



North Dakota

Associated Gas Utilization Study

with a summary of other US States' legal anti-flaring measures

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With thanks to Tom Mitro for his very useful insights.



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Summary of findings

Lack of intra-state infrastructure that would enable access to the huge US inter-state gas pipeline network

Independent producers, private ownership of mineral rights and too recent anti-flaring regulations

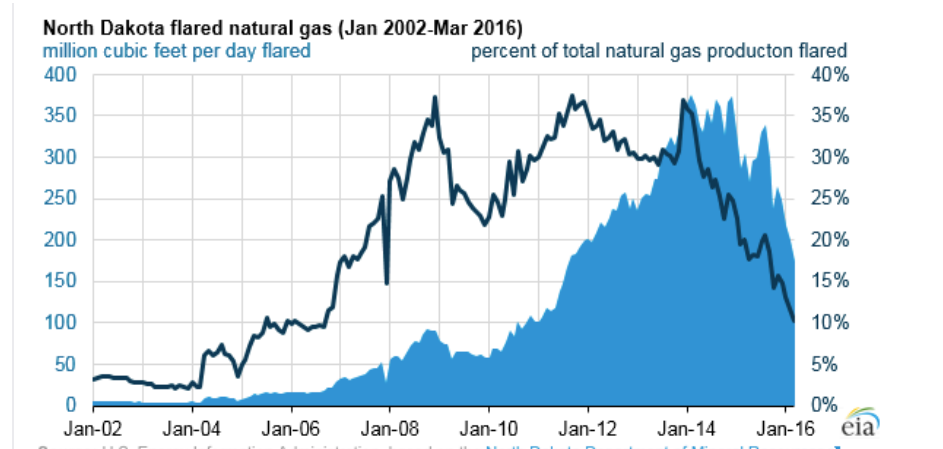
On site power generation and CNG

Stricter regulations, EPA's growing oversight and increased public pressure

- ◆ North Dakota (ND) presents the paradoxical case of being at the doorstep of a huge network of gas pipelines, opening access to the vast US market, while flaring at the level of 30% of the Associated Petroleum Gas (APG) produced as of 2014. However, ND is a recent producing state, rural and remote, lacking intra-state gas gathering facilities and pipelines.
- ◆ This paradox results from a combination of factors: the local oil industry is composed of multiple independent producers that rarely possess the policies nor the financial capacity needed to internalize the cost of gas gathering facilities, particularly in times of low prices; oil and gas subsurface rights are privately owned and neither subject to the 'delay rental' clause nor to the power eminent domain when it comes to gathering lines; effective anti-flaring regulations have been lacking until July 2014.
- ◆ While waiting for the completion of substantive investments in gas gathering and intra-state pipelines, on-site power generation using APG is increasingly becoming an option. It comes as a substitute for costly non-local diesel fuel, particularly with the development of gas turbine technology able to use APG with notable amounts of NGLs. Overall, CNG and power production appear to be the dominant options for APG use in ND.
- ◆ Recent stricter requirements and penalties on oil producers engaged in flaring, US EPA's growing oversight on the state level and increased public pressure, have succeeded as of June 2016 in both reducing flaring and increasing APG use through infrastructure development. More remains to be done.

The statistics of APG flaring in North Dakota: How bad is it?

Gas Flaring in North Dakota , 2002-16



Source: US EIA, 2016

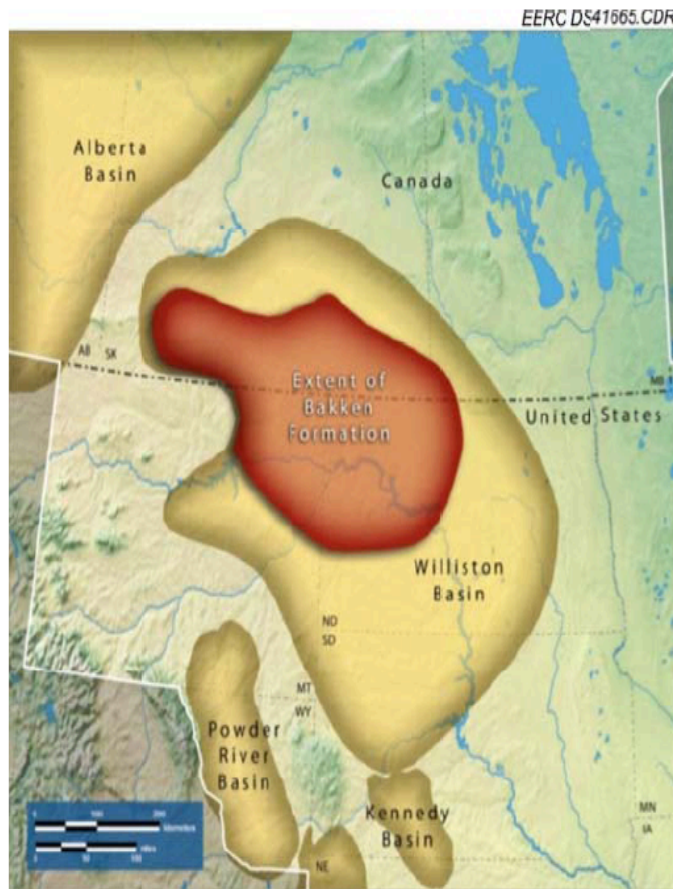
Statistics on APG
flaring

- ◆ In 1999, ND flared just 3% of gas produced, while the figure for gas flaring was up to 36% of gas produced as of 2014, or about 10.3 billion cubic feet each month. (Texas flares less than 1% of its shale oil in comparison). It was the equivalent of \$100 million worth of gas is estimated to be flared in ND every month.
- ◆ Since 2014 however the volume of flared natural gas production has fallen sharply in both absolute and percentage terms. In March 2016, 10% of North Dakota's total natural gas production was flared as compared to 36% in January 2014.



The Bakken Formation

Location of Bakken Formation in North Dakota



- The recently exploited Bakken Formation, an oil-wet shale formation of approximately 200,000 square miles in area is situated within the Williston Basin.
- The Williston Basin covers parts of ND, South Dakota, Montana, and the Canadian provinces of Manitoba and Saskatchewan.
- In the American section of the Williston Basin, the Bakken Formation occupies most of western ND and northeastern Montana.
- Crude oil accounted for 87.3% of the value of a barrel of Bakken oil in late 2012, while NGLs made up 8.9% and dry gas (methane) accounted for just 3.7%.

Source: UNDEERC, 2013



What is the legal and fiscal framework in place to stop flaring and incentivize APG use?

Agencies

Legal framework

Fiscal framework

Agency	Description
North Dakota Industrial Commission (NDIC)	<p>The NDIC is the primary regulator for the state's oil and gas industry and sets standards regarding gas flaring in the state.</p> <p>NDIC can grant confidential reporting status to wells for their first six months of production. According to the EIA, these confidential wells have almost double the flaring rates of non-confidential wells (From April 2015 through March 2016, confidential wells flared 29% of the natural gas produced whereas non-confidential wells flared 15%).</p>



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Legal Framework for APG use	Description
<p>NDIC regulation on gas flaring and gas capture - Section 38-08-06.4 of the North Dakota Century Code (as of August, 2013, new regulations take effect as of July, 2014)</p>	<ul style="list-style-type: none"> • ND law permits limited amounts of gas flaring in the first year after an oil well enters production if particular oil production limits are adhered to. • According to the law, after the one year period stipulated above, flaring of gas must stop and the well must be: <ul style="list-style-type: none"> • “capped, • connected to a gas gathering line, • equipped with an electrical generator that consumes at least 75% of gas from the well • equipped with a system that takes at least 75% of gas and NGL volume from well for beneficial consumption by means of compression to liquid use for fuel, transport to a processing facility, production of chemicals or fertilizers conversion to liquid fuels, separating and collecting over 50% of the propane and heavier hydrocarbons; or • equipped with other value added process as approved by the industrial commission which reduce the volume or intensity of the flare by more than 60%” (N.D. CENT. CODE § 38-08-06.4 (2013)). • If the well is operating while breaking any of the above stipulations, the producer must pay royalties to royalty owners equal the value of the flared gas and are required to pay a gross production tax on the flared gas at a preset rate • If any of the above-mentioned methods to capture the gas is demonstrated as being economically infeasible, NDIC may grant an exemption.



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Legal Framework for APG use	Description
<p>Order 24665, released on July 1, 2014.</p>	<ul style="list-style-type: none"> • The order stipulates that as of October 1, 2014, all Bakken and Three Forks oil and gas wells must capture at least 74% of produced gas. Failing this, the producers will be subject to production restrictions. By January 1, 2015, this capture percentage rises to 77%; by 2016, to 85%; and by 2020 to 90%. • The order also addresses the flowback period that was not addressed by the NDIC rules: <ul style="list-style-type: none"> • Producers are given 90 days post first production to produce at maximum efficient rate (the volume of the first 14 days are not counted as this is where the bulk of the fracturing liquid is removed). • After the first 14 days, the producers must use the next 76 days to assess how to connect the well to a gathering facility or to utilize remote capture processes to meet the gas capture volume. Failing this, the producer will be subject to production reduction (“capturing 60% of gas through remote capture results in a production allowable of up to 200 barrels a day. Failing to employ gas capture technology results in a restriction of 100 barrels a day until remedied” (Ehrman, 2015).)

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Legal Framework for APG use	Description
Siting and eminent domain federal rules for gas pipelines.	<ul style="list-style-type: none"> • In the 1930's – 1940's, Congress creates nationwide siting and eminent domain authority for natural gas pipelines in order to preempt state barriers to infrastructure build-up. • The interstate natural gas pipelines require federal approval in the US. Every new or modified pipeline requires a certificate of public convenience and necessity from the Federal Energy Regulatory Commission (FERC). Gathering lines, even if they are inter-state and intrastate distribution pipelines are outside of FERC's jurisdiction. • To accelerate permitting procedures, "FERC instituted pre-filing and EAct 2005 made FERC the lead agency responsible for coordinating federal agency authorizations and compliance with National Environmental Policy Act ("NEPA") during pipeline certificate application reviews" (Klass et al., 2014). • FERC is said to have facilitated a significant build-out of new pipeline infrastructure to move new sources of shale gas on the East Coast and in Texas and efforts still continue to expedite the process for review and approval of interstate gas pipelines in areas of major new gas production. • This abundance of infrastructure (whose cost is not borne by the operator necessarily) has increased competition and has decreased gas prices. While low gas prices act as a dis-incentive in areas rich in oil and wet gas where infrastructure to move oil and NGLs is prioritized, the abundance of infrastructure makes it much easier to commercially develop and transport natural gas discoveries in the U.S..

What is the legal and fiscal framework in place to stop flaring and incentivize APG use?

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Legal Framework for APG use	Description
<p>EPA's rules to cut methane and VOC emissions from the oil and natural gas industry and clarify permitting requirements (May 2016)</p>	<ul style="list-style-type: none"> • The EPA announced changes to the new source performance standard (NSPS) - establishing minimum performance standards for new or modified sources of air pollution – and draft amendments to the control techniques guidelines (CTGs) (that help achieve the NSPS) for the oil and natural gas industry. The goal is to further reduce volatile organic compound (VOC) and methane emissions by 40–45% from 2012 levels by 2025. The new measures add emission limits for any new, modified, and reconstructed sources [leaks, compressors, completions and pneumatic devices]. EPA also issued amended CTGs for states that have failed to achieve mandatory limits on VOC emissions. States must consider these CTGs when evaluating their individual regulatory programs and for enforcement actions. • Finally, states are free to adopt and expand their own VOC and methane reduction program under EPA's new NSPS.



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Fiscal Framework for APG use	Description
Taxes and Royalties	Royalty payments and state taxes on flared gas for producers that fail to get a written exemption for future flaring from the NDIC after the first year of oil production



The special context of North Dakota's regulations

Agencies

Legal framework

Fiscal framework

Description

- ND's regulations arose from a specific collaboration between the the NDIC and the industry association, the North Dakota Petroleum Council (the "Council").
- In a desire to understand what would be achievable and realistic regulations, the NDIC first only provided the Petroleum Council with a set of flaring goals. In turn, the Council consulted with its membership on each goal in order to review possible unintended consequences and analyze best solutions, eliminating those that were impractical. Most importantly, the Council found that flaring was principally due to the lack of processing capacity in ND. In addition, the council proposed making the gas capture plans part of the drilling permit process whereby producers would be responsible for proving to the NDIC how they planned on capturing the APG in order to obtain the permit. To show the good faith of the producers, the council also proposed an affidavit requirement showing that the gas capture plan has been provided to a listed group of midstream gathering companies in the area. The Council also proposed a timeline of implementation and penalties for non-compliance under the form of production curtailment (which would act as an incentive to comply) (Ehrman, 2015).
- This cooperative industry-regulatory relationship has been subject to criticism for fear of "regulatory capture." Some analysts have concluded that the interest of the Council in this cooperation stems from the fact that the industry feared the EPA's federal oversight over oil wells and wanted to pre-empt it, that the industry is commercially interested in capturing this wasted gas, that many of the Council's members voluntarily already implemented some kind of anti-flaring technology (Ehrman, 2015). Lastly, 10 mineral rights holders brought lawsuits against 10 oil producers in North Dakota in October 2013; which has urged producers to react.



Legal obstacles to APG use in the Bakken Formation

Agencies

Legal framework

Fiscal framework

Legal obstacles to APG use	Description
Legal Obstacles	<ul style="list-style-type: none"> • Private property rights in the state mean that companies must engage in short term lease agreements with landowners or mineral rights owners to drill for oil. This short time horizon leading companies to drill and fracture oil wells before natural gas gathering lines are made available has been cited by local stakeholders as a reason for high incidence of flaring in ND. However in other US States, leases might include “delay rental” clauses to enable the producer to keep and extend the lease if a well is not drilled on time or delayed in particular because of a pipeline. • Additionally, the NDIC has cited difficulty attaining permission from landowners for pipeline connection activities which can significantly slow down the process of gas gathering line installation as well. Unlike In other US states, in ND the power of eminent domain has not been granted to gathering lines. To reduce the impact on landowners, the energy policy commission announced plans to create an energy corridor along Allete’s existing 465-mile electric transmission right-of-way. • In an attempt to reduce flaring, the participation of the producers of the Fort Berthold Indian Reservation needs to be tackled. The Reservation is controlled by the Tribes and is difficult to regulate given the uncertainty as to who has jurisdiction over mineral development: ‘The composition of land on the reservation is made up of “a variety of differing legal tenures (e.g., tribally-owned lands, federally-owned lands, allottee-owned lands, and non-Indian-fee-owned lands)”’ (Ehrman 2015). The Tribes issued anti-flaring rules that conflict with the NDIC’s rules and what prevails remains unclear. Until 2008, the Tribes agreed to give jurisdiction over oil wells to the State of ND but they then decided that ‘oil and gas wells are “subject to applicable federal, tribal, and state regulatory provisions for the life of the well”’ (Ehrman 2015).

Technical obstacles to APG use in the Bakken Formation

Agencies

Legal framework

Fiscal framework

Technical obstacles to APG use

Description

Technical Obstacles

- ND lacks pipeline and processing infrastructure. Unlike states such as Texas and Oklahoma, that have a long history of petroleum exploitation that created a comprehensive networks of pipelines, processing facilities, and marketing hubs, ND's recent history in petroleum production indicates that it has a limited transportation and processing infrastructure in place.
- The North Dakota Pipeline Authority provides additional factors contributing to the state's high flaring rates: " the size of the Bakken oil field dwarfs the state's existing natural gas gathering infrastructure; North Dakota itself is "rural and remote" with winter conditions that limit the construction season; and the industry does not construct gathering pipelines until after producers complete and test wells to determine how much oil and gas the well will produce" (Klass et al., 2014). Those factors came in addition to the legal issues highlighted before.
- Midstream companies are however attracted to the Bakken because of the NGLs. But given the scarcity of gathering and processing facilities, the mid-stream companies have the upper hand in the negotiation in the Bakken. To avoid the imposition of exorbitant fees and terms by midstream companies, producers have to partner and amass volumes of oil to have more balanced negotiations with midstream companies.
- In 2014, 2 midstream companies agreed to increase gathering capacity on Aux Sable Midstream's pipeline network. A ND company announced a plan to build a 375-mile natural gas pipeline connecting northwestern ND with upper Midwestern commercial and residential markets provided that it receives sufficient capacity commitments from producers.
- Since existing pipeline capacity is scarce, producers have limited choices if they want to comply with the regulations: internalize the cost of gathering and processing facilities and build their own by partnering together and with midstream companies despite the current downturn in prices, practice "green completion processes" that separate and recover the gas to prevent emission, or invest in research to investigate gas capture solutions and localized APG use.

What are some current APG use projects that could serve as blueprints for future projects?

Power Generation

CNG

Gas to Liquids

Summary of Evaluated Technologies with Qualitative Characteristics

Technology	Gas Use Range, Mcfd	NGL Removal Requirement	Scalability to Resource	Ease of Mobility	Likelihood of Deployment at Small Scale
Power – Grid Support	1000–1800	Minimal	Very scalable	Very easy	Very likely
Power – Local Load	300–600	Minimal	Very scalable	Very easy	Very likely
CNG	50+	Yes	Scalable	Very easy	Possible
Chemicals	1,000,000*	No	Not scalable	Not mobile	Very unlikely
Fertilizer	300–2000	No	Scalable	Not easy	Possible
Gas-to-Liquids	1,000,000*	No	Scalable	Easy	Possible

* Typical commercial-scale plant.

Source: EERC, 2013

- The University of North Dakota's Energy & Environmental Research Center ("EERC") studied the potential for on site and local power generation, CNG, and Gas to liquids APG use projects in the Bakken oil fields. Power generation seems the most likely option. It also answered a surge in demand:

 - Increasing demand for power in the Williston Basin region has generated significant interest in APG for, in particular, on-site power generation for drilling and other shale oil production processes in the region. One of two electric utilities serving the area, the Basin Electric Power Cooperative (BEPC), forecasted a load increase from 600 MW to 1900 MW between 2010 and 2025



APG use case studies: Power generation

Summary of Power Generation Scenarios

Power Generation

Scenario	Capital Cost	Annual O&M Cost	Annual Revenue ¹
Grid Support – Reciprocating Engine	\$7,500,000	\$650,000	\$2,832,400
Grid Support – Gas Turbine	\$9,900,000	\$890,000	\$4,152,240
Local Power – Reciprocating Engine	\$3,200,000	\$270,000	\$1,149,896
Local Power – Microturbine	\$3,383,200	\$283,640	\$1,092,956

¹ Assumes 80% annual system availability.

Source: EERC, 2013

CNG

NGLs

- On site power generation is becoming an option with the development of technology such as the 'Lean, Premixed, Prevaporized (LPP) combustion technology' (Roby et. al, 2014), that is able to convert liquid fuels into a substitute for natural gas. Other technologies include steam turbines and microturbines. This is especially important for Bakken flare gas which is rich in NGLs, a fact which was viewed to make the APG "unsuitable" as a fuel for traditional natural gas fired turbines for on site power generation. The EERC also analyzed how flared gas could be used in diesel generators powering remote drilling rigs. They showed 'that 1.8 billion cubic feet of gas "could be used annually to power 200 drilling rigs in North Dakota, saving over \$72 million in fuel cost"'(Ehrman, 2015).
- A sample summary of power generation scenarios and costs are provided from the EERC above.

APG use case study: Statoil CNG project

Power Generation

CNG

NGLs

🔥 Project Participants:

- Statoil North America Inc.

🔥 Project Description and Motivation:

- As of June, 2014, Statoil is testing out a “mobile system” to transform APG to CNG at the well site (OGJ, 2014).
- Using the locally sourced CNG is expected to replace more costly diesel that is usually transported by truck, pipeline or rail from out of state.
- Construction of the refinery is reported to be about 60% complete.

🔥 Project Location:

- The project is located in Stark County near Dickinson in ND .

🔥 Associated Gas Use:

- The mobile system converts APG into CNG for in house use by Statoil. It should prevent 20% of the flaring that is currently occurring.

🔥 Project Technology:

- The system, known as the Last Mile Fueling Solution, employs a device the size of a standard 8 by 20 ft shipping container to compress the APG.



APG use case study: Vortex system to gather NGLs

Power Generation

CNG

NGLs

Project Participants:

- Bismarck-based Carbontec Industries' subsidiary: Bakken Frontier

Project Description and Motivation:

- Bakken Frontier is introducing the Vortex system to oil companies: The system separates out the liquids. The liquids are gathered by the system and shipped to a processing plant to be separated, processed and sold.
- Vortex is already in use in Texas and other oil producing areas, with 1,400 systems already installed.
- The system is said to be particularly appropriate for remote oil wells that are too far from the main natural gas pipeline: In those cases, the Vortex becomes the only tool to gather the liquids from those sites.
- According to Bakken Frontier, oil companies likely will receive 80 cents to \$1 per gallon of liquids, making US\$670,000, minus freight, lease and royalty payments.

Associated Gas Use:

- The system gathers the NGLs of the APG, reducing the amount of energy flared by about 40%.

Project Technology:

- Vortex works by using the pressure of the natural gas to spin the liquids from the methane.



Annex: Other states' legislation against flaring

◆ Indiana

- “In the 1890s, Indiana enacted a statute prohibiting the release of natural gas from oil wells for longer than two days after the well was drilled. (...) When the state sought to enjoin Ohio Oil Company from violating the statute and wasting gas, Ohio Oil argued that the statute provided only for damages as a remedy, not an injunction. The Indiana Supreme Court disagreed and held that despite the limited remedies in the statute, common law doctrines of waste and nuisance allowed the state to enjoin the release and waste of such an important natural resource” (Klass et al., 2014).

◆ Texas

- 1919: state legislature of Texas passed a comprehensive conservation law requiring the conservation of oil and gas, prohibiting waste and granting extensive regulatory and enforcement powers to the railroad commission (RRC).
- 1925: Texas legislature passed a law permitting the flaring of associated or casing head gas from oil wells in Texas.
- 1947: RRC issued an order shutting in all 615 oil wells in Seeligson Field in South Texas until flaring of casing head gas was eliminated and measures were taken to utilize the gas. Operator filed suits challenging the orders. The Texas Supreme Court upheld the RRC orders.
- RRC further issued orders to shutdown 17 fields for gas flaring, and was again challenged. Texas supreme court once again upheld the RRC's orders.
- 1949: RRC won the battle: no flaring was possible without valid permit.
- 1967: Texas Air Control Board adopted its first air quality regulations in line with the recently voted Clean Air Act.
- 1969: EPA was created by a presidential executive order and Texas took over most of the air monitoring responsibilities from the federal government

◆ Alaska

- In 1971, the Alaska Oil and Gas Conservation Commission (“AOGCC”) ordered offshore oil platforms operating in Cook Inlet to limit the burning of APG to what was needed for safety purposes, and to otherwise bring the gas to market or reinject it.
- “Mobil Oil challenged the AOGCC's regulations in court, but the Alaska Superior Court found the Commission had acted within its authority to prevent waste” (Klass et al., 2014).



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