The Triple "A" Argument for Natural Gas

By Maximilian Kuhn and Frank Umbach*

Until a few years ago, declining indigenous natural gas production in the U.S. and Europe led to consuming markets seeking more distant supplies, delivered in the form of LNG, often from stranded or displaced sources. Future dependencies on a few countries--notably Russia, Qatar, Iran, Turkmenistan, and Australia--that control the bulk of conventional gas reserves were expected. Energy security issues arose out of the concerns over import dependents on these countries and supply disruptions therefrom. Historically, the use of the "energy weapon" as a political tool has often created tensions between suppliers and consuming countries. The fact that 63 percent of conventional gas reserves are located in regions other than the Middle East increases the appeal of gas to governments wishing to reduce their energy dependency on this region. The dramatic rise in unconventional gas over the last decade has changed the market in unanticipated ways.

Unconventional gas (shale gas, tight gas, and coal-bed methane) developments are not really a (r-) evolution but rather an evolution of utilizing modern techniques and combining two key technologies–horizontal drilling and "slick water" hydraulic fracturing–which finally cracked the shale rock and thus cracked the code for opening up major North American shale gas resources.[1] The release of unconventional gas resources triggered what can be called a revolution in global gas markets. Unconventional gas not only transformed the U.S. energy market, and in particular the natural gas market, it was also the tipping-point of a fundamental change in global gas markets. Not only has it provided a solution to American supply concerns, it also affected global spot gas prices. In this way, natural gas is evolving from a local, stationary, non-residential commodity into a mobile, international, primary product similar to crude oil. At the same time, a significant change in the incremental flexibility of global deliveries of liquefied natural gas (LNG) has occurred. LNG has become a key component of the U.S. and European energy mix.

In sum, the combination of three factors: (1), a drop in demand linked to the global recession; (2), an increase in U.S. non-conventional shale gas production; and (3), the arrival of new LNG delivery capacity has created a sudden abundance of natural gas.

Today, in the U.S. the combination of enhanced LNG transportation and increases in delivery capacity, together with current and expected shale gas supplies, have changed the gas landscape and resulted in the freeing up of some previously contracted LNG volumes bound for the U.S. Global liquefaction capacity is expected to be up sharply this year and outpace demand for LNG. In 2009-2010, an additional 9 billion cubic meters of liquefaction capacity came online. These additional volumes created an excess supply in the market with an immediate impact on spot market prices and on the need for imports (both pipeline and LNG). Some contracted LNG will be forced to go to U.S. terminals, even if demand is not there.[2] This would force Henry-Hub (HH) spot gas prices to go down further and keep U.S. near-term prices range-bound ($4-8/mmcf). Thus, North American LNG gas prices, which are naturally connected to the Henry Hub spot market prices, will lead to low marginal prices for LNG in other markets like Europe and Asia.

As a consequence of these developments, today's distinct regional gas markets—where demand is more or less fully satisfied by national or regional supply—will become more integrated under the impact of the transitory "gas glut", more flexible forms of trade like liquefied natural gas (LNG), dramatic increases in U.S. unconventional gas production, global shopping for resources by an energy-hungry China, and through the continuing liberalization and integration process of the EU energy markets. In addition, unconventional gas shifts the focus from major conventional production regions back to the national level–from globalization to localization–so to speak; it turns the traditional picture of natural gas being transported from producing to consuming countries through pipelines upside down, as unconventional gas can now be developed close to demand centers. The advantage of unconventional gas is that it is a domestic, national source of fuel supply, which enhances the energy security of each country. Thus, traditional views about geographic distribution, politically unstable producer countries and about 'energy security' in general are clearly being challenged.

As witnessed, the energy world is undergoing major shifts in all its fundamentals areas: supply, demand, infrastructure, economics, and international compe-

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See footnotes at end of text.

tition. In addition, climate change mitigation efforts and the setting of a price for carbon have major implications for energy policy in general and for natural gas policy in particular. This emerging 'new world' will require adjustment from industry, governments, and from new technology providers. Gas market participants will need to understand markets and pricing structures more intimately and will have to invest in diversification for both supply and demand to achieve greater strategic flexibility. The current balance of forces is far from stable; changes-- irrespective of the outcome--will have a significant impact on transatlantic relations, national economies, and, ultimately, on consumers.

In light of such uncertainties, the emerging global gas market can be summarized in one word: volatile.

However, looking at these developments from a market cycle perspective they become less surprising. In their study on "the Dynamics of Energy Systems" Cesare Marchetti and Nebojsa Nakicenovic developed a mathematical model for the long-term pattern of energy change in industrial economies.[3] As Montgomery writes: "The Machetti-Nakicenovic theory showed each energy source rising, peaking, and then falling as a series of partly overlapping, symmetrical curves, one replacing another, like waves smoothly running upon a shore – oil ascending as coal declines, then cresting and collapsing as it is replaced by natural gas, which then gives way to some future source (solar energy and fusion were mentioned)."[4] Robert A. Hefner III further adapted this model in the 1990s but saw it as a "progression from solids (wood and coal), to liquids (mainly oil), and finally to gases (natural gas and hydrogen), a progression that would lead to […] an 'age of energy gases'".[5] The way Hefner sees the development of the energy cycles in the context of human development can be seen in Figure1,The Age of Energy Gases. This illustrates, Hefner idea by taking into account Marchetti and Nakicenovic work, how the waves of energy transition took place over time and how "over time we have been de-carbonizing or we might say have been "hydrogenising" our energy consumption."[6]

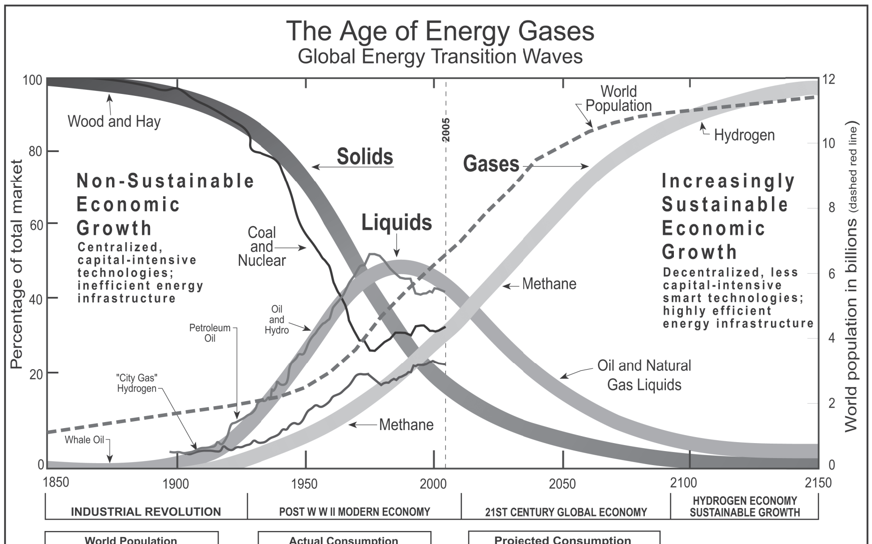


Figure 1
The Age of Energy Gases
Source: Robert A. Hefner III (2007), The Age of Energy Gases. Page 12-13.

As Hefner, rightly states, natural gas should not be seen in the "long-held concept of 'oil and gas' where 'gas' comes second, as a little valued by-product of oil".[7] In fact, he argues, natural gas is a better fuel for a number of reasons:

Firstly, natural gas is chemically simple, with four hydrogen atoms and only one carbon in contrast to oil which is chemically complex and contains more dirty carbon.

Secondly, due to its chemical status gas is lighter than air, and its leaking from the Earth's crust apparently does not have as negative effect on the environment as oil.

Thirdly, also attributed to its chemical status, natural gas is compressible, unlike oil.[8]

Putting forward a triple "A" argument for natural gas, it is:

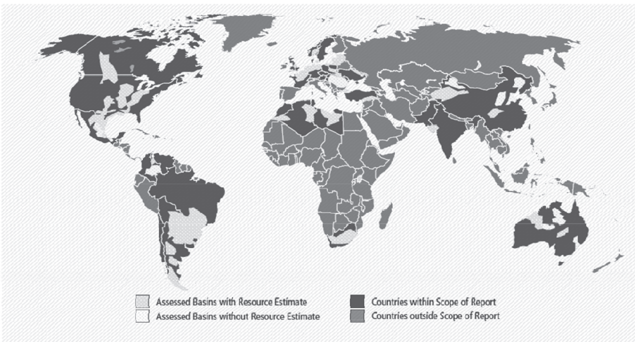
- Acceptable,
- Abundant,
- Affordable.

Acceptable, due to its lower emissions and because it burns cleaner than coal or oil. Abundant, as natural gas resources can be "produced from all the volumes of rocks that contain oil, as well as vast volumes of rocks, particularly tight sandstones, shales and coals that contain no oil, the global volumes of sediments capable of producing natgas commercially are at least twice and probably closer to several times the volumes of rocks capable of oil production."[9] The rise of commercial gas reserves, by almost 30 percent over the last decade, has to some extent proven this assumption. However, in general this is due to the fact that oil companies have begun to search, explore, and produce gas in its own right and due to technological advances in developing and transporting natural gas.

Consequently, with fewer constraints on the supply side and rapidly falling costs of production, as seen in the U.S. "shale gale," natural gas is becoming one of the most affordable fuels. Moreover, natural gas will become more relevant for the renewable energy industry as *Green Gas* or so called SNG (Synthetic or Substitute Natural Gas), can provide storage for and also transport energy by using already existing infrastructure. Natural gas will provide a balancing option for renewable energy and the possibility to store and save electricity through conversion into gas.[10] Thus, gas will not only be a bridge to a sustainable future energy mix, but will be a component in the provision of energy security.[11]

Current studies show that the global potential, especially in the key demand centers for natural gas, is substantial.[12] Besides the direct market effect, the development of unconventional gas also has foreign policy implications for supplier countries.

Unconventional Gas – Here, There, Everywhere



Own graphic, adapted from: EIA, World Shale Gas Resources: An Initial Assessment of 14 Regions Outside the United States, Washington D.C. (U.S. Department of Energy), April 2011, p. 3.

Europe (in bcm)	
France	5 097
Germany	226
Nederland	481
Norway	2 350
UK	566
Denmark	651
Sweden	1 160
Poland	5 295
Turkey	424
Ukraine	1 189
Lithuania	113
Others	538

South America (in bcm)	
Venezuela	311
Columbia	538
Argentina	2191
Brazil	6399
Qiile	1812
Uruguay	594
Paraguay	1755
Bolivia	1359

North America (in bcm):	
USA	2441
Canada	1784
Mexico	1444

Asia (in bcm)	
China	
Indie	1 783
Indonesia	1444

Foreign Policy Implications of (unconventional) Gas[13]

The impact of the shale gas buzz is even greater. It is not only about the radical change of the energy industry, but also about the political and international relations effects of these developments. Unconventional gas has become the new "elephant in the room", with global geopolitical implications that have caused a chain reaction: European gas prices are being renegotiated and revised. It has also caused an average of 15 percent of Gazprom's supplies to be delinked from oil-indexation. Yet, as Dieter Helm puts it, the implications are greater still: relatively cheap and abundant gas, along with the carbon advantage of gas, makes "nuclear and coal relatively more expensive than currently assumed." "By switching from coal to gas, emissions can be quickly reduced at a very low cost". Indeed, making gas a major transition fuel will help renewable energy efforts to reduce emissions at a low cost and quickly in order to mitigate the impact of climate change.[14]

Unconventional gas has helped to shift the balance from a seller-dominated market to one dominated by buyers. Unconventional gas is nowadays the "new policy" option for European countries, giving buyers more leverage to renegotiate high Russian oil-indexed gas price demands that are included in long-term contracts. Thus, unconventional gas, even without being produced in Europe, puts a certain price cap on high Russian gas prices, as it can become a potential source of diversification, particularly if Russian gas prices are higher than the break-even point for European unconventional gas. All this has the potential to make unconventional gas development economically feasible and, politically speaking, more appealing. Unconventional gas, and shale gas in particular, has become a negotiating tool for Europe in a changing gas market that is enhancing the region's energy security by diversifying energy sources and enabling the prioritization of a domestically located resource.

Consequently, regardless of how the outlook for European unconventional gas development looks – and whether or not unconventional gas will become affordable and sustainable in the mid-to-long term in Europe – shale gas has already changed the European market, even before a single well has been drilled or a single molecule of unconventional gas extracted from European basins.

Summary

In sum, as a consequence of recent developments, gas prices are becoming de-linked from the oil price through a combination of three factors: recession, U.S. unconventional production, and LNG capacity

Furthermore, unconventional gas, particularly in the U.S., has become cheaper to produce than most conventional gas, especially if it contains natural gas liquids (NGL). This makes gas the most compatible available energy source for consumers and the best bridge towards a renewable and sustainable energy system.

As recent studies have shown, the unconventional gas resource base is bigger than that of conventional gas resources and is abundantly located worldwide. It may extend the gas availability up to 250 years worldwide and at least 60 years in Europe.

Earlier anticipated hurdles for replicating the U.S. shale gas (r-)evolution in Europe can be overcome by time, technical advancements, the right regulatory framework, and a favorable fiscal and pricing mechanisms. However, market structure and environmental policies remain critical components in determining if unconventional gas production will take place to a greater extent. In this context public acceptance is crucial for unconventional gas development. Education, involvement and engagement with the public are needed to understand the risks and benefits.

Groundwater contamination in the EU is unlikely to occur due to fracking itself. The likely cause of early contamination, is drilling fluids or fracturing fluids spilled on the ground or overflowing/leaking from storage pits where it then infiltrates downwards to shallow groundwater and poses a risk. But good oil field practices and state-of-the-art cementation and fracture monitoring techniques should prevent drilling fluids, hydraulic fracturing fluids, or natural gas from leaking into the permeable aquifer and contaminating groundwater.

With further technological improvements the potential to develop more environmentally friendly drilling technologies will offer a way to cope with the many water issues related to drilling and reduce these obstacles over time. Moreover, in comparison to the U.S., European rock strata containing unconventional gas resources are generally located deeper in the earth and beneath the groundwater.

As portrayed, unconventional gas is a political asset. As a major domestic fuel – similar to renewables – it increases energy security and reduces import dependencies while it also can help fulfill political agendas and solve regional and local development issues.

In the medium term, unconventional gas has the potential to change the industry structure. The oversupply of gas helps in the liberalization process of the European market. Therefore, it has major implications for conventional gas suppliers – like Russia – and the European Union as well.

Consequently, regardless of how the outlook for European unconventional gas development looks today, and regardless of whether or not unconventional gas becomes affordable and sustainable in the mid-to-long term in Europe, shale gas has already changed the European market. This is true even before a single well has been drilled, or a single molecule of unconventional gas has been produced from European basins.

Footnotes

[1] The following analysis is based on Maximilian Kuhn and Frank Umbach, "Strategic Perspectives of Unconventional Gas: A Game Changer with Implications for the EU`s Energy Security." A EUCERS Strategy Paper, Vol. 01, No. 01, May 2011 (London: EUCERS/King's College, 2011). (available at: http://www.eucers.eu/wpcontent/uploads/EUCERS_Strategy_Paper_1_Strategic_Perspectives_of_Unconventional_Gas.pdf)

[2] Gas Matters (Gas Stragegies, 2010), "Shale Gas in Europe: A Revolution in the Making."

[3] See Scott L. Montgomery (Chicago; London: University of Chicago Press, 2010), *The Powers That Be : Global Energy for the Twenty-First Century and Beyond,* 23-24. And C. Marchetti, Nebojsa Nakicenovic et al. (Laxenburg, Austria: International Institute for Applied Systems Analysis, 1980), *The Dynamics of Energy Systems and the Logistic Substitution Model.*

[4] Montgomery (2010), *The Powers That Be : Global Energy for the Twenty-First Century and Beyond,* 24.

[5] Ibid. and For further reading on the future potential of natural see Robert A. Hefner III, "The Age of Energy Gases: The Importance of Natural Gas in Energy Policy," speech and paper by Robert A. Hefner III at the Aspen Institute's Aspen Strategy Group's conference "The Global Politics of Energy," Aspen, Colorado, August 2007. Available at: http://www.ghkco.com/downloads/ASG-ImportanceofNaturalGasinEnergyPolicy08.07.doc And Robert A. Hefner (Oklahoma City: The GHK Company, 2007), "The Age of Energy Gases," in *The Importance of Natural Gas in Energy Policy*.

[6] Hefner (2007), "The Age of Energy Gases", 12-13.

[7] ——— (2007), "The Age of Energy Gases".

[8] Ibid., 4-5.

[9] Ibid.

[10] Referred to as the Methanation.

[11] For further information see: S. N. G. Symposium and Technology Institute of Gas ("Papers on Substitute Natural Gas from Hydrocarbon Liquids") (Chicago, 1973); Synthetic Natural Gas (Sng) from Coal and Biomass: A Survey of Existing Process Technologies, Open Issues and Perspectives, INTECH Open Access Publisher, http://www.intechopen.com/articles/show/title/synthetic-natural-gas-sng-from-coal-and-biomass-a-survey-of-existing-process-technoligies-open-issue; Energy United States. Dept. of, Laboratory National Energy Technology et al.

(2009), "Production of Substitute Natural Gas from Coal," United States. Dept. of Energy ; distributed by the Office of Scientific and Technical Information, U.S. Dept. of Energy, http://www.osti.gov/servlets/purl/993826-aTrqoP/; Planning American Gas Association and Group Analysis (Arlington, Va.: American Gas Association, 1978), *Sng Fact Book*; H. Boerrigter and R. W. R. Zwart (Petten: Netherlands Energy Research Foundation, 2004), *High Effiency Co-Production of Fischer-Tropsch (Ft) Transportation Fuels and Substitute Natural Gas (Sng) from Biomass*.

[12] Based upon Umbach, Kuhn, "Unconventional Gas Resources: A Transatlantic Shale Alliance?", in: David Koranyi (Ed.), Transatlantic Energy Futures. Strategic Perspectives on Energy Security, Climate Change and New Technologies in Europe and the United States, Center for Transatlantic Relations, Paul H. Nitze School of Advanced International Studies, John Hopkins University, Washington D.C. 2011, pp. 207-228

[13] Based upon Umbach, Kuhn, "Unconventional Gas Resources: A Transatlantic Shale Alliance?", in: David Koranyi (Ed.), Transatlantic Energy Futures. Strategic Perspectives on Energy Security, Climate Change and New Technologies in Europe and the United States, Center for Transatlantic Relations, Paul H. Nitze School of Advanced International Studies, John Hopkins University, Washington D.C. 2011, pp. 207-228.

[14] Dieter Helm (2010), The Coming of Shale Gas: the Implications for Oil and Energy http://www.terrafirma.com/Alternative-perspective-page/articles/295.html This is in contrast to a report from the Tyndall Centre arguing against shale gas in particular as a transition fuel and highlighting the potential risks to human health and the environment. See: Wood. R., Gilbert P., et al: 2011, Shale gas: a provisional assessment of climate change and environmental impacts. A report commissioned by the Cooperative and undertaken by researchers at the Tyndall Centre, University of Manchester See also Robert W. Hogath, Renee Santoro, Anthony Ingraffea (2011), "Methane and the Greenhouse-Gas Footprint of Natural Gas from Shale Formations", Climate Change (Springerlink.com), 12 April 2011; critical comments to this "biased" study - see "Five Things to Know About the Cornell Shale Study", European Energy Review, 27 April 2011 (originally in: Energy in Depth) and Gregory C. Staple/Joel N. Swisher (2011), "The Climate Impact of Natural Gas and Coal-Fired Electricity: A Review of Fuel Chain Emissions Based on Updated EPA National Inventory Data", American Clean Skies Foundation (www.cleanskies.org), 19 April 2011.