Energy Security:
The Gas Dimension

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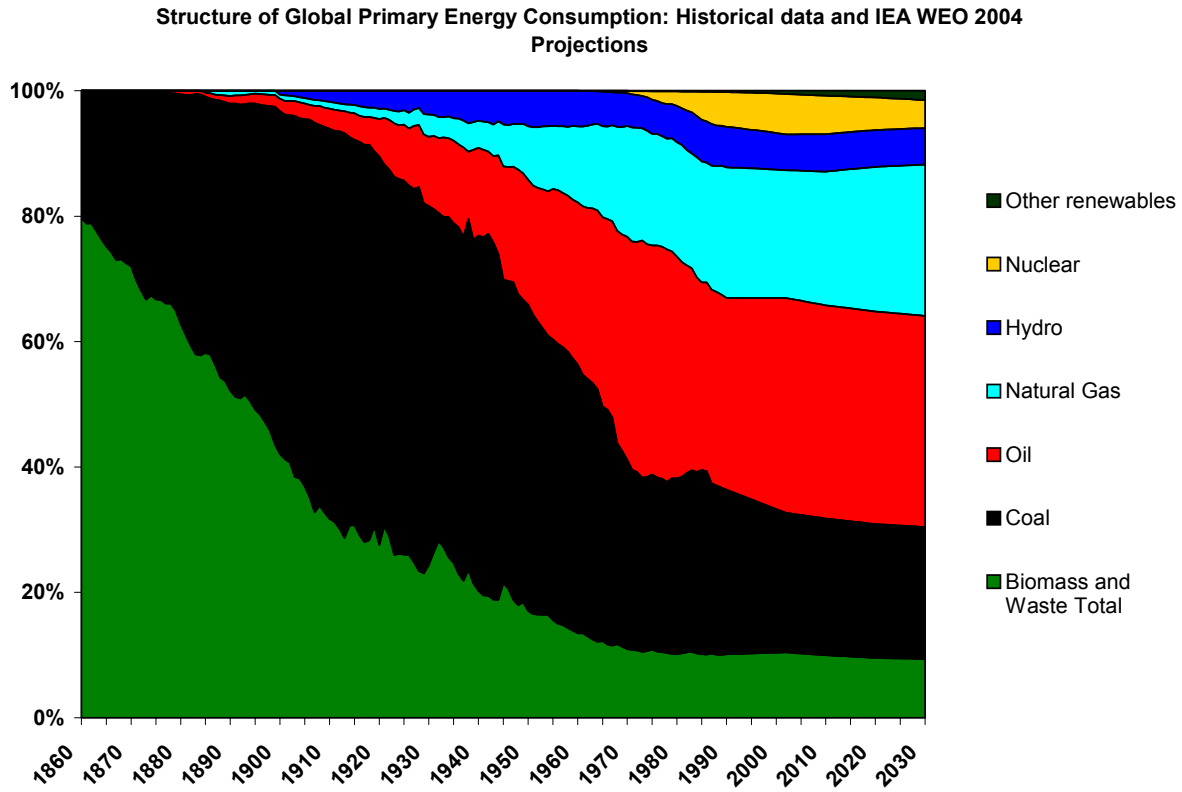
BEYOND OIL

For more than three decades Americans have examined their energy security through the lens of oil. Liquid in form and dense with energy, oil has been unbeatable in moving cars, trucks, and airplanes. Oil prices arise in a world market that is often buffeted by geopolitical gyrations, occasionally with severe effects on the world economy. Outside oil, however, questions of energy security have barely arisen. And while oil is the single largest source of primary energy for the world economy, nearly three fifths of the world's energy comes from sources that are close to home and available with confidence (figure 1).

This oil-centered concept of energy security is set to change rapidly. Prized for its high efficiency and clean burning, consumption of gas has grown sharply since the 1950. Natural gas has become an indispensable fuel, especially for the generation of electricity. Gas drillers, like all who hunt and gather, are exhausting the conventional gas sources close at hand and are now tapping more distant and exotic locales. Consequently, most of the world's largest gas markets face the prospect of importing large amounts of natural gas. In the United States, for example, onshore gas production is declining sharply; while deepwater production in the Gulf of Mexico and techniques for extracting the natural gas from coal seams in the West have filled the gap, total U.S. domestic gas production has been nearly flat since the early 1990s. Almost all the incremental U.S. demand in gas over that period has been supplied by imports from Canada; yet in recent years Canadian supplies have also begun to dwindle, leading North American gas users to look further afield.

Figure 1:



These issues are hardly unique to North America. In Europe, the gas market emerged in the 1950s around local supplies in areas such as in the Netherlands and in northern Italy. For the last three decades, however, most new supplies have come from outside western Europe—notably Russia and Algeria. About 30 percent of the gas in the west European market comes from Russia; the fraction approaches 100% in parts of central and eastern Europe where bottlenecks in the pipeline network and the absence of convenient alternative energy sources gives Russia (i.e., Gazprom) a secure monopoly. So far, Russia has proved to a highly reliable supplier. From the time that the first Russian export pipelines began operation around 1970, through even the darkest period of the cold war in the early 1980s, the record of Soviet gas deliveries was remarkably consistent. Only the 1990s—after the Cold War had ended—did the Russian supply hiccup for two brief periods. One, in 1995, arose in the wake of political turmoil in Ukraine, the main transit country for Russian gas exports. These troubles spurred Gazprom and a German importer to build a bypass line around Ukraine and through Belarus, which was seen at the time as more reliable. The second interruption, in February 2004, lasted only a day and involved

relatively small amounts of gas in transit along that new pipeline across Belarus. Belarus had fallen out of Russian favor, and Gazprom was freezing its users to demand higher prices and control of the pipeline. These events are rare because Gazprom knows that they are a one-shot game. In the early 1980s Algeria—the second-largest exporter of gas to Europe, after the Soviet Union—left a costly pipeline that crossed the Mediterranean empty for nearly two years while it haggled over price. (At the same time, Algeria was the largest supplier of LNG to the United States and demanded higher prices. The U.S. government refused to let private importers pay the new price, Algeria's LNG supply faltered, and the U.S. actually shut one of its LNG terminals—only in 2004, more than two decades later, the facility on Elba Island was reopened.) The experience branded Algeria as an unreliable gas exporter and explains why Algeria, ever since, has fallen far short of its potential role of gas exporter. Algeria's catastrophic strategy—an effort to do for its gas exports what Algeria and other OPEC members had achieved in higher oil prices—is long remembered as a misstep. It is unlikely, but not impossible, that Russia could strategically or accidentally become a flaky supplier, and such a risk requires contingent planning.

In the coming decade the big news for gas-poor markets will be rising gas imports in the form of liquefied natural gas (LNG). There has been steady progress in the entire chain of LNG technologies—the compressors and coolers that turn it into a minus 260 degree Fahrenheit liquid, the stainless steel tanks and special ships for storage and conveyance, and the receiving terminals that regasify the liquid to useful form. The cost of moving a quantity of LNG today - through the whole chain of compressors, coolers, tanks, ships, and regasifiers - is just two-thirds that of the projects that began operation in the early 1990s.

LNG matters because it appears to be changing the structure of gas markets. In its natural state, gas is bulky and costly to move except by pipeline. Even as pipeline technologies have improved—in part under competition with LNG—it is impractical to build most pipelines longer than a couple thousand miles, and underwater pipelines are especially costly to install and operate. Thus most natural gas markets have been regional affairs—covering Western Europe, or bits of Latin America or North America, for example—often with large variations in price

between markets because it was nearly impossible to move gas from glutted regions to those where prices were dear. As a compact liquid, natural gas can move in a global market.

LNG has allowed much longer distance gas transportation, but until very recently the LNG business did not yield an integrated world gas market. The reasons are technological, financial and political. The basic technologies for LNG have been known since the 1940s and were first used as convenient way to keep gas on hand for moments of peak demand. (The worst accident in LNG history occurred in 1944 at the very first of these early "peaker" LNG storage facilities—in Cleveland. A ruptured tank filled the sewers with gas, and the subsequent explosion killed 128 people and leveled one square mile.) As a scheme for bulk trading, LNG was really pioneered in the late 1960s by Japanese engineering companies; their government, aware that Japan's growth required energy resources and the country was poorly endowed with its own, led the effort. LNG trains are capital intensive, and justifying the expenditure required long-term contracts (typically 20 to 25 years). In this contracted market, there was no fungibility of supply, which is the hallmark of a global commodity. The banks that financed these projects liked point-to-point trading because revenues were easier to predict; the Japanese government also favored dedicated trading because it assured security. The business was extremely lucrative as the Japanese governments was willing to allow its gas and electric companies to pay high prices for LNG, which was seen as more secure than oil. While other countries—the United States, Korea, Taiwan, Italy, Spain and France—also imported LNG, Japan dominated the business and valued security over flexibility. Nearly everywhere, until the 1990s, LNG trading routes were more like long, dedicated pipelines than fungible cargoes that could sail to whatever port offered the best price.

These managed markets are now changing. The world's largest gas markets—the United States—is been open to competition since the late 1980s. The Western European gas market is now increasingly governed by rules and trading relationships that allow markets to determine prices and shipments. Elsewhere in the world—in South America and India, notably, but not yet in China—market forces are arriving, slowly, for gas. At the same time, the cost of LNG trading has declined—making it competitive with local gas sources in many markets, not just in security-minded Japan—and new suppliers and users of LNG are creating a liquid market. The

significance of LNG is not its sheer volumes, but the prospect for arbitrage. The volumes are still small—in 2003, for example, just 6% of the world's gas consumption was moved as LNG. Even if the volumes of gas traded as LNG remain small, this arbitrage is already connecting disparate markets into something resembling a global market. As shown in figure 2, while the total production of gas today is about 2.5 times the level in 1970 international trade has risen sharply. LNG trade has increased more than sixty-fold during the period. Pipelines dominate international gas trade because bulk gas over relatively short distances is easier to move by pipe than as LNG (figure 3).

The emerging global gas market will force policy makers in the U.S. and other gas-using nations to adopt new thinking about energy security. LNG offers the potential for a more efficient and environmentally 'friendly' energy system, but the security challenges will be difficult to handle because they do not map easily onto any of the existing foreign policy apparatus. Key decisions about fuel choices will be made by regulators, especially in the electric sector, who are not accustomed to pursuing a global security strategy. Insofar as the LNG industry itself has worried about security, it has hardened its facilities against the already miniscule threat of terrorist attack; yet the much larger risks arise from market manipulation and interconnections in a global gas market that local regulators have barely contemplated. In addition to preparing the markets where gas is used, a successful gas security strategy will require engaging with the world's largest gas producers—notably Russia, which holds one-quarter of the world's gas reserves, is already the world's largest producer and exporter, and is best positioned to be a direct and indirect supplier to the U.S. market.

Figure 2:

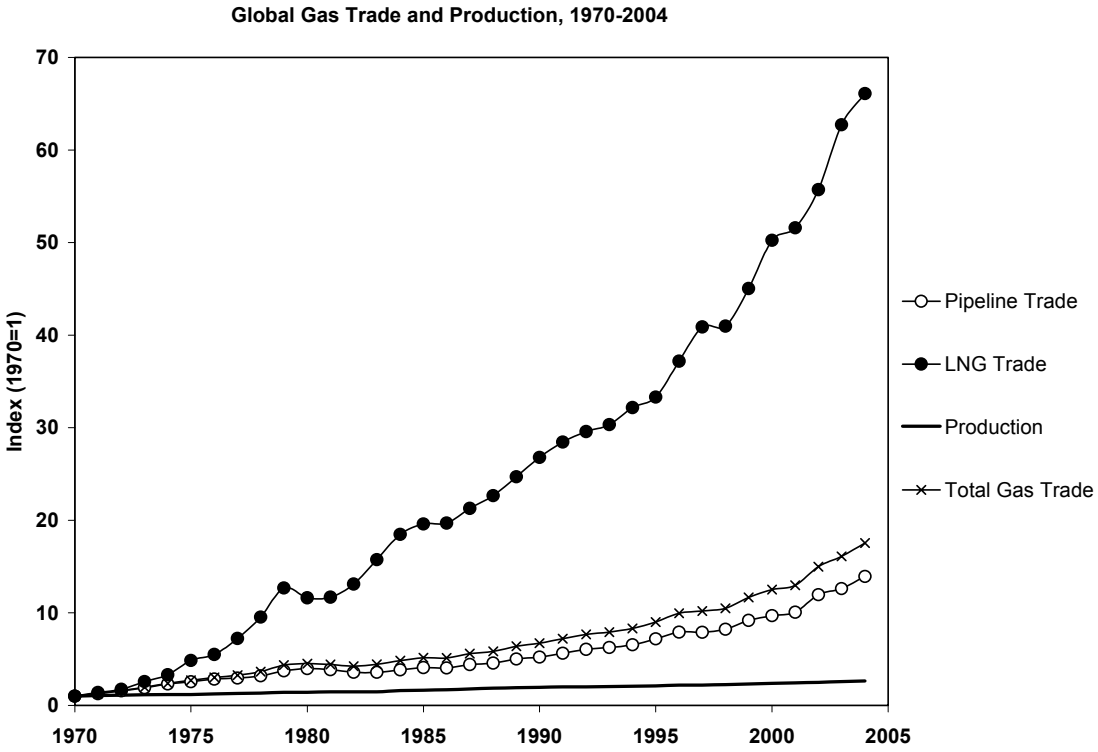
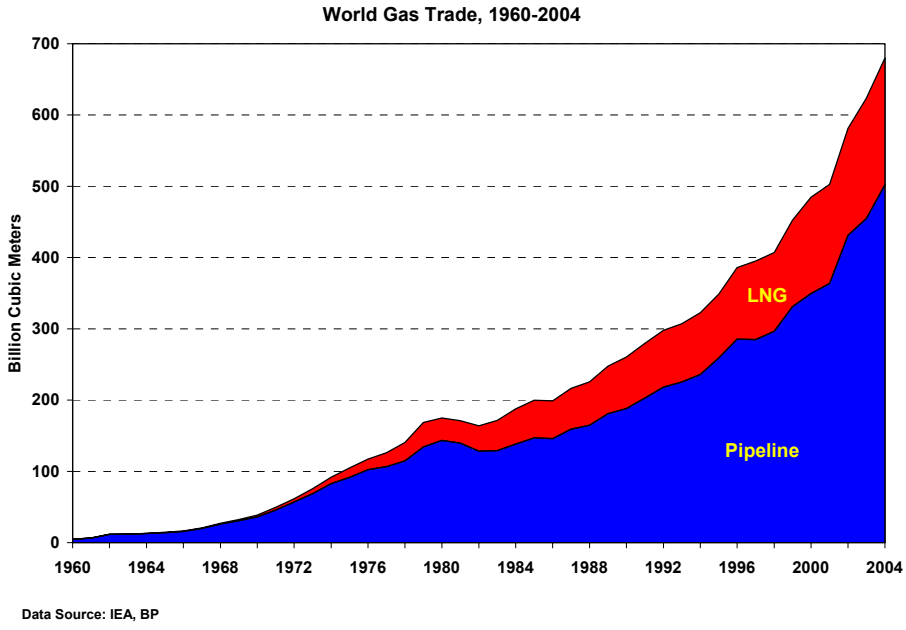


Figure 3:



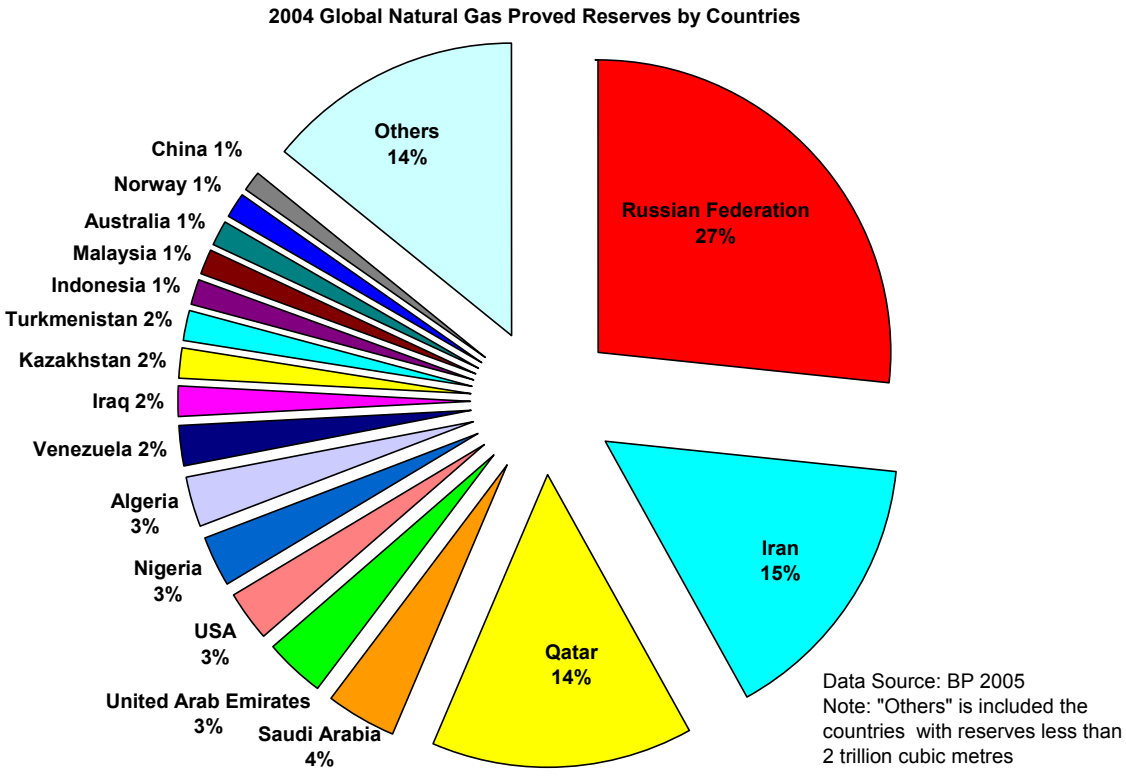
RUSSIA'S SPECIAL ROLE

A full tour of the world's gas producing and consuming regions is beyond the scope of this paper, but the most striking feature of this emerging gas market is the central position of Russia. Russia's proximity to the European market has already made it the world's largest gas exporter, accounting for 21% of all the international trade in gas. (The next largest exporter, Canada, is far behind.) Russia is poised to become even more dominant supplier in the global gas market. While world is generally rich in gas resources—proved reserves will last 70 years at current production level, and likely resources are many times that level—Russia unquestionably controls the largest cache (about 27 percent of the world total, see Figure 4). While most of Russia's richest resources are found in difficult terrain or distant from markets (or both)—in Northwest Siberia where permafrost makes it difficult to anchor equipment to the ground, in the icy seas off Sakhalin and in the Arctic where drilling is costly and dangerous, and off Lake Baikal where more than three thousand kilometers of pipelines are needed to reach the closest markets in China and Korea—technological change is making it feasible to tap those resources economically. The size of the resource is staggering. The giant Shtockman field in the Barents Sea, discovered only in 1988, has reserves double those of all Canadian gas fields combined. The Kovykta field near Lake Baikal holds roughly twice the reserves in all of China. Most of Russia's gas appears to be in the Far East where essentially none of the potential has been tapped; active drilling could find still more super-giant gas fields. With an attractive environment for investors to apply capital and new technology, Russia is the prize in the gas world.

Russia's biggest liability is the firm Gazprom, a state-dominated company that controls nearly all gas production, piping and distribution. Like most state energy companies, Gazprom is organized to yield political benefits rather than economic efficiency and sustainable profit. The firm is heavily indebted and would be bankrupt under western accounting standards. Its assets are not financial but political—Gazprom, unlike any other player in Russian gas, can mobilize the power of the Russian state and thus is assured of a lucrative role in any gas project. As incumbent owner of Russia's pipeline system it can control which firms are able to sell their

gas, which explains why 93% of all the gas produced in Russia comes from Gazprom's own fields even though the ownership of gas resources is more evenly distributed and includes independent gas companies and oil companies. The neighboring gas-rich countries of Kazakhstan and Turkmenistan are also at the mercy of Russia and Gazprom when they attempt to move their gas across Russian territory to markets in Ukraine and especially the west. Landlocked Turkmenistan, is especially disadvantaged because it has huge gas production but no access to markets. Gazprom has forced Turkmenistan to accept prices that are about one-third the level at which Russia exports gas to the west and has appropriated the difference for itself. This predatory arrangement explains why Gazprom's production strategy for the near term relies on the fact that it is cheaper to buy gas from Turkmenistan than to invest in practically any new gas producing project.

Figure 4:



Gazprom's dysfunction is a looming problem for the West because Russia is already the largest fixture on the world gas market, and success in creating an attractive place for new production is important to the realization of a vision of globally available gas supplies at low

cost. Western experts have poured obsessive attention on the need to open the Russian gas market to alternative suppliers, such as through the adoption of rules that allow "third party access" to the Russian pipeline network and break the grip of Gazprom on trading and marketing of gas. Such initiatives are probably a fantasy, and the most likely outcome is that Russia will sustain and solidify its position as the world's largest gas producer and exporter while, at the same time, keeping Gazprom intact. Indeed, within the last year Russia has not only reasserted it special position as Russia's gas hegemon, but it has also used the power of the Russian government to help acquire assets that are making Gazprom a large state-owned oil producer as well.

Among the many problems created by Russia's dysfunctional system for owning and managing its gas infrastructure is economic inefficiency. At present, Russia yields just 85 cents of economic output per cubic meter of gas that it consumes. In contrast, other nations that share Russia's frigid latitudes are much more efficient—for example, Canada produces $8 and Finland $32 in income for each cubic meter of burned gas. If Russia used gas with Canadian efficiency then Russia would liberate 360bcm of gas, or nearly three times as much as it exports today to all the European Union. Such comparisons are obviously unfair because Russia and Canada differ in many ways, but they are a first order indication of the massive inefficiency that remains to be undone. Skeptics will argue that so much will be difficult to change in Russia, but it is sobering to recall that the same arguments were made about the U.S. in the early 1970s. Faced with the shock of higher energy prices—a rise not dissimilar to the increase in internal prices that could occur in Russia—Americans found myriad ways to save energy. In 1974 the Ford Foundation published *A Time To Choose*, a report by the leading experts of the day on the possible futures for U.S. energy consumption to the year 2000. The actual energy consumption in the U.S. in 2000 was equal to the lowest level that the Ford group imagined would be achievable. With sustained effort, markets can deliver striking changes in technology and efficiency at a profit.

Russia is hardly the only potential supplier in this future gas market. Other countries rich in gas resources could emerge as pivotal. Iran, with the world's second largest resources, is geologically well positioned. However, the Iranian political climate is a liability in the new world of global gas trading and private investment. Even more than in Russia, private investors

in Iranian gas projects must contend with the risk that the political environment could shift, stranding investments. (And American companies are completely excluded from Iran due to U.S. sanctions.) Iran's largest gas field is offshore in the Persian Gulf and shared with Qatar, whose fortunes are rising because the government has been able to combine its rich gas resources with a political and commercial environment that investors believe is stable and conducive to long-term projects. Gas resources are abundant elsewhere in the world, and in some places have been able to offer similarly attractive commercial settings. Australia, Egypt and Libya are among the rising stars; Algeria's star appears to be fading; Trinidad, Nigeria, and Indonesia are among the other large established LNG suppliers that seem likely to remain important. But only Russia combines a pivotal position in both the bulk pipeline export of gas (thanks to its proximity to Europe) and a potentially large role as LNG supplier.

POSSIBLE PRESSURES AND ROLES FOR THE L20

The fundamental advantages of gas over its competitors—especially coal—are strong and durable. The shift to gas is good news for environmental quality in the locales where it is burned instead of other fossil fuels. Because it emits much less CO_2 than all the other fossil fuels, gas will also lighten the pressure of climate change on the global environment. And because gas is deployed mainly for efficient and flexible generation of electric power, the shift to gas and electricity are strongly associated with economic modernization and growth. In every major economy, industrialization has been synonymous with electrification. Small and responsive gas power plants, coupled with advanced electronics, are key elements of advanced power grids that deliver highly reliable clean electricity needed for computers and other essential devices of the post-industrial information economy as well.

While the advantages for gas are strong, for large importers the shift to gas will raise troubling questions about security. This paper is part of a larger effort to explore possible agenda items for the L20—a standing forum of the leaders of about 20 key industrialized and developing countries. What could the L20 do to help advance the agenda for gas? I suggest four answers.

First, the L20 can help to articulate a vision for why a global gas market will aid security, not undermine it. That vision will require, initially, avoiding the wrong analogies with oil. In oil, the industrialized world responded to the risk of interrupted supplies by building and filling strategic stockpiles and coordinating through the International Energy Agency to manage such reserves as a single global public good. Pressure will arise for an analogous response to the globalization of the gas market, and a credible federal strategy for gas must articulate why a mandated stockpile approach to gas security would be extremely unwise. Compared with oil, it is much more costly to store gas, and in every large gas market there is already considerable amount of private storage that already responds to expected seasonal and annual swings in price. In managing sharp peaks in price, LNG is also playing a role. In 2004 the U.S. imported one cargo of LNG that had been stored temporarily in Spain, and onshore use of LNG is a long-standing part of U.S. storage. There are 96 onshore LNG storage facilities, dotted mainly across the Eastern United states, and dedicated to keeping gas on hand when demand for gas exceeds the capacity of the local pipeline network—most are in the Northeastern U.S. and deliver gas only a few days per year during cold snaps. There is not much else that federal policy should do to promote storage as a response to concerns about security.

Rather than storage, the most efficient way to reduce vulnerability to shocks in supply is by lubricating a more flexible demand. Through the 1990s, power plants and some industrial facilities gradually removed their capacity to switch between oil and gas; that, along with higher oil prices, explain why U.S. industry barely cut demand in response to the recent spike in gas prices; from 1999 to 2000, gas prices doubled and consumption still rose by nearly 4%. Some low-value applications, such as ammonia fertilizer producers, have cut or shut their production and moved overseas (e.g., Trinidad, where gas is plentiful and cheap), but most of the easy and automatic flexibility has been exhausted from the American system. In large measure, the relative cost of fuels and the location of industrial facilities are matters for markets to settle, but as the U.S. market becomes more dependent on imported gas and the flexibility of LNG cargoes rises, it is easy to see that a few percent of U.S. gas supply could quickly become unavailable; such amounts, while seemingly small, are larger than the change in supply that has caused gas prices for the last five years to be double the average of the previous half-decade. In the Atlantic

basin, such a scenario could begin with a sharp rise in the need for imported gas, such as would arise if there were a severe disruption in Russian exports—such as occurred in the middle 1990s (albeit briefly) in the midst of turmoil in The Ukraine. (90% of all Russian gas exports cross Ukranian territory.) In the pacific basin, such a scenario could begin with a sharp rise in the need for gas in China, Japan or Korea. Indeed, in recent years Korea and Japan have demanded abnormally high amounts of LNG—due to very hot weather and because of persistent problems with Japan's nuclear industry, which has created a need for LNG as a replacement fuel. Worldwide, many scenarios arise. On the current trajectory, the Middle East could supply one-quarter to one-third of world LNG by 2020, and that neighborhood is famous for concentrated troubles that impede time-sensitive shipping. A strike in India's or China's coal mines could create a surge in demand for those countries rapidly expanding LNG facilities. And a prominent accident with LNG could create pervasive difficulties such as port closings and costly surveillance. As with any globally visible technology, such as nuclear power, trouble anywhere can create political opposition everywhere.

Second, the L20 can play a role in advancing key gas projects. In the past, gas infrastructure projects generally have created stability between supplier and user countries rather than dependencies. In Europe, notably, major international pipeline projects were political endeavors—such as the large pipelines built in the 1970s and 1980s from the Soviet Union under the orchestration of the German and French government and the novel underwater pipeline from Algeria to Sicily built with Italian technology and capital. These projects sought to use gas revenues and immovable pipes as means of binding these countries on the periphery to the European commercial and political core. (The Reagan administration in the height of the cold war saw things differently and tried to kill the largest Soviet pipeline project by withholding key technologies for gas compressors and pipelines and threatening trade sanctions against German suppliers. German and Soviet suppliers circumvented the sanctions and built their own pipes and compressors.) Especially for the Soviet Union this strategy has worked well.

A large role for gas in the future will require the construction of some key infrastructure projects. One is a pipeline network from Russia to China (and perhaps on to Korea). A second is a pipeline from either Iran in the West or Myanmar or Bangladesh in the East to India. A third

is an expanded pipeline network from Bolivia to the rest of its neighbors. None of these projects can be created from the top down by an institution such as L20, but high-level blessing can help to focus minds and effort on finding ways to clear the barriers that are stopping these projects.

Third, the L20 can help to fix a problem that is likely to loom large for questions of energy security. Namely, questions about the gas dimension to energy security will arise through the parts of national regulatory systems that are rarely engaged in matters of national security strategy: electricity regulators. A well-articulated plan for assuring gas security (and for why a global gas market is not threatening to security) will help these regulators avoid spurious arguments that would hurt the prospects for gas. At present, many regulators are finding that the coal lobby is filling the vacuum with a litany of reasons on why locally abundant fuels (notably coal) should be favored for the future.

Fourth, the L20 would be uniquely positioned to pursue a comprehensive gas security strategy because it would engage key countries of geopolitical importance for current and future gas markets. Notably, it would involve key gas importers today (U.S. and Europe) and the likely large importers of tomorrow (China and India). It will include key net suppliers (notably Russia and Canada), but the L20 as currently conceived is unlikely to include other potential hegemons—notably Iran and Qatar. To be credible, the L20 will need to find a way to engage such countries on an ad hoc basis.

In some ways, the L20 will not have a strong advantage over the G8 in that both institutions involve Russia, and it seems to be essential that Russia be engaged in order to assure gas security. A coherent strategy for encouraging investment in Russia's gas industry must begin with the realization that outsiders will have little direct leverage. The Russian government's vision of its geopolitical position is built on control of hydrocarbons. The Russian state is reasserting its authority in oil and gas, creating a managed internal "market" that gives preference to strategically important sectors, and using the exports of oil and gas to create special positions with China, the EU and the United States. At the same time, Russia is aiming to create national energy champions—Gazprom, for example, is the kernel of a vertically integrated energy company. Not only does it control gas but its production of oil is also set to rise, and

Gazprom has taken a stake in the Russian electric power company and is also venturing into district heating services. According to this new logic, the waning of Russian power after the cold war is to be rebuilt through the control of hydrocarbons. Given this vision, it is not surprising that liberal western ideas such as open markets and free publication of data on gas trading—such as enshrined in the E.U.'s *Energy Charter Treaty*—have been rejected by Russia as unacceptable interference. A more subtle and responsive strategy is needed.

Part of the strategy is obvious and already being implemented. The west can serve Russian and western interests by diversifying transit routes out of Russia. New transit routes—such as the proposed Baltic Sea pipeline, which would allow Russian exports to bypass Belarus and Ukraine—will allow importing markets to reduce the risk of troubles in transit countries. A western strategy will also require encouraging Gazprom and other Russian companies as investors. Investment and operations outside Russia, at a world class level of performance, will offer a useful conduit for new technologies and ideas, which in turn will help Gazprom better manage its operations more efficiently. In addition to carrots, some sticks are also needed to engage Russia. Western nations must be prepared to make access to their markets conditional upon market-compatible behavior. The dangers are already evident in Europe where Gazprom has injected itself into nearly every market—mainly through cross-holdings that give it access to pipelines and to information that is essential to controlling markets. In central European markets the dangerous domination of Gazprom has already arrived; yet European competition authorities have been slow to impose clear rules against price fixing and market domination because some European states (notably Germany) fear that those same rules will be applied to break up their own national gas champions. Although most gas in Europe is still traded under contracts that are indexed to oil, the European gas market is in the midst of a shift to true gas-on-gas competition. That effort will fail without stronger market discipline, and the U.S. has a stake in cooperating with E.U. authorities to ensure that the transition is orderly since the integration of the U.S. and European markets means that anticompetitive practices in Europe will affect (albeit very slightly today) the operation of markets at home. Ideally, the *Energy Charter Treaty* would offer a framework for such competition, but that track has proved unproductive because the large treaty is inflexible and contains provisions that are incompatible with the divided federal systems of government that prevail in the North American market. A better track would be to build on the

informal transatlantic cooperation on competition that already exists in other areas; indeed, that cooperation has been strained by conflicts over aircraft subsidies, Microsoft and other topics where the US and EU diverge. Here is a topic where they should agree.