Prospects for gas markets

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and the implications for cogeneration worldwide

Natural gas is the most important fuel for CHP in most parts of the world. The prospects for cogeneration are therefore very much linked with those of gas markets around the globe. Aksel Hauge Pedersen from the International Gas Union discusses the likely future of gas and, thus, on-site power.

A look at the current consumption of energy by regions (Figure 1) makes clear the way developing countries still lag far behind in their consumption patterns compared with developed countries. For example, the rest of the world would need to consume twice the energy it does to bring it to the level of Europe, which as a whole is a moderate energy consumer. This factor is five times to bring it to the level of the US.

Not surprisingly, the International Energy Agency (IEA) predicts a 60% increase in energy demand between 2002 and 2030.[1] Oil demand is expected to grow at 1.6% per year, coal demand at 1.4% per year and gas demand at 2.3% per year between 2002 and 2030. This means, for example, that consumption of natural gas is expected to almost double between 2002 and 2030.

The energy industry is thought to be capable of meeting this IEA predicted demand. It has succeeded in doing so over the last 30 years (there was an 87% increase between 1971 and 2002). At current production rates, reserves of oil, gas and coal are estimated at 41, 67 and 164 years, respectively.[2]

However, other figures in circulation range from a more optimistic to a more pessimistic view. One example concerns the volumes of gas contained in the methane hydrates of the world's sea beds. If a cost-effective method of extracting this gas could be developed, it would create a supply that would satisfy natural gas demand for several centuries.

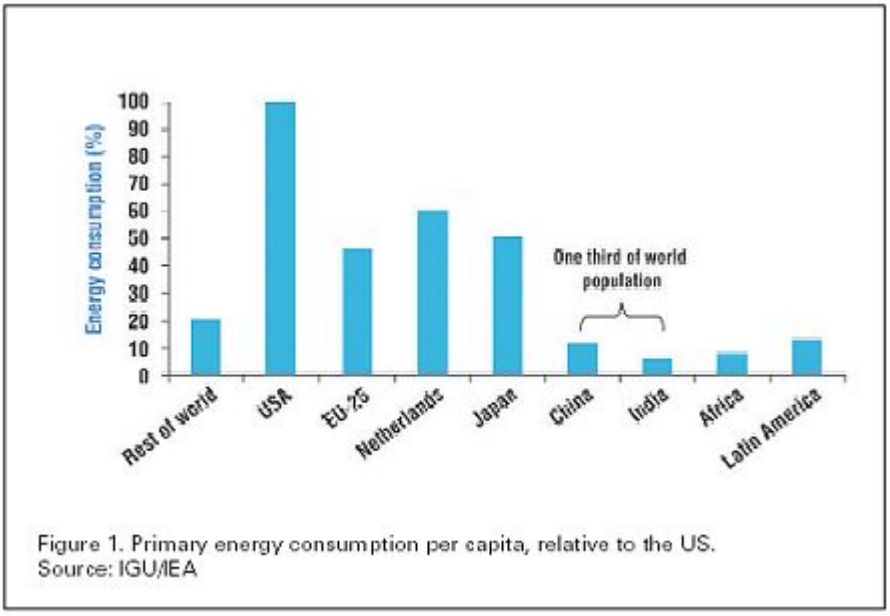

Figure 1. Primary energy consumption per capita, relative to the US.
Source: IGU/IEA

Coal is predominantly used in electric power plants (about 70% by volume) and around 60% of the demand for oil is for transportation. Both sectors have enormous growth potential, especially in the world's emerging economies. Gas demand is rising in all market segments, but the demand for natural gas is highest for electric power generation.

GAS FOR POWER – THE GROWTH OF LNG

Much attention is on India and China, whose economies are experiencing high growth and each of whose energy consumption is expected to rise accordingly. India and China are expected to consume 3.0–3.5 times more natural gas within the next 15 years, but their market share for natural gas will remain small. Nevertheless, the impact of natural gas consumption in these countries is likely to affect the global market for natural gas.

In the electric power sector, the market share of natural gas is expected to increase from 19% of the total energy market in 2002 to 29% in 2030 (Figure 2). This means that almost 60% of the additional natural gas volumes will be required for electric power stations, resulting in 47% of all natural gas being used for the generation of electricity by 2030.

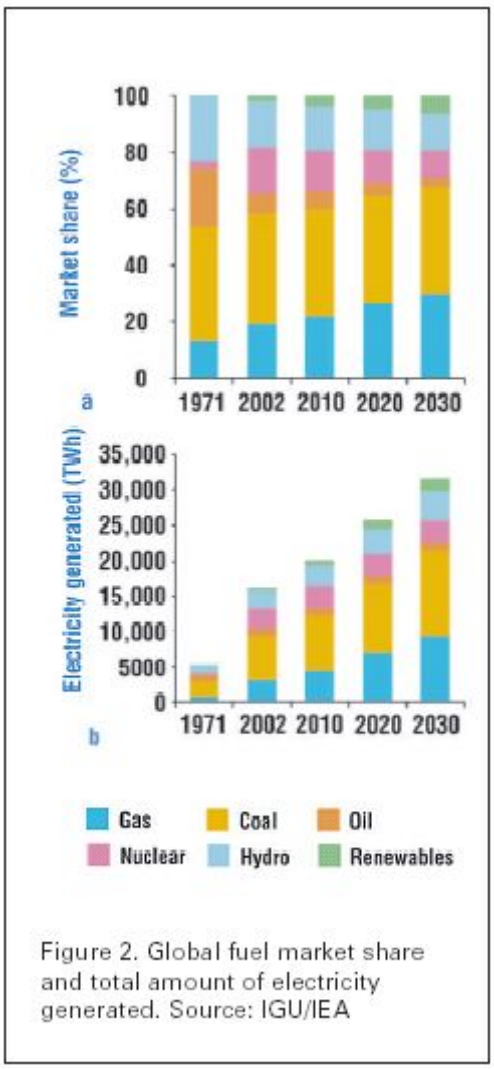

Figure 2. Global fuel market share and total amount of electricity generated. Source: IGU/IEA

There are logical reasons why power generators prefer natural gas. From an environmental point of view, it scores the highest among the fossil fuels. The required capital investment and lead time for natural gas-fired plants are the most attractive among the alternative options for power plants.

However, the rise in gas price could jeopardize projects that are still on the drawing board. Uncertainty over longterm gas prices could make alternative fuels more attractive to investors. Nuclear power is being discussed again as an option for electric power generation due to the potential for lower CO_2 emissions and the independence of nuclear fuel supply from the world's hydrocarbons- producing regions.

Gas and oil imports in the US and Europe will grow over the next few years as their own supplies of these resources falls. The forecast for natural gas demand suggests it is likely to be a seller's market in which prices could rise significantly. Thus the real competition for natural gas and oil is likely to take place between countries or continents rather than inside the European market. The increasing demand for all energy makes it unlikely that prices will fall. New supply projects are likely to become technically more complex and require more investment. They are likely to involve deep water, harsh environments, longer pipeline connections and the transportation in liquefied natural gas (LNG) form rather than by pipeline. The final price to the customer could be subject to higher environmental duties and could bear the burden of CO_2 emission rights.

This high price scenario is likely to support trends in the industry for efficiency improvements using technological innovations and economies of scale. These trends might help to stabilize

energy costs somewhat.

The costs of LNG delivery have been falling. This fall has been accompanied by a rise in boat size. The largest liquefaction trains under construction in Qatar today have a capacity of 7.8 million tonnes/year for deliveries to the UK and the US. Such shipment will require boats with a capacity greater than 200,000 m^3. Such boats will carry 50% more than the vessels they will replace.

New gas supplies for Europe, the US, Japan and emerging economies will not be found in the traditional oil and gas regions but further away from consumer markets. Europe will rely heavily on Russian reserves with pipeline transport. Most of the world outside Europe is likely to depend on LNG – the bulk of new supplies coming from the Middle East and from Russian territories such as Sakhalin.

> The rise in gas price could jeopardize projects that are still on the drawing board

This highlights the problem of security of supply. Questions about the political stability of the supplying nations, security of shipping routes and reasonable transmission fees through transit countries will have to be answered. The possibility of supply interruptions will also rise, simply because transport over long distances poses more technical risks. It is possible that more underground storage facilities will be needed to provide strategic stocks.

PROSPECTS FOR CHP IN THE GAS MARKET

United States

An LNG plant at Kenai, Alaska, US. The market share of natural gas is expected to increase from 19% in 2002 to nearly 30% in 2030, much of this increase due to the rising demand from India and China
(ConocoPhillips)

There is interest in CHP in the US for industrial and commercial applications but only where there is a clear economic advantage. Some potential customers also see it as a way to increase reliability of supply.

The Department of Energy (DOE) has developed a roadmap for CHP installations of 92 GW by 2010. This will represent about 10% of total electricity generation.

The main barrier to the uptake of CHP by industry is the current low cost of electricity.

Russia

Economics and the ability to provide a reliable, uninterrupted power supply are the two major factors influencing distributed generation development in Russia. Cogeneration equipment costs are often comparable with the cost of grid-connected power, while the cost of distributed power can be either comparable with or even lower than the central power supplier's price.

Russia has no preferential generation regimes or financial or other incentives for distributed generation development. It is not possible to sell excess heat and power to the grid, and it is difficult to gain consent from the operators of the electricity network for connection to the grid.

However, a combination of factors means distributed power generation is expected to expand rapidly in the near future. These include the aging electricity transmission lines of largest supplier RAO UES of Russia, supply failures in some Russian regions, low gas prices and high electricity prices.

Japan

Reduced energy costs and energy savings are the main drivers for investment in CHP in Japan. For example, companies using large amounts of energy are compelled to reduce energy consumption by 1% every year to satisfy the Kyoto Protocol. Although CHP is increasingly being introduced, it is held back by high equipment costs, an inability to use the waste heat and the need to meet new NO_x emission limits.

China

China requires immense expansion in its infrastructure for both electricity generation and distribution. Some 144 power plants are currently being built in China, and 32% of global orders for power equipment between 2003 and 2008 are expected to come from this country. The Government forecasts a need for 950 GW of installed capacity by 2020, compared with the current level of 385 GW.

Distributed power is likely to expand rapidly in Russia in the near future

China has only a few small CHP systems as yet. A 2001 survey by the China Energy Conservation Investment Corporation found only 304 units of less than 6 MW in the chemical, papermaking and non-ferrous metal industries. It predicted that only 3150 MW of new capacity of all unit sizes would be added in these industries by 2005. Although significant quantities of natural gas would be available by 2005, the survey pointed out that over 95% of the fuel consumed by cogeneration plants in China in 2001 was coal. The number of combined-cycle cogeneration projects is small due to the limited availability of natural gas and its high price.

The main barriers for the deployment of CHP in China are what the country lacks: incentive policies, technical know-how in design and control, financing mechanisms and domestic gas resources. It is hoped that the price of imported gas in the long term might be competitive with domestic coal prices. However, the underlying need to expand the Chinese energy market is likely to overcome these barriers, and the market situation is seen as optimistic.

Europe

The main driver in Europe is the EU Directive for CHP published in February 2004.[3] This aims to increase energy efficiency and to improve security of supply by creating a framework for the promotion and development of high-efficiency CHP. However, the Directive does not set any targets for an increase of CHP production nor does it oblige Member States to promote CHP.

Most European countries support cogeneration by obligating the network operator to buy cogenerated electricity. However, there is limited investment in cost-support schemes. Also, most countries have no firm targets, and only a few have support mechanisms or promote fuels for cogeneration.

In most European countries, CHP requires further measures by governments to increase its profitability and to convince potential users of its benefits. However, there is a considerable potential for expanding the use of CHP in the EU to satisfy residential heat demand and to provide small or micro-scale CHP to replace individual boilers. Further uptake of CHP in Europe is likely be linked to a move towards the use of cleaner and local energy resources such as natural gas, biomass and waste. This would help to fulfil the EU's objectives of increasing the diversity of fuel and securing supply.

Electricity prices are expected to increase more than fuel prices in the future, resulting in a greater incentive to invest in CHP. However, barriers to CHP installations, such as interconnection to the electricity grid and technical limitations, will need to be addressed.

PRICES, DEMAND AND THE SUPPLY BALANCE FOR NATURAL GAS

Natural gas supply in North America is likely to be tight, and a large market for LNG is likely to develop over the next 10 years. Prices of natural gas have already risen significantly and are likely to increase further – especially if the winter is cold.

Three Jenbacher natural gas-fired units operate in island mode in Yamal-Nenets Autonomous Region, a major gas producer in Russia's far north
(GE Jenbacher)

The energy strategy of the Russian Federation provides for an increase in gas prices up to US$40–41 per 1000 m^3 by 2006 and to $59–64 per 1000 m^3 by 2010. Given favourable economic development conditions, gas production is expected to reach 645–665 billion cubic metres (bcm) by 2010 and 710–730 bcm by 2020. Under a favourable scenario, natural gas production will reach 635 bcm in 2010 and 680 bcm in 2020. Under a scenario of minimum economic development, natural gas production would be 610 bcm by 2020. Domestic gas consumption is expected to increase from 456.5 bcm to 504 bcm by 2020, according to information from OAO Promgas, a Gazprom group.

The outlook of increased natural gas supply in China is related to expected growth in CHP. Gas flowing along the West–East (W–E) pipeline from Xinjiang will make up to 10 bcm per year available along China's east coast. Thus key industrial cities along the eastern seaboard – including Beijing, Tianjin, Xuzhou, Nanjing, Shanghai and Hangzhou – already have W–E gas or will have it by the end of 2005. Other inland cities on or near the pipeline route will also benefit from increased natural gas supply. In addition, large volumes of gas (around 5 bcm per year) will become available by 2006 through the construction of LNG receiving terminals in the provinces of Guangdong, Fujian and Zhejiang, as well as in the city of Shanghai. Up to five other terminals may also be developed by 2010. In addition, smaller quantities of domestic LNG carried by road and rail from Xinjiang are also expected to become available as a result of the increased gas supply to the region.

The rapid expansion in the EU gas market is expected to continue for the next two decades. This expansion is driven primarily by the use of natural gas for power generation. Nevertheless, the EU contribution to world gas consumption is expected to fall. European gas resources

The rapid expansion in the EU gas market is expected to continue for the next two decades are

limited, and production is expected to decline steadily beyond 2010, resulting in an increasing dependence on external gas supplies. The rapid gas demand growth in Asia is expected to have some influence on the EU gas supply pattern by 2030. While Asia is expected to rely predominantly on gas from the Middle East, the 25 EU Member States will import more than half of their natural gas needs from the area covered by the Commonwealth of Independent States by the beginning of the decade starting 2030. Although this may translate into higher supply risks for the EU, these risks could be limited by the strategy outlined by the European Commission in its Green Paper. These include the multiplication of gas transport routes, further integration of the European gas network and a continuous dialogue with gas-producing countries.[4] Long-term contractual LNG supplies are projected to accelerate moderately and to come from diverse sources in Africa and the Middle East.

RISE IN GAS SHARE EXPECTED

Efficiency and environmental performance continue to improve for all kinds of power-producing technologies. Future CHP technologies present the best opportunities in relation to large-scale power production. This is due to a number of reasons, including:

- low investment risk. For new largescale power production capacity, the payback period will be 30 years or more, while the lifetime and payback period for decentralized CHP is normally much less than 20 years
- reduced transmission losses
- the potential for very high power efficiency. Fuel cells, for example, have a power efficiency of more than 50%
- the use of micro-CHP by individual households
- political back-up in most countries for CHP.

This leads to the conclusion that there will be a remarkable future rise in gas share for the generation of power and CHP. It is generally agreed that this could rise to 28% of all power produced in 2030, up from 18% in 1990 and 19% in 2000.

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NOTES

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3. *Directive on promotion of cogeneration based on a useful heat demand in the internal energy market* (2004/8/EC), Official Journal of the European Union, L52, pp. 50–60, 21 February 2004.
4. *European Commission Green Paper Towards a European strategy for the security of energy supply*, COM(2000)769 final, 2001, http://europa.eu.int/comm/energy_transport/en/lpi_en.html