

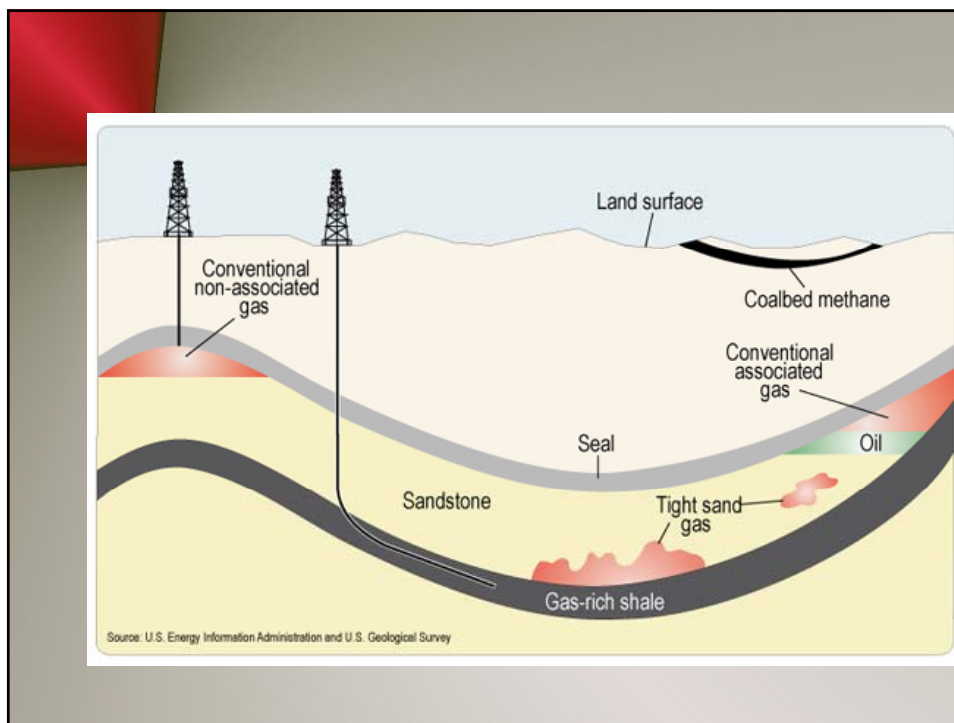
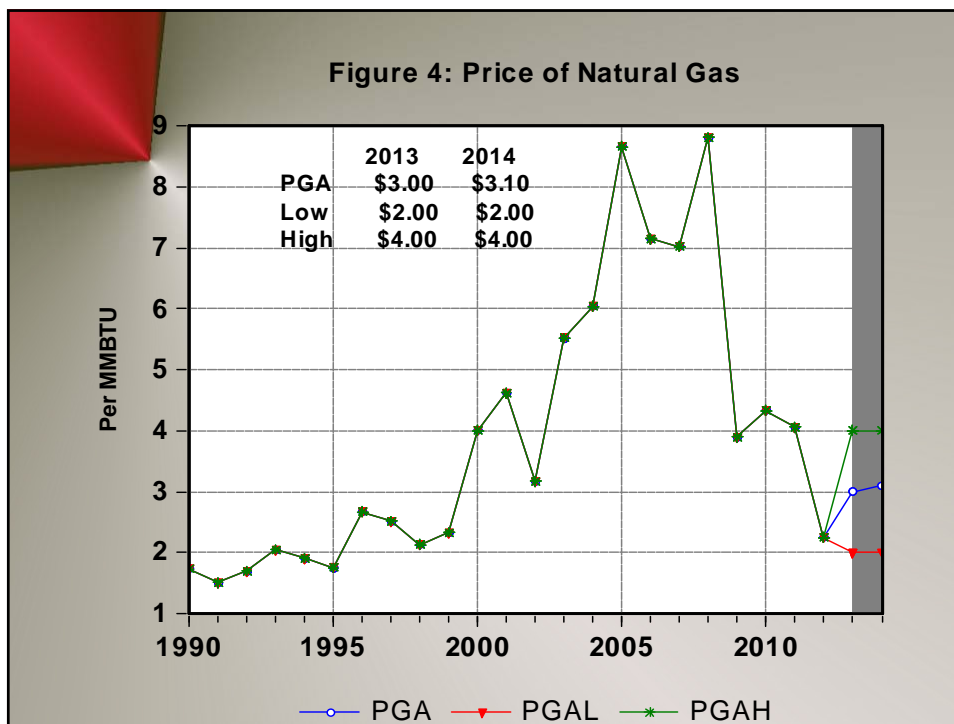
Chicago Federal Reserve Bank

Economic Outlook Symposium
November 30, 2012

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Natural Gas

An economic civil war underway

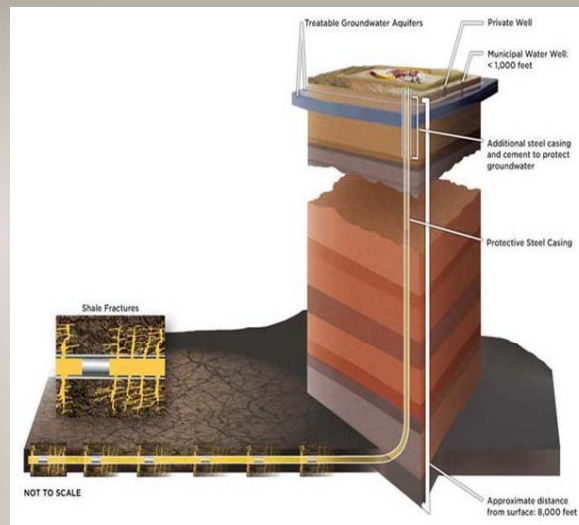


Logistical Issues

- **Each hydraulic fracking stage requires:**
 - 300,000 gallons of water
 - 200 tons of sand
- **20-40% of fluid solids used in fracking flow back to the surface as hazardous waste and require transportation to other well sites or treatment and/or disposal sites**

Subsurface water contamination?

- **Significant distance between frac zone and aquifer**
- **Proper casing & cementing and regulatory oversight are important**

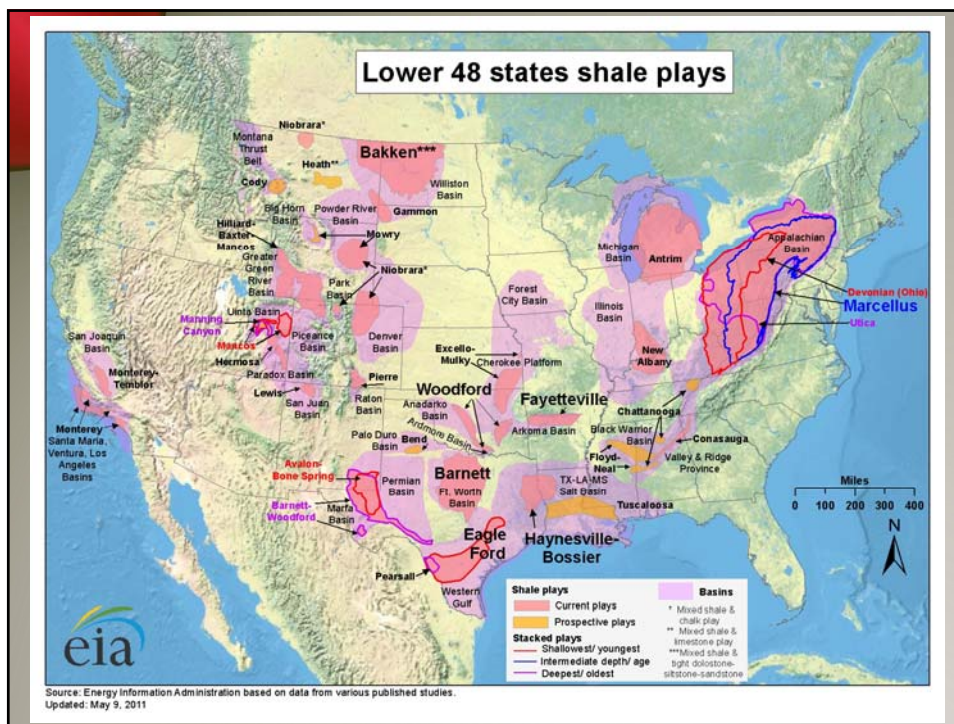


Michael Economides in Offshore Engineer 11/11

- **2011:**
 - 35,000 wells drilled in U.S.
 - 120,000 hydraulic fracturing treatments executed; 4 stages per well on average
 - Zero cases of drinking water contamination
- **60 years of fracturing**
 - 1.2 million wells
 - No scientific cases of drinking water contamination

John Deutch, Former CIA Chief, Chair of President Obama's Panel on Hydraulic Fracturing

“...economic benefits of natural gas production massively outweigh environmental and public health concerns.”



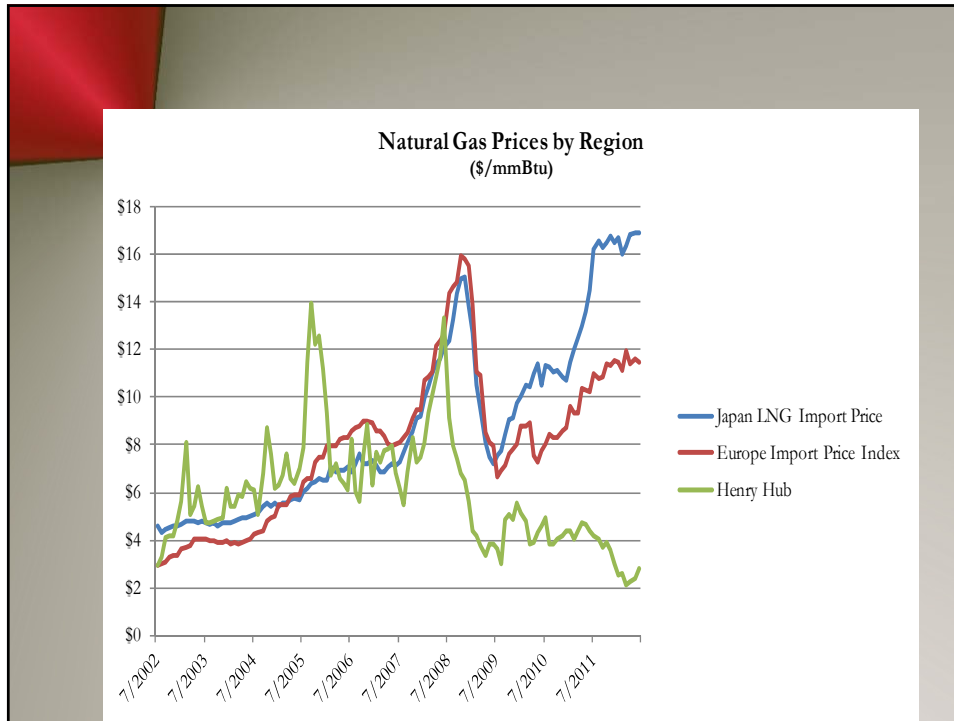
More demand coming from 3 sources

Manufacturing in general; Chemicals specifically

Three Major Benefits to Chemical Producers

Price of Major Input has Declined

- **Ammonia fertilizer**
- **From natural gas liquids like ethane we get ethylene which is the foundation of**
 - Food packaging, toys, house wares
 - Swimming pool liners, vinyl pipes
 - Pantyhose, clothing, carpets
 - Bottles, cups
 - Tires, foot ware, auto antifreeze
- **Clean burning boiler fuel**



3rd: Naphtha v. Ethane

- Ethylene made of
 - In Europe:
 - naphtha derived from oil
 - Oil @ \$100 \$1,400 to make ton of ethylene
 - In U.S.
 - Ethane, derived from natural gas
 - \$730 to make ton of ethylene

**Manufacturing in general should
gain worldwide market share**

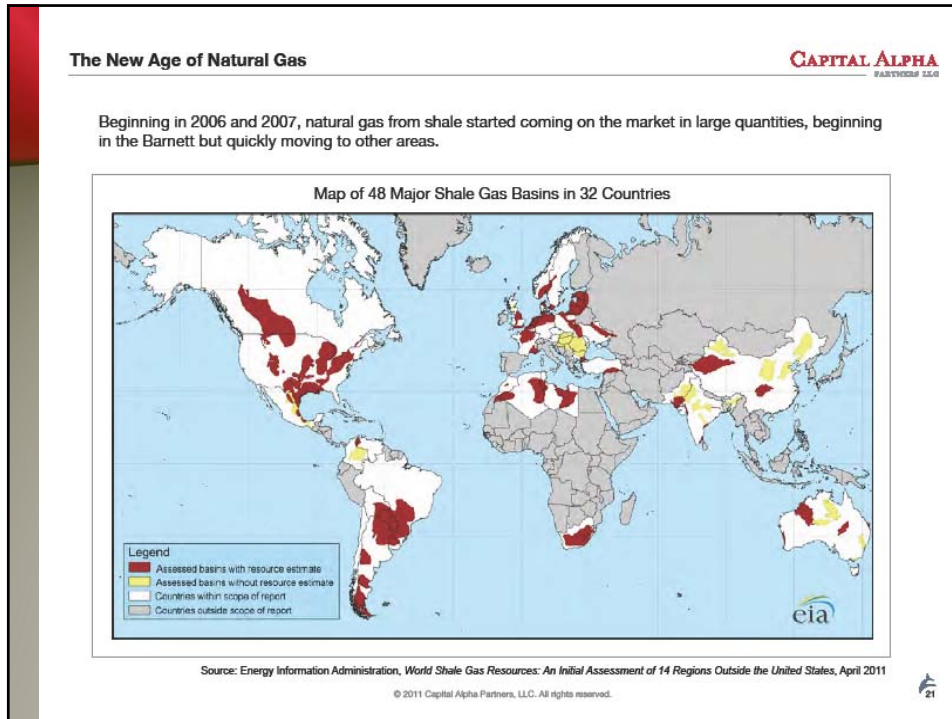
**Cheap energy off-setting cheap labor
advantage**

Example: Benteler Steel

\$900 mm capex; 675 jobs

Port of Caddo Bossier

**Potential Problem:
European Shale Gas Plays**



Potential Problem: European Shale Gas Plays

- **Cuadrilla Resources: September 2011**
 - Bowland Shale
 - 200 TCF play in northwest England
- **Potential salvation:**
 - Extreme greens in Europe
 - Environmental group WWF has called for moratorium on shale gas exploration in the UK, with more focus on renewable energy.
 - UK parliamentary committee has investigated & will not introduce restrictions

Thank God for France!

- **May 11, 2011 National Assembly voted to prohibit hydraulic fracturing in the country**
- **France now imports 98% of its natural gas**
- **Ranks 2nd among European states in shale-gas potential according to the EIA.**
- **Bulgaria recently disallowed as well**

Second source of demand: Power producers

EPA attacks on coal-fired power plants: an alternative low cost fuel is great

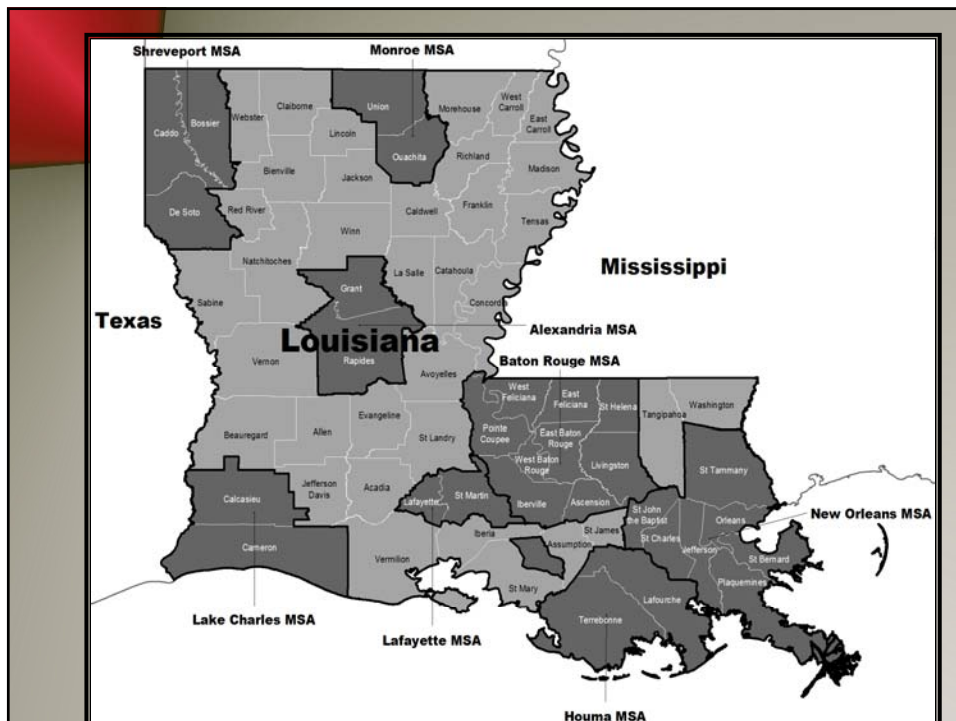
Power Use of Natural Gas

- Next 2-3 years little change
- After that, between 35-75 gigawatts of coal-fired power plants will be shut down
- Amount depends on how rapidly EPA regulations on cross-state pollution & mercury emissions are implemented

**One estimate:
Industrial & Power needs will
increase demand by
2-3 TCF a year**

Presently: 22 TCF per year total

3rd demand source:
Exports

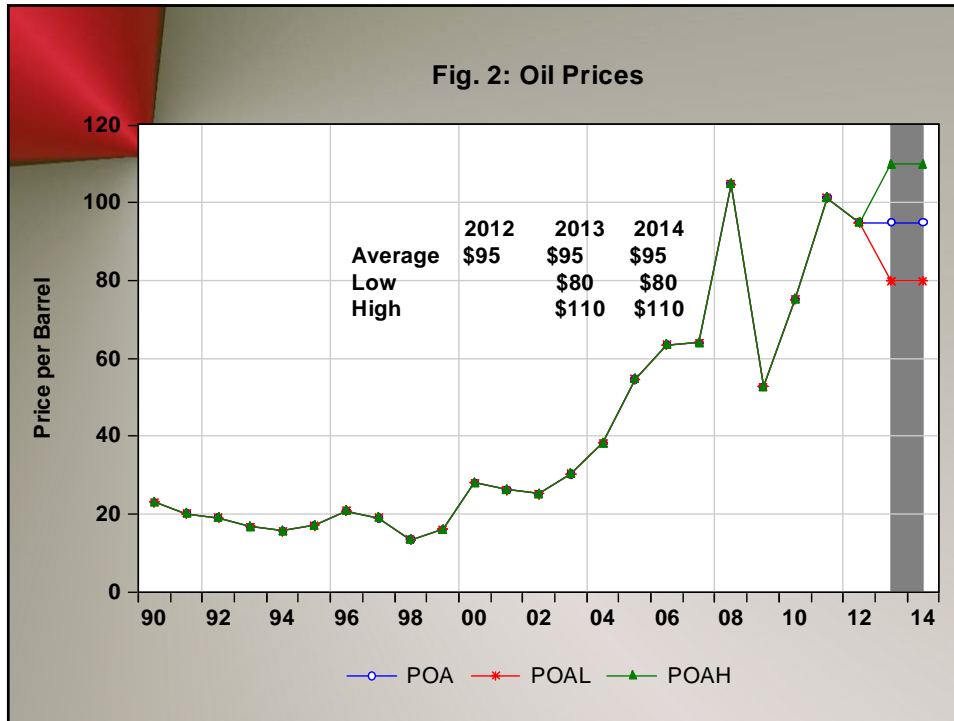


Construction in Lake Charles Future:LNG

- **Retrofit LNG import terminals near Lake Charles**
 - Cheniere Energy
 - Cameron LNG (Sempra)
 - Lake Charles Exports, LLC (Trunkline)
- **Permission to export to non-free trade partners VIP**
- **All 3 LNG: about 2-3 tcf per year (+10-13%)**
- **Note: LNG export price - \$18 mmbtu**
- **Opposition from (1) users and (2) environmentalists**

Oil: Lots of potential

Watch the Gulf & the shale
plays



The Permittorium

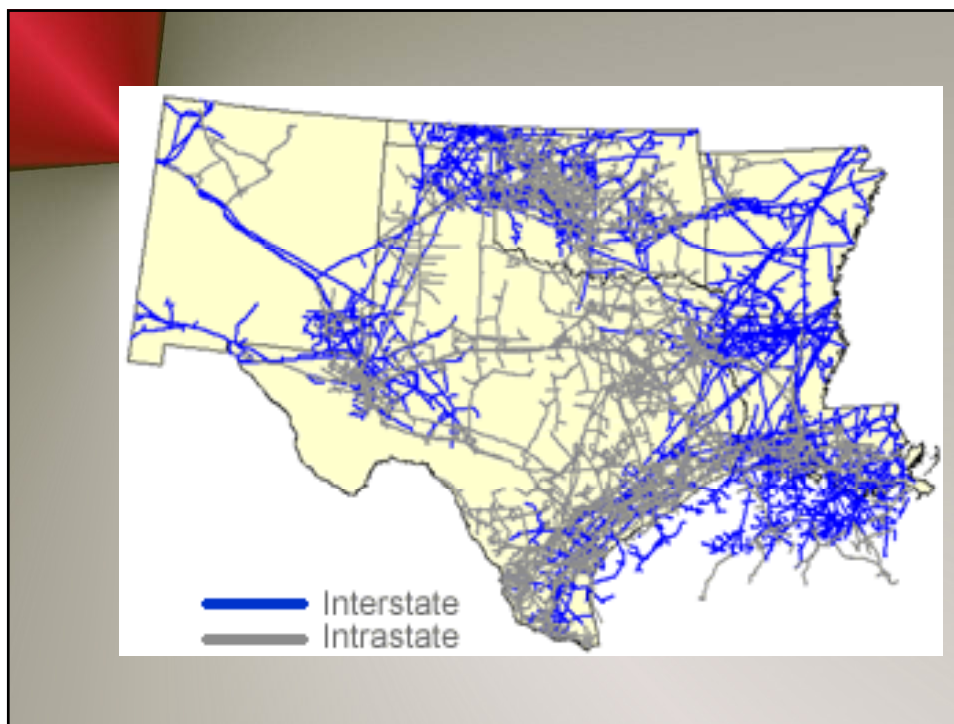
- **As of 12/1/11:**
 - Average approval time pre-moratorium: 61 days
 - Average approval time 2011: 213 days
- **Average Approval rate:**
 - Pre-spill: 73.4%
 - Post-spill: 34%
- **Permits issued for deepwater:**
 - 2009: 163
 - 2010: 74
 - 2011: 79
 - **2012-I: 44 (176 annual rate)**

The Permitatorium

- CFO of ATP Oil & Gas Corp: One permit that used to take 30-40 pages took 3,600 pages.
- Pre-spill: 33 rigs in deep waters
- Post-spill: 11 rigs
- 11 deepwater drill ships left the GOM after spill
- Good news: As of 5/12---24 rigs in deep waters
- Good news: 9 new drill ships or semi-submersibles on way & in place by 2013-II

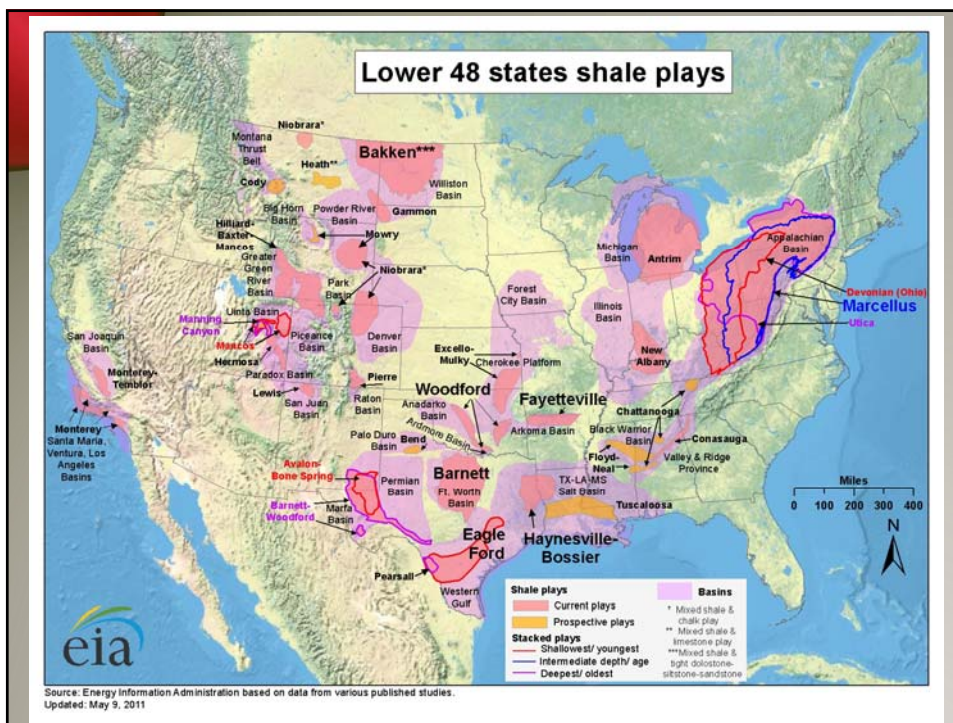
Benefits of the Gulf?

- Elephant finds
- Straddles world's biggest consumer
- Politically stable area (Argentina alarm)
- Cost of taxes, royalties, and regulations among lowest in world
- Vast network of pipelines & refineries



“Shale Gale”

Fracking applied to oil shale



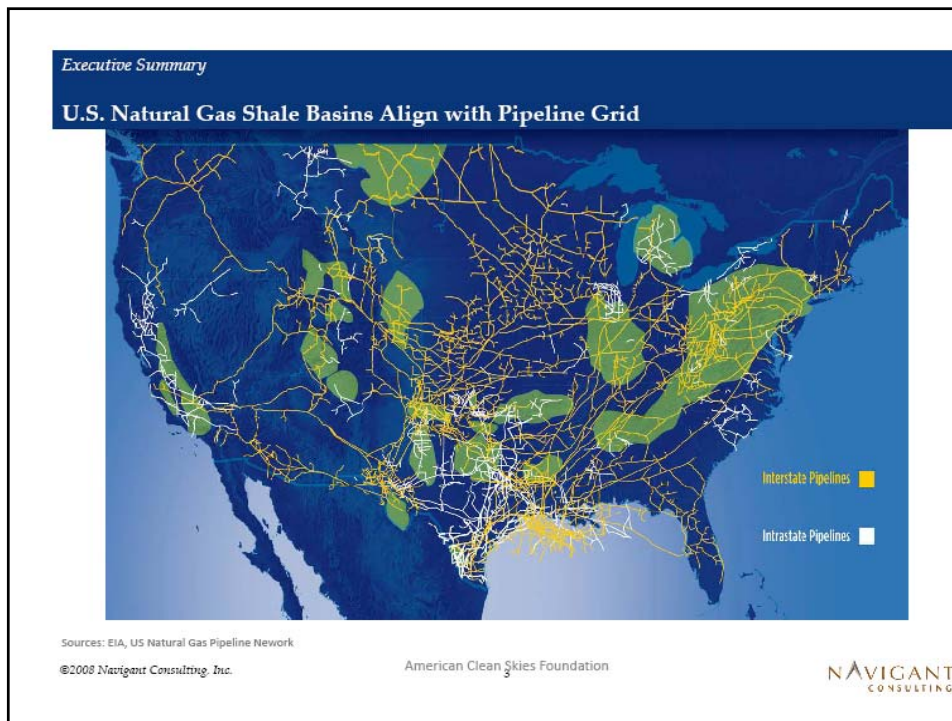
HIS - Shale plays Responsible for:

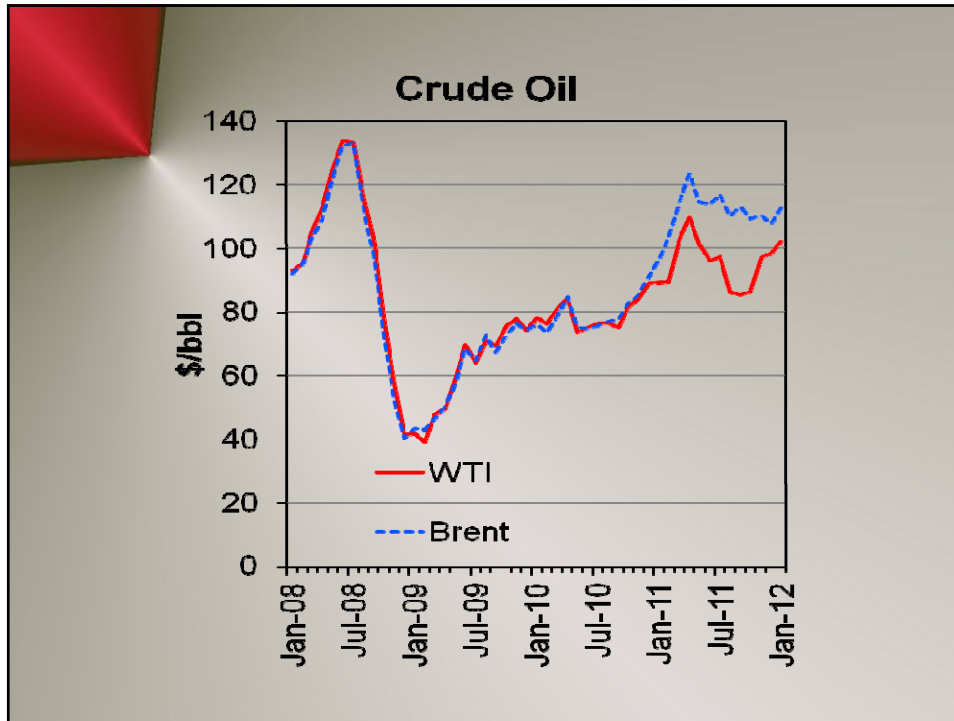
- U.S. oil production up 25% since 2008---highest growth of any country in world over that period
- Balance of payments effect:
 - Production over last 5 years has reduced our oil import bill by \$75 billion
 - Growth of shale gas will prevent spending \$100 billion o import natural gas.
- Increase since 2008 in oil = 80% of Iran’s exports before sanctions imposed. Helped make sanctions work well.



North Dakota's Bakken Field

- **2003: 10,000 b/d produced**
- **5/2012: 660,000 b/d produced---66-fold increase**
- **ND surpassed Alaska as 2nd largest source of domestic oil 3/12**
- **Biggest Field ever in U.S.? Potential-O&G Journal 4/12:**
 - Prudhoe Bay: sustained a 1.5 mmbd rate for 9 years
 - Bakken: May sustain 1.5 mmbd rate for 25 years
- **Strange result: First time ever oil price differentials**



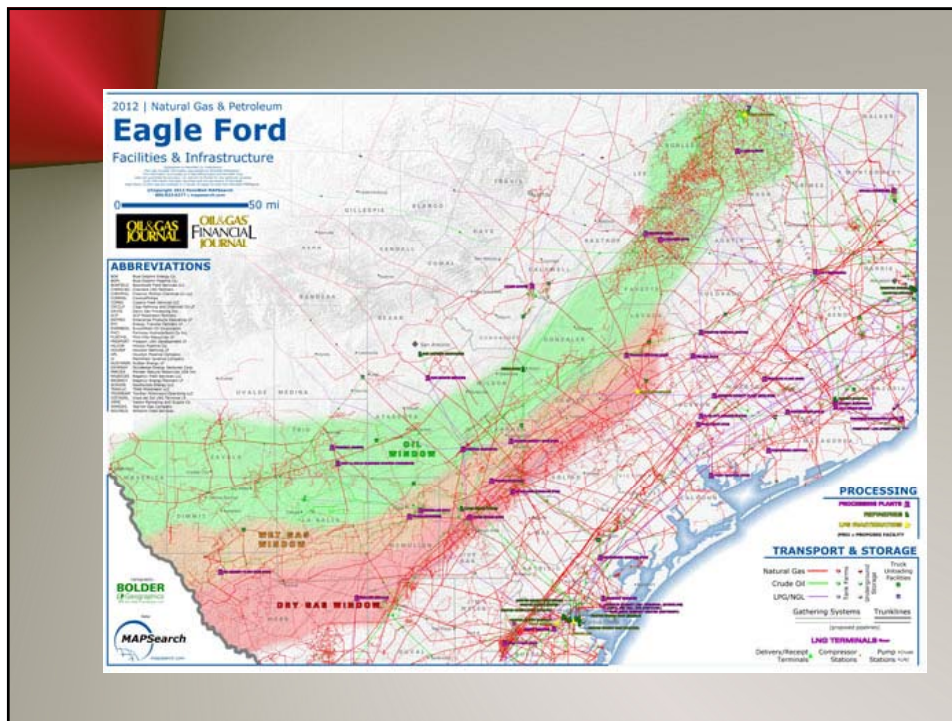


Cushing to Houston Pipeline

- Enterprise Products partners and Enbridge : 50-50 joint venture: (11/11)
 - Reverse Seaway Pipeline;
 - **First shipment South 6/7/12 @ 150,000 bd; adding pumping capacity for 400,000 bd**
- TransCanada (11/11)
 - Cushing Marketlink crude pipeline to Gulf Coast
 - **Will not proceed unless entire XL pipeline approved. Economics do not support stand alone project. (7/12)**

Sweet v. Sour Oil Issue

- Most refineries on Gulf Coast refitted to refine imported, high sulfur sour crude
- Bakken and other plays produce a sweeter, less sulfur-intensive crude.
- Added to glut in Midwest
- Producers end up wanting to export!
- If refinery able to refine sweet crude--- great margins now because of glut.



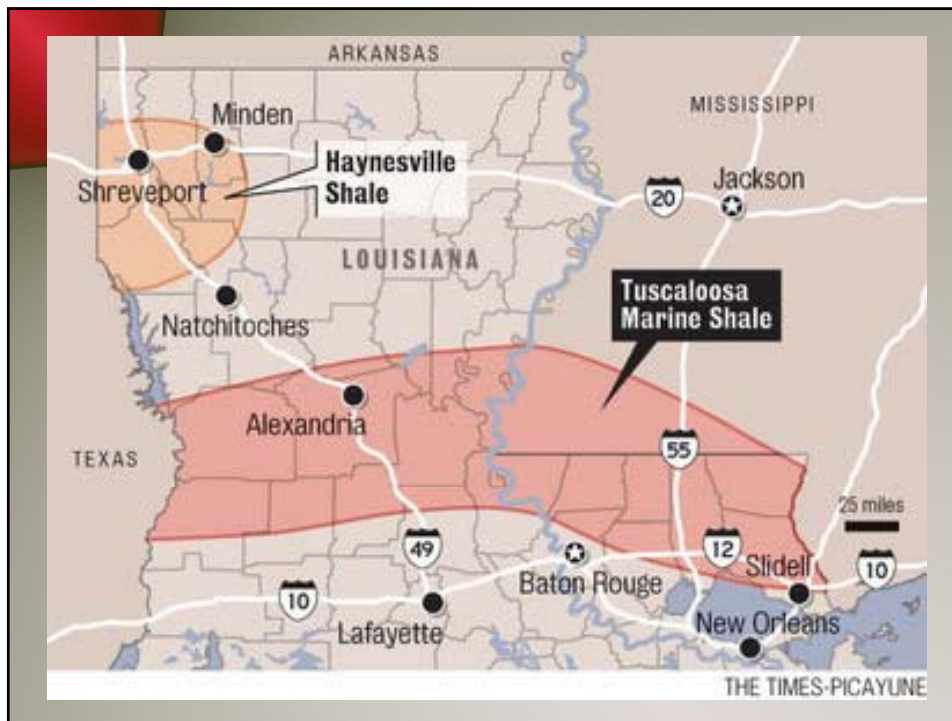
HIS Study, July 2012 Eagle Ford Bigger than Bakken?

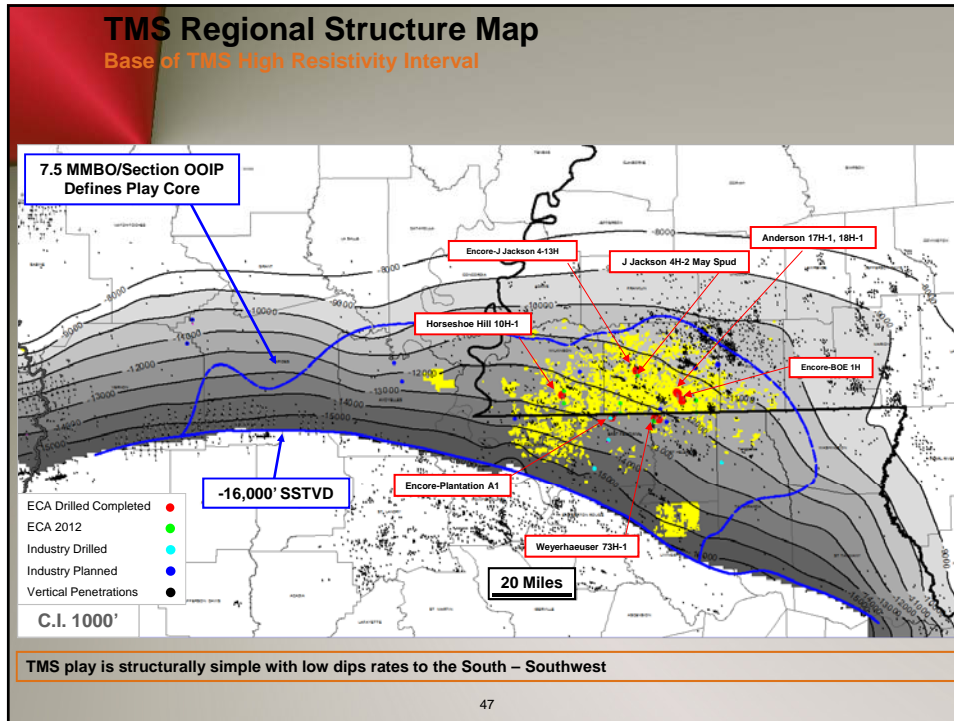
- Based on typical well performance & peak-month production
- Peak-month production:
 - Eagle Ford: 300-6,000 bd
 - Bakken: 150-300 bd
- Well count still much higher in Bakken



Ohio DNR: Utica

- About = size of Eagle Ford
- Could be #3 producing 200,000-500,000 bd
- 3.75 - 15.7 TCF of gas
- 1.31 – 5.5 bill bbls of oil
- Shallower
 - 4,600' v 6,000 in Eagle Ford
- Recovery factor; 5% v 4%
- Formation thickness: 140 feet v 100 feet
- USGA: need 110,000 gas wells & 17,500 oil wells; only 144 drilled so far





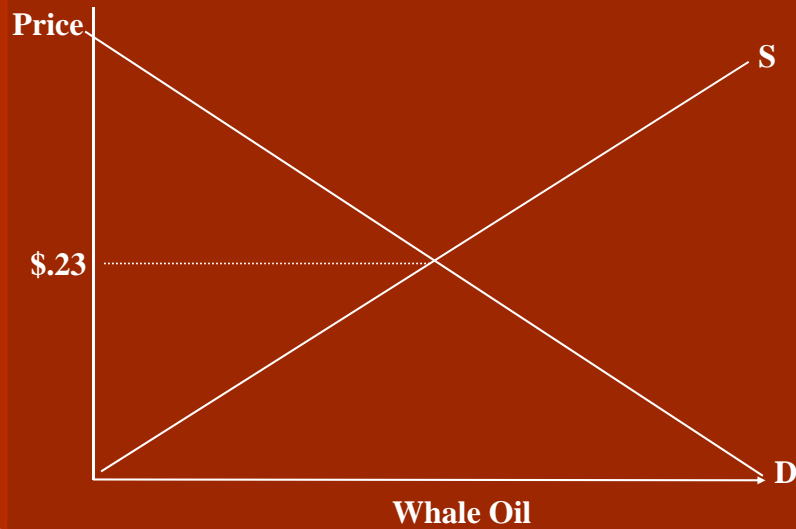
Pipeline Shortage Issue

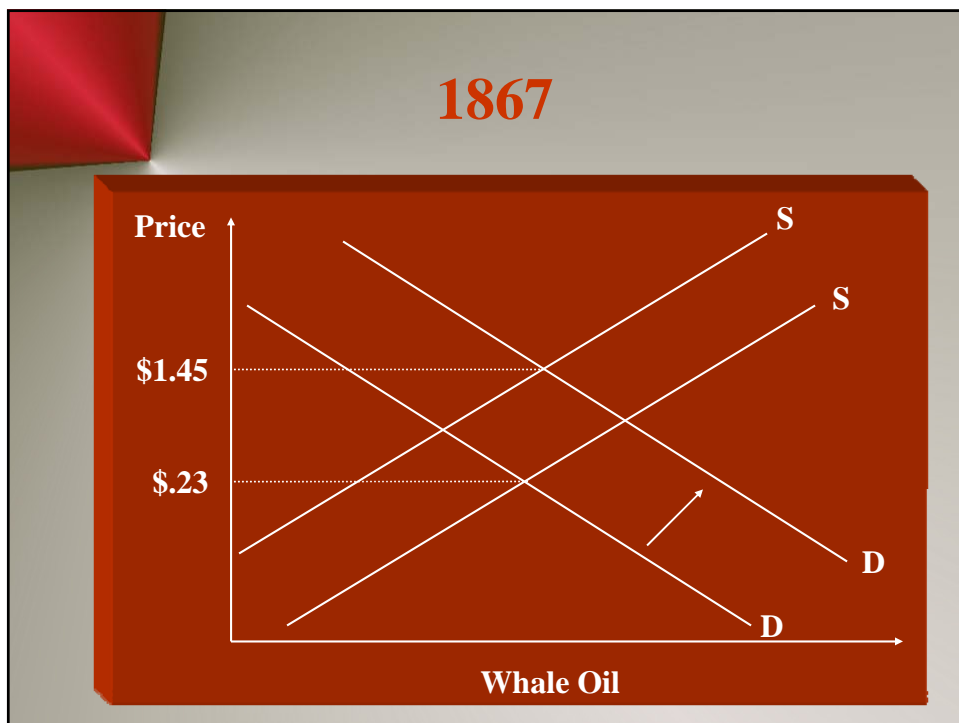
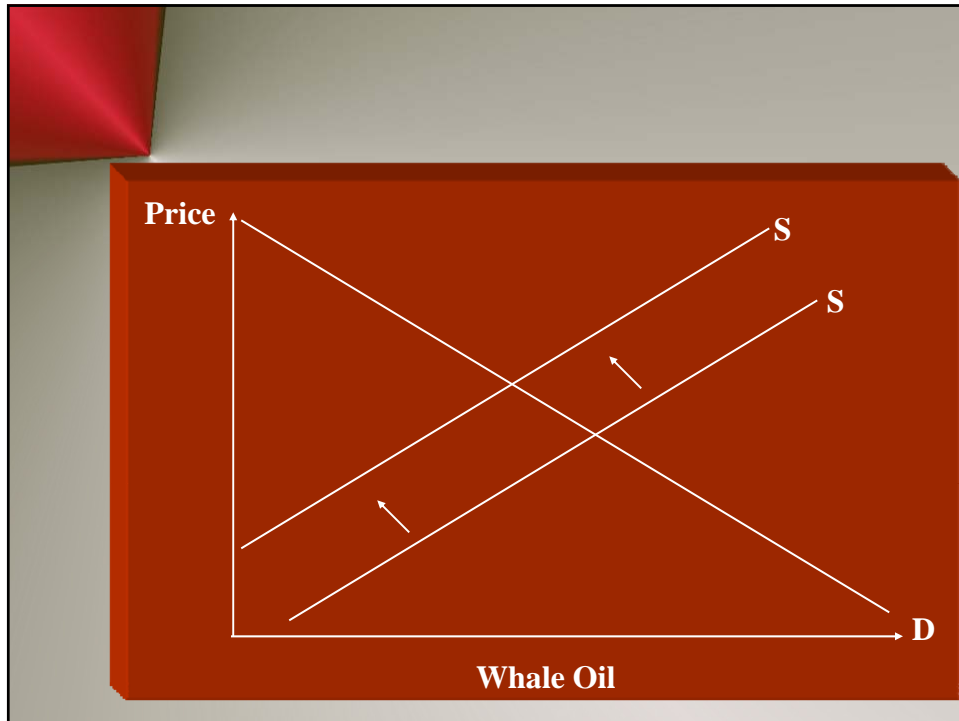
- In Northeast and West
 - Increased demand for rail cars
 - Demand rose from 9,000-11,000 rail cars for petroleum and products for years to 17,000 now. 70% increase
 - Union Tank Car in Alexandria
 - 2010 at 270; 2012 at 584 (+116%)
 - 2012 is **sold out**, including 14% increase in production in 2012-II (+50 jobs)
 - 2013 already **1/3rd sold out**; expect 15% increase in 2013-I (more jobs)
 - Chemical demand also helped
 - Railcar repair facility – Louisville MS

Other Rail Car Demand Boosts

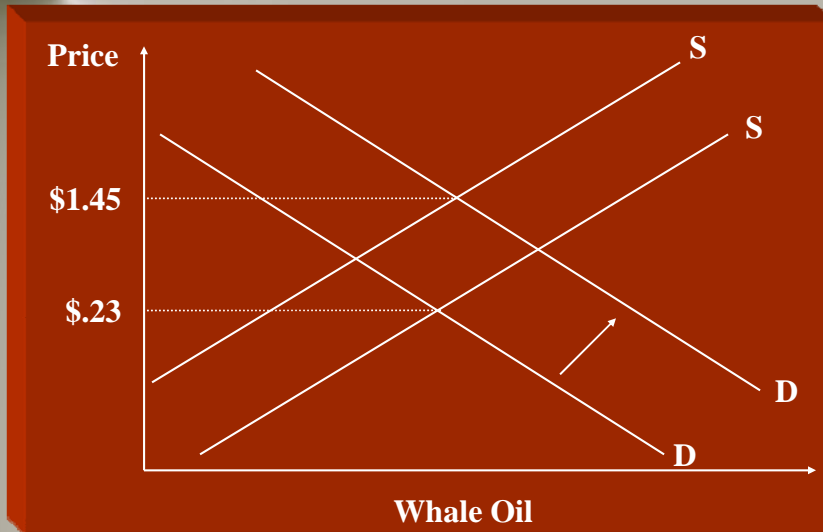
- Hauling proppant sand, drill pipe and other materials to well site
- Some producers building their own loading/unloading terminals
- Pipelines move product from point A to point B; Rail car can go to highest value market. (**Optionality**)
- Companies formed to develop “**unit trains**” rather than “manifest trains” to gain cost advantage and turn around benefits. Works for big plays like Bakken & Eagle Ford
- Unit trains and optionality may mean rail car not just interim solution until pipelines are built.

1865





1859: Oil Discovered



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