Resources, Pipelines, and Hydraulic Fracturing – What will be the Future Natural Gas Mix in New England?

Commissioner Bob Anthony
Chairman, Oklahoma Corporation Commission
NARUC Natural Gas Committee, member since 1989
Past Chairman, National Regulatory Research Institute

Brewster, Massachusetts
NECPUC Symposium – 5/18/2010
2009 Boston Harbor – LNG
Everett, Massachusetts
2009 Boston Harbor – LNG
Everett, Massachusetts
2009 Boston Harbor – LNG
Everett, Massachusetts
2009 Boston Harbor – LNG
Everett, Massachusetts
2009 Boston Harbor – LNG
Everett, Massachusetts
# Oklahoma vs. New England

<table>
<thead>
<tr>
<th></th>
<th>Oklahoma</th>
<th>Ratio</th>
<th>New England</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area</td>
<td>69,898 sq mi</td>
<td>x1</td>
<td>71,991.8 sq mi</td>
</tr>
<tr>
<td>Gross Domestic Product</td>
<td>$150 billion</td>
<td>x4</td>
<td>$636 billion (2007)</td>
</tr>
<tr>
<td>Peak Power Load</td>
<td>15,000 MW</td>
<td></td>
<td>28,000 MW</td>
</tr>
<tr>
<td>Electric Capacity</td>
<td>20,000 MW</td>
<td></td>
<td>31,000 MW</td>
</tr>
<tr>
<td>EIA 2009 Retail Residential Electricity Price</td>
<td>7.48 cents/KWHr</td>
<td>x2</td>
<td>16.32 cents/KWHr</td>
</tr>
<tr>
<td>% Capacity Mix for Electric Generation</td>
<td>51.4/0.2/0.0/32.8/3.3/0.1/12.2%</td>
<td></td>
<td>38.0/24.6/14.4/8.9/10.8/3.3/0.0%</td>
</tr>
</tbody>
</table>
63% of the 2009 ISO-NE Planned Generation Additions Queue is Natural Gas

![Pie chart showing generation sources]

- **Coal**: 8,712 MW (63.0%)
- **Wind**: 2,530 MW (18.3%)
- **Hydro & Pumped Storage**: 1,207 MW (8.7%)
- **Other Renewables**: 583 MW (4.2%)
- **Oil**: 740 MW (5.3%)
- **Nuclear**: 13 MW (0.1%)
- **Natural Gas**: 13,823 MW (32.8%)
- **Massachusetts**: 4,294 MW (31.0%)
- **New Hampshire**: 1,536 MW (11.1%)
- **Vermont**: 315 MW (2.3%)
- **Rhode Island**: 1,033 MW (7.5%)
- **Maine**: 2,111 MW (15.3%)
• Agency established by Constitution at statehood (1907)
• 3 Commissioners, elected statewide, daily meetings
• 15,000 Commission Orders issued in 2009
• 440 Employees
• The OCC has broad regulatory powers over:
  – oil and gas drilling, production and pollution abatement
  – public utilities (telephone, electric and natural gas)
  – trucking
  – railroad crossings
  – petroleum storage tanks and fueling stations
  – pipeline safety
Oklahoma Oil and Gas Industry

- Active wells:
  - 43,600 natural gas
  - 83,600 oil
  - 10,500 injection/disposal
  - 137,700 Total active wells
- ~310,000 plugged and abandoned wells
- ~450,000 wells drilled in Oklahoma history
- 100,000+ hydraulically fractured oil and gas wells
- 2,660 active operators of oil and gas wells
- ~40,000 miles of pipelines under commission jurisdiction
- Oklahoma Oil Production:
  - 2007: 62,539,000 bbls $4.3 billion
  - 2008: 67,304,000 bbls $6.5 billion
  - 2009: 61,535,000 bbls $3.5 billion
- Oklahoma Natural Gas Production:
  - 2007: 1,704,400 MMcf $10.6 billion
  - 2008: 1,792,600 MMcf $13.1 billion
  - 2009: 1,630,200 MMcf $5.7 billion
# Oklahoma Corporation Commission

## Oil and Gas Inspection and Enforcement

<table>
<thead>
<tr>
<th></th>
<th>FY 2007</th>
<th>FY 2008</th>
<th>FY 2009</th>
<th>FY 2010**</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inspections</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Well Site</td>
<td>67,666</td>
<td>74,873</td>
<td>73,661</td>
<td>43,201</td>
</tr>
<tr>
<td>UIC</td>
<td>9,870</td>
<td>9,865</td>
<td>9,844</td>
<td>6,486</td>
</tr>
<tr>
<td>Total</td>
<td>77,536</td>
<td>84,738</td>
<td>83,505</td>
<td>49,687</td>
</tr>
<tr>
<td><strong>Complaints</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pollution</td>
<td>1,377</td>
<td>1,201</td>
<td>1,079</td>
<td>630</td>
</tr>
<tr>
<td>Other</td>
<td>1,939</td>
<td>1,928</td>
<td>1,731</td>
<td>575</td>
</tr>
<tr>
<td><strong>Contempts/Citations</strong></td>
<td>147</td>
<td>150</td>
<td><strong>176</strong></td>
<td>76</td>
</tr>
<tr>
<td><strong>Fines ($)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assessed</td>
<td>$395,386</td>
<td>$238,750</td>
<td><strong>$447,900</strong></td>
<td>$63,400</td>
</tr>
<tr>
<td>Collected</td>
<td>$292,736</td>
<td>$227,250</td>
<td>$291,101</td>
<td>$43,750</td>
</tr>
</tbody>
</table>

* These numbers are for cases filed in the fiscal year and reflect assessments and collections through March 31, 2010.  
** FY10 numbers are from 7/1/09 – 3/31/10.

UIC = Underground Injection Control - EPA program for Class 2 Wells
The oil and gas industry is regulated.

- **CWA**: Clean Water Act
- **SDWA**: Safe Drinking Water Act
- **CAA**: Clean Air Act
- **NEPA**: National Environmental Policy Act
- **ESA**: Endangered Species Act
- **CERCLA**: Comprehensive Environmental Response, Compensation, and Liability Act
- **SARA**: Superfund Amendments and Reauthorization Act

States and state agencies may adopt their own standards; however, these must be at least as protective as the federal standards they replace, and may even be more protective in order to address local conditions.
Oil and Gas Drilling and Production can be Safe – but **Regulation is Essential**

- Oklahoma has over 100 years of experience with oil and gas exploration and production, and our land is arable and our drinking water is safe—in fact Texas wants to buy Oklahoma water.
- However, Safe does not mean accident free.
  - Cars, Airplanes
- Regulation must evolve as experience is gained and oil and gas technology evolves. We update our rules every year.
  - Hydraulic Fracturing and long lateral Horizontal Drilling are just the latest steps in the evolution of Gas Well Drilling technology.
- Regulation must cover the entire life cycle—spudding to plugging.
- Regulation capability must grow to stay in front of the volume of activity—as Pennsylvania and New York are now doing.
- Due to the Marcellus, Pennsylvania and New York may have numbers of wells comparable to Oklahoma in the near future.
Shale Basins and the U.S. Pipeline Grid

Source: American Clean Skies Foundation.
Shale gas and Alaska production offset declines in supply to meet consumption growth and lower import needs.
Hydraulic Fracturing - How to balance the need for new gas supplies with environmental uncertainties

Hydraulic fracturing releases natural gas by injecting highly pressurized water mixed with some sand and a small amount of chemicals through a deep well, lined with steel pipe and sealed with cement, into the ground to break shale rocks and release natural gas.

By enabling access to previously untapped shale basins, hydraulic fracturing has been projected to increase the nation's gas supply by over 35%. Yet, uncertainty about potentially adverse environmental impacts, including concerns about drinking and agricultural water contamination, have raised questions about potential unintended environmental consequences.

Moderator: Hon. Bob Anthony-Chairman, Oklahoma Corporation Commission

Panelists:
Hon. Barry Smitherman-Chairman, Public Utility Commission of Texas
Steve Heare-Dir, Drinking Water Protection Division, Office of Groundwater & Drinking Water, US EPA
Bill Kappel, Hydrologist, Section Chief, US Geological Survey, Water Science Center, Ithaca, NY
Michael Bahorich -Executive Vice President and Technology Officer, Apache Corporation
Nancy Johnson-Dir, Environmental Science and Policy Analysis, DOE Office of Oil and Natural Gas
EPA Official: State Regulators Doing Fine On Hydrofracking

February 15, 2010, Dow Jones, Ian Talley

WASHINGTON (Dow Jones)--State regulators are doing a good job overseeing a key natural gas production technique called hydrofracking and there's no evidence the process causes water contamination, a senior federal environment official said Monday.

Environmentalists and some lawmakers are pressing to give the Environmental Protection Agency federal oversight of the process, concerned that the drilling technique is contaminating water suppliers.

State regulators and the natural gas industry have been fighting against federal regulation, saying it could prevent or delay development of trillions of cubic feet of new resources.

The process, which injects water, sand and a small amount of chemicals into natural gas reservoirs under high pressure, has opened new deposits to development, dramatically expanding estimates for domestic production.

"I have no information that states aren't doing a good job already," Steve Heare, director of EPA's Drinking Water Protection Division said on the sidelines of a state regulators conference here. He also said despite claims by environmental organizations, he hadn't seen any documented cases that the hydro-fracking process was contaminating water supplies.

In its 2011 budget, the EPA is seeking to spend $4 million to study the environmental impacts of the process.

Bill Kappel, a U.S. Geological Survey official, said contamination of water supplies is more likely to happen as companies process the waste water from hydrofracking. In some instances, municipal water systems that treat the water have reported higher levels of heavy metals and radioactivity.

"Treatment of the [waste] water hasn't caught up with the hydro-fracking technology," Kappel said.

But both re-injection of that waste water and water treatment at the surface is already regulated by the federal government under the Safe Drinking Water and Clean Water Acts.

Although legislation in the House and Senate to bring greater federal oversight of the hydro-fracking process hasn't gained momentum, Heare said even if such proposals are approved, it wouldn't likely have a dramatic affect on regulation. States would still have the right under the Safe Drinking Water Act to use their own regulatory standards.

The National Association of Regulatory Utility Commissioners has pushed to maintain state's primacy in oversight of oil and gas activities.

Contrary to some press reports, Heare also noted that the EPA wasn't conducting any current investigations linking hydrofracking to water contaminations.

Companies such as Range Resources Corp. (RRC), EOG Resources Inc. (EOG), Devon Energy Corp. (DVN), Royal Dutch Shell PLC (RDSA) and Chesapeake Energy Corp. (CHK) say the process is multiplying their reserves. For example, the Marcellus deposit that lies under Pennsylvania, Virginia, Ohio and New York is estimated to hold more than 500 trillion cubic feet, compared to total conventional natural-gas resource estimates in the U.S. of around 378 trillion cubic feet, according to the U.S. Geological Survey.

http://online.wsj.com/article/BT-CO-201002150706628.html?mod=WSJ_latestheadlines

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Hydraulic Fracturing on the Net


- The technique of hydraulic fracturing is used to increase or restore the rate at which fluids, such as oil, gas or water can be produced from a reservoir, including unconventional reservoirs such as shale rock or coal beds. **Environmental concerns** regarding hydrofracturing techniques include potential for contamination of aquifers with fracturing chemicals or waste fluids. On the other hand, hydraulic fracturing is applied to remediation of environmental waste spills.

- The process of hydraulic fracturing is used to enable the production of natural gas and oil from rock formations deep below the earth’s surface (generally 5,000-20,000') that otherwise do not possess sufficient porosity and permeability to allow the natural gas and oil to flow up the borehole to be recovered at the surface of the earth. Creating conductive fractures in the rock is essential to produce hydrocarbons due to the extremely low natural permeability of shale reservoirs (measured in the microdarcy to nanodarcy range). The fracture provides a conductive path connecting a larger area of the reservoir to the well, thereby increasing the area from which natural gas and liquids can be recovered from the targeted formation.

- Hydraulic fracturing for stimulation of oil and natural gas wells was first used in the United States in 1947. It was first used commercially in 1949, and because of its success in increasing production from oil wells was quickly adopted, and is now used worldwide in tens of thousands of oil and natural gas wells annually.

- As estimated 90% of the natural gas wells in the U.S. rely on hydraulic fracturing to produce natural gas at economic rates.

Natural Resources Defense Council (NRDC)
http://switchboard.nrdc.org/blogs/amall/incidents_where_hydraulic_frac.html

Gas Shale Primer
(DOE Office of Fossil Energy)

IOGCC on Hydraulic Fracturing

Hydraulic Fracturing
Hydraulic fracturing is a technique used to allow oil and natural gas to move more freely from the rock pores where they are trapped to a producing well that can bring them to the surface. The technology was developed in the late 1940s and has been continuously improved and applied since that time. The process of hydraulic fracturing plays a major role in the development of virtually all unconventional oil and natural gas resources.

State Regulation
Hydraulic fracturing is regulated by the states. IOGCC member states each have comprehensive laws and regulations to provide for safe operations and to protect drinking water sources, and have trained personnel to effectively regulate oil and gas exploration and production. On March 5, 2009, the IOGCC hosted two briefings on Capitol Hill to explain state regulation of oil and natural gas. The presentation included an explanation of hydraulic fracturing and how existing state regulations prevent contamination of drinking water resources during hydraulic fracturing operations.

Is Hydraulic Fracturing Safe?
In 2004, the U.S. Environmental Protection Agency completed a study of the environmental risks associated with the hydraulic fracturing of coal bed methane wells. The EPA concluded that the injection of hydraulic fracturing fluids poses little or no threat to underground sources of drinking water.

Although thousands of wells are fractured annually, the EPA did not find a single incident of the contamination of drinking water wells by hydraulic fracturing fluid injection. Additionally, IOGCC member states have all stated that there have been no cases where hydraulic fracturing has been verified to have contaminated drinking water.
Hydraulic Fracturing Basics

Oklahoma

- Over 60 years of Hydraulic Fracturing (better than nitroglycerin)
- Over 100,000 hydraulically fractured oil and gas wells
- No verified or documented instances of harm to groundwater from HF
- Cost per well: $10,000 to $1 million plus
- HF tailored to individual well characteristics

What is Hydraulic Fracturing?

- A method for creating a conductive fracture or crack in a subsurface formation to provide an easier path for fluids to flow to the well bore from the extremities of the well's drainage area

Why Frac?

- To stimulate oil and/or gas production to increase Net Present Value (NPV) of a well through:
  - Accelerating income through increasing production rates
  - Reducing well life operating expenses
  - Increasing total cumulative production (reserves)

Source: “Hydraulic Fracturing”, Mohd Zaki bin Awang
Hydro Fracking is used for water wells in New England . . .

WATER WELL FRACKING RESOURCES
(different drillers use their own proprietary chemical mixtures)

American Well Water Trust--What is Hydro Fracking

Goodwin Well & Water (North Turner, ME)
http://www.goodwinwellandwater.com/hydrofac/index.html

Cushing and Sons (Keene, New Hampshire)
http://www.cushingandsons.com/wells.html

Northeast Water Wells (Hudson, New Hampshire)
http://www.wellguy.com/Hydrofrac1.html

Schrader Well Drilling (Carbon, Indiana)
http://www.schraderwells.com/Hydrofracking.html

Lusier Drilling (Oconto Falls, WI)
http://www.luisierdrilling.com/hydro.html
Hydraulic Fracturing Installation
Natural Gas
Traps vs. Shales

Hydrocarbon Trap

Impermeable Sealing Layer

Organic Rich Source Layer

Migrating Hydrocarbons

Porous & Permeable Reservoir Layer

Source: Devon Energy

Source: NECPUC Symposium – 5/18/2010
Natural Gas
Traps vs. Shales

Source: Devon Energy
EXHIBIT 30: CASING ZONES AND CEMENT PROGRAMS

Source: "Modern Shale Gas, A Primer", p. 52
The fracking process takes place 2 miles below the base of the fresh water aquifer.
Process Flow of a Hydraulic Fracturing Job

EXHIBIT 35: VOLUMETRIC COMPOSITION OF A FRACTURE FLUID

Source: “Modern Shale Gas, A Primer”, p. 62
Typical Deep Shale Fracturing Mixture

More than 99% of the fracturing mixture is comprised of freshwater and sand. The remainder is additives; the main components are listed below.

<table>
<thead>
<tr>
<th>Additive Type</th>
<th>Main Compound</th>
<th>Purpose</th>
<th>Common Use of Main Compound</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acid</td>
<td>Hydrochloric acid or muriatic acid</td>
<td>Helps dissolve minerals and initiate cracks in the rock</td>
<td>Swimming pool chemical and cleaner</td>
</tr>
<tr>
<td>Antibacterial agents</td>
<td>Glutaraldehyde</td>
<td>Eliminates bacteria in the water that produce corrosive by-products</td>
<td>Disinfectant; sterilizer for medical and dental equipment</td>
</tr>
<tr>
<td>Breaker</td>
<td>Ammonium Persulfate</td>
<td>Allows a delayed break down of the gel</td>
<td>Used in hair coloring, as a disinfectant, and in the manufacture of common household plastics</td>
</tr>
<tr>
<td>Corrosion inhibitor</td>
<td>Formamide</td>
<td>Prevents the corrosion of the well casing</td>
<td>Used in pharmaceuticals, acrylic fibers and plastics</td>
</tr>
<tr>
<td>Crosslinker</td>
<td>Borate salts</td>
<td>Maintains fluid viscosity as temperature increases</td>
<td>Used in laundry detergents, hand soaps and cosmetics</td>
</tr>
<tr>
<td>Friction reducer</td>
<td>Petroleum distillate</td>
<td>“Slicks” the water to minimize friction</td>
<td>Used in cosmetics including hair, make-up, nail and skin products</td>
</tr>
<tr>
<td>Gel</td>
<td>Guar gum or hydroxyethyl cellulose</td>
<td>Thickens the water in order to suspend the sand</td>
<td>Thickener used in cosmetics, baked goods, ice cream, toothpaste, sauces and salad dressings</td>
</tr>
<tr>
<td>Iron control</td>
<td>Citric acid</td>
<td>Prevents precipitation of metal oxides</td>
<td>Food additive; food and beverages; lemon juice ~7% citric acid</td>
</tr>
<tr>
<td>Clay stabilizer</td>
<td>Potassium chloride</td>
<td>Creates a brine carrier fluid that prohibits fluid interaction with formation clays</td>
<td>Used in low-sodium table salt substitute, medicines and IV fluids</td>
</tr>
<tr>
<td>pH adjusting agent</td>
<td>Sodium or potassium carbonate</td>
<td>Maintains the effectiveness of other components, such as crosslinkers</td>
<td>Used in laundry detergents, soap, water softener and dishwasher detergents</td>
</tr>
<tr>
<td>Proppant</td>
<td>Silica, quartz sand</td>
<td>Allows the fractures to remain open so the gas can escape</td>
<td>Drinking water filtration, play sand, concrete and brick mortar</td>
</tr>
<tr>
<td>Scale inhibitor</td>
<td>Ethylene glycol</td>
<td>Prevents scale deposits in the pipe</td>
<td>Used in household cleaners, de-icer, paints and caulk</td>
</tr>
<tr>
<td>Surfactant</td>
<td>Isopropanol</td>
<td>Used to reduce the surface tension of the fracturing fluids to improve liquid recovery from the well after the frac</td>
<td>Used in glass cleaner, multi-surface cleansers, antiperspirant, deodorants and hair color</td>
</tr>
<tr>
<td>Water</td>
<td>Water</td>
<td>Used to expand fracture and deliver proppant (sand)</td>
<td>Landscaping, manufacturing</td>
</tr>
</tbody>
</table>

Source: Chesapeake Marcellus Hydraulic Fracturing Fact Sheet, March 2010
# Water Usage

**EXHIBIT 37: ESTIMATED WATER NEEDS FOR DRILLING AND FRACTURING WELLS IN SELECT SHALE GAS PLAYS**

<table>
<thead>
<tr>
<th>Shale Gas Play</th>
<th>Volume of Drilling Water per well (gal)</th>
<th>Volume of Fracturing Water per well (gal)</th>
<th>Total Volumes of Water per well (gal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barnett Shale</td>
<td>400,000</td>
<td>2,300,000</td>
<td>2,700,000</td>
</tr>
<tr>
<td>Fayetteville Shale</td>
<td>60,000*</td>
<td>2,900,000</td>
<td>3,060,000</td>
</tr>
<tr>
<td>Haynesville Shale</td>
<td>1,000,000</td>
<td>2,700,000</td>
<td>3,700,000</td>
</tr>
<tr>
<td>Marcellus Shale</td>
<td>80,000*</td>
<td>3,800,000</td>
<td>3,880,000</td>
</tr>
</tbody>
</table>

* Drilling performed with an air “mist” and/or water-based or oil-based muds for deep horizontal well completions.
Note: These volumes are approximate and may vary substantially between wells.

Source: "Modern Shale Gas, A Primer", p. 64
What’s The Problem With Flowback Water?

• Can pick up contaminants downhole such as:
  – Barium, Calcium Bicarbonate, Iron, Magnesium Sulfate, Sodium Chloride, Strontium

• Possibly comes back with:
  – Organic materials (bacteria from rock, chemicals from job)
  – Polymer from friction reducer
  – Residual Hydrocarbons
  – Suspended solids (clay, iron oxides, silica)
## Variable Water Sources

<table>
<thead>
<tr>
<th>Sample</th>
<th>#1</th>
<th>#2</th>
<th>#3</th>
<th>#4</th>
<th>#5</th>
<th>#6</th>
<th>#7</th>
<th>#8</th>
<th>#9</th>
<th>#10</th>
<th>#11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific Gravity</td>
<td>1.026</td>
<td>1.036</td>
<td>1.019</td>
<td>1.012</td>
<td>1.07</td>
<td>1.1</td>
<td>1.17</td>
<td>1.105</td>
<td>1.066</td>
<td>1.02</td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td>7.92</td>
<td>7.51</td>
<td>7.91</td>
<td>6.61</td>
<td>6.72</td>
<td>6.68</td>
<td>6.05</td>
<td>7.11</td>
<td>7.04</td>
<td>6.83</td>
<td></td>
</tr>
<tr>
<td>Bicarbonate</td>
<td>1,010</td>
<td>717</td>
<td>1,190</td>
<td>259</td>
<td>183</td>
<td>193</td>
<td>76</td>
<td>366</td>
<td>366</td>
<td>839</td>
<td>94</td>
</tr>
<tr>
<td>Chloride</td>
<td>19,400</td>
<td>29,400</td>
<td>10,000</td>
<td>6,290</td>
<td>59,700</td>
<td>87,700</td>
<td>153,000</td>
<td>96,400</td>
<td>58,300</td>
<td>11,500</td>
<td>19,730</td>
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<tr>
<td>Sulfate</td>
<td>34</td>
<td>0</td>
<td>88</td>
<td>67</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>670</td>
<td>479</td>
<td>0</td>
<td>3,100</td>
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<tr>
<td>Calcium</td>
<td>630</td>
<td>1,058</td>
<td>294</td>
<td>476</td>
<td>7,283</td>
<td>10,210</td>
<td>20,100</td>
<td>4,131</td>
<td>2,573</td>
<td>282</td>
<td>451</td>
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<tr>
<td>Magnesium</td>
<td>199</td>
<td>265</td>
<td>145</td>
<td>49.6</td>
<td>599</td>
<td>840</td>
<td>1690</td>
<td>544</td>
<td>344</td>
<td>40.7</td>
<td>1,330</td>
</tr>
<tr>
<td>Barium</td>
<td>49.4</td>
<td>94.8</td>
<td>6.42</td>
<td>6.24</td>
<td>278</td>
<td>213</td>
<td>657</td>
<td>1.06</td>
<td>5.1</td>
<td>97.4</td>
<td></td>
</tr>
<tr>
<td>Strontium</td>
<td>107</td>
<td>179</td>
<td>44.7</td>
<td>74.3</td>
<td>2,087</td>
<td>2,353</td>
<td>5,049</td>
<td>178</td>
<td>112</td>
<td>45.3</td>
<td></td>
</tr>
<tr>
<td>Total Iron</td>
<td>4.73</td>
<td>25.7</td>
<td>8.03</td>
<td>14</td>
<td>27.4</td>
<td>2.89</td>
<td>67.6</td>
<td>26.4</td>
<td>33.8</td>
<td>63.4</td>
<td>0</td>
</tr>
<tr>
<td>Aluminum</td>
<td>0.17</td>
<td>0.21</td>
<td>0.91</td>
<td>0.38</td>
<td>0.18</td>
<td>0</td>
<td>0</td>
<td>0.17</td>
<td>0.78</td>
<td>1.12</td>
<td></td>
</tr>
<tr>
<td>Silica</td>
<td>33.8</td>
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**Woodford**  **Marcellus**  **Bakken**  **Piceance**  **GOM Sea water**

**NECPUC Symposium – 5/18/2010**
State Regulation is better than EPA Regulation

- Geology differs among/within states, not one size fits all
- Water best allocated by state/local authorities
- Local knowledge of specific aquifers and producing gas formations is required
- States can adopt rules for specific geographic areas--field rules
- States can adopt, amend rules quickly to respond to changing circumstances, technology
- State Inspectors live in the area and are more responsive to citizen concerns
- States can react and make decisions more quickly
  - Recent purging well in Bartlesville, OK was dealt with within hours
- Historically EPA has not focused on groundwater
- EPA has not had adequate financing to address known groundwater problems
- EPA traditionally grants primacy for inspection/enforcement program to states