Natural Gas Market

The natural gas market also has gone through substantial changes in the last 40 years, with change accelerating in the last fifteen years. In the United State, natural gas has swung from overpriced in 1980, to underpriced in the late 1980s and early 1990s, to overpriced in the period 2000-2008, to underpriced over the last five years. Lack of responsibility (either government or some other entity) to manage the natural gas market to benefit stakeholders, exacerbated these irrational swings in pricing and cost.

Natural gas supplies in foreign countries have a set of complex and confusing implications on relationships between suppliers and customers, particularly regarding natural gas reserves in countries that emerged from the former USSR. The comments in this review focus primarily on the US market, although any realistic plan for natural gas markets for the next 5-10 years should include the Canadian and Mexican markets.

Natural Gas Market Overview

Domestic natural gas reserves provide an extremely important resource for the long term; serving some critical end-use markets that don't have other energy sources that provide effective substitutes. The important strategy: Conserve substantial shale gas field reserves to supply long-term critical market uses.

Recent gas market prices (over the last several years) value natural gas energy at only 10-25% of crude oil energy valuation, only a fraction of historical norms of 70-90%, signaling problems in both energy markets.

Existing market prices undervalue shale gas long-term value in critical markets; and the existing energy markets use this valuable long-term resource for non-critical uses. In particular, the current price and investment/utilization trends result in irrational over-displacement of other energy sources used for power generation. The current gas price also competes with green power short term, slowing the trend to build green power projects with lower long-term fully loaded cost.

Natural gas prices exhibit cyclical swings, preventing knowledge based planned substitution. In particular regional shortages cause natural gas price spikes. Preventing swings and price spikes requires holding back some curtailed production, and using seasonal storage to provide supply to meet unusual demand surges.

Improving the gas natural gas market requires some means of controlling shale gas development, and holding back both reserves and curtailed production capability. A severance tax used to pay a fee to withhold acreage in major shale gas fields, and restricting acreage are several possible solutions.

No entity currently attempts to control the natural gas market, or holds the responsibility to ensure effective market functioning and optimize natural gas resources. Historically, various federal and state governments have used government agencies, rules and regulations, mandates, and tax policy to control natural gas markets. Efforts to control natural gas supply/demand and pricing mostly ended around 1980.

One non-governmental solution to 'control' natural gas supply/demand and prices, uses a regulated predominantly business coalition to monitor the market, invest in incentives

to hold back reserves, and optimize the market to serve customers. This “Natural Gas Market Group” could receive funding from a shale gas severance tax, or from a portion of a tax on oil or liquids produced with natural gas.

Many natural gas industry corporate management teams failed to understand the impact of removing controls on the natural gas market in the 1980s and 1990s, or the development of shale gas reserves in the last eight years, with the consequent boom/bust in shale gas field development. Currently drilling in the Marcellus field predominately targets wet gas acreage, instead of the drier gas in the deeper portion of the Marcellus.

Many of the companies that bootstrapped the initial DOE funded development of shale field technology into commercial fracking methods and pioneered shale field development have gone through bankruptcy proceedings. Some pioneering companies, and their reserves and leases, ended up being acquired by bigger oil or energy companies. This example demonstrates the importance of analyzing, monitoring, and managing energy markets. Particularly, some type of entity should fund early stage energy technology research, provide necessary funding to ensure commercial development of useful systems and methods, and monitor, evaluate, and manage the energy market to achieve optimal outcomes for stakeholders.

Natural Gas Market Overview

Natural Gas Market – Market is Busted!

- Natural gas prices falling to $2.50, down from $5-$10 over the last eight years.
- Shale gas is important stopgap supplement to Green Power sources => Don’t blow through reserves, quickly; Too valuable to produce and sell at such low prices.
- Need new regulatory controls on Shale Gas development to slow down and curtail supply
    - Hold shale gas acreage back from development for now.
    - Compensate leaseholders for slow shale gas development.
- Levy a shale gas severance tax to address other economic and environmental concerns
- Select critical markets where natural gas provides a critical energy source
- Substitute other energy sources or technology in non-critical markets
    - Provide green energy subsidies for new facilities using green energy sources to reduce or replace natural gas demand

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The natural gas market has exhibited dysfunctional price swings in repeated drilling boom/bust scenarios. Recently, the price fell below $2.00 per million BTU in 2012, down from the $5-$10 range over the period 2003-2008. Drilling in shale gas fields, particularly in fields producing wet gas (containing significant extractable natural gas liquids), or gas produced associated with fracked shale field oil production, increased due to high oil prices. This in turn, collapsed natural gas prices to undesirable (for the long term) low-price levels. Many oil producers flare much of the associated natural gas in some fields, such as the Bakken field in North Dakota, in the rush to begin and keep producing oil from the horizontal wells. The build out of the gas gathering systems can't keep up with the rush to drill new wells. These wells deplete rapidly, so the high flows of associated gas produced over a significant portion of the first year of production ends up flaring.

To optimize benefits to all stakeholders, including customers, producers, and royalty owners, America should have an organization responsible for controlling natural gas prices within a reasonable range. Prior to the late 70s, natural gas prices were controlled in a range using well spacing and pro-rationing in the largest natural gas fields in the US, notably the supergiant Hugoton field in Kansas and Oklahoma. Since the drilling boom/bust in the 1980s, natural gas market prices were depressed in the 1990s; but since 2000 there have been another boom/bust due to shale gas field development in the last ten years. Methods previously used to control natural gas prices by controlling production, don't work well with shale gas fields and associated gas production.

Over the long haul, shale gas provides an important stopgap supplemental fuel for power generation and other critical uses. Blowing through shale gas reserves quickly is a shortsighted mistake. We should use new regulatory controls on shale gas development to curtail some supply, and control prices in a desirable price range. One possible plan includes holding back and scheduling shale gas acreage from development, coupled with compensation for leaseholders for slower resource exploitation.

The natural gas market also has backup reserve constraints, storage, pipeline, and infrastructure issues. These issues become even more complicated when LNG terminals are integrated into the system. A shale gas severance tax could provide funds to compensate leaseholders and address other economic and environmental concerns arising from shale gas development, including infrastructure issues. A knowledgeable and capable organization should design and implement a new natural gas system.

Primary Strategy: In order to conserve natural gas reserves for the long haul (several hundred years), natural gas use should be limited to critical markets where gas provides the best source of energy or feedstock. In non-critical markets, other energy sources or technology should substitute for gas. We should provide green energy subsidies for new facilities using green energy sources to reduce or replace natural gas.

Methods Used to Control the Natural Gas Supply and Gas Prices

Government agencies in large producing states controlled natural gas supply historically by using well spacing and pro-rationing in giant gas fields. The pro-rationing in the supergiant Hugoton field in Kansas/Oklahoma had significant leverage to essentially control gas prices. Withholding publicly owned acreage from development in some fields helped control natural gas supply; but in conventional oil and gas fields, with fluid

communication throughout the reservoir coupled with drainage concerns, withholding acreage isn't effective.

But in shale fields, withholding acreage should be effective, especially if planned and coordinated with producers. Shale fields have very poor fluid communication, with drill pads isolated from each other by several miles. The approximate spacing between drill pads represents roughly 2500 acre spacing, versus spacing of typically 160 acres in conventional gas fields. Of course the horizontal wells penetrate and produce the target formation almost a mile from the drill pad, but essentially shale fields developed with horizontal drilling methods don't have major drainage issues. This offers an opportunity to plan development of shale fields to systematically tap the reserves over decades. Limit the amount of acreage annually developed within a region or field, and schedule drill pad deployment over the appropriate time period.

Controlling development would also reduce the amount of gathering and gas processing capacity needed to prevent flaring, and yet produce gas and associated liquids effectively. Staged drilling also reduces the demands on local water supply, and reduces the impact of frack fluid discharges on streams and lakes.

Drilling and production companies should participate in designing methods to control shale gas production to ensure natural gas sells in an optimal price range. Shale gas production companies would benefit from establishing a "floor price" on natural gas, and should suggest the most effective methods to accomplish this desirable outcome.

Shale development technology has unleashed reserves that can swing energy prices wildly, a market situation that doesn't benefit customers, suppliers, landowners, leaseholders, and communities in producing regions, as well as state and federal governments. A new set of methods and processes need to be developed and implemented to ensure adequate supply is available to avoid disruptions, while at the same time controlling prices within a desirable price range.

Although producers should contribute development of this system, another entity should have responsibility for system design and manage implementation. The needs of customers and other stakeholders must be integrated into the development planning process. Government agencies, or elected bodies, don't have the skill sets to accomplish this mission effectively.

One of the key problems preventing rational shale gas field development involves traditional leasing/royalty methods that reward rapid development of reserves, instead of optimized development of shale gas reserves. A refundable severance tax would help the situation significantly, if producers compensate royalty owners and hold acreage for future development using a portion of the severance tax retained for this purpose. We need a system that rewards long-term planned development versus short-term TTMAR business strategies and tactics. We want the shale gas producers to make money with less risk. Controlling development and gas prices to ensure profitable projects makes sense, but only works if some field development and drilling is deferred to avoid a glut of natural gas on the market.

As green energy sources take market share from natural gas, a system to control natural gas supply and price becomes critical to achieving an effective natural gas market. Putting this system in place as soon as possible, should be a key objective of the

organization responsible for optimizing the natural gas market, in conjunction with the other energy markets.

Natural Gas: Critical End-Markets versus Non-Critical Markets

The key strategy for the natural gas market recognizes that natural gas supplies the best long-range source of stopgap energy to fill in for green energy sources and avoid disruptions, particularly in critical end-markets. The strategy uses natural gas only for critical end-markets where alternatives don't make sense, and discourages natural gas use for non-critical markets.

Natural Gas: Critical End-Markets vs. Non-Critical Markets

Key Strategy: Use Natural Gas only for Critical End-Markets where alternative energy sources don't make sense. Discourage Natural Gas use for Non-critical markets.

Critical End-Markets:

- Stopgap Electric power generation
- Industrial Fuel for high temperature heat source
- Petrochemical feedstock
- Back-up/Supplement for heat pump space heating
- Oven/cooktop fuel

Non-critical End-Markets:

- Baseload and Peak Electric power generation
- Primary residential or commercial space heating or water heating
- CHP (combined heat and power) systems

Other Markets:

- Motor vehicle fuel (CNG) – perhaps use to help rapidly reduce oil demand, then transition to other biofuels

Reviewing critical end-markets, the largest involves stopgap electric power generation. The critical need for backup stopgap electric power generation was discussed in the section of these comments covering the Electricity Market. As green power reaches 50% of the market, backup-generating capacity becomes very important. By the time green power reaches 80%, having stopgap generating capability becomes a critical requirement, especially in the high growth case that improves customer QOL and addresses key environmental and scarcity issues.

Space heating using natural gas fired furnaces or boilers wastes highly valued fuel to provide low temperature heat. The most likely alternative uses a electric motor driven heat pump, but this system still needs the backup gas-fired heating unit.

Industrial fuel that provide high temperature heat source, comprises a third end-market where natural gas has inherent advantages. Gas-fired heaters provide high temperature heat very effectively, and other systems can't easily compete. Petrochemical feedstock, particularly NGLs recovered from produced gas, is another critical end-market. Industrial use represents one of the most important natural gas markets.

Since increased agricultural productivity depends greatly on fertilizer, with the cost of fertilizer an important portion of corn and grain growing costs, fertilizer plant natural gas feedstock represents another critical end-market. Since expansion of biofuel growth required both fertilizers and possible high temperature heat source, the biofuel industry and related farms, need a long-term stable supply of natural gas at reasonable prices.

Non-critical natural gas end-markets include:

Baseload and peak electric power generation represents one of the largest non-critical use of natural gas. Eventually green power sources should replace most baseload and peak demand period power generation. Natural gas should provide stopgap power generation to fill in for seasonal or weather related green power supply declines, or backup power for supply interruptions. Rapidly transitioning to green power sources to replace coal and natural gas as fuels for power generation should be a key goal for energy system managers.

Another large existing natural gas market that needs to transition away from gas provides primary residential or commercial space heating or water heating. These applications only require relatively low temperature heat, and using natural gas is a waste. The most likely alternative uses a electric motor driven heat pump, using natural gas only as backup. Eventually a combination of solar thermal storage system, coupled with a heat pump can provide a better system, one that also provides air conditioning. Energy system managers should provide enough incentives to rapidly transition to these better building heating/cooling systems.

One worrisome trend is the projected growth of combined heat and power (CHP) units, particularly in commercial buildings and large residential buildings. The engineering logic behind CHP systems is sound: use high value high temperature thermal energy to generate power, followed by using lower temperature thermal energy from the exhaust of the power generation unit to supply space heating and hot water heating. However, the logic collapses when compared with the long-term vision and the goals needed to reduce climate change and environmental impact of GHG emissions. CHP units deployment depends on low natural gas prices, coupled with high electricity prices. The recent markets could encourage installation of CHP units. If the trend continues, we could end up replacing 500 central station coal-fired power plant carbon emission sources, with 100,000+ CHP carbon emission sources widely distributed. This increases the complexity and difficulty of controlling carbon emission sources.

The key to keeping solutions that thrive on low cost natural gas from driving up carbon emissions, involves maintaining gas prices in a range that doesn't hit customers too hard, yet prevents irrational substitution. Yet again, we find the actual energy market operations require overall energy system management, and this job should be assigned to an appropriate organization (unlikely to be a government agency or department).

Transitional natural gas end-markets:

The much-discussed use of natural gas as “bridge fuel” represents a transitional end-market that doesn’t help achieve desirable long-term objectives in both the electricity market and natural gas market. We should attempt to skip this transitional phase by rapidly ramping green power supply.

One helpful transitional natural gas end-market provides vehicle fuel such as compressed natural gas (CNG). This substitution can help rapidly reduce crude oil demand, and eventually this market segment can then transition to other biofuels, or convert to electric vehicles. For a time period, particularly the first decade of a green vehicle substitution program, using CNG vehicles can assist a Green Vehicle Group in their efforts to convert the vehicle fleet.

Natural Gas: Controlling Power Plant Use

Key Strategy: Use Natural Gas only for stopgap power generation in dual source thermal energy power plants.

Use state/regional energy standards to control natural gas power generation:

- Use regional considerations to develop plan to shut down coal fired PPs and transition to green power
- Use natural gas as a transitional fuel, but reduce use of natural gas over the longer term

Transition to Green Power Generation:

- Phase out construction of natural gas turbine combined cycle power plants
- Support development of hybrid solar thermal/natural gas power plants using thermal energy storage systems

Place limitations on Combined Heat and Power (CHP) installations:

- Consumes fossil fuel for non-critical application
- Preferred approach: Use a solar thermal/geothermal CHP, with natural gas back-up

Again, the key strategy for natural gas used for power generation: By the end of the thirty-year planning period, use natural gas only for stopgap power generation in dual source thermal energy green power plants, or use as industrial fuel to supply high temperature heat, or as a chemical feedstock. The use of dual fuel source solar thermal and advanced geothermal utilizing thermal energy storage should spread throughout the west and southern tier of the United States. Biomass dual fuel source plants with thermal energy storage should be used for stopgap power generation in the Midwest, East, and Southeast. Existing natural gas combined cycle plants should be transitioned into spinning reserve power generators by the middle and late decades of the thirty-year planning period.

The preferred method to control natural gas power generations uses state/regional energy standards. Regional power generation planning should focus on subsidizing investment in green power plants, coordinated with shutting down coal-fired power plants. The plans should use some natural gas as a transitional fuel, but reduce the use of natural gas over the long term. Ramping green power quickly is key to avoiding a mass transition from coal to gas that pushes gas demand too high, and ends up building too much single source gas-fired generating capacity.

Regional plans should also place limitations on combined heat and power (CHP) installations. CHP consumes fossil fuel for a non-critical application. Without limitations on CHP, market forces will rapidly expand CHP installation, in effect creating potentially millions of new expanded carbon dioxide emission sources. In many cases, heat pump systems with natural gas backup firing would be a better choice than CHP. Transitioning the space heating energy source to electricity, addresses stakeholder needs better than gas-fired space heating over the long term. We should encourage and subsidize the heat pump systems and discourage CHP, unless solar thermal or other green power source is integrated into the CHP system.

Natural Gas and LNG Import, or Export? Or Alaska/Beaufort pipeline, or AAGP?

When the people realize that clear knowledgeable action is needed, some would-be leaders tend to just “Jump on their horse, and ride off in all directions…”.

Adding to the confusion in the natural gas market over the last fifteen years was the on-again, off-again Alaska/Beaufort gas pipeline, now morphing into the All-Alaska Pipeline to a LNG terminal on the Kenai Peninsula. In the 2008 presidential campaign, the natural gas pipeline through British Columbia to the United States was an issue, with ex-Governor Palin pushing for construction. Collapsing gas prices caused by shale field development stopped that proposal. In 2000-2005, the industry was pushing to build LNG import terminals in California, Baja California, or elsewhere on the West Coast, as well as LNG import terminals on the Gulf Coast.

But now the landscape has shifted. Currently planning is underway on LNG export terminals in Alaska, West Coast, East Coast and Gulf.

This demonstrates the complete lack of coordination of the natural gas market, and the confusion of suppliers proposing conflicting and irrational competing alternatives. Currently suppliers plan to keep increasing investments for more drilling to increase natural gas production (“drill, baby,drill”); and in turn increase gas fueled power generation and replace coal-fired power plants in the electricity sector; and provide LNG for export. This shortsighted overall “plan” does not serve the best interest of customers, who want and need long-term low cost green energy and a secure backup supply of natural gas for critical uses.

The federal government and many state governments push for increased natural gas production. Government subsidies, especially tax breaks, reinforce the natural gas production boom. As discussed in the sections on crude oil, and electricity, energy sourced from fossil fuels should not get any federal government tax breaks and subsidies, such as investment tax credit, accelerated depreciation, and the domestic manufacturing allowance, let alone state and local tax breaks. Investment flow should be

directed as quickly as possible into green power, energy efficiency and conservation actions, and other substitutes or alternatives that reduce or replace fossil fuel use.

Absent any kind of management and control systems in place, America's natural gas reserves will be wasted on non-critical uses. The production of natural gas will spiral upward through a series of boom/bust cycles until the reinforcing loop of increased drilling, higher production and consumption; higher customer costs; and ballooning investment in gas exploration and production… finally ends with environmental destruction and leaves customers stuck with a costly energy system ill-suited to perform well into the future.

Natural Gas (and Shale Gas) Markets – Summary and Conclusions

Examining and summarizing the important tasks needed to accomplish the mission of improving the natural gas market to please customers and satisfy other stakeholders generates this list:

1. Control natural gas supply to raise natural gas prices into the desired range, controlling shale gas development by limiting acreage development and drilling.

2. Placing a severance tax on shale gas development, retainable and refundable if the shale gas operator holds undeveloped acreage and compensates royalty owners, or invests a portion of the funds on green energy projects.

3. Ensure that surplus gas storage and enough pipeline capacity exists to keep gas prices from spiking regionally.

4. Recommend government energy policies, tax benefits, and energy subsidies to drive transformation of energy markets served by natural gas, particularly the home/commercial building heating market to transition to green sources.

5. Develop a plan for the natural gas markets, to reduce non-critical use of natural gas, and coordinate planning with critical natural gas end-markets such as fertilizer, petrochemicals, and backup (stopgap) generation of electric power.

6. Work with state/regional governments and organizations to plan and manage the natural gas market and electric power market.

7. Address LNG exports/imports. Since 2000, the private sector strategy on LNG has swung from building LNG import terminals to building LNG plants for export. This demonstrates yet again, how a competitive unregulated free energy market fails to develop a cogent long-term strategy that serves stakeholders. We need a market where a skilled organization plans and manages energy market development and transition to best meet stakeholder needs.

A private sector entity, a business coalition, assigned this responsibility can best accomplish these tasks. The coalition can evaluate, plan, invest, and monitor progress in the applicable markets to ensure stakeholders are served optimally.

Just as the transportation fuels market would be better served by a Green Vehicle Group, and the electric power sector by a Green Power Coalition, a private sector entity, the Natural Gas Market Group should have the responsibility to optimize the end markets and control the development and use of natural gas resources in America.

The DOE should recommend that the Obama administration encourage and establish a Natural Gas Market Group to identify methods to improve and optimize the natural gas market to best serve stakeholders. President Obama can simply ask the private sector to submit proposals to form the Group. After establishing this Group, they should coordinate with efforts to improve other energy markets, to ensure coherent overall energy market control and optimization efforts.