

## Outlook for the Natural Gas Industry

World consumption of natural gas continued to climb in 2007, but with significant variations depending on the geographical region. The market is expected to keep growing for years, albeit at a slower rate due to the competition with coal, because of the specific advantages that natural gas brings to the energy mix. Consumption may be inhibited by the global financial and economic crisis. By 2030, gas supply and demand will diverge widely at regional level. Considering the uncertainties associated with key markets like the United States, Europe and Russia, it is imperative to develop appropriate strategies to meet the justifiable need to ensure the security of each link in the gas supply chain.

### Growth on the gas market

In 2007, the consumption of natural gas continued to rise throughout the world at a rate that varied from country to country. For instance, it grew by 6.5% in the United States and by 9% in Japan. In Europe, a mild winter curbed growth although, judging by first quarter 2008, a reversal in trend has occurred. Spain has already seen demand for gas increase by 20% for the first half-year.

The International Energy Agency (IEA) predicts that demand will grow steadily at a rate of 1.8% between now and 2015. It should be stressed that the United States is investing heavily in the production of non-conventional gases (coalbed methane, shale gas and tight gas), which become more competitive when prices are high on the conventional gas market (*i.e.* when they exceed US\$6/MBtu). If this trend persists, it is likely that the US market will undergo a radical transformation. Strong world demand is maintaining upward pressure on gas prices, which are already very high because of their alignment with oil prices.

The main factor driving growth continues to be high demand from the electricity production sector. In 2007, the latter increased reliance on gas by 10% in the United States and 13% in Japan; 41.5% of British power is generated using gas.

This trend should intensify: projects to build nuclear power plants in OECD countries will take decades to

reach completion. Many governments, including in Spain and Germany, are supporting the development of gas-fired power plants that often use combined cycle gas turbines and will absorb more than 50% of the increase in gas demand by 2015. Non-OECD countries are also choosing this model, except China and India, where coal remains dominant. This mode of production is successful owing to its flexibility, especially insofar as the construction time and financing are concerned, and to its environmental benefits compared to coal. By 2010, 25% of EU electricity production is expected to derive from gas.

### North America: a particular case

The “peak oil” issue should not obscure the fact that natural gas production at regional level will also top out.

Canada ranks third in the world for NG production (188 bcm) and the US second (546 bcm) behind Russia (607.4 bcm)—one notes that the US and Russia are also the top two consuming countries—and Iran occupies fourth position (111.9 bcm).

In North America, the supply-demand equilibrium and natural gas prices depend on the production surplus from Canada, which serves to cover the US production deficit.

Between 1987 and 2001, Canadian natural gas production rose steadily, from 80 to 180 bcm. From 2001 to

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2006, it stagnated in the vicinity of 186-188 bcm. In 2007, it registered a 2.5% decrease. The National Energy Board of Canada says that output could fall again in 2009, by between 7 and 15%.

Between 1984 and 2003, Canada's natural gas reserves fell by 42% but have remained stable since then. The province of Alberta represents 81% of Canadian production (136 bcm in 2007) and contains 70% of the national reserves. British Columbia weighs in with 13% of national production and Saskatchewan 3.7%. In 2007, 46.5 bcm/yr of tight gas was produced and marketed in Canada, accounting for 27% of output in the Canadian West.

Spending on gas and oil equipment has tripled in Alberta and the number of active oil wells has almost doubled in eight years. At the same time, natural gas production and reserves have been falling since 2000 in this region of great strategic importance. Since 2001, when Canadian gas production began to stagnate, capital expenditure on natural gas and oil prospection has tripled. During this period, the number of exploration wells drilled has doubled, and the minimum gas price has tripled.

For the Canadian natural gas sector, this has been a period of high investment spending and exploration activity, driven by the increase in natural gas prices. In spite of these favorable factors, production stagnated then fell in 2007 and will probably turn down again in 2008.

In other words, the industry must spend more to drill more wells in order to produce the same quantity of gas, at best.

In Canada, natural gas production must also contend with another problem. Tar sand projects attract capital that would otherwise have been invested in projects to produce natural gas. Moreover, the production of oil from tar sands requires the consumption of natural gas. Therefore, the existence of these competing projects diverts financing and increases pressure on demand.

In North America, high gas prices are essential to maintaining the level of natural gas production. Increasing numbers of wells are needed. In addition, they need to be more complex and drilled deeper, which drives costs up. Admittedly, the current economic and financial crisis is having a moderating effect in this respect, because it sharpens the competition between drilling operators.

In 2007, gas production in the United States was up by more than 4% after nine years of stagnation or decline. It is thought that this growth spurt, whose magnitude was unexpected, will reach 7% in 2008. According to the

US government, more than 50% of this increase was generated in Texas (+ 15%), Wyoming (9%), Oklahoma (6%) and Louisiana (4%), where high prices and technology improvements (horizontal drilling) encouraged the large-scale development of non-conventional gases. Shale gas, especially the Barnett Shale block in Texas, saw the highest growth, even if it still only represents the smallest component (12%) of total non-conventional gas production. The latter stood at an estimated 250 bcm/yr in 2007, more than 45% of national production. During the period 2007-2020, shale gas production should continue to grow very rapidly. It is thought that, by 2020, it will have passed the 170 bcm/yr mark and represent 40% of total non-conventional gas output (more than 400 bcm/yr).

The production of US tight gas rose by 58% between 1998 and 2007 to reach a volume of 170 bcm/yr in 2007, more than two-thirds of national non-conventional gas output and nearly one-third of total production. More than 40% of this volume came from the Rocky Mountain area, where tight gas production has been growing fastest (+121% for 1998-2007). This type of production is underway at six of the top ten natural gas fields in the United States. Between 2007 and 2020, tight gas should continue to dominate among non-conventional gases. However, by 2020, its share of the total is expected to decrease to 45%, about the same as shale gas.

According to the most recent data put out by Advanced Resources International, US non-conventional gas resources come to a total of 16,400 bcm in volume, including 10,760 bcm of tight gas. More than half is located in the Rocky Mountains. The different estimates vary substantially according to the data source (Table 1). In the area of tight gas development, it will be absolutely vital to improve efficiency and well productivity *via* technical progress, which means stepping up R&D investment.

Coalbed methane production is expected to remain constant (nearly 55 bcm/yr) between 2007 and 2020. CBM will account for 13% of total non-conventional gas output by 2020, down from 23% in 2007.

Table 1  
Estimates of US tight gas resources

bcm	US Geological Survey	US Department of Energy	National Petroleum Council	Advanced Research International
Tight gas	5,270	9,685	4,500	10,760
Total non-conventional	8,665	13,450	8,300	16,400

Source: Cedigaz

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Between now and 2020, the biggest technology challenges will be in the area of:

- real time detection and analysis during drilling,
- treatment of the water used in production,
- technologies involving recompletions and the refracturing of existing wells.

High prices rescue production in the short run, but they will not suffice to prevent its decline in North America over the long term. The Canadian natural gas surplus, destined for the United States, is starting to decrease. Falling production in Alberta is disturbing the supply-demand equilibrium in North America (the United States, Canada and Mexico).

The problem of the natural gas market in North America is its distance from producing areas located elsewhere. Gas cannot be shipped *via* pipeline from Russia, West Africa or the Middle East. The only possible transport solution is the methane carrier, bringing its cargo of liquefied natural gas.

However, the plan to supply North America with LNG in future is jeopardized by renewed interest in non-conventional gases, relatively low Henry Hub prices and the fact that gas consumption forecasts are undergoing substantial revisions downwards due to the economic recession.

The outlook for LNG imports to the US, already down by an estimated 55% this year, suggests that LNG competition in the Atlantic Basin may subside to some extent, which would leave more LNG available for Europe in the next few years to help cover peak winter demand and the increase in annual consumption in the electric power sector.

### The European supply situation

The domestic production curve for 2005-2030 shows a significant downturn in 2010, and then stabilizes at about 80 bcm in 2030, a decrease of nearly 60% (Table 2). Contractual imports (including contract extensions) from Norway and other non-EU countries should remain stable during the period 2010-2030.

On the other hand, consumption shows an upswing. Estimates put demand at 585 bcm in 2010 and at nearly 750 bcm in 2030, which corresponds to a 30% increase. In 2010, a widening gap will appear between supply and demand, reaching 285 bcm/yr by 2030. Europe must find new sources to cover domestic demand for natural gas, in addition to the procurement contracts that have already been signed and extended.

Table 2

Additional gas supplies required for Europe (2010-2030)

bcm	2005	2010	2015	2020	2025	2030
Domestic production EU27	218	195	130	100	80	80
Contractual imports from Norway	85	80	125	125	120	115
Contractual import from other non-EU countries	222	310	320	310	310	265
Total	525	585	575	535	510	460
Consumption	525	585	635	685	715	745
Additional supply required	0	0	60	150	205	285

Source: Eurogas

It takes time to implement long-term contracts, so the matter should be raised now. The problem is especially acute considering that possible additional supplies only exist outside Europe. It is also important to point out that total capex of more than US\$300 billion will be needed to add 200 bcm/yr of gas to the European supply.

Credit is tight all over the world. Only large companies able to develop a long-term vision without undue opportunism will be able to undertake high-cost projects that are extremely complex to develop, finance and build.

Several planned gas pipeline projects, intended to give Europe a steady long-term supply, have run into obstacles that challenge their feasibility and short-term implementation.

One exception is the Medgaz project. On the Algerian side, installation of the offshore section of this gas pipeline running from Algeria to Spain (capacity: 8 bcm/yr) has been completed. Work on the compressor station in Beni Saf, Algeria and on the overland section of pipe between Almeria and Albacete in Spain is still in progress. The situation of other projects is more problematical:

- the North Stream project is stalled due to environmental issues. The European Commission has confirmed that an environmental impact study must be done in accordance with its own rules, despite threats by Russian authorities to drop a project whose feasibility seems to be jeopardized,
- ENI and Gazprom have announced that the South Stream project will be postponed for a few years.

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### Central Asia outlook

The planned Nabucco pipeline is now facing further obstacles:

- Iran has officially announced that it will not take part in project implementation and intends to build its own pipeline to Europe. Many experts think that Iran's large reserves are vital to project feasibility,
- Azerbaijan, the main potential source of supply for the Nabucco pipeline, seems to be tightening its political and contractual ties with Russia,
- Turkey says it will use the natural gas to cover its domestic needs first, which undermines the plan to route the pipe through Turkey.

Central Asia is among the sources that could supply Europe *via* pipeline in the short and medium term. Following recent large discoveries, its estimated reserves have been revised upwards. This is an important element to consider when assessing the security of the European gas supply:

- in Kazakhstan, the public authorities are planning to double national production to more than 60 bcm by 2015 and raise it to 114 bcm by 2020. National consumption is expected to increase by about 5 bcm over the period 2007-2020. This leaves a promising margin that could be used to boost exports,
- the government of Azerbaijan is also planning to nearly double national production, with the offshore field of Shah Deniz playing a major role. This year, the estimates of its reserves were reevaluated and revised substantially upward after a new find confirmed the economic feasibility of Stage 2 of the project,
- a current audit of Turkmenistan's gas reserves, performed by the British company Gaffney Cline & Associates, has already confirmed the most optimistic estimates formulated in recent years. In October 2008, it found that the South Yolotan-Osman gas field contained between four and 14 trillion cubic meters. Eventually, production could reach 70 bcm/yr. With this new find, Turkmenistan may be able to meet the government target of exporting nearly 125 bcm/yr by 2015, 140 bcm/yr by 2020 and 200 bcm/yr by 2030 (versus about 50 bcm/yr in 2007).

### A key role for Russia and Gazprom

Russia has every intention of enlarging its already important role in supplying Europe with gas. The Russian energy ministry has published a master plan bearing on the development of the gas sector during the period 2008-2030. Russia plans to boost gas exports to

the Europe of Twenty-Seven from 153 bcm/yr in 2007 to 161 bcm/yr in 2008, 167 bcm/yr in 2010 and 220 bcm/yr in 2015-2020. In the short and medium term, Gazprom will probably prefer Europe to the Asian market, which it seems to find less attractive under present economic conditions. In this eventuality, its exports to Asia (China and South Korea) will not exceed 50 bcm/yr by 2020. Gazprom should see its aggregate natural gas exports (including ex-USSR and Asian countries) increase from 260 bcm/yr in 2009 to about 360 bcm/yr by 2015 and 430 bcm/yr by 2030. To cover growing exports as well as an expected average increase in domestic demand of 10% over the next eight years, the ministry is planning to raise production by about 100 bcm/yr between 2008 and 2015, and by another 100 bcm/yr between 2015 and 2030. Central Asian imports must also be taken into account. In the long term, they are expected to reach 70 bcm/yr.

Gazprom's projection for the development of the Russian gas sector through 2030 anticipates that production will increase by about 40% in the next twenty years. At the same time, it indicates values for sales growth in Asia that are lower than earlier forecasts. Gazprom had previously estimated that 80 bcm/yr would be shipped to China by pipeline but the new forecasts specify a lower figure. They also show a decline in commercial flows of associated gases produced by oil companies over the period, an apparent indication that efforts to avoid flaring have not been made, as widely hoped.

According to Gazprom estimates, the domestic industry needs to invest between US\$545 and 645 billion over the period 2007-2030 for Russia to cover internal demand and meet its export commitments. The bulk of this capital would be spent on extending Gazprom's gas transport network (including the North Stream and South Stream projects) and intensifying gas exploration and production operations (especially at the Shtokman Field and the Yamal Peninsula).

### The largest Russian projects

By 2030, eastern Siberia and the Russian Far East should account for one-eighth of total Russian production (between 89 and 121 bcm/yr), compared to 12.5 bcm/yr in 2008. These volumes of gas will come from the Sakhalin I and Sakhalin II projects, but also from Sakhalin III to VI, which have been undertaken on Russia's Pacific coast. A larger contribution is anticipated from Chayanda Field (1,200 bcm). Commercial production at Kovykta Field, currently owned by TNK-BP, will not start before 2017.

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Table 3  
Russian gas production by 2030

bcm	2007	2008	2010	2015	2020	2025	2030
Gas producers	603.6	629.5	674.5	741-805	813-904	834-938	840-945
Western Siberia	557.0	582.0	617	624-688	629-707	631-712	637-719
Eastern Russia	34.8	35.0	34.9	73	108-120	116-140	114-137
Eastern Siberia, Russian Far East	11.8	12.5	22.7	44	77-108	87-118	89-121
Oil companies	50.4	48.5	42.4	40	37	36	36
Total production	654.0	678.0	716.9	781-845	850-941	871-974	876-981

Source: Gazprom

The Gazprom plan (Table 3) will probably be included in the national energy strategy through 2030, which the government is aiming to finalize this year. The plan shows that Russian gas output should increase from 654 bcm/yr in 2007 to 876-981 bcm/yr in 2030. Gazprom does not specify the quantities that it will produce or those to be provided by independent producers. However, it does give an indication about commercial production by oil companies by announcing that it will decrease steadily over the period: from 50.4 bcm/yr in 2007, it will fall to 48.5 bcm/yr in 2008 and 36 bcm/yr by 2030. According to the World Bank, Russia flares more than 50 bcm of gas per year.

Gazprom stresses that, with the slowdown in production at mature western Siberian fields and the price hikes affecting imported gas from Central Asia, it will have to develop new reserves at higher cost on the Yamal Peninsula and at Shtokman Field on the Arctic Coast.

Gazprom predicts that onshore fields on the Yamal Peninsula will initially yield about 8 bcm/yr (2011) and 250 bcm/yr by 2030. Shtokman is slated to come onstream in 2013 and produce 11 bcm/yr. By 2014, LNG exports to Europe and North America should reach 10.4 bcm/yr (7.5 Mt/yr).

According to forecasts, domestic demand will reach 613 bcm/yr and exports 440 bcm/yr by 2030, which implies the purchase of about 85 bcm/yr from Central Asia, mainly Turkmenistan.

By 2030, Russia will be exporting nearly 345 bcm/yr to Europe, Asia and North America, more than double the present-day figure. Europe alone will absorb 161 bcm/yr. By 2030, annual exports to Europe will be situated in the 220-227 bcm range. At the same time, Gazprom will be selling 66-97 bcm/yr (48-71 Mt/yr) of LNG on the world market and delivering 25-50 bcm/yr of gas to Asia via gas pipelines.

As for the Asia-Pacific region, Gazprom notes that China and South Korea will become the largest markets for the gas that it ships by pipeline by 2030. Deliveries will start in 2015 and reach 25-50 bcm/yr by 2020.

LNG deliveries will start in 2020 (20 bcm/yr) and reach 26.6 bcm/yr by 2030. This shows that LNG is a priority and that Russia wants to establish an export route to China in order to capitalize on Gazprom reserves in western Siberia.

### A larger role for LNG

Liquefied natural gas (LNG) is the second most important driver of growth on the world gas market. Global production increased by 9% in 2007 to 233 bcm. Qatar remains the world's top producer (40 bcm). The number of LNG transactions was up in 2007 and many methane carriers (a total of 12.5 bcm) were diverted from the Atlantic Basin to Asia to take advantage of the very attractive prices on its markets. In 2007, China and India increased their imports significantly to stand at 4 and 10 bcm, respectively.

The expansion of LNG changes the status quo on the gas market. Traditionally, the LNG market has been based on long-term contracts between producers and consumers, but it is now seeing more and more contracts offering greater flexibility (contracts with prices calculated on a f.o.b. basis, spot market contracts and short-term contracts). Countries like China, Japan and South Korea purchased spot cargos at very high prices in 2007. High prices and the development of the short-term market and the spot market—whose share of the total market, according to the International Group of Liquefied Natural Gas Importers (GIIGNL) reached 20% in 2007—undoubtedly boosted transactions on the world gas market.

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LNG also represents a new vector of growth for international oil and gas companies capable of developing integrated projects (liquefaction to regasification). In France, LNG is at the heart of current strategy at large energy companies. Total is buying into an increasing number of regasification and liquefaction plants; EDF is investing in a project for a terminal in Dunkirk; and GDF SUEZ has put LNG at the core of its business model. Even so, the gas market has remained largely regional in nature, in marked contrast to the globalization of the oil market.

### Boosting capital expenditure is imperative

Taking a close look at the LNG market, one sees that the need to invest in infrastructure projects persists. In 2007, liquefaction capacity was operating at 91%, proof that more production units must be built. In 2007, little new capacity became available, even if Norway and Equatorial Guinea have recently exported their first cargoes of methane. Similarly, few new projects have been announced, apart from Pluto in Australia (6.5 bcm/yr), Skikda in Algeria (to replace a train, capacity: 6.1 bcm/yr) and Angola LNG (7.1 bcm/yr). Delays and postponements have been announced for many liquefaction projects, which gives great cause for concern. It has become very complicated to implement a project, owing to the shortage of qualified labor, the escalation in construction costs (engineering and raw materials) and the increase in geopolitical risks. This is true for regasification terminals, which must also contend with growing local opposition, as well as pipeline projects (the cost of the North Stream and South Stream projects has doubled). To alleviate these difficulties, the natural gas industry is investing in new technologies. Among them are ship-board regasification plants anchored offshore (e.g. Bahía Blanca in Argentina), which are easier to implement and more flexible to use.

The industry must also invest in gas pipelines. In Europe, gas hubs have not developed sufficiently to cover future demand. Regional integration of the European market is still a prerequisite for implementation of a competitive market that can perform the necessary arbitrage.

According to IEA projections for 2010-2030, the crude price should be high in real terms, rising from US\$70/bbl in 2007 to more than US\$100/bbl. As a result, the gas price will also be high, up from US\$7.3/MBtu on average in 2007 to more than US\$13/MBtu for the period. Gas price values vary significantly according to region (for instance, in the United States, Europe and Japan). These price conditions are favorable to capital investment by the gas industry.

The only thing that might challenge this scenario of inexorably rising gas prices is a disconnect between the gas price and the oil price. If this happened, the gas market might experience greater price volatility, which would be more accurate in reflecting the specific gas supply and demand conditions prevailing at regional level.

### Conclusions

The United States possesses non-conventional gas reserves that can now be exploited, thanks to technology advances; these reserves are generally recognized to be economically viable. This state of affairs will help postpone the appearance of a supply deficit to be covered by a call on LNG.

As for Europe, there are abundant reserves that it could conceivably draw on, but it becomes increasingly apparent that optimized use will not be possible before 2015. Financial efforts must also be made to increase storage capacity by building more storage sites, preferably within easy reach of consumers. This would help react to sharp variations in demand and to meet objectives with respect to security of supply.

If Russia intends to keep playing a major role in the supply of natural gas to Europe, it will have to concentrate on the upstream end of the supply chain (exploration and development), cut back on flaring and improve pipeline quality. Russia will also have to build up its industrial partnerships to benefit from the best technologies available worldwide.

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