The Ohio Oil & Gas Association

Overview of Ohio Oil & Natural Gas

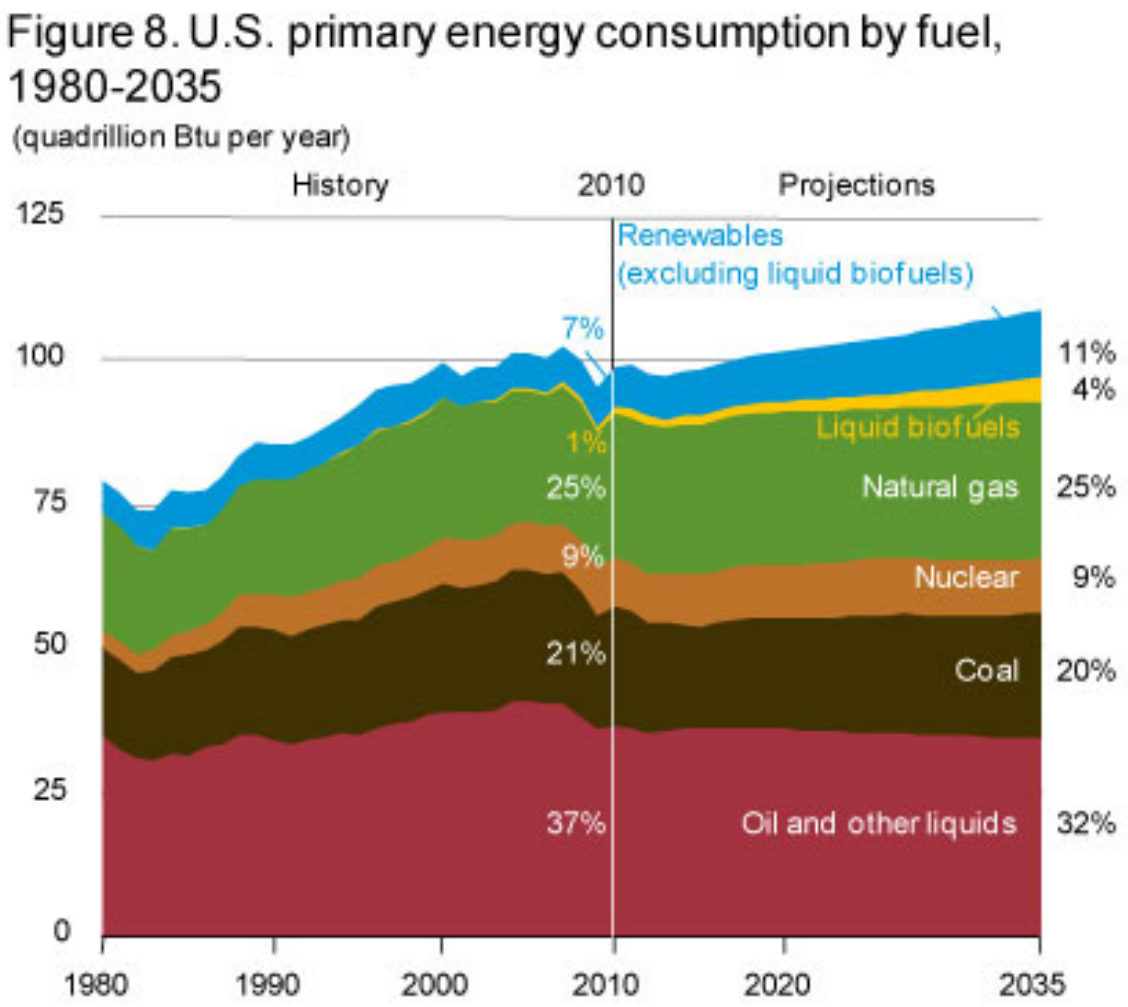
American Association of Energy Engineers
April 5, 2013 - Cleveland, Oh

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

EIA Energy Consumption by Fuel, US

Ohio Oil and Gas Association

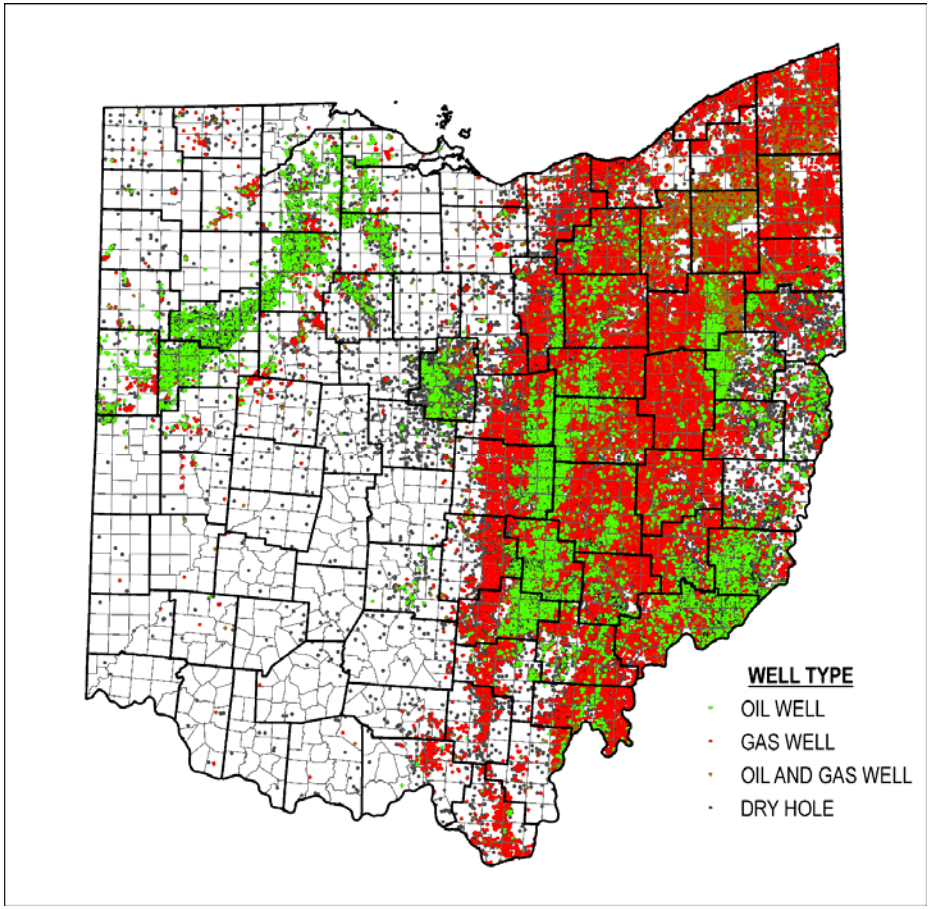


Oil & Gas, in Ohio?

Ohio Oil and Gas Association

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

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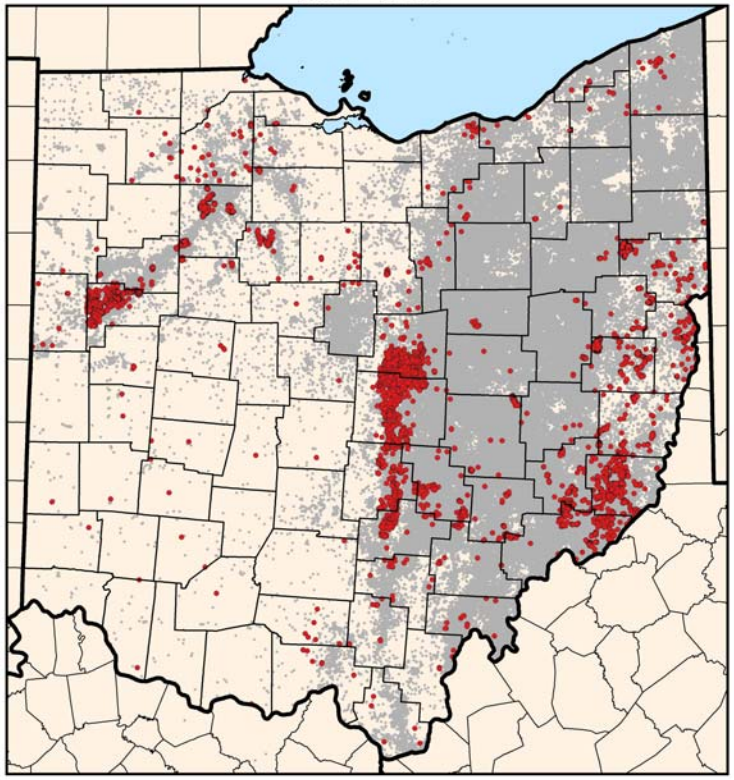
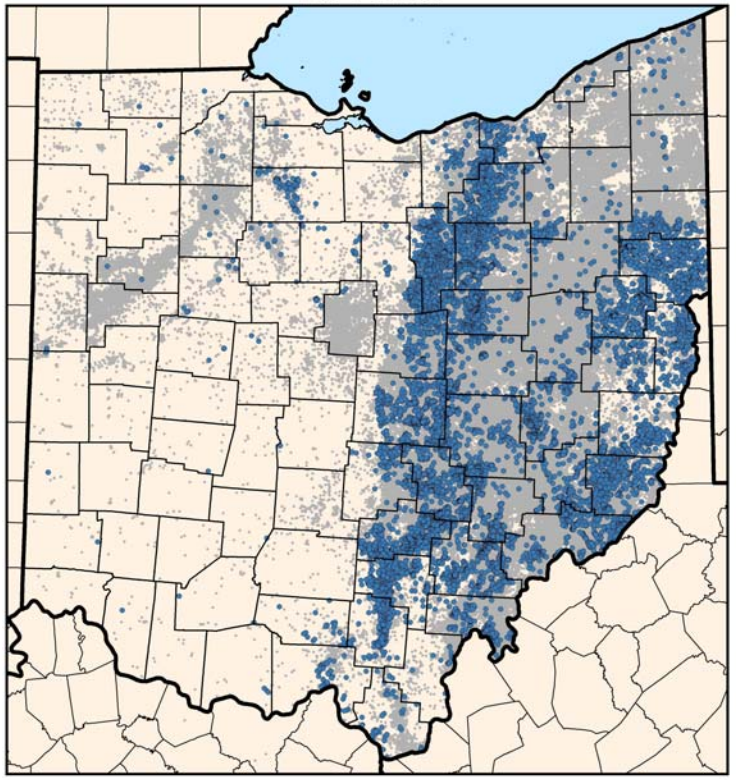
OHIO OIL & GAS WELL HISTORY 1897-1930

1897-1910



1911-1930



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

N

0 40

Miles

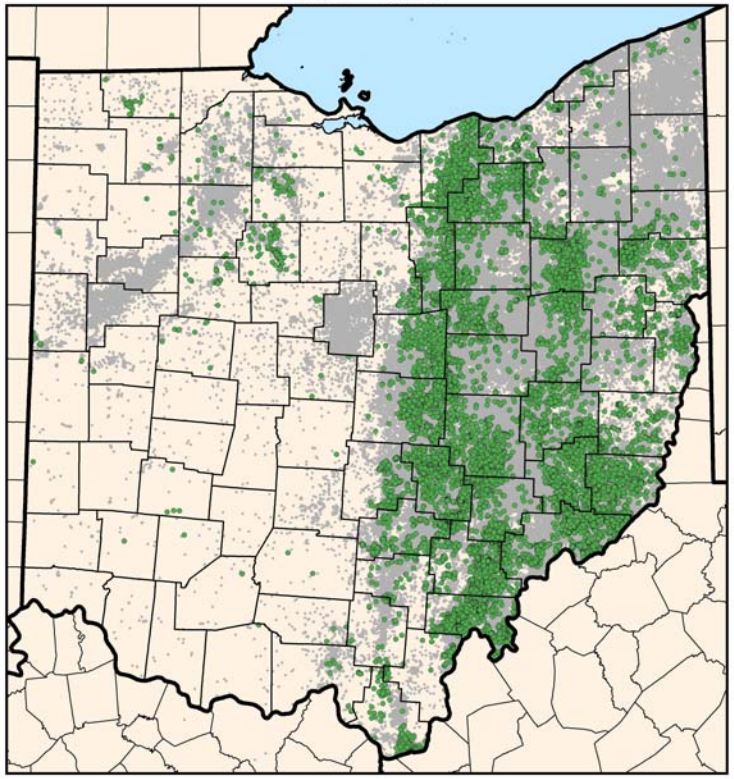
MacKenzie
Land & Exploration Ltd.
www.mackex.com

Ohio Oil & Gas Well History
1931-1950 & 1951-1970

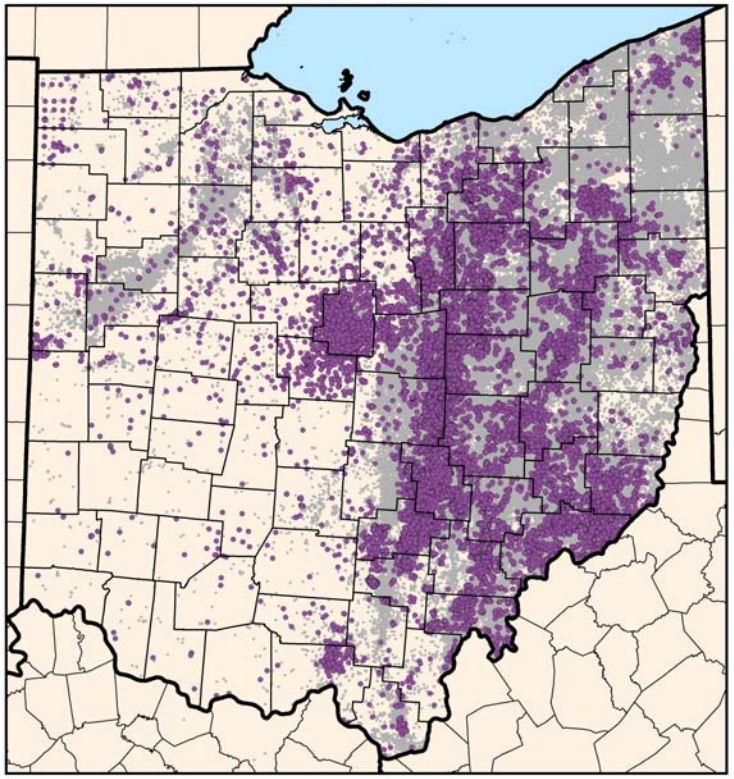
Ohio Oil and Gas Association

OHIO OIL & GAS WELL HISTORY 1931-1970

1931-1950



1951-1970



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Ohio Oil & Gas Well History
1971-1990 & 1991-2012

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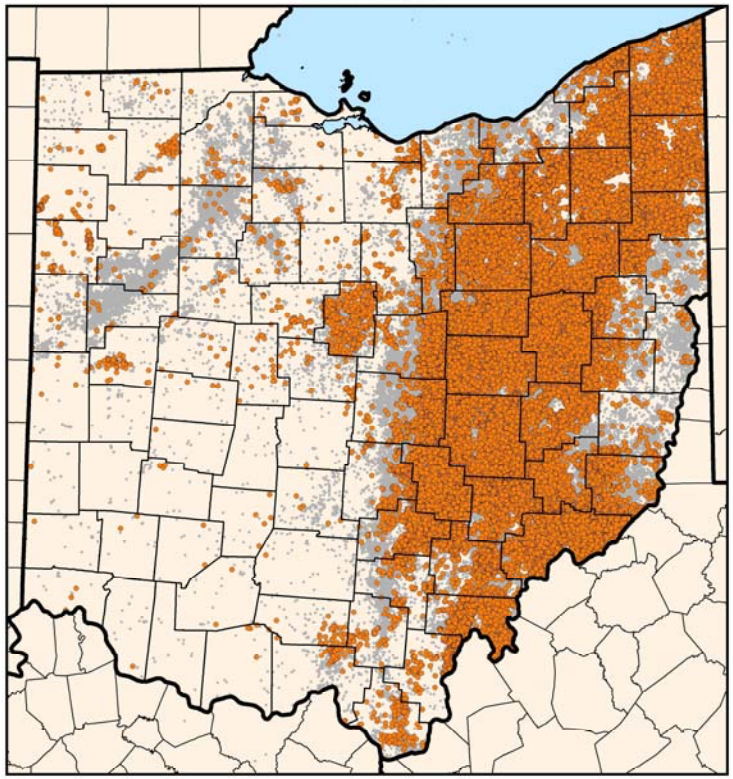
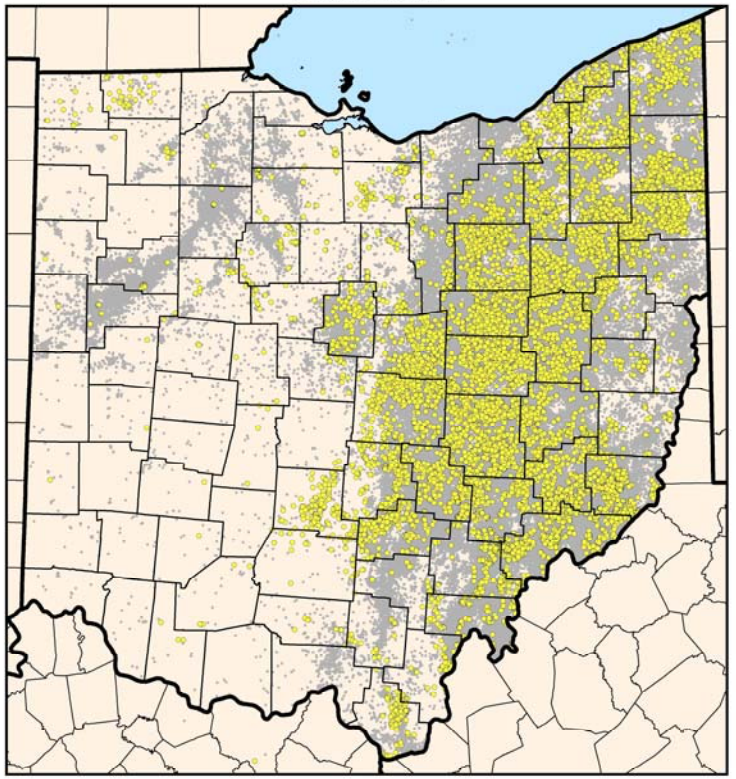
OHIO OIL & GAS WELL HISTORY 1971-2012

1971-1990



1991-2012



ALL OHIO OIL & GAS WELLS SHOWN AS GRAY DOTS
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Ohio Oil & Gas Well History
1960-2012 & 1897-2012

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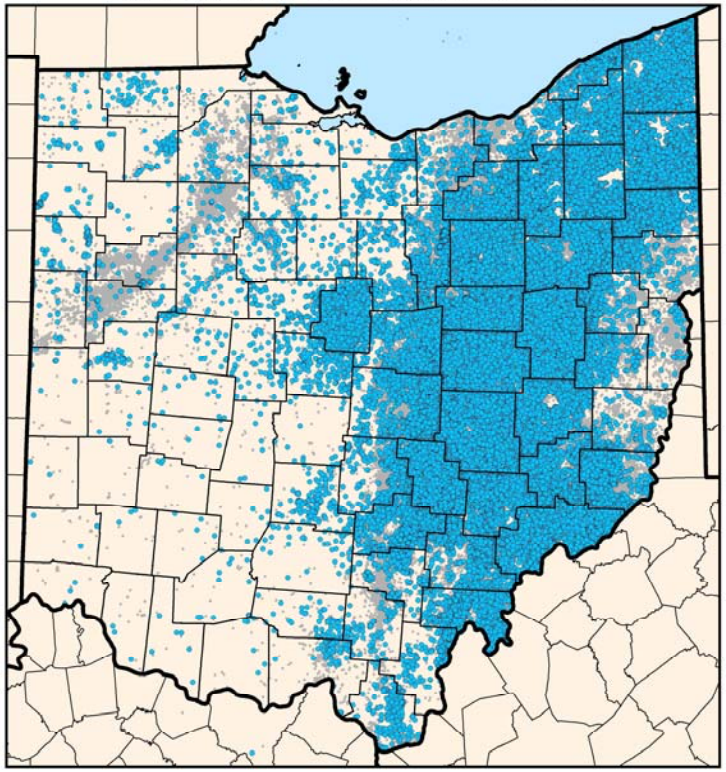
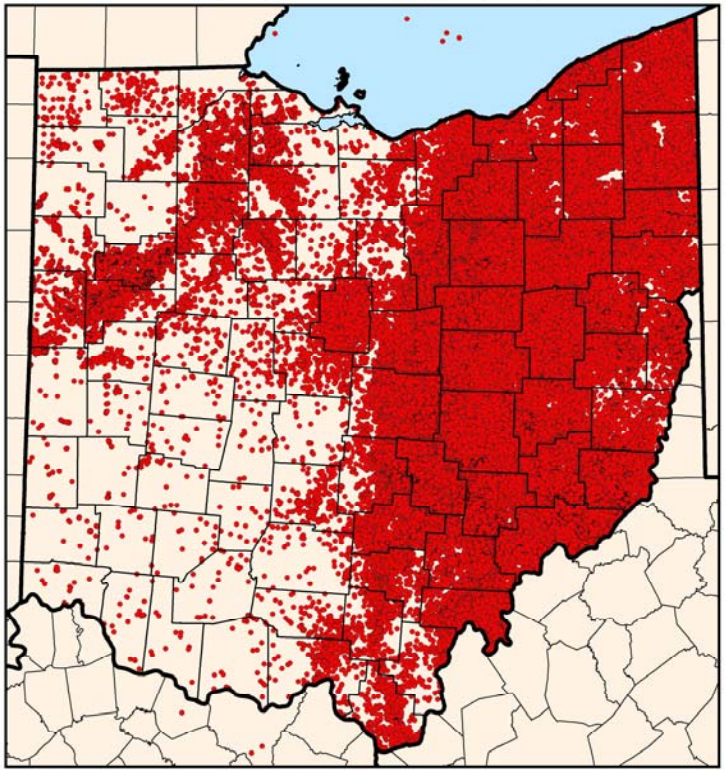
OHIO OIL & GAS WELL HISTORY

WELLS DRILLED 1960-PRESENT



ALL WELLS 1897-2012



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.

N

0 40

Miles

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Production in Ohio 1985-2009

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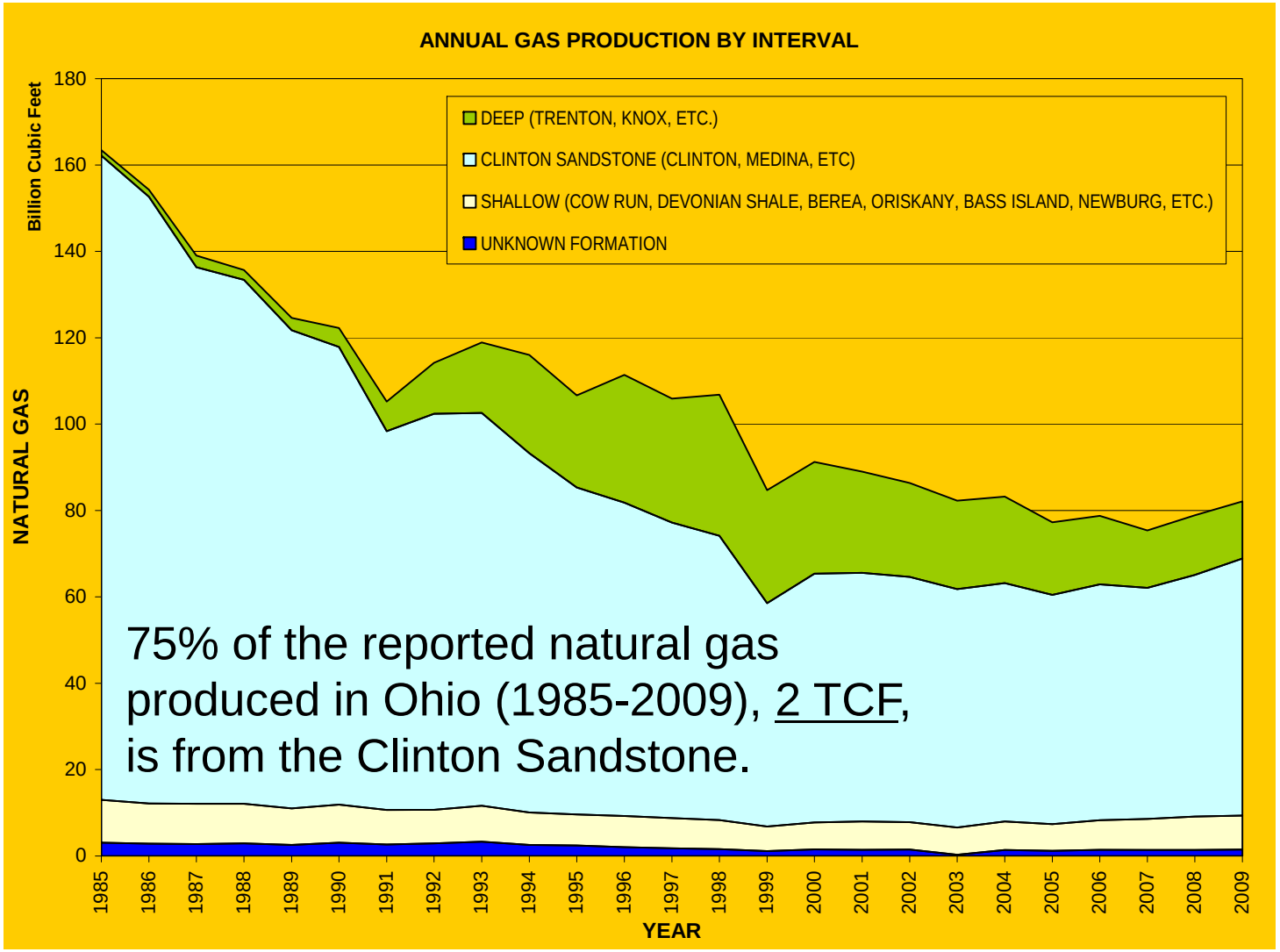
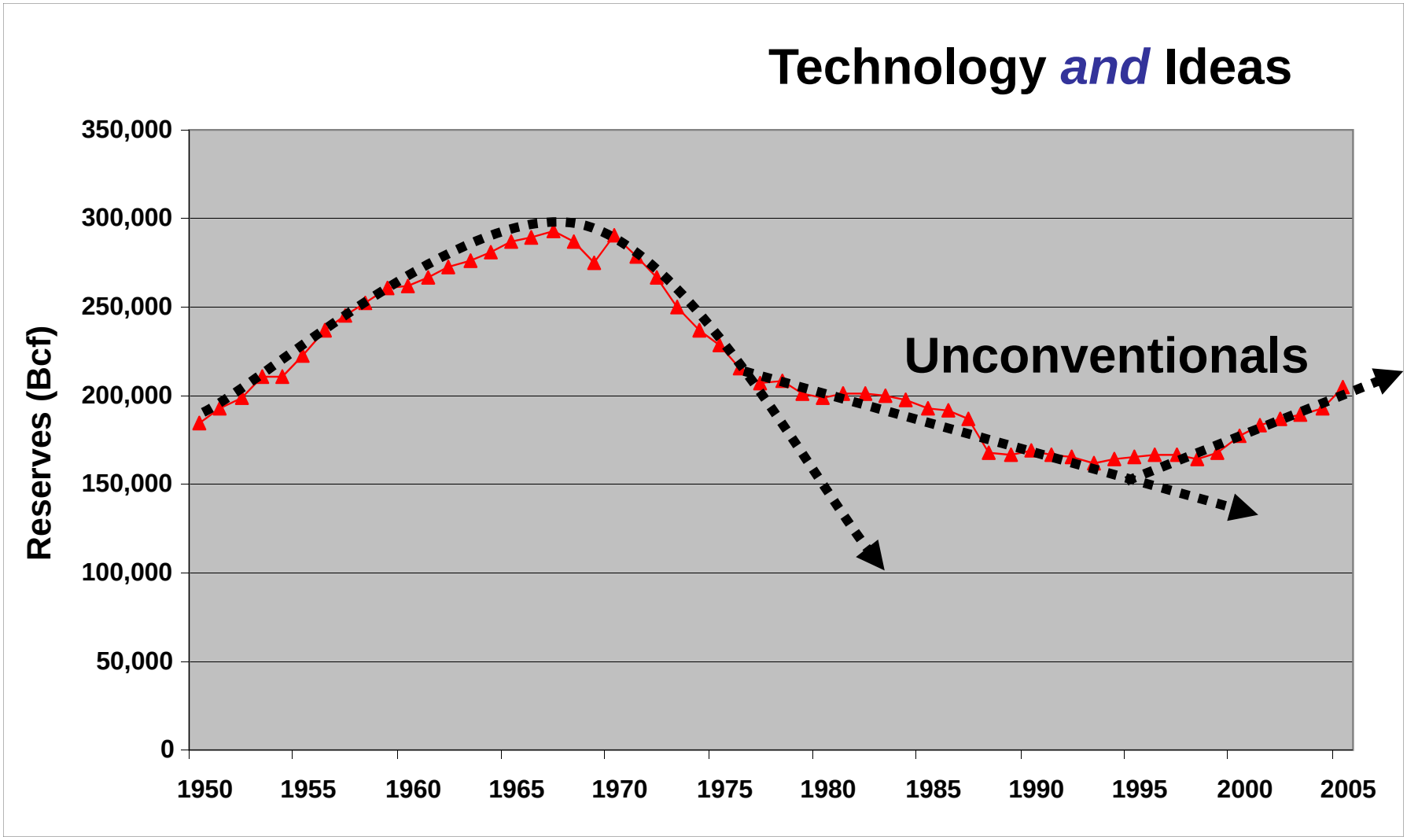
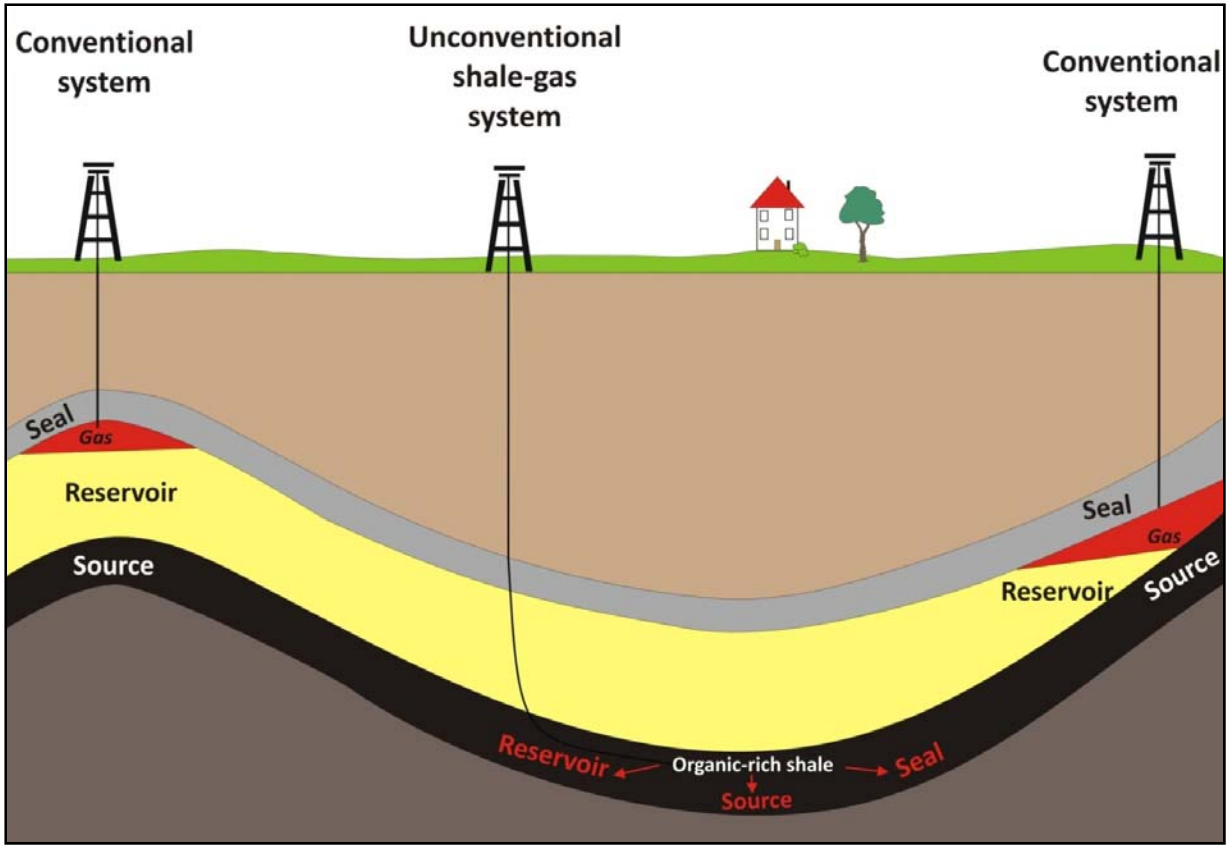


Dry Natural Gas Reserves, US



Why today? Technology & Source Rocks



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.

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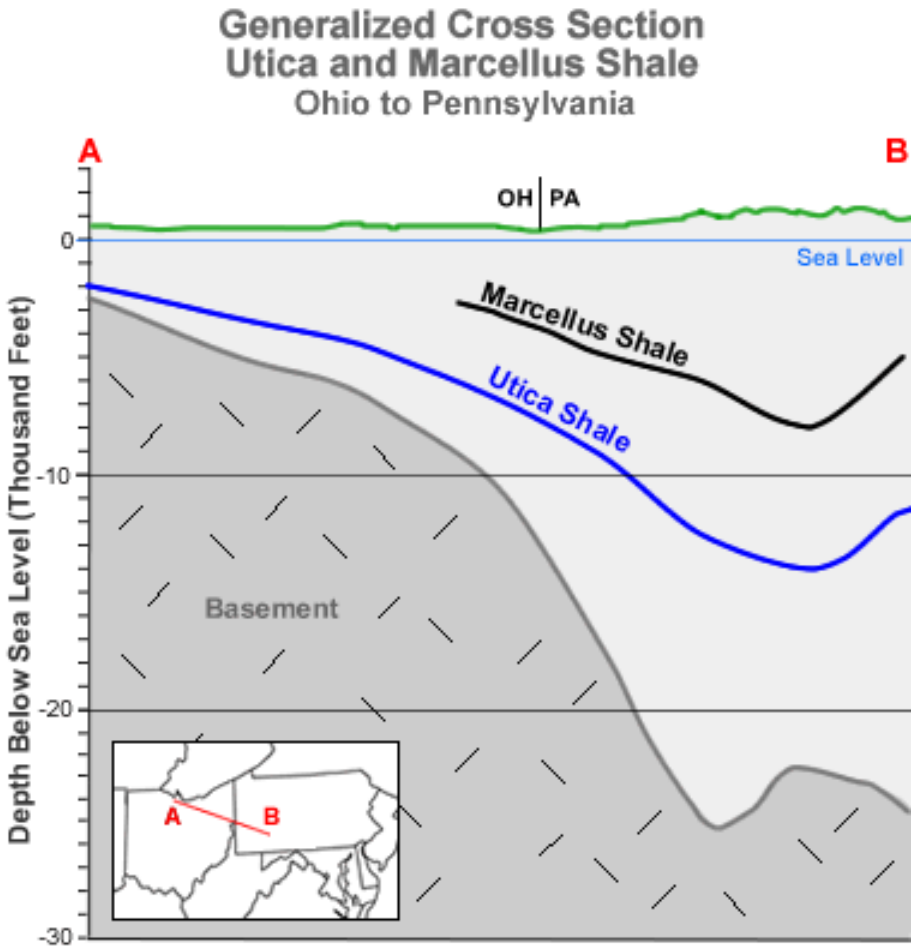

Depositional Model NW-Ohio to WV

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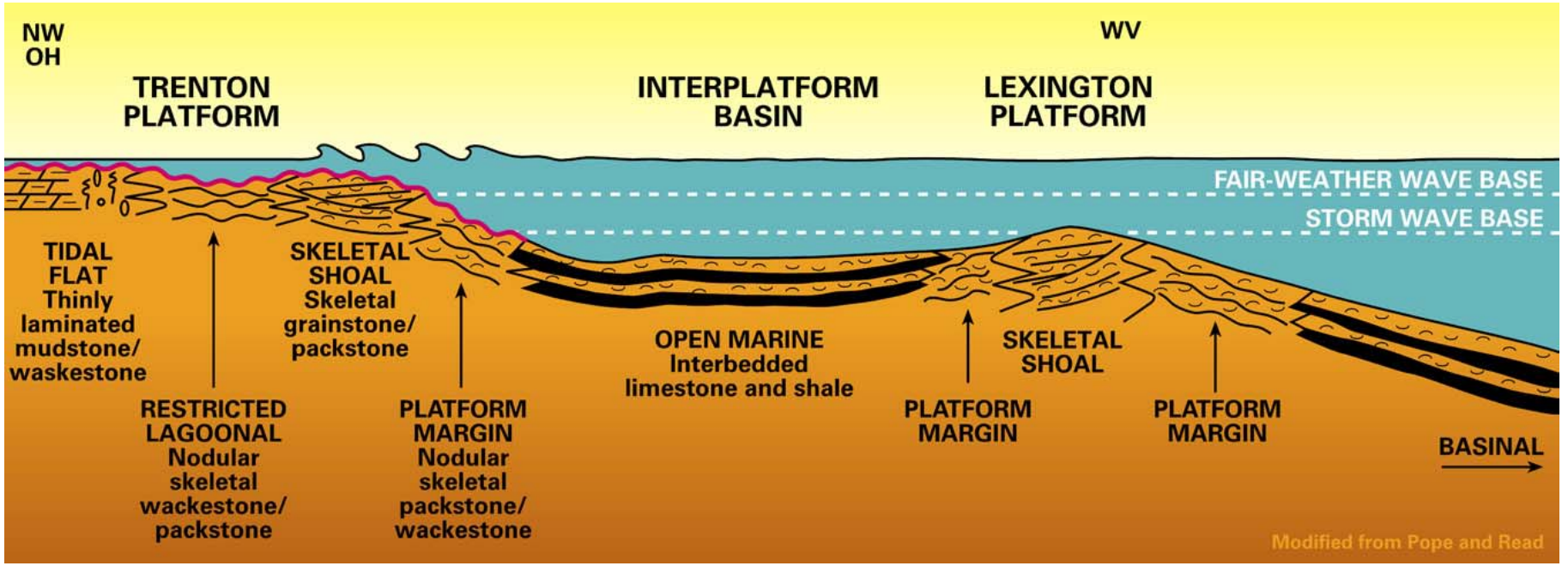
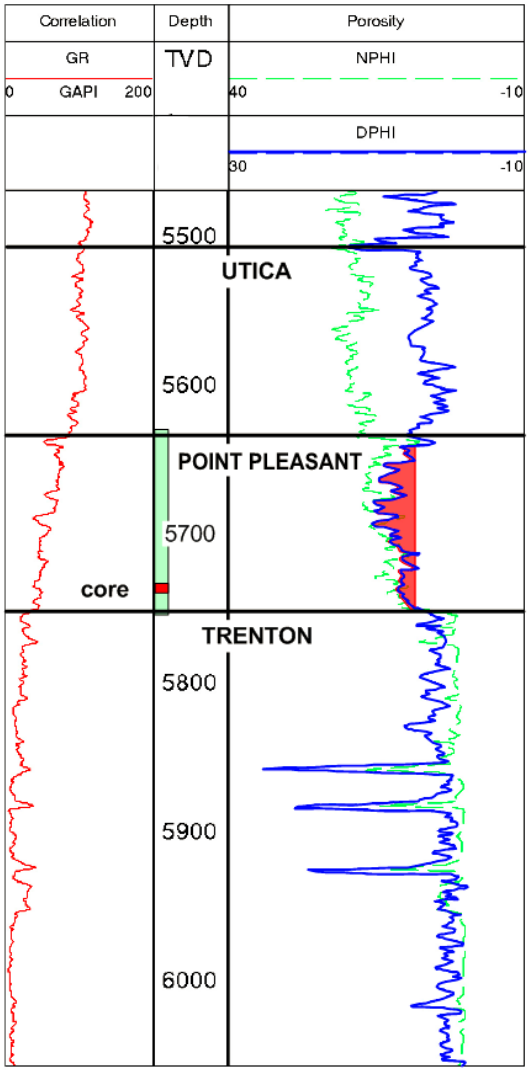
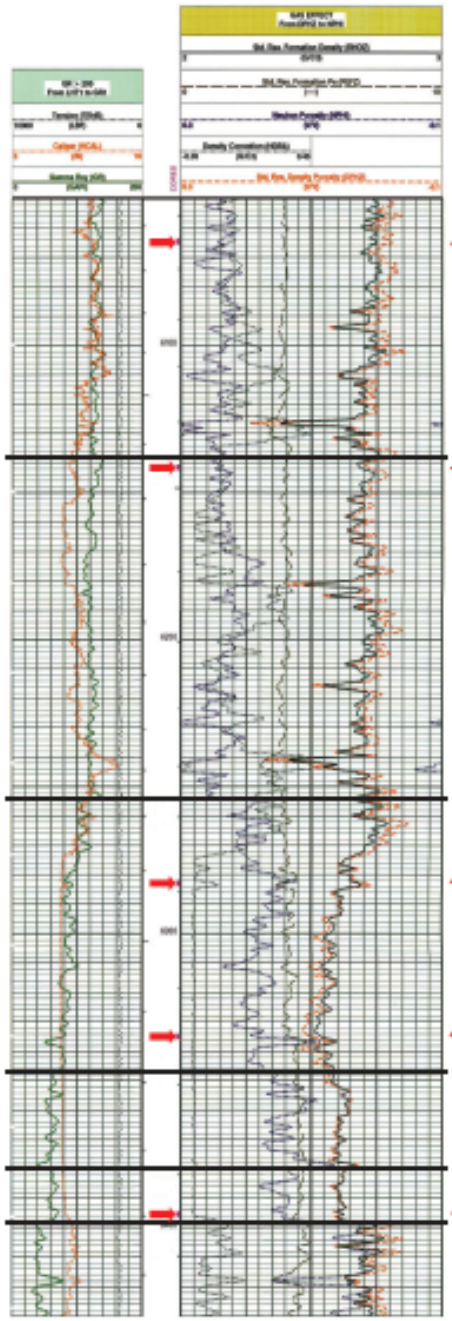



Correlation
Depth
Porosity
GR
TVD
NPHI
0 GAPI 200
40 -10
DPHI
30 -10
5500
UTICA
5600
POINT PLEASANT
5700
core
TRENTON
5800
5900
6000

A Utica-Point Pleasant Type Log for Eastern Ohio

APINO 3415725334



Source Rock Analyses

Depth (ft)	Sample Type	TOC	Rock Unit
6064	core	0.48	Cincinnati gp
6141	core	2.72	Utica Sh
6282	core	2.41	Point Pleasant Fm
6336	core	3.73	Point Pleasant Fm
6396	core	1.61	Logana Mbr
7192	core	0.11	Wells Creek Fm
7579	core	0.14	Copper Ridge dol
8274	core	0.23	Conasauga gp

Recommended citation for page 1: Riley, R.A., 2010, A Utica-Point Pleasant type log for eastern Ohio: Ohio Department of Natural Resources, Division of Geological Survey, one sheet (PDF), available at <http://www.dnr.state.oh.us/Portals/10/Energy/Utica/TuscarawasWellRockAnalyses.pdf>.

Utica Shale – Natural Resources

Ohio Oil and Gas Association

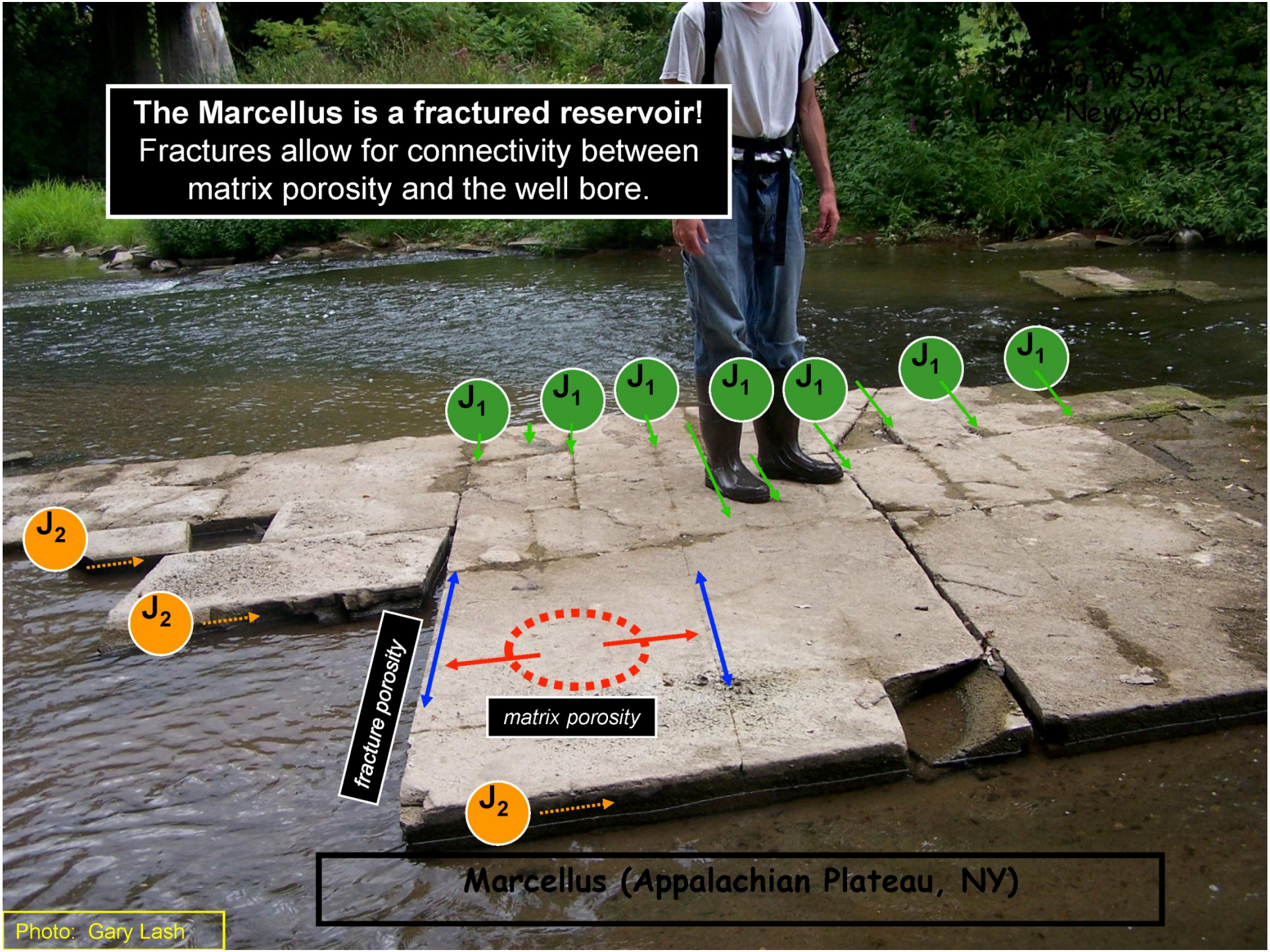

The Marcellus is a fractured reservoir!
Fractures allow for connectivity between matrix porosity and the well bore.
Looking WSW
Leroy, New York
J1
J2
fracture porosity
matrix porosity
Marcellus (Appalachian Plateau, NY)
Photo: Gary Lash

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

Source: EIA

Natural Gas Pipelines, US

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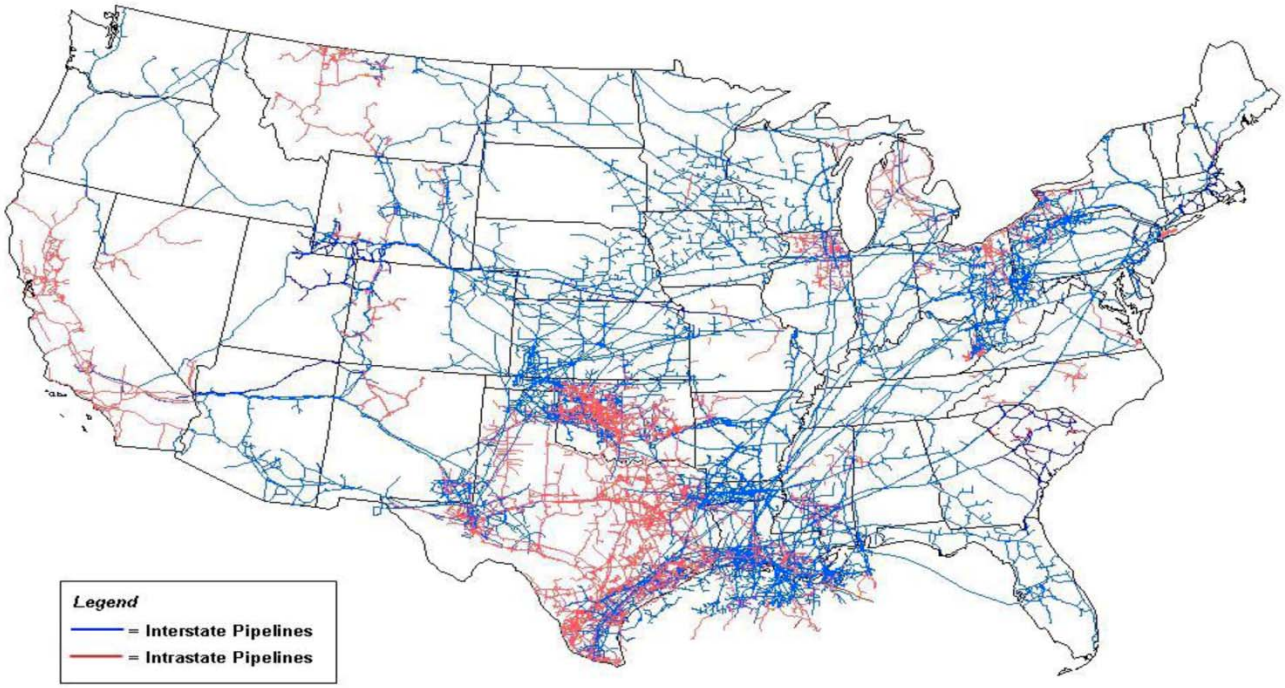
U.S. Natural Gas Pipeline Infrastructure 2009



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

AGA American Gas Association

Hydraulic Fracturing

Ohio Oil and Gas Association

- This is not new technology, although it is constantly improving over time, todays 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?

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Conditions needed to complete a economically successful oil an 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

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- Reservoir Properties
  - Permeability and Porosity
  - Height
  - Borehole Pressure and Borehole Temperature
  - Brittleness 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)
    - Brittleness Factor

Hydraulic Fracturing – Fluid Considerations

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- 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

Frac Constituents - (www.fracfocus.org)

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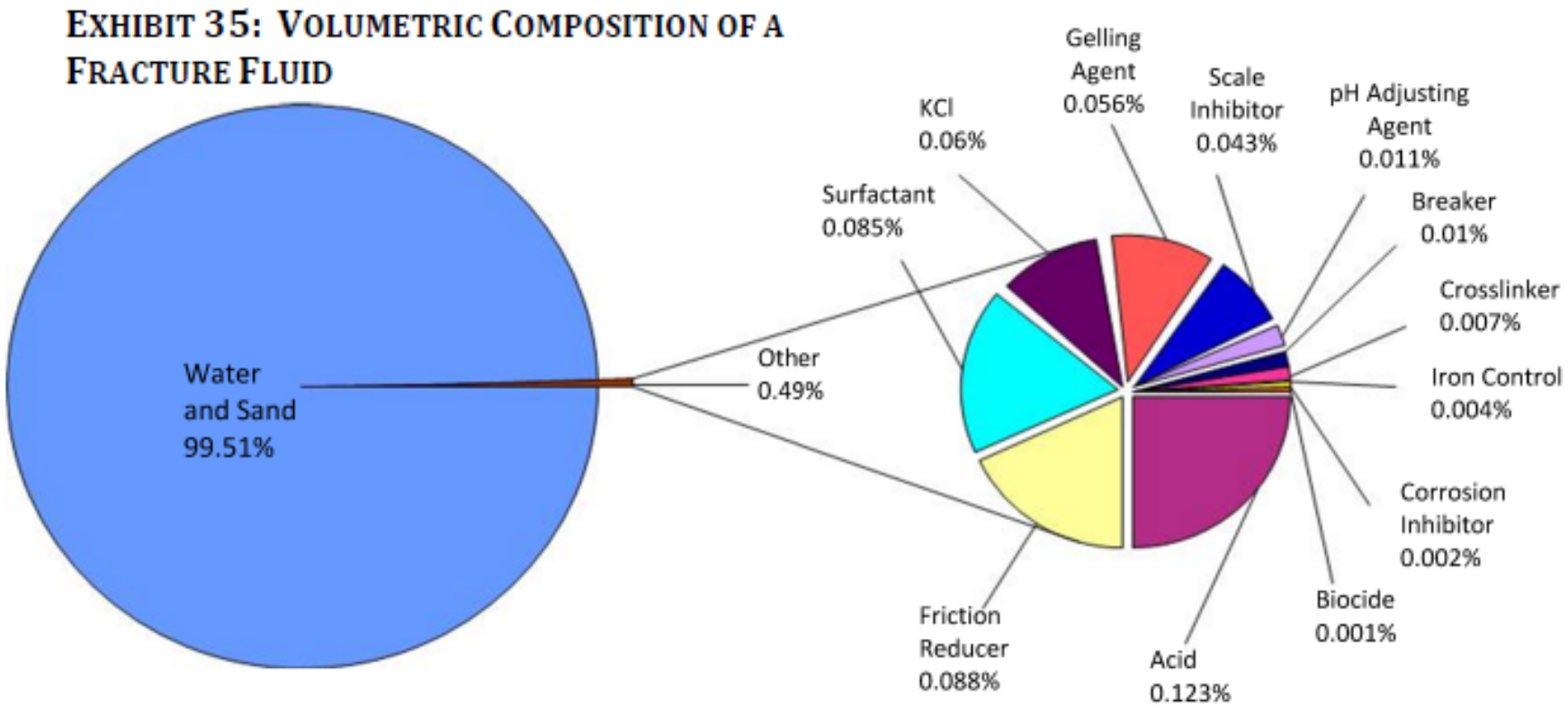


Hydraulic Fracturing

- 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.

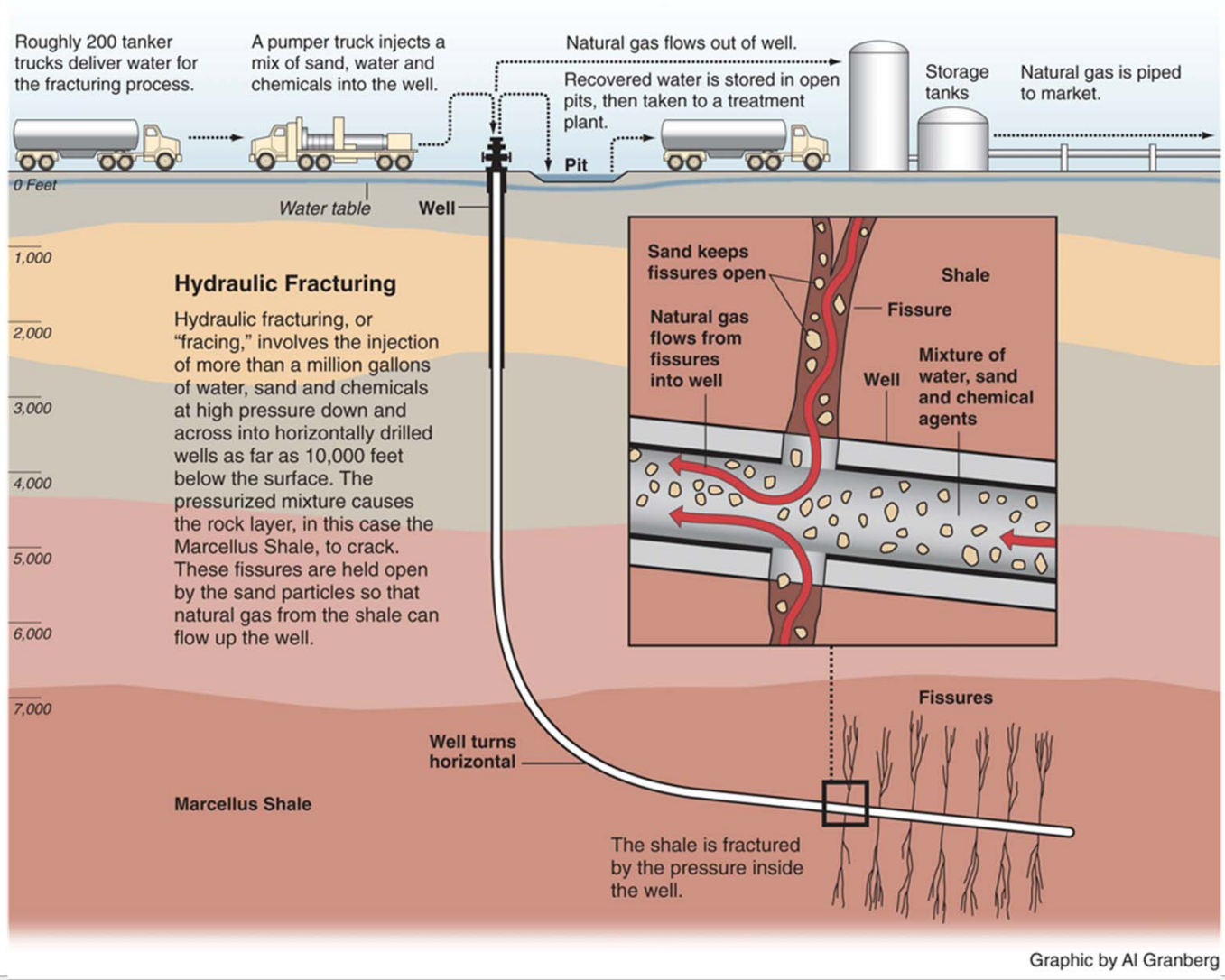
Hydraulic Fracturing in Ohio

Ohio Oil and Gas Association

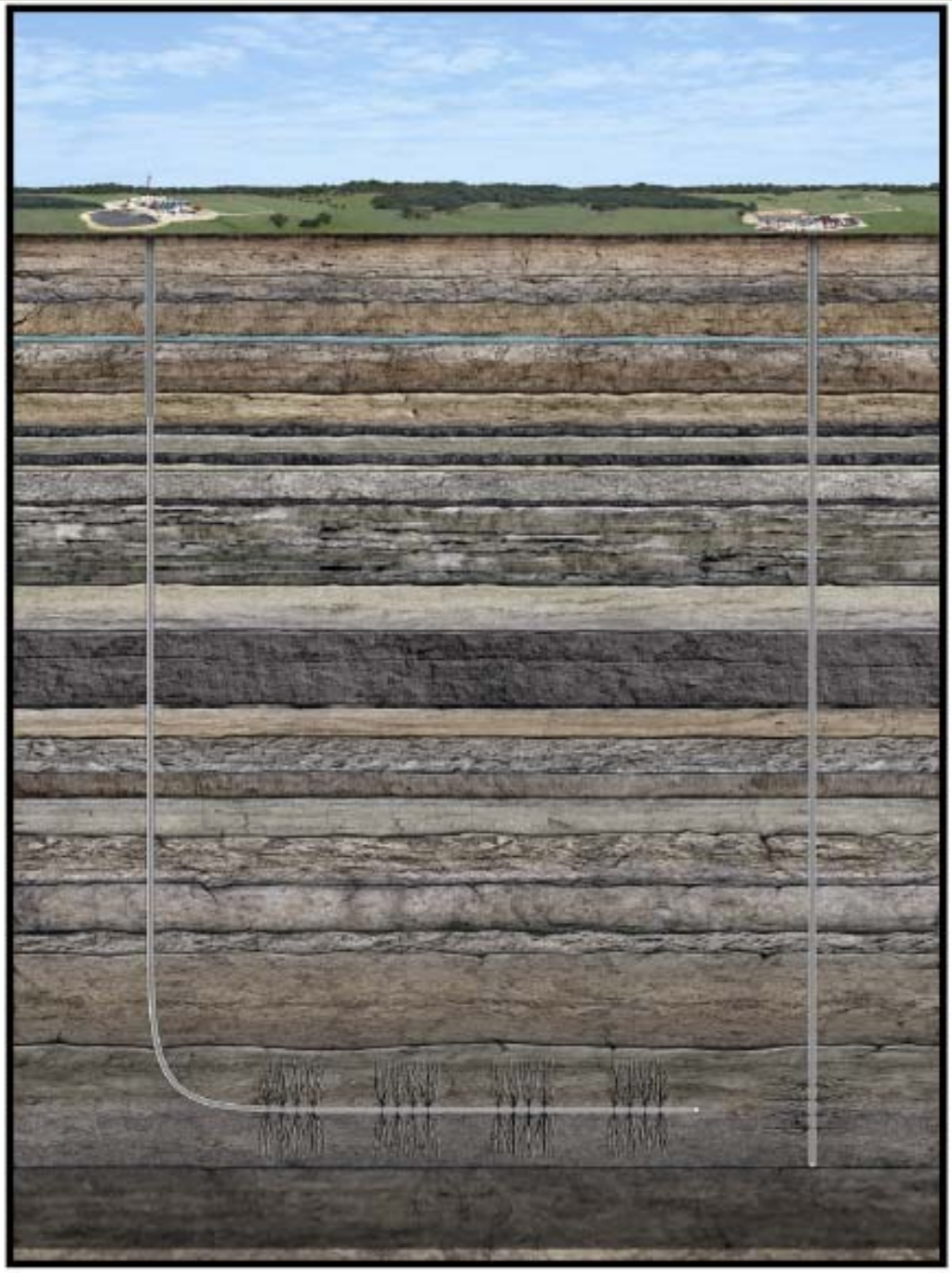
- First Ohio frac job - 1953
  - 1958 Study - as a result of fracturing, the Clinton dry hole rate of 42% in 1951 decreased to 15% by 1957 and that, “as a result of the success of hydraulic fracturing, many sub-marginal areas which would have been economically undesirable, are now being produced profitably.”
- 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

Ohio Oil and Gas Association



Graphic by Al Granberg



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Footprint Advantage – Horizontal Wells

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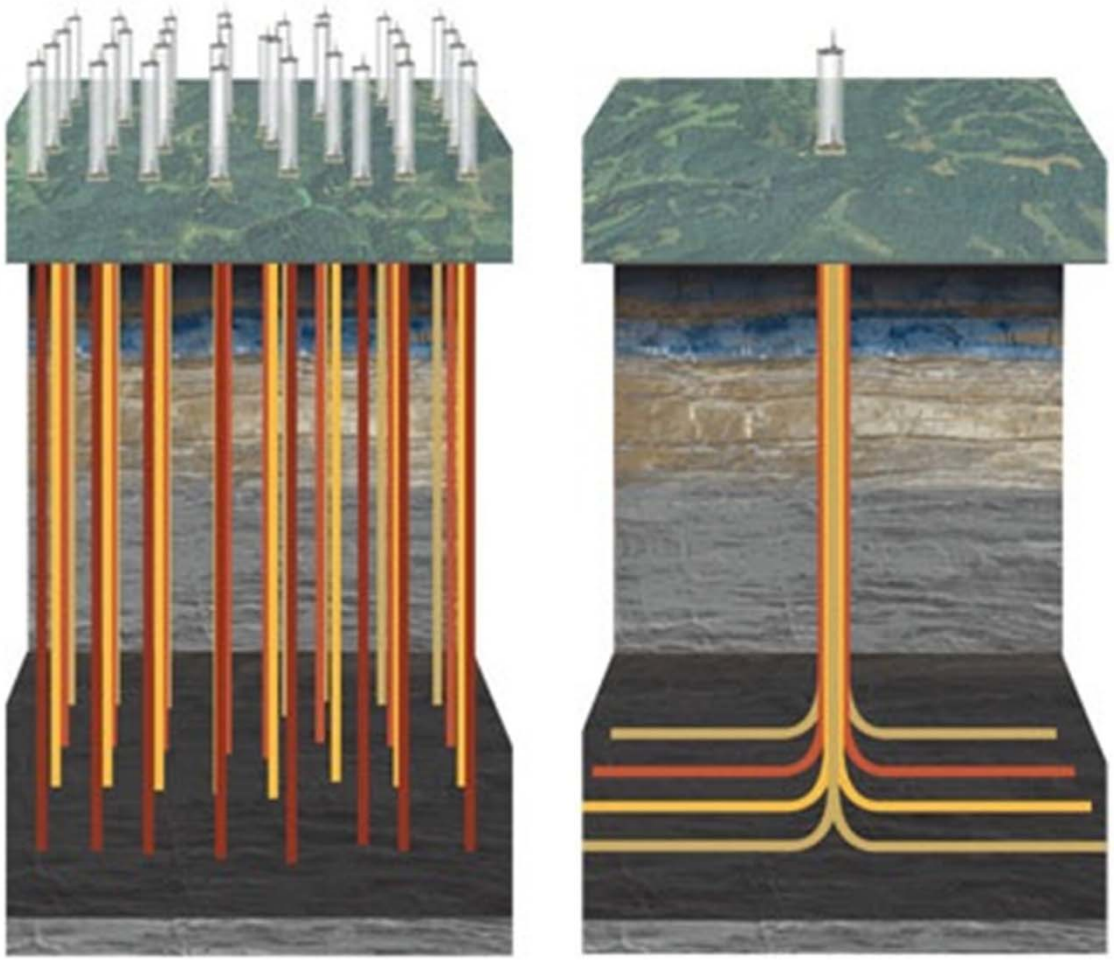
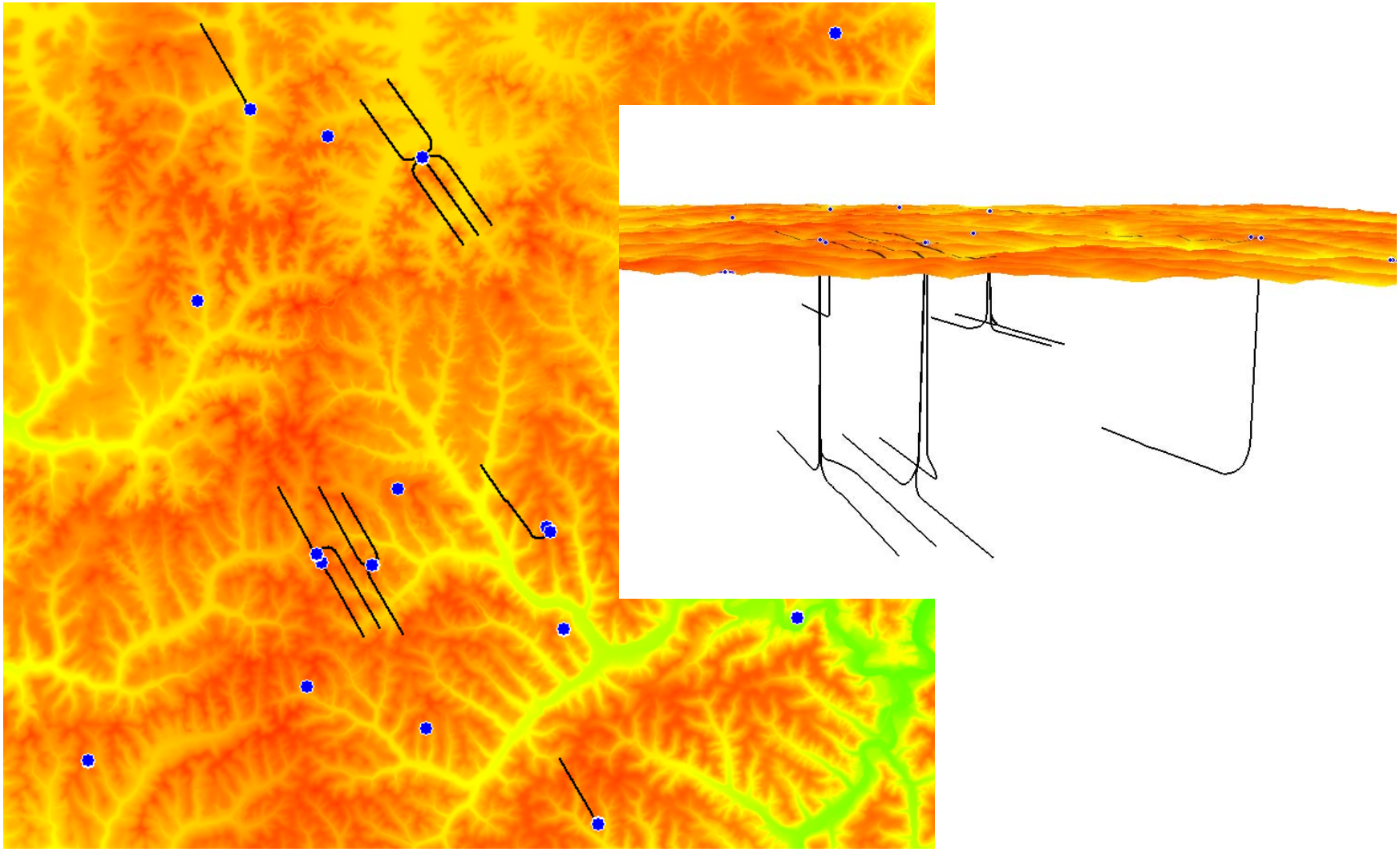


Traditional Vertical Well Spacing:
32 Separate Padsites Needed For 32 Wells.

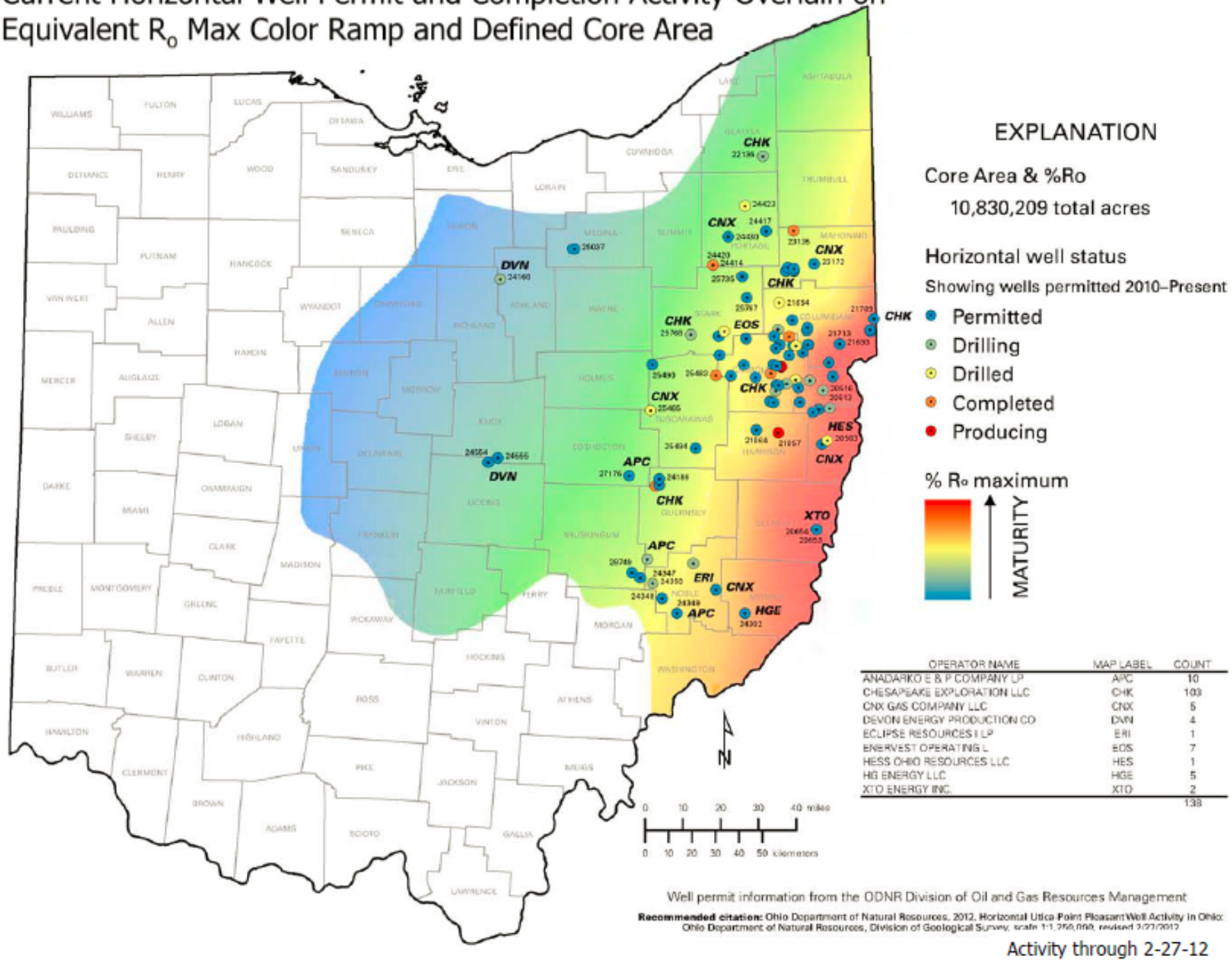
Idealized Horizontal Well Spacing:
1 Padsite Yields Up To 32 Wells.

Horizontal Well Development

Ohio Oil and Gas Association



Current Horizontal Well Permit and Completion Activity Overlain on Equivalent R_o Max Color Ramp and Defined Core Area



OPERATOR NAME	MAP LABEL	COUNT
ANADARKO E & P COMPANY LP	APC	10
CHESAPEAKE EXPLORATION LLC	CHK	103
CNX GAS COMPANY LLC	CNX	5
DEVON ENERGY PRODUCTION CO	DVN	4
ECLIPSE RESOURCES I LP	ERI	1
ENERVEST OPERATING L	EOS	7
HESS OHIO RESOURCES LLC	HES	1
HG ENERGY LLC	HGE	5
XTO ENERGY INC.	XTO	2
		138

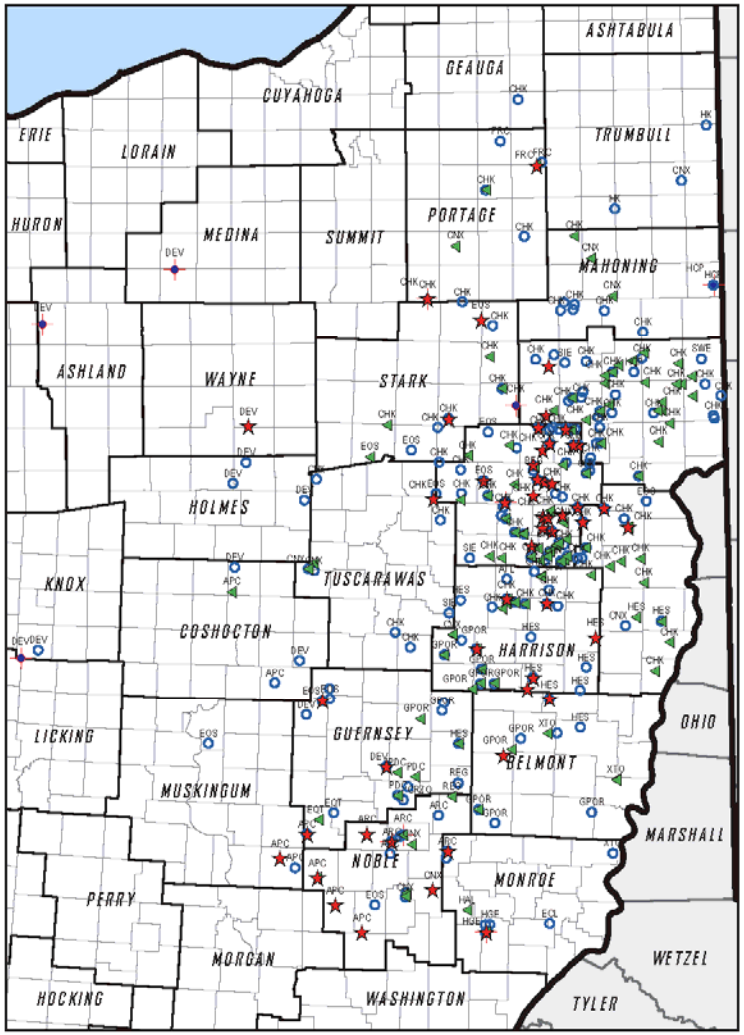
Well permit information from the ODNR Division of Oil and Gas Resources Management

Recommended citation: Ohio Department of Natural Resources, 2012, Horizontal Utica-Point Pleasant Well Activity in Ohio: Ohio Department of Natural Resources, Division of Geological Survey, scale 1:1,250,000, revised 3/27/2012

Activity through 2-27-12

Utica Permit Activity

Ohio Oil and Gas Association



UTICA HORIZONTAL WELL STATUS THROUGH 3/2/2013

- PERMITTED OR NOT DRILLED (286)
- PRODUCING (73)
- DRILLED, DRILLING OR INACTIVE (173)
- PLUGGED (11)

OPERATOR	LBL	PROD	PMT	DRLG	DRLD	PLUG	INAC	NDRD	TOT
ANADARKO E & P ONSHORE LLC	APC	6	4	1	1	0	0	0	12
ANTERO RES APPALACHIAN CORP	ARC	3	11	1	1	2	0	0	18
ATLAC NOBLE LLC	ATL	0	5	0	0	0	0	0	5
CHEASPEAKE EXPLORATION LLC	CHK	49	162	2	125	3	1	4	346
CNX GAS COMPANY LLC	CNX	1	9	3	7	0	0	1	21
CARRIZO (UTICA) LLC	CRZO	0	2	0	0	0	0	0	2
CHEVRON APPALACHIA LLC	CVX	0	0	0	2	0	0	0	2
DEVON ENERGY PRODUCTION CO	DEV	2	6	0	0	3	0	2	13
ECLIPSE RESOURCES I LP	ECL	0	1	0	0	0	0	0	1
ENERVEST OPERATING LLC	EOS	3	12	0	1	0	0	0	16
EQT PRODUCTION COMPANY	EQT	0	2	0	1	0	0	0	3
MOUNTAINEER KEYSTONE LLC	FRC	1	5	0	1	0	0	0	7
GULFPORT ENERGY CORPOTATION	GPOR	3	18	4	5	0	0	1	31
HALL DRILLING LLC (OIL & GAS)	HAL	0	0	1	0	0	0	0	1
HILCORP ENERGY	HCP	0	2	0	0	1	0	0	3
HESS OHIO RESOURCES LLC	HES	3	13	1	2	0	0	0	19
HG ENERGY	HGE	1	10	1	0	2	2	0	16
HALCON OPERATING COMPANY	HK	0	2	0	0	0	0	0	2
PETROLEUM DEVELOPMENT CORP	PDC	0	1	1	2	0	0	0	4
R E GAS DEVELOPMENT LLC	REG	1	8	0	4	0	0	0	13
SIERRA RESOURCES LLC	SIE	0	3	0	0	0	0	0	3
SWEPI LP	SWE	0	1	0	0	0	0	0	1
XTO ENERGY INC.	XTO	0	1	1	2	0	0	0	4
	TOTALS	73	278	16	154	11	3	8	543

KEY	DESCRIPTION
DRLD	DRILLED
DRLG	DRILLING
INAC	INACTIVE
NDRD	NOT DRILLED
PMT	PERMITTED
PLUG	PLUGGED
PROD	PRODUCING

N

0 10 20
Miles

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www.mackex.com

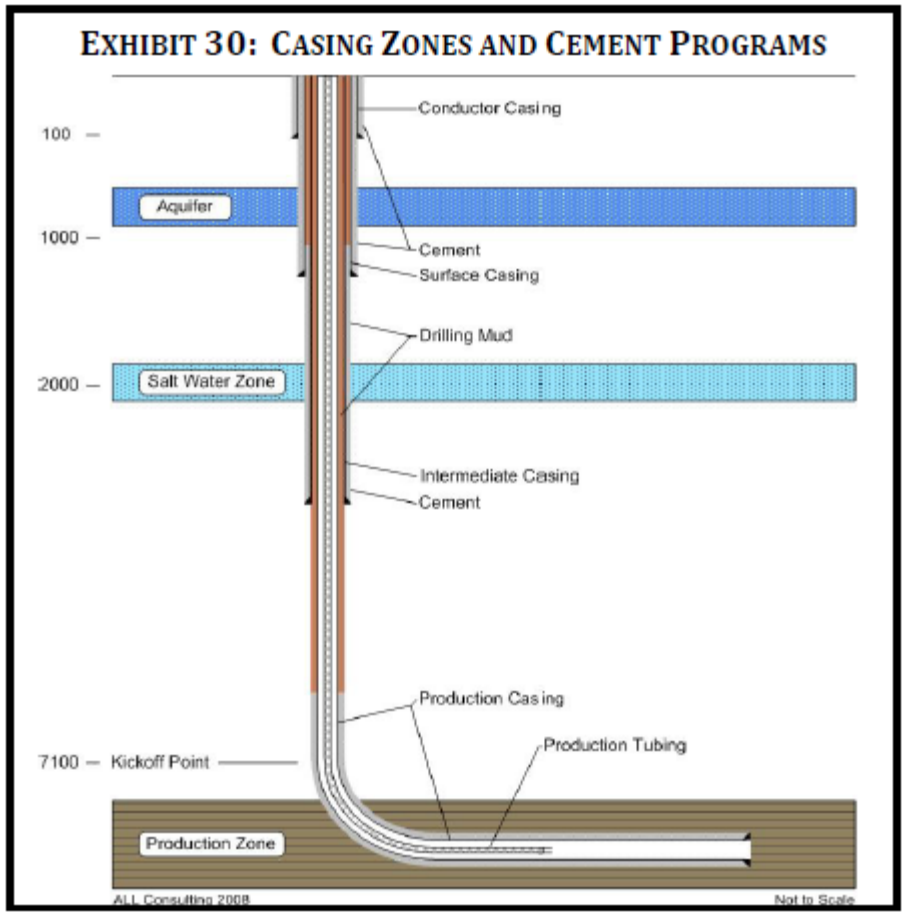
Utica Well Status

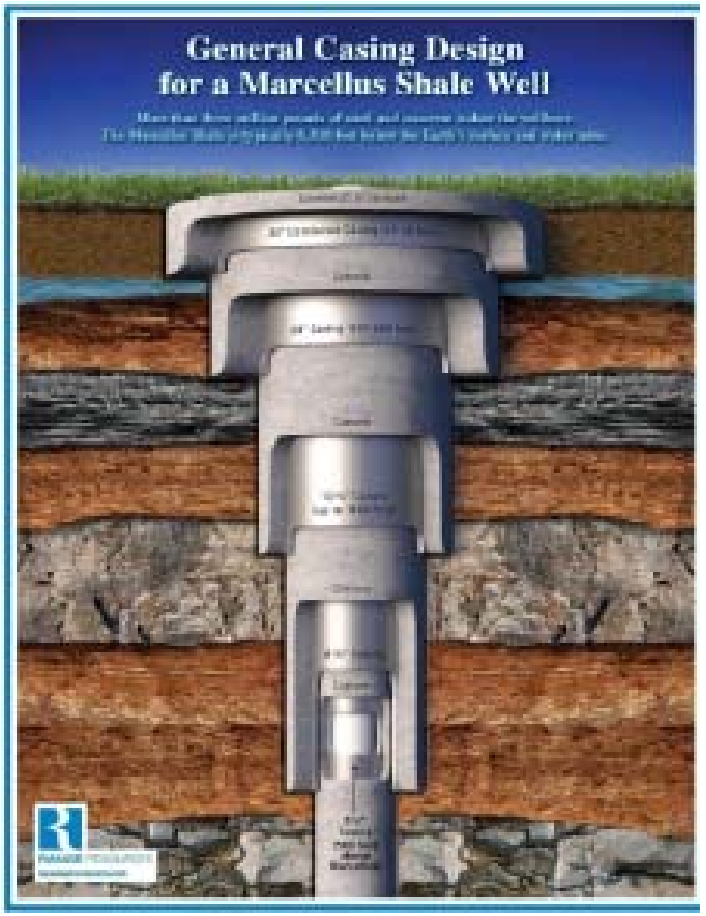
Ohio Oil and Gas Association

OPERATOR	LBL	PROD	PMT	DRLG	DRLD	PLUG	INAC	NDRD	TOT
ANADARKO E & P ONSHORE LLC	APC	6	4	1	1	0	0	0	12
ANTERO RES APPALACHIAN CORP	ARC	3	11	1	1	2	0	0	18
ATLAS NOBLE LLC	ATL	0	5	0	0	0	0	0	5
CHEASPEAKE EXPLORATION LLC	CHK	49	162	2	125	3	1	4	346
CNX GAS COMPANY LLC	CNX	1	9	3	7	0	0	1	21
CARRIZO (UTICA) LLC	CRZO	0	2	0	0	0	0	0	2
CHEVRON APPALACHIA LLC	CVX	0	0	0	2	0	0	0	2
DEVON ENERGY PRODUCTION CO	DEV	2	6	0	0	3	0	2	13
ECLIPSE RESOURCES I LP	ECL	0	1	0	0	0	0	0	1
ENERVEST OPERATING LLC	EOS	3	12	0	1	0	0	0	16
EQT PRODUCTION COMPANY	EQT	0	2	0	1	0	0	0	3
MOUNTAINEER KEYSTONE LLC	FRC	1	5	0	1	0	0	0	7
GULFPORT ENERGY CORPOTATION	GPOR	3	18	4	5	0	0	1	31
HALL DRILLING LLC (OIL & GAS)	HAL	0	0	1	0	0	0	0	1
HILCORP ENERGY	HCP	0	2	0	0	1	0	0	3
HESS OHIO RESOURCES LLC	HES	3	13	1	2	0	0	0	19
HG ENERGY	HGE	1	10	1	0	2	2	0	16
HALCON OPERATING COMPANY	HK	0	2	0	0	0	0	0	2
PETROLEUM DEVELOPMENT CORP	PDC	0	1	1	2	0	0	0	4
R E GAS DEVELOPMENT LLC	REG	1	8	0	4	0	0	0	13
SIERRA RESOURCES LLC	SIE	0	3	0	0	0	0	0	3
SWEPI LP	SWE	0	1	0	0	0	0	0	1
XTO ENERGY INC.	XTO	0	1	1	2	0	0	0	4
	TOTALS	**73**	**278**	**16**	**154**	**11**	**3**	**8**	**543**

What Really Matters, Well Construction

Ohio Oil and Gas Association





Regulatory

- 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)

More Regulators, Even the EDF…

- "*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)

Parting Thoughts

Ohio Oil and Gas Association

US Demand for hydrocarbons is projected to continue growing

Saudi Arabian demand for it's 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.

Sources: STRONGER – State Review Process
www.strongerinc.org

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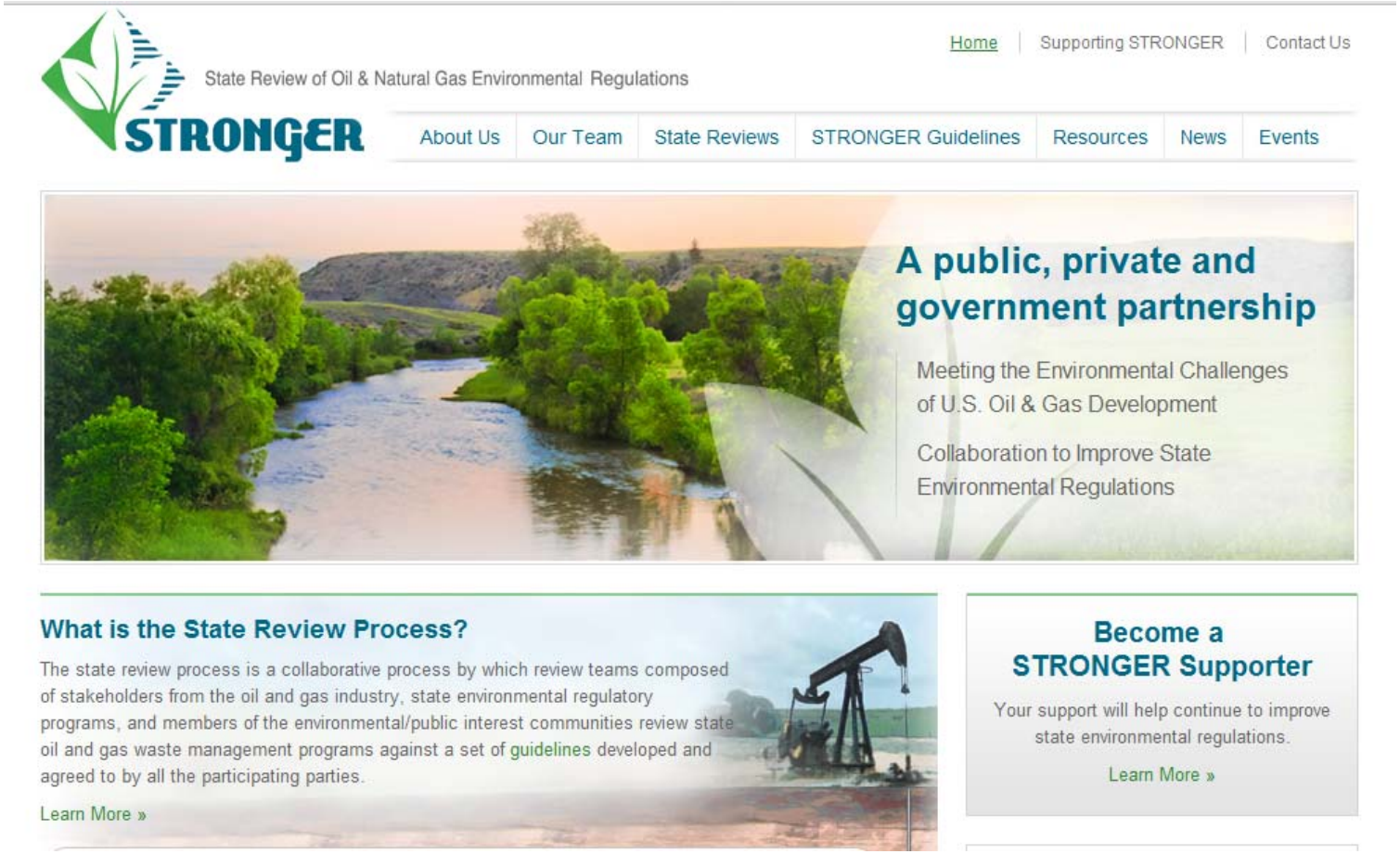
A stakeholder driven process based on consensus evaluation to improve state exploration and production environmental programs (started in the 80's and 90's)



www.fracfocus.org

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www.eidohio.org

Ohio Oil and Gas Association

www.ooga.org

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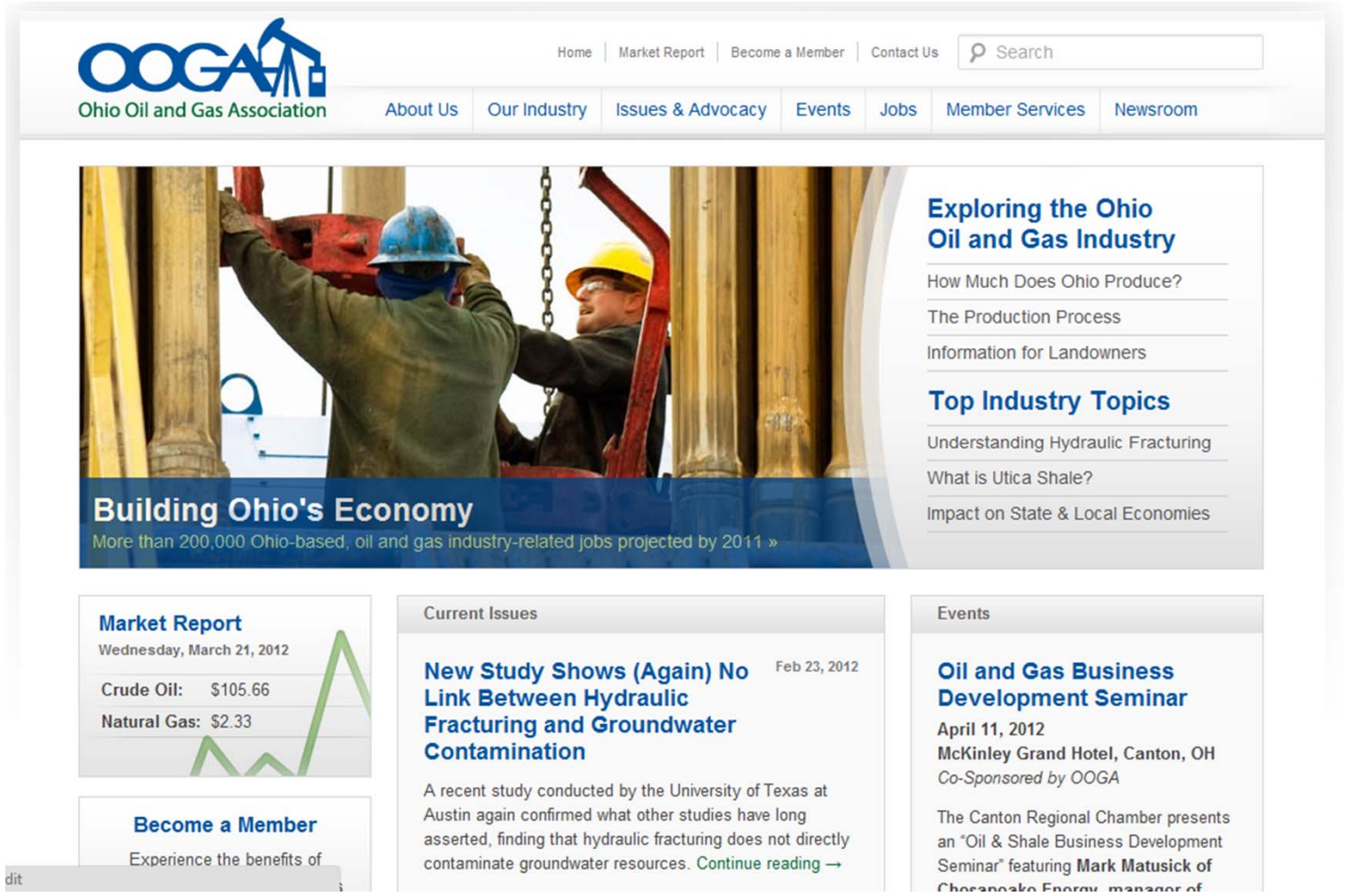

Resource: www.eia.gov

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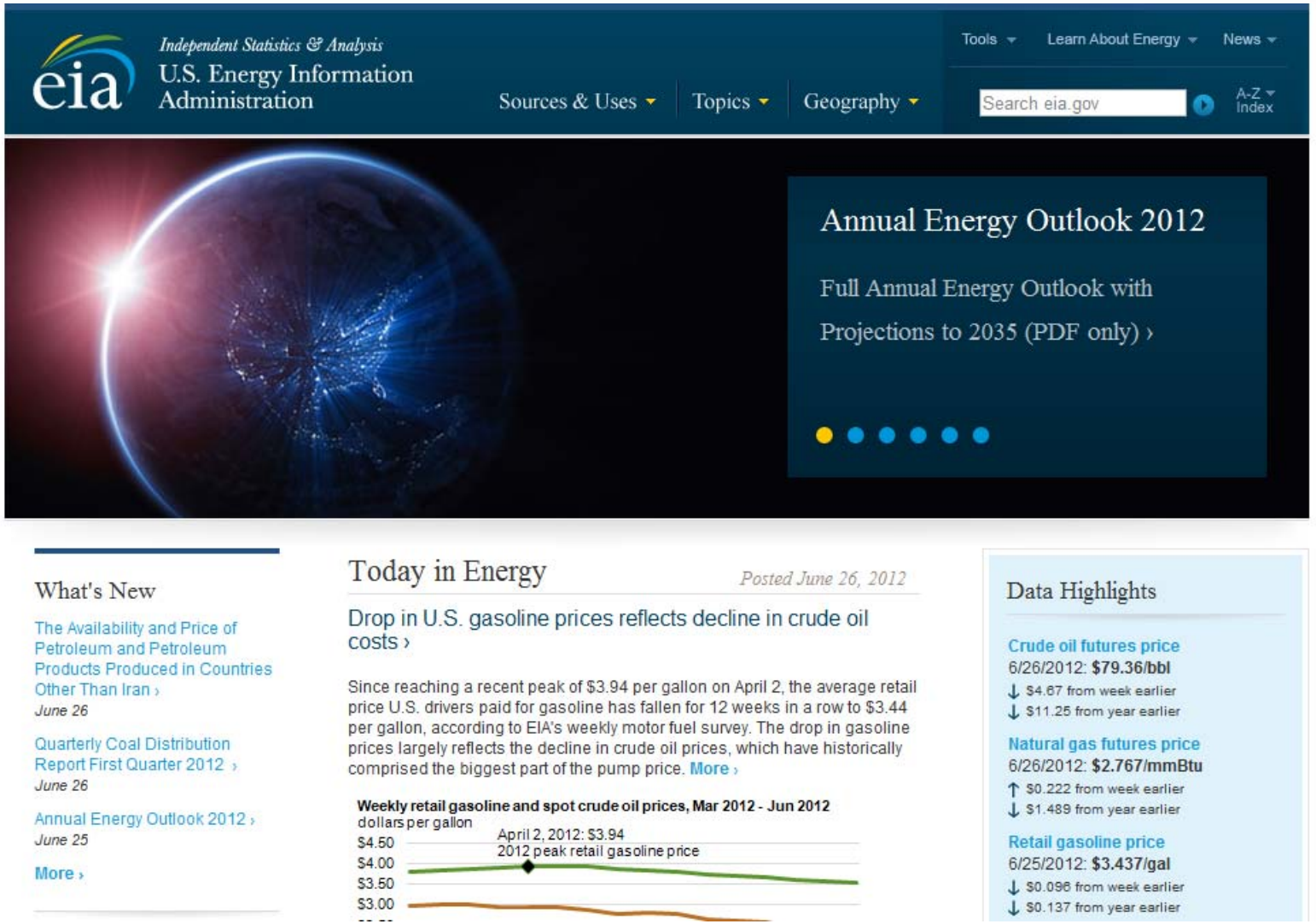

Resource: www.switchenergyproject.com

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7/12 Anchorage, AK
7/16 Houston, TX
7/17 Lafayette, CA
7/28 Katy, TX

MORE SCREENINGS →

Resource & Counterpoint
www.truthlandmovie.com

Ohio Oil and Gas Association

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?

Ohio Oil and Gas Association

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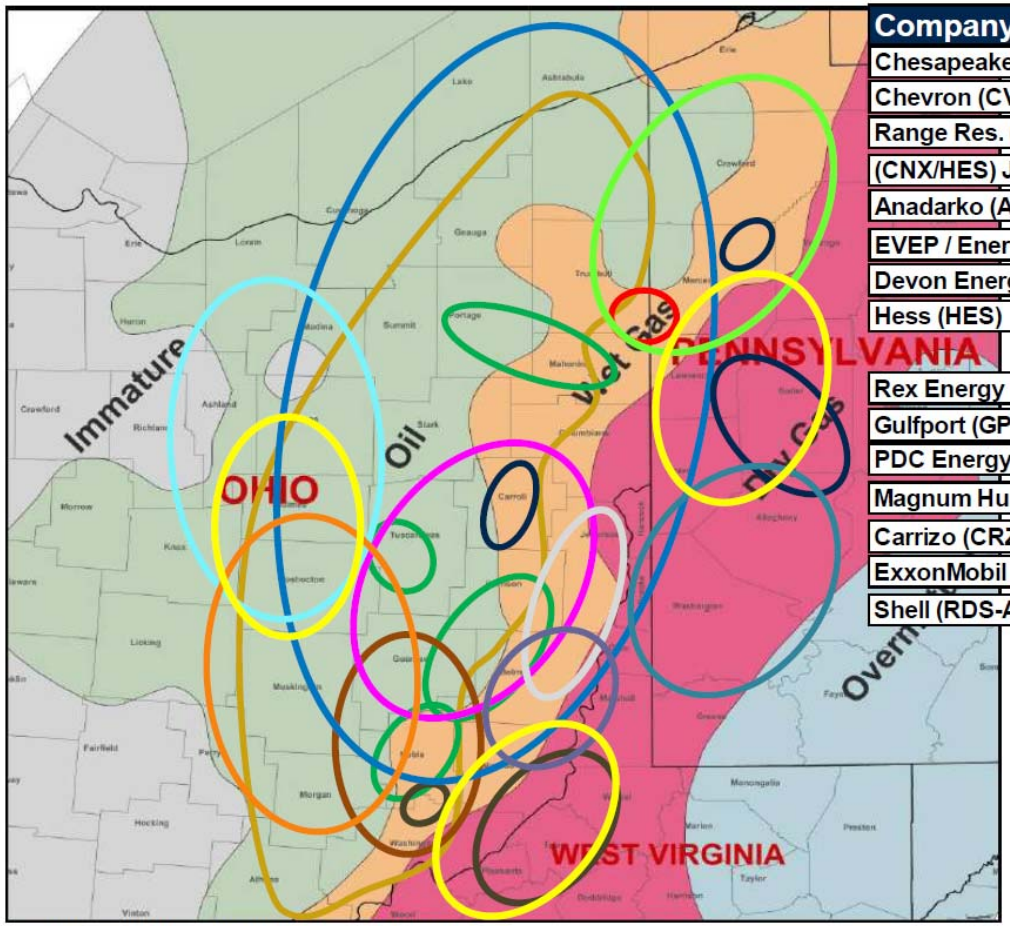
Acreage Positions



Company	Net Acres
Chesapeake (CHK)	1,360,000
Chevron (CVX)	623,000
Range Res. (RRC)	357,000
(CNX/HES) JV	200,000
Anadarko (APC)	200,000
EVEP / Enervest	159,000
Devon Energy (DVN)	110,000
Hess (HES)	85,000
Rex Energy (REXX)	58,900
Gulfport (GPOR)	62,500
PDC Energy (PETD)	40,000
Magnum Hunter(MHR)	16,000
Carrizo (CRZO)	1,500
ExxonMobil (XOM)	Unknown
Shell (RDS-A)	Unknown

Source: Company Data, modified Gulfport map, GHS Research

Energy Footprints

Ohio Oil and Gas Association

To power a town of 100,000 people, for 1 year:

Footprint	Energy Source
8 acres	20 Onshore Gas Wells
12 acres	1/30th of a Nuclear Plant
1,615 acres	724 Wind Turbines
2,907 acres	241,000 Solar Panels

Parting Thoughts

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!

Peter MacKenzie, CPG
Vice President Operations
Ohio Oil & Gas Association
P.O. Box 535
Granville, OH 43023

o: 740.587.0444
pete@ooga.org
www.ooga.org

@ooga_hq

/ooga.org