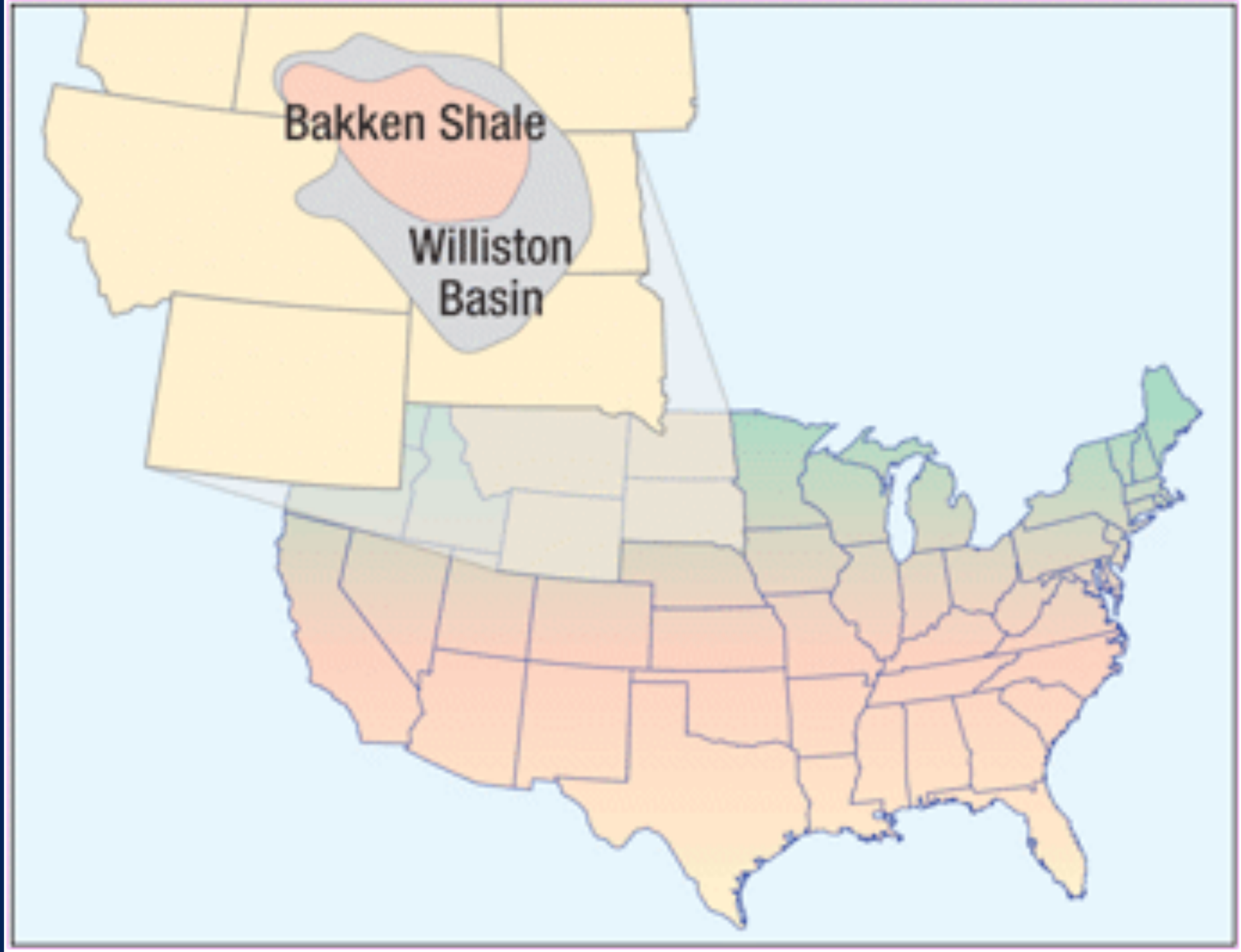
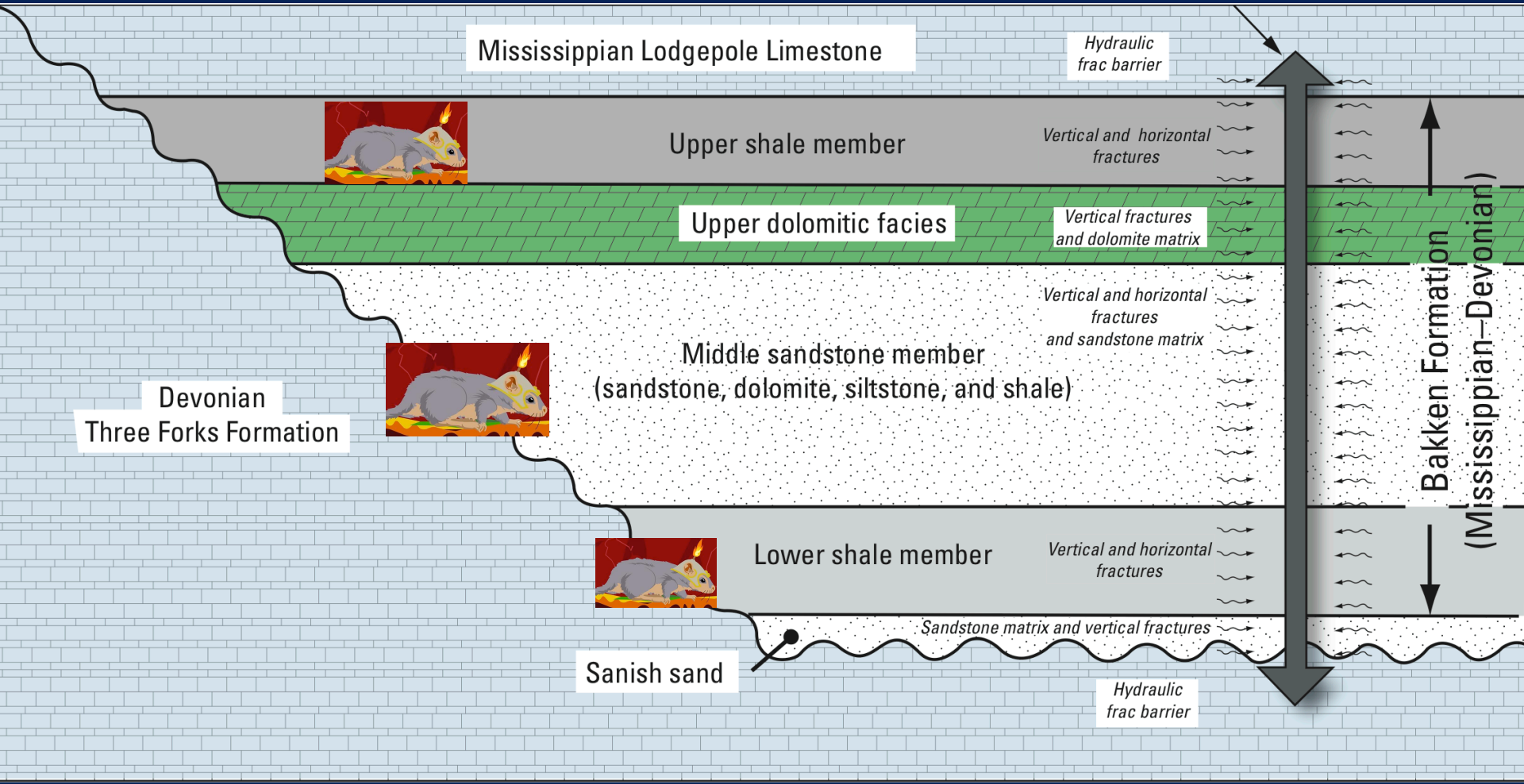
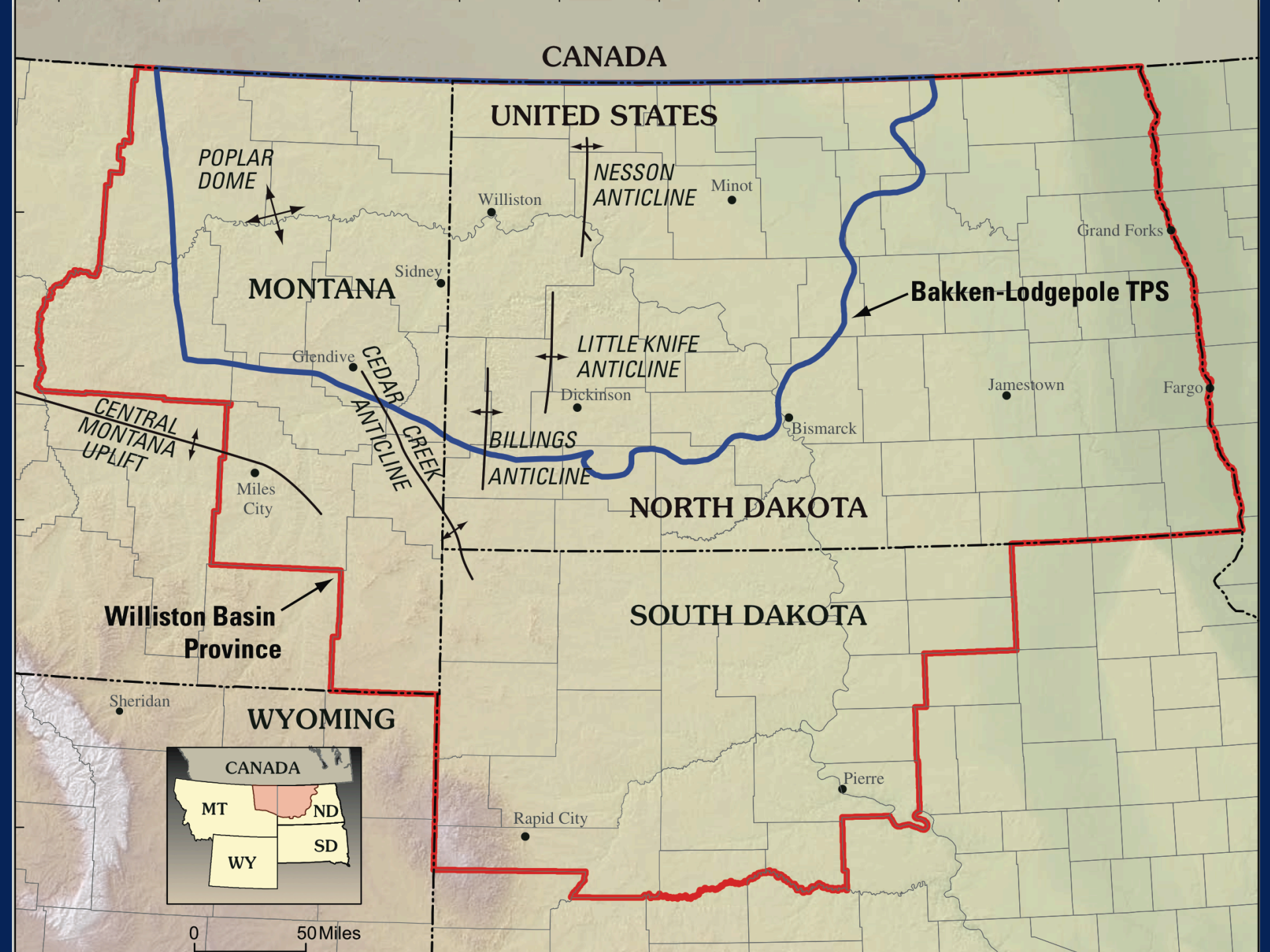

Bakken Shale
Williston
Basin


CANADA
UNITED STATES
BAKKEN
POPLAR DOME
NESSON ANTICLINE
Williston
Minot
Grand Forks
Sidney
MONTANA
Bakken-Lodgepole TPS
LITTLE KNIFE ANTICLINE
Glendive
CEDAR CREEK ANTICLINE
Dickinson
Jamestown
Fargo
Bismarck
CENTRAL MONTANA UPLIFT
BILLINGS ANTICLINE
Miles City
NORTH DAKOTA
Williston Basin Province
SOUTH DAKOTA
Sheridan
WYOMING
CANADA
MT
ND
SD
WY
Pierre
Rapid City
0
50 Miles

3 Members Comprise Bakken

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WYOMING
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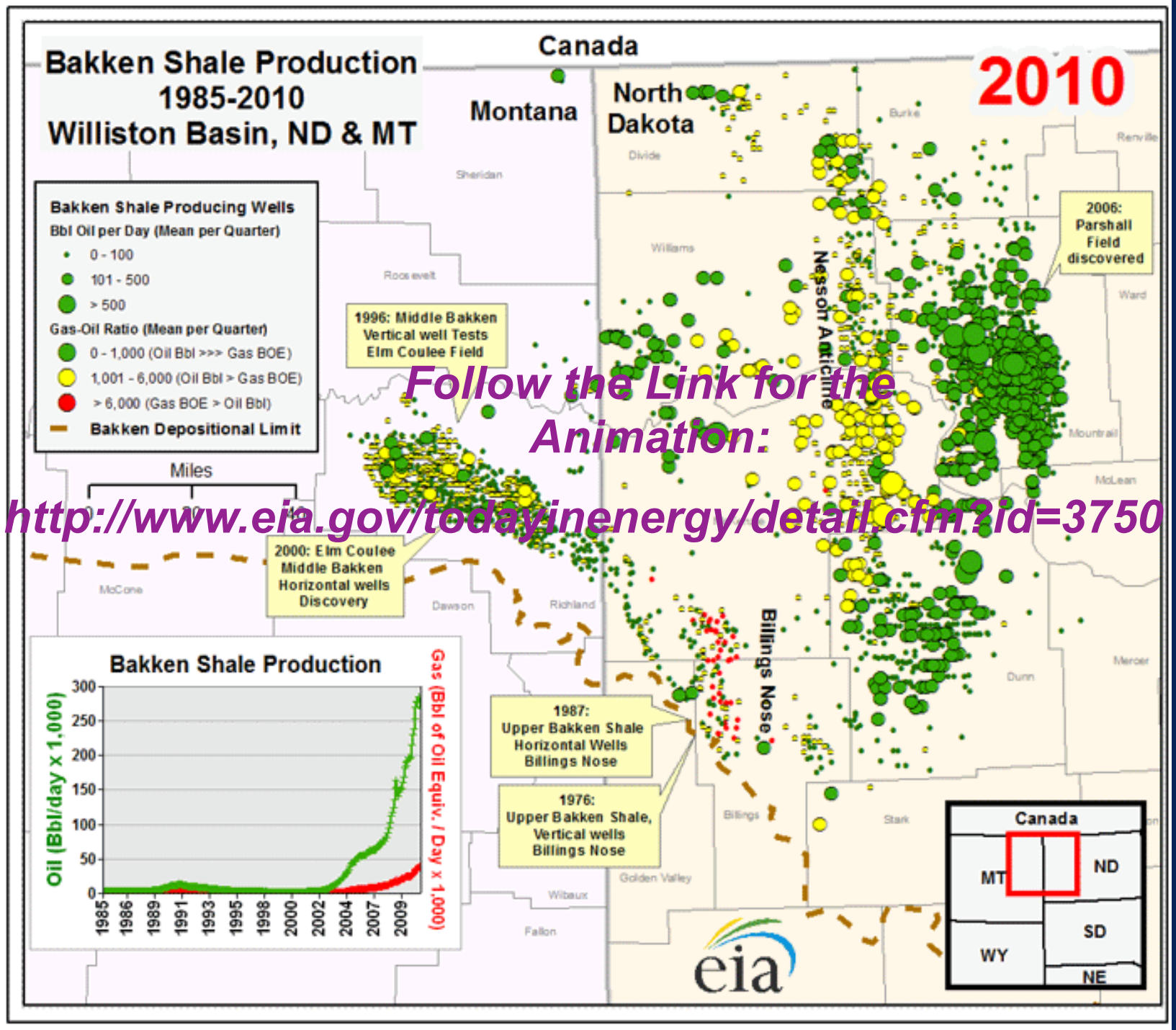
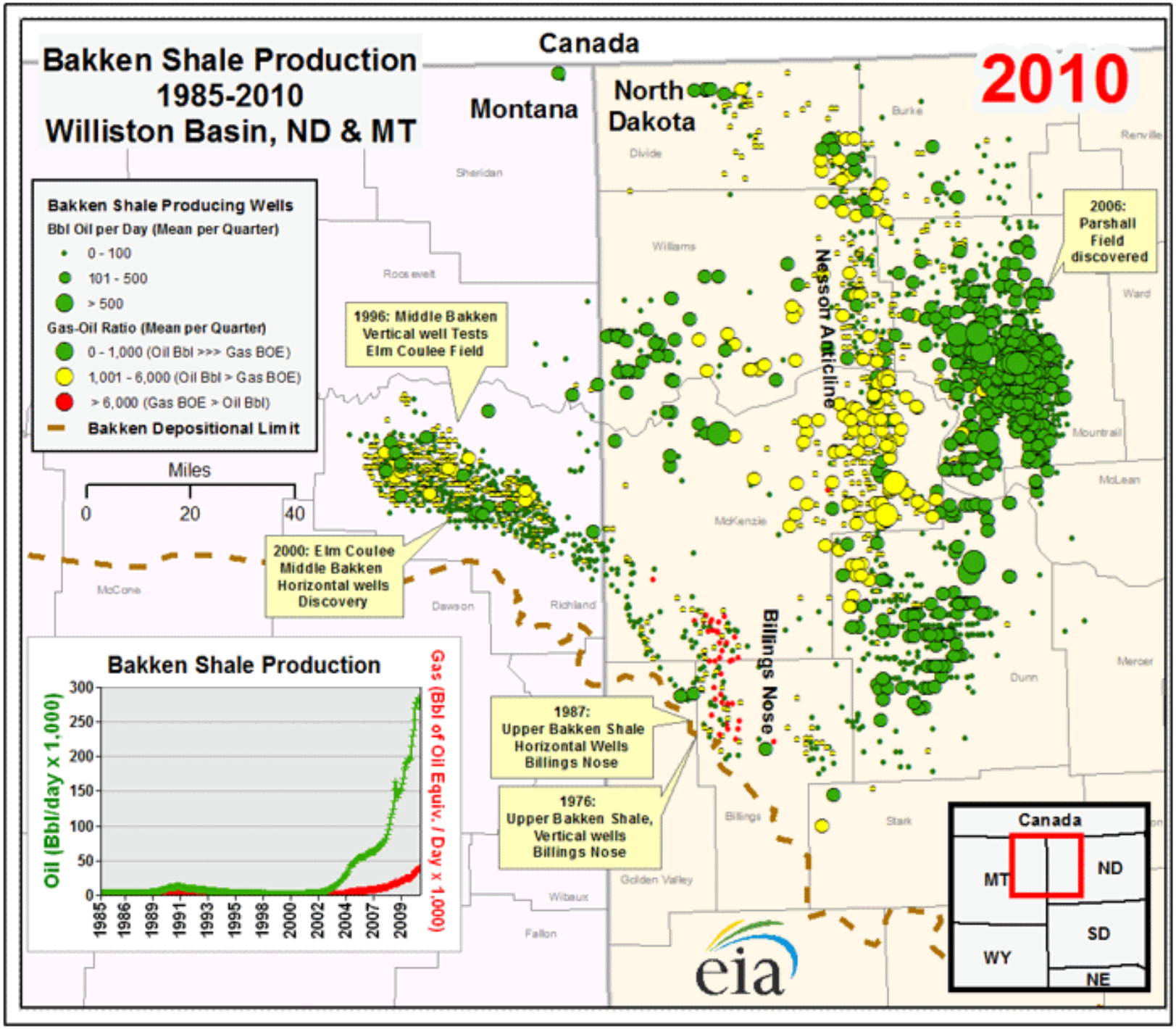
MT
ND
SD
WY
Pierre
Rapid City
0
50 Miles

But… Sweet Spots


Bakken Shale Production
1985-2010
Williston Basin, ND & MT
Canada
Montana
North Dakota
2010
Bakken Shale Producing Wells
Bbl Oil per Day (Mean per Quarter)
0 - 100
101 - 500
> 500
Gas-Oil Ratio (Mean per Quarter)
0 - 1,000 (Oil Bbl >>> Gas BOE)
1,001 - 6,000 (Oil Bbl > Gas BOE)
> 6,000 (Gas BOE > Oil Bbl)
Bakken Depositional Limit
Miles
1996: Middle Bakken Vertical well Tests Elm Coulee Field
2006: Parshall Field discovered
Nesson Anticline
Billings Nose
2000: Elm Coulee Middle Bakken Horizontal wells Discovery
1987: Upper Bakken Shale Horizontal Wells Billings Nose
1976: Upper Bakken Shale, Vertical wells Billings Nose
Follow the Link for the Animation:
http://www.eia.gov/todayinenergy/detail.cfm?id=3750
Bakken Shale Production
Oil (Bbl/day x 1,000)
Gas (Bbl of Oil Equiv. / Day x 1,000)
300
250
200
150
100
50
0
1985
1986
1989
1991
1993
1995
1998
2000
2002
2004
2007
2009
Canada
MT
ND
SD
WY
NE
eia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Miles
0
20
40
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50
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1985
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2000
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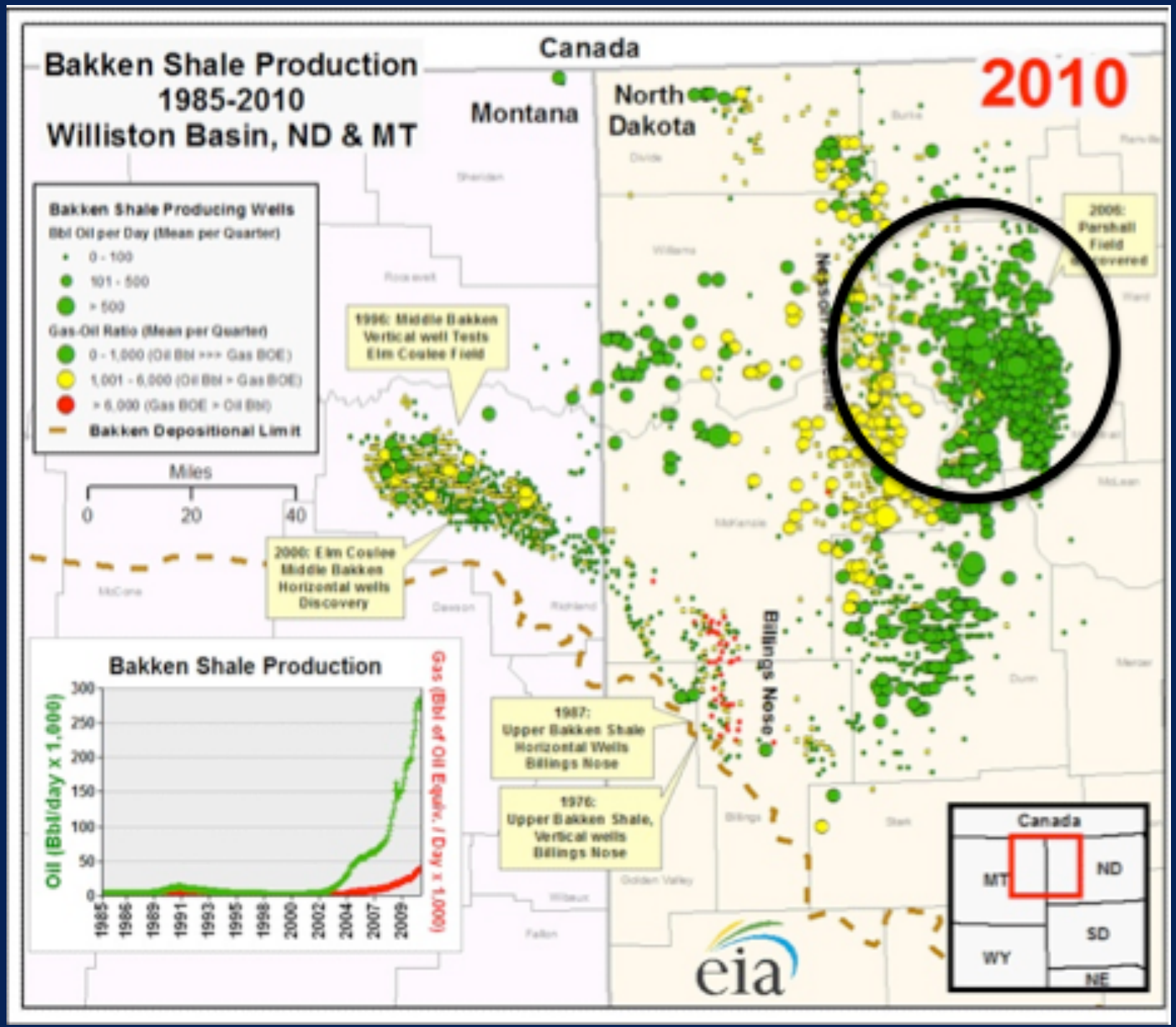
2004
2007
2009
Canada
MT
ND
SD
WY
NE
eia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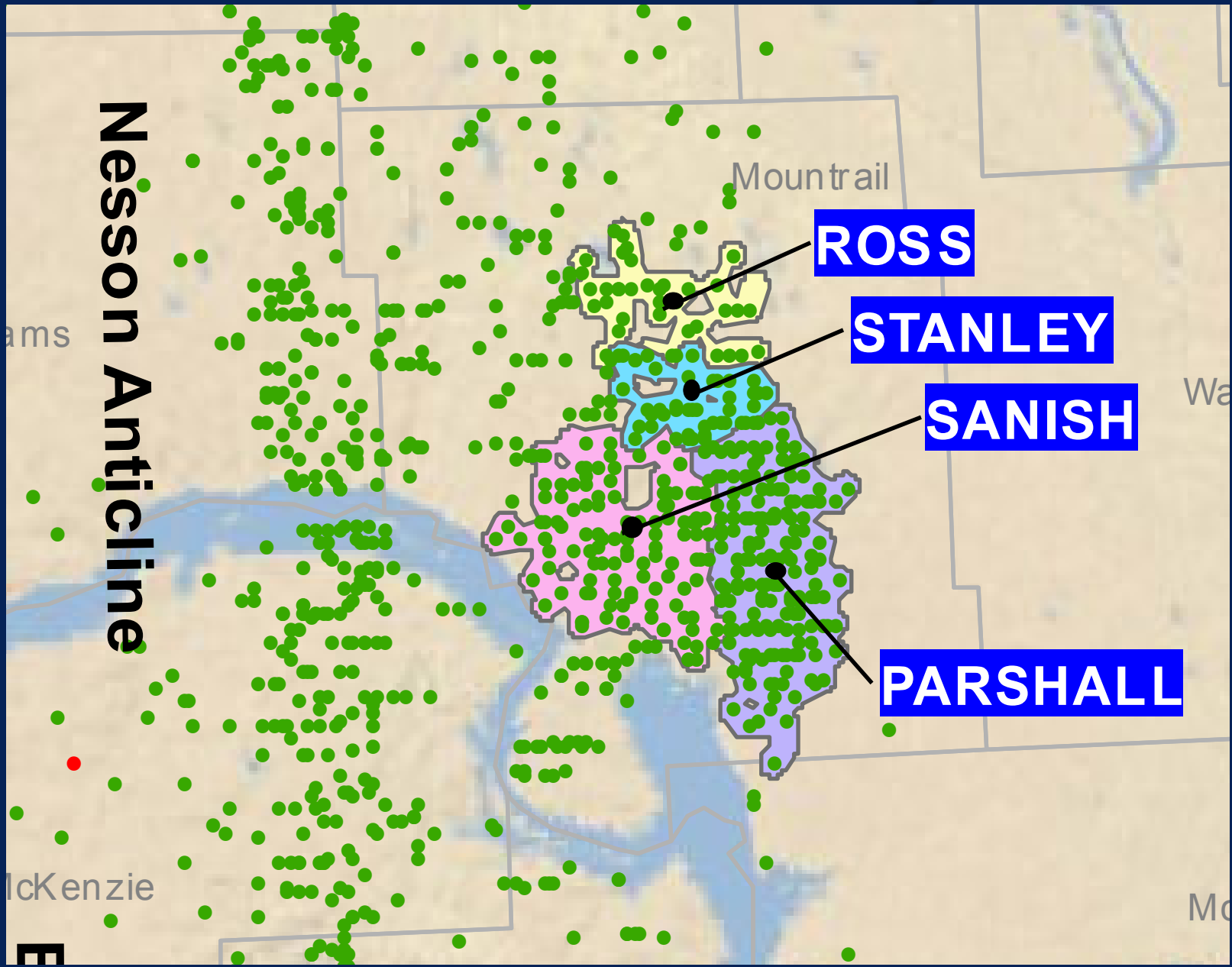
Oil (Bbl/day x 1,000)
Gas (Bbl of Oil Equiv. / Day x 1,000)
300
250
200
150
100
50
0
1985
1986
1989
1991
1993
1995
1998
2000
2002
2004
2007
2009
Canada
MT
ND
SD
WY
NE
eia

Mountrail County




The Parshall Promoters
Welcome You To
Parshall
LEWIS & CLARK
A North Dakota Legend
The World Famous
Paul Broste
Rock Museum

Two miles west of Parshall – not an oil rig in sight….

Three miles West of Parshall – first grasshopper

Then the oil rigs came faster than you could snap the pictures – dozens and hundreds

New Town: one of the many fracking facilities

Downtown New Town

New Town: Standard apartment Living

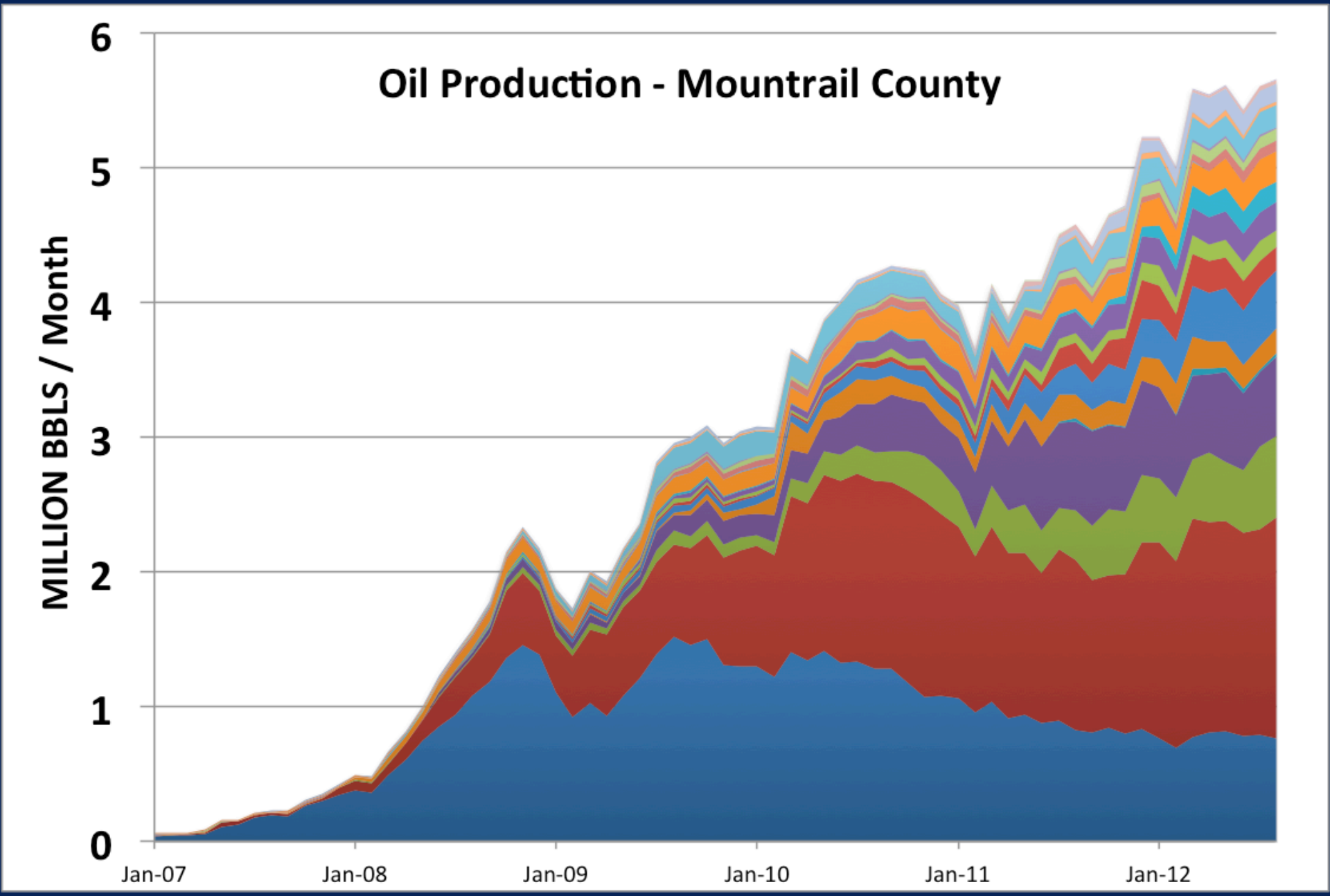
Typical street corner scene

Typical scene …

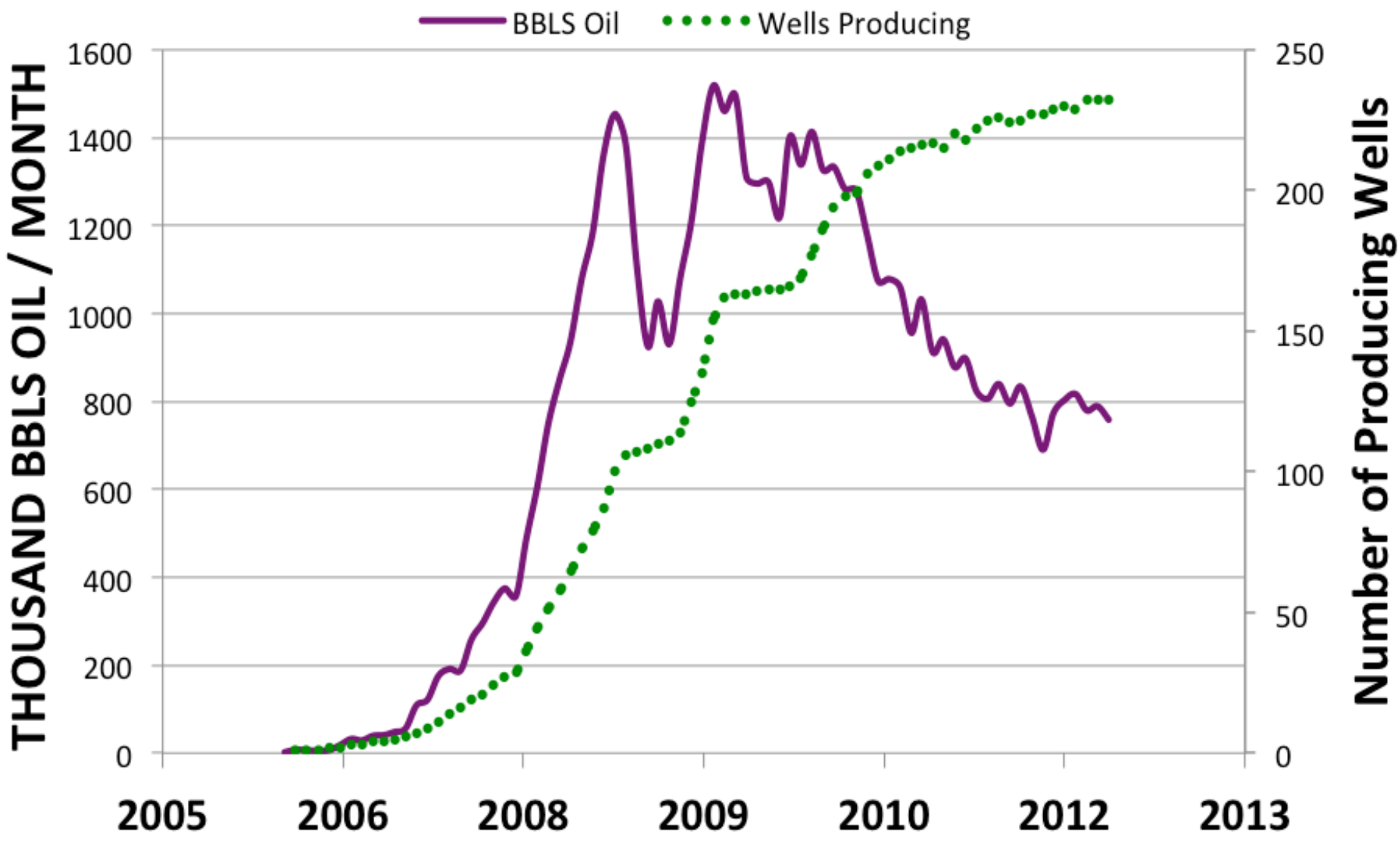
Mobile Drilling Rig

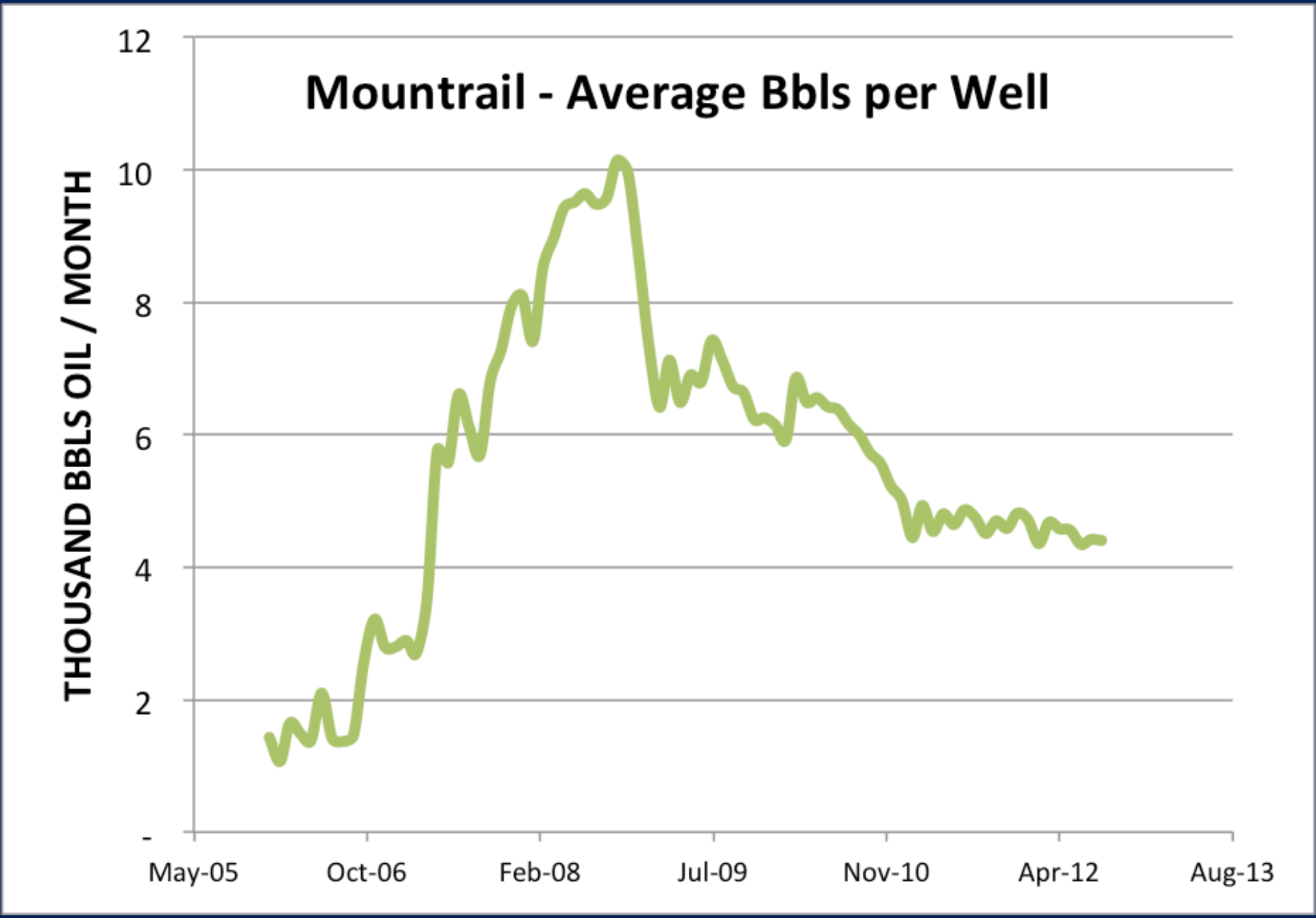
Looks like a sweet spot to me…

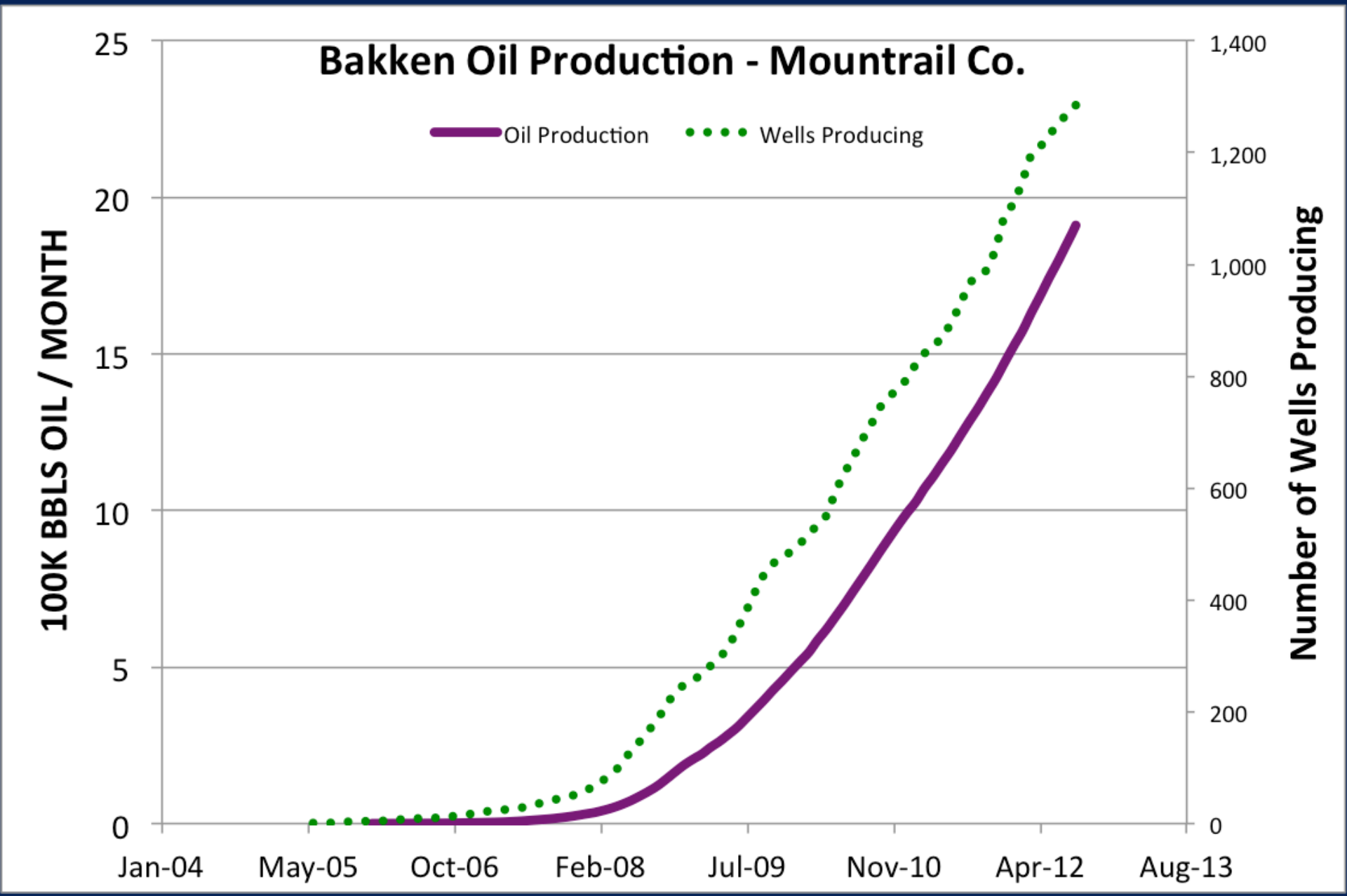
Before long…no more visible oil activity


Oil Production - Mountrail County
MILLION BBLS / Month
6
5
4
3
2
1
0
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12

Parshall - Mountrail Co.




Mountrail - Average Bbls per Well
THOUSAND BBLS OIL / MONTH
12
10
8
6
4
2
-
May-05
Oct-06
Feb-08
Jul-09
Nov-10
Apr-12
Aug-13


Bakken Oil Production - Mountrail Co.
Oil Production
Wells Producing
100K BBLS OIL / MONTH
Number of Wells Producing
25
20
15
10
5
0
1,400
1,200
1,000
800
600
400
200
0
Jan-04
May-05
Oct-06
Feb-08
Jul-09
Nov-10
Apr-12
Aug-13

Preliminary EROI Mountrail County

$$\text{EROI} = \frac{\text{Energy Delivered to Society [Eout]}}{\text{Energy Put into that Activity [Ein]}}$$

Energy [out]=

EUR x Energy in a Bbl Oil

- EUR = 405 Million BBLS Estimated Ultimately Recoverable

Energy [in]

- Number of wells producing
- Cost per well
- Dollars converted using energy equivalents to Joules

EROI = 12.9 : 1

Assumptions…

Conservative Estimate:

- Doubling wells halves EROI

Conventional Oil (and gas) Initial Reserves:

Proved plus probable Source Jean Laherrere

		Number fields		Oil Gb	NG Tcf
Africa		3560		217	716
Asia		4900		139	941
CIS		4940		258	2,156
Europe		5190		100	676
Latin Am		4770		280	778
MiddleEast		1530		733	3,233
US&Canada	frontier	600		50	144
non frontier	?		208	1482	
WORLD		?		1985	10126

conventional oil = crude oil less extra-heavy oil

By comparison:

Used so far at end 2011	1163	
U.S. use per year	7	
Bakken reserves	4-6 (USGS)	to 24 (optimistic)
Eagle Ford reserves	3.35 (USGS)	to 21 (optimistic)

Gas: Marcellus ??? 1.1 BCf per well

Thus none of these new fields are important relative to conventional reserves. They are useful but not game changers at all.

Data & Resources

- Photos Courtesy of Myrna Hall Glamour Shots
- North Dakota Industrial Commission, Department of Mineral Resources, Oil and Gas Division
- Pollastro, et al (2008). Assessment of Undiscovered Oil Resources in the Devonian-Mississippian Bakken Formation, Williston Basin Province, Montana and North Dakota, 2008.
- US Energy Information Administration
- Murphy, et al (2011)Order from Chaos: A Preliminary Protocol for Determining the EROI of fuels. Sustainability 2011, 3, 1888-1907.
- Moerschbaecher & Day (2011). Ultra-Deepwater Gulf of Mexico Oil and Gas: Energy Return on Financial Investment and Preliminary Assessment of Energy Return on Energy Investment. Sustainability 2011, 3, 18--
- King & Hall (2011). Relating Financial and Energy Return on Investment. Sustainability 2011, 3, 1810-1832.