Look Before You Leap Off the Natural Gas Bridge: Lessons from the Rockies

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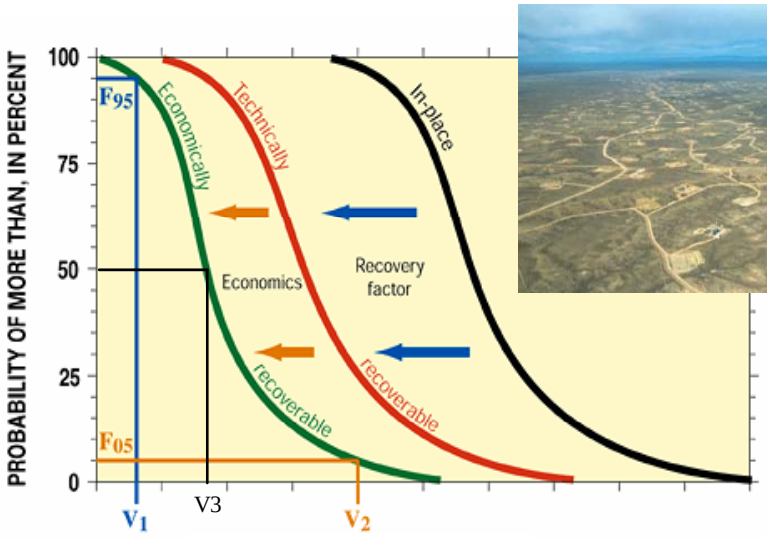
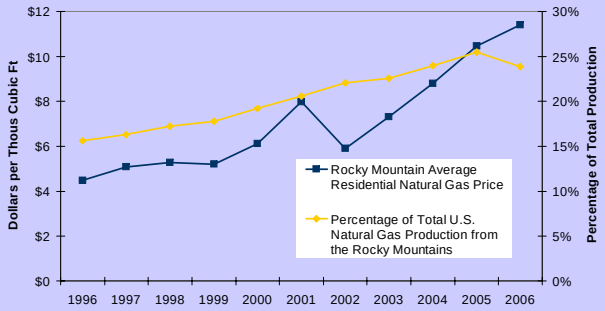
Is this "environmentally friendly" drilling?

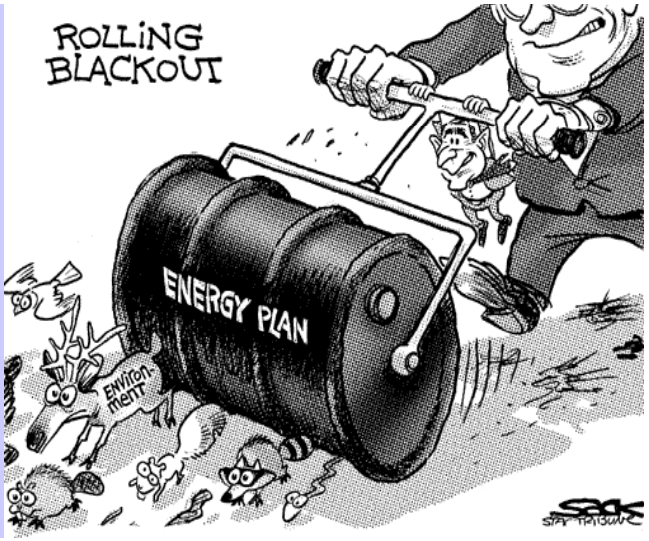


Volume of gas increasing ⇨

Estimates of the energy potential should be based on the economically recoverable amount of gas. Relying on technically recoverable estimates exaggerates the energy potential and the opportunity costs.

Rocky Mountain States Natural Gas Production and Residential Prices





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Look Before You Leap Off the Natural Gas Bridge: Lessons from the Rockies

1. Review of TWS Energy Research 2001 – 2009
2. Economics 101
3. A Look Back at the Bush Drilling Boom in the Rockies
4. **A Continued Emphasis on Domestic Drilling for Natural Gas is an Inefficient and Short-sighted Energy and Climate Policy**
5. Summary

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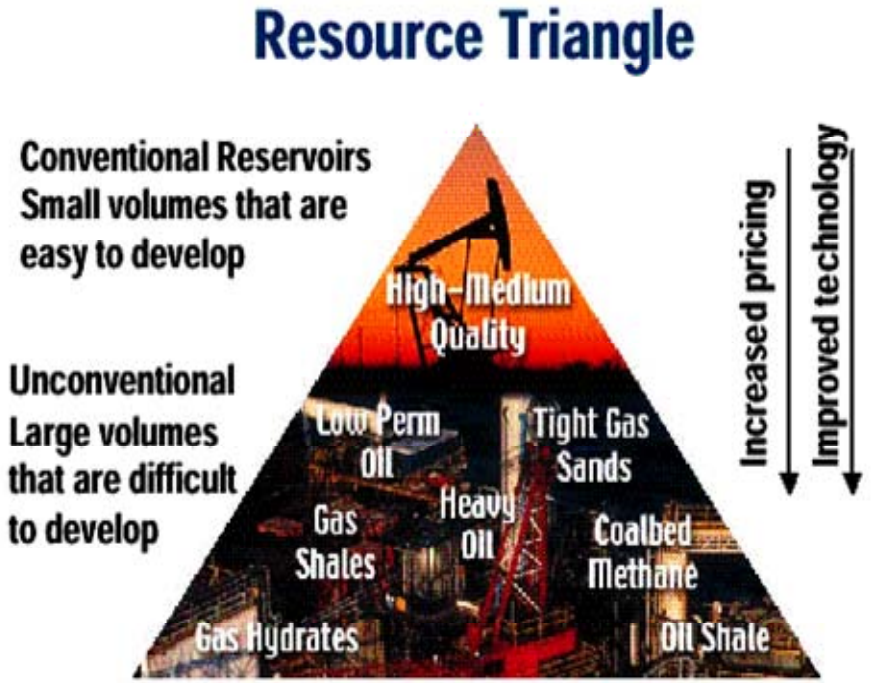
A Continued Emphasis on Domestic Drilling for Oil and Natural Gas is an Inefficient Energy-Climate Policy

As a result of extensive domestic drilling in the past, the U.S. has a “mature” oil and natural gas resource base. Our remaining domestic oil and natural gas are expensive to extract. Natural gas is a non-renewable fossil fuel resource that increases greenhouse gas emissions when extracted and consumed.

<u>Thesis</u>

An energy-climate policy that continues to emphasize domestic drilling is an inefficient approach for reducing energy costs for consumers, creating jobs, increasing long term energy security for America, and addressing global climate change.



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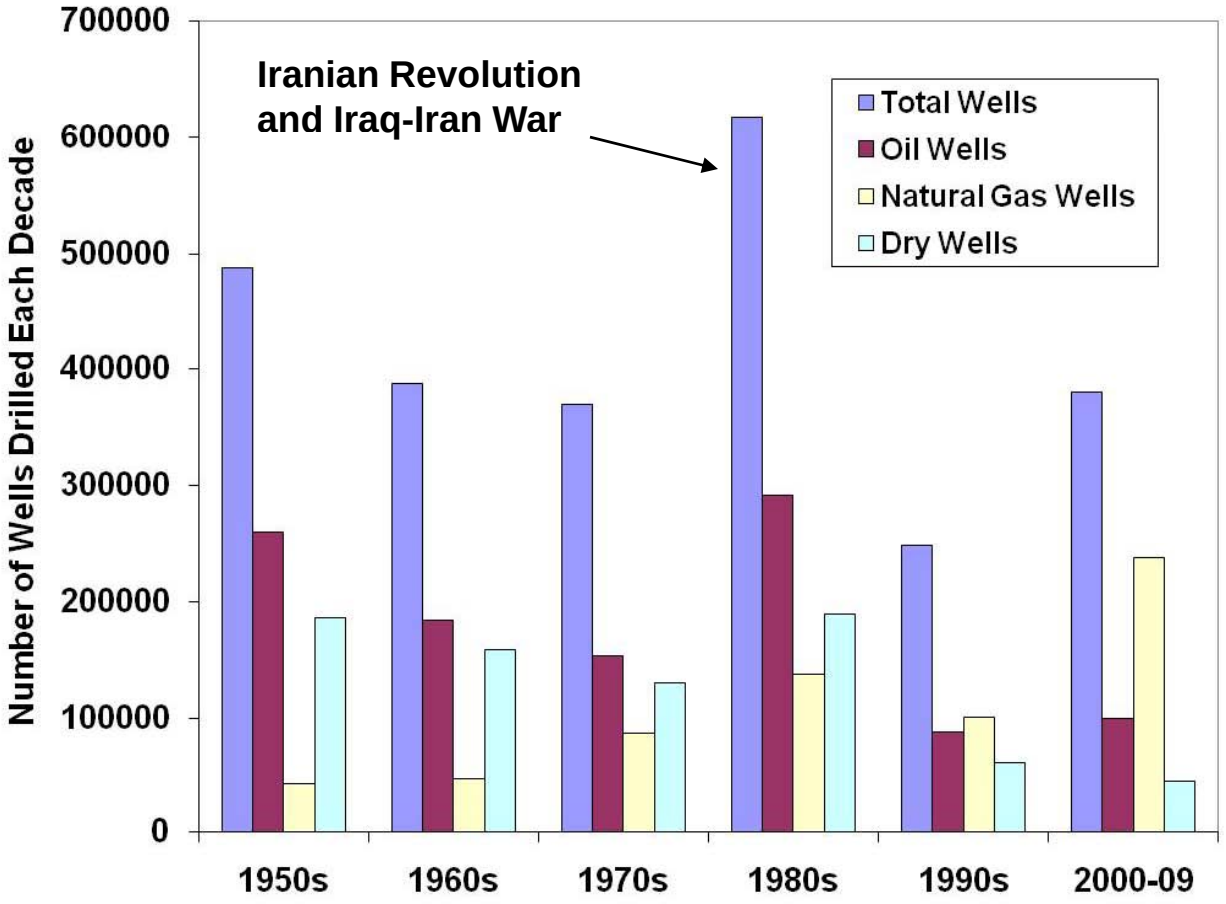
U.S. Domestic Drilling by Decade, by Type of Well

(1950s, 1960s, 1970s, 1980s, 1990s, and 2000 – Aug 2009)

Since 1950, nearly 2.5 million wells were drilled in the U.S., including over 1 million oil wells, about 650,000 natural gas wells, and 766,000 dry wells. More oil and natural gas wells have been drilled in the U.S. than the rest of the world combined.



Data Source: U.S. Energy Information Administration, October 2009

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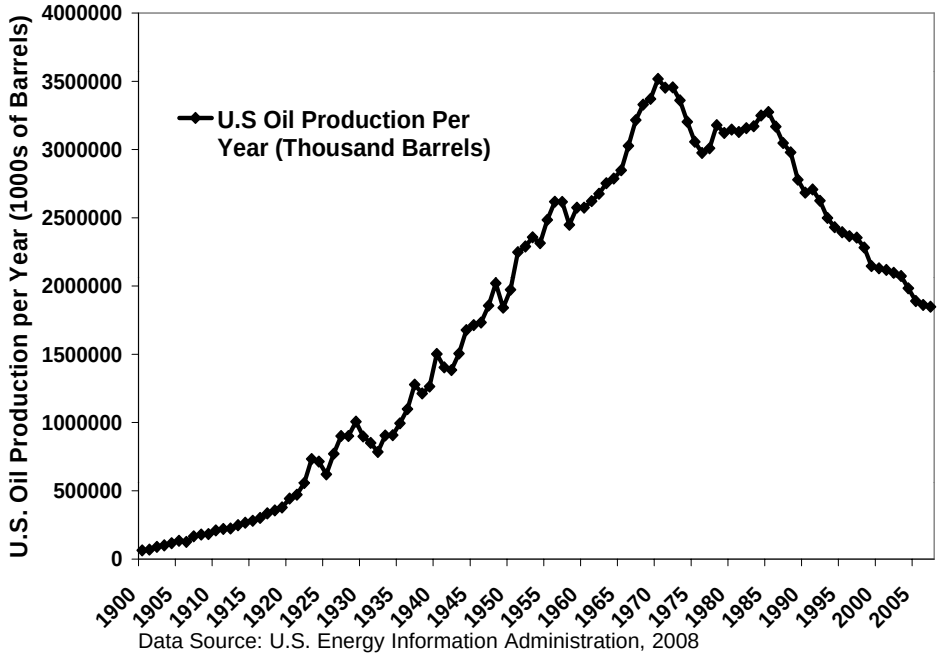
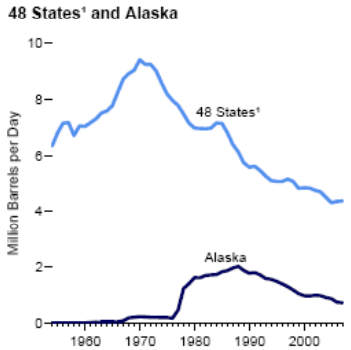
U.S. Domestic Oil Production Per Year (1949 – 2006)

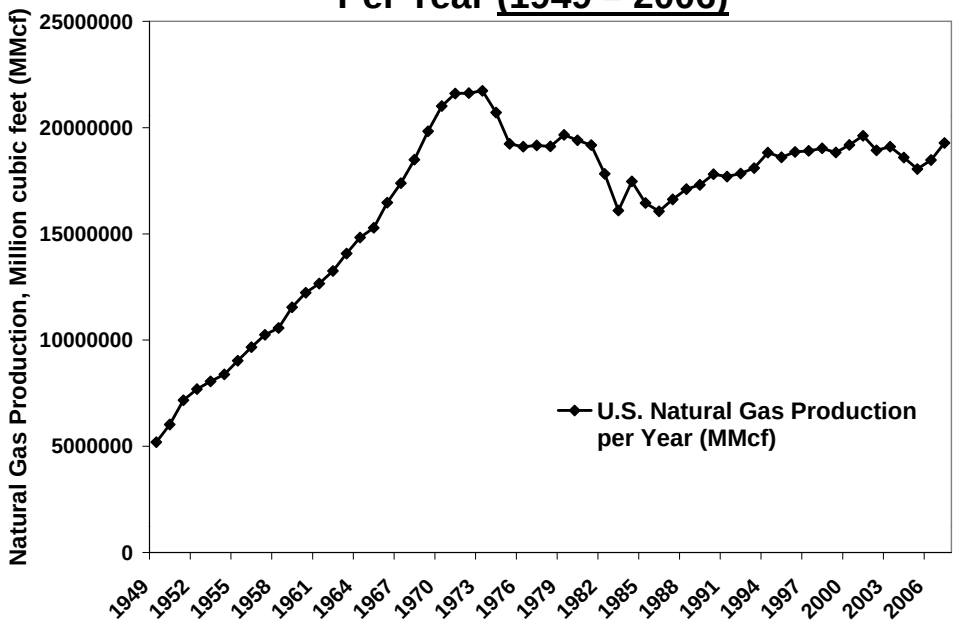


Data Source: U.S. Energy Information Administration, 2008

U.S. domestic oil production peaked in 1970.



U.S. Domestic Natural Gas Production Per Year (1949 – 2006)



Data Source: U.S. Energy Information Administration, 2008

U.S. domestic natural gas production peaked in 1973.

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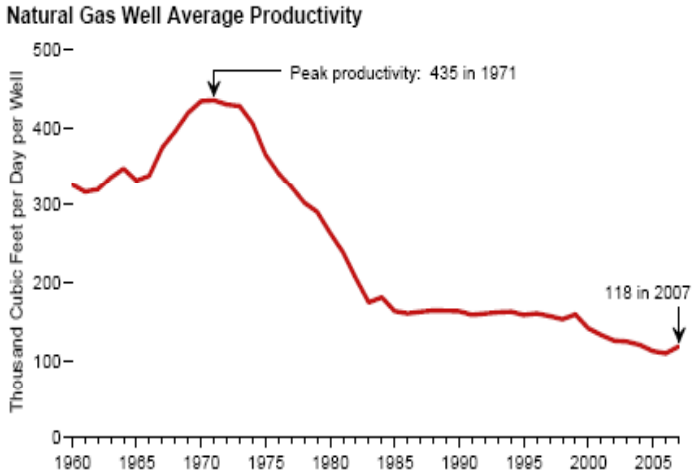
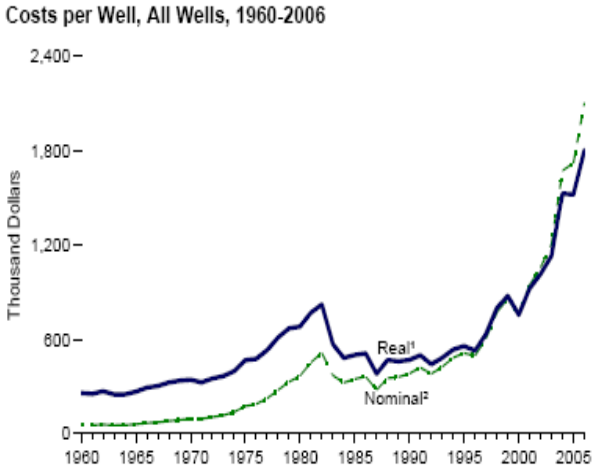
The U.S. has a Mature Resource Base and our Remaining Domestic Oil and Natural Gas Resources are Expensive

More oil and natural gas wells have been drilled in the U.S. than in all other countries combined. In general, our remaining oil and natural gas resources have high extraction and energy costs, emit considerable pollution during production and consumption, and have a declining productivity per well.

The declining productivity of U.S. oil and natural gas wells, when combined with the increasing extraction costs, support the thesis that an emphasis on domestic drilling is an inefficient energy and climate policy.

The Average Productivity of U.S. Oil and Natural Gas Wells is Declining while the Costs per Well are Increasing (Source: U.S. EIA 2008).





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A Continued Emphasis on Domestic Drilling is an Inefficient Energy-Climate Policy

Subsidizing domestic drilling hurts the U.S. economy by increasing the federal deficit and by directing capital investments away from other more productive sectors of our economy (Kaufman and Cleveland 1991).

"The available evidence suggests that these (Bush energy) policies will collide with the realities of the state of depletion of the domestic oil resource base, the economics of the international oil market, and the ecology of some the planet's most important ecosystems. The policies will fail to improve our energy security or reduce OPEC's market control, and they will damage the U.S. economy and the environment in significant ways" (Cleveland and Kaufman 2002).

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"The Potential Gas Committee… reported in June that the U.S. has 1,836 Tcf …of technically recoverable natural gas…When the U.S. Department of Energy's proven reserves are added to the total, the U.S. future natural gas supply is over 2,000 Tcf. At today's rate of use, this is enough natural gas to meet demand for the next 100 years." *Senator James Inhofe (R-Okla.), July 2009*

Does the U.S. really have 100-year supply of natural gas?

Let's do the math – based on current demand.

If we assume an economic recovery rate of 100 percent for the undiscovered, unproven, technically recoverable natural gas, the PGC estimate suggests 2,074 Tcf (trillion cubic feet) of U.S. total domestic supply (1,836 Tcf recovered plus 238 Tcf of proven reserves).

Current U.S. natural gas demand is about 23 Tcf per year. Optimistically assuming an economic recovery rate of **100 percent**, domestic supplies will last **90 years**. Note: This calculation assumes we become "energy independent". If we continue to import natural gas, our supply will last longer.

If we assume an economic recovery rate of **80 percent**, our domestic supply of natural gas will last **74 years** based on current demand.

If we assume a **50 percent** economic recovery rate, our domestic supply of natural gas will last **50 years** based on current demand.

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Does the U.S. have 100-year supply of natural gas?
Let's do the math – but this time with natural gas demand increasing.

Let's again use the PGC estimate of 2,074 Tcf of total domestic natural gas supply – but assume that Congressional tax breaks and subsidies increase the demand for natural gas.

If we assume annual demand for natural gas increases **2 percent**, domestic natural gas supplies will last only **46 to 52 years**, based on economic recovery rates of **80 and 100 percent**, respectively.

If we assume annual demand for natural gas increases **5 percent**, domestic natural gas supplies will only last **32 and 35 years**, based on economic recovery rates of **80 to 100 percent**, respectively.

Note: Natural gas supply estimates from the government's Energy Information Administration are 15 percent less than the PGC supply estimates. Obviously if we use the lower EIA estimates, our nation's supply of natural gas will last fewer years than estimated here.

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"I am disturbed that public companies and investment analysts make fantastic claims about the rates and reserves for new shale plays without calibrating them to the only play that has significant production history. Almost every assumption used by the industry to support predictions about the Haynesville or Marcellus Shale plays is questionable based on well performance in the Barnett Shale….There are many lessons we can learn from the Barnett Shale, and they all suggest a cautious approach to developing new shale plays."

Arthur Berman, a contributing editor and columnist for World Oil *magazine, is a geological consultant whose specialties are subsurface petroleum geology, seismic interpretation, and database design and management*

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"…my concern is that everybody wants natural gas to be their answer. Pickens wants it to displace imported oil. Proponents of renewable energy want it as a backup to fill the intermittency of wind and solar. Anti-nuclear people want it instead of nuclear. And anti-coal people want it to displace coal. Everybody wants to put all their eggs in the basket of natural gas."

Vince Matthews, Colorado State Geologist (2009)

"But Matthews isn't convinced enough natural gas exists to be the answer for all needs. Unlike the earlier deposits of natural gas, the so-called shale plays stop producing very rapidly, requiring far more drilling."

The Carbon Conundrum, Allen Best (2009)

Morton, P. (2009)

True or False: Natural gas produces half as much carbon as coal.

This statement is only true if we narrowly focus only on combustion at the power plant.

<u>This statement is false</u> when we include the fugitive carbon dioxide and methane emissions associated with upstream and downstream activities.

It is the fugitive emissions, not necessarily the combustion emissions, that are causing significant air pollution problems in rural communities in the west.

A Life Cycle Analysis is needed to really compare the GHG emission benefits from burning more natural gas.

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A Life Cycle Analysis Reveals that the Climate Advantage of Natural Gas over Coal is Smaller than Assumed.

"One of the most important results of this thesis is that life cycles matter…. When comparing coal and natural gas for electricity generation, if we only look at the GHG emissions from the power plant, natural gas looks like a much better fuel choice…Looking at the life cycle however, has allowed us to see that these benefits at the combustion plant are reduced by the emissions from other stages of the life cycle. **Looking at the life cycle also allowed us to identify that…the benefits of natural gas over coal are not very significant…**." (Jaramilla 2007, page 73-74)

Dr. Jaramilla's dissertation found that the life cycle analysis does not increase greenhouse gas emissions as much for coal as it does for natural gas. This is because most of the GHG emissions associated with coal occur during combustion.

Extracting unconventional natural gas (shale gas, coal bed methane, tight sands gas) requires drilling more wells, requires more pipelines, more compressor stations, and more roads – all of which suggest that fugitive GHG emissions per Btu will increase with unconventional natural gas when compared to conventional natural gas.

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When Fugitive GHG Emissions are Counted, the Climate Advantage of Natural Gas over Coal Decreases and may Disappear all Together.

The life cycle analysis by Jaramillo (2007) shows the CO2 advantage of burning natural gas over coal to be small.

That advantage will decrease when we include the GHG emissions produced from building the necessary infrastructure to burn natural gas in coal plants and/or cars.

The advantage of natural gas over coal may disappear all together when we include the carbon lost from converting forestland to natural gas pads. Forest conversion accounts for approximately 25% of global carbon dioxide emissions.

If industry drills 30-50,000 wells each year and converts 100,000-250,000 acres of forest land in the south and the east to natural gas well pads, waste pits and pipelines – the forest carbon lost from the forest conversion will be significant.

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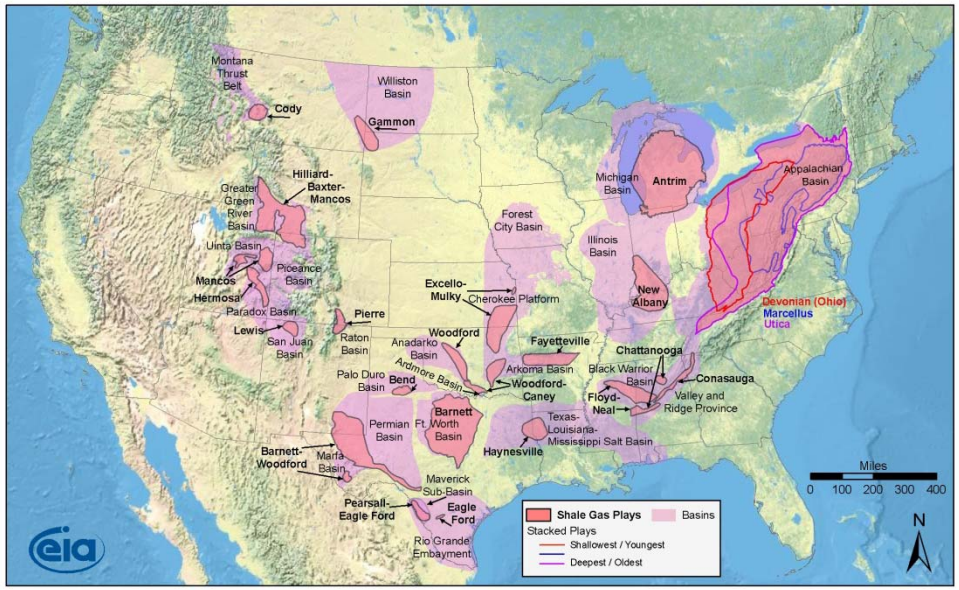
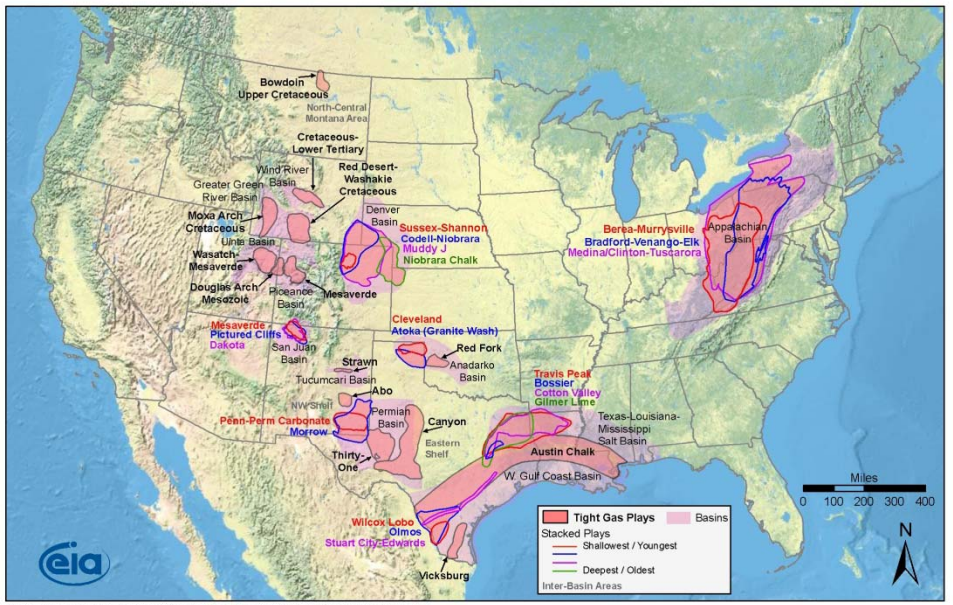
Shale Gas Plays, Lower 48 States



Source: Energy Information Administration based on data from various published studies
Updated: May 28, 2009

Major Tight Gas Plays, Lower 48 States



Source: Energy Information Administration based on data from various published studies
Updated: April 8, 2009

As the U.S exploits its remaining natural gas endowment, much of the new drilling is likely to occur on private land in Texas, the south, and the eastern United States.

Potential concerns for local citizens include private property rights, water and air pollution, impacts on other businesses, and social justice issues.

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What About Future Generations?

The U.S. has less than 4 percent of the world's natural gas reserves but we account for 21 percent of the world's demand for natural gas (EIA 2009).

Question 1: Does a continued emphasis on increasing domestic production of our non-renewable oil and natural gas resources reduce the energy security of our great grandchildren?

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What About Future Generations?

The U.S. has less than 4 percent of the world's natural gas reserves but we account for 21 percent of the world's demand for natural gas (EIA 2009).

Question 2: Do we have a moral responsibility to reduce our oil and natural gas consumption in order to "stretch" our domestic supply, so that future generations will have more resources and more energy options available to them?

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Rawls's Veil of Ignorance and Our Decision to Drill for Natural Gas

> The "veil of ignorance" deprives parties of all knowledge of particular facts about themselves, about one another, and even about their society and its history. John Rawls, A Theory of Justice, 1971

Question 3. If you did not know whether you were to be alive in 2009 -- the current generation -- or in the year 2525 – a future generation -- would you:

A) Prefer the current generation to rapidly consume our remaining non-renewable natural gas endowment?

B) Prefer the current generation to dramatically reduce its demand-consumption in order to leave some natural gas for future generations?

What would Henry David Thoreau, John Muir, Rosalie Edge, Aldo Leopold, Marjory Stoneman Douglas, Teddy Roosevelt, Rachael Carson, Celia Hunter, or Gaylord Nelson do?

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Demand Side Management and A Consumption Ethic

To address consumer costs, energy security, job creation and climate change in an economically sound manner, we should focus our efforts and incentives much more on the demand side of the equation -- and much less on the supply side.

If, for example, we decrease our annual demand for natural gas 1 percent -- down to half of our current rate of consumption -- U.S. domestic **natural gas supplies will last 118 to 150 years**, based on economic recovery rates of 80 and 100 percent, respectively.

To help reduce our energy demand and our nation's ecological footprint, perhaps it is time to embrace an American "consumption ethic" -- which flows directly from Aldo Leopold's "land ethic".

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The Land Ethic

"All ethics so far evolved rest upon a single premise that the individual is a member of a community of interdependent parts….The land ethic simply enlarges the boundaries of the community to include soils, waters, plants, and animals, or collectively: the land.

In short, a land ethic changes the role of *Homo sapiens* from conqueror of the land-community to plain member and citizen of it. It implies respect for his fellow-members, and also respect for the community as such."

Aldo Leopold (1949), A Sand County Almanac.

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