

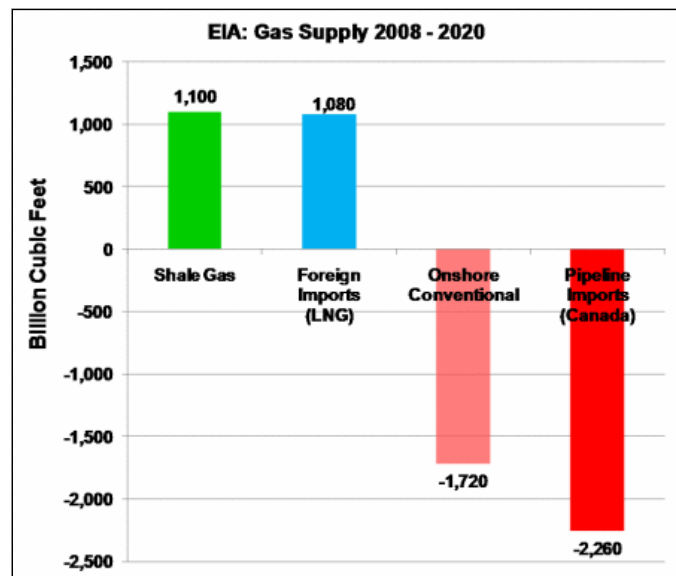
# Can shale gas be delivered at scale and at an affordable price?

Conventional natural gas production in the U.S. is increasingly on the decline, and Canadian imports are expected to decrease 80% over the next decade. [1] Many see "shale gas" as the emerging solution to not only offset these declines but also to provide fuel for vehicles, baseload electric power and even backup to wind turbines since they produce power only about 25% of the time. [2]

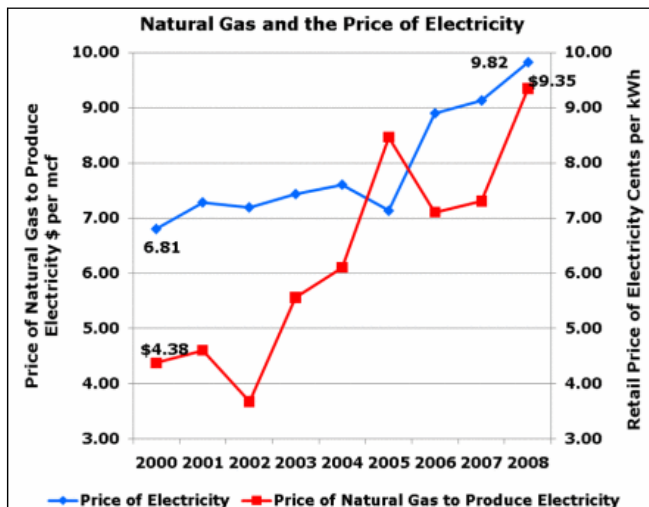
**The question** is, however, can shale gas production even meet existing demand in balancing declining supply? The resource is there, and the horizontal drilling technologies have been developed, but the issues of deliverability at the scale required at affordable prices are still largely unknown.

**SCALE:** The Energy Information Agency (EIA), projects that through 2020, shale gas will only offset a fraction (28%) of declines in other sources of supply. Indeed, EIA forecasts overall gas supply to **decline** by 9% over the next decade. [1]

**PRICE:** Aubrey McClendon, Chair of Chesapeake Energy, one of the nation's largest natural gas producers, has cautioned that the cost of shale gas will not be low:



*"You are really seeing an increase in cost in those marginal plays but it's those plays that are going to set natural gas prices going forward... And that gas price, we think, is probably at least three times what your finding costs are, so we think that is \$7.50 to \$8 to \$9 going forward" [3]*



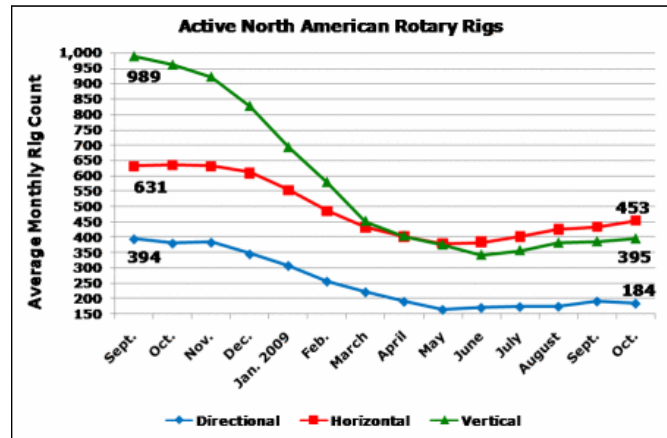
**Unfortunately,** we already know what \$7.00 gas will do. From 2000 to 2008, the price of natural gas to produce electric power averaged only \$6.29. But the cost of electricity during the same period increased 44%. [1]

Further, it is increasingly clear that both deliverability at scale and affordable prices will be challenged by a series of interrelated constraints:

(Continued on reverse)

(Continued from front)

1. **Cost of the process:** McClendon himself has said: "You simply cannot make money in a sub-\$7-and-\$8 dollar environment". [4]
2. **Decline rates** in shale gas wells can approach 70% the first year, creating a constant treadmill to find additional resources and drill new wells. With an increasingly larger proportion of drilling focused on horizontal wells, the treadmill accelerates proportionately and presents an unprecedented challenge to the industry -- especially as the number of active rigs of all types has dropped precipitously. [5]
3. **New regulations** could have an impact upon both production and price. IHS Global Insight has estimated that simply subjecting hydraulic fracturing to the Federal underground injections control requirements in the Safe Drinking Water Act would result in a 20% reduction in the number of new wells drilled and a 10% loss of natural gas production. [6]



4. **Water and other environmental issues:** Hydraulic fracturing for a typical shale gas well requires 3 to 4 million gallons of water -- an increasing concern as more drilling rigs migrate to populated areas. In the Marcellus shale region, for example, the Delaware River Basin Commission, responsible for a watershed that serves over 10 million people, has identified three major areas of concern: (1) reduction of stream flow, (2) pollution of ground and surface water and (3) proper disposal of "frac water." [7] These concerns were highlighted in September when Pennsylvania's Department of Environmental Protection ordered a major shale gas producer to "cease all natural gas well hydro fracking operations in Susquehanna County" pending investigation regarding "three separate spills there in less than one week." [8]

The National Academy of Sciences' major report in July on "America's Energy Future" [9] clearly took some of the constraints discussed here into account when concluding that: "it is not clear whether natural gas supplies at competitive prices would be adequate to support substantially increased levels of electricity generation"-- let alone provide fuel for millions of vehicles and serve as the backup to wind and solar power.

#### References:

1. <http://www.eia.doe.gov/>, 2009
2. Pickens Plan, <http://www.pickensplan.com/theplan/>, 2009
3. Presentation to Deutsch Bank Energy Conference, May 28, 2009
4. Presentation to Howard Weil Energy Conference, March 2009
5. Baker Hughes rig count, [http://investor.shareholder.com/bhi/rig\\_counts/rc\\_index.cfm](http://investor.shareholder.com/bhi/rig_counts/rc_index.cfm), 2009
6. IHS Global Insight, "Measuring the economics of energy impacts of proposals to regulate hydraulic fracturing," June, 2009
7. Delaware River Basin Commission, "Natural Gas Drilling" August ,2009
8. Pennsylvania Department of Environmental Protection, 9/25/2009
9. National Academy of Sciences, America's Energy Future, July 2009

#### About Frank Clemente, Ph.D.

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