Chapter 9

The Shale Revolution and the International Security Environment

The global energy market has recently seen the emergence of the so-called "shale revolution." This is a game-changing development involving the large-scale commercial production of oil and gas from shale formations, which has been made possible by new technologies developed in the United States, and industry observers are examining and discussing its probable impacts over a wide range of economic and political areas. Hopes are rising particularly for the impact of the shale revolution in the international security sphere. Firstly because it may help stabilize global energy markets by providing a reliable long-term source of energy, and secondly because, by raising the energy self-sufficiency of importing countries, it will reduce energy-exporting countries' ability to use these exports for political purposes.

The increased production of shale oil and gas in the United States is already causing impacts in the global energy market in a variety of ways. Some improvements have been observed in the energy security environments of certain countries, resulting from increased energy price stability thanks to the supply of shale oil and/or gas, among other factors. However, the conditions under which shale oil and/or gas can be commercially produced are subject to uncertainty, and it is difficult to make accurate predictions regarding how long production in the United States will continue to grow, or about the possibilities for production in other countries and their likely scale. A number of experts in this field have speculated about the implications of the shale revolution for the international security environment, but these experts may be going too far out on a limb. In order to gain a clearer insight into the probable impact of the shale revolution on the international security environment, we must obtain an accurate picture of the policies adopted in response by the principal countries.

In the United States, the authorities are aiming to effect a turnaround in its energy strategy to an active approach in which production of shale oil and gas is increased, thereby improving the country's energy self-sufficiency. The country's spare export capacity of liquefied natural gas (LNG) is expected to increase, and there has been a notably large amount of speculation about the government using LNG exports as a diplomatic tool.

Turning to the relationship between Russia and Europe, while the two sides are expected to maintain their longstanding relationship of mutual dependence as a linchpin of their energy security, they are both seeking to adapt to changing market circumstances. In this context, as the focus of its energy strategy, Russia

appears to be accelerating its efforts to capture the opportunities offered by the East Asian market.

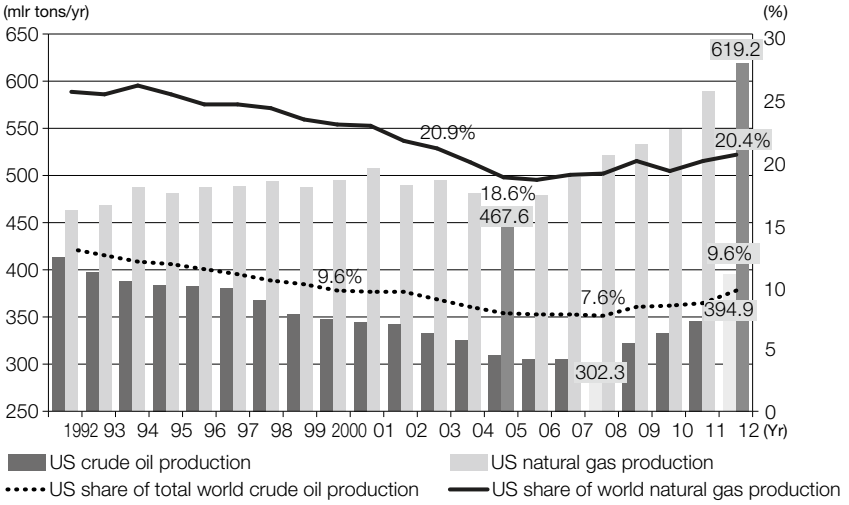
In the case of China, its dependence on imports of energy is growing in parallel with the sharp growth of total energy demand, and the government is clearly seeking to expand domestic production of shale oil and gas through the adoption of cutting-edge technology. This would enable it to keep the country's reliance on imports to an acceptable level and improve the energy security situation.

1. An Overview of the Shale Revolution

(1) Revolution Stems from Technological Innovation in the United States

Oil production in the United States in 2012 grew by 13.9 percent over the previous year, to 8.9 million barrels per day, while production of natural gas rose 4.7 percent year on year, to 681.4 billion cubic meters. These two figures accounted for 9.6 percent and 20.4 percent, respectively, of total world production for that year, and were the result of large-scale commercial production of shale oil and gas, which was made possible by the adoption of groundbreaking new development and production

Figure 9.1. Crude oil and natural gas production in the United States



Sources: Compiled principally from *BP Statistical Review of World Energy June 2013*.

technologies. This recent development represents a sharp upward turnaround from the declining trend followed by US oil and gas production up to the mid-2000s.

As of the end of 2013, full-scale commercial production of shale oil and gas was taking place only in North America, but many experts believe that the increase in oil and natural gas production in the United States heralds the unfolding of a "shale revolution" on a global scale. That is to say, the increased production of oil and natural gas in the United States could not only alleviate the global energy shortage in the short term, but might also bring about a structural realignment of the global energy market over the medium-to-long term, and in this way cause major changes in the world economy and in international relations. This prompts the question as to why it is that this increased production of shale oil and gas in the United States has the potential to bring about changes of such magnitude that it is being referred to as a "revolution." The first reason for this lies in the innovations that have been introduced in the technology employed in development of shale oil and gas fields, and in production methods, as described below.

Hydrocarbons such as crude oil and natural gas are produced through chemical synthesis from kerogen, which is a mixture of organic chemical compounds found in sedimentary rock. When the rock is gradually heated within the Earth's crust at the right temperatures, kerogen becomes a liquid organic substance in the form of crude oil, or releases natural gas. As kerogen is found within source rocks such as low-permeability gray mudstone or shale, research efforts were directed to finding a way of extracting hydrocarbons (fossil fuels) directly from shale formations that contain large amounts of kerogen. However, as kerogen itself does not flow, much of the liquefied organic substances derived from kerogen collect in low-permeability shale formations or adjacent sandstone formations. Since it is difficult to extract these substances from such formations using existing technologies, commercial production until recently had been limited almost entirely to organic substances in liquid form that had migrated to high-permeability reservoir rocks.

In the United States, the oil industry had long eyed the possibilities of developing such resources, and research had been conducted into viable production technologies since the 1980s, stimulated by preferential tax measures by the federal government. Even after the system of tax breaks ended, a number of companies continued their efforts to develop new technologies. These efforts bore fruit in 1998, opening up the way to the start of commercial production in the early 2000s.

Three breakthrough technologies were involved in making commercial

production possible: (1) horizontal drilling, a technology by which the shallow sections of shale wells are vertically drilled down to shale or sandstone formations, and the well then deviates to become horizontal; (2) hydraulic fracturing (fracking), in which fractures are artificially induced in dense, low-permeability shale or sandstone formations; and (3) the 4-D seismic resolution technique, which facilitates effective and efficient extraction of fossil fuels through more accurate monitoring and control. The commercial production of shale oil and gas became possible for the first time through the combination of these leading-edge mechanical technologies with advanced information and communications technology. The International Energy Agency (IEA) describes hydrocarbons of this kind—which require production technologies significantly different from existing ones—as "unconventional hydrocarbons."

(2) Why a "Revolution"?

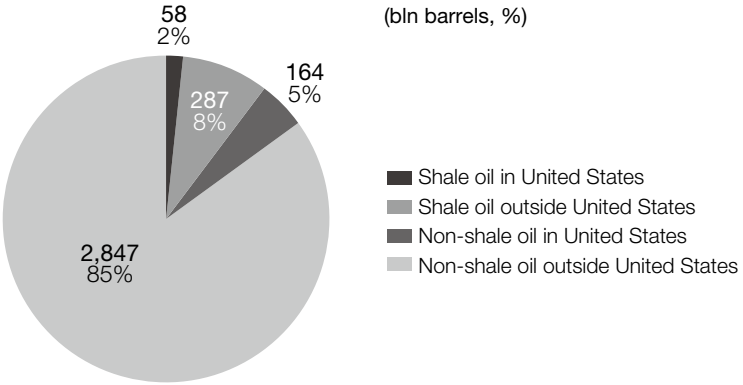
These technological advances have increased the scale of technically recoverable oil and gas resources, that is to say, those that can be produced using current technology. According to the latest assessment of world shale oil and gas resources, issued by the US Department of Energy (DOE) in June 2013, shale oil accounts for 10 percent of total global technically recoverable crude oil, and their exploitation would increase total oil resources by 11 percent. The contribution made by shale gas would be even greater, accounting as it does for 32 percent of total world technically recoverable natural gas, equivalent to an increase of 47 percent in total gas resources.

While it is not the case that all these resources are certain to be commercially exploited, at the very least, the volume of resources that can be produced employing current technology has risen enormously. Depending on economic viability, we should see a large increase in the volume of oil and gas supplied to the market, and the development of shale oil and shale gas resources will extend mankind's ability to continue producing oil and gas. As shale oil and gas resources exist not only in the United States, but in many countries throughout the world, the technologies developed in the United States will make a contribution not simply to the energy self-sufficiency of the United States itself, but also to other economies that are currently dependent on imports of oil and gas. If production of shale oil and gas commences and progresses in such economies, they, like the United States could also see a dramatic improvement in their energy self-sufficiency.

In other words, it has now become clear that the practical application of shale oil and gas production technologies in the United States will open up the way to a variety of benefits, including: (1) increased supply of oil and gas to the market; (2) the possibility of continued oil and gas production; (3) the diversification of supply sources, and a strong possibility of improved energy self-sufficiency for importing countries; and (4) improved energy price stability. In addition, these benefits are likely to interact with one another and exert far-reaching effects, in different ways, on the global economy and international relations. It is for these reasons that the recent development of shale oil and shale gas resources has been hailed as a revolution.

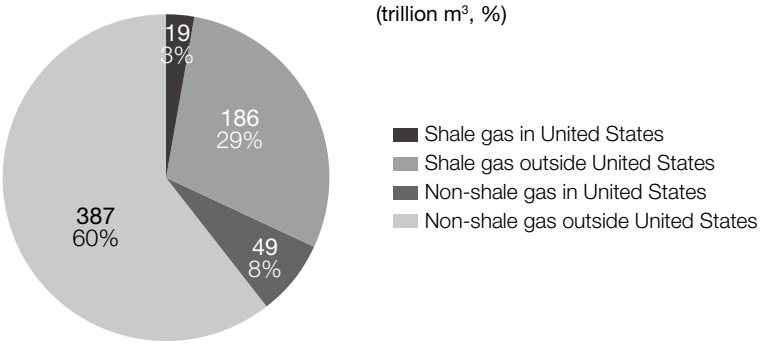
Having said that, there are a number of risks inherent in the application of these new technologies to the development and production of unconventional hydrocarbon resources, of which the three most notable are: (1) possible contamination of surface water and groundwater by the chemicals employed in fracking; (2) the possibility of leakage into the atmosphere of methane (a powerful greenhouse gas) from wells; and (3) the possible inducement of minor earthquakes. Until effective steps are taken to deal with these risks, the world will not be able to enjoy the benefits of the shale revolution. Moreover, the probable repercussions of the shale revolution should be taken into consideration, in particular whether it will improve the global economy and international relations, or whether it will upset the existing international order.

Figure 9.2. (1) Technically recoverable crude oil resources



Source: Compiled from EIA, *Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States.*

Figure 9.2. (2) Technically recoverable shale gas resources



Source: Compiled from *EIA, Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States.*

(3) Looking at the Shale Revolution from the Perspective of National Security

There are two main points to keep in mind when examining the implications of the shale revolution from the viewpoint of national security. The first is its impact on so-called "energy security," and the second is its effects on the wider field of international relations and its geopolitical implications, including energy security concerns.

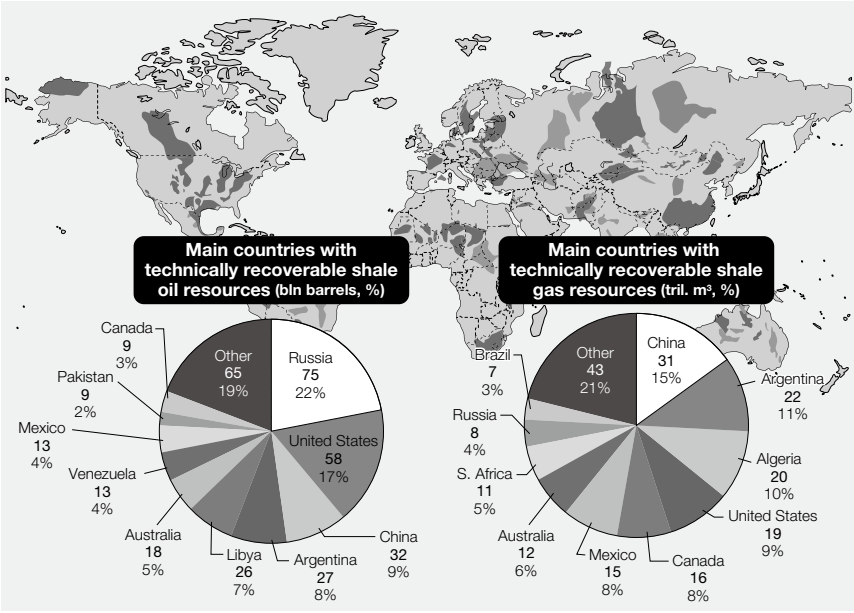
In a country's energy security policy, the government strives to support the national economy by ensuring the reliable supply of energy at affordable prices. Short-term risks attached to such a strategy include supply disruptions, or sharp price volatility, caused by civil unrest, or by natural disasters. Over the medium term, risks include supply shortages or environmental issues arising from underinvestment in exploration and development, or necessary infrastructure. At the same time, there is also the impact of developments in energy supply on a wide range of international relations, including geopolitical implications, at the core of which lies market domination by some producing countries, and the utilization of energy supplies by such countries for specific political ends. In such cases, suppliers may withhold energy supplies, in the manner of a hostage, so as to coerce consumer countries into falling in line with their political desires. This is an issue that touches on the question of national sovereignty.

Principal countermeasures against energy security risks include diversification

of energy sources and sources of supply, as well as steps to stabilize supply routes, in addition to the construction of an emergency stockholding system based on international cooperation. In other words, the prime focus is on constructing a series of mutually complementary systems to ensure that market mechanisms operate in a stable fashion. Regarding energy trade issues related to national sovereignty, as the root cause of any problems would lie in the intentions of the energy-supplying countries in question, the most fundamental form of countermeasures would consist of steps to render it meaningless for such countries to put those intentions into practice. In practice, it would be most effective to reduce one's dependence on specific suppliers, and in its most extreme form, this would involve the establishment of a system of complete energy self-sufficiency.

In view of these factors, our discussion of the shale revolution in this chapter will be guided by two focuses. First, we will examine—in the context of the need to stabilize the global energy market—the question of whether the shale

Figure 9.3. Distribution of basins with assessed shale oil/gas formations



Source: Compiled from EIA, *Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States.*

revolution is likely to facilitate a sustainably adequate supply of oil and gas to the market and the diversification of supply sources and routes. Second, we will explore whether the revolution is likely to improve the energy self-sufficiency of the United States and other energy importing countries. Specifically, we will discuss the likelihood for those countries to adopt the shale technologies developed in the United States and use them to expand commercial production of shale oil and gas. In the following section, we will first examine the current state of shale oil and gas production in the United States, and its impact.

2. How the Shale Revolution Stands at Present

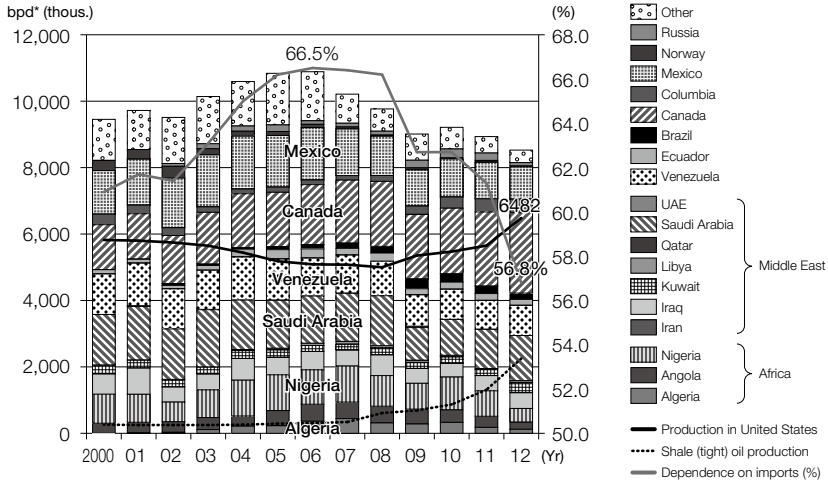
(1) Increase in Shale Oil Production in the United States

By the middle of the 1940s the United States had already become a net importer of crude oil. From that point on, the country increased its imports of crude oil in parallel with the growth of its economy, and from the 1970s had been a major importer, accounting for one third of the global crude oil trade. The commencement of shale oil production, however, has caused a complete change in this situation. Total production of crude oil within the United States has risen sharply since the full-scale start of domestic shale oil production in 2008.

In parallel, consumption of crude oil, which had been growing, reached a peak of 20.80 million barrels per day in 2005, and subsequently followed a downward trend as a result of energy conservation measures as well as a switch to other forms of primary energy. Due to the simultaneous effect of these two factors, imports of crude oil into the United States, which had been following a consistent upward path, turned downward from 2007. The country's dependence on crude oil imports, which had almost reached 70 percent, had declined to just above 50 percent by 2012.

In 2012 the United States was dependent on imports from the Middle East for roughly 20 percent of its crude oil needs, and it would appear at first sight that the recent expansion in crude oil production within the United States has greatly reduced the country's dependence on Middle East producers. In fact, however, the situation is that shale oil (which is a light oil) is only a viable alternative—either from the technological or from the economic perspective—to imports of light crude oil. Thus, crude oil exporting countries from which US imports have declined sharply are African countries that produce light oil, such as Nigeria and

Figure 9.4. US crude oil imports



* barrels per day

Source: Compiled from data released by the US Energy Information Administration (EIA).

Algeria. About 60 percent of the decline in US crude oil imports is accounted for by reductions in these two countries' exports. Consequently, over the short term, increased production of shale oil will result in still further declines in imports from African countries, but there is little likelihood of a rapid decrease in imports of oil from the countries of the Middle East and Latin America, which produce mainly heavy oil.

The increase in production of shale oil in the United States is said to be helping stabilize the international energy market. The supply of crude oil from North Africa has decreased since 2011, owing to the events known as the Arab Spring, in addition to which fears of a steep rise in crude oil prices have emerged against the backdrop of the conflict that continues to rage in Syria, due to its destabilizing impact on the Middle East as a whole. However, thanks to the decreased amount of crude oil being imported by the United States, spare oil supply capacity of the world as a whole remains sufficient. Consequently, crude oil prices have not risen by as much as initially feared, and the impact on the global economy has been of limited extent. In fact, however, what lies behind this development is not the increased production of oil within the United States, but the major contribution made by increased production in Iraq and Saudi Arabia.

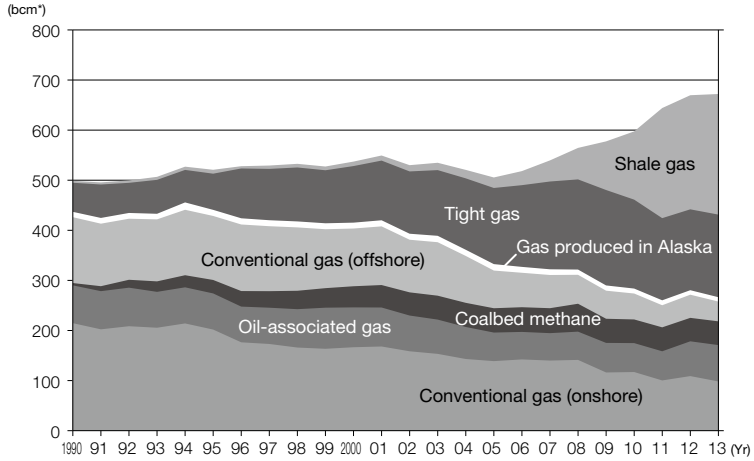
(2) Increase in Shale Gas Production in the United States

Shale gas commercial production in the United States began in 1998, and expanded dramatically from 2007, resulting in a steep growth of total natural gas production in the country. Natural gas production volume, which had been 536 billion cubic meters in 2002, reached an all-time high of 681 billion cubic meters in 2012, representing an increase of roughly 150 billion cubic meters, or 28 percent, in ten years. This increase easily exceeds the natural gas consumption by Japan for 2012 of 117 billion cubic meters and even surpasses China's consumption for the same year of 144 billion cubic meters.

Shale gas accounted for three percent of total US natural gas production in 2002. This had grown to 39 percent by 2012. The pace of growth was particularly fast over the five years from 2007 to 2012, during which it rose six-fold from 45 billion cubic meters to 264 billion cubic meters. This increased production of shale gas did not merely offset the decline in production of conventional natural gas; it caused a sea change in the US domestic natural gas market, and this is having an impact on the US economy as a whole.

Natural gas prices in the United States followed an upward trend until the latter half of the 2000s, when they fell sharply due to increased domestic production. For this reason, natural gas now enjoys a price advantage over other forms of primary energy. Consequently, thermal power plants fueled by natural gas now account for a growing proportion of all electric power generated in the United States, and electricity prices are declining, thereby raising overall industrial competitiveness. This, in turn, is stimulating economic activity and improving employment rates. Particularly notable increases have been seen in the international competitiveness of energy-intensive manufacturing sectors such as the steel industry, as well as the petrochemical industry, which employs natural gas as an important feedstock, and large-scale investment is being seen in these sectors.

Figure 9.5. Natural gas production in the United States



* billion cubic meters

Source: Compiled from *Annual Energy Outlook 2013 Early Release*, published by US Energy Information Administration.

(3) Impact of Increased US Production of Shale Gas on Global Energy Market

Increased shale gas production in the United States is continuing to exert a significant impact on the global energy market as a whole. Up to the latter half of the 2000s, it was predicted that the United States would become a major importer of natural gas as a result of the twin trends toward declining domestic production and growing demand. The increased production of shale gas has turned this situation completely around, rendering increased imports of natural gas completely unnecessary. At the same time, because domestic gas production was forecast to grow at a pace surpassing that of internal consumption, a strong probability emerged of the United States becoming a net exporter of natural gas. Consequently, certain gas-producing countries that had been investing in increased facilities for the export of LNG to the United States were forced to seek alternative export destinations.

Meanwhile, in view of the fact that world LNG trade volume was now expected to exceed the initial forecasts, countries that were net importers of natural gas enjoyed improved price bargaining power. No longer did they have to buy natural gas solely on long-term contracts linked to the price of oil (a practice known as "oil-indexed pricing"), and in their negotiations with the suppliers they were able

to begin setting price levels that reflected actual market developments. In contrast, gas-exporting countries of long standing, which had hitherto sold their gas via conventional contract-based methods, were not only forced to develop new export markets, but were also subjected to strong pressure to lower their prices.

In the United States, as a result of the newfound price competitiveness of natural gas, coal produced in the United States, which had hitherto been used domestically as a fuel for power generation, began to find its way into the international markets, and this, too, had an indirect impact on the global gas market. The amount of coal exported from the United States grew from 10 million metric tons in 2006 to 100 million metric tons in 2012, and as a consequence coal prices outside the United States were also subjected to downward pressure. Coal thus became price competitive. Particularly in Europe, which has been the principal market for US coal, coal began to replace natural gas as a fuel of choice, and the volume of natural gas consumption has been declining.

In these ways, the increased production of shale gas in the United States had by the end of 2013 already exerted a notable impact on the global energy market by inducing fluctuations in the relative prices of other forms of primary energy, and the scale and extent of this impact far exceeds that of shale oil. Anticipating this impact, in 2009 the IEA called shale gas a "game changer" that would probably bring about a major transformation in the United States and global energy markets. In fact, shale gas is currently effecting a structural change within the international energy market at a pace and on a scale that both surpass the IEA's projections. Recently, the term "shale revolution" has become widely accepted, but it would be more accurate to call it the "shale gas revolution." In the following section, we examine the principal arguments being discussed among experts in this field regarding prospects for the further development of the shale revolution.

3. Prospects for the Further Development of the Shale Revolution

(1) Likely Impact of Shale Oil Production on International Security Scene

The IEA estimates that production of shale oil in the United States will peak out around the year 2020. However, as oil consumption in the United States is likely to follow a continuous and gradual declining trend, due to energy conservation

measures among other factors, the country's imports of crude oil will decline to around 40 percent of the present level by 2035, at 3.4 million barrels per day, and US dependence on oil imports will fall below 30 percent of its total oil needs. The IEA also projects that the United States may become a net exporter of crude oil by 2030 or thereabouts.

Conversely, the IEA warns that the United States is not likely to be completely immune to the effects of developments on the global crude oil market, despite its improved energy self-sufficiency rate. In other words, as fluctuations in the price of crude oil, which is an international commodity, will affect the average US consumer, the country cannot afford to remain indifferent toward its interests in the sphere of national security, such as measures to maintain a steady supply of crude oil to the global market and thereby stabilize international crude oil prices. The geopolitical attention of the US authorities will thus remain focused principally on the countries of the Middle East.

Regarding the reliability of the data that lies behind the above-quoted views of the IEA regarding future shale oil production trends in the United States and the continued importance of the Middle East from the standpoint of energy security (as well as the IEA's analysis of that data), it is worth noting that the IEA's conclusions are shared by the British international oil major BP PLC, whose forecasts for the global energy situation up to 2030 are shown below. Oil production by nonmembers of OPEC (Organization of the Petroleum Exporting Countries)—led by production of shale oil in the United States—will continue to increase up to around 2020, but this growth will come to an end soon after 2020, and is then likely to soon begin trending downward.

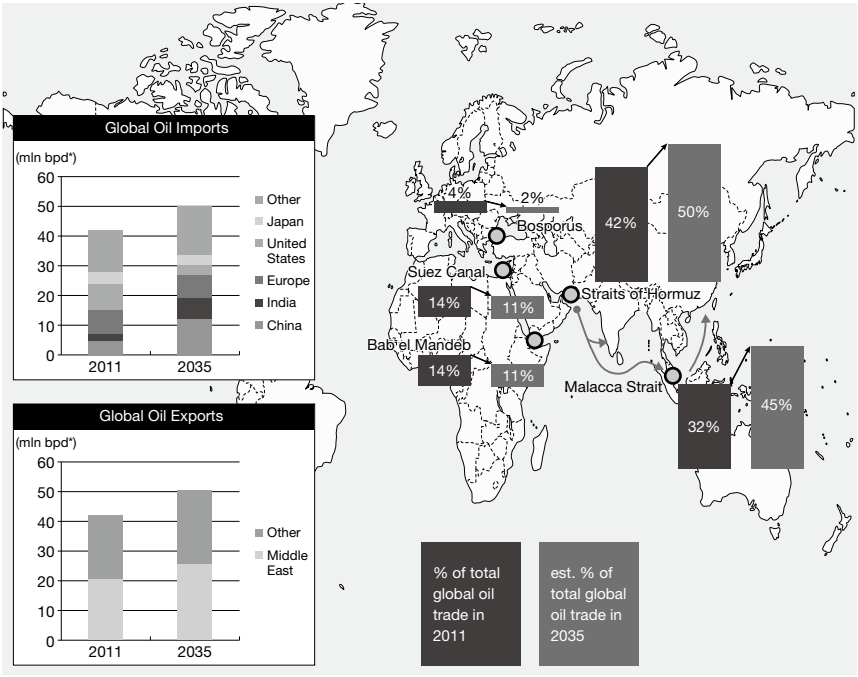
During this period, consumers are expected to reduce their consumption of oil amid persistently high international crude oil prices, and the OPEC members are not likely to take unreasonable steps to increase their production volume. After 2020, however, as oil production volume by non-OPEC countries declines, the OPEC members, who will still possess production capacity to spare, are forecast to begin increasing their output. In short, the analysis suggests no diminution in the importance of OPEC, an organization whose main members are in the Middle East.

Meanwhile, as the volume of crude oil imported by the United States is decreasing, that of a number of countries in Asia—notably China and India—is expected to grow. As a result, Asian destinations will account for a sharply increased percentage of total crude oil exports from the Middle East and Africa.

In turn, the increased volume of total world trade in crude oil transported by sea will be forced to pass through chokepoints on the routes to Asia. In terms of global energy security, this means that greater risk will be entailed in passage through certain chokepoints, such as the Hormuz Strait at the entrance to the Persian Gulf and the Strait of Malacca between Malaysia and Indonesia.

This means that, with regard to ensuring the safety of maritime crude oil transit routes, and with respect to building up strategic oil stockpiles and drawing on those stockpiles as appropriate (stockdraw), the strengthening of the international system of cooperation—including with the participation of China and India—will become even more vital than at the moment. With respect to this issue, the IEA adopts a very positive stance on taking steps to circumvent the riskier chokepoints, such as constructing oil pipelines across the Arabian Peninsula or across Myanmar to China. In line with this, the IEA is calling on both China and India to participate more positively in such international collaborative projects.

Figure 9.6. Forecast changes in world oil trade flows



* barrel per day
Source: Compiled from IEA, *World Energy Outlook*, 2011 and 2012.

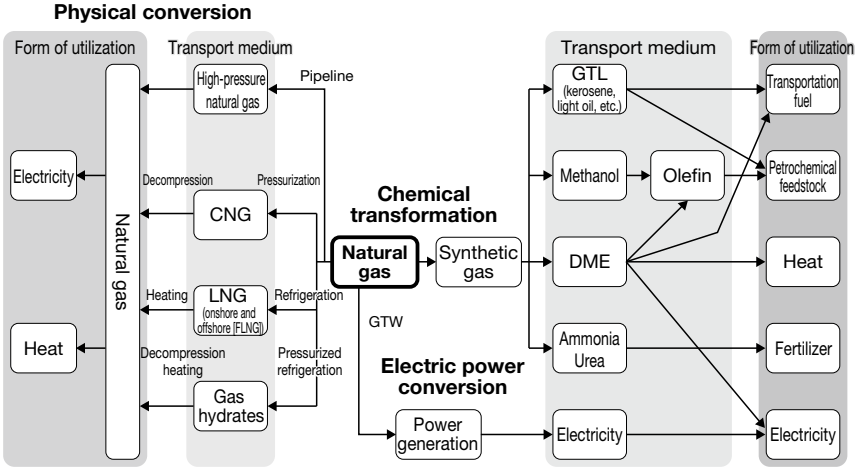
(2) Outlook for Shale Gas Production

Experts in this field generally concur that US natural gas production will continue to increase steadily, led by shale gas, and that the United States should begin exporting LNG from around 2017. Turning to other countries, the future of shale gas production is uncertain. Prospects for shale gas production in Europe remain unclear in view of technical problems and environmental issues, among a wide range of factors. China is taking a positive stance on shale gas development, but here, too, technical problems make accurate production forecasts impossible. In the event that production of shale gas expands on a global scale, the impact of the shale gas revolution on the future of the world's economies will be extremely significant.

In its World Energy Outlook 2011, the IEA published a special report entitled *Are We Entering a Golden Age of Gas?* in which it argued that the shale gas revolution had the following long-term implications. First, world natural gas resources are vast, exceeding those of oil, and technological advancement means that potential production volume is steadily increasing. As a result, natural gas is likely to account for a larger proportion of global primary energy usage. Notably, demand is forecast to rise sharply for the application of gas as a form of fuel for overland transportation use—fuels whose production has hitherto been limited for technical and economic viability reasons. Against the background of growing worldwide energy consumption, natural gas is likely to account for a growing percentage of total energy in view of its comparatively limited environmental impact, and this bodes well for the future coexistence of mankind's industrial activities with the natural environment.

To meet this level of demand for gas, it will be necessary to ensure a system for the reliable supply of natural gas, but with the growth of international trade in LNG, the pricing systems that have prevailed hitherto—which differ from one part of the world to another—are gradually starting to reflect market realities more precisely. It is to be hoped that effective supply-and-demand adjustment will be realized through the medium of pricing, thereby enabling the steady and reliable supply of gas to consumer markets. Additionally, if the shale gas development and production technology currently used in the United States diffuses throughout the world, many countries will become more self-sufficient in natural gas, and international relations as a whole will benefit from the reduced ability of suppliers to apply political pressure through market manipulation.

Figure 9.7. Natural gas transformation and utilization methods



Source: *The Efficient Use of Natural Gas and Future Prospects: Sharp rise in known natural gas reserves and the outlook for the popularization of natural gas and methods for its utilization* (Ken Ihara): JOGMEC Reference Data (published in May 2012).

(3) Impact of Shale Revolution on International Relations

Among notable discussions regarding the impact of the shale revolution on international relations and other geopolitical implications is the report entitled *Global Trends 2030: Alternative Worlds*, published by the National Intelligence Council (NIC) of the United States in December 2012. As one plausible scenario for a structural realignment of international relations in the period leading up to 2030, the NIC proposes that there will not be any hegemonic power. Rather, power will shift to networks and coalitions in a multipolar world. At the same time, the report maintains, the United States is likely to become energy-independent thanks to increased production of shale gas.

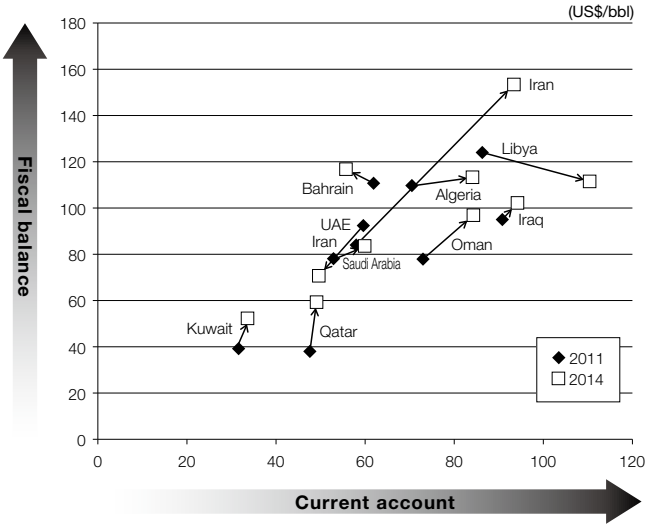
Regarding crude oil, the NIC forecasts that increased domestic production in the United States will lead to a reduction in imports, causing global spare export capacity to exceed eight million barrels per day, at which point OPEC—which has up to now enjoyed a dominant position against the backdrop of its enormous crude oil spare export capacity—would lose price control. This would almost certainly spark a collapse of crude oil prices, which would have a major adverse impact on oil-export economies. This scenario has already set alarm bells ringing in the Arab states of the Persian Gulf—whose economies are almost totally

dependent on revenues from energy exports—regarding the continuation of their present fiscal administration policies. Crude oil prices are currently maintaining a level above their fiscal breakeven oil price of one-hundred dollars per barrel.

Javier Solana, who up to 2009 served as the EU High Representative for the Common Foreign and Security Policy (CFSP)—the European Union's equivalent of a foreign minister—recently opined that if the United States achieves energy independence, this would be sufficient to induce it to effect a phased withdrawal from the Middle East. Solana's thesis is that, although the United States would not completely cease its attempts to solve the Middle East's political problems—in view of the necessity of maintaining stability in international crude oil prices and out of consideration for the geopolitical needs of its ally Israel—the focus of Washington's foreign policy will surely shift to Asia. In other words, according to this analysis, the United States is faced with the need to respond to the rise of China on the one hand and to ensure political stability in the Middle East on the other, and thus the shale revolution promises to give it greater freedom of action in the sphere of foreign policy.

There has been much and varied discussion regarding the implementation of

Figure 9.8. Breakeven oil prices



Source: Compiled from IMF, *Regional Economic Outlook: Middle East and Central Asia* (November 2013).

LNG exports by the United States, but regarding the geopolitical impact of the exports, a dominant theme has been the need for the United States to provide support to those of its allies in Europe and Asia that currently depend on LNG imports. Rather than LNG exports being used to directly meet the needs of US allies, it is envisaged that they would provide indirect support through their effect on the global gas market. Specifically, US exports of LNG would inject liquidity into the market, thus helping nations that depend on LNG imports, such as Japan and India, to secure gas supplies at more favorable prices. They would also free the countries of Europe from Russia's price control.

However, exports of LNG by the United States would not, in themselves, be sufficient to eliminate gas price disparities between different parts of the world. As of the time of writing, the average price of gas in Europe was three times higher than in the United States, while in Japan it was five times higher. This, in turn, translates into higher prices of electric power, or of gas as a raw material for the chemical industry, thereby impacting the industrial competitiveness of these countries. According to the latest IEA forecasts, released in November 2013, exports of LNG by the United States should bring down the average regional price disparity of natural gas to about two-fold by the year 2035. However, as that still represents a considerable difference, the percentage of total exports by energy-intensive industries accounted for by European companies will fall by a margin of 10 percent, while that of Japan will decline by 3 percent.

Against this background, there has been much discussion among concerned parties in Asian countries concerning the problem of high-priced LNG. In February 2013 the IEA released a report entitled *Developing a Natural Gas Trading Hub in Asia: Obstacles and Opportunities*. In this report, the IEA concedes that the system of long-term, fixed-price contracts employed up to now has not only allowed Asian buyer countries to reliably meet their steeply rising demand for gas, but also provided the sellers with a steady stream of funding for the necessary infrastructure investment. On the other hand, it points out, the price of LNG purchased by Asian countries is higher than in other regions of the world, and this constitutes a drag on the Asian economies.

The report also maintains that the ideal solution to this problem would be the creation of a regional trading hub that would enable unrestricted trading in natural gas and guarantee the transparency of price determination mechanisms, but points out that the conditions under which such a trading hub might come into existence do

not exist in Asia either from the structural or the political standpoint. In addition, to improve the flexibility of trading in LNG, the IEA advocates opening up regasification facilities to third parties, and deregulating destination restrictions, among other measures. The IEA calls on the governments of all countries involved to cooperate in raising the transparency of gas trading and encouraging greater competition.

These issues were also taken up by the Second LNG Producer-Consumer Conference, held in Japan in September 2013. Participants in this conference included cabinet-level representatives of numerous governments, top management members of various companies involved, and Maria van der Hoeven, the executive director of the IEA, as well as representatives from major research institutes and other organizations concerned. The purpose of the conference was to exchange information and promote mutual understanding regarding the current state and future prospects of the shale gas revolution, as well as the Asian LNG markets. Many countries involved in LNG trade are taking steps to improve the LNG trading situation. Examples include Singapore, which in May 2013 opened a large-scale facility for the unloading of LNG imports as part of its plans to become a hub for the trading of LNG in the Asian market. Plans are on the drawing board for the further expansion of this facility. In Japan, which is the world's biggest importer of LNG, the Tokyo Stock Exchange is moving forward with preparations to create the world's first LNG futures market.

(4) Constraints on the Production of Shale Gas

The reason that the shale revolution is expected to have an impact of the highest order on international relations is that it will raise the energy self-sufficiency of consumer countries, but opinions differ considerably concerning the probability of this scenario. Discussion in the energy industry currently centers on an extremely simple question: why did the shale revolution occur in the United States? In connection with this, research is being conducted into the preconditions for shale gas production in other countries.

This issue was examined in a paper submitted to the 2013 Annual Meeting of the American Economic Association, a world-renowned learned society. According to this paper, at the time of the 1973 oil crisis, an increase was seen in demand for natural gas, as an alternative to oil, and this led to a shortage. The industry attempted to tighten regulations on natural gas supply, particularly by controlling the wellhead price (the price at which oil or gas is traded between

corporations at the point of delivery or handover at the actual oilfield or gas field), but they were later forced to ease these regulations incrementally in the face of a continued natural gas supply shortage. The industry was also unable to successfully cope with the second oil crisis in 1979. In 1992, the Federal Energy Regulatory Commission (FERC) instructed the industry to deregulate the production, transportation, and sale of natural gas, thereby removing most existing barriers to the development of new gas wells. This laid the foundations of a new energy system that facilitated the shale revolution.

The shale revolution did not, however, result solely from this deregulation and the emergence of new technologies: the rise in the price of natural gas during the 2000s was also a crucial factor. In other words, because global energy prices had been on an uptrend until the eruption of the financial crisis of 2008, gas suppliers had reason to expect their profits to cover their production costs, and were able to plow back sufficient funds into investment in the development of new technologies. This, in turn, led to a virtuous cycle in which productivity improved and production costs decreased.

In fact, as of the time of writing (at the end of 2013), as the selling price of natural gas in the United States was too low to enable operators to recoup the costs of development and production of shale gas, production of shale gas was somewhat stagnant. Conversely, production of natural gas associated with shale oil production—which has been holding firm against the backdrop of the high global price of oil—was also robust. Total production of natural gas in the United States consequently showed no decline. But while the pace of increase in production of natural gas as a whole has been falling, demand has held steady, and inventories have therefore decreased. The price of natural gas has been recovering since falling below US$2 per MBtu (million British thermal units) in April 2012 to hit a record low. This indicates that natural gas is not yet in a state of oversupply in the United States, and this fact is cited as reason to fear that exports of LNG may adversely impact the selling price of LNG on the US domestic market.

In this way, even in the United States, where the basic conditions for shale gas production are in place, trends in the development and production of the gas are influenced by price disparities with other forms of energy over the short term. Other factors that make it difficult for companies to make decisions on investment in the development of new gas wells or fields include the need for construction of related infrastructure and the rapid pace of decline in productivity shown by shale

gas fields. In the case of the United States, the shale revolution was facilitated by the fact that adequate infrastructure was already in place. Further increases in production volume or the development of new gas fields, however, will require the enlargement of existing pipelines or the construction of new facilities, and it will also be necessary to provide storage facilities to allow inventory adjustment in response to price fluctuations.

In addition, since the productive lifespan of shale gas fields is relatively limited due to technical factors, gas field operators seeking to procure funds from the market have to assume an extremely short investment recovery period (five years or less)—much shorter than in the development of conventional natural gas fields. For this reason, shale gas producers are forced to limit the scale of their investment in each individual operation, and to constantly move on to new gas field developments. The gas field operators are making use of the futures market to reduce price fluctuation risks, and a tendency is seen for the operators to procure funds via the over-the-counter derivatives markets and through collaboration with other companies. These developments are encouraging participation in the market by non-US companies.

As we have seen, shale gas production involves a large number of uncertain factors, and it is not easy to make confident predictions about shale gas production, either in the United States or the rest of the world. This does not mean, however, that prospects for the shale revolution are not bright. There is plenty of room for developments that cannot be foreseen at present. Let us, therefore, examine the range of possibilities that lie ahead. The possibilities will probably depend to a large extent on the policies adopted by the principal actors in the global energy market—the United States, Russia, the countries of Europe, and China. In the following section of this report, and in the further subsequent sections, we will examine the responses of these actors to the possibilities opened up by the shale revolution, separately examining their respective energy security strategies, distinctive trends, and specific measures.

4. US Energy Policy Amid the Shale Revolution

(1) Shift to an Active Energy Security Strategy

In March 2011 the administration of President Barack Obama released its energy security strategy under the title of *Blueprint for a Secure Energy Future*

(hereinafter, "the 2011 US energy security strategy"). In this document, the administration positioned unconventional natural gas, particularly shale gas, as a vital part of domestic energy resources, and stated that the development of this energy resource would assure the United States of a safe supply of energy in the future. Up to now, the US energy security strategy has been based on lowering the country's dependence on crude oil imports by taking steps to enable a drastic reduction in gasoline consumption and by diversifying the types of fuel used, in addition to building a more resilient energy structure by bolstering the Strategic Petroleum Reserve. That is to say, the United States adopted a passive response to the long-term decline in its domestic energy production.

However, US crude oil and gas production has grown at a steep pace since the end of the last decade, and the 2011 US energy security strategy has switched the focus of domestic energy to an active policy of ensuring safe and reliable development and production. The strategy consistently adopts a target of lowering dependence on oil imports with a view to stabilizing economic activity by limiting the impact of oil price fluctuations on the global market, and the country's vast reserves of shale gas are attracting attention as the centerpiece of this strategy.

The US oil industry's operational safety standards have been severely criticized following the *Deepwater Horizon* oil spill, which occurred in the Gulf of Mexico in 2010. The 2011 US energy security strategy clearly puts the responsibility for the accident on the failure to adequately observe the safety standards in place, and promises that the authorities will ensure strict observation of safety standards from here on. In addition, regarding the potential environmental impact of shale gas development, as one of its central points, the security strategy document calls for collaboration between the government and the private sector in developing advanced gas production technology that will minimize operational impact on the natural environment, and for the diffusion of this technology throughout the industry. It would not be accurate, however, to interpret these statements in the 2011 energy security strategy document as urging a cautious approach to the development and production of shale gas.

In fact, the document makes clear the government's responsibility to ensure the safety of the population, and on that basis encourages the further development and exploitation of the country's shale gas resources. In response to the publication of the 2011 energy security strategy, since April 2012 the DOE, the Department of the Interior (DOI), and the Environmental Protection Agency (EPA) have been

engaged in a joint research project aimed at more thoroughly identifying the environmental impact of shale oil and gas development with a view to putting the appropriate regulations in place.

The 2011 energy security strategy document also calls for the United States to fulfill its international responsibilities by conserving energy, particularly oil, thereby contributing to holding down the growth of total global energy demand, and to cooperate internationally with other countries and organizations in ensuring the stable supply of energy in the global market. In respect to this aim, the strategy document calls on the United States both to expand its own supply of natural gas and to help promote the development and production of shale gas in other countries. It also urges the replacement of oil by natural gas as the primary fuel for electric power generation.

For this purpose, the US government has proclaimed a policy of facilitating greater involvement in finding solutions to global energy issues through concerted action by all federal departments and agencies. In November 2011 the Bureau of Energy Resources (ENR) was set up within the Department of State to manage an integrated program of diplomatic efforts in the field of energy. The three core objectives of the ENR are: (1) to facilitate access to energy services for impoverished people around the world, (2) to manage the geopolitics of the world's energy economy through proactive diplomacy with major producers and consumers, and (3) to stimulate the market forces that will sustain transformational energy policies in terms of alternative energy, electricity, development, and reconstruction. The ENR is the agency with principal responsibility for the Unconventional Gas Technical Engagement Program (UGTEP), under which the government aims to provide the necessary information and technical support to countries interested in developing shale gas resources within their own borders.

(2) The Economic Viability of LNG Exports

Exports of crude oil from the United States fall under the jurisdiction of the Department of Commerce, and are subject to a number of regulations that effectively prohibit such exports on the grounds of national security. For this reason, discussion regarding energy exports currently focuses on exports of natural gas, over which the authority for granting approvals lies with the DOE. However, natural gas exports are entangled in a complex web of interests involving parties such as the US domestic energy industry and other related sectors, as well

as agencies responsible for environmental protection, foreign affairs, and national security. As a result, a wide range of views is being aired regarding this issue.

To give some concrete examples, in the first half of the 2000s, predicting a steep rise in LNG imports, energy interests made preparations for this, but at present, as the operating rate of the facilities prepared for reception of LNG imports is low, these facilities are being converted for use in LNG exports. At the same time, investments were made in gas field development and production with the aim of securing profits. Meanwhile, for industrial operators that utilized natural gas, this issue was of paramount interest because of its impact on international industrial competitiveness in the event of a rise in the price of gas in the US domestic market resulting from gas exports. These discussions within the energy community have also seen contributions from certain parties warning of the adverse environmental impact of the sharp increase in shale gas production that would accompany the export of gas.

US exports of natural gas are subject to regulations under the Natural Gas Act of 1938, aimed at protecting the public good, and the DOE's procedures for approving exports differ depending on the destination of the exports. In the event that the destination of the exports of gas for which an operator applies for approval is a country with which the United States has a free trade agreement (FTA), the DOE applies the principle of "national treatment" (a principle in international law involving treating foreigners and locals equally), and regards the exports as being in the public interest. As long as there are no other problems with the application, approval is swiftly granted. On the other hand, if the country to which the gas is to be exported has not concluded an FTA with the United States, the DOE will also give approval unless it deems that the exports are not in the public interest. In this case, however, the Office of Fossil Energy within the DOE, which handles these procedures, will open the application inspection process to the public and solicit comments from interested parties, thereby ensuring the transparency of the proceedings and guaranteeing the legitimacy of the DOE's judgment as to whether or not the exports in question are in the public interest.

The first application for approval of natural gas exports to a country with which the United States had not concluded an FTA was made in July 2010 by Sabine Pass Liquefaction, LLC, and this was approved in May 2011 after a ten-month review period. This operation plans to begin exports of LNG by 2015 at the earliest, utilizing the LNG receiving terminal at Sabine Pass on the Gulf of Mexico, which

will be converted for use as an export facility. Other new applications were received by the DOE's Office of Fossil Energy during this review period and after its conclusion, and the DOE is busy dealing with these cases.

Moreover, many of the corporations making these applications are seeking permission for export arrangements that will allow them to freely choose among a variety of destinations—including both countries with which the United States has signed FTAs and those with which it has not—and this has made the review process more difficult. In addition, the DOE has been criticized for the ambiguity of its definition of "public interest," which is the sole basic standard used in granting approval. For these reasons, while the DOE accepted a joint application in December 2012 from two operators in Freeport, Texas, a decision on approval was put on hold while the DOE conducted an investigation into the likely impact of the proposed LNG exports and drafted specific standards for the assessment of public interest.

This investigation encompassed a survey of the probable impact of the project on US domestic gas prices—entrusted to the US Energy Information Administration (EIA), a sub-organization of the DOE—and a survey of its probable macroeconomic impact, entrusted to the private-sector company NERA Economic Consulting. The EIA published the results of its survey in January 2012. It analyzed various scenarios incorporating differing conditions, including export volume. Although the degree of impact in terms of raising gas prices differed from one scenario to another, the agency reached the conclusion that such an impact would be of limited extent even in the event of the export of a quite considerable volume of gas. Meanwhile, NERA had conducted a survey that complemented the EIA's research with even more precise and detailed analysis. In its report, released in December 2012, NERA concluded that although the gas exports in question were likely to have an adverse impact on certain sectors of industry, the effect on the US economy as a whole would be a positive one.

(3) The Impact of LNG Exports on International Relations

A number of differing views have been voiced regarding the impact of exports of LNG from the United States on international relations in general, rather than solely in the economic sphere. Discussion of this issue in public forums began around 2010, and in November 2011 the National Intelligence Council first broached the question of the probable effect of increased production of shale oil

and gas on international relations. Then, in December, Senator Richard Lugar submitted a bill to the Senate Foreign Relations Committee proposing an amendment to the Natural Gas Act to allow exports of LNG to members of the North Atlantic Treaty Organization (NATO) to be treated in the same way as exports to countries with which the United States had concluded FTAs. This is just one example of the lively debate within the US energy and national security communities regarding the strategic implications of LNG exports.

In proposing the bill, Senator Lugar explained that the European member nations of NATO lacked adequate diversity in their natural gas procurement sources, and that this was an issue with crucial ramifications for US national security. He argued that in order to dissuade Russia or Iran from using the supply of energy for political ends, the United States needed to deregulate the export of LNG so as to give the European NATO members greater leverage in their negotiations with such gas suppliers. Senator Lugar further maintained that a situation had now arisen in which the United States was able, for the first time in its history, to use its advantageous position in the energy market as an effective tool of national diplomacy.

In response to these arguments, during the 113th US Congress a large number of public hearings have been scheduled on the issue of LNG exports. For example, at a hearing held before the House Committee on Energy and Commerce in February 2013, the opinion was put forward that increased production of US shale oil and gas had served to strengthen the sanctions imposed on Iranian oil exports. Then, at a meeting of the committee in May, the argument was made that LNG exports would serve to thwart Russia's aims of severing the ties between the United States and its European allies, and would simultaneously provide support to Japan and South Korea—both of which were attempting to reduce their dependence on energy imports from the Middle East—and strengthen the international position of the United States vis-à-vis China.

Specifically, it is argued that the shale revolution would bring about a positive turnaround in both the US economy and the federal fiscal position. Moreover, with respect to maintaining the safety of global maritime transportation routes—on which the United States has expended an enormous amount of money—this development would force China, which has up to now enjoyed virtually a free ride, to accept responsibility and pay its way. In this event, the conflict of interests that has been smoldering between the United States and China over Middle East

issues might well die down, as the interests of the two countries vis-à-vis the stability of the Middle East region begin to converge.

Similar arguments were aired at a series of hearings before the House Committee on Foreign Affairs in April and May. In addition to the impacts described in the foregoing paragraph, one testimony maintained that the export of LNG to India and certain other developing countries, which are planning to expand their nuclear power industry as a solution to their chronic energy shortages, will make nuclear power less attractive to them and therefore serve to strengthen the system for prevention of nuclear weapons nonproliferation. In addition, in response to opinions urging the complete liberalization of LNG exports to countries with which the United States has not signed free trade agreements, other experts have recommended leaving the present DOE approval procedure in place, as this would serve as an incentive to non-signatory countries to sign FTAs with the United States.

Regarding the effectiveness of exporting LNG to European countries, a number of observers have asserted that such exports would be particularly effective to Central and Eastern European countries, as well as the Baltic nations, all of which are heavily dependent on Russia for their energy supplies, and to Turkey, which currently relies heavily on imports from Iran. It has also been opined that LNG exports would function even more effectively if they were implemented in an integrated manner with European energy supply source diversification schemes, such as plans to construct supply routes from Central Asian nations.

Discussion of similar matters has also taken place at the United States Senate. In particular, at a forum hosted by the Senate Committee on Energy and Natural Resources in May 2013, it was argued that LNG exports would satisfy the energy demands of Japan, South Korea, India, and the nations of Southeast Asia, and would serve to hold down prices of natural gas. In so doing, the exports would serve as an invaluable economic and strategic asset for the United States, which is seeking to switch the prime focus of its foreign policy to Asia. At the same forum, it was reported that Japan and Russia had reached an agreement on the joint construction of LNG facilities. This was cited in support of the argument that now was a not-to-be-missed chance for the United States to improve its geopolitical position, in that its important trading partners in Europe, as well as Japan and other Asian countries, would not wait much longer for Washington to grant permission for LNG exports.

(4) Impact of Shale Revolution on US Energy Policy

The application made by the operators at Freeport for permission to export LNG to FTA non-signatory countries, which was the second such application received by the DOE, was approved on May 17, 2013. After reviewing the results and analyses of the above-described surveys, the arguments made at the hearings, and more than 200,000 public comments, the DOE concluded there were no grounds to evaluate the exports as not being in the public interest. In this case, the DOE explained that its assessment of public interest, which had come in for a good deal of criticism, had focused on four factors, i.e., (1) the impact on the domestic economy, (2) international impact, (3) the relationship with stability of natural gas supply within the United States, and (4) impact on the environment.

Regarding its assessment of international impact among these factors, the DOE explained that it had taken into account the US commitment to promoting free trade, based on the federal government's basic policy of making concerted efforts by all government departments and agencies to create the conditions that would encourage the private sector to export gas, thereby creating new jobs. In addition, the DOE explained that it had concluded—on the basis of projections indicating the feasibility of the United States acquiring a certain degree of competitiveness in the global LNG market—that the approval of the exports would be in the public interest as it would expand the range of global natural gas supply options and improve the energy security of US allies and trading partners.

The third application approved by the DOE was that of Lake Charles Exports LLC, which was approved on August 7, 2013. This was followed by the fourth by Dominion Cove Point LNG, LP approved on September 11, and the fifth by Freeport LNG Expansion, LP approved on November 15. Assessments of these applications were handled as separate cases, and the nature of the conclusions reached were essentially identical to the case of the initial Freeport application. As of the end of 2013, thirty-seven applications had been made for approval to export LNG, of which the destinations in twenty-eight cases included non-free-trade agreement countries. At present, five approvals have been granted for LNG exports to non-signatory nations.

From these developments, it appears that the increase in shale oil and gas production has prompted the United States to switch from the passive energy security strategy employed up to now to an active strategy in which the country's plentiful energy resources are being utilized both as a means of stimulating the

Table. 9.1. Approvals of LNG exports

As of Dec. 31, 2013

Company	Project	Allowable maximum	FTA Applications		Non-FTA Applications		Major stakeholders	contracts	current processing position
		bcm***/yr	Date of receipt of application	Date of approval	Date of receipt of application	Date of approval			
Sabine Pass Liquefaction, LLC*	Sabine Pass	22.5	2010/ 8/11	2010/ 9/7	2010/ 9/7	2011/ 5/20	Cheniere Energy	BG (UK) Gas Natural (Spain) Kogas (S. Korea) GAIL (India) Total (France) Centrica (UK)	
Freeport LNG Expansion, L.P. and FLNG Liquefaction, LLC*	FLEX	14.3	2010/ 12/17	2011/ 2/17	2010/ 12/17	2013/ 5/17	Freeport Macquarie	Osaka Gas** Chubu Electric** BP Energy Company (UK)	
Lake Charles Exports, LLC*	LCE	20.4	2011/ 5/6	2011/ 7/22	2011/ 5/6	2013/ 8/7	Southern Union BG		
Carib Energy (USA) LLC	Carib	FTA: 0.32	2011/ 6/6	2011/ 7/27			Carib Energy		7
		non-FTA: 0.1			2011/ 10/20				
Dominion Cove Point LNG, LP*	Dominion	FTA: 10.2	2011/ 9/11	2011/ 10/7			Dominion	Sumitomo Corp.** GAIL (India)	
		non-FTA: 7.9			2011/ 10/3	2013/ 9/11			
Jordan Cove Energy Project, L.P.	Jordan Cove	FTA: 12.3	2011/ 9/22	2011/ 12/7			Front Chicago Energy Project Development		2
		non-FTA: 8.2			2012/ 3/23				
Cameron LNG, LLC	Cameron LNG	17.4	2011/ 12/21	2012/ 1/17	2011/ 12/21		Sempra Energy	GDF Suez (France) Mitsui Corp.** Mitsubishi Corp.**	1
Freeport LNG Expansion, L.P. and FLNG Liquefaction, LLC*	FLEX	14.3	2012/ 1/12	2012/ 2/10	2011/ 12/19	2013/ 11/15	Freeport Macquarie	Osaka Gas** Chubu Electric** BE Energy Company (Spain) SK E&S (S. Korea) Toshiba**	
Gulf Coast LNG Export, LLC	Gulf Coast	28.6	2012/ 1/10	2012/ 10/16	2012/ 1/10		Gulf Coast LNG		7
Gulf LNG Liquefaction Company, LLC	GLLC	15.3	2012/ 5/2	2012/ 6/15	2012/ 8/31		Kinder Morgan		9
LNG Development Company, LLC	d/b/a Oregon LNG	12.8	2012/ 5/3	2012/ 5/31	2012/ 7/16		Oregon LNG		3
Total		388.0							

* Five projects approved by the DOE as of December 31, 2013
** Japanese corporations
*** billion cubic meters
Source: US Department of Energy website.

economy and as an effective tool of foreign policy. That is to say, the principal effect of the shale revolution for the US government has been to facilitate this switchover in its approach to energy security.

As a result, even if the economic efficiency of the planned increase in shale oil and gas production, or of LNG exports, turns out to be minimal, the US government may well decide to push ahead with these programs in view of their probable benefits from the perspectives of national security and foreign policy. Conversely, even if the economic advantages are considerable, one cannot rule out a scenario in which the government holds down the levels of either shale oil and gas production or LNG exports if it deems them to be counterproductive from the standpoint of national security or foreign policy. In this context, we can expect to see intensified debate in the United States over the issue of crude oil exports.

In fact, US Senator Lisa Murkowski, one of the leading representatives of the Republican Party to sit on the Senate Committee on Energy and Natural Resources, mentioned crude oil exports during her keynote address at the annual conference of the EIA in June 2013. Then, the following December, US Secretary of Energy Ernest Moniz indicated that in his view it was necessary for the administration to review the current restrictions on crude oil exports. In ways such as these, if we are to gain an insight into the probable future direction of US energy policy, we must examine not only the arguments regarding economic viability, but also the forward-looking debates concerning national security and foreign policy that are taking place within the energy community and other related US government circles.

5. Likely Impact of Shale Revolution on US Relations with Russia, Europe, and East Asia

(1) Interdependence between Russia and Europe

Some observers take the view that the shale revolution promises to free Europe from the shackles of Russian market domination, but Russia and Europe are linked by a complex web of energy-related interdependencies whose historical roots go back a long way, and the probable reactions of the two sides to the shale revolution will likewise be complex.

In discussing the situation in which the Russian government finds itself, we should first note that the oil and gas sector accounts for almost 50 percent of the total revenues and more than 60 percent of the export earnings of the government

of the Russian Federation. On a simple comparison of export earnings, crude oil exports came to US$180.93 billion in 2012, roughly three times higher than exports of natural gas, at US$62.25 billion. Turning to Russia's domestic consumption of primary energy, on the other hand, whereas oil accounted for around 20 percent, natural gas accounted for over 50 percent and was the leading form of energy consumed by the electric power generation, household consumption, and industrial consumption sectors. Up to now, the Russian authorities have always held down the selling price of natural gas on the domestic market to assist the standard of living of ordinary households. At the same time, by helping to just barely prop up the international competitiveness of Russian industry, exports of natural gas have a special significance for the country.

That is to say, the Russian authorities must at all costs ensure the continued steady supply of natural gas at low prices in the domestic market in order to shore up the economy, and for this purpose, continued prospecting for natural gas, followed by drilling and production, is essential. For this reason, the Russians must export gas at a scale that allows them to recoup the investment costs involved. The main market for Russian gas is Europe, which accounts for roughly 80 percent of Russia's total energy export earnings, while Russian natural gas accounts for about 25 percent of total European gas imports. Thus, in this field, the relationship between the two sides is one of mutual dependence.

(2) The Relative Importance of the European and East Asian Markets as Factors behind the Changes in Russia's Energy Policy

Russia's current energy strategy was set out in a document entitled *Energy Strategy of Russia: For the Period up to 2030* (hereinafter, "the 2009 Energy Strategy"), which was adopted in November 2009 by the administration of then President Dmitry Medvedev. This strategy called for the active utilization of Russia's vast energy resources as a means of realizing the goal proclaimed in the *National Security Strategy through to 2020 (of Russian Federation)*—adopted the previous May—of turning Russia into an "economic superpower."

The focus of the 2009 Energy Strategy was to maintain Russia's market dominance through the stable supply of energy to the domestic market as well as through exports. Specifically, while steadily increasing the production volume of energy, the authorities aimed to maintain their dominant position in their

traditional market of Europe while also securing a substantial share of the East Asian market, where rapid growth was projected. This basic policy is identical to the policy first incorporated into a Russian government energy strategy in the 2003 document *Energy Strategy of Russia: For the Period up to 2020* (hereinafter, "the 2003 Energy Strategy"). However, the energy strategy environment—both internal and external—that formed the background to the two strategy documents had changed greatly in the intervening six years, particularly the relationship between Russia and Europe.

As a result of the economic turmoil that followed the breakup of the Soviet Union, including rapid privatization, Russia's energy industry underwent much deterioration. Other industrial sectors also stagnated, and the country's overall economic base was weakened. In response to this situation, following his election as president of Russia in 2000, Vladimir Putin positioned the revitalization of the energy industry as the key to economic recovery, and undertook a program of reorganizing the energy sector, including extensive renationalization of companies in this sector. At the same time, Putin ordered increased investment in drilling and production of oil and gas resources in Western Siberia in order to maintain the region's production capacity, which was initially developed in the 1970s but had been going downhill for many years. He also laid down a policy of developing Russia's promising energy resources in Eastern Siberia and Russia's Far East region to serve as the country's main base for future energy production. These factors constituted the background to the 2003 Energy Strategy.

The Russians were encouraged to pursue this strategy by the persistent uptrend of global oil prices from 2003 onwards, and demand from their principal export market of Europe expanded firmly. Long-term contracts for natural gas in which the prices are linked to those of oil—which now constitutes a problem for Russia—were not considered problematic at that time, and were thought necessary to secure the investment funds required for a stable supply of gas in the future. However, European countries had adopted a policy of reducing their reliance on hydrocarbon resources over the long term to minimize environmental impact. Moreover, as a result of Russia's temporary cutoff of natural gas supplies to Ukraine in January 2006—as the culmination of the two countries' dispute over prices—the European Union proclaimed a policy of diversifying its gas supply sources to further reduce dependence on Russia. This policy was incorporated in the EU's first official energy policy document, published in January 2007.

In response, in a similar manner, the Russian government decided to commence full-fledged entry into the East Asian energy market—a move it had been studying since 2005—to reduce its dependence on the European market over the long term. This policy was embodied in the Eastern Gas Program, which was approved by the government in September 2007. This program included plans for gas development on Sakhalin and for the construction of an LNG terminal at Vladivostok—both of which are currently attracting attention in energy circles—and a plan to construct a pipeline for transporting gas to China. These plans were part of a wider concept of promoting the development of gas fields in Eastern Siberia and the Russian Far East region to serve as energy sources for the East Asian market and in turn to stimulate general economic development in those parts of Russia. Against the backdrop of international crude oil prices moving at consistently high levels, Russia was able to take a long-term perspective on the development of gas fields with an eye to supplying the gas to the East Asian market.

As a result of the global financial crisis that unfolded toward the end of the 2000s, however, there was a complete about-face in this favorable environment, amid which Russia had had considerable room to maneuver. Global oil prices fell sharply, demand from Russia's principal market of Europe declined, and the country posted a decrease in energy export earnings, which was a severe blow to the economy as a whole. The situation was then aggravated by the dispute with Ukraine over gas prices and debts, resulting in the cessation of gas supplies to and via Ukraine in January 2009. The European Union took action to further reduce its dependence on Russia for energy supplies, and announced a policy of promoting further liberalization of the energy market within the EU in order to ensure energy supply flexibility. The EU also strongly requested Russia to abolish discriminatory price-setting practices and the setting of unreasonable restrictions on gas delivery destinations, among other measures.

In the face of this situation, the Russian government was forced to direct its full efforts into diversifying its energy export markets—with a prime focus on East Asia, where demand was forecast to grow—and into securing sufficient funds for the necessary investment. It was amid these circumstances that the 2009 Energy Strategy was drawn up. Among the new export markets for Russian natural gas that were considered as part of the diversification policy was the United States, where a steep increase in imports was predicted, and for this reason Russia commenced development of the Shtokman field in the Barents Sea and of gas

fields on the Yamal Peninsula, both of which lie within the Arctic Circle.

The development of gas fields in Eastern Siberia and the Russian Far East with a view to selling the gas on East Asian markets will require not only the construction of production facilities, but also one or more massive pipelines, as the gas fields are located far inland. For this reason, in order to recoup the massive initial investment involved, Russia needed to be sure of a sufficient level of demand and prospects for long-term contracts that would enable an adequate profit yield. Consequently, while the 2009 Energy Strategy document called for Russia's entry into the East Asian market, against the background of severe budgetary constraints, up to the final investment decision, the authorities were forced to adopt an extremely cautious stance on everything involved, including the contract negotiations. Moreover, to fulfill its obligations under the long-term contracts it had signed with European countries, Russia was required to make investments to offset the declining production volume at existing gas fields, and was thus not in a position to simply switch all its gas production to the East Asian markets.

(3) Responses of Russia and Europe to the Shale Revolution

From 2011 through into 2012, the impact on Europe and the East Asian market of the growing production volume of shale gas in the United States began to become clear, and this forced Russia to refashion its energy policy. That is to say, it restructured Russian operations involved in exporting LNG to the United States and promptly made moves to enter the East Asian market, where fierce competition was anticipated. Simultaneously, it was forced to take concrete steps to maintain its share of the European market.

The Russian authorities have been taking these changes in the energy environment very seriously. In *Policy Priorities of the Government of the Russian Federation to 2018*, adopted in January 2013, the Russian government published analysis of the situation, concluding that if shale gas development continued at the current pace, resulting in the supply of large amounts of gas to Europe and East Asia, this could easily have a major adverse impact on Russia's control of the market. The document concluded that Russia's current energy position was a passive one that threatened to expose the country to negative effects from changes in the global balance of energy supply and demand.

To counter this threat, at the end of October 2012 the Russian government lost no time in preparing to supply natural gas to the East Asian market. It took a final-

stage decision to commence new gas field development projects in Eastern Siberia—which had been kept on hold—for the production of gas for the East Asian market, and in February 2013 it finalized plans for the construction of an LNG loading terminal at Vladivostok. Particularly notable was the holding of four summit-level meetings with Japan during 2013, at which the two sides discussed cooperation in the energy field. At the corporate level, too, numerous joint development agreements were concluded between Russian and Japanese firms.

In Europe, at the government level, *Roadmap: EU-Russia Energy Cooperation until 2050* was signed by Russian Minister of Energy Alexander Novak and European Commissioner for Energy Günther Oettinger in March 2013. Against the backdrop of a distinct lack of progress in negotiations on the conclusion of a Partnership and Co-operation Agreement between the EU and Russia, which had been going on since 2008, the agreement on this roadmap (work on which had been proceeding since 2011) represented a de facto strengthening of cooperation in the field of energy, which is the most vital to both sides.

The roadmap displays a shared understanding between the two sides regarding probable future developments in the energy market—both globally and at the Russo-European regional level—while recognizing one another's differing interests, and proposes measures to strengthen the various separate cooperative relationships between the EU and Russia in the electric power, gas, and oil sectors, among others. Cooperation in the field of energy was the top-priority issue discussed at the summit meeting between the EU and Russia in June 2013, and the two sides confirmed their intention to further strengthen cooperation in this area on the basis of the roadmap. At the summit, President Putin stated his understanding that the EU was aiming to integrate its energy market on the basis of free competition, and stressed the importance of Russia and the EU collaborating in the search for measures acceptable to both sides.

At the corporate level, in March the state-owned oil company Rosneft completed acquisition of TNK-BP, a joint venture between BP PLC and Russian business interests. With this, Rosneft became the world's largest publicly traded oil/gas company. Moreover, as a result of the share exchange accompanying this acquisition, BP's equity stake in Rosneft rose to 19.75 percent, making it into Rosneft's largest shareholder with the exception of the Russian government. At an Anglo-Russian summit meeting held in May, this acquisition was one of the major points of discussion, alongside the Syrian crisis, and the participants agreed to work to build

an even stronger relationship of mutual trust, centered on ties in the energy sector.

In addition, a joint venture among Russian gas monopoly Gazprom, the Italian energy company Eni, France's electric utility EDF, and Wintershall of Germany had been promoting South Stream, a project involving the construction of a huge pipeline to supply gas to the markets of central and southern Europe. This plan received a major boost when the EU effectively abandoned its rival Nabucco gas pipeline plan in June. This came about because the operators of the gas field in Azerbaijan from which the Nabucco pipeline would have supplied gas—BP and the State Oil Company of the Azerbaijan Republic—chose instead to construct the Trans Adriatic Pipeline, which would not compete with South Stream for the same consumer markets.

Against the background of these developments, the reality behind Russia's apparent domination of the European energy market is that, due to its economic structure and the technological constraints on the development of energy, it has been forced to choose this strategy in order to survive amid the drastic ongoing changes in the market environment, and the shift in the country's prime focus to the East Asian market is just one part of this entire process. In Europe, meanwhile, the EU is examining a raft of new energy options, including the promotion of shale gas development within the EU's territory. However, the EU has not yet built up an adequate level of technological expertise, and the estimates of the volume of recoverable resources are also inadequate. In contrast to the United States, shale gas development would have to be conducted in areas of high population density, and the necessary infrastructure is not in place. The EU is thus faced not only with environmental issues, but also with many structural issues, and as of the present time, there is no guarantee that such gas development projects will be economically viable.

For these reasons, most observers believe it unlikely that shale gas will become a game changer for the EU in the way it has for the United States. The EU would, of course, like to realize energy production within its own borders. However, amid the current market environment, over the short and medium terms, the EU is thought likely to adopt a policy of continuing to diversify its procurement sources while promoting further stock swaps and share crossholding agreements with Russian corporations in order to maintain the stability of energy supplies from Russia.

6. Impact of Shale Revolution on China's Energy Policy

(1) China's Energy Policy

Imports of energy by China have been climbing steeply in parallel with the rapid growth in demand, and consequently the direction taken by China's energy policy will be an extremely decisive factor not only for Chinese energy security, but also for the stability of the global energy market. According to IEA estimates, Chinese energy demand will increase by 60 percent by 2035 over the 2010 figure, accounting for 33 percent of the growth in total world energy demand. Especially notable is the projected average annual growth of 2.2 percent in China's consumption of oil in volume terms, with daily consumption rising from 9 million barrels per day in 2010, eclipsing that of the United States by the late 2020s and reaching 15.1 million barrels per day by 2035.

This would represent 54 percent of the growth in global oil consumption, and would offset the projected decline in oil demand from OECD member countries. During this period, production of oil within China is likely to decline, and thus its dependence on oil imports would increase from 54 percent in 2011 to 82 percent in 2035.

The Chinese government has long been aware of this problem, and has been working to diversify its oil procurement sources. Meanwhile, it has been attempting to restrain the growth in oil consumption while maintaining a high economic growth rate through large-volume consumption of domestically mined coal. In recent years, however, the government has recognized the environmental consequences of large-scale coal burning as a serious obstacle to continued economic development. As a result, at the 12th session of the National People's Congress in March 2011, a policy was adopted to expand consumption of the more environmentally friendly natural gas as an alternative to both oil and coal. This was proclaimed as the basic policy underlying the energy measures stipulated in the country's currently ongoing Twelfth Five-Year Guideline.

To raise the proportion of environmentally friendly primary energy, the Chinese government has announced a policy of expanding the percentage of energy accounted for by sources other than fossil fuels from the 8.3 percent figure of 2010 to 11.4 percent by 2015, and of doubling the percentage of total energy usage accounted for by natural gas to 8.6 percent by 2015. The government aims to achieve this short-term goal principally by expanding imports of natural gas,

but as its goal over the medium-to-long term, it plans to reduce China's dependence on imports through expanded domestic production of nonconventional forms of gas including coalbed methane (CBM) as well as shale gas. In this connection, the government has focused its attention on the possibilities for taking advantage of the US shale revolution by introducing US shale gas development and production technology into China.

(2) China's Energy Security Policy Focuses on Expanding Domestic Production

China's Twelfth Five-Year Guideline (the term "guideline" has now officially replaced the formerly used term "plan") was approved by the National People's Congress in March 2011. Following this, the National Energy Administration solicited the opinions of interested parties, and after estimating the possibilities for further advances in the shale revolution and for the acquisition of the necessary technology by China, in January 2013 the government published its Twelfth Five-Year Guideline for the energy industry. Under this guideline, domestic production of natural gas is to be increased from 110 billion cubic meters in 2012 to 156.5 billion cubic meters in 2015. Of this increase, shale gas will account for only 6.5 billion and CBM for 20 billion, and the majority of the growth will continue to come from conventional natural gas fields. The Guideline emphasizes the importance of promoting development of shale gas reserves such as in the Tarim Basin in Xinjiang in China's far west as well as in Changqing in Inner Mongolia, so as to contribute to economic and social stability in those regions.

In line with its national energy plan, the Chinese government has also been directing research into the technologies required for shale gas development, and has been calling for strengthened collaboration with other countries in this field. In December 2013, US Vice President Joe Biden met with Chinese Premier Li Keqiang in Beijing, and the two reached agreement on strengthened cooperation in the energy field, including shale gas development. At the end of October 2013, China National Petroleum Corporation (CNPC) and Royal Dutch Shell jointly established a shale oil research center. While shale gas development will continue within these collaborative frameworks, the Chinese have already started preparing to increase production of shale gas from a number of promising resources.

According to the US Energy Information Administration, technically recoverable shale gas resources in China amount to around 32 trillion cubic

meters, or about twice the volume of the US reserves, and the most promising region for discovery and exploitation of such reserves is the Sichuan Basin.

Bidding was held for shale gas well exploration and drilling rights in the Sichuan Basin on two occasions, in June 2011 and September 2012. Currently, initial development work is being undertaken by CNPC subsidiary PetroChina, China Petrochemical Corporation (Sinopec), China National Offshore Oil Corporation (CNOOC), and various development companies associated with local governments in the region. Shale gas resource studies and actual drilling projects are being pursued in collaboration with European and US oil majors that possess advanced technology for shale gas development and production. These include Royal Dutch Shell, ExxonMobil, Chevron, and Conoco Phillips.

Also of note was the purchase by CNOOC in 2012 of Nexen, which was then Canada's seventh-ranked oil and gas company. The purpose of this purchase is thought to have been not only to acquire oil and gas interests in Canada, but also to directly acquire shale gas field development technology.

Regarding energy development plans in China by individual companies, PetroChina, the country's largest such enterprise, plans to increase production of natural gas (including shale gas) from the 80 billion cubic meters in 2012 to 150 billion cubic meters by 2020, while China's No. 2 company Sinopec plans to boost production from 3.7 billion in 2012 to a possible maximum of 10 billion by 2020. The IEA forecasts that the scale of China's domestic production of natural gas will roughly triple between 2011 and 2035, from 103 billion to 320 billion cubic meters. Of this increase, nonconventional gas—principally shale gas—is projected to account for over 70 percent, reaching some 230 billion cubic meters by 2035.

(3) Impact of Shale Revolution on China's Energy Security

As we have seen, the Chinese government is pursuing the production of shale gas as a matter of national policy, but at the same time, a number of issues need to be addressed. Firstly, on the technical front, in contrast to the shale gas deposits in the United States, those in China generally lie at greater depths, up to a maximum of 6,000 meters. Moreover, as they are located in mountainous areas or deserts, the Chinese will not be able simply to apply existing US technology to the development of these resources, and the necessary infrastructure, including pipelines, has yet to be constructed. Finally, as gas prices on the domestic market

Table. 9.2. Developments in the energy security policies of the major economies

State or Region	Energy security environment	Forecast direction of energy security policy	
USA	Before the shale revolution: ○ growing energy imports • Worsening trade balance ○ Declining industrial competitiveness Shale revolution: ○ Increased production of shale oil & gas • Economic recovery and higher employment • Outlook for spare export capacity	**Take active energy security measures** ○ Increase domestic production, reduce imports, improve global gas market supply ○ Increase coal exports (mainly to Europe) ○ LNG exports ○ Technology cooperation in shale development ○ Deregulation of crude oil exports?	
Middle East	○ Economies dependent on energy exports • Expansionary fiscal policy	Short term	○ Production adjustment ○ Increased proportion of exports to Asian markets
		Medium-to-long term	○ Reduction of risk of financial collapse / Strengthening of fiscal discipline?
	○ Adequate spare production/export capacity	○ Maintain status as swing producer	
Russia	○ Economy dependent on energy exports • Dependent on exports to European market	Short term	○ Diversification of export destinations; entry into Asian markets
		Medium-to-long term	○ More rapid economic modernization (structural reform)
	○ Declining yields at existing oil/gas fields • Need for continued investment in exploration and development	○ Maintain interdependence with Europe • Measures to stabilize relationships through equity exchange and infrastructure investment	
Europe	○ Growing dependence on energy imports • Dependence on Russia ○ Growing disparities between electricity prices within EU • Long-term decline in industrial competitiveness	Short term	○ Diversification of supply sources and routes ○ Negotiations with Russia on price reductions
		Medium-to-long term	○ Deregulation of energy markets within EU ○ Shale oil/gas development/ production within EU?
	○ Growth in natural demand over long term • Securing of stable, long-term procurement sources	○ Continued mutual dependence with Russia • Both sides to search for rational pricing mechanism	
China	○ Steep rise in energy demand • Sharp increase in dependence on imports • Growing geopolitical risks associated with supply routes ○ Worsening environmental problems	Short term	○ Diversification of procurement sources and routes
		Medium-to-long term	○ Cutting back on coal use and raising proportion of gas to total energy
			○ Energy conservation measures
			○ International cooperation in energy security field
	○ Abundant domestic energy resources	○ Bringing down import dependence through increased domestic production • Development of shale gas/oil resources through active introduction of production technology	

Japan	○ Need to rethink energy policy • Fukushima Daiichi nuclear disaster • Rising cost of energy imports • Declining industrial competitiveness due to comparatively high electricity prices	Short term	○ Diversification of procurement sources and routes ○ Securing stable supplies of natural gas • Capital participation in development of North American shale oil/gas resources
		Medium-to-long term	○ Establishing flexible supply-and-demand system ○ Creating rational pricing mechanisms
	○ Extremely high import dependence ○ Advanced environmental preservation and energy conservation technologies	○ Resource diplomacy to remain very important • Securing stable supplies of resources; cooperation in economic and technological fields	

Source: Compiled from a variety of sources.

are strictly regulated, the gas companies may not be able to sell their gas at prices that will enable them to adequately recoup their development investments. For these reasons, irrespective of the production plans put forward by the enterprises involved, some observers expect the start of full-scale production volume growth to be delayed to 2020 or beyond.

Meanwhile, viewing the government-led development of the Chinese domestic natural gas market as an attractive business opportunity, a number of foreign companies are taking an aggressive approach to capital participation. These expectations regarding the growth of the Chinese natural gas market would facilitate the realization of China's energy imports policy. Up to now, the Chinese government has expended considerable effort on the active pursuit of "resource diplomacy," so as to secure rights and interests overseas, but with the increasing attractiveness of the natural gas market, China is aggressively engaged in attracting investment in its domestic natural gas market, principally from the countries of Central Asia as well as Russia.

This conforms to China's overriding interest in ensuring a reliable supply of gas via pipelines and thereby reducing its vulnerability to disruptions of LNG transportation by ship. For example, China began importing natural gas from Turkmenistan in 2009, and in 2011 signed an agreement to increase the import volume to 40 billion cubic meters, thereby raising the volume from 3.5 billion in 2010 to 20 billion in 2012. This accounts for more than fifty percent of China's total imports. Then, in June 2012 a further contract was signed for a maximum annual import volume of 60 billion cubic meters. With this, Turkmenistan became China's largest supplier of natural gas. Imports of natural gas, albeit of only a

small volume, began from Uzbekistan in August 2012, and the government of Kazakhstan is also considering plans to export to China.

Demand for natural gas in the Chinese market is estimated to grow to 544 billion cubic meters by 2035, or five times the consumption in 2012. The Chinese government plans to meet this demand through a combination of domestic production and imports, but if global shale gas production continues to increase steadily, the country should be able to reduce its dependence on imports. In specific terms, in 2010 it was estimated that China's dependence on imports would rise steeply, to 53 percent by 2035, but in the 2012 estimates the possibility emerged of this figure being revised downward to 41 percent. Additionally, import conditions are also moving in a direction favorable to China. In view of these factors, while there remain a number of issues to be addressed before the shale revolution can exert an indirect impact on China, it will probably help improve the country's energy security situation and also make some contribution toward stabilizing the global energy market.

Japan's Response to the Shale Revolution

As a result of the catastrophic failure of the Fukushima Daiichi nuclear power plant that occurred on March 11, 2011, when the plant was hit by a tsunami triggered by the Great East Japan Earthquake, the Japanese government has been under pressure to reexamine the country's energy policy. In line with this, work proceeded throughout 2013 on the drafting of a new Basic Energy Plan by the Basic Policy Subcommittee of the Advisory Committee on Energy and Natural Resources. At the meetings of the subcommittee, the members recognized four basic perspectives from which the nation's energy policy must be viewed, i.e., the conventional need for supply stability, reductions in costs, and measures to minimize the impact of energy on the natural environment, in addition to the necessity of ensuring public safety. On top of this, the subcommittee also recognized the importance of evaluating policy proposals from the perspectives of their international impact and their effect on Japan's economic growth. At most of the fifteen meetings held by the subcommittee, the impact of the shale revolution over the medium and long term was repeatedly assessed, as this constitutes an important factor with relation to all the above-listed basic perspectives.

The results of the subcommittee's discussions were incorporated into the Basic Energy Plan, which was submitted for government approval in December. In this plan, the drafters welcomed the shale revolution as a development that would not only facilitate imports of LNG from the United States but also supplies of LPG (liquefied petroleum gas)—which is refined from "wet" natural gas and is frequently found together with shale gas—and would also help improve the environment surrounding LNG price negotiations, among other beneficial side-effects.

At the same time, in the Basic Energy Plan, the Basic Policy Subcommittee also noted the uncertainties surrounding the likely geopolitical impact of the shale revolution as well as the changes it was expected to bring about in the structure of global energy supply and demand. They urged the Japanese authorities to constantly monitor the direction taken by the shale revolution and the separate responses to it by individual countries. They further maintained that it was necessary for Japan to proactively and comprehensively pursue all available measures to move its energy policy in the desired direction, including resource diplomacy, rather than simply reacting passively to events on the global stage. In other words, Japan should refashion its energy policy—which has hitherto been crafted in response to a comparatively static energy supply-and-demand structure—to one that is focused on adapting to a constantly changing energy environment in which uncertainty is taken for granted. In this way, the Basic Energy Plan is seen as indicating a change of policy direction for the purpose of creating a multi-tiered, diverse, and flexible energy supply-and-demand structure.