Chapter 7: Markets and Geopolitics

As we have seen in Chapter 3, there are substantial economic benefits to a global natural gas market. Geology, geography and historical market and geopolitical arrangements have, however, limited the development of a global market that links supply centers to major demand centers, which would have significant energy security ramifications.

At present, trade is centered in three distinct regional gas markets — North America, Europe (including Russia and North Africa) and Asia with links to the Persian Gulf (see Figure 3.11). Each has a different market structure resulting from the degree of market maturity, the sources of supply, the dependence on imports and other geographical and political factors. Importantly, these regional markets set natural gas prices in different ways. In general, the U.S. has gas-on-gas competition and open access to pipeline transportation, and manages risk through spot and derivatives markets. The European market relies more heavily on long-term contracts with price terms based on a mix of competing fuels, e.g., fuel oil, and pipeline access is restricted. Asia uses crude oil as a benchmark for natural gas prices and favors long-term contracts; this structure has kept LNG prices in Europe and Asia high relative to other regions. These market features, along with the availability of domestic natural gas resources and geopolitical interests, establish the boundary conditions for the development of global natural gas markets, at the same time that significant price disparities between regions create greater interest in such a market.

This regionalized and varied structure of natural gas markets stands in contrast to the global oil market, and it is instructive to understand the fundamentals of the difference between oil and natural gas markets. The physical characteristics of oil — a very high energy density at normal conditions of temperature and pressure — make it readily transportable over long distances, by a variety of means, at moderate cost. This has allowed the development over time of a global oil market, where multiple supply sources serve multiple markets at transparent spot prices, with price differences largely attributed to transportation costs and oil quality. Notwithstanding dependence on imports, the diversity and robustness of this marketplace adds significantly to security of supply for consumers and to security of markets for producers.

In comparison, natural gas markets are smaller and less mature, and the physical characteristics of natural gas constrain transportation options. Unlike oil, transportation costs — whether for pipeline gas or liquefied natural gas (LNG) — constitute a significant fraction of the total delivered cost of natural gas. Also, because of the relative immaturity of natural gas markets, compared to oil, and the very high upfront capital costs, long-term contracts have been necessary to underwrite the cost of infrastructure development and to ensure a market for the supplier.

Pipeline gas accounts for almost 80% of today's interregional gas trade (a share that is expected to decline as the LNG trade grows). Pipelines may transit many countries. The number of parties involved in a multi-national pipeline project can slow project development considerably and political instability in host or transit nations raises security of supply issues. Also, cross-border pipelines must invariably comply with multiple and dissimilar legal and regulatory regimes, further complicating pipeline construction and operations. Finally, the strong mutual interests of buyers and sellers in cross-border pipeline projects are not fully shared by transit nations, such as Ukraine for Russian supply to Western Europe.

Pipelines have a distinct economic advantage over LNG for shorter distances but LNG gains advantage over longer distances and is a key enabler of a global gas market. LNG offers the potential for a greater diversity of suppliers and markets, both key ingredients for increased reliability and energy security. Also, LNG is generally contracted between a single buyer and seller, simplifying contract negotiations and transport routes. However, the investment required for capacity expansions of each link in the LNG supply chain is considerable; since minimizing investment risk is a fundamental driver for developing global LNG markets, longer-term contracts are favored.

The U.S. natural gas market functions well, with infrastructure development more or less keeping pace with changing market needs.

The geological realities of natural gas resources are similar to those of oil in terms of the degree of concentration of conventional resources, with Russia, Iran and Qatar having the largest conventional natural gas resource base (see Chapter 2). As with oil, at issue is the extent to which major resource holders, over time, will manipulate supply and prices to advance political and/or economic objectives in ways that are detrimental to the U.S. and its allies. Consequently, the future structure of these markets and the degree of integration that may develop have both economic and security implications. Several factors could lead to greater market integration and diversity of supply:

- the competition for supply from regions that can serve multiple major markets, such as the Caspian;
- growth in LNG trade and the development of a market in which cargoes seek favorable prices, a trend that has been seen in the Atlantic basin; and
- development of major unconventional gas resources could diversify supply in strategic locations such as Europe and China, with mixed implications for market integration.

Of course, there are many unknowable factors that can impede market integration, including the geopolitical aims of current and future natural gas exporters.

MARKET STRUCTURES

The U.S. Market

The U.S. natural gas market is the most mature of the world's three major regional markets. Significant exploitation of natural gas began in the latter half of the 19th century centered in Appalachia, with much larger production and consumption starting in the 1920s after discoveries in the Southwest. This expansion was aided by advances in pipeline technology, eventually creating a continent-wide, integrated natural gas market.

The regulatory institutions governing the natural gas markets in the U.S. have undergone their own historical evolution. New Deal initiatives in the 1930s broke the control of the holding companies over local utilities and established the Federal Power Commission as a regulator of the interstate sale and shipment of natural gas. The Natural Gas Act of 1938 and its subsequent amendments provided federal eminent domain authority for the construction of new interstate natural gas pipelines and natural gas storage. These policies facilitated the robust growth of a continent-wide network.

Initially, long-term contracts were the rule. There was no single benchmark price for natural gas in the U.S. This changed with the passage of the Natural Gas Policy Act of 1978, which gradually led to the removal of price controls on the interstate sale of natural gas in the U.S. Starting in 1985, ceilings were removed

on the sale of new natural gas and the Federal Energy Regulatory Commission (FERC) issued a series of Orders between 1985 and 1993 that served to create an open and transparent continent-wide market in natural gas. This market-based focus was extended to natural gas storage in the Energy Policy Act of 2005.

A robust spot market has developed in the U.S. and Canada, with prices set by the forces of supply and demand. Contracts continue to play a role, albeit diminished, in the market, where price clauses typically reference the spot market. This expansion has been supported by an expanded pipeline network and associated midstream gas facilities. The U.S. natural gas market functions well, with infrastructure development more or less keeping pace with changing market needs (see Chapter 6).

At present, North America is largely self-sufficient in natural gas, and this situation is likely to continue for some time, as indicated in Chapter 3. The substantial surplus of LNG import capacity, discussed in Chapter 6, effectively provides backup capacity in the event of unanticipated supply shortfalls or high prices.

It should also be noted that the U.S. exports natural gas. LNG exports from Alaska to Japan have been in place for 40 years, but are likely to face additional competition in the Asian market, particularly as the Cook Inlet production tapers off. Part of this competition may come from Canada, which has a large shale gas resource. The Department of Energy (DOE) has approved an application to export LNG from a Gulf of Mexico (GOM) facility. The U.S. also exports natural gas by pipeline to Mexico and Canada, although with a significant net import from Canada. Especially since passage of the North American Free Trade Agreement (NAFTA), there has been increased North American energy market integration.

The large Canadian shale gas resource adds to the diversity of supply within the functioning North American market.

U.S. Oil and Natural Gas Prices

There have been long-running discussions about the relationship between oil and natural gas prices; these have intensified as the ratio of oil to natural gas prices reached historic highs over the last year. This growing spread could have enormous implications for U.S. natural gas markets and is especially critical for gas producers, industrial gas users and the use of natural gas as a transportation fuel. For CNG or LNG vehicles, a low natural gas price relative to oil is essential for a reasonable payback period because the vehicle capital cost is appreciably higher (see Chapter 5). In this chapter, we explore the history of these prices and price movements in the U.S. market during the preceding decades.

Oil prices have hovered around $100/barrel (bbl) for much of the last year while the U.S. Henry Hub (HH) price has been consistently below $5/MMBtu, for a ratio at or above 20. (We caution the reader that this ratio involves two different quantities; it is normally stated in terms of the price for a barrel of oil, about 6 MMBtu, in relation to the price for a 1 MMBtu of natural gas because these are the benchmarks in commodity markets.) A common assumption is that opportunities for substituting oil for natural gas, and vice versa, will equilibrate the prices. A simple energy equivalency argument would pin the price of a barrel of oil at about six times the natural gas price, but this simple energy-equivalence argument is unlikely to be accurate because oil and natural gas undergo different processing, distribution and storage for different end uses. A number of "rules of thumb" have emerged. An empirical rule that is often invoked sets the crude oil/gas price ratio at 10. Others are based on the competition between natural gas and distillate fuel oil or between natural gas and residual fuel oil, using typical ratios of fuel oil and crude oil prices.

Figure 7.1 Log Values of the Natural Gas and Oil Spot Prices, 1991–2010 (2010 dollars)

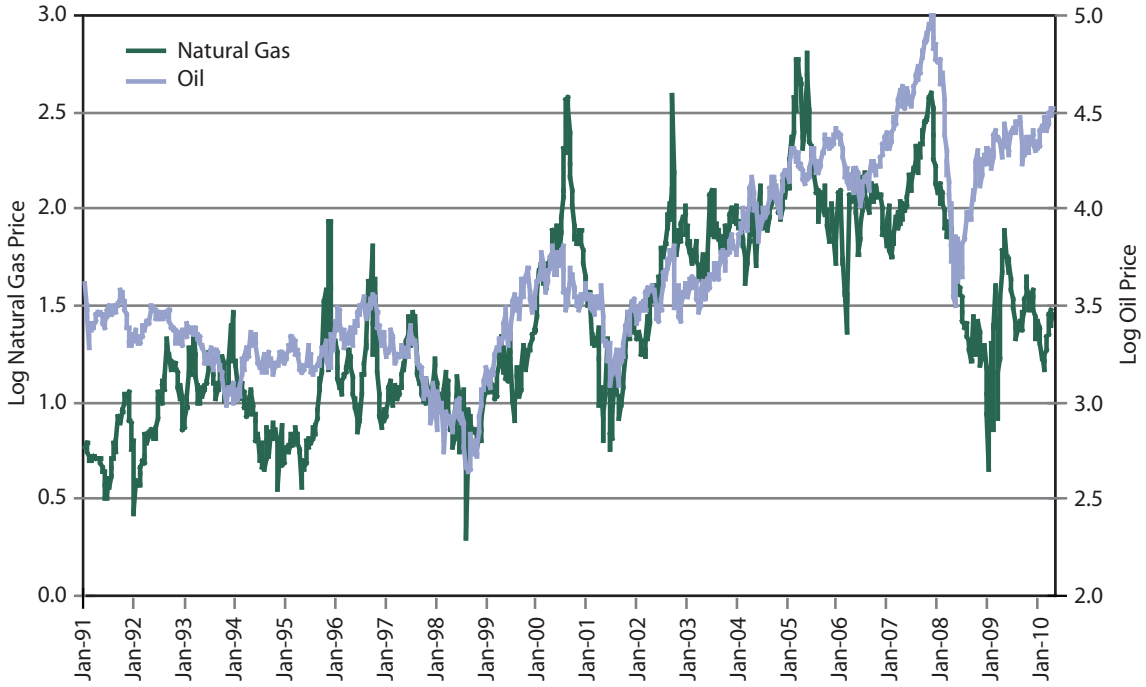


Figure 7.1 shows the (natural) logarithm of the HH natural gas price and the West Texas Intermediate (WTI) crude oil price (the logarithms are used so that the same percentage change in price appears the same irrespective of the price) over the period 1991 to 2010. It is clear in Figure 7.1 that no simple rule of thumb can fully capture the relationship between the natural gas and oil prices. The natural gas price is approximately twice as volatile as the oil price, and short-run swings in both prices are overlayed on top of whatever long-run relationship may exist. A more detailed statistical analysis by Ramberg and Parsons confirms this point even after incorporating key exogenous factors affecting the natural gas price, such as seasonality, storage levels, shut-in production and the vagaries of weather.[1] Nevertheless, they also find that it is possible to identify a statistically significant relationship between the two price series.

Figure 7.2 shows the data of Figure 7.1 as a set of WTI and HH price pairs along with the simple rules of thumb indicated above.[2] Over this time period, the oil and natural gas prices each spanned a wide range, and the ratio of the WTI and HH prices ranged from about 5 to 20. None of the simple rules of thumb reproduce the principal trends over the full range of oil prices. However, it is interesting that, during the period 1991 to 2010, the oil/natural gas price ratio consistently exceeded 10, sometimes substantially, when the WTI price was above $80/bbl. As already noted, the ratio is close to 20 in the first half of 2011. Should these price ratios persist at high oil prices, the opportunities for opening up the transportation fuels market to natural gas would be enhanced.

Figure 7.2 Price Benchmarks Versus Observed Prices 1991–2010

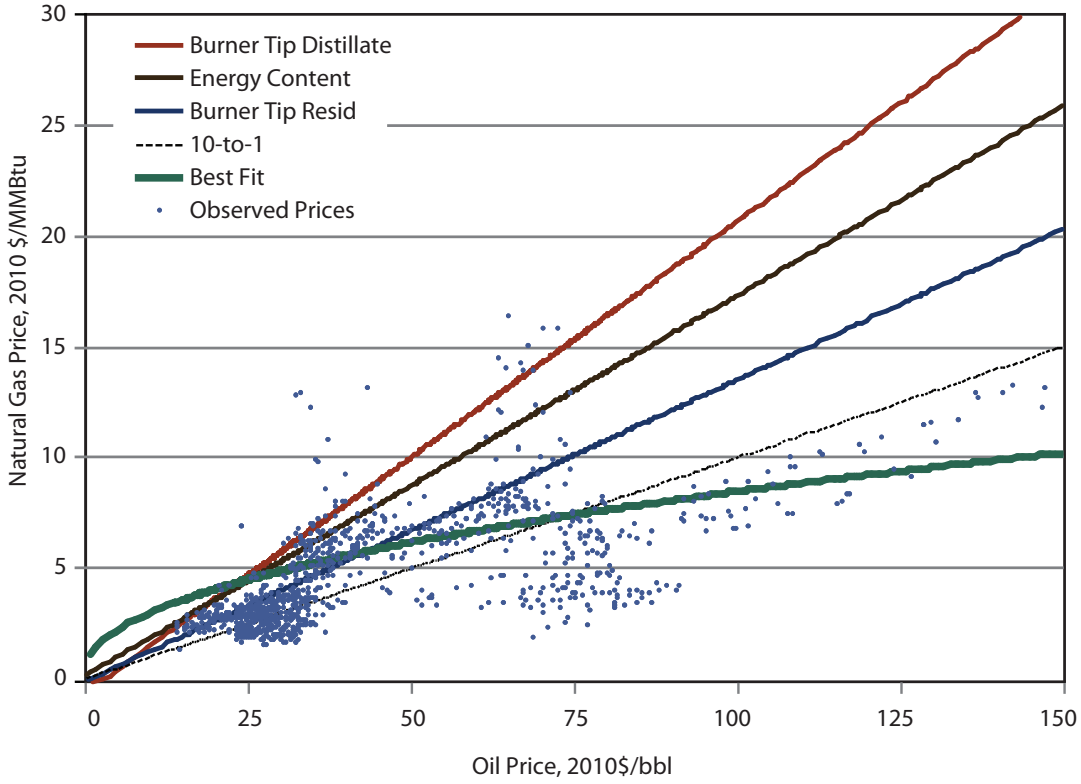


Figure 7.2 charts natural gas prices as a function of oil prices. The four straight lines show the four pricing rules-of-thumb. Using the ordering of the lines at the right of the figure, the top line is the burner-tip parity rule based on natural gas competing with distillate fuel oil, the second line is the energy-content equivalence rule, the third line is the burner-tip parity rule based on natural gas competing with residual fuel oil, and the fourth line is the 10-to-1 rule. The slightly curved line is the best-fit line calculated from a statistical analysis incorporating a number of additional variables and dynamics. The scatterplot of data points are the actual price combinations observed over the 1991 to 2010 period. All observed prices are quoted in real terms in 2010 dollars.

Using a relationship that is linear in the logarithm of prices, and accounting for a number of additional variables moving the natural gas price, Ramberg and Parsons derive a best-fit that can be approximated as

$$\frac{P_{WTI}}{P_{HH}} = 10\sqrt{\frac{P_{WTI}}{70}}$$

with the WTI and HH prices in dollars. This relationship is also shown in Figure 7.2 (solid line, labeled "best fit" relationship) and captures, to some extent, the increasing price ratio with increasing oil price. However, their analysis also confirms that the "best fit" relationship has shifted towards higher oil/gas price ratios in recent years.[2]

During the period 1991 to 2010, the oil/gas price ratio consistently exceeded 10, sometimes substantially, when the WTI price was above $80/barrel… Should these price ratios persist at high oil prices, the opportunities for opening up the transportation fuels market to natural gas would be enhanced.

European and Asian Markets

The European natural gas market developed later than that in the U.S. The initial impetus came with the discovery of the Groningen fields in the Netherlands starting in 1959. In the early 1960s, Algeria began LNG shipments to the U.K., then to France. Small quantities of

natural gas from the Soviet Union flowed into the other countries of Europe beginning with Austria in 1968.

The current structure of Europe's natural gas markets is shaped by the 1973 Organization of the Petroleum Exporting Countries (OPEC) oil embargo. The European reaction was to explicitly tie the delivered price of natural gas to the price of crude oil or crude products. This limits the development of a deep and liquid spot natural gas market in Europe.

Currently, almost half the natural gas for Organization for Economic Cooperation and Development (OECD) Europe is imported, mostly by pipeline from Russia and North Africa, sometimes traversing other countries. LNG also supplies parts of Europe and is especially important to Spain and Portugal, which are on the far end of the Russian pipeline system.

The long supply chains into Europe, the prevalence of pipeline gas and the relative inflexibility of the markets create much more significant security of supply concerns than are experienced in North America. Diversification of supply is a high priority. However, even though the U.S. is not significantly dependent on imports, American security interests can be strongly affected by the energy supply concerns of its allies.

There have been moves in the EU to liberalize gas markets, starting with the U.K. in 1986. As part of a larger energy market liberalization effort, the EU in 1998 sought to create common rules for an internal natural gas market. The result has been the development of a small spot market on the European continent. Ultimate success will depend upon the future course of the EU's regulatory reform. Progress is slow.

Industrialized Asia led the way in setting LNG prices through oil-indexed long-term contracts and remains bound to this market structure. This does not appear likely to change in the near term. With limited indigenous conventional natural gas resources, industrialized Asia and the emerging economies in that region are almost totally dependent on imported LNG from Southeast Asia, Australia and the Middle East. This dependence places a high premium on security of supply, which is reflected in the region's dependence on long-term, relatively high-priced contracts indexed to oil.

The indexation of natural gas contract prices to the oil price was a necessary innovation to enable long lead-time contracts to partially accommodate fluctuating energy prices. But oil is an imperfect index for natural gas, as seen in our discussion of U.S. prices. Since the spot market oil and natural gas price relationship does not match any simple formula, an oil-indexed contract price cannot mimic very well the spot natural gas price; oil indexed prices are out of sync with the value of marginal deliveries of natural gas, sometimes being too high and other times too low. Therefore they cannot give the right signals for consumption of natural gas, inhibiting efficient use of the resource. In order for both buyers and sellers to capture the full value of natural gas resources, it is essential for long-term contracts to reflect the specific supply and demand conditions of natural gas, meaning a liquid market in gas spot deliveries. Absent this, buyers and sellers have not been able to do better than index contracts to the liquid oil price. Encouragement of the expansion of a liquid market in spot natural gas deliveries in Asia is in the interest of buyers and sellers and other parties in the value chain. As the use of natural gas grows throughout industrialized Asia and Europe, the opportunity is ripe to realize the establishment of a spot market. This would make it possible to switch long-term contracts from a price linked to spot oil markets to a price linked to spot natural gas markets. In turn this will create the opportunity for the expanded use of natural gas and improve the possibility for international linkage. Nevertheless, the path to a spot market is likely to be

complex and slow, and long-term contracts operating side by side with the spot market will be necessitated by the capital requirements of very long pipelines and LNG infrastructure.

Finally, we note that domestic markets in some major supplier countries, such as Russia, operate with very large subsidies. This leads to inefficient use that impacts volumes of natural gas available for export.

Long-term contracts operating side by side with the spot market will be necessitated by the capital requirements of very long pipelines and LNG infrastructure.

IMPLICATIONS OF MARKET INTEGRATION

Extrapolating from the lessons learned from the North American market, an interconnected delivery system combined with price competition are essential features of a "liquid" market. This system would include a major expansion of LNG trade with a significant fraction of the cargoes arbitraged on a spot market, similar to today's oil markets.

As described in Chapter 3, the Emissions Prediction and Policy Analysis (EPPA) model was used to investigate the consequences of global natural gas prices differentiated only by transportation costs (which are appreciable for long distances between buyer and seller). We emphasize that this is not a prediction that such a market will emerge, but rather an exploration of the implications of global market integration. For the U.S., with the median expectations for both North American and global gas resources, the U.S. becomes a substantial net importer of gas in future decades in an integrated market and long-term domestic prices are lower than in the regionalized market structure. Also, greater diversity of supply is seen for all the major markets in this scenario.

Clearly other scenarios could result from changes in resource estimates or from geopolitical realities.

Extrapolating from the lessons learned from the North American market, an interconnected delivery system combined with price competition are essential features of a "liquid" market.

In addition, a functioning integrated market can help overcome disruptions, whether political in origin or caused by natural disasters. An example of this was seen in the U.S. oil markets, which recovered quickly following the 2005 hurricanes in no small part because of international market adjustments.

Overall, a "liquid" global natural gas market would be beneficial to U.S. and global economic interests and, at the same time, it would advance security interests through diversity of supply and resilience to disruption. These factors moderate security concerns about import dependence.

DIVERSITY OF SUPPLY

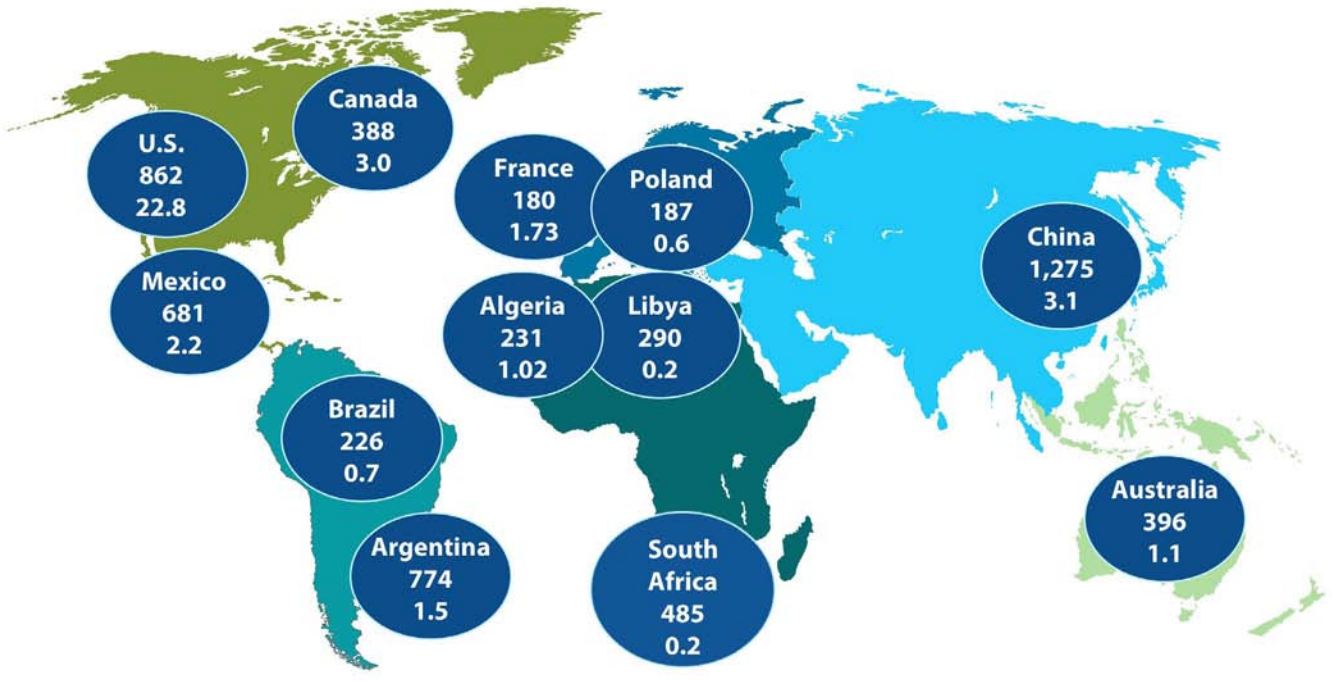
As already noted, the distribution of conventional natural gas resources is highly concentrated, with Russia, Iran and Qatar being the largest resource holders. Indeed the global market scenario of Chapter 3, referenced above with regard to U.S. import possibilities, shows Russia and the Middle East becoming major suppliers to all three of the major regional natural gas markets — the U.S., Europe and industrialized and emerging Asia. The recent experience of Europe (curtailment of Russian natural gas) and the uncertain political future in the Middle East are a cause of concern, especially in Europe and Asia because of their large demand and limited or declining production.

As has already happened in the U.S., unconventional resources could change the picture dramatically. The Energy Information Administration (EIA) recently released "World Shale Gas Resources: An Initial Assessment".[3] This report, prepared by Advanced Resources International (ARI), presents estimates for potential shale gas development in 48 basins in 32 countries outside the U.S. It does not include regions with large conventional resources, such as Russia and the Middle East, since these seem unlikely to develop the shale resource in the near future. Even with this restriction, the estimate is for 5,760 Trillion cubic feet (Tcf), which is a substantial fraction of the approximately 16,000 Tcf mean estimate of global resources discussed in Chapter 2. None of these shale resources was included in the global estimate or in the trade models of Chapter 3. ARI acknowledges that the estimates may have considerable uncertainty at this time, and will be refined over time as the shale resources are investigated by an increasing number of industry players.

The scale of the global shale gas resource is a potential game-changer…the trade flows in a global market could be affected substantially…and the leverage of MRHs to follow politically motivated strategies would presumably be diminished.

The distribution of these shale resources is also interesting. Figure 7.3 shows some of the results[3] along with the current annual natural gas use in those countries. Pertinent to the discussion above, France and Poland are each estimated to have around 180 Tcf, and China over 1,200 Tcf.

Figure 7.3 Global Shale Opportunities: Technically Recoverable Shale Reserves and 2009 Consumption (Tcf)



Source: : EIA/ARI, 2011

These resources dwarf annual use and therefore present the possibility of exports that significantly affect import requirements for their regional natural gas markets. How this plays out remains uncertain; for example, while Poland intends to pursue production aggressively, France has declared a moratorium because of concerns about environmental impact. Nevertheless, the trade flows in a global market could be affected substantially if the global shale gas resource is developed at scale over the next decade or so, and the leverage of MRHs to follow politically motivated strategies would presumably be diminished.

Conventional natural gas finds, even if not on the scale of the apparent shale resource, can also impact diversity and security of supply when they occur in strategic locations. A recent example (2009 and 2010) is the large offshore finds in the eastern Mediterranean Levantine basin. The expectation is for more than 25 Tcf of resource in the Israeli economic zone. Inevitably there will be issues to be resolved involving the maritime borders of Israel, Lebanon, Gaza and Cyprus. Nevertheless, it appears that the security of supply for Israel, which currently uses about 0.2 Tcf of natural gas per year, has been transformed by the offshore natural gas finds. In particular, it offers the possibility of greatly reduced oil dependence through direct or indirect use in transportation.

NATURAL GAS SECURITY CONCERNS AND RESPONSES

Energy supply generates security concerns when an economy is exposed to sudden disruptions that cannot be addressed by substitution of alternative primary energy sources. It should be noted that any source can be replaced with sufficient time and investment. For example, security concerns led France to make a strategic decision to base its electricity supply on nuclear power. Restricted access to oil led World War II-era Germany and Apartheid-era South Africa to large coal conversion to liquid fuel programs. For natural gas, the end use with the most difficulty for adjustment to a sudden disruption is space heating. This was seen in January 2009 when Russian natural gas to Europe was cut off because of a dispute with Ukraine, a key pipeline transit country from Russia to Europe. Although the U.S. is not at risk of natural gas supply disruptions because of the large North American resource and production infrastructure, the vulnerability of key allies is itself a security concern. Furthermore, the opportunity to substitute natural gas for oil as a transportation fuel feedstock improves resilience to "oil shocks."

Transparent markets with diverse supply, whether global in reach or within large regions that encompass both major suppliers and large demand centers, do much to alleviate security risks. Nevertheless, the anticipated growth in gas use, combined with the geological realities of conventional gas resources, inevitably will produce continuing concerns, such as:

1. **Natural gas dependence could constrain U.S. foreign policy options.** U.S. freedom of action in foreign policy is tied to global energy supply. Iran, for example, presents many security challenges in the Middle East and is in confrontation with the West over a developing nuclear weapons capability. However its oil exports and its potential for natural gas exports set up conflicting objectives for the U.S. and its allies: altering Iran's behavior, yet not risking supply interruptions of the oil and (eventually) natural gas markets. Such situations threaten allied cohesion in foreign policy.

   Specifically, the U.S., with its unique international security responsibilities, can be constrained in pursuing collective action if its allies are limited by energy security vulnerabilities.[4] The natural gas cutoff to Europe demonstrated Russia's market power

in a situation where key allies have inadequate alternative supplies and insufficient short-term substitution possibilities in a key sector. Russia has argued that the Ukraine dispute was commercial, that Ukraine should not have blocked transshipments and that it is a reliable supplier. However, the fact that they were selectively moving towards market prices in some Former Soviet Union states and not others suggested political motivations for the disruption. In any event, security implies removing or minimizing vulnerabilities, so U.S. support and encouragement of shale gas development, alternative pipeline supplies (e.g., from the Caspian region) and transparent LNGs markets with a robust LNG infrastructure should be viewed as favoring U.S. security interests.

A global "liquid" natural gas market is beneficial to U.S. and global economic interests and, at the same time, advances security interests through diversity of supply and resilience to disruption.

2. **New market players could introduce impediments to the development of transparent markets.** The new large consuming economies, such as China and India, are increasingly seeking bilateral arrangements that include non-market concessions. Such arrangements have the potential to influence long-term political alignments, move away from open, transparent natural gas markets and work against the interests of consuming nations as a whole. Major natural gas producers have shown some interest in forming a cartel to control supply, but this movement is not yet very advanced.[5] Global shale gas developments would make such a cartel very difficult to implement effectively.

3. **Competition for control of natural gas pipelines and pipeline routes is intense in key regions.** Control of pipeline routes gives natural gas suppliers tremendous leverage over consuming nations, and competition for these routes is often a "high stakes game." The landlocked Caspian region, which possesses large oil and gas resources, provides an important example of the geopolitical complexity that can develop. Decades ago, the Caspian was surrounded by only the USSR and Iran, and the legacy natural gas pipeline infrastructure is entirely through Russia. The Russia-Ukraine-Europe natural gas delivery cutoff of 2009 spurred Europe to further its intentions to explore pipeline routes out of the Caspian Sea region to Europe while avoiding Russia. This mirrors the earlier construction of the Baku-Tbilisi-Ceyhan (BTC) oil pipeline that took an East-West route from Azerbaijan to Georgia to Turkey, but the gas pipeline is more complicated precisely because of the physical characteristics of oil and natural gas and the resulting transportation options. The BTC oil pipeline can use ships to cross the Caspian for supply from Kazakhstan and ships to export the oil from Turkey. On the other hand, the proposed Nabucco pipeline from Baku to Austria is thousands of kilometers long and crosses Romania, Bulgaria and Hungary just from Turkey to the Austrian hub. Furthermore, supply from the Eastern side of the Caspian, particularly Turkmenistan, is crucial for supplying sufficient natural gas volumes, but a subsea pipeline to Baku faces complications because of unresolved seabed jurisdictional disputes. Yet another complication is competition for Turkmen natural gas from China, which has already begun supply through a very long pipeline to Shanghai. Not surprisingly, the competition and competing political pressures on the governments in Central Asia and the Caspian region over pipelines out of the region is intense. It is unclear how this will be resolved.

While the Caspian presents a particularly complex situation, long pipelines crossing multiple countries inherently raise transshipment concerns. Another example is the proposed Iran-Pakistan-India pipeline. For a summary, see "Natural Gas and Geopolitics: From 1970 to 2040".[6]

4. **Longer supply chains increase the vulnerability of the natural gas infrastructure.** As supply chains multiply and lengthen, these infrastructures have become increasingly vulnerable to both malevolent attacks and natural disasters. Pipelines, processing facilities, LNG terminals and tankers are "soft targets," i.e., easy to locate and destroy, usually undefended and vulnerable to attacks, including cyber attacks.

As the use and trade of natural gas grow over the coming decades, with an uncertain global market structure, U.S. policy makers must be well informed and manage the interrelationship between natural gas markets, both domestic and international, and security in order to limit adverse effects on U.S. and allied foreign policy.

RECOMMENDATIONS

1. **The U.S. should sustain North American energy market integration and support development of a global "liquid" natural gas market with diversity of supply. A corollary is that the U.S. should not erect barriers to natural gas imports or exports.**

   Robust global LNG trade and progress toward spot pricing of cargoes, especially in Asia, are necessary for establishment of a global natural gas market.

2. **A federal multi-agency coordinating body should be established to better integrate domestic and international implications of natural gas market developments with foreign and security policy.**

   Numerous agencies (Energy, State, Treasury, Defense, Commerce, etc.) have a major stake in this integration, so the Executive Office of the President must exercise the necessary convening power and leadership. To be successful, strong energy policy support for the coordinating group must be established in the Department of Energy. This is in accord with the recommendation for a Quadrennial Energy Review issued by the President's Council of Advisors on Science and Technology.[7]

A federal multi-agency coordinating body should be established to better integrate domestic and international implications of natural gas market developments with foreign and security policy.

3. **The IEA should be supported in its efforts to place greater emphasis on natural gas and security concerns.**

   To do so meaningfully, it must bring the large emerging natural gas-consuming economies (such as China, India, Brazil) into the IEA process as integral participants. The process should promote open and transparent energy markets, including the natural gas market.

   A global natural gas market may lead, as in the U.S., to lower natural gas prices relative to oil. If this in turn stimulates more substitution of natural gas for oil in the transportation fuels market, IEA's core mission of advancing energy security will be advanced.

4. **The U.S. should continue to provide diplomatic and security support for the siting, construction and operation of global natural gas pipelines and LNG facilities that promote its strategic interests in diversity and security of supply and global gas market development.**

5. **The U.S. government, in concert with the private sector, should seek to share experience in the characterization and development of global unconventional natural gas resources in strategic locations. This includes strengthening the Global Shale Gas Initiative (GSGI).**

   Global shale gas resources at the several thousand Tcf scale have the potential to be game-changers with regard to the market and security issues discussed in this chapter. The U.S. has a strong interest in seeing this development and, to date, has been by far the leader in exploiting unconventional natural gas resources. The GSGI is led by the Department of State, with support from the Departments of Interior, Energy and Commerce and from the Environmental Protection Agency. It provides assistance as requested on resource assessments; production and investment potential; and business and regulatory issues. China, India, Jordan and Poland are working with the GSGI.

   The experience of states in regulating environmental performance of shale gas production should also be brought to bear through the GSGI.

6. **The U.S. should take the lead in international cooperation to reduce the vulnerability of natural gas infrastructure; help set security standards for facilities and operations; and provide technical assistance for sharing threat information, joint planning and exercises for responding to incidents.**

NOTES

[1]David J. Ramberg and John E. Parsons, MIT Center for Energy and Environmental Policy Research report 10-017, November 2010.

[2]ibid.

[3]World Shale Gas Resources: An Initial Assessment, prepared by ARI for the U.S. EIA, April 2011, www.eia.gov/analysis/studies/worldshalegas.

[4]National Security Consequences of U.S. Oil Dependency; J. Deutch and J. Schlesinger, chairs, D. Victor, project director; Council of Foreign Relations Independent Task Force Report No. 58 (2006).

[5]What is the Gas Exporting Country Forum (GECF) and what is its objective?, EIA 2009; http://www.eia.doe.gov/oiaf/ieo/cecf.html.

[6]Natural Gas and Geopolitics: From 1970 to 2040, D. Victor, A. Jaffe, and M. Hayes, editors, Cambridge University Press, 2006.

[7]Report to the President on Accelerating the Pace of Change in Energy Technologies through an Integrated Federal Energy Policy, President's Council of Advisors in Science and Technology, November 2010, www.whitehouse.gov/ostp/pcast.