North Dakota Department of Mineral Resources

http://www.oilgas.nd.gov  http://www.state.nd.us/ndgs

600 East Boulevard Ave. - Dept 405
Bismarck, ND 58505-0840
(701) 328-8020 (701) 328-8000
Wells

14,457 active
  1,830 conventional
  12,627 Bakken/Three Forks

1,653 inactive
  916 waiting on completion
  1,888 permitted
13,451 increased density approved 04/17/18

32,022 total

55,000-65,000 estimated final
Impact Year End 2017

Wells drilled and completed - $100 billion > $330 billion to go
Wells drilled not yet completed - $11 billion > $1 billion
Natural Gas gathering and processing - $13 billion > $15 billion
Rail and rail transportation facilities - $1.25 billion
Crude Oil transmission pipelines - $2 billion > $2 billion

Total estimate - $127 billion > $348 billion to go = $475 billion

This does not include investments in housing and infrastructure made by private firms and state-local-federal government.
North American shale plays (as of May 2011)

- Current shale plays
- Stacked plays
  - Shallowest/youngest
  - Intermediate depth/age
  - Deepest/oldest
- Mixed shale & chalk play
- Mixed shale & limestone play
- Mixed shale & tight dolostone-siltstone-sandstone play
- Prospective shale plays
- Basins

Source: U.S. Energy Information Administration based on data from various published studies. Canada and Mexico plays from ARI.

Updated: May 9, 2011
New-well oil production per rig
barrels/day

- Anadarko
- Appalachia
- Bakken
- Eagle Ford
- Haynesville
- Niobrara
- Permian

March-2017
March-2018
Taxes
- Permian: 3.75% to 7.5%
- Anadarko: 7%
- Eagle Ford: 7.5%
- Appalachia: 0.2%
- Bakken: 10%
- Haynesville: 5% to 7.5%
- Niobrara: 3% to 6%

Federal & Tribal Lands
- Permian: <2%
- Anadarko: <2%
- Eagle Ford: <2%
- Appalachia: <2%
- Bakken: 9% to 30%
- Haynesville: 2% to 9%
- Niobrara: 36% to 48%

ND Potential unconventional oil
17 Source Rock formations
- Spearfish 1
- Tyler 1
- Lodgepole 1 Bakken 2
- Birdbear 1
- Winnipegosis 1
- Red River 2 Winnipeg 1
- Deadwood 1

Drilling Rigs This Week
- Permian: 467
- Anadarko: 83
- Appalachia: 79
- Eagle Ford: 77
- Bakken: 65
- Haynesville: 54
- Niobrara: 24
Bakken Breakeven Price Range (20% IRR)

Bakken Breakeven Prices
$6 - $8 Million
Completed Wells Cost

- $58-$73
- $49-$61
- $43-$52
- $39-$48
- $36-$43
- $34-$40
- $32-$38
- $28-$33
- $26-$30

Background Map: Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community
44% Economic Area Increase 2017 to 2018

Peak 30-Day Production Level / Wellhead Breakeven Range (20% IRR)

<table>
<thead>
<tr>
<th>North Dakota Bakken Area, Square Miles</th>
<th>400</th>
<th>500</th>
<th>600</th>
<th>700</th>
<th>800</th>
<th>900</th>
<th>1000</th>
<th>1250</th>
<th>1500</th>
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<tbody>
<tr>
<td>~2018 YTD Range Square Miles:</td>
<td>11,824</td>
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<td>~2017 Range Square Miles:</td>
<td>8,223</td>
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<td>~2016 Range Square Miles:</td>
<td>5,474</td>
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</table>

JJ Kringstad - North Dakota Pipeline Authority
DOE-EIA Forecasted Oil Price

Av. WTI ($/bbl)

- EIA Forecast
- Historical
North Dakota Forecast Activity Assumptions

- ND New Wells Added Per Month
- ND New Wells Case 1
- ND New Wells Case 2

JJ Kringstad - North Dakota Pipeline Authority
North Dakota Oil Production Forecast
Williston Basin Oil Production & Export Capacity, BOPD

Production forecast is for visual demonstration purposes only and should not be considered accurate for any near or long term planning.
NDPA North Dakota Gas Production Forecast

Natural Gas Production, MMCFD

- ND Gas Case 1 - MMCFD
- ND Gas Case 2 - MMCFD

NDPA Forecast
Solving the Flaring Challenge

MMCFD

- Suspended Plant Capacity
- Planned Plant Capacity
- Existing Plant Capacity
- NDPA Case 1 Forecast
- NDPA Case 2 Forecast
- Historical Sold, MMCFD
- Historical Flared, MMCFD
- Targets Case 1 (Sold)
- Targets Case 1 (Flared)

JJ Kringstad - North Dakota Pipeline Authority
Major Gas Pipeline and Processing Infrastructure
**Project Highlights**

- Existing 36” Pipeline
- Existing ~1,600 MMCFD Capacity
- Proposing ~400 MMCFD of Additional Capacity to Canadian and US Shippers
- 2021 Proposed In-Service
  - Dense Phase Gas Transportation to Chicago
Conclusion: **IF** no other gas export options open and all other deliveries on other pipelines stay static, ND gas production could increase 1.56-1.86 BCFD (from Mar-18) before Northern Border is 100% Bakken production. **BTU management becomes increasingly important for Bakken residue gas.**
North Dakota Captured* NGL’s

*Non-flared NGL’s & Assumes 10 GPM
Regional NGL Infrastructure

Kinder

JJ Kringstad - North Dakota Pipeline Authority
North Dakota Oil Production

Barrels per Day

G1  G2  G3  G4  G5

Reclaim

EOR?

+++
Evolution of Oil Gathering in ND Statewide Totals

Estimated Piped, BOPD

- 2012: 263,352
- 2013: 410,629
- 2015: 725,743
- 2016: 718,177
- 2017: 725,512

Estimated Trucked, BOPD

- 2012: 465,966
- 2013: 524,649
- 2015: 441,644
- 2016: 281,372
- 2017: 285,231
### Evolution of Oil Gathering in ND

<table>
<thead>
<tr>
<th>Year</th>
<th>BILLINGS</th>
<th>BOTTEMA</th>
<th>BOWMAN</th>
<th>BURKE</th>
<th>DIVIDE</th>
<th>DUNN</th>
<th>GOLDEN VALLEY</th>
<th>MCHEHRY</th>
<th>MCKENZIE</th>
<th>MCLEAN</th>
<th>MOUNTAIN</th>
<th>RENVILLE</th>
<th>SLOPE</th>
<th>STARK</th>
<th>WARD</th>
<th>WILLIAMS</th>
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<tr>
<td>2012</td>
<td>1.653</td>
<td>1.641</td>
<td>1.411</td>
<td>1.345</td>
<td>1.432</td>
<td>1.463</td>
<td>1.278</td>
<td>1.314</td>
<td>1.237</td>
<td>1.269</td>
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<td>2013</td>
<td>1.891</td>
<td>1.864</td>
<td>1.607</td>
<td>1.538</td>
<td>1.368</td>
<td>1.303</td>
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<td>2014</td>
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<td>1.811</td>
<td>1.671</td>
<td>1.598</td>
<td>1.351</td>
<td>1.306</td>
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**Source:** J.J. Kringstad - North Dakota Pipeline Authority
Forecasting Activity vs. Price

- EIA Forecast, Case 1 Wells
- EIA Forecast, Case 2 Wells
- Historical

JJ Kringstad - North Dakota Pipeline Authority
New Miles and Activity Footprint

**New Miles of Pipe**

- 673 (2008)
- 1,355 (2009)
- 1,010 (2010)
- 2,353 (2011)
- 3,184 (2012)
- 2,828 (2013)
- 2,179 (2014)
- 2,178 (2015)
- 914 (2016)
- **3,578** (2017* Forecasted)

**Square Miles**

- 6,262 (2008)
- 6,493 (2009)
- 9,866 (2010)
- 13,735 (2011)
- 16,267 (2012)
- 13,428 (2013)
- 12,053 (2014)
- 8,433 (2015)
- 4,206 (2016)
- 3,578 (2017*)

*2017 Forecasted*
Solving the Flaring Challenge

- Suspended Plant Capacity
- Planned Plant Capacity
- Existing Plant Capacity
- NDPA Case 1 Forecast
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North Dakota Pipeline Construction

- New Miles
- Year End Miles

Sources: NDIC & PHMSA

<table>
<thead>
<tr>
<th>Year</th>
<th>New Miles of Pipe</th>
<th>Total Miles of Pipe</th>
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<tbody>
<tr>
<td>2008</td>
<td>673</td>
<td></td>
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<tr>
<td>2009</td>
<td>1,355</td>
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Sources: NDIC & PHMSA