³⁴ Ellerd, Mike, "Exciting future for gas," Petroleum News, 19 August 2012, <http://www.petroleumnews.com/pntruncate/575967322.shtml> (accessed July 2013)

Conclusion and Recommendations

These findings and projections highlight the importance of developing aggressive near-term solutions to the issue of flaring in order to limit the amount of economic waste for producers and to mitigate environmental harm.

Near-term recommendations include:

- **Improved standards.** When compared with other resource-rich states like Texas, California or Alaska, North Dakota's flaring regulations are unusually permissive, and its flaring rate is correspondingly much higher. Producers in North Dakota are not flaring because capturing gas is uneconomic, but simply because it is not as economic as developing additional oil-focused wells. New tax incentives are a start, but a stronger regulatory regime would provide the economic signal needed to drastically reduce flaring in North Dakota, improving the state's tax base for providing vital services for a growing population.
- **Increased exchange of best practices.** As previously noted, several Bakken producers have set strong goals to reduce natural gas flaring. Given that economically viable solutions, including further investments in natural gas collection and processing infrastructure, are likely to benefit multiple producers within the region, companies should work together to share best practices and strategies for minimizing the flaring of gas.

If Bakken producers and North Dakota regulators are able to generate economic solutions to the problem of flaring, ideally those solutions would be replicable in the Eagle Ford, Permian and other U.S. oil plays, generating positive outcomes for a variety of stakeholders. Undoubtedly, no investor, regulator or producer wants to see billions of dollars of product go up in flames.



Ceres is a nonprofit organization mobilizing business leadership on sustainability challenges such as climate change and water scarcity. It directs the Investor Network on Climate Risk (INCR), a network of more than 100 investors with collective assets totaling more than \$11 trillion.

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