Shale Oil and Gas, Frac Sand, and Watershed Changes in Energy Transportation

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Minnesota Department of Transportation
(in association with Wisconsin & North Dakota DOT)
U.S. could soon overtake Saudi Arabia as world's top oil producer

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NEW YORK - U.S. oil output is surging so fast that the United States could soon overtake Saudi Arabia as the world's biggest producer.

Driven by high prices and new drilling methods, U.S. production of crude and other liquid hydrocarbons is on track to rise 7 percent this year to an average of 10.9 million barrels per day. This will be the fourth straight year of crude increases and the biggest single-year gain since 1951.

The boom has surprised even the experts.

"Five years ago, if I or anyone had predicted today's production growth, people would have thought we were crazy," said Burkhard, head of oil markets research at IHS CERA, an energy consulting firm.

The Energy Department forecasts that U.S. production of crude and other liquid hydrocarbons, which includes biofuels, average 11.4 million barrels per day next year. That would be a record for the U.S. and just below Saudi Arabia's output of 11.6 million barrels. Citibank forecasts U.S. production could reach 13 million to 15 million barrels per day by 2020, helping North America "the new Middle East."
Hydraulic Fracturing

Hydraulic fracturing, or “fracing,” involves the injection of more than a million gallons of water, sand and chemicals at high pressure down and across into horizontally drilled wells as far as 10,000 feet below the surface. The pressurized mixture causes the rock layer, in this case the Marcellus Shale, to crack. These fissures are held open by the sand particles so that natural gas from the shale can flow up the well.
HYDROFRACKING A WELL

Fluid pressure fractures the rock, sand grains keep the fractures open
WHERE THE BEST FRAC SAND IS **(RED)**
The district’s sandbox

Existing and proposed frac sand mine operations

FRAC SAND MINING FACILITY OPERATING OR UNDER CONSTRUCTION
△ FREESTANDING FRAC SAND PROCESSING PLANT OPERATING OR UNDER CONSTRUCTION
● PROPOSED FRAC SAND MINING FACILITY
▲ PROPOSED FRAC SAND PROCESSING PLANT
== RAILROADS RELEVANT TO FRAC SAND OPERATIONS
ROUGH EXTENT OF FRAC SAND DEPOSITS

Sources:
Mine locations: State and county permitting records; industry contacts / Sand deposits: U.S. Geological Survey / Rail data: Minnesota and Wisconsin departments of transportation
Projected Frac Sand Demand

• Current Wisconsin & Minnesota production at 28-30 Million tons/year (90% Wisconsin)
• Estimated long-term demand, 34-50 MMT/Yr
• Estimated production if all prospective WI mines brought on line, 60-70 MMT/Yr
• Life of current Shale Oil & Gas exploration trend, 25-35 Years (?- new discoveries indicate more)
• Volume of sand resources – 100+ Years or more
Wisconsin Results

• 2,800 direct jobs – 100 jobs per Million Tons/Year (WisconsinWatch.org)

• Average wage, $18-20 per hour (truckling, maintenance, machine operator)

• Direct Wages - $140 Million/Year or $5M per Million Tons

• Total Cost to Mine and Process = $15 – 40 per ton
Local Investments

• Processing Plants - $20-70 Million each
• Resin Coating Plant - $100 Million
• 150-300 Construction jobs/plant
• Infrastructure (Electric, gas, water, roads, rail)
• Local trucking
• Secondary service jobs
• 6-10 secondary jobs for each primary job

(Wisconsin Workforce est. – 30,000 new jobs – 2012)
Minnesota Sand Accomodations

- New EQB silica sand standards issued, 2014.
- Catalogs best practices, options for Local Government Units (LGU’s) – per 2013 Legislature direction & statute
- Effective use of Zoning, Conditional Use Permits, setbacks and buffers
- Road wear and compensation, routes, traffic and safety mitigation controlled by permitting LGU, shared with impacted LGU’s
Significant Changes in Logistics

- Reduced Coal moves thru state (-4 trains/day in MN) as gas replaces coal in power plants
- High volumes of sand (2-3 trains/day) to fields
- Unit Oil Trains by Rail (7/day, BNSF; 2/day, CP)
- Similar offsets in barge, Laker traffic
- Similar traffic changes in Texas, Oklahoma, Kansas, Pennsylvania, Ohio, Wisconsin
Bakken Oil Shale scope

• Light, Sweet crude – ideal for automotive fuels and mid-size refineries (Midwest & East Coast)
• 1 million Bbls/Day – 1/8 of all US production
• 1.6-2 million Bbls/day by 2020 (20% of U.S. production)
• 185 rigs working, 10 well completions a day
• 15,000 wells completed, 45,000 more planned
• Bakken is 25% of new shale oil and gas in US
Large Geologic Scale, Reserves
Safety and the Environment

- Hazardous materials; Flammable
- Spills toxic to environment, hard to contain
- Different problems for different modes
- Rail has more incidents, occupational injuries
- Pipeline has fewer but larger spills
- Pipelines carry most oil, but rail volumes have become significant and growing
- Rail exposure in urban areas, grade crossings create more conflict points
Crude-by-Rail Issues

• Bakken crude oil volatile (natural gas liquids)
• Unit trains; 110 cars, 80,000 Bbls/train
• Sturdy but complex mode, many moving parts & human interaction to allow faults, failures
• Deficiencies in track, signals, tank cars, operations

• Lac Megantic, Quebec, CA tragedy
• Casselton, ND, USA incident
• Lynchburg, VA, derailment
Responses

- New FRA Safety Rules
- Voluntary industry operational changes
- Improved Tank Car standards – CPC 1232+
- Delays and debates in federal rulemaking; PHMSA, NTSB
- Expand Inspection and Oversight (FRA, DOT)
- Expanding Emergency Response capability
Gas as Transport Fuel

- CNG
- LNG
- Rail
- Trucks
- Ships
- Ferries
- Buses
- Cars
Challenge: Conversion & Distribution

Proposed Nationwide LNG Fueling Network

Shell and TravelCenters of America plan to develop a nationwide network of liquefied natural gas (LNG) fueling centers for heavy-duty road transport customers.

*Sites will be developed in a phased approach, based on customer demand and are subject to change.*
Other Factors in Play

- **Distance to market**: Marcellus (biggest field) on East Coast, new finds in California, Midwest
- **High quality**: light, sweet Bakken; “Rich, wet” Marcellus & Utica gas - high BTU & natural gas liquids – chemical feedstocks (isobutane, ethylene)
- **Environmental benefit**: ½ of coal carbon emissions, slow greenhouse gases in short term
- **Lower cost for US industry**: fuel & chemicals
- **Extensive reserves**: “energy independence by 2017”; major improvement in trade balances
Gas-Driven Technology Changes

• “Gas-to-Liquid” (GTL) plants to convert natural gas to liquid fuels – diesel and jet fuel
• New interest in rail electrification
• High-speed ships & ferries – gas turbine power
• Decline in thermal coal production & end of “clean” coal power generation new-builds
• High-efficiency, low-cost solar and wind energy installations
Thank You.

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