Flares in the Oilpatch: Understanding ND Infrastructure

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Energy Policy Research Foundation, Inc. (EPRINC)
Platts Rockies 5th Annual Oil and Gas Conference
April 12th, 2012
Outline

Gas Flaring -- Issues and Potential Outcomes

• What is happening in North Dakota -- How much gas is being flared and why?
• What is the value of the flared gas?
• State regulations
• State of flared gas in the Rockies
• Infrastructure and investment
• From the New York Times to Washington, DC -- Senators, investigations, and potential regulations
Who is EPRINC?

EPRINC stands for *Energy Policy Research Foundation, Inc.* Non-profit research group that does economic and policy analysis on the petroleum industry

Founded in 1944 in New York. Established as a group to explain markets and fundamentals, heating oil industry

Previously the Petroleum Industry Research Foundation, Inc (PIRINC) until we moved to Washington in 2007

Grew largely into a downstream organization, but have since moved extensively into upstream and midstream

Extensive work on ethanol, refining, U.S. shale plays, Keystone XL

[www.eprinc.org](http://www.eprinc.org) -- check out our research, its free
North Dakota and the Bakken
Williston Basin Production

Barrels Per Day

North Dakota accounts for almost 10% of US Production

Almost all new production is from the Bakken/Three Forks

Source: NDIC
North Dakota Oil and Gas Production

Source: HPDI March 17, 2012. Does not include confidential wells and is therefore under current state figures.
Produced, Sold, and Not Sold (majority flared)

Source: North Dakota Pipeline Authority
North Dakota Wells with Gas Sales

Source: North Dakota Pipeline Authority
Number of Wells with First Time Gas Sales by Month

Source: North Dakota Pipeline Authority
Economic Value Captured

96.8%

Economic Value Captured

3.2%

Economic Value Flared

Source: North Dakota Pipeline Authority
Greater than 90% of Energy Production Captured

92.0% Energy Captured
8.0% Energy Flared

Source: North Dakota Pipeline Authority
Bakken Gas Infrastructure

Source: GIS Data Hart Energy  April 2012
Natural Gas Processing Plants and Pipelines

[Map showing natural gas processing plants and pipelines with various symbols indicating plant capacity and gas production.]

Gas Production

Plant Capacity

MMCFD

So, why so much flaring?

1. **Feasibility and economic viability of immediately getting gas to market.** Most of these wells will in time will be hooked up to gas processing facilities; however, there are some wells in North Dakota that are decades old and so far from any other existing well or facility that it may never be feasible to capture the gas from that single well.

2. **Size and Maturity of the Play.** New play with rapid development (partially because of leasing requirements) and spread across over 15,000 sq. miles continually seeing better well completion and higher production rates

3. **Severe weather limitations in North Dakota,** housing shortages, manpower

4. **Valuable associated natural gas that is high in NGLs,** but low in pressure, must be processed and separated to remove the different components in the NGL stream. Much higher value than current Henry Hub prices

5. Over $3 billion is being invested by the industry for gathering and processing in the next few years. **Significant gathering and processing growth** has taken place over the past several years, but has simply been unable to keep up with such strong production growth...lag in gathering, compression, and processing infrastructure...older facilities were not built to handle current volumes
38-08-06.4. FLARING OF GAS RESTRICTED - IMPOSITION OF TAX - PAYMENT OF ROYALTIES - INDUSTRIAL COMMISSION AUTHORITY. As permitted under rules of the industrial commission, gas produced with crude oil from an oil well may be flared during a one-year period from the date of first production from the well. Thereafter, flaring of gas from the well must cease and the well must be capped, connected to a gas gathering line, or equipped with an electrical generator that consumes at least seventy-five percent of the gas from the well. An electrical generator and its attachment units to produce electricity from gas must be considered to be personal property for all purposes. For a well operated in violation of this section, the producer shall pay royalties to royalty owners upon the value of the flared gas and shall also pay gross production tax on the flared gas at the rate imposed under section 57-51-02.2. The industrial commission may enforce this section and, for each well operator found to be in violation of this section, may determine the value of flared gas for purposes of payment of royalties under this section and its determination is final. A producer may obtain an exemption from this section from the industrial commission upon application and a showing that connection of the well to a natural gas gathering line is economically infeasible at the time of the application or in the foreseeable future or that a market for the gas is not available and that equipping the well with an electrical generator to produce electricity from gas is economically infeasible.

Source: N.D. Century Code.
Covering Multiple States and Two Countries

Source: EPRINC

Source: HPDI
This winter has been easy, but last summer....

Source: Oil Patch Hotline May 5, 2011 and EPRINC photo Trisha Curtis June 2011
Natural Gas Prices

“Natural gas delivered to Northern Border at Watford City price is down to $1.89/MCF”
Additionally...Need to Understand Processing

- Unlike crude oil which can be transported via rail in tank cars, by truck, or by pipeline, natural gas *must* be transported via pipeline and then sent to a proper facility to separate the products in the natural gas. Plant capacity construction is currently keeping up with production, but....

- Building gathering capabilities is not done by the producer, but rather by a third party and requires designing facilities, permits (rights of way), manpower, capital investment, and compliance with regulatory requirements.

- Shortage of equipment and manpower in North Dakota as well as housing (which men working will need)
Natural Gas Liquids Processing and Contents

- Dry gas is lean and mainly methane. It has about one gallon of NGLs per Mcf
- Wet gas is rich in NGLs, but the amount (gallons per Mcf) varies from play to play
- NGL stream includes: ethane, propane, butane, iso-butane, and natural gasoline
  - 40% is ethane; 30% is propane; 30% other

Source: Crestwood Midstream Partners LP
**Valuable NGLs in the Bakken**

<table>
<thead>
<tr>
<th>Typical Bakken Well</th>
<th>BTU</th>
<th>MOL %</th>
<th>GPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methane C1</td>
<td>1,534</td>
<td>51.246</td>
<td></td>
</tr>
<tr>
<td>Nitrogen N2</td>
<td></td>
<td>4.626</td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td>0.858</td>
<td></td>
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<tr>
<td>Ethane C2</td>
<td></td>
<td>20.374</td>
<td>5.447</td>
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<tr>
<td>Propane C3</td>
<td></td>
<td>13.407</td>
<td>3.693</td>
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<tr>
<td>Iso-Butane IC4</td>
<td></td>
<td>1.443</td>
<td>0.472</td>
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<tr>
<td>Normal Butane nC4</td>
<td></td>
<td>5.335</td>
<td>1.682</td>
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<tr>
<td>Iso Pentane IC5</td>
<td></td>
<td>0.909</td>
<td>0.332</td>
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<tr>
<td>Normal Pentane nC5</td>
<td></td>
<td>1.403</td>
<td>0.508</td>
</tr>
<tr>
<td>Natural Gasolines C6+</td>
<td></td>
<td>0.399</td>
<td>0.164</td>
</tr>
</tbody>
</table>

**Gallons of NGLs per Mcf**

- Ethane: 5.45
- Propane: 3.69
- Butanes: 2.15
- Natural Gasoline: 1.00

* NGL Rich Gas

Source: BearTracker Energy, Presentation Bakken Product Markets and Take-Away Denver Jan 31-Feb 1 2012

NGLs, Infrastructure, and Ethylene Plants

### Rich Gas Shales and NGL GPM

<table>
<thead>
<tr>
<th>Shale</th>
<th>NGL GPM ¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avalon/Bone Springs ²</td>
<td>4.0 to 5.0</td>
</tr>
<tr>
<td>Bakken ²</td>
<td>6.0 to 12.0</td>
</tr>
<tr>
<td>Barnett</td>
<td>2.5 to 3.5</td>
</tr>
<tr>
<td>Cana-Woodford</td>
<td>4.0 to 6.0</td>
</tr>
<tr>
<td>Eagle Ford ³</td>
<td>4.0 to 9.0</td>
</tr>
<tr>
<td>Granite Wash</td>
<td>4.0 to 6.0</td>
</tr>
<tr>
<td>Green River ²</td>
<td>3.0 to 5.0</td>
</tr>
<tr>
<td>Niobrara ²</td>
<td>4.0 to 9.0</td>
</tr>
<tr>
<td>Piceance-Uinta</td>
<td>2.5 to 3.5</td>
</tr>
<tr>
<td>Montney</td>
<td>3.0 to 4.5</td>
</tr>
<tr>
<td>Marcellus–Utica ³</td>
<td>4.0 to 9.0</td>
</tr>
</tbody>
</table>

¹ GPM = gallons NGLs per mcf
² Oil Shale Plays
³ Oil and Gas Shale Play

Source: Veresen, Presentation Bakken Product Markets and Take-Away Denver Jan 31-Feb 1 2012

# NGLs and the Value of New Cryogenic Plants

<table>
<thead>
<tr>
<th>Typical Bakken Analysis</th>
<th>Refrig</th>
<th>Recovered</th>
<th>Price</th>
<th>Cryo</th>
<th>Recovered</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mol %</td>
<td>GPM</td>
<td>Rec %</td>
<td>Gallons</td>
<td>$/Mmbtu</td>
<td>$/Gal</td>
</tr>
<tr>
<td>N2</td>
<td>4.626</td>
<td></td>
<td>0.00%</td>
<td>0.00</td>
<td>$3.310</td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>0.858</td>
<td></td>
<td></td>
<td>0.00%</td>
<td>$3.310</td>
<td></td>
</tr>
<tr>
<td>C1</td>
<td>51.246</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00</td>
<td>$3.310</td>
<td></td>
</tr>
<tr>
<td>C2</td>
<td>20.374</td>
<td>5.00%</td>
<td>0.27</td>
<td>$3.310</td>
<td>$0.220</td>
<td>80.00%</td>
</tr>
<tr>
<td>C3</td>
<td>13.407</td>
<td>70.00%</td>
<td>2.58</td>
<td>$13.428</td>
<td>$1.230</td>
<td>99.00%</td>
</tr>
<tr>
<td>t-C4</td>
<td>1.443</td>
<td>80.00%</td>
<td>0.38</td>
<td>$15.153</td>
<td>$1.510</td>
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<tr>
<td>n-C4</td>
<td>5.335</td>
<td>90.00%</td>
<td>1.51</td>
<td>$14.558</td>
<td>$1.510</td>
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</tr>
<tr>
<td>t-C5</td>
<td>0.909</td>
<td>100.00%</td>
<td>0.33</td>
<td>$17.430</td>
<td>$1.910</td>
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</tr>
<tr>
<td>n-C5</td>
<td>1.403</td>
<td>100.00%</td>
<td>0.51</td>
<td>$17.216</td>
<td>$1.910</td>
<td></td>
</tr>
<tr>
<td>C6+</td>
<td>0.399</td>
<td>100.00%</td>
<td>0.17</td>
<td>$16.231</td>
<td>$1.910</td>
<td></td>
</tr>
</tbody>
</table>

|                |        |           |       |       |        |       |        |       |
|----------------|--------|-----------|-------|-------|--------|-------|
| 100,000        | 12,304 | 5.76      |       |       |        |       |
| **Value of the Residue Sale per Mcf** | $ 3.124 | $ 1.814 |
| **Value of the Liquid Sale per Mcf** | $ 8.030 | $11.644 |
| **Value at the Wellhead per Mcf** | $ 11.155 | $13.458 |

Pricing is based on 100% of the value at the sales point i.e. tailgate of the Plant. No costs assumed for gathering and processing.

Pricing is based on average prices paid at two different plants in the Bakken area averaged August 2011 - November 2011. Difference shown is the recovery in a full Cryogenic vs a Refrigeration Plant.

Ethane recoved in a refrigeration plant is shown as getting a gas (residue value).

Source: BearTracker Energy, Presentation Bakken Product Markets and Take-Away Denver Jan 31-Feb 1 2012

North American Natural Gas Pipelines

Source: GIS Data Hart Energy April 2012
NGL, LPG, HVL Pipelines and Nat Gas Processing Plants

Source: GIS Data Hart Energy April 2012
Companies are Investing, Infrastructure is Being Built

Source: Oneok Partners North Dakota
Natural Gas Flaring Webinar Nov 2011

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**ONEOK Compression Projects**

Approved and in various stages of construction

<table>
<thead>
<tr>
<th>Facility</th>
<th>Location</th>
<th>Capacity</th>
<th>Target In-Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Garden Creek Compressor Station</td>
<td>McKenzie County</td>
<td>30 MMcf/d</td>
<td>In Service</td>
</tr>
<tr>
<td>Stateline Compressor Station</td>
<td>Williams County</td>
<td>25 MMcf/d</td>
<td>In Service</td>
</tr>
<tr>
<td>Lodgepole/16” Trunkline</td>
<td>Dunn/Stark Counties</td>
<td>10 MMcf/d</td>
<td>In Service</td>
</tr>
<tr>
<td>Blue Buttes Units 5&amp;6</td>
<td>McKenzie County</td>
<td>10 MMcf/d</td>
<td>October 2011</td>
</tr>
<tr>
<td>Alexander Booster Expansion</td>
<td>McKenzie County</td>
<td>5 MMcf/d</td>
<td>October 2011</td>
</tr>
<tr>
<td>Charlson Compressor Station</td>
<td>McKenzie County</td>
<td>30 MMcf/d</td>
<td>November 2011</td>
</tr>
<tr>
<td>Cherry Creek Compressor Station</td>
<td>McKenzie County</td>
<td>30 MMcf/d</td>
<td>December 2011</td>
</tr>
<tr>
<td>Epping Compressor Station</td>
<td>Williams County</td>
<td>15 MMcf/d</td>
<td>January 2012</td>
</tr>
<tr>
<td>Twin Valley Compressor Station</td>
<td>McKenzie County</td>
<td>30 MMcf/d</td>
<td>March 2012</td>
</tr>
<tr>
<td>Epping Station Expansion</td>
<td>Williams County</td>
<td>15 MMcf/d</td>
<td>2Q 2012</td>
</tr>
<tr>
<td>Cooperstown Station Expansion</td>
<td>McKenzie County</td>
<td>10 MMcf/d</td>
<td>2Q 2012</td>
</tr>
<tr>
<td>Tree Top Station Expansion</td>
<td>Billings County</td>
<td>5 MMcf/d</td>
<td>3Q 2012</td>
</tr>
<tr>
<td>Bear Den Compressor Station</td>
<td>McKenzie County</td>
<td>30 MMcf/d</td>
<td>3Q 2012</td>
</tr>
<tr>
<td>Alamo Compressor Station</td>
<td>Williams County</td>
<td>15 MMcf/d</td>
<td>3Q 2012</td>
</tr>
</tbody>
</table>

**Total Capacity of Field Compression Expansions:** 260 MMcf/d
Innovative Solutions being Sought in ND

Environmental Energy Research Center (EERC)
Project will explore, identify, and demonstrate technologies for utilizing wellhead gas. Results will provide producers with a technical evaluation of gas fired biofuel (firing of natural gas and diesel fuel simultaneously in a diesel engine)diesel power for drilling operations, a demonstration of compressed natural gas (CNG) transport and delivery, and expanded markets for Bakken Formation associated gas.

Blaise Energy  To demonstrate the commercial viability of using otherwise wasted associated gas as fuel for on-site electrical power generation and its subsequent sale to the grid of the electricity as an alternative to flaring.

Bakken Express Evaluation of compressed natural gas (CNG) technologies as an economic method to capture and transport produced natural gas and gas liquids to market.

Source: NDPA Webinar Summer 2011
Rockies and the Niobrara
Oil and Gas Production in the Niobrara

Source: HPDI March 17, 2012. Niobrara, Codell, Frontier and related reservoirs included for Colorado and Wyoming
State of Flared Gas in the Rockies

• Some gas is being flared in the Rockies, but it is not nearly the issue as it is in North Dakota
• Flaring seems to have picked up somewhat with the boom of the Niobrara, but because this oil boom is much smaller and still in its infancy flaring is not nearly as significant as it is in ND
• Additionally, in places like the Wattenberg field there is already significant infrastructure in place...up north the infrastructure seems to be catching up
• In theory, slower pace of drilling gives infrastructure more time to catch up
• Wyoming does show a significant amount of flared or vented natural gas, but the majority of this is coming from venting off processing plants
Vented and Flared Gas Volumes and Comparison

- Colorado Natural Gas Vented and Flared
- Wyoming Natural Gas Vented and Flared
- North Dakota Natural Gas Vented and Flared
- Texas--onshore Natural Gas Vented and Flared
- U.S. Natural Gas Vented and Flared
Comparing just Colorado, Wyoming, and ND

Million Cubic Feet

- Colorado Natural Gas Vented and Flared
- Wyoming Natural Gas Vented and Flared
- North Dakota Natural Gas Vented and Flared
Niobrara Gas Infrastructure

Source: GIS Data Hart Energy  April 2012
Wyoming Regulations on Gas Flaring

Section 40. Authorization for Flaring and Venting of Gas.

(a) Venting or flaring under the following circumstances has not and does not constitute waste and is authorized by the Commission:

(i) Emergencies or upset conditions: During temporary emergency situations, such as compressor or other equipment failures, relief of abnormal system pressures, or other conditions which result in the unavoidable short-term venting or flaring of gas at a lease, gas plant or other facility;

(ii) Well purging and evaluation tests: During the unloading or cleaning up of a well during routine purging or drillstem, producing, or evaluation tests;

(iii) Production tests: During initial or recompletion evaluation tests not exceeding a period of fifteen (15) days, unless a longer test period is authorized by the Supervisor.

(b) Low rate casinghead gas. Unless it is determined by the Supervisor or the Commission that waste is occurring, up to 60 MCF of gas per day is authorized to be vented or flared from individual oil wells. Venting or flaring is authorized either at the well or at a lease facility which serves several wells.

Source: Wyoming Oil and Gas Conservation Commission
New Flaring Regulations in Wyoming

“Wyoming’s top elected officials on Thursday unanimously agreed oil and gas operators need an additional state sign-off before flaring, or burning off, natural gas vented from industry wells on state-owned land. The decision means the State Board of Land Commissioners will now be involved in deciding whether state royalties should be charged on natural gas flared on state-leased wells.”

“Between six and eight gas wells are currently venting gas, with an estimated total value of about $250,000 in lost royalties over a two-year period, according to state estimates.”

“Cheryl Sorenson, vice president of the Petroleum Association of Wyoming...noted that in Wyoming it takes four to six months to obtain a permit from the Wyoming Department of Environmental Quality for a compressor, while such a permit is issued immediately in Texas.”
Colorado Regulations on Flaring

912. VENTING OR FLARING NATURAL GAS

a. The unnecessary or excessive venting or flaring of natural gas produced from a well is prohibited.

b. Except for gas flared or vented during an upset condition, well maintenance, well stimulation flowback, purging operations, or a productivity test, gas from a well shall be flared or vented only after notice has been given and approval obtained from the Director on a Sundry Notice, Form 4, stating the estimated volume and content of the gas. The notice shall indicate whether the gas contains more than one (1) ppm of hydrogen sulfide. If necessary to protect the public health, safety or welfare, the Director may require the flaring of gas.

c. Gas flared, vented or used on the lease shall be estimated based on a gas-oil ratio test or other equivalent test approved by the Director, and reported on Operator's Monthly Production Report, Form 7.

d. Flared gas that is subject to Sundry Notice, Form 4, shall be directed to a controlled flare in accordance with Rule 903.b.(2) or other combustion device operated as efficiently as possible to provide maximum reduction of air contaminants where practicable and without endangering the safety of the well site personnel and the public.

e. Operators shall notify the local emergency dispatch or the local governmental designee of any natural gas flaring. Notice shall be given prior to flaring when flaring can be reasonably anticipated, or as soon as possible, but in no event more than two (2) hours after the flaring occurs.

Source: Colorado Oil and Gas Conservation Commission
From North Dakota to Washington, D.C.
Hitting the News

In North Dakota, Flames of Wasted Natural Gas Light the Prairie

Green
A Blog About Energy and the Environment
September 27, 2011, 7:34 AM
Flames Light the Prairie and Warm the Planet
By CLIFFORD KRAUSS

In Tuesday’s Times, I write about the flaring of pipes, pits and hundreds of oil wells in the Bakken, North Dakota and Montana, which emits a constant, toxic gas cloud. It’s a big waste of energy and, as even oil executives admit, a big problem.

Politics
U.S. Delays Decision on Pipeline Until After Election
WASHINGTON – The Obama administration, under sharp pressure from officials in Nebraska and restive environmental activists, announced Thursday that it would review the route of the disputed Keystone XL oil pipeline, effectively delaying any decision about its fate until after the 2012 election.

The State Department said it would delay a decision on the pipeline, which would carry crude oil from Canada to refineries in the U.S. Midwest.
What is Happening Outside of North Dakota?

In North Dakota, Flames of Wasted Natural Gas Light the Prairie

Sep 27, 2011
N. Dakota gas flaring raises energy, pollution concerns

Green
A Blog About Energy and the Environment
September 27, 2011, 7:34 AM
Flames Light the Prairie and Warm the Planet
By CLIFFORD KRAUSS

Natural Gas is a Burning Issue
Wasting gas when we are energy starved
Ken Silverstein | Oct 05, 2011
Oil and gas industry at the center of controversy...Gulf spill, pipeline leaks, GHG emissions, Keystone XL and oil sands “dirty oil”

Purposed ozone rules on fracking postponed and in comment period, but flaring part of regulations

Significant legislation on GHG emissions regarding Cap and Trade did not pass, no massive oil spill legislation, all out battle on Keystone XL, big oil tax breaks
EPA Regulations on Air Pollution

EPA has proposed a suite of highly cost-effective regulations that would reduce harmful air pollution from the oil and natural gas industry, while allowing continued, responsible growth in U.S. oil and natural gas production. The proposed updated rules would rely on proven technologies and best practices that are in use today to reduce emissions of smog-forming volatile organic compounds (VOCs).

The proposed rules include a requirement that would capture 95 percent VOC emissions from wells that are hydraulically fractured. This dramatic reduction would largely be accomplished through capturing natural gas that currently escapes into the air, and making that gas available for sale. The rules also would reduce emissions of methane, a potent greenhouse gas, and air toxics, which are known or suspected of causing cancer and other serious health effects.

The proposal includes the review of four rules for the oil and natural gas industry: a new source performance standard for VOCs; a new source performance standard for sulfur dioxide, an air toxics standard for oil and natural gas production; and an air toxics standard for natural gas transmission and storage.

Basic Information — Information about the air toxics standards under review

Regulatory Actions — Links to proposed and final rules, fact sheets, and other rulemaking documents

Technical Information — Technical information about the air toxics standards under review
Investor Push Back and Royalty Payments

Exclusive: Investors press U.S. shale oil drillers to control flaring

By Timothy Gorinc
WASHINGTON, Mar 23, 2012 (11:43 pm EST)

(Reuters) - Investors representing $500 billion in assets are pushing energy companies in the shale oil rush in North Dakota and other states to disclose the amount of natural gas they burn - a practice they see as a wasteful financial risk.

"We want to encourage companies to articulate plans for resolving this issue while shale oil production is still in its relative infancy," said Karina Litvack, the head of governance and sustainable investment at F&C Asset Management.

Source: Reuters March 28 2012; Oil Patch Hotline March 22 2012

Hess Ordered To Pay Royalties on Flared Gas

Hess Corporation was ordered by the ND Industrial Commission March 19 to pay taxes and royalties on flared gas from an oil well in Mountail County that had been burning gas beyond the one-year limitation.

A hearing will be held April 25 to determine the amount of royalties owed on the Nelson Farms #11-19H well in Sec. 19, T156N-R91W. Located two miles from the nearest gas gathering line, the well produces 32 Mcf of gas.

The Jensen Family Trust also objected to extending exemptions to Hess for the well, which has been flaring since it was completed in Dec. 22, 2006. Hess is obligated to pay for taxes and royalties beyond Dec. 22, 2007.

State law requires operators to stop flaring and connect the well to a gas line or hook up to an electrical grid.
The US is going through a major liquids renaissance...
Elm Coulee Field (Bakken) Oil and Gas Production

Source: HPDI March 26, 2012