Rockin’ the Bakken

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Rockin’ the Bakken
Outline

• The Bakken Formation
  – What is it? How Big?
  – Oil and Gas Development

• Electrical Infrastructure Challenges
  – Load Estimates
  – System Limitations
  – Changes in Infrastructure
Bakken Oil Shale Formation
Our initial entry point into the O&G industry has been to sell these traditional HDR services to our clients.
Top oil-producing states as of July 2012

- Top 5 states produce thousands of barrels of oil on a monthly basis.
- North Dakota recently jumped ahead of Alaska and California to become the number 2 oil producer.

1. Texas - 59,675
2. North Dakota - 20,896
   (Oct 2013: 23,226)
3. California - 16,430
4. Alaska - 12,873
5. Louisiana - 5,917

Note: Number of barrels per month as of July 2012.
**Figure 2.** Map showing boundary of Bakken-Lodgepole Total Petroleum System (TPS) (in blue), five continuous assessment units (AU) (in green), and one conventional AU (in orange) defined for the assessment of undiscovered oil resources in the Upper Devonian–Lower Mississippian Bakken Formation in the U.S. portion of the TPS. The outermost green line defines the area of oil generation for the upper shale member of the formation.
Est. Mature Area of Bakken Formation

15,000 sq mi
8000 wells
1H/1280
Well Development

By the Numbers: February 8, 2013

• Price of oil: $96/Barrel
• ND oil production: #2 in USA, Oct 2013: 23.2 MMBO
• Active Rigs in ND: 185 (high: 218, May 29, 2012)
Well Facts

• 8100 producing wells
  – 4,600 Bakken (57%)
  – 3,600 more to secure leases

• 40,000 additional development
  – 225 rigs – another 16 years
  – 100 rigs – another 30 years
North Dakota Wells Producing Each Year

4600 Bakken Hori. / 8100 Total (57%)
Typical 2012 Bakken Well

- 45 year well life
- 615,000 barrels of oil
- $9 million to drill/complete
- $20 million net profit

- $4 million in taxes
- $7 million in royalties
- $2 million in wages
- $2 million in oper. expense
ND Monthly Production – Top 12 Counties
ND Daily Oil Production (1951-2012)

- 666,000 BBLS Oil/Day in 2012
- Increased 37% in 10 months to 750,000 BBLS
- 8100 Producing Wells
Well Development - # of Drilling Rigs

NORTH DAKOTA – 54 DRILLING RIGS – Oct 2009

NORTH DAKOTA – 153 DRILLING RIGS – Oct 2010

NORTH DAKOTA – 208 DRILLING RIGS – Aug 2012
Oil Drilling Rigs in Western ND, Oct 2012
Oil Drilling Rigs in Townships in WND, Oct 2012
Horizontal Drilling in WND, Oct 2012
Typical Minimal Impact Multi-pad Site
Typical Minimal Impact Multi-pad Site
Continental Resources Eco-Pad

ECO-Pad®

MIDDLE BAKKEN

THREE FORKS
Continental Resources 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

1st ECO-Pad well pair
Upper Bakken Shale
Lower Bakken Shale
Charlotte 2-22H: 1,140 Boepd IP
Nisku
Three Forks
Performing hydraulic fracture stimulation south of Tioga
- all Bakken wells must be hydraulically fractured to produce
- > 2 million gallons of water
- > 3 million pounds of sand
- cost > $2 million
Why Fracture the Rock?

• Already developed easy oil
  – Oil flows easily without hydraulic fracturing
  – Pools where oil is trapped
  – Natural fractures in earth

• Unconventional Reserves
  – Reservoirs are tight
  – Uneconomic to produce without hydraulic fracturing
  – Must create a path for oil to flow
Frac Water Additives

• 99.5% water and sand
  • 80.5% water
  • 19.0% sand or ceramic beads
• 0.5% chemicals
  • Most are found in every household
ND and MT Bakken Assoc. Gas Production
Electrical Infrastructure Challenges

• Load Estimating
• Electric Utility System Limitations
• Changes in Design and Infrastructure
Estimating Electrical Load Growth

- Well Sites: 20-30 kW/well, 1 to 8 wells/section
- Salt Water Injection: 100-750 kW/site
Estimating Electrical Load Growth (cont.)

- Compressor Stations: 500 to 10,000 kW/site
- Gas Processing Plants: 10-40 MW/site
Estimating Electrical Load Growth (cont.)

- Oil Loading Facilities – Truck and Rail: 1-4 MW
- Workforce Camps: 4-6 kW/bed
Estimating Electrical Load Growth (cont.)

• Williston, ND Growth: 2-4 MW/section for Residential
  – Up to 10 MW/section for Comm./Industrial
• Other Communities: 3-5 MW/section
Regional Electric Supply

Upper Missouri G. & T. Electric Cooperative, Inc.

Central Power Electric Cooperative, Inc.
Your Touchstone Energy® Partner

Basin Electric Power Cooperative
A Touchstone Energy® Cooperative

Montana-Dakota Utilities Co.
A Division of MDU Resources Group, Inc.
In the Community to Serve®

Western Area Power Administration
North Dakota/Montana Electric Cooperatives
Load Forecast – Coop X

KLJ projects
820 MW by 2025
Load Forecast – Coop Y

KLJ projects
561 MW by 2025
2012 Load Forecast
for Coops Serving the Bakken Area

Feb 2012 Peak
500 MW
Basin Electric – 2011 Oil Load Study Area
2011 Pocket Area Load Forecast

SYSTEM INTACT LOAD SERVING CAPABILITY

- Xcel Load at Souris
- MDU Load in Study Area
- Coop Bottineau Area Load
- Coop Minot Area Load
- Coop West ND, East MT Area Load

2800 MW in 2021, 3721 MW in 2032
Williston Load Pocket (500 MW Jan 31 ‘13)
Williston Load Pocket Profile Jan 31, 2013

Current MWS
Current MWS Last: 494.1 Avg: 460.2 Min: 395.9 Max: 500.8
Last updated at Thu Jan 31 08:34:49 2013
2011 Transmission System in WND
Proposed 345 kV Additions

Williston

Des Lacs

Blaisdell

Tioga

Williston

ECR

AVS

Proposed 345 kV Line
No. of Substations – Coop X

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of Subs</th>
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<td>2007</td>
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<tr>
<td>2012</td>
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Substation Capacity – Coop X

Bar chart showing:
- Base MVA: 95 in 2007, 568 in 2012
- Upper MVA: 118 in 2007, 912 in 2012
Substation Design Changes

• 2007 Design
  • Radial 57 and 69 kV Source
  • Single Bus Design, 69-12.47/7.2 kV
  • HS Fuses, 7.5/10.5 MVA Transformer, Regs, and 4 to 6 Feeders

• 2012 Design
  • Looped 115 kV Source
  • Ring Bus Design (4 to 6 Position), 115-24.94/14.4 kV,
  • HS Breaker or Cir Sw, One or Two 15/20/25 MVA Transformers, Regs, 6 to 12 Feeders
Miles of Transmission Line – Coop X


- **60 Yr Old Line**
- **New Line**
Miles of Distribution Line – Coop X

- **Small Cond -1PH**: 1105 miles (2007), 498 miles (2012)
- **Small Cond - 3PH**: 259 miles (2007), 102 miles (2012)
- **Large Cond -3Ph**: 52 miles (2007), 1015 miles (2012)

- **60 Yr Old Line**: 12.47/7.2kV
- **New Line**: 24.94/14.4kV
Distribution Line Changes - 2007 to 2012

• 2007: 395 miles of 3Ø (red)
  • 12.47/7.2kV

• 2012: 1090 miles of 3Ø (red)
  • 24.94/14.4kV
Meters in Rural Mountrail County

- **1Ø Meters**: 4714 meters (2012) vs. 1848 meters (2007)
- **3Ø Meters**: 1688 meters (2012) vs. 195 meters (2007)
- **Total**: 6402 meters (2012) vs. 2043 meters (2007)
HDR Activities in the Bakken

- Transmission, distribution and substation design
- Transportation – truck bypass
- Railroad oil loading facility
- Water and waste water facilities
- Power generation
Build Out and Expansion
Limitations to Development

- Workers and worker housing
- Water: fresh water and water treatment – Frac water
- Product transportation -- trucks, rail, pipelines
- Electrical infrastructure and power supply
- Environmental laws – future of hydraulic fracturing
The Mystery City
Typical Load Factor – Dec 15 to 22, 2012

LF = 97%

LF = 82%