North American shale plays
(as of May 2011)

Source: U.S. Energy Information Administration based on data from various published studies. Canada and Mexico plays from ARI.
Updated: May 9, 2011
Bakken Development Plan

- Original dual-zone development plan
  - 8 wells per 1,280 acres – 4 MB, 4TF
  - 603,000 Boe EUR per well (avg. 24.5 stages/completion)
  - ECO-Pad® design: 2 wells south, 2 wells north

- Additional Three Forks potential
Western North Dakota

- 1,100 to 2,700 wells/year = 2,000 expected
  - 100-225 rigs = 12,000 – 27,000 jobs
  - Another 10,000-15,000 jobs building infrastructure
  - 200 rigs can drill the wells needed to secure leases in 1 year
  - 225 rigs can drill the wells needed to develop spacing units in 16 years
  - 35,000-40,000 new wells = 45,000-50,000 long term jobs
A typical 2012 North Dakota Bakken well will produce for 45 years

    If economic, enhanced oil recovery efforts can extend the life of the well

In those 45 years the average Bakken well:

    Produces approximately 615,000 barrels of oil

    Generates about $20 million net profit

    Pays approximately $4,325,000 in taxes
       $2,100,000 gross production taxes
       $1,800,000 extraction tax
       $425,000 sales tax

    Pays royalties of $7,300,000 to mineral owners

    Pays salaries and wages of $2,125,000

    Pays operating expenses of $2,300,000

    Cost $9,000,000 to drill and complete
North Dakota Oil Production

4,040 Bakken and Three Forks wells drilled and completed
36,000 more new wells possible in thermal mature area
Proven=7 BBO  Probable=10 BBO  Possible=15 BBO (billion barrels of oil)
PROPPANT PROJECT

Millions of tons of sand and ceramic proppants are used every year in the Williston Basin, part of a multi-billion dollar industry. The Geological Survey has collected 125 sand samples throughout the state in our search for deposits that could be utilized for oil and gas proppants in the well fracturing process. We are in the process of performing preliminary analysis on those samples to determine if any would fit the proppant criteria. We have also collected clay samples and will be testing those samples for their kaolin content to determine their suitability in the manufacturing of ceramic proppants.

Under the second phase of this project, the ten most promising sand samples will undergo full ISO analysis (including bulk density, specific gravity, crush resistance, etc), mineralogy (XRD), and slurry conductivity analysis to determine which are the most suitable proppant candidates and we will continue to evaluate the clay beds.

Locations of sand samples (red dots) and clay samples (blue dots) collected during this study. The areas in yellow are known sand deposits and the areas in brown are kaolinitic claystones within the Golden Valley Formation.
The North Dakota Way
Vern Whitten Photography
Six Wells on a Single Pad

Vern Whitten Photography
Oil and gas well locations are built (stockpiling top soil and lining reserve pits) to make reclamation easier.
DRILL TO BASE OF POTABLE WATER SOURCES WITH FRESH WATER
- Drill with fresh water
- Total depth below lowest potable water
- Run in hole with surface casing
- 1\textsuperscript{st} layer of surface water protection
- Cement casing back to surface of ground
- 2\textsuperscript{nd} layer of surface water protection
DRILL TO TOP OF HYDROCARBON ZONE WITH FRESH WATER, SALT WATER OR OIL BASE MUD
TYPICAL HORIZONTAL OIL WELL

- 9 5/8” surface casing
- 7” production casing
- 4.5” liner
- 30-40 swell packers
- sliding sleeves
- 4.5” frac string
- 5 layers of protection

Potable Waters

Upper Bakken Shale
Middle Bakken 10,000’
Lower Bakken Shale
Significant Salt Intervals of Northwestern North Dakota

- Precambrian Basement
- Red River Formation
- Madison Group
- Tyler Formation
- Spearfish Formation
- Dakota Group
- Bakken-Three Forks
- Shallow Gas Zone
- Fresh Water Zone

- Siberian Formation:
  - Pine Salt
  - A Salt
  - D Salt
  - F Salt

- Charles Formation:
  - D Salt
  - A Salt
  - Salt A

- Prairie Formation:
  - Prairie Salt
  - A Salt
  - D Salt

- North Dakota Geological Survey

North Dakota Depart. of Mineral Resources
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The Geological Survey recently completed phase I of a study of shallow natural gas in North Dakota. We investigated 9,400 ND State Water Commission monitoring well sites, tested 4,325 wells, and detected methane in 905 wells. Approximately 20% of the wells contained detectable gas.

During the second phase of the project, thirty groundwater samples, primarily from eastern North Dakota, will be analyzed for dissolved gas composition, isotopes, and general chemistry. This will enable us to determine the source of the gas and identify chemical groundwater signatures that might assist the oil and gas industry in natural gas exploration.
PLUG AND ABANDON

Cmt. Plug

Cmt. Plug

Cmt. Plug

Cmt. Plug
Well was plugged in 07/1998
Reclamation work in 09/1998
Seeded in Spring of 1999

BTA Oil Producers. JV-P#1. Near Rider Field
NDIC File No. 14857. SE SE 15-140-103.
Panoramic Reclamation photo taken looking 070
towards middle of location. May 1, 2001. dwn.

BTA Oil Producers - JV-P#1 - Rider Field.
NDIC File No. 14857. SE SE 15-140-103.
Panoramic photo looking east. Photo taken from butte to west on 7/2/2002.
BTA Oil Producers. JV-P#1. Near Rider and Knutson Fields.
NDIC File No. 14857. SE SE 15-140-103.
Panoramic photo looking east from butte west of location.
Photo taken on May 7th, 2003. dwn.
The North Dakota Challenges
North Dakota Crude Gathering

Pie Charts
Truck = Red
Pipeline = Blue

Williams: 95% (5%)
Mountrail: 55% (45%)
McKenzie: 89% (11%)
Dunn: 78% (22%)
New or Expanding Gas Plants

Gas Production

Plant Capacity

$4b

MMCFD


$4b
The future looks promising for sustained Bakken/Three Forks development.

Draft BLM Hydraulic Fracturing rule could double federal drilling permit approval time or worse. Comments due 7/10/12

Draft EPA guidance on diesel fuel in hydraulic fracturing could triple drilling permit approval time or worse. Comments due 7/9/12

Current administration budget contains tax changes that could reduce drilling capital 35-50%.

World and U.S. economies continue to struggle. If China joins the downward spiral oil price could fall enough to make some areas uneconomic.