

# TCU Energy Institute



*Teaching and Research For  
Our Domestic Energy Future*



Rees Jones Hall

**TCU**  
**ENERGY**  
INSTITUTE

# The Global Dilemma

Energy

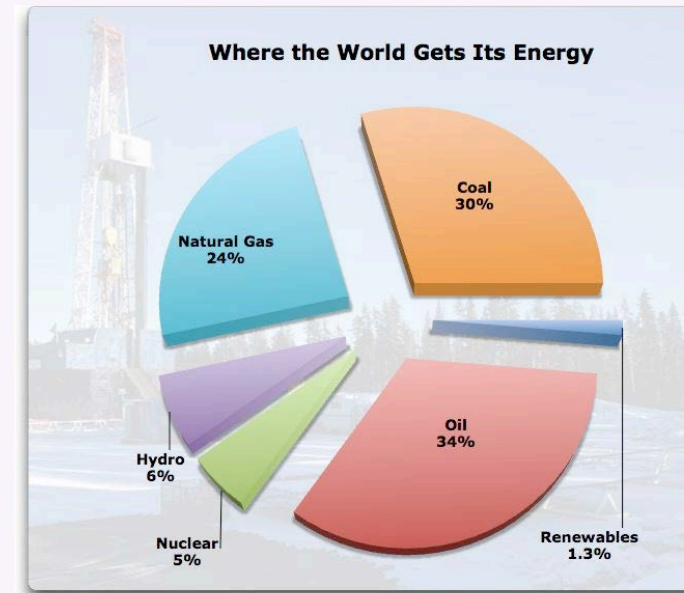


Food

Water

# \*\*Global Energy Reality\*\*

- U.S = 100 Q-BTUs  
85% FF, 8% Nuclear, 7% Renewables
- World = 500 Quads  
20% U.S., 17% China (2x), 16% Europe
- 2030....600 Quads!!!



Who will produce it?  
How will they produce it?



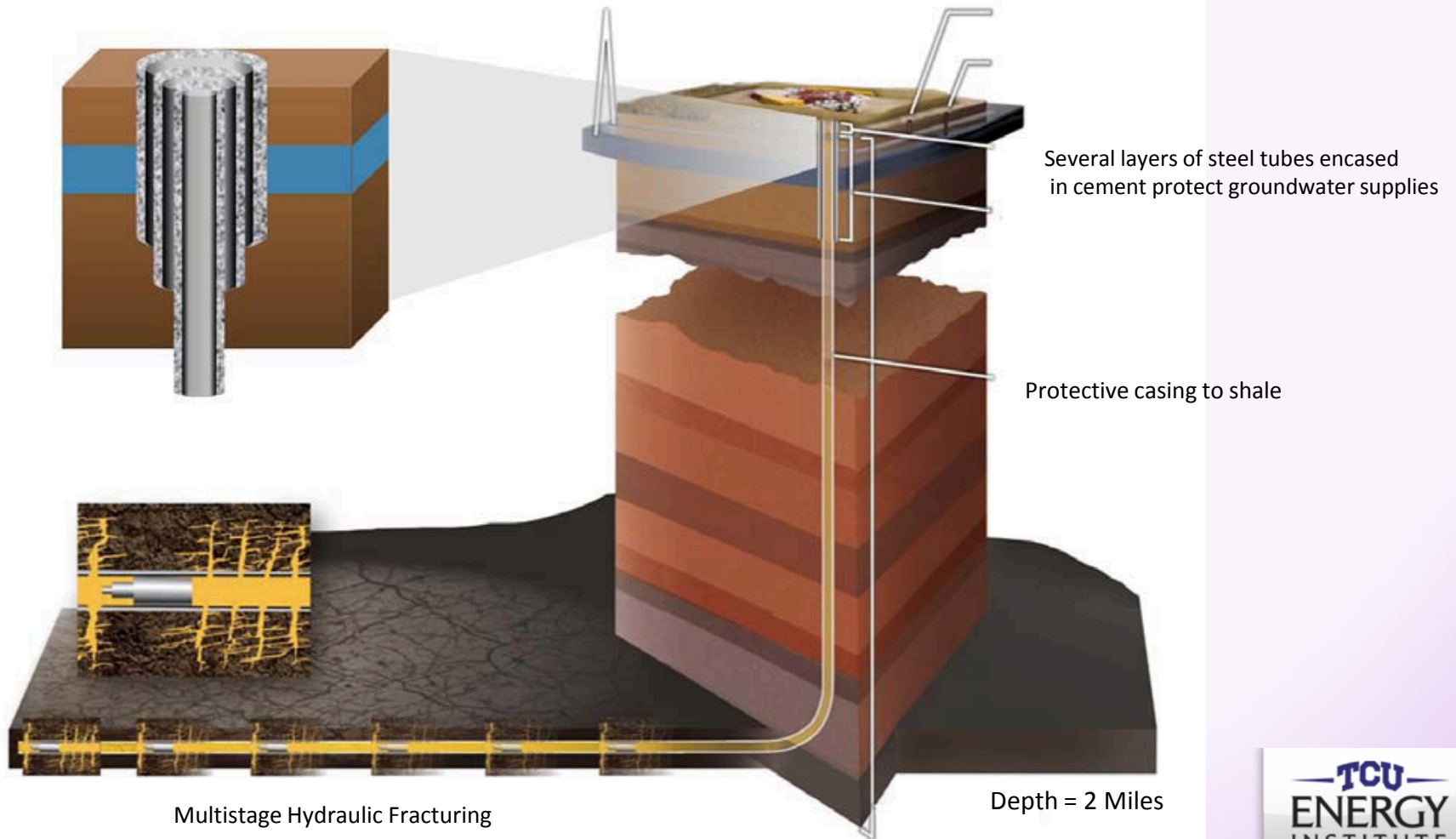
# Global Sellers-Buyers



What will the U.S. be by 2030?



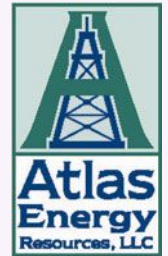
# The U.S. Game Changer!!



Multistage Hydraulic Fracturing

Depth = 2 Miles

# Domestic Independent Producers ??

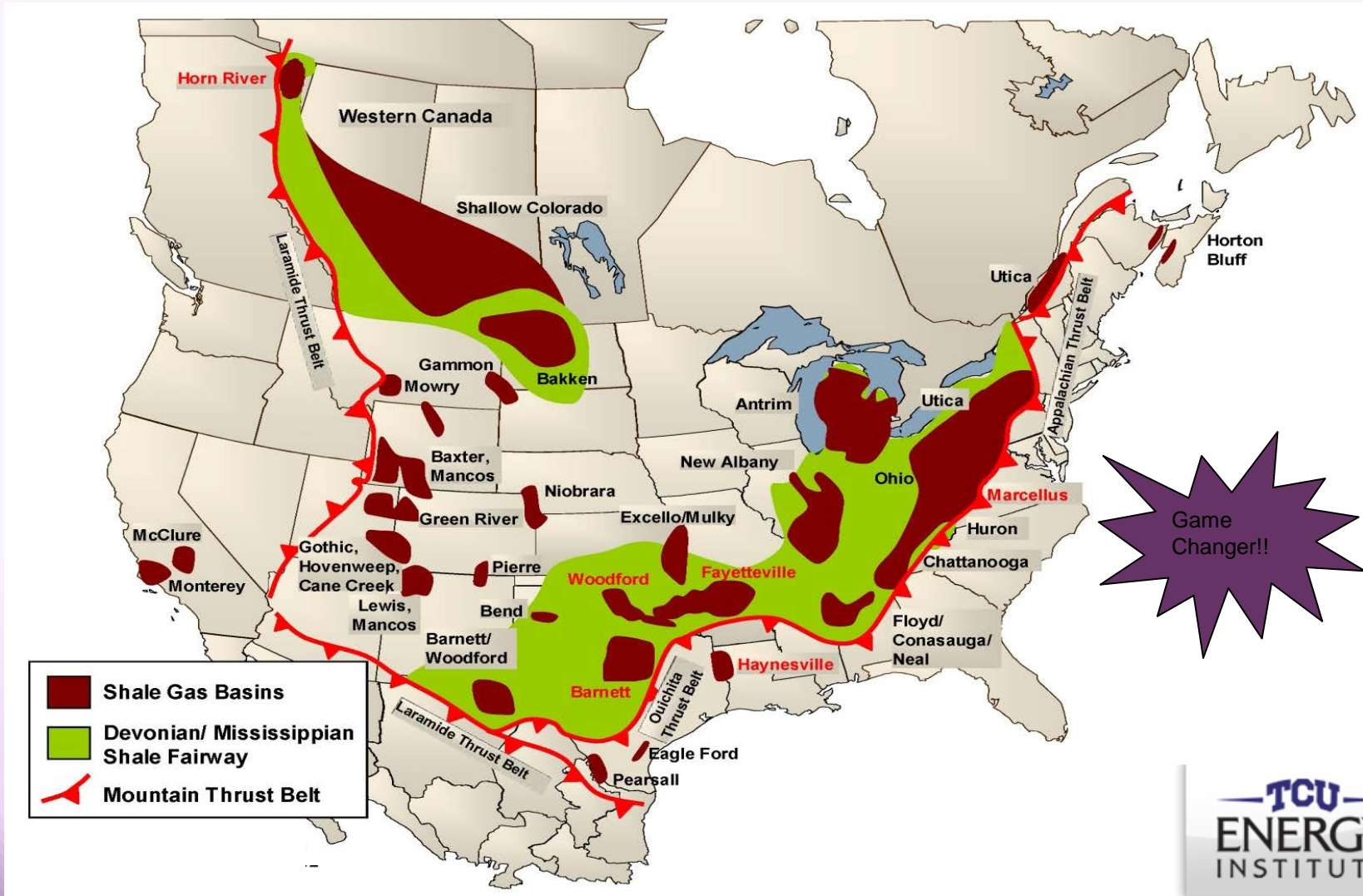


Shale Discoveries = Barnett, Haynesville, Fayetteville, Marcellus, Bakken, Eagle Ford, Niobrara, Antrim, etc



# Abundance-Energy Security

- 100+ years of secure natural gas resource



# “The Big Boys”

- Jan '10..TOTAL & Chesapeake—Now #3, \$2.5 Billion!
- March 10'...Exxon-Mobil & XTO Energy—\$41 Billion!!
- May '10..Quicksilver Resources partners with ENI (Italy)
- May '10...Shell...\$4.7 B! buys East Resources (Marcellus)
- Nov '10...Chevron acquires Atlas Energy \$4B! (Marcellus)
- Dec '10...CNOOC....1B! in Chesapeake Energy-Barnett
- Jan '11..Quicksilver lease agreement-Reliance Energy (India)
- Feb 1 '11...CNOOC-1/3 of Niobrara (Colo) with CHK
- May 5 '11...Chevron Buys Chief O&G in Marcellus
- Jan 2012...Marubeni (Japan) in Eagle Ford (52,000 acres)
- Feb 2013...CNOOC-1/2 of Chk in northern Oklahoma

Are “The Big Boys” now “In the Driver’s Seat” ?



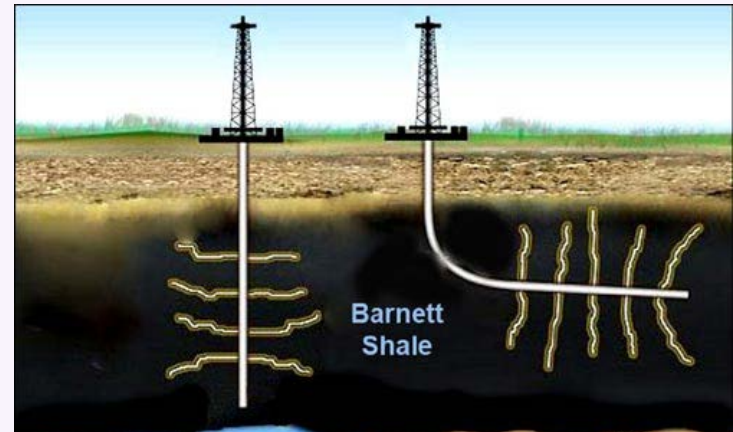


# Shale Plays: What to do?

Regulation or Incentives?



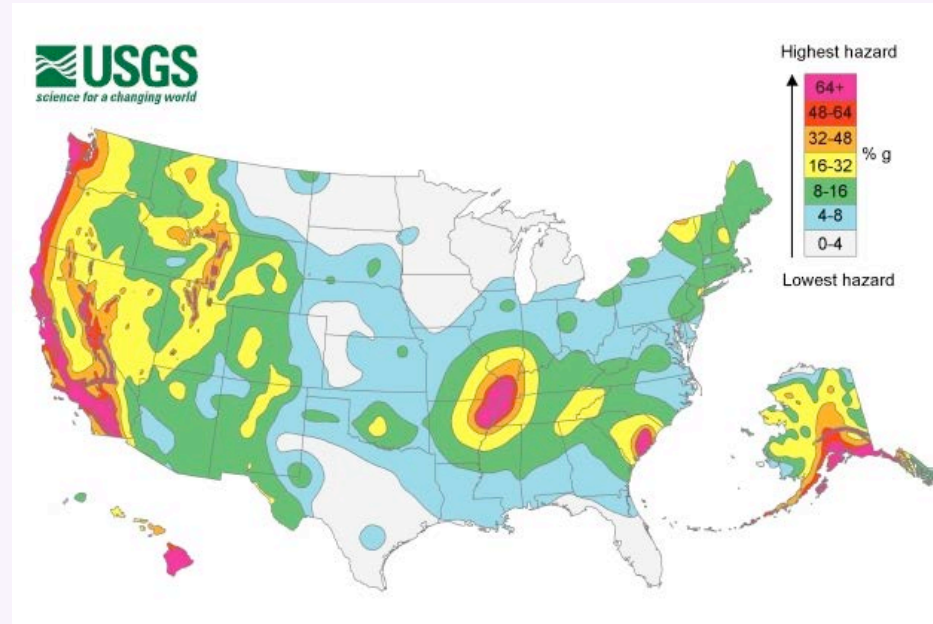
- Water Use & Recycling
- Size of Fracking Operations
- Methane Emissions
- Disposal & Earthquakes
- Well Casing & Cement Design
- Other



Remember: It's Domestic!



# What's Causing Small Scale Seismic Events in our Area??

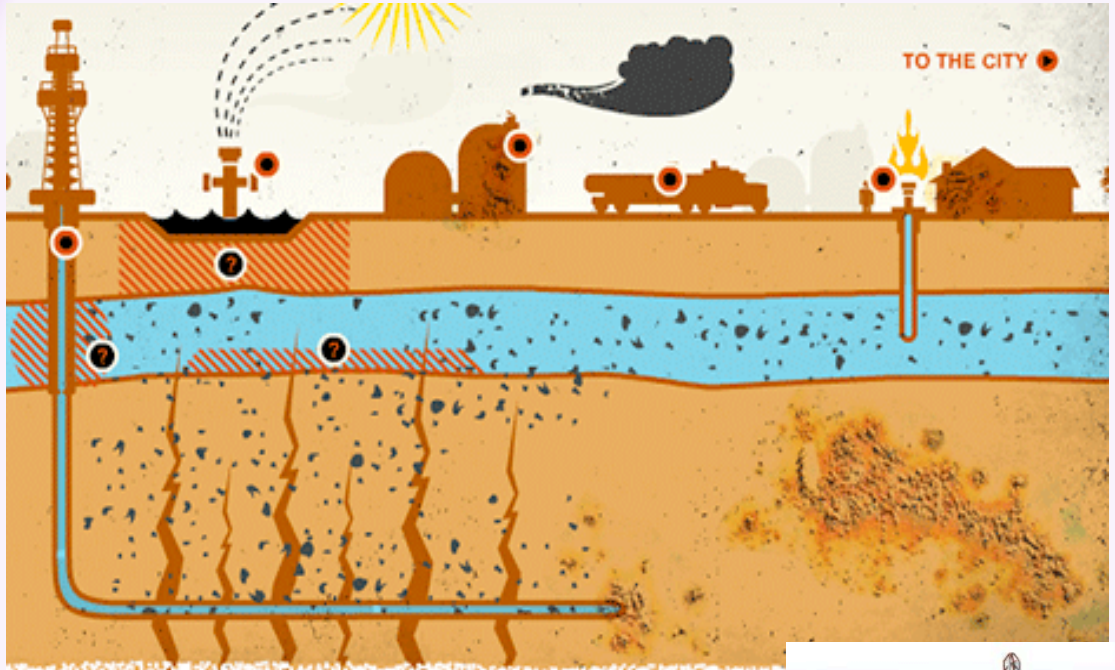


- Geology?
- Fracking?
- Disposal?
- Injection (Water & CO<sub>2</sub>)?
- Water Extraction Wells?
- Other?



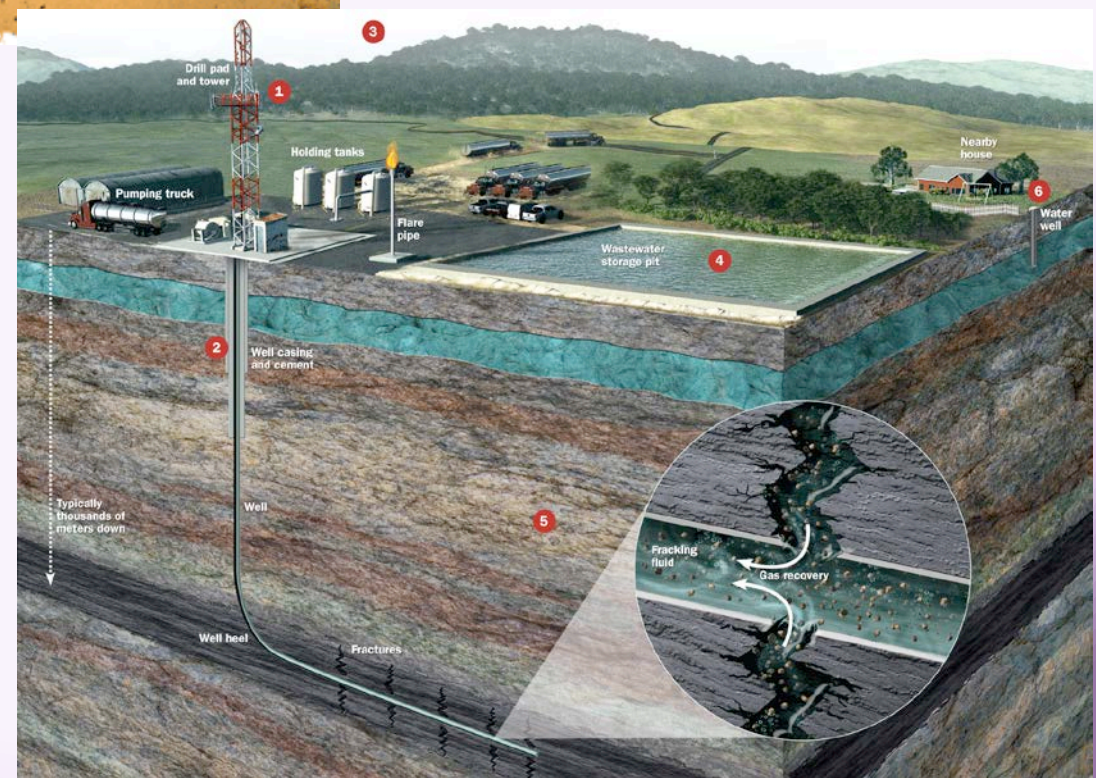


Air & Water???



# Hydraulic Fracturing???

Which is the Truth??



# Hydraulic Fracturing

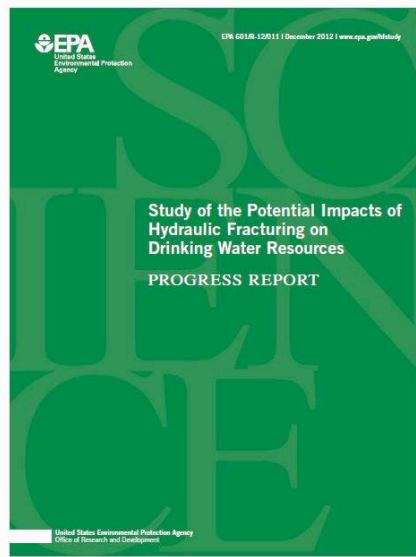


2-5 million gals per well

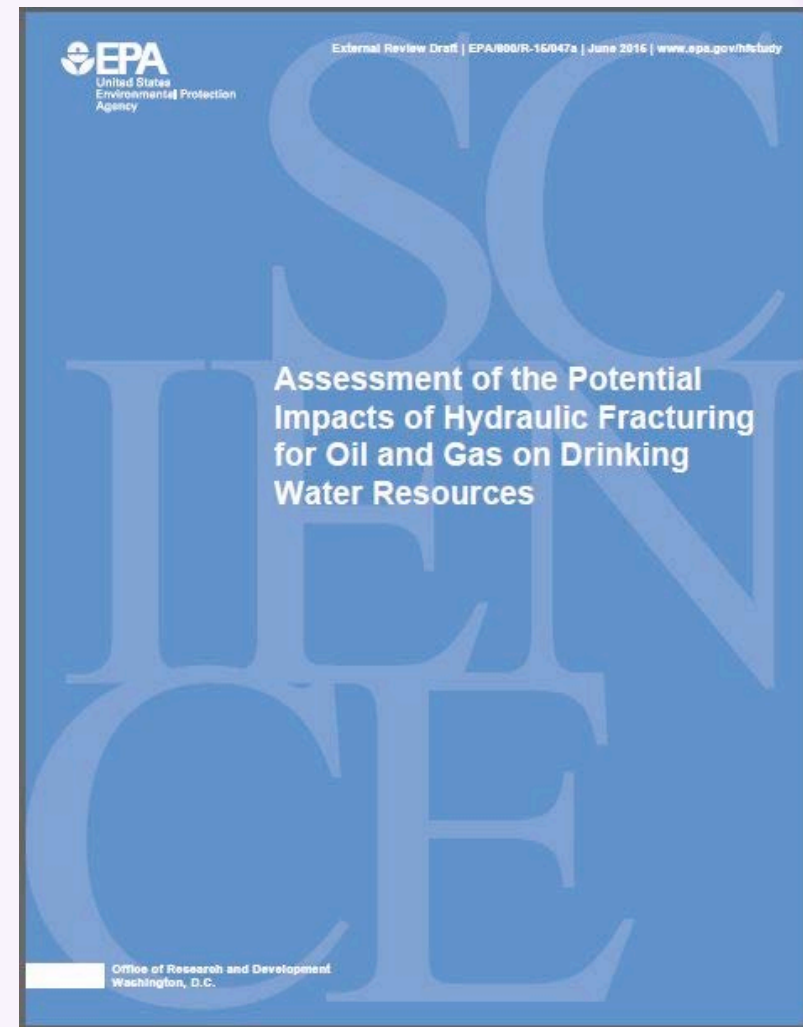


Sand as a Proppant





EPA Report 2012



EPA Report: June 2015

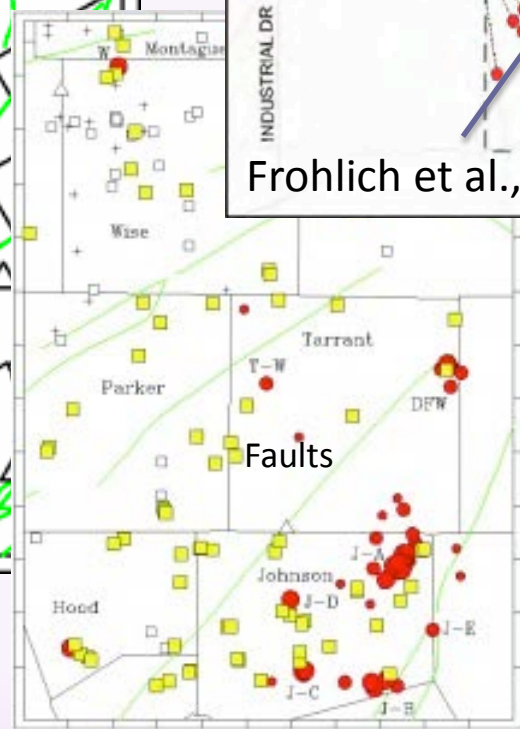
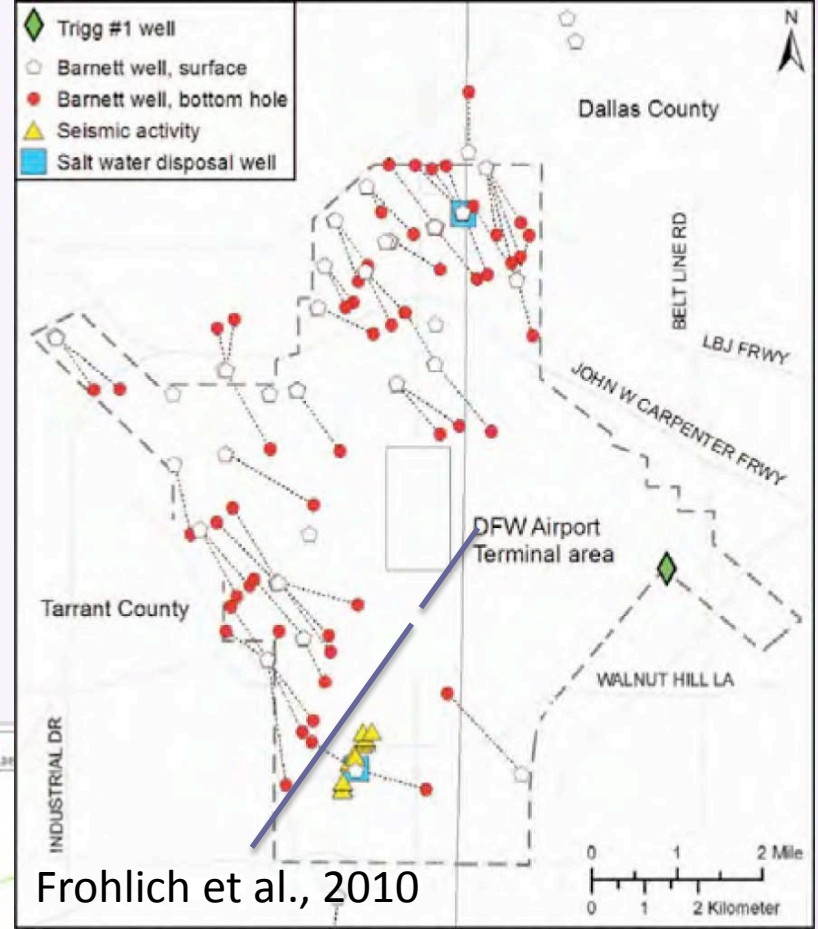
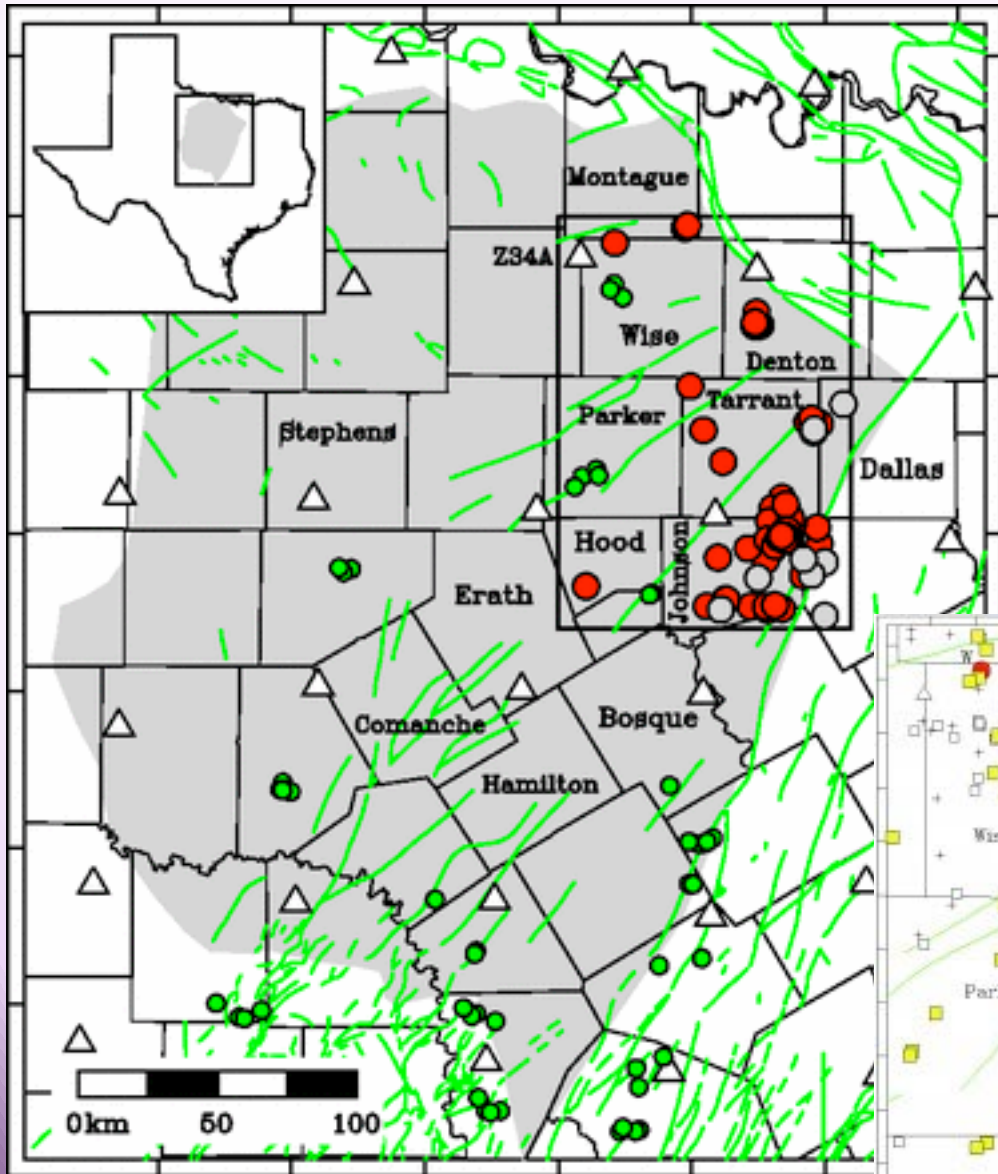
Source: [www.epa.gov/research](http://www.epa.gov/research)

“May Impact Water Use in Some Areas”

“No Evidence of Significant Impacts on Drinking Water”



# DFW Area Earthquakes 2008-09



Disposal Wells ●  
Seismic Events ●

Earthquakes began  
6 weeks after Disposal  
Well started  
Faults??

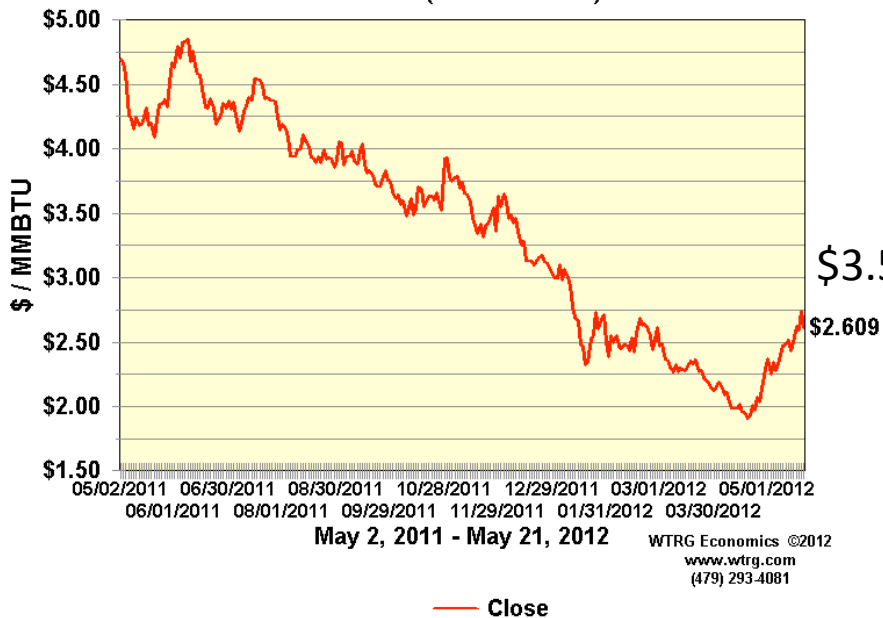
Seismic Event ●  
Disposal Wells ▲

# The Future!!



Shale Oil

NYMEX Natural Gas Futures  
Close (Front Month)

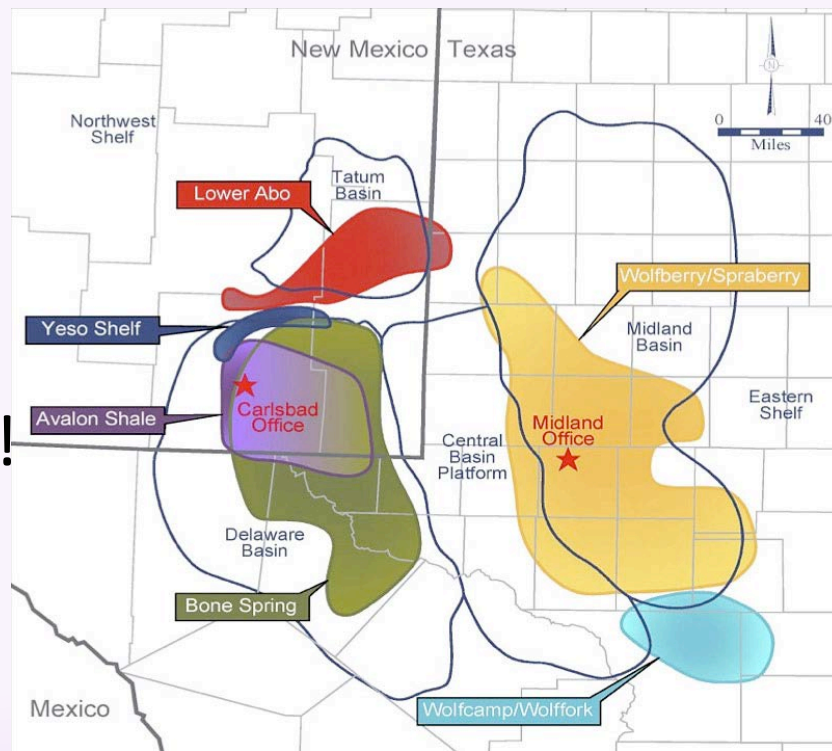


\$3.50-\$4.50

Nat Gas Prices

Alaska...Shublik Shale!

The Wolfberry!



World Oil & Gas Prices!!



# Spraberry - Stacked Pay Oil Resource Play

- Approximately 4,000' of gross pay interval from ~6,000' to 10,000'
- Comprised of 4 main traditional pay units

TARGET COMPLETION ZONES		
	"SPRABERRY" WELL	"WOLFBERRY" WELL
UPPER SPRABERRY	YES	YES
LOWER SPRABERRY	YES	YES
DEAN	YES	YES
WOLFCAMP	NO	YES

- Additional upside potential from non-traditional organic rich shale/silt zones

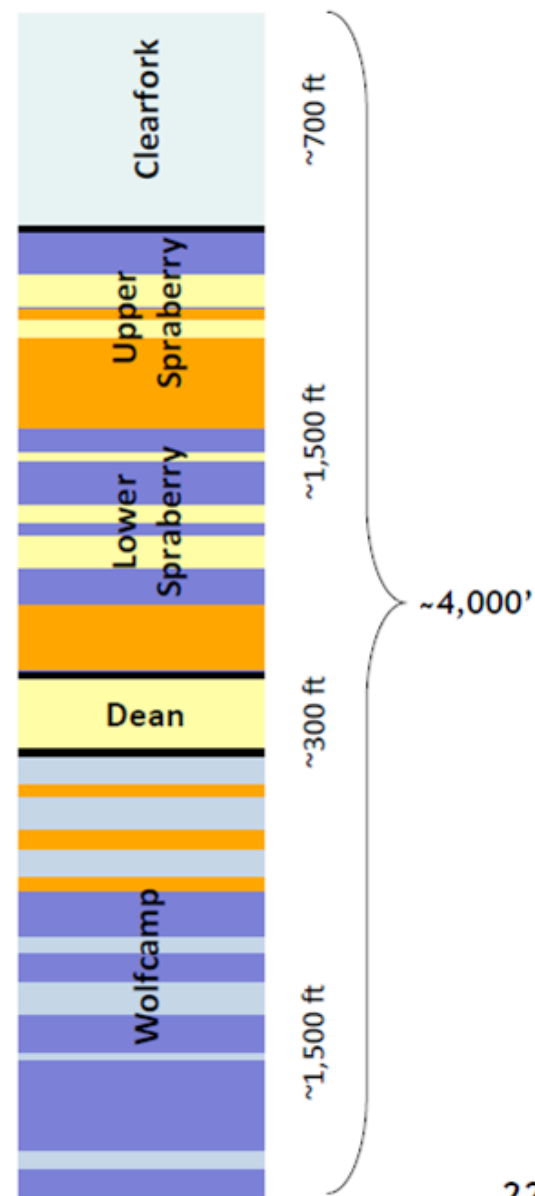
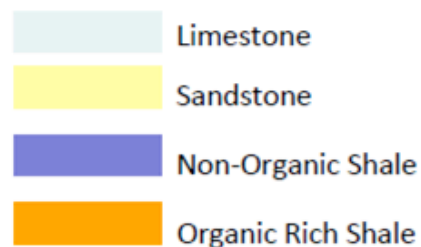


Figure 1. Map of basins with assessed shale oil and shale gas formations, as of May 2013



Source: United States basins from U.S. Energy Information Administration and United States Geological Survey; other basins from various published studies.

## Known Shales Worldwide



# Expanding Markets!!



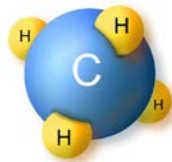
CNG

Transportation Fuel

LNG



Base Fuel-Electricity



Ultra Clean Hydrogen Source



Air Products makes the Hydrogen for the Space Shuttle  
They also made the Hydrogen Fuel Station at Worldsnest  
Hydrogen for the Space Shuttle is from Natural Gas

Air Products worlds largest supplier of hydrogen from sustainable sources  
Natural Gas  
Solar  
Wind  
Gasification  
Anaerobic Digester

Robert Plarr  
Victoria Peters  
Chris Sanders  
supports sustainable integration



Back-Up Fuel-Renewables



Clean Air-Clean Fuel For Texas!!

# Alternative Fueled Vehicles

## AFV's



# Choosing Natural Gas Vehicles

- Do we have enough natural gas?
- Do we have the infrastructure?
- What are the benefits?
- What are the costs?



# NGVs = Should we go there!!



>1,000

1.8 b gal/yr



1,000!



>5,000

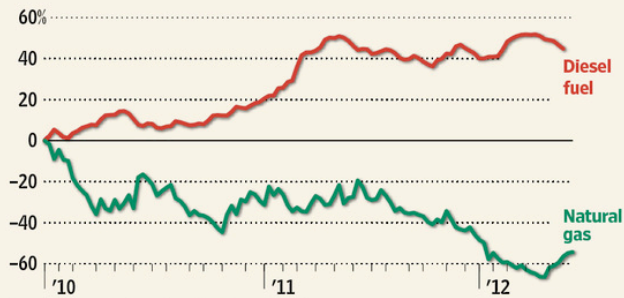
# UPS—1000 New LNG Trucks!

Building 4 New Filling Stations in:  
Knoxville-Nashville-Memphis-DFW



## Going Separate Ways

Performance of natural gas futures prices and diesel fuel spot prices.



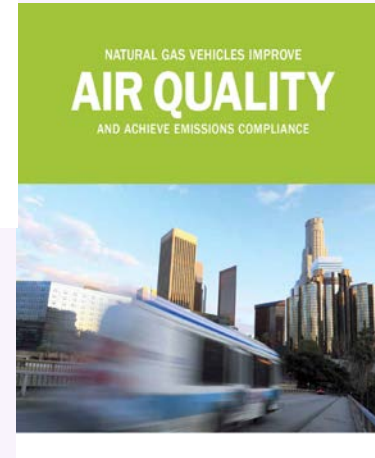
Sources: Energy Information Administration (diesel),  
WSJ Market Data Group (Nymex natural gas)

The Wall Street Journal



# NGVs: The Real “Green Vehicles”

- Natural Gas vehicles...



Reduce CO<sub>2</sub> emissions **20-30%**

Reduce CO emissions **70-90%**

Reduce NO<sub>x</sub> emissions **75-95%**

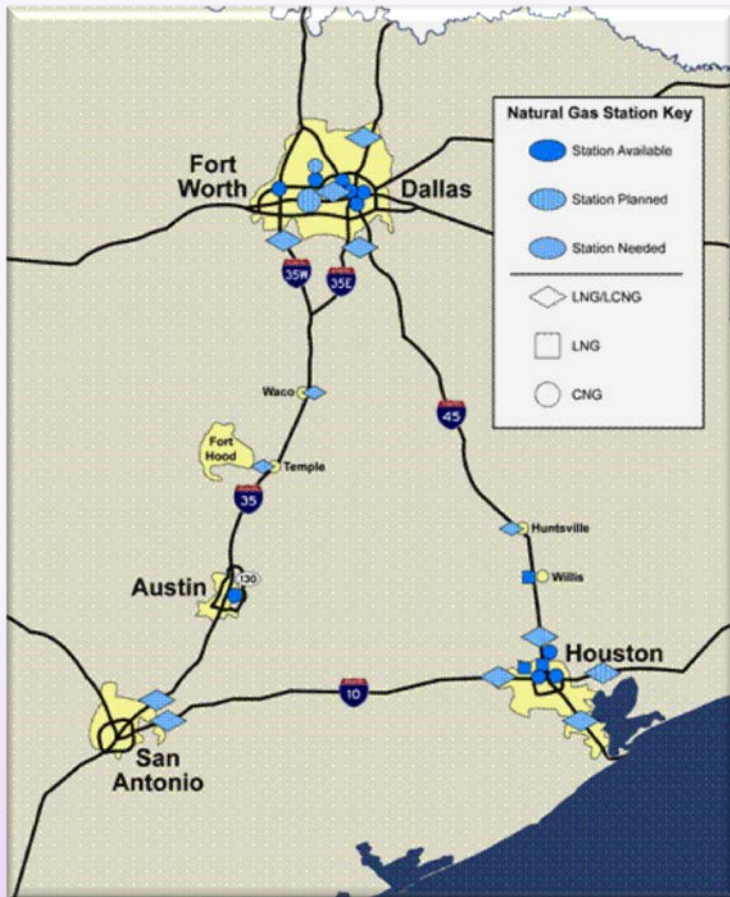
Reduce Particulate Matter emissions **90%**

Reduce VOC emissions **89%**

...compared to gasoline or diesel



# The Texas NGV Clean Transportation Triangle—10% of US Business Transportation Sector



## Texas SB-20

- 20% of TERP Money (Texas Emissions Reduction Plan)--\$20-\$30 million
- 20% for new stations offering public LNG and CNG—grants for **20 new stations**
- 80% for government rebates for fleet owners for HDVs-**500 Trucks!**

*Clean Air-Clean Fuel For Texas!!*



Metroplex NGV Consortium



# National NGV Stations

Pilot Flying J to Get Natural Gas Fueling Outlets

Leading the Pack!!



150 New NGV  
Travel Stations!!



# GE & Chesapeake "CNG In A Box" Lowers Cost!!



**\*\*GE Home Refueling Unit--\$500!!  
60 million homes already have Nat Gas!**

# Honda & Detroit



2013  
GM, Ford  
and Chrysler



2014  
F-150!!!

Since 1999



Today

Change??

Tomorrow??

# Imports

Rare Earth Elements  
"Green Technologies"

Oil



Opec--\$1B/day



China...97%



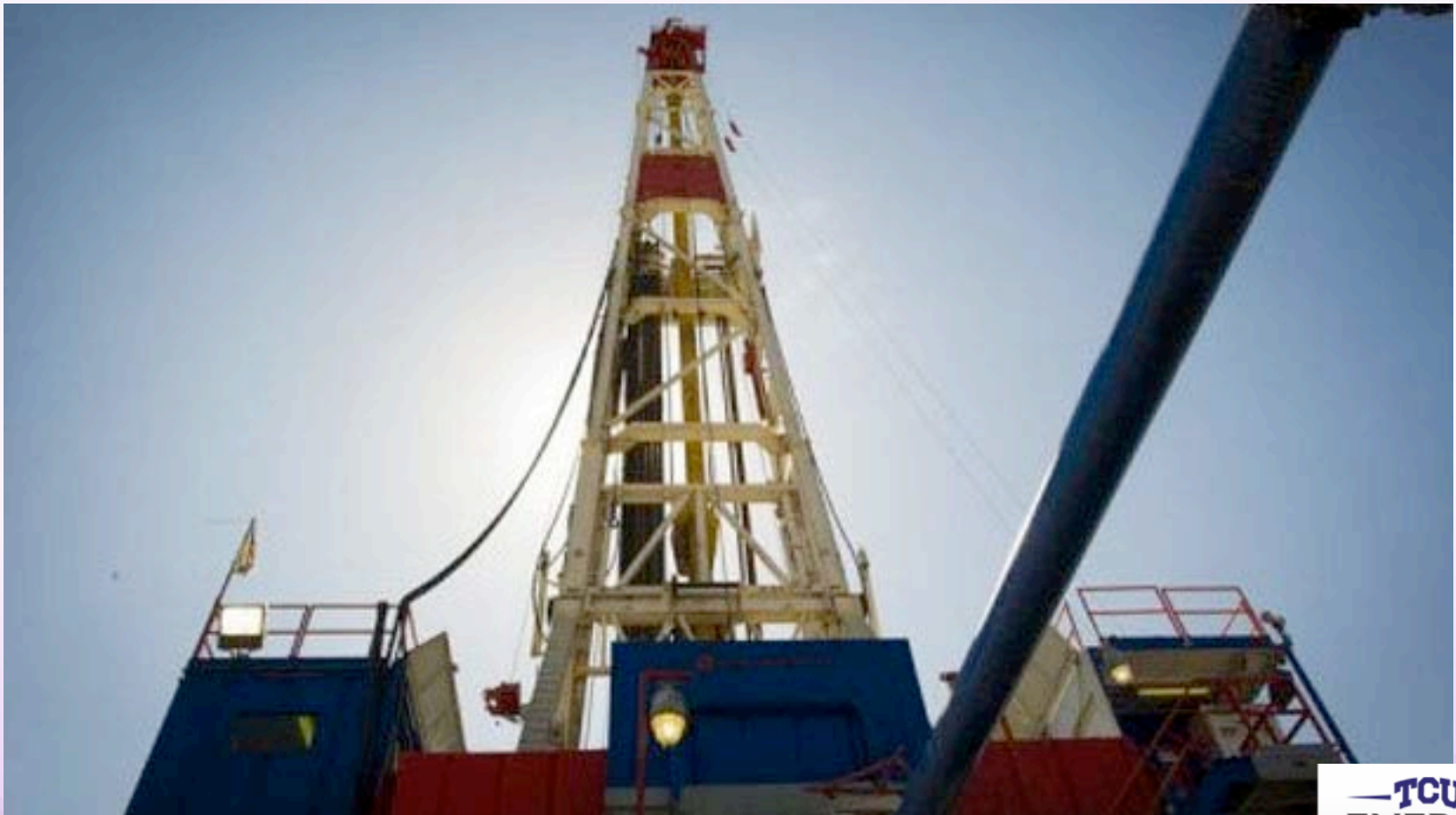
Batteries, Magnets, Control Rods, Lasers

## China's seven most prospective shale gas and shale oil basins



Source: Advanced Resources International

# U.S. surpasses Russia as world's top oil and natural gas producer with output at 25 million barrels per day...Oct 2013



# Natural Gas Exports??



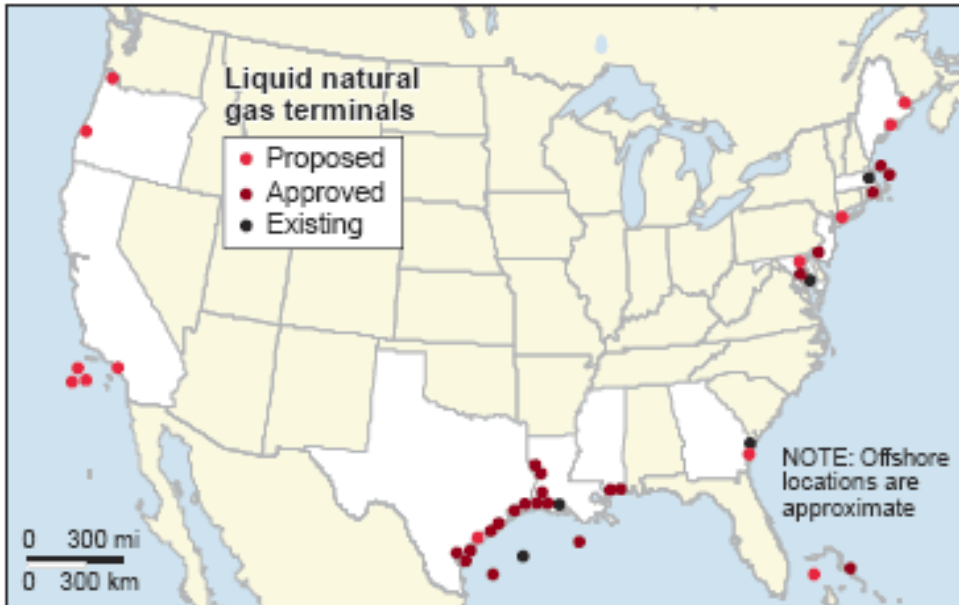
Louisiana  
Cheniere Energy

## It's a Global Play



## More LNG terminals going online

Energy companies have proposed 35 new liquid natural gas terminals, 22 of which have been approved by regulators.



## And a Global Market!!





# Nat Gas to Mexico

2012...80% gas imported was from U.S.  
New Los Ramones Pipeline  
South Texas to Guanajuato, Mexico  
**Projected = 3 billion cf/day 2015!!**

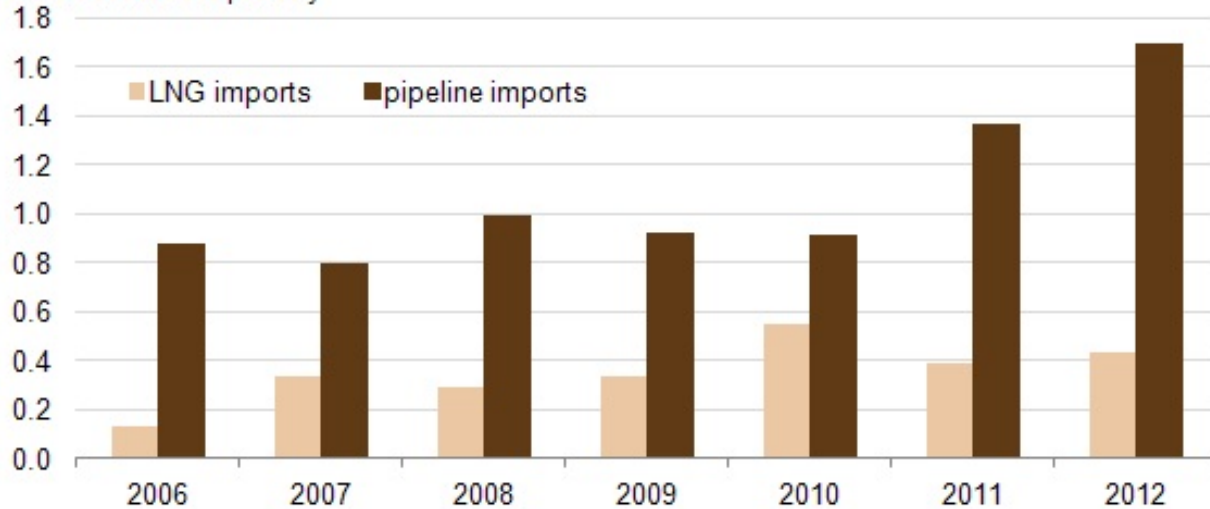
Buyer!!



Mexico natural gas imports by type

(2006-12)

billion cubic feet per day

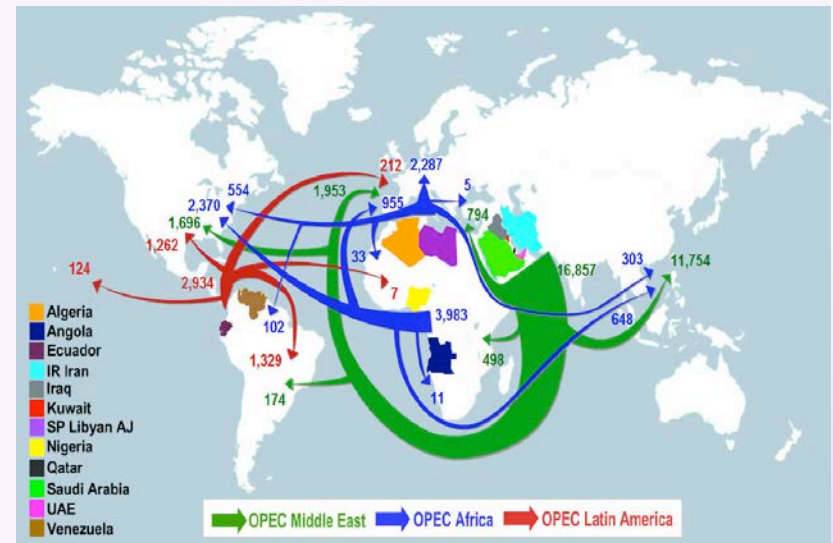
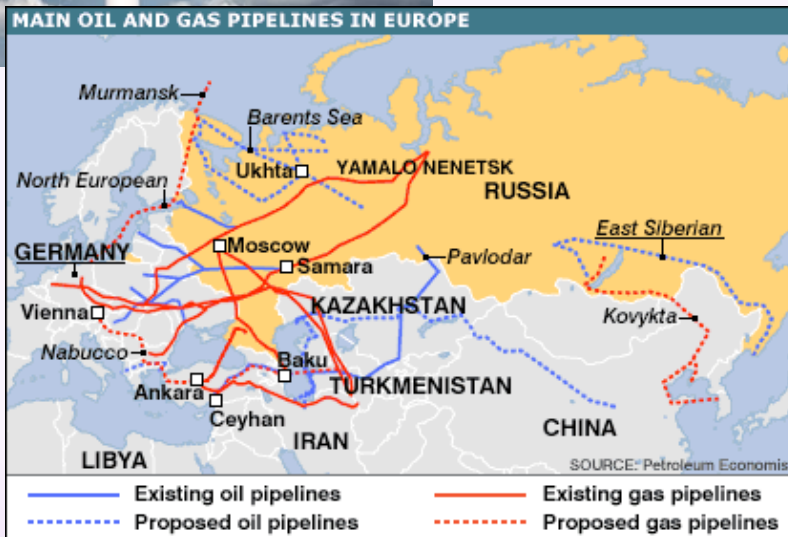


Seller!!

# Proposals to President

- Approve Keystone Pipeline
- Lift Ban On Exporting Oil (since WWII)
- Expedite Nat Gas Permits
- Implement the North American Energy Infrastructure Act—key to linking up Canada, U.S. and Mexico

# Who's against U.S. Gas Exports?

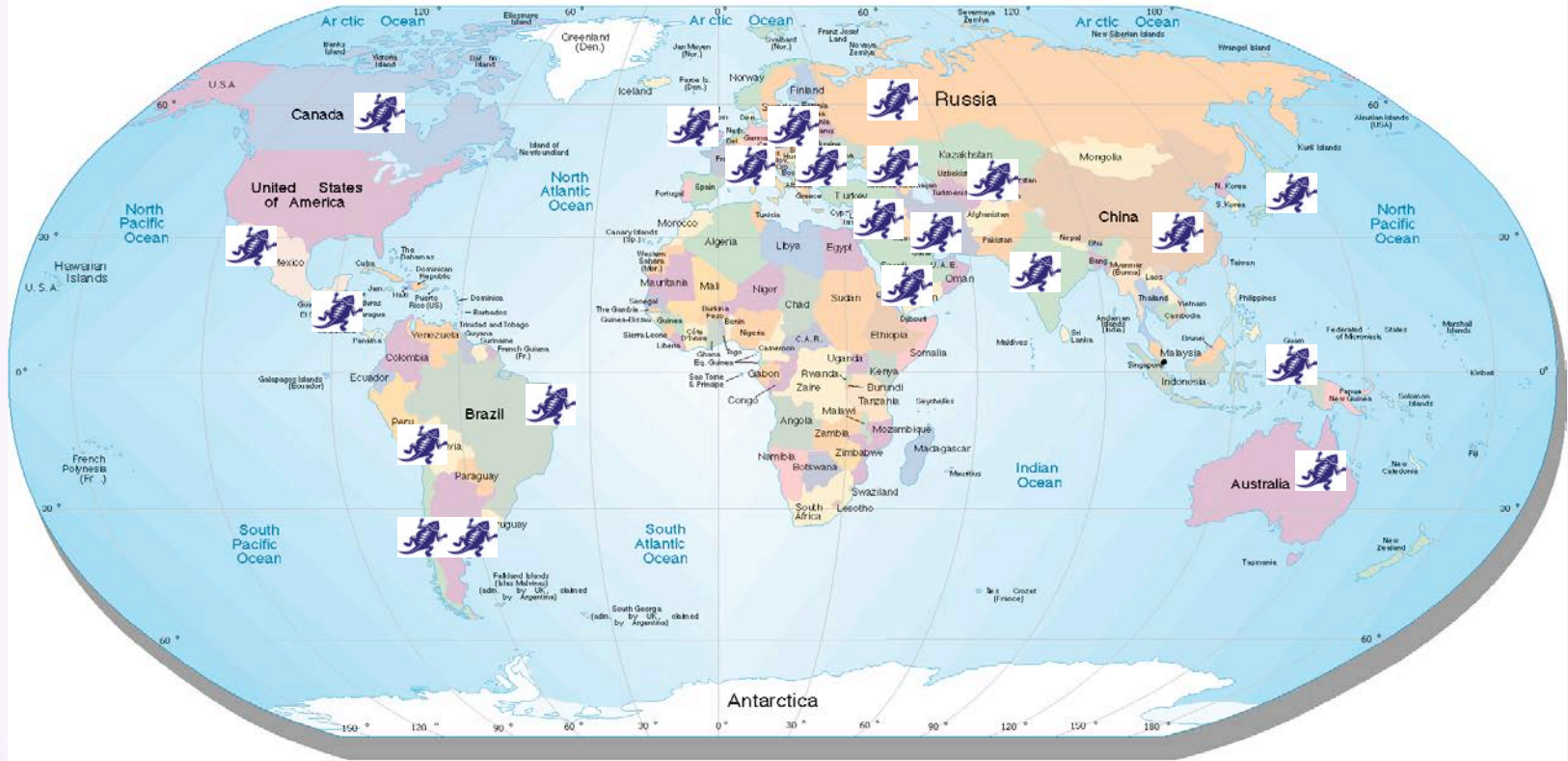


Others??

# People Want to Know More About Energy!!

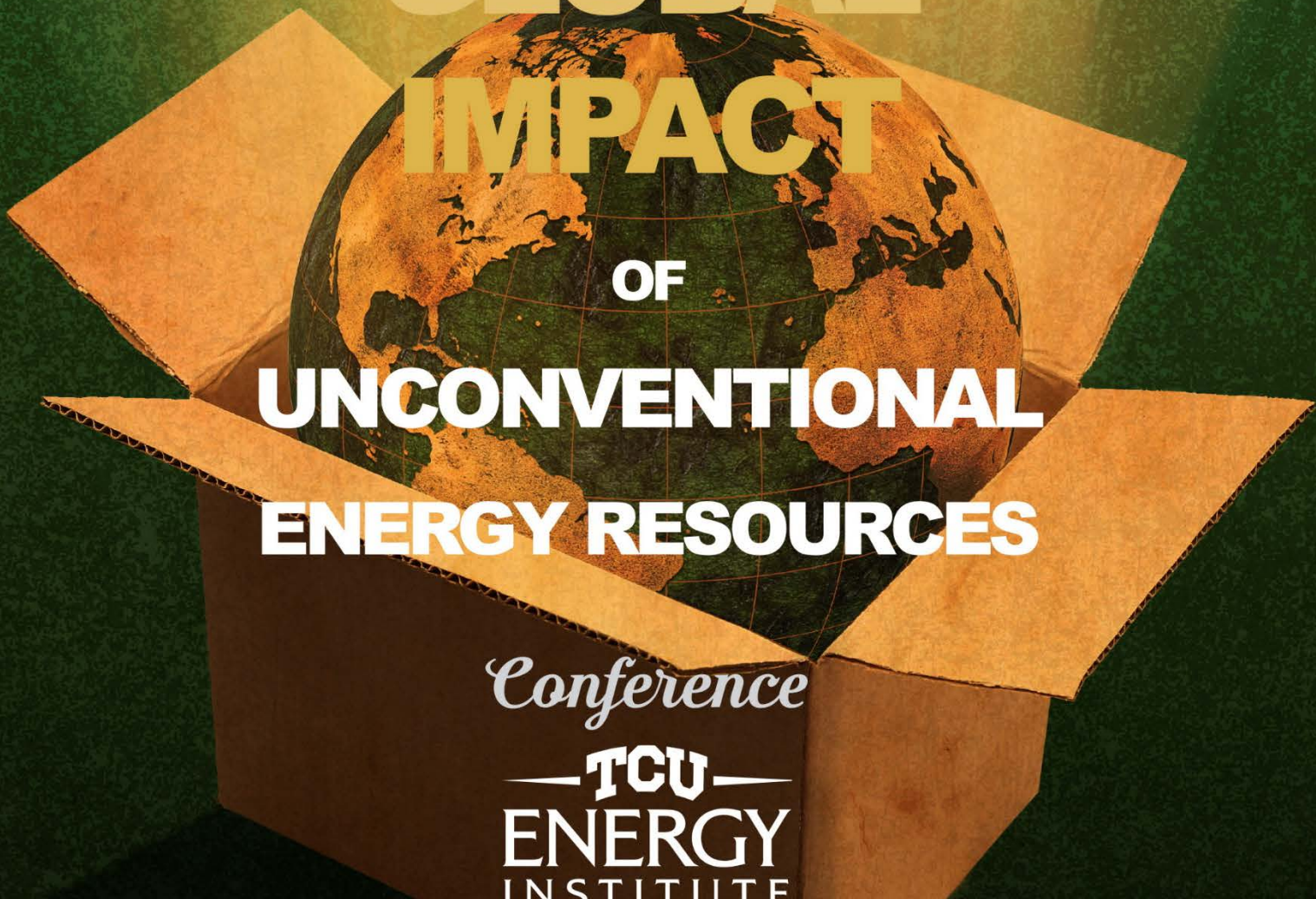


# The World Want to Know More About It!!



International Visitors  
22 Countries





*The*  
**GLOBAL  
IMPACT**  
OF  
**UNCONVENTIONAL  
ENERGY RESOURCES**

*Conference*

—TCU—  
**ENERGY  
INSTITUTE**

# ExxonMobil Energy Outlook to 2040

- Natural Gas to Outpace all Energy Sources through 2040 increasing by 65%.
- Asia will lead the way in NG Consumption
- Global Demand for Natural Gas will increase by over 200 Bcf/day.
- Globally, Natural Gas will overtake Coal for Electrical Generation.
- U.S. to be a net Nat Gas Exporter by 2020!



# Global Sellers-Buyers



What will the U.S. be by 2030?



# TCU - Right Place...Right Time!



**TCU**  
**ENERGY**  
**INSTITUTE**



Rees-Jones Hall - October 3, 2013



# TCU ENERGY INSTITUTE

Dr. Ken Morgan, Director  
[www.energyinstitute.tcu.edu](http://www.energyinstitute.tcu.edu)



**CHANGING OUR ENERGY FUTURE!!**

# TCU Energy Institute Education Outreach Partnerships



## **Royalty Owners Program-A Team Approach**

### **Royalty Owners Certificate**

(Texas Energy Law, The Mineral Estate, Post Production)

### **Advanced Royalty Owners Certificate**

(Legal Foundation, Surface Issues, Critical Clauses)

### **Wealth Management & Estate Planning**

(Preserving Wealth, Transferring Assets)

### **Geology Of Shale Plays**

(Prospect to Production, Issues and Markets)

***Fort Worth-San Antonio-Midland-Oklahoma City***

# China Looks to West For Energy

Jan 2011-Chesapeake, CNOOC strike second shale deal for \$1.3 B

March 2013 - China Petrochemical (Sinopec) & Chesapeake for \$1 B

March 2013 – CNOOC buys NEXEN (Canada) for \$15 B

Past 2 years– *Asian companies have completed \$31 B in North American Acquisitions and Ventures...* Wall Street Journal 2/27/2013

**\*China's ENN—500 new NGV Refueling Stations in U.S. (Reuters, March 2013)**

**\*Canada, Mitsubishi and PetroChina plan new export terminal in Kitimat, BC**



# Nat Gas to Hydrogen: The Energy End Game

