The Ohio Oil & Gas Association

*Overview of Ohio Oil & Natural Gas*

American Association of Energy Engineers
April 5, 2013 - Cleveland, Oh
Overview

1. OOGA
2. Ohio Oil & Gas history
3. Utica
4. Well Pad and Well Construction
5. Hydraulic Fracturing, wait, what?
   1. FUD
   2. What - Brief technologic overview
   3. Why
   4. How
6. Regulatory
7. Resources for more information
Figure 8. U.S. primary energy consumption by fuel, 1980-2035
(quadrillion Btu per year)
Founded in 1947, the Ohio Oil & Gas Association strives to serve the broad range of entities involved in the Ohio oil and natural gas extractive industry.

- 275,774 wells drilled for oil and gas
- Wells have been productive in 79/88 counties
- Ohio has 64,378 active wells
- In 2010 Ohio produced 70 BCFG, 4 MMBO (~100 BCFE) ~ $1 Billion
- Oil & gas reservoirs have been tested at depths from less than 100 feet to over 13,700 feet
- Ohio ranks 4th nationwide in number of wells drilled
Historic Ohio Oil & Gas Facts

- 1814 oil discovered in Noble County, Thorla-McKee Well
- 1860 first commercial oil production
- 1861 first off shore production, Mercer Reservoir
- 1884 first commercial gas production, Findlay
- 1887 Clinton phase 1, Fairfield Co. and Canton
- 1897 Lima-Indiana field “Middle East” of world
- 1908 Technologic Advance: Rotary drill bit
- 1947 Technologic Advance: Hydraulic Fracturing
- 1953 Clinton revitalized by new HF technique
- 1963 Morrow County Oil Boom, Multi-Channel Seismic
Historic Ohio Oil & Gas Facts

• 1970 Clinton phase 2: Rising oil and natural gas prices and increased local demand, and 1978 NGPA S.107 “Tight Sands” incentive pricing and S.29 tax credit incentives created boom. – 1981 6,085 wells drilled (and frac’d).

• 1985 Knox Rose Run, **Multi-Fold Seismic**

• 1986 Oil price collapse, stagnant natural gas prices slowed activity significantly.

• 1990’s Deeper Knox drilling, **Digital and 3D Seismic**

• 2010 **Technologic Advance: Horizontal Drilling** opens the door to hydrocarbon molecules in the Shales that had previously been impossible to release.
Ohio Oil & Gas Well History
1897-1910 & 1911-1930

OHIO OIL & GAS WELL HISTORY 1897-1930

1897-1910

1911-1930

ALL OHIO OIL & GAS WELLS SHOWN AS GRAY DOTS
WHICH INCLUDE WELLS WITHOUT COMPLETION DATES

MacKenzie Land & Exploration Ltd.
www.mackex.com
Ohio Oil & Gas Well History
1931-1950 & 1951-1970

OHIO OIL & GAS WELL HISTORY 1931-1970

1931-1950

1951-1970

ALL OHIO OIL & GAS WELLS SHOWN AS GRAY DOTS
WHICH INCLUDE WELLS WITHOUT COMPLETION DATES

Mackenzie Land & Exploration Ltd.
www.mackex.com
Ohio Oil & Gas Well History

Ohio Oil & Gas Well History
1971-2012

ALL OHIO OIL & GAS WELLS SHOWN AS GRAY DOTS
WHICH INCLUDE WELLS WITHOUT COMPLETION DATES
Ohio Oil & Gas Well History
1960-2012 & 1897-2012

OHIO OIL & GAS WELL HISTORY

WELLS DRILLED 1960-PRESENT

OIL & GAS WELLS DRILLED IN OHIO AFTER 1960 WERE LIKELY COMPLETED USING HYDRAULIC FRACTURING. MORE THAN 75,000 WELLS WERE DRILLED AND COMPLETED IN OHIO DURING THIS PERIOD.

ALL WELLS 1897-2012

MacKenzie Land & Exploration Ltd
www.mackex.com
Production in Ohio 1985-2009

75% of the reported natural gas produced in Ohio (1985-2009), 2 TCF, is from the Clinton Sandstone.
Prior to the late 1990s these shales were thought of principally as the source of oil and gas that would then migrate slowly over time into “conventional” reservoirs.
Generalized Cross Section
Utica and Marcellus Shale
Ohio to Pennsylvania
Depositional Model NW-Ohio to WV

Northwestern Ohio to West Virginia depositional model, showing the transition from the Trenton Platform to the Lexington Platform through the interplatform basin. The model includes various depositional environments and sediment types, such as tidal flats, restricted lagoons, skeletal shoals, and open marine environments. The boundaries between these environments and the associated sedimentary facies are indicated.

Modified from Pope and Read.
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![Image of core samples]
Utica Shale – Natural Resources
The Marcellus is a fractured reservoir! Fractures allow for connectivity between matrix porosity and the well bore.
Figure 3. Abundant shale plays, accessed by hydraulic fracturing and horizontal drilling technology, are a key driver behind North America becoming the globe’s “energy island” by 2020; EIA map of North American shale plays

North American shale plays
(as of May 2011)

Source: EIA
Natural Gas Pipelines, US

U.S. Natural Gas Pipeline Infrastructure 2009

Legend
- Interstate Pipelines
- Intrastate Pipelines

Source: Energy Information Administration, Office of Oil & Gas, Natural Gas Division, Gas Transportation Information System
Hydraulic Fracturing

- This is not new technology, although it is constantly improving over time, today's HF are more controlled, more engineered, more focused than ever before.
- Fracing has been a standard practice for over 60 years. First well frac'd – Kelpper # 1, Kansas - 1947
- 1989 SPE estimates over 1 million frac jobs have been completed
- 600 TCF of natural gas and 7 billion barrels of oil have been captured as a result of hydraulic fracturing – energy that would not have been acquired without it.
- Fracing is responsible for 30 percent of America's recoverable oil and natural gas
- 90 percent of wells currently operating today have been frac'd
- American operators now frac 35,000 wells each year
- Not a single case of drinking water contamination attributable to HF has ever been recorded. Not one.
- Hydraulic fracturing has been aggressively regulated by the states. In that time a staggering record of safety has been amassed.
Why Hydraulic Fracturing?

Conditions needed to complete a economically successful oil and gas well:

- **Porosity**: Oil and gas trapped in the pore spaces of a reservoir rock
- **Permeability**: The pore spaces are connected allowing fluid to move through the rock
- Most productive wells have good porosity but poor permeability
- Hydraulic fracturing is a “well stimulation” technique to create drainage pathways within the oil and gas bearing rock
- HF allows us to access and produce oil and gas trapped in the rock that we would not otherwise produce.
Hydraulic Fracturing – Rock Mechanics

- Reservoir Properties
  - Permeability and Porosity
  - Height
  - Borehole Pressure and Borehole Temperature
  - Britteness and Strength/Hardness
    - Young’s Modulus (“stiffness” of a material)
    - Poisson’s Ratio (ratio of transverse strain to axial strain)
    - Brinell Hardness (indentation strength of a material)
    - Britteness Factor
Hydraulic Fracturing – Fluid Considerations

**Fluid Design**
- Compatibility with the reservoir
  - Salt Tolerance
  - Surfactants/flowback Aids
  - Friction Reducers
  - Gels
  - Fines migration chemistry
  - Acid breakdown and scale/salting treatment
    - May be reactive or non-reactive systems base on clay mineralogy
    - Geochem -
- Functionality: create complexity; carry proppant
Hydraulic Fracturing consists of blending a carrying fluid, water and special chemicals and proppants to make an appropriate fracturing fluid, this is a highly engineered liquid, custom designed to do a very specific job.

This engineered fluid (99% sand and water) is then pumped down the wellbore, into the target reservoir at carefully specified and monitored rates, based upon the petrophysics of the reservoir in order to induce the intended fracture networks within the reservoir.

HF allows us to access and produce oil and gas trapped in the rock that we would not otherwise produce.
Hydraulic Fracturing in Ohio

• First Ohio frac job - 1953
  • 1958 Study - as a result of fracturing, the Clinton dry hole rate of 42% in 1951 decreased to 15% by 1957 and that, “as a result of the success of hydraulic fracturing, many sub-marginal areas which would have been economically undesirable, are now being produced profitably.”
  • Since then, over 80,000 wells have been frac’d in oil and gas formations, in Ohio, ranging from 1,000’ to 10,000’.
• First horizontal well - 1941
Elements of a Frac

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.

Marcellus Shale

Well turns horizontal

The shale is fractured by the pressure inside the well.
Footprint Advantage – Horizontal Wells

Traditional Vertical Well Spacing: 32 Separate Padsites Needed For 32 Wells.

Idealized Horizontal Well Spacing: 1 Padsite Yields Up To 32 Wells.
Horizontal Well Development
Current Horizontal Well Permit and Completion Activity Overlaid on Equivalent R_o Max Color Ramp and Defined Core Area

EXPLANATION
Core Area & % Ro
10,830,209 total acres

Horizontal well status
Showing wells permitted 2010–Present
- Permitted
- Drilling
- Drilled
- Completed
- Producing

% R_o maximum

Well permit information from the ODNR Division of Oil and Gas Resources Management

Recommended citation: Ohio Department of Natural Resources, 2012, Horizontal Utica shale gas well activity in Ohio: Ohio Department of Natural Resources, Division of Geological Survey. Scale 1:1,760,000. Revised 7/31/2012

Activity through 2-27-12
Utica Permit Activity

UTICA HORIZONTAL WELL STATUS
THROUGH 3/2/2013

- PERMITTED OR NOT DRILLED (26)
- PRODUCING (73)
- DRILLED, DRILLING OR INACTIVE (173)
- PLUGGED (11)

Map and table showing well status by operator.
# Utica Well Status

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What Really Matters, Well Construction

EXHIBIT 30: CASING ZONES AND CEMENT PROGRAMS

1000 —
Aquifer

1000 —
Cement
Surface Casing
Drilling Mud

2000 —
Salt Water Zone

Intermediate Casing
Cement

7100 —
Kickoff Point

Production Casing
Production Tubing

Production Zone

General Casing Design for a Marcellus Shale Well

More than three million pounds of steel and concrete underlie the wellhead. The Marcellus Shale typically 8,000 feet below the Earth's surface and underlies...
Anti Oil & Gas groups routinely attack the industry by promoting a corruption of the specific treatment directed to oil and gas as found in the landmark federal environmental laws (ie RCRA, SDWA, CWA, CAA, etc.)

- These statutes rely upon the long-standing and rational principle that state based regulation, firmly grounded in the evolution of sound regulatory policy applied by experts, is the preferred regulatory model.
- Why? Because geology varies greatly from region to region.

Critics seek to stop energy resource development by saying that the risks associated with (continuing) to develop Ohio’s energy resources outweighs the benefits citizens receive from local energy supplies
Regulatory

- To address present-day health, safety and social issues related to oil and gas development.
- Provide to the regulatory agency the funding resources necessary to administrate an effective enforcement program – particularly in light of concerns some have raised within urban situations.
- Ensure public faith and trust in the state oil and gas regulatory program.

With the recent passage of Senate Bill 165 in 2010 and then Senate Bill 315 last month, you would be hard pressed to find a stronger oil and gas regulatory system than the one in place in Ohio.
What are Regulators Saying?

• “I’m not aware of any proven case where the fracking process itself has affected water, although there are investigations ongoing” – US EPA Administrator Lisa Jackson, May 24, 2011
• “There is no way that the fracking process is going to affect ground water.” Chief, Ohio Geologic Survey Larry Wickstrom
• “Though hydraulic fracturing has been used for over 50 years in Texas, our records do not indicate a single documented contamination case associated with hydraulic fracturing.” – Victor Carrillo, Chairman, Texas Railroad Commission
• “There have been no instances where the Division of Oil and Gas has verified that harm to groundwater has ever been found to be the result of hydraulic fracturing.” – Indiana Department of Natural Resources
• “There is no indication that hydraulic fracturing has ever caused damage to ground water.” – Michigan Department of Environmental Quality
• “…we have found no example of contamination of usable water where the cause was claimed to be hydraulic fracturing.” – Mark Fesmire, Director, New Mexico Oil Conservation Division
What are Regulators Saying?

- "He said he has been examining the science of hydrofracturing the shale for three years and has found no cases in which the process has led to groundwater contamination." "As it turns out hydraulic fracturing itself appears to be safe." – Taury Smith, New York State’s top geologist

- "It’s our experience in Pennsylvania that we have not had one case in which the fluids used to break off the gas from 5,000 to 8,000 feet underground have returned to contaminate ground water." - Former PA DEP Sec. and Former PennFuture CEO John Hanger

- "The [2004 EPA] study determined that fracturing posed 'little or no threat' to groundwater. – U.S. EPA

- “There have been no documented cases of drinking water contamination that have resulted from hydraulic fracturing.” - Association of American State Geologists President

- “No Documented Cases of Hydraulic Fracturing Contamination.” When asked, “Do any one of you know of one case of ground water contamination that has resulted from hydraulic fracturing?”, Mr. Silva said: “Not that I’m aware of, no.”

  Peter Silva, USEPA (U.S. Senate hearing, 12/8/09)
• “After 25 years of investigating citizens complaints, DMRM (ODNR) geologists have not documented a single incident involving contamination of ground water attributed to hydraulic fracturing” Scott Kell, deputy chief, ODNR/DMRM in testimony submitted to the Committee on Natural Resources, Energy and Mineral Resources Subcommittee, U.S. House of Representatives, June 4, 2009.

• “If wells are constructed right and operated right, hydraulic fracturing will not cause a problem. … Our natural gas supplies would plummet precipitously without hydraulic fracturing.” Scott Anderson, Environmental Defense Fund’s Senior Policy Advisor (E&E TV, 10/27/10)
US Demand for hydrocarbons is projected to continue growing

Saudi Arabian demand for its own production may reach 50% by 2035

Economic growth in China and India continues at 7 to 9% per year

So, competition for energy is not going away.
A stakeholder driven process based on consensus evaluation to improve state exploration and production environmental programs (started in the 80's and 90's)
Welcome to FracFocus, the hydraulic fracturing chemical registry website. This website is a joint project of the Ground Water Protection Council and the Interstate Oil and Gas Compact Commission.

On this site you can search for information about the chemicals used in the hydraulic fracturing of oil and gas wells. You will also find educational materials designed to help you put this information in perspective.

Looking for information about a well site near you?

Search for nearby well sites that have been hydraulically fractured to see what chemicals were used in the process.

FAQs

Q. How is water used in hydraulic fracturing?
Commonsense Energy

Jobs, revenue and opportunity a mile below our feet? Click here to learn more about what the Utica and Marcellus Shale could mean for Ohio.

Energy Jobs Abundant at Congressman Johnson's Job Fair

Over 500 attended Congressman Johnson’s job fair Monday, some leaving with jobs and others receiving a prime opportunity to put their best foot forward (along with their resumes) in front of prospective employers. Thankfully, Utica Shale development has helped drive the need for new employment, directly or indirectly, for the job seekers in the area. Keep Reading »

Tags: BioTech Bliss, Chesapeake, Columbiana County, Congressman Bill Johnson, East Liverpool, East Liverpool Motor Lodge, International Union of Operating Engineers, Job Fair, Local 16, Local 666, Mahoning Valley Manufacturers Coalition, MarWest, Plumber and Pipeliners, Steel, Utica

Education is Key to Ohio’s Energy Future

Too often these days, it seems those with the least education are doing the most educating. This is a
Today in Energy

Drop in U.S. gasoline prices reflects decline in crude oil costs

Since reaching a recent peak of $3.94 per gallon on April 2, the average retail price U.S. drivers paid for gasoline has fallen for 12 weeks in a row to $3.44 per gallon, according to EIA’s weekly motor fuel survey. The drop in gasoline prices largely reflects the decline in crude oil prices, which have historically comprised the biggest part of the pump price. More

Weekly retail gasoline and spot crude oil prices, Mar 2012 - Jun 2012

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Data Highlights

- Crude oil futures price
  - 6/25/2012: $79.36/bbl
  - $4.67 from week earlier
  - $11.25 from year earlier

- Natural gas futures price
  - 6/20/2012: $2.767/mmbtu
  - $0.222 from week earlier
  - $1.488 from year earlier

- Retail gasoline price
  - 6/25/2012: $3.437/gal
  - $0.060 from week earlier
  - $0.137 from year earlier
“Switch is engaging, funny and educational, all at the same time. I have done nothing but rave about it.”

— Niall Bellmonde
Leggette, Brashears & Graham

THE SWITCH ENERGY PROJECT

A film, web and education program to build energy awareness and efficiency, and help us move forward together toward a smarter energy future.

Energy is the most important issue of our time.

It impacts the economy, the environment, food and water, population, everything. To understand these challenges, we first need to understand energy.

Then, we need to get efficient.

Efficiency – the smarter use of energy – reduces emissions, stabilizes prices, extends supply and saves money.

It’s the most important thing we can do in energy, and each of us can make a difference. Starting today.

EXPLORE THE VIDEOS

2-minute primers, exclusive site visits and international experts – organized by energy topics.

SEE THE FILM

Switch explores the world of energy to discover our future.

ATTEND A SCREENING

7/6 Anchorage, AK
7/10 Barrow, AK
7/10 Atlanta, GA
7/11 Fairbanks, AK
7/12 Anchorage, AK
7/16 Houston, TX
7/17 Lafayette, CA
7/28 Katy, TX

MORE SCREENINGS

Resource: www.switchenergyproject.com
Resource & Counterpoint
www.truthlandmovie.com

DISPATCHES FROM THE Real GASLAND
CLICK THE MAP, MEET THE EXPERTS

WHAT ARE THE FACTS BEHIND OIL AND NATURAL GAS DEVELOPMENT IN AMERICA TODAY?

One woman from rural Pennsylvania decided to find out — for her family, for her community, for herself. Hear what some of the experts she interviewed along her journey had to say.

VIEW THE TRAILER

In the HBO movie “Gasland,” New York City filmmaker Josh Fox tried to scare people into thinking that natural gas development and hydraulic fracturing are new, unregulated and dangerous. It made one Pennsylvania mom living atop the Marcellus Shale wonder what she was getting into. She asked environmentalists, academicians and everyday people...
Local Production

Local Supply = Less Disruptions = Less Volatility

Local production – natural gas produced in our own backyard – is a safeguard that offers market protections against pipeline capacity and delivery constraints, particularly during peak demand periods. This represents a unique value to a state, such as Ohio, that is an industrialized large consumer of natural gas.

Local production feeds into the eastern Ohio distribution system, so Ohio citizens tend not to experience the extreme price swings caused by short-term peak-demand volatility that many other high-population centers suffered during recent years.
What that means?
To power a town of 100,000 people, for 1 year:

<table>
<thead>
<tr>
<th>Footprint</th>
<th>Energy Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 acres</td>
<td>20 Onshore Gas Wells</td>
</tr>
<tr>
<td>12 acres</td>
<td>1/30th of a Nuclear Plant</td>
</tr>
<tr>
<td>1,615 acres</td>
<td>724 Wind Turbines</td>
</tr>
<tr>
<td>2,907 acres</td>
<td>241,000 Solar Panels</td>
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All energy consumers have an ethical obligation to educate ourselves and those around us regarding the consequences of our demands for cheap energy and a preserved environment.
Thank YOU!

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