



Teaching and Research for Our Future Energy Needs

*Let's Go Domestic Energy!!*

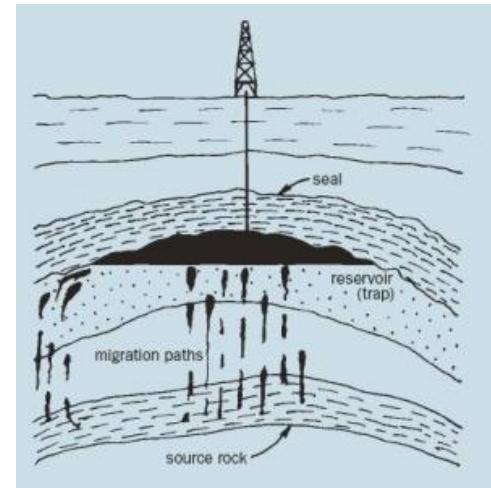
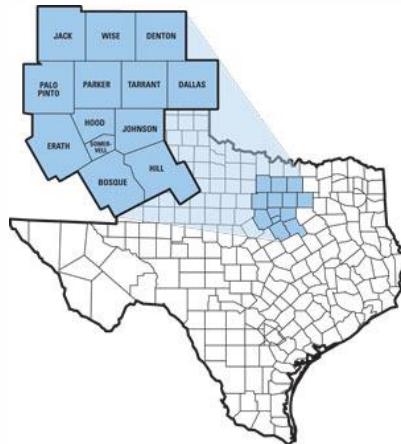
# **\*\*The Energy Driver's Seat\*\***

- 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!!!

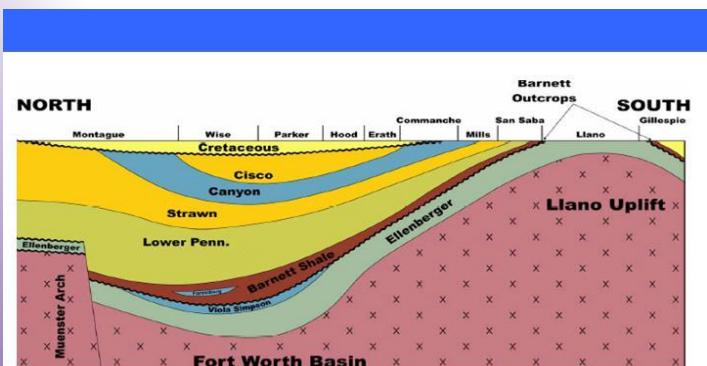
  

- U.S. Oil Imports....\$1 Billion A Day!!
- For 50 years...  
Oil and OPEC in The Driver's Seat!!

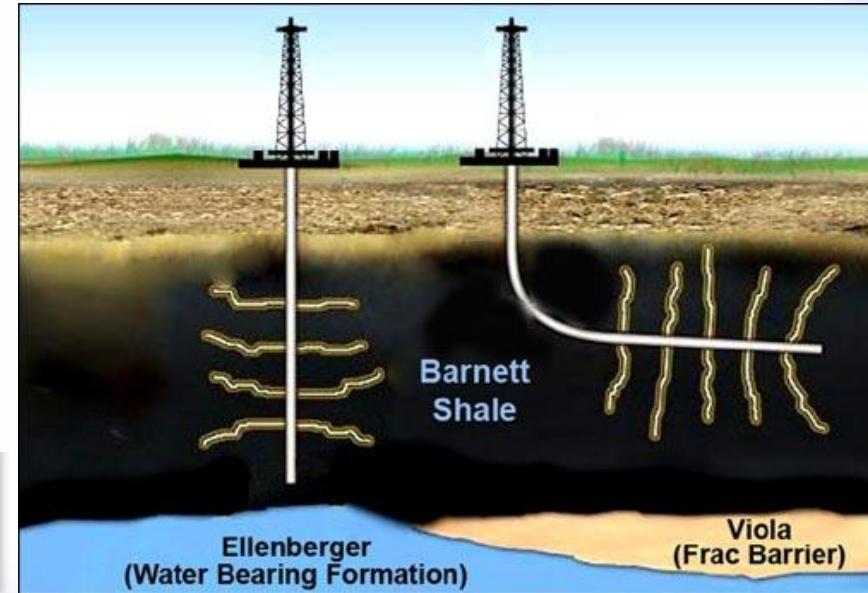
# 2002- Shale Plays Mitchell Energy Led the Way



- 1950's-1990's.. George Mitchell produces gas from Ft. Worth Basin
- "small" oil & gas wells for many years
- The "source"--Barnett Shale--"Mother Lode"
- It was under "everything" for 5,000 sq mi!!

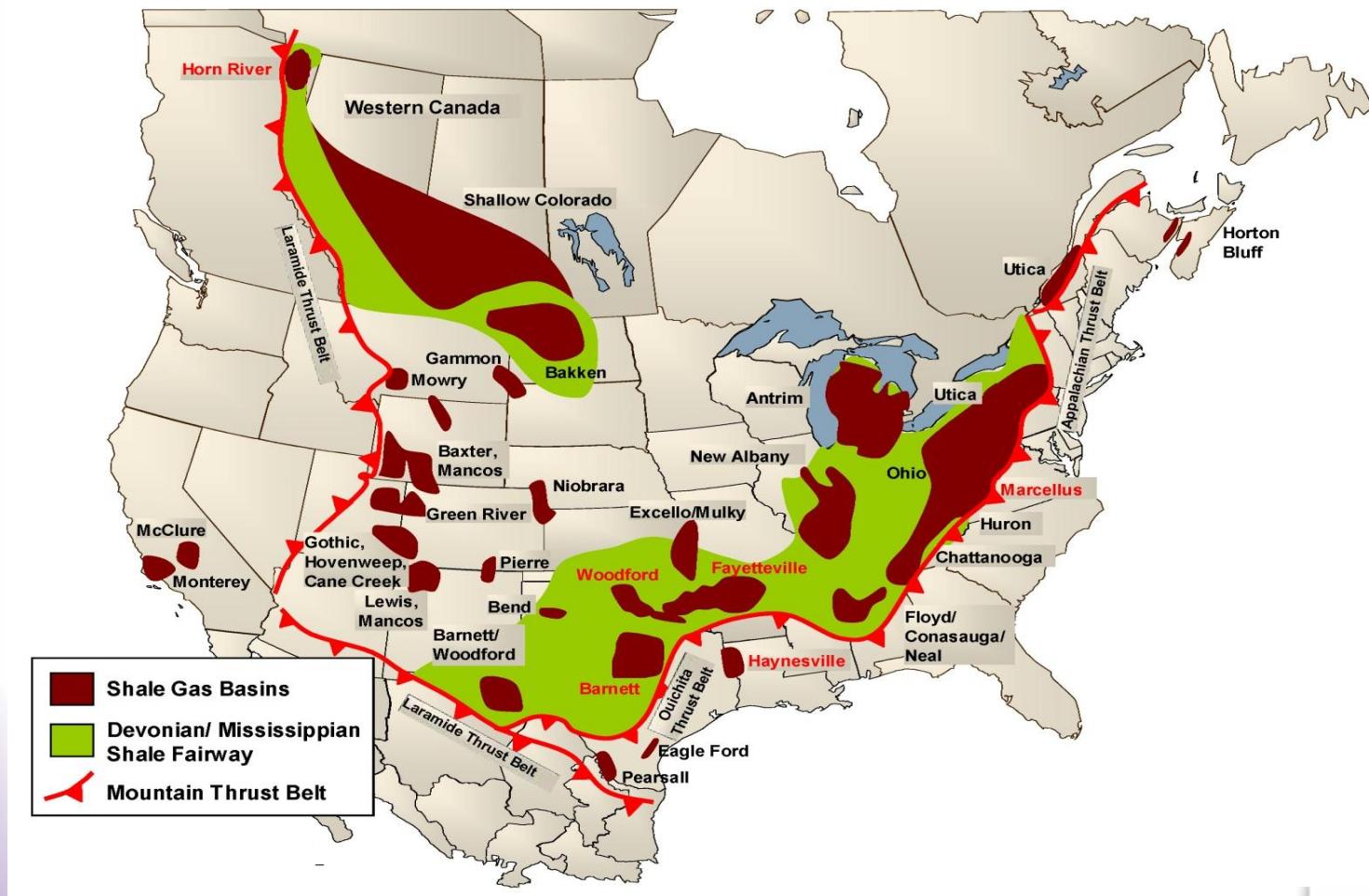


**TCU**  
**ENERGY**  
**INSTITUTE**



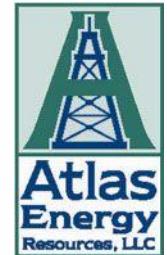
# Gas Shales!!

- 100+ years of cleaner burning natural gas



So....Who's in the Fracking Driver's Seat???

# Domestic Independent Producers ??



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

# “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)

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



**ExxonMobil**



# The Future!!

NYMEX Natural Gas Futures  
Close (Front Month)



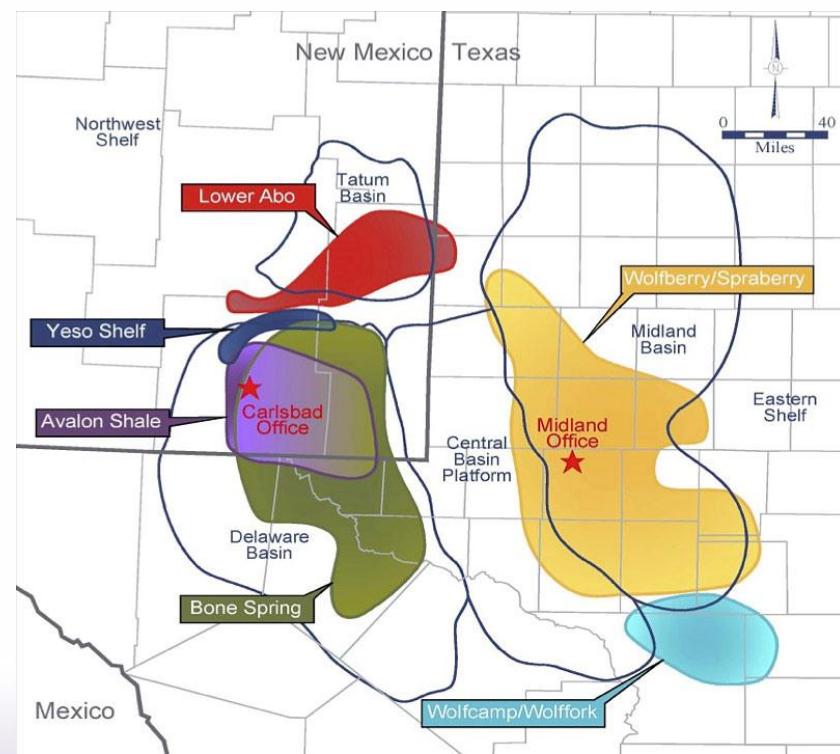
Nat Gas Prices

Alaska...Shublik Shale!

The Wolfberry!  
15 Bbbl O & G!!



Shale Oil



# Expanding NG Markets!!



CNG  
Transportation Fuel  
LNG



Back-UP Fuel

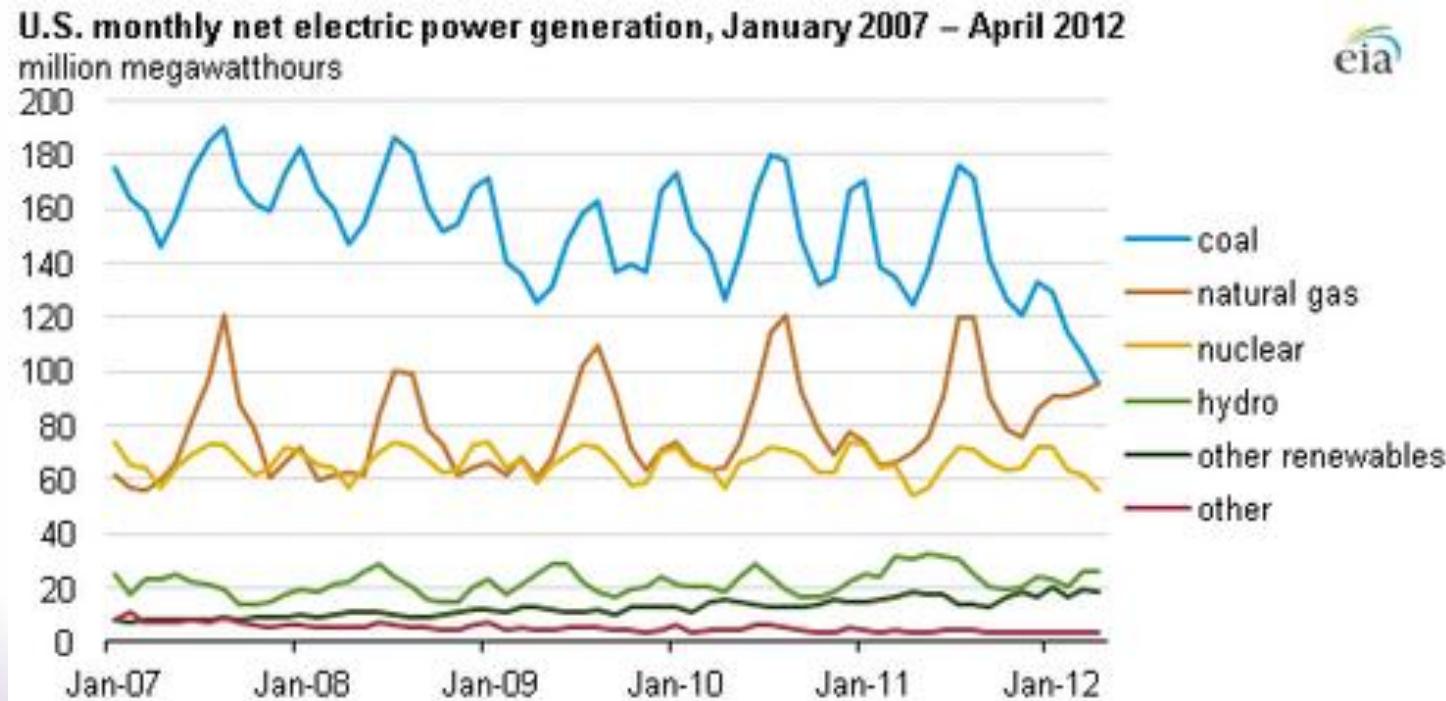


Base Fuel



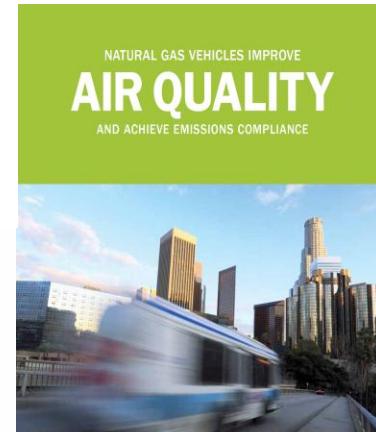
Hydrogen Source

# Nat Gas Catches Coal!!



# NGVs: The Real “Green Vehicles”

- Natural Gas vehicles..



Reduce CO<sub>2</sub> emissions

**20-30%**

Reduce CO emissions

**70-90%**

Reduce NOx emissions

**75-95%**

Reduce Particulate Matter emissions

**90%**

Reduce VOC emissions

**89%**

...compared to gasoline or diesel



# Another Approach – Driving The Market!

## *Metropolex NGV Consortium*



- Altech Eco
- American Honda Motor Co
- American Lung Association
- ANGI-Energy Systems
- Atmos Energy
- AT&T, Fleet Operations
- BAF Technologies
- Barnett Shale Energy Education Council
- Burns & McDonnell Engineering
- Chesapeake Energy
- City of Fort Worth
- Clean Energy Fuels
- Coalition, Inc
- CoServe Inc
- Cygnet Inc
- Dale Gas Partners
- Dallas Transit—DART
- Devon Energy
- DFW Clean Cities
- Dillon Transport
- Encana Oil & Gas
- Enterprise Rent-A-Car
- Emissions Solutions, Inc
- EOG Resources
- EWI Risk Services
- Fort Worth Chamber
- Fort Worth Transit Authority (The “T”)
- Freese & Nichols engineering
- Garland ISD
- IPAA –Ind. Petrol. Assoc of America
- Jetta Operating Company
- Jack B. Kelly, Inc
- J-W Power Company
- Marriott Hotels, USA
- NASCO (A) North America SuperCorridor
- National Fuel Marketing
- Navistar, Inc
- North Central Texas Council of Gov'ts
- NGV America
- NGV Texas
- PACCAR Inc
- Pioneer Resources
- Pinnacle CNG Systems, LLC
- Purple Land Management
- Pioneer Resources
- Quicksilver Resources
- Republic Services, Inc
- Smith Family Investments
- SWEPCO USA
- TCU Energy Institute
- TCU Institute for Environmental Studies
- Tandy Center For Executive Leadership
- Texas Gas Association
- Trillium, USA
- UPS
- Vista Sand
- Western Production Co.
- Wynne Motor Coaches
- XTO Energy
- Zeit Energy

Promote Natural Gas Transportation Markets!!

# NGVs in Austin



Meeting



Demo



ALA!!!

*Clean Air-Clean Fuel For Texas!!*



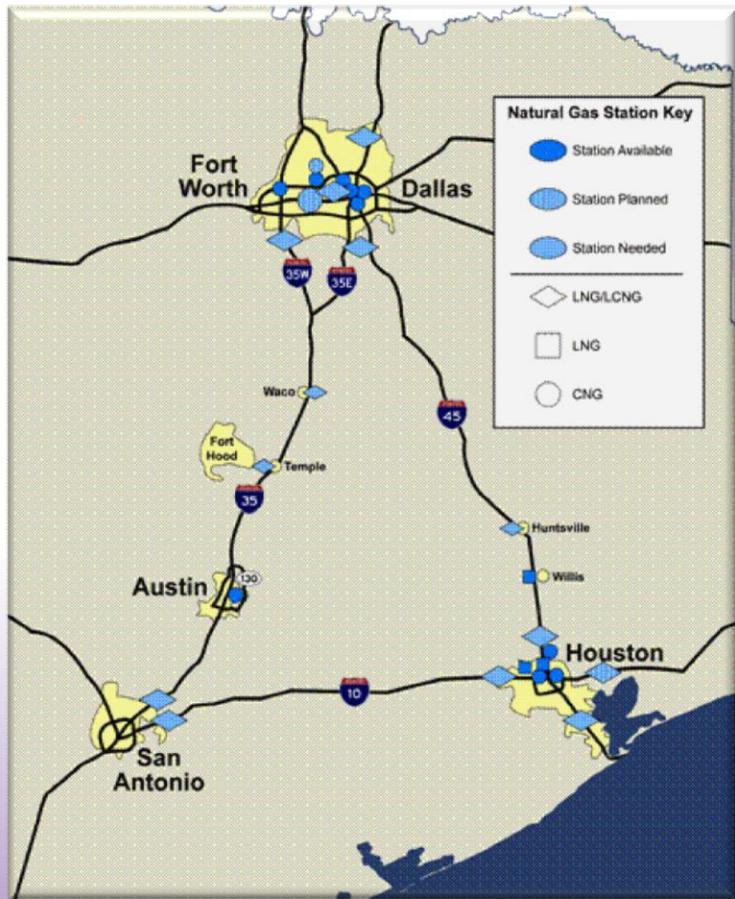
Metroplex NGV Consortium



State  
Capitol



# 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!!*



# NGVs = Should we go there!!



# Detroit—GM, Ford Chrysler

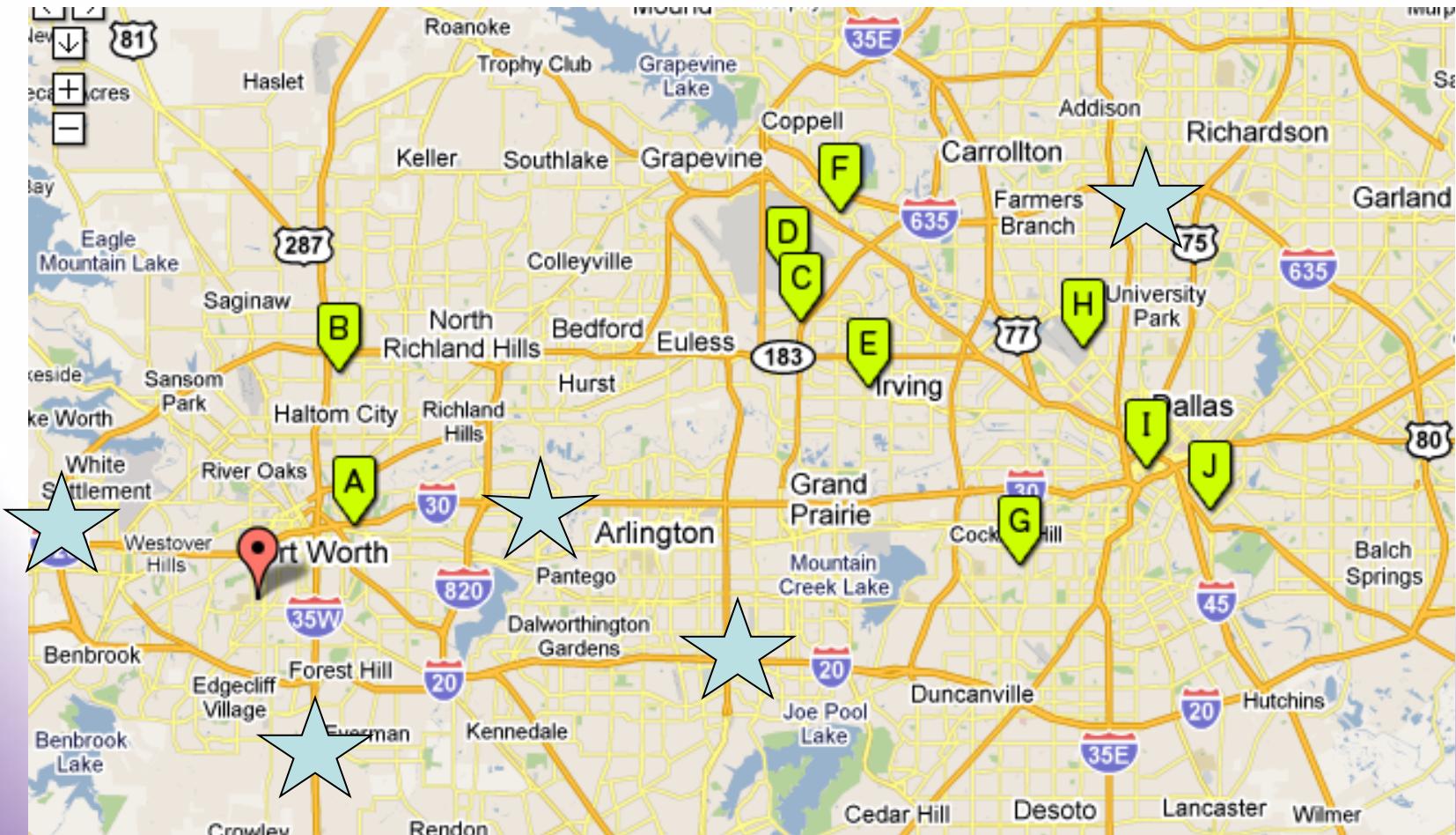


Change for 2012-13!!



# DFW NG Public Stations Map

Average Price per equivalent gallon = \$2.10!!



Web site: [www.cngconnect.org](http://www.cngconnect.org)

# National NGV Stations

**Pilot Flying J to Get Natural Gas Fueling Outlets**

Leading the Pack!!



150 New NGV  
Travel Stations!!



# Shell & TA Centers!

Shell Oil and truck stop chain TravelCenters of America agreed to build and operate at least **100 natural gas fueling stations** for heavy-duty trucks along U.S. Interstates.



# GE & Chesapeake

## "CNG In A Box"

### 8' X 20' & 8' X 40'



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



## 3M to Make Fuel Tanks for Natural Gas Vehicles

The manufacturing giant, intends to develop less-expensive, higher-performance, lighter, and higher-capacity fuel tanks—which it hopes will jump-start the market for natural gas-fueled vehicles.

Carbon Fiber and new Nanoparticles for extra strength

Up to 20% lighter and 20% greater capacity

# 13 Governors Support NGVs



April 27, 2012

RE: Request for Information - Multi-State Natural Gas Vehicle Procurement

For many Americans, high gasoline prices create a financial strain in an already difficult economic environment. As governors, we share the concerns of citizens and are committed to finding solutions. A bipartisan partnership between governors and auto manufacturers in the U.S. makes sense and has the potential to create new options for alternative fuel vehicles and transportation fuel diversity.

Abundant, affordable, clean-burning natural gas presents a tremendous opportunity for America to realize an energy future using domestic resources to fuel our nation's transportation needs. To that end, we are committed to explore the aggregation of our annual state fleet vehicle procurements to provide an incentive to manufacture affordable, functional natural gas vehicles. In coordination with this letter, we are releasing to all auto manufacturers in the U.S. a request for information (RFI) intended to assist our states in gathering the necessary information for developing a multi-state solicitation.

Recently, automakers announced several new original equipment manufactured natural gas vehicles. We believe this multi-state effort can create even more momentum. We appreciate your thoughtful evaluation of our upcoming RFI and the opportunity to work together to make American energy security a reality.

Sincerely,

Mary Fallin

Mary Fallin  
Governor, State of Oklahoma

John Hickenlooper

John Hickenlooper  
Governor, State of Colorado

Matthew H. Mead

Matthew H. Mead  
Governor, State of Wyoming

Tom Corbett

Tom Corbett  
Governor, State of Pennsylvania

Gary R. Herbert

Gary R. Herbert  
Governor, State of Utah

Paul R. LePage

Paul R. LePage  
Governor, State of Maine

Susana Martinez

Susana Martinez  
Governor, State of New Mexico

Steve L. Beshear

Steve L. Beshear  
Governor, State of Kentucky

John R. Kasich

John R. Kasich  
Governor, State of Ohio

Rick Perry

Rick Perry  
Governor, State of Texas

Phil Bryant

Phil Bryant  
Governor, State of Mississippi

Bobby Jindal

Bobby Jindal  
Governor, State of Louisiana

# General Dempsey-Chair, Joint Chiefs of Staff

## June 27, 2012—Ft. Worth



Domestic Military Bases

# Growth of NGVs

- There are about 140,000 NGVs on U.S. roads today and more than **14.8 million worldwide**.
- According to the American Public Transit Association, **nearly one-fifth of all transit buses were run by compressed natural gas (CNG) or liquid natural gas (LNG) in 2012**.
- The fastest growing NGV segment is **waste collection and transfer vehicles**.
- More than **35 airports in the U.S.** have natural gas vehicles in their own fleets.
- NGV Global estimates there will be more than **50 million natural gas vehicles worldwide within the next 10 years**, or about 9% of the world transportation fleets

Source: NGV America

Today

Change??

Tomorrow??

# Imports

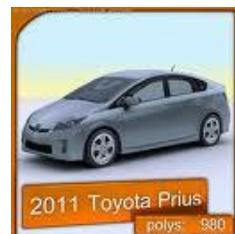
Oil



Opec--\$1B/day



China...97%



Batteries, Magnets, Control Rods, Lasers

# Natural Gas Exports??

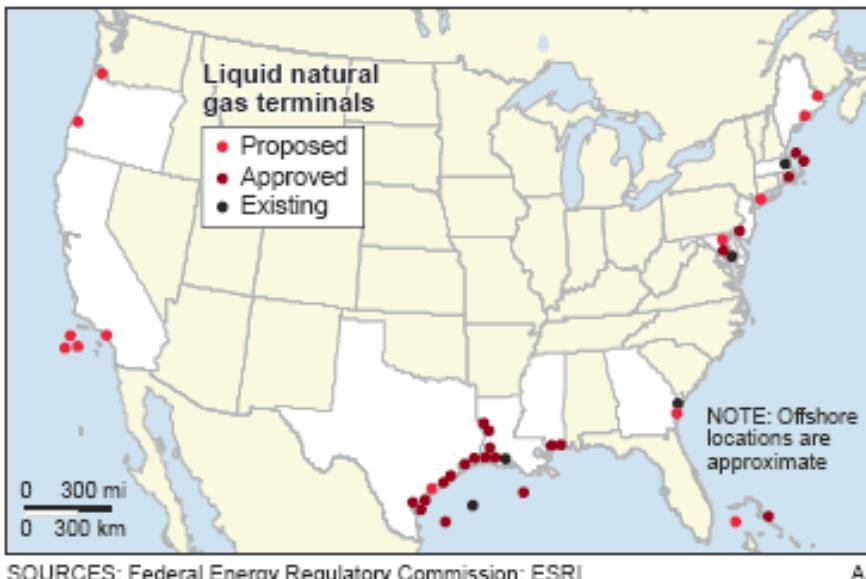


Louisiana  
Cheniere Energy

It's a Global Play  
Canada? Australia?

## More LNG terminals going online

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



Markets??  
China, Europe, Japan??

AP

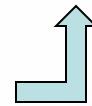
# So, For Domestic Gas...Who's in the Driver's Seat????



# We ARE!!!!

1. Grass Roots NGV Organizations in U.S.
2. Fleet Conversions-Large and Small Companies
3. Infrastructure/Vehicles--Detroit
4. Future-Jobs, Business Growth

That's what happened  
100 years ago!



1909 Model T

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

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

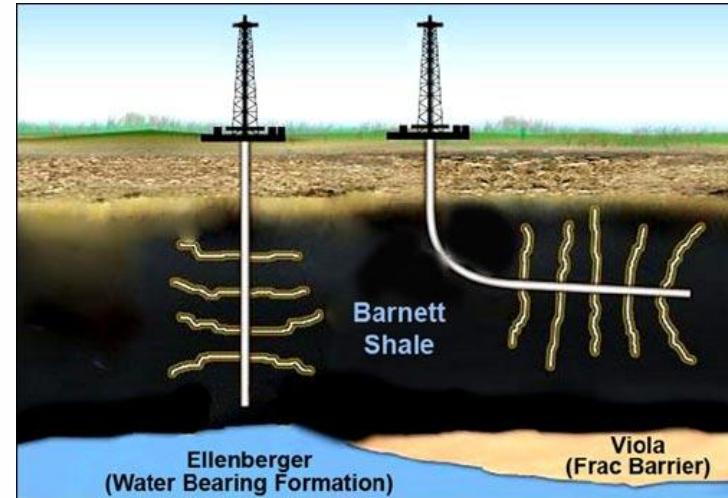


Go Domestic Energy...Go Domestic Natural Gas & Oil!!

# Shale Plays: What to do?

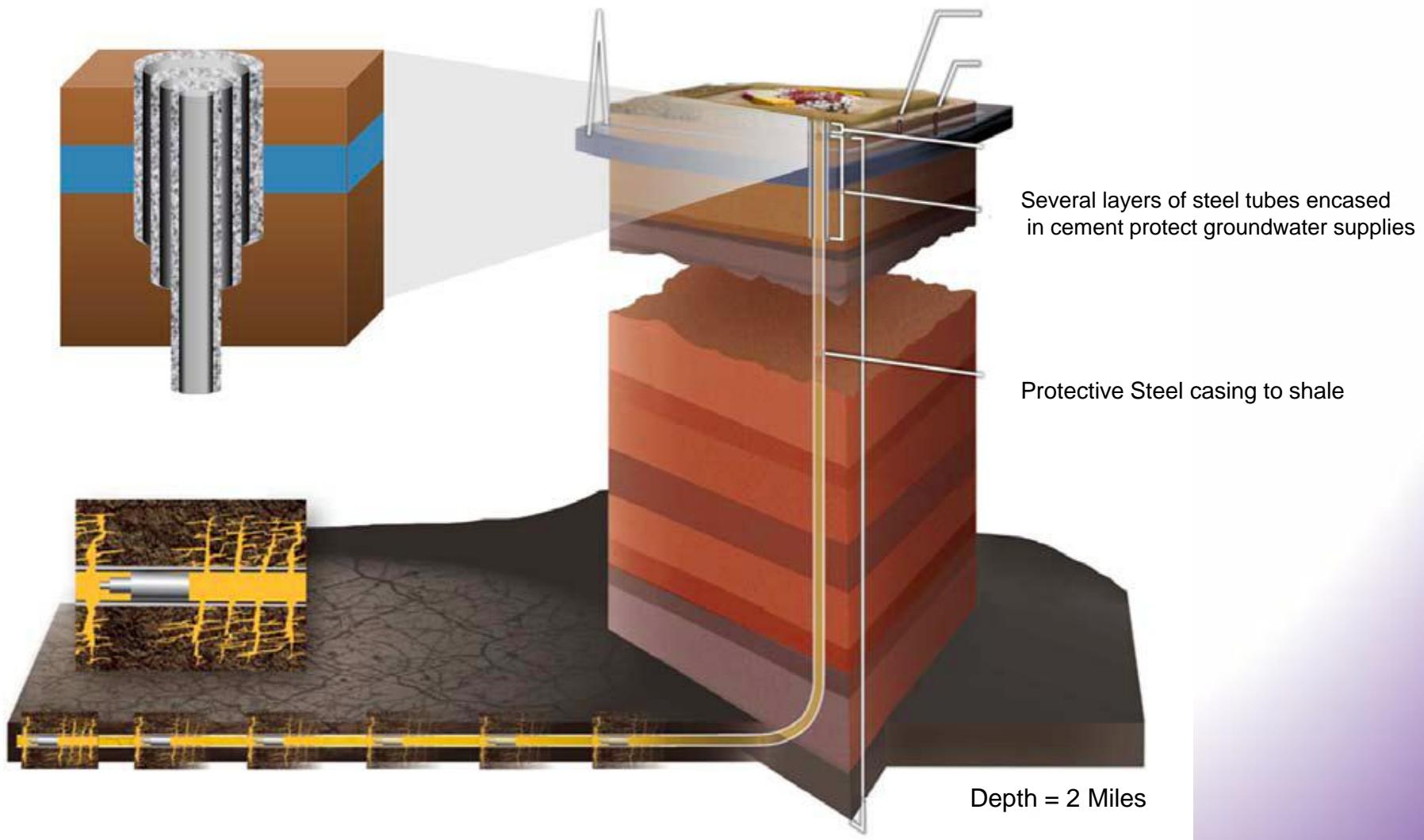
Regulation or Incentives?

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



Remember: It's Domestic!

# Shale Plays: Aquifer Protection



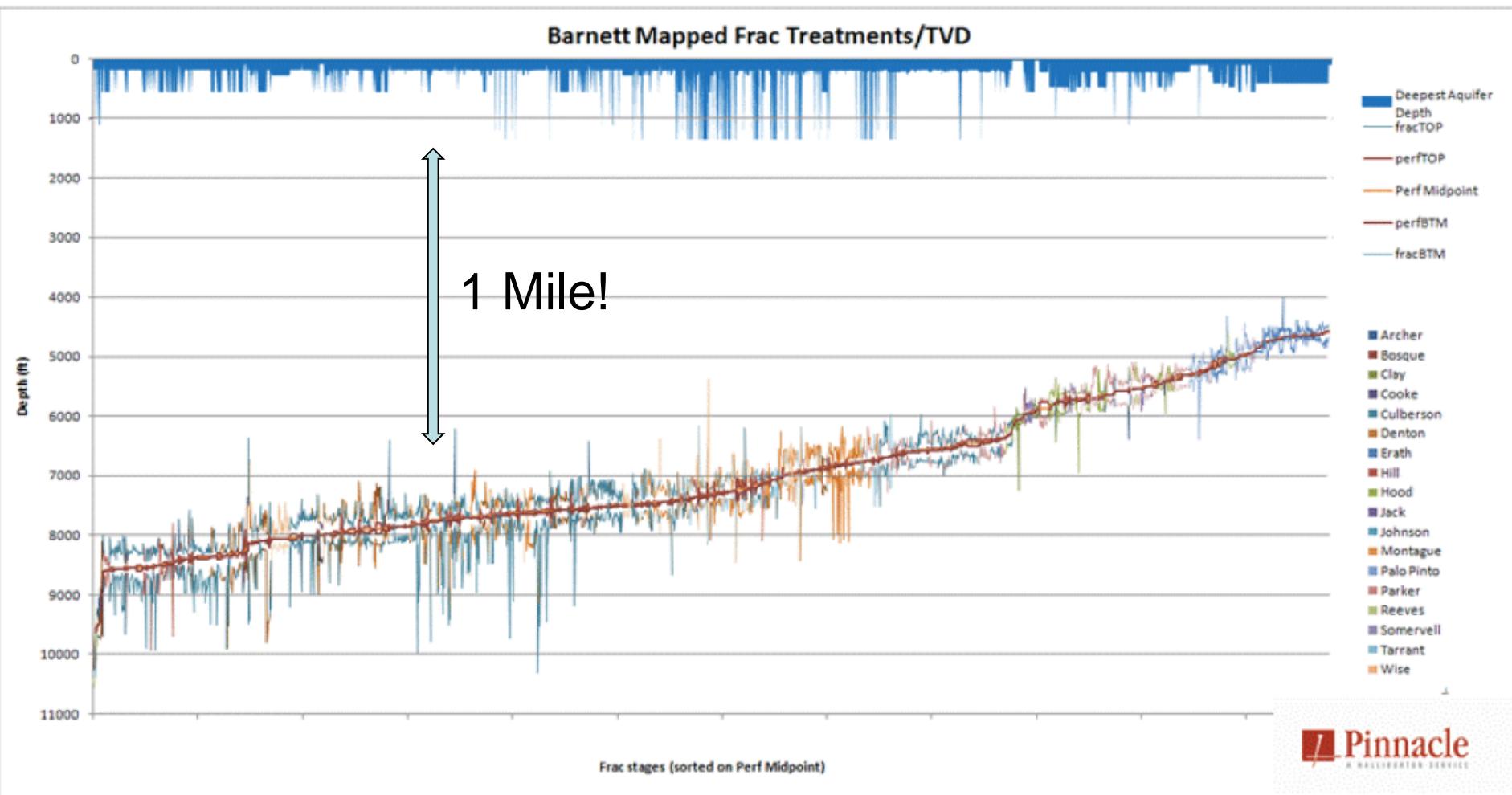
# Water Use & Recycling

- DFW Barnett Activities Water Use: < 2% of Total Water Use.
- The Real Problem: Waste & Leaks accounted for 30% of Total Water Use...TWDB, 2011.

Recycling Pond  
Pennsylvania



# Depth of Affected Region Affected by Hydraulic Fracturing

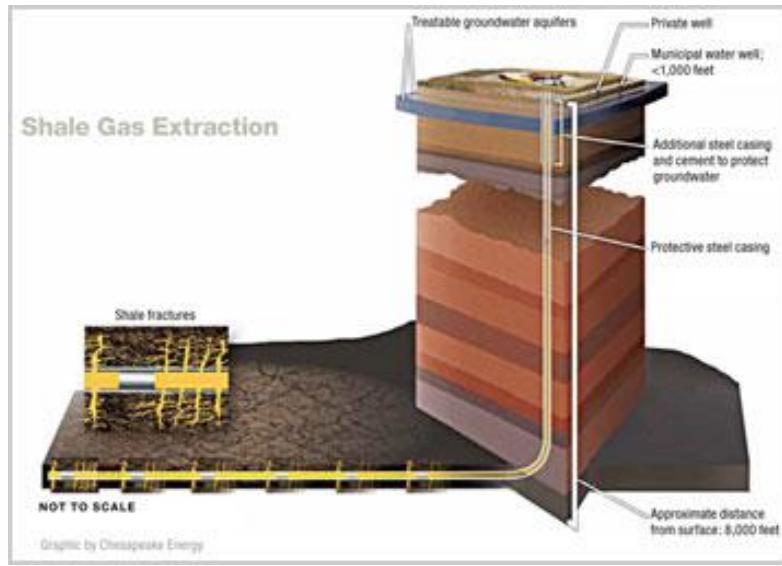


Fisher (2010)

<http://nwis.waterdata.usgs.gov/nwis/inventory>

# Shale Gas Development

UT-Austin & Environmental Defense Fund Study, March 2012



	Negative	Neutral	Positive
National Newspapers	64%	25%	12%
Local Newspapers	65%	23%	12%
National Television & Radio	64%	19%	18%
Local Television	70%	27%	3%
Online News	63%	30%	7%

Key Findings: Over 1 Million Fractured Wells in U.S. since 1960

1. Many reports of [groundwater contamination](#) occur in conventional oil and gas operations **NOT FRACKING**.
2. [Methane](#) found in water wells in some shale gas areas DUE TO NATURAL SOURCES... **NOT FRACKING**
3. [Surface spills](#) of fracturing fluids appear to pose greater risks to groundwater sources.....**NOT FRACKING**
4. [Poor Cement Casing](#) appears to be an issue in some shale wells.....**NOT FRACKING**