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The European Natural Gas Market: Imports to Rise Considerably

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Since the late 1990s, natural gas has been the second most important source of energy in the European Union after oil. Current forecasts predict that the demand for natural gas will continue to rise over the long term. As the production of natural gas in the EU has already passed its peak and will drop in coming years, natural gas imports will have to rise considerably. To ensure according supplies is possible in the long run, as approximately 80% of the world's natural gas reserves are located within the economic reach of the EU—primarily in the former Soviet Union and Middle East. A supply of imported natural gas adequate to cover declines in EU production is contractually guaranteed through 2020. Additional projects will permit an increase in natural gas consumption in the EU of 20 to 30%. By 2020, 80% of the EU's supply will come from imports. Russia will remain by far the largest supplier, followed by Norway and Algeria.

Security concerns are raised by the importation of natural gas from a small handful of suppliers. While the regional diversification of imports is only possible to a limited extent, the construction of a pipeline to connect Europe with natural gas rich nations on the Caspian Sea and in the Middle East would be a step in the right direction. The expansion of capacities for production, transport and storage of liquified natural gas (LNG) could also help to augment diversification.

In the 1980s natural gas was still considered the energy source of the future. Many predicted natural gas would replace oil as the principal source of the world's energy and would help to bridge the transition to a renewable energy economy. This forecast initially appeared correct, as the share of natural gas consumed worldwide rose continuously throughout the 1980s and 90s. Since the year 2000, however, the consumption of coal has risen faster than the consumption of natural gas. Coal is currently the world's second most important source of energy after oil (Figure 1).

Rising Demand and Falling Production

For a long time, natural gas was considerably less important in the European Union than in other regions of the world—particularly North America and the (former) Soviet Union. At the beginning of the 1970s, the share of natural gas consumed by the region that makes up today's EU was just under 10 percent—only half of

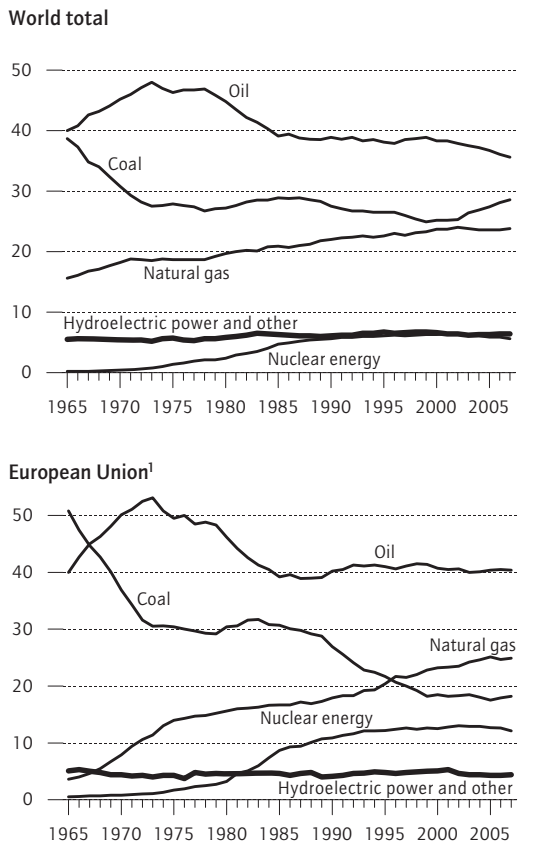
JEL Classification:
Q41, L12, L13

Keywords:
Natural gas, LNG, Import dependence, Reserves, Pipelines.

Figure 1

Primary Energy Consumption According to Source

In percent



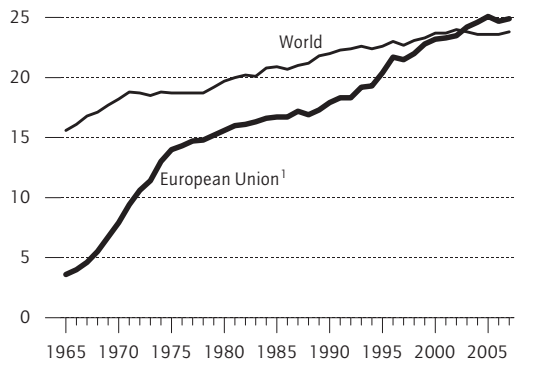
1 Before 1986: without Estonia, Latvia, and Lithuania; before 1992: without Slovakia.

Sources: BP Statistical Review of World Energy 2008; calculations by DIW Berlin. **DIW** Berlin 2009

Figure 2

Share of Natural Gas in Primary Energy Consumption

In percent



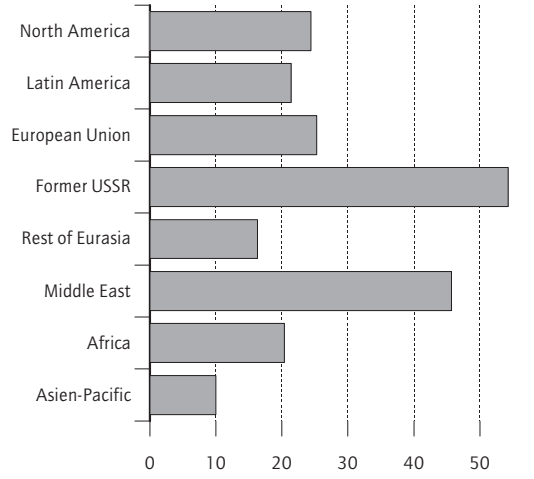
1 Before 1986: without Estonia, Latvia, and Lithuania; before 1992: without Slovakia.

Sources: BP Statistical Review of World Energy 2008; calculations by DIW Berlin. **DIW** Berlin 2009

Figure 3

Share of Natural Gas in Primary Energy Consumption by Region, 2007

In percent



Sources: BP Statistical Review of World Energy 2008; calculations by DIW Berlin. **DIW** Berlin 2009

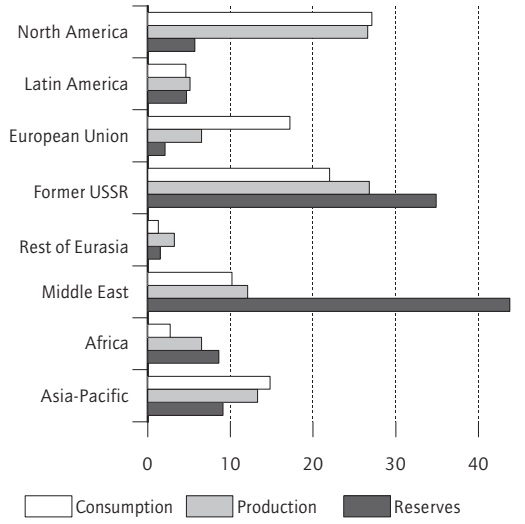
the world average (Figure 2). This figure rose to approximately 16 percent by 1980 with the expansion of oil and natural gas production in the North Sea; imports over this period were also initially low. The discrepency between the EU and the rest of the world in terms of natural gas consumption as a percentage of total energy usage was thereby reduced to just four percentage points. In subsequent years, production and imports rose further. In 1996, natural gas surpassed coal as the most important energy source after oil in the EU. In 2007, natural gas usage reached 25% of primary energy consumption. This share of consumption slightly exceeded the world average as well as the share in most regions (Figure 3). In 2007, the EU's share of world natural gas consumption was 17%, despite the fact that the EU accounted for just under 2% of world natural gas reserves (including unconventional reserves) and only about 7% of world natural gas production (Figure 4).

Although it was possible to meet the greater part of the sharp rise in demand between 1970 and 1980 with increased production in EU member states, the subsequent continuous increase in consumption was predominantly met with increased imports (Figure 5). Between 1980 and 1996, the consumption of natural gas rose by about 50%, while domestic production only rose by 19%. Two thirds of the increase in consumption was thus covered by imports. In 1996, natural gas production in the

Figure 4

Natural Gas Consumption, Production, and Reserves by Region, 2007

In percent

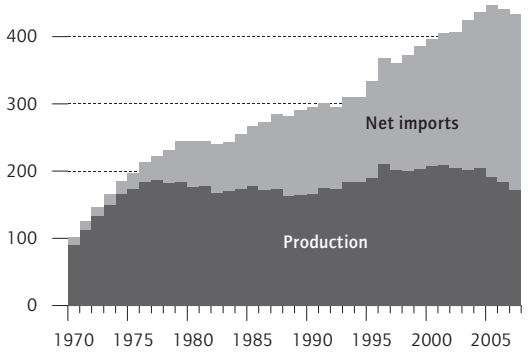


Sources: BP Statistical Review of World Energy 2008; calculations by DIW Berlin. **DIW** Berlin 2009

Figure 5

Natural Gas Production and EU Net Imports

In billions of cubic meters



Sources: BP Statistical Review of World Energy 2008; calculations by DIW Berlin. **DIW** Berlin 2009

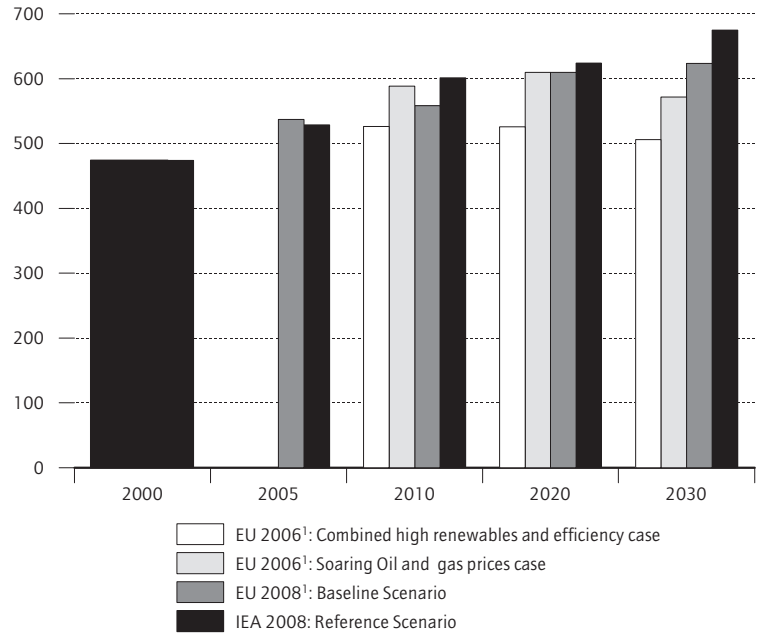
Imports to Rise through 2030

According to the International Energy Agency (IEA) and Energy Information Administration (EIA), in the face of continued high oil and natural gas prices, the share of natural gas in total world energy consumption could decrease by 2030, while total consumption in the EU reached its peak of about 211 million tons of oil equivalent (MTOE) (over 230 billion cubic meters) and after several years of stagnation, began to decline, while consumption continued to rise up to 2005. Because of significant price increases, natural gas consumption fell in the EU in 2006 and 2007. Production declined even faster than consumption over this period, however, causing imports to increase slightly. The share of imports in total natural gas consumption in the EU increased from 10% in 1970 to over 27% in 1980 and to 60% in 2007. Compared to the other import regions of North America, Asia-Pacific, and Africa, the EU is the most dependent upon imports.[1] Even higher import levels are possible, as 80% of worldwide natural gas reserves are located within the economic reach of the EU (when one includes the Middle East). These reserves are located in countries whose economic development has more or less lagged behind that of the EU, and for whom energy exports are the most important source of tax income and foreign exchange proceeds.

Figure 6

EU Natural Gas Consumption Scenarios

In billions of cubic meters



1 Converted from tons of oil equivalent to cubic meters using a factor of 1.208.

Sources: EU Commission; IEA; calculations by DIW Berlin. **DIW** Berlin 2009

1 In 2007, import dependence was 13% in the Asia-Pacific region and 3% in North America. The EU's oil dependence was thus 5 and 20 times higher—respectively—than these two regions.

sumption of coal could disproportionately expand, as it already has in recent years—especially in Asia. For Europe, the picture may be quite different: in its current Reference Scenario (update 2007), the EU Commission expects natural gas to be the only fossil fuel whose consumption will continue to increase significantly through 2020 (Figure 6).

This is partly explained by the fact that nuclear energy consumption and the use of coal for electricity generation will decline. The share of renewable energy will grow by over three percentage points to reach 10% of primary energy consumption by 2020. After 2020, the consumption of natural gas will only rise minimally in the EU, while renewable energy will continue to account for a larger share. With the aid of accelerated improvements in energy efficiency and the further expansion of renewable energy production, it may be possible to reduce natural gas consumption by 2030 to approximately the level anticipated for the year 2010, according to EU Commission estimates.[2]

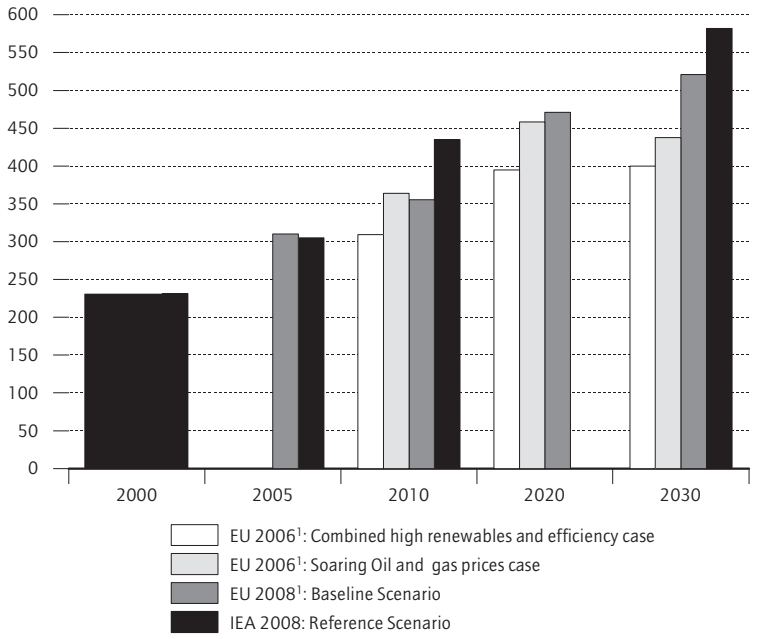
For some time, natural gas production in most member states of the EU has been in decline due to the depletion of reserves. In the Netherlands, this has been true since the end of the 1970s, and in Britain since 2000. These are the two EU nations with the largest current natural gas production. Britain's natural gas production in particular has declined in recent years. Between 2005 and 2030, the EU's natural gas production will fall by one half; falling production in Britain and the Netherlands will account for nearly 80% of this decline.

Due to this sharp decline in domestic natural gas production, the EU Commission estimates that—despite only a small increase in consumption—natural gas imports will rise between 2005 and 2030 from 175 MTOE (about 210 billion cubic meters) to 431 MTOE (about 520 billion cubic meters) (Figure 7).[3] Even if the ambitious targets for energy conservation and the expansion of renewable energy are completely fulfilled (under the "Combined high renewables and efficiency case" of 2006), natural

Figure 7

EU Net Natural Gas Importation Scenarios

In billions of cubic meters



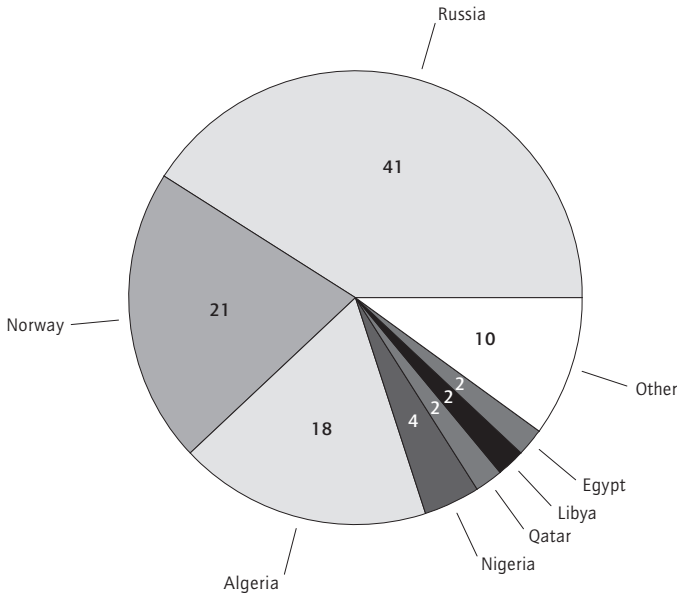
1 Converted from tons of oil equivalent to cubic meters using a factor of 1.208.

Sources: EU Commission; IEA; calculations by DIW Berlin. **DIW** Berlin 2009

Figure 8

EU Natural Gas Import Sources, 2006

In percent



Sources: IEA; calculations by DIW Berlin. **DIW** Berlin 2009

2 Based on these estimates, renewable energy could account for a larger share of energy consumption than solid fuels as early as 2020. By 2030, renewable energy could account for over 20% of primary energy consumption—nearly as much as natural gas. See European Commission: European Energy and Transport. Scenarios on Energy Efficiency and Renewables, Brussels 2006.

3 The EU Commission presents natural gas data in its scenarios exclusively in caloric values. In order to convert these figures to billions of cubic meters, we assumed that natural gas supplies in the EU have an average caloric value of 34.7 megajoules per cubic meter, as implied by the IEA's 2008 World Energy Outlook. One kilogram of oil equivalant, by comparison, has a caloric value of 41.9 megajoules. Based on these figures, the conversion factor for natural gas in MTOE to billions of cubic meters is 1.208.

gas imports will still have to rise by 74 MTOE (90 billion cubic meters) by 2030.

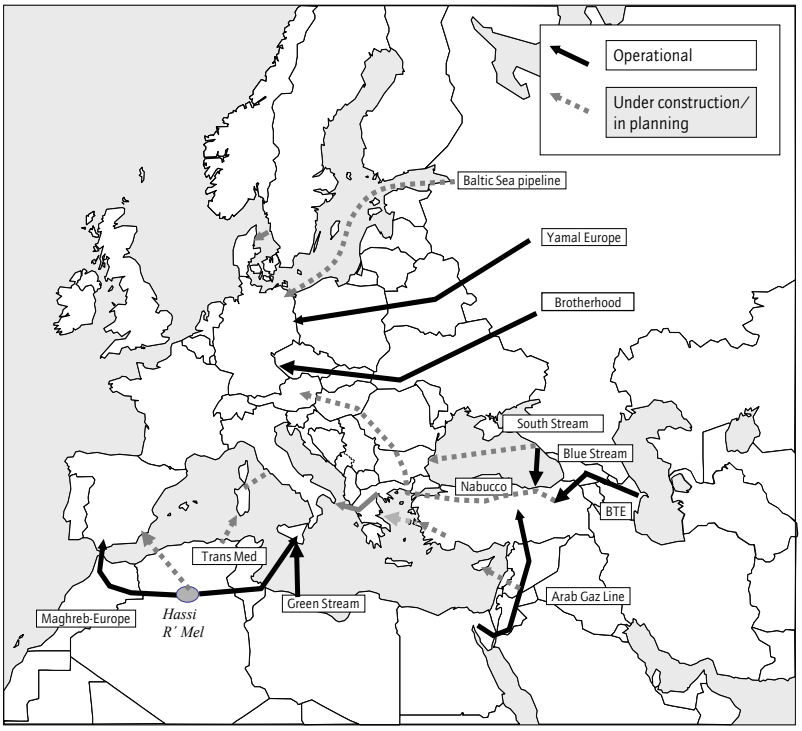
Domestic production of natural gas and contractually guaranteed imports were more than sufficient to cover natural gas demand in 2007, and will meet 82% of 2020's expected needs (590 to 631 billion cubic meters). Projects already well underway will likely cover an additional 5% of expected needs. By 2020 some 18% of natural gas could be imported in the form of LNG (liquid natural gas). Russia's share of EU natural gas imports could fall to 35% by 2020.[4] The regional configuration of natural gas imports would thus change very little. In 2006, Russia provided 41% of imports, Norway 21% and Algeria 18% (Figure 8).

Adequate Infrastructure Projects under Construction or in Planning

Russia is the nation with the world's largest natural gas reserves (currently over 47 trillion cubic meters) and is already connected to the EU's natural gas network by means of numerous pipelines. Russia will remain the largest natural gas supplier to the EU.[5] The future contribution made by other export nations to Europe's natural gas supply depends on which pipeline routes and LNG terminals are completed.

Figure 9

Selected European Natural Gas Import Pipelines



Sources: IEA; graphic by DIW Berlin. **DIW** Berlin 2009

Pipelines

Natural gas is imported to the EU primarily via pipelines from Norway, Russia and North Africa (Figure 9). These pipelines have a total annual capacity of about 320 billion cubic meters. Russia accounts for about half of this total, and Norway for more than one third. In order to secure natural gas supplies over the long term, the construction of additional pipelines is underway or in planning.

Russia's share of natural gas imports to the EU could increase somewhat once the controversial Baltic Sea pipeline (Nord Stream) is complete. The pipeline will run from Wyborg in Russia to the German Baltic seacoast near Greifswald, and will have a total capacity of 55 billion cubic meters when fully complete in 2012.[6] Since the end of 2000, the pipeline has been an EU "Trans-European Networks" project. Russian gas is currently transported to Europe via land routes across Ukraine or Belarus and Poland. The transportation route across the Baltic Sea will provide direct delivery to Germany and Western Europe, making it possible to bypass these transit nations. According to the proponents of the pipeline, this will increase supply security. Once fully commissioned in 2012, the dual pipeline could guarantee natural gas supply to northwestern Europe in the event of a trans-Ukrainian supply breakdown. However, the current transit nations see their position weakened by the construction of a direct connection between Russian gas reserves and northwestern Europe. The Baltic Sea pipeline is also currently the most expensive option for pipeline construction to supply northwestern Europe.

The South Stream pipeline, which is slated for completion in 2013 and has a projected capacity of 20 billion cubic meters, will establish a connection between Russia and Southern Europe. Nations such as Bulgaria—which was seriously impacted by Russia's termination of gas delivery to the Ukraine in January of 2009—will benefit from this direct route to Russia. In order to secure natural gas supplies in Southeastern Europe in the event of temporary supply interruption, additional increases in

4 See http://www.eon-ruhrgas.com/cps/rde/xchg/SID-67D0717C-085C43ED/er-corporate/hs.xsl/792.htm.

5 Regarding Russian gas exports, see Engerer, H.: Russlands Energieexporte. Potential, Strategien, Perspektiven, in: Osteuropa, Blick in die Röhre. Europas Energiepolitik auf dem Prüfstand, Energie-Dossier, 2009, p. 39-55.

6 See Hubert, F., I. Suleymanova: Ostsee-Pipeline: Die Gewinne werden neu verteilt, Wochenbericht des DIW Berlin Nr. 7/2009.

storage capacity are also necessary. In contrast to other EU nations, Bulgaria and Greece have very little to no storage capacity. In other countries such as Hungary, the expansion of storage capacities is long overdue given the increased household consumption of natural gas.[7]

The Nabucco pipeline, which is scheduled to begin operation in 2012 with a capacity of 31 billion cubic meters, will connect European consumers to natural gas reserves in the Caspian Sea region.[8] The establishment of a direct connection to natural gas reserves in Central Asia and possibly from Iran is often advocated in order to diversify European natural gas imports and reduce dependency on Russia. In this connection Turkey has special significance as a transit nation and distribution center for natural gas.[9] Due to the planned capacity of this pipline, however, it would only be possible to replace Russian supplies to a limited extent. In addition, Russia is currently negotiating to purchase natural gas from Central Asian nations and would like to further expand its role as re-exporter.

Among Central Asian nations, Turkmenistan and Uzbekistan are currently net exporters of natural gas. In 2007 they export net 54.3 and 14.7 billion cubic meters respectively. Kazakhstan and Azerbaijan only export small quantities of natural gas to non-CIS nations. According to the IEA, these four countries exported a total of 73 billion cubic meters of natural gas in 2007, of which 64 billion cubic meters went to Russia[10] On the basis of a long-term agreement, Turkmenistan will increase its annual deliveries to Russia from 48 billion cubic meters to between 70 and 80 billion cubic meters. Turkmenistan has also announced plans to increase its overall production from 72 billion cubic meters in 2007 to 230 billion cubic meters by 2030 as well as significantly increase its natural gas exports. The actual extent of Turkmenistan's natural gas reserves is not yet clear, and it is an open question as to whether the nation can achieve its planned expansion of production and exports (Table). The other nations of the region will only make a small amount of additional natural gas supplies available to Western Europe. Uzbekistan will thus need to use a large part of its natural gas production to cover domestic needs. Kazakhstan possesses large natural gas reserves in the form of associated gas in crude oil deposits. During oil extraction, however, most of this associated gas is re-injected into the oil fields. The quantity of natural gas that Kazakhstan will produce for domestic consumption and export in 2020 falls in the range of 20 to 40 billion cubic meters—a production figure much lower than its reserve capacity would suggest.[11] The country's potential export volume will range between of 12 to 20 billion cubic meters in the future. As a whole, the region—especially Turkmenistan—could help the EU to meet its natural gas needs, but it cannot replace Russia as the largest EU supplier.

Table

Natural Gas Situation in Selected EU Supply Countries, 2007

In billions of cubic meters

	Production	Consumption	Production surplus	Reserves	Reserve life in years[1]
Russia	650.8	451.1	199.7	47 693	73.3
Caspian Sea region[2]					
Turkmenistan	72.2	15.0	57.2	3 000	41.6
Usbekistan	65.3	55.1	10.2	1 841	28.2
North Africa					
Algeria	84.8	27.3	57.5	4 515	53.2
Egypt	46.5	36.5	10.0	2 048	44.0

1 At current extraction rates.
2 Kazakhstan excluded due to unreliable data.

Source: German Federal Institute for Geosciences and Natural Resources. **DIW** Berlin 2009

A number of smaller pipeline projects will lay the foundation for increased imports from North African suppliers, including the Galsi (Algeria-Italy) and Medgaz (Algeria-Spain) pipelines. The Medgaz pipeline should be in operation by the second half of 2009. Together, these new transport routes will have a capacity of eight billion cubic meters per year. Two additional projects—the Trans-Adriatic Pipeline, or TAP (Albania-Italy), and the TGI pipeline (Turkey, Greece, Italy)—will improve Southern Europe's connection to natural gas suppliers.

LNG

Pipelines are not the only option for the transport of natural gas from supplier nations. Gas can also be shipped by sea in the form of liquefied natural gas (LNG). For this to occur, exporting nations must possess special liquefaction facilities, and importing

7 See DG Tren C1: Study on Natural Gas Storage in the EU. Draft Final Report, October 2008, http://ec.europa.eu/energy/gas_electricity/studies/ gas_en.htm.

8 Currently, the BTE pipeline (Baku-Tbilisi-Erzurum) extends from Azerbaijan to Turkey, and has a capacity of 8.8 billion cubic meters. Planning foresees a capacity expansion to 12 billion cubic meters by 2012.

9 See Götz, R.: Pipeline-Popanz. Irrtümer der europäischen Energiedebatte, in: Osteurope, Energie-Dossier, 2009, p. 5-20.

10 International Energy Agency: Perspectives on Caspian Oil and Gas Development, December 2008, http://www.iea.org/Textbase/publications/ free_new_Desc.asp?PUBS_ID=2076..

11 The IEA emphasizes that Kazakh reporting on the subject of natural gas production and consumption varies greatly. The reason for this is that production and consumption are reported either gross or net (adjusted for technical usage and flaring).

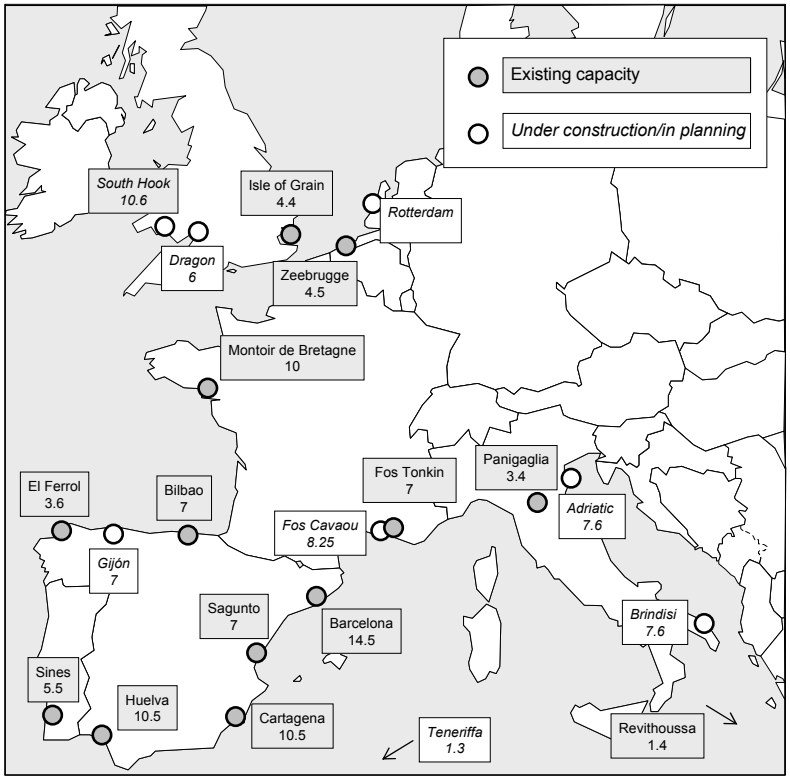
nations must construct LNG receiving terminals. In general, the liquification of natural gas and shipment of LNG only makes sense economically for distances above 4,000 kilometers. The LNG market has grown rapidly in recent years worldwide.

In 2007, the EU imported some 46 billion cubic meters of natural gas in the form of LNG, a volume representing about 9% of total European natural gas consumption.[12] To date, only a few European nations have terminals available for the regasification of liquefied natural gas (Figure 10): Belgium, France, Greece, Italy, Portugal, Spain and Britain. Concrete plans for the construction or expansion of terminals exist in France (Fos Cavou, 8 billion cubic meters), Spain (Gijon, 7 billion cubic meters; Arinaga in Grand Canary, 1.3 billion cubic meters; and Arico-Granadilla in Tenerife, 1.3 billion cubic meters) and Italy (Rovigo, offshore 7,6 billion cubic metres; Brindisi, 1,6 billion cubic metres).[13] Great Britain, which must increasingly cover its own natural gas needs with imports, also plans to increase the capacity of its LNG terminals (South Hook I and II will provide 21.1 billion cubic meters of additional capacity, and Dragon 3 billion cubic meters). Additional terminals are in planning in the Netherlands, Italy, France and Poland; the capacities of these terminals have not yet been determined in all cases. In Germany, the construction of an LNG terminal in Wilhemshaven has been repeatedly postponed.

Figure 10

LNG Terminals for EU Natural Gas Supply, 2008

Capacity in billions of cubic meters per year



Sources: GLE map dataset; IEA; graphic by DIW Berlin. **DIW** Berlin 2009

Planned construction will increase the receiving capacity for LNG in the EU from about 55 billion cubic meters to about 150 billion cubic meters.[14] At the moment, on average, half of the total available capacity is being utilized. In addition to this terminal receiving capacity, it is also possible using special tankers to regasify LNG as it is being unloaded, and to pipe it directly into the gas network of a receiving nation.

The growth of the LNG market worldwide and in Europe depends not only on the speed with which receiving facilities in import nations and special tanker fleets can be constructed. The capacity of export terminals in supplier nations is also a key factor. Currently, Qatar has the largest export terminal (39.8 billion cubic meters), followed by Malaysia (28.4 billion cubic meters), Indonesia (28.4 billion cubic meters), Algeria (25 billion cubic meters) and finally Nigeria (20.8 billion cubic meters).[15]

Algeria and Nigeria are particularly significant suppliers to the European market. Each nation plans to increase its capacity over the next few years by six billion cubic meters. Russia has emerged as a new supplier of LNG to the European market (around 13 billion cubic meters), and suppliers in the Pacific region plan to increase the capacity of their LNG terminals. The IEA expects worldwide capacity to increase from 255 billion cubic meters in 2007 to 402 billion cubic meters by 2012.[16]

12 See OECD: Natural Gas Information, 2008.

13 The capacities for the terminals planned in the Netherlands (Rotterdam) and in Britain (Milford Haven) have not yet been established.

14 There are additional plans to build LNG terminals which will raise Europe's receiving capacity to a total of about 325 billion cubic meters. It is not clear at present which projects will actually be completed. See IEA: Natural Gas Market Review, Paris, 2008.

15 According to the OECD's political stability classification, both Qatar and Malaysia fall in the desirable risk class 2, and Algeria is in class 3. Indonesia has a poor rating with class 5 and Nigeria is rated as class 6.

16 See International Energy Agency: World Energy Outlook, 2008, p. 122.

Import Dependency Fosters Diversification and Networking

Eighty percent of the world's natural gas reserves are located within the economic reach of the EU—above all in the former Soviet republics and Middle East. Thanks to increased imports from these regions, the EU will be able to increase its natural gas consumption between 20 and 30% by 2020 despite falling domestic production.

The intensification of the ongoing gas dispute between Russia and Ukraine at the beginning of 2009 resulted in a short-term cessation of gas deliveries from Russia to Europe. It also raised questions about energy security. To date, the EU has had positive experiences with the contractual loyalty of Russia and other natural gas suppliers. Supplier nations have an economic interest in stable export earnings.

In the discussion on how dependency can be reduced, the reduction of additional import needs and the diversification of supplies are often mentioned. Increased consumption can certainly be avoided by means of energy conservation and the expanded deployment of renewable energy. These measures will not be sufficient, however, to compensate for ongoing reductions in production or to prevent the need for additional natural gas imports. Increased regional diversification of European natural gas imports (which will be enabled in part by the increased use of LNG) will also only be possible to a limited extent. By 2020, the percentage of imported natural gas that comes from Russia (currently 40%) is likely to only fall slightly in favor of imports from Africa and the Middle East. If the EU wishes to continue to take advantage of the benefits of natural gas, then transnational pipeline networks should be improved and natural gas storage capacities should be expanded.

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