polinares
EU Policy on Natural Resources

POLINARES is a project designed to help identify the main global challenges relating to competition for access to resources, and to propose new approaches to collaborative solutions

POLINARES working paper n. 24
March 2012

Transport of Natural Gas

By Jürgen Messner and Georg Babies

EUROPEAN COMMISSION
European Research Area
SEVENTH FRAMEWORK PROGRAMME
Funded under Socio-economic Sciences & Humanities

The project is funded under Socio-economic Sciences & Humanities grant agreement no. 224516 and is led by the Centre for Energy, Petroleum and Mineral Law and Policy (CEPMLP) at the University of Dundee and includes the following partners: University of Dundee, Clingendael International Energy Programme, Bundesanstalt fur Geowissenschaften und Rohstoffe, Centre National de la Recherche Scientifique, ENERDATA, Raw Materials Group, University of Westminster, Fondazione Eni Enrico Mattei, Gulf Research Centre Foundation, The Hague Centre for Strategic Studies, Fraunhofer Institute for Systems and Innovation Research, Osrodek Studiow Wschodnich.

12 Transport of Natural Gas

Jürgen Messner, Georg Babies

In the long run the proportion of LNG in the supply of natural gas of the European and Asian markets for natural gas will increase. In principle, however, it can be assumed that the supply of pipeline gas from Russia, Norway, and North Africa and possibly from Iran will remain dominant for Europe. LNG will however have its share in the diversification of the supply of natural gas.

12.1 Development of the transport of natural gas

Regions producing and consuming natural gas do not always coincide, thus natural gas partly has to be transported over long distances. Transport of natural gas takes place either in the gaseous state via pipelines or in the liquefied state as LNG in special tankers. Due to the lower energy content of natural gas per volume, the costs for transportation are approximately one order of magnitude higher than for petroleum and coal. Thus, natural gas has a considerable competitive disadvantage, in particular deposits located far away from the consumers as far as costs are concerned. The use thus depends on the special requirements of the consumer country, its economic policy, basic requirements and increasingly also on environmental aspects.

When transporting natural gas via pipeline, the transportation costs depend to a large degree on the capacity of the pipeline (Figure 1). For instance, transportation costs decrease by approximately half for an increase of the capacity from 5 to 20 Bcm per year. Offshore transport through pipelines is approximately 50 % more expensive than onshore. Steinmann (1999) estimates for an average transport distance of approximately 4700 km transportation costs of € 56.25 per 1000 m³. His calculations are based on a pipeline diameter of 1400 mm and an operating pressure of 84 bar at transportation capacities of 26 Bcm per year. The capital expenditure requirements for such a pipeline are thus about € 7.7 billion.

Leaks in the pipelines, in the distribution networks or at the end consumer decrease the economically usable volume of natural gas. The losses in the industrialized western nations have been estimated to range up to 1 % of the volume of natural gas produced.

Beside transport via pipeline, the transport in form of liquefied natural gas becomes increasingly important. It is not, as frequently misunderstood, an alternative to natural gas, but a transport option besides the traditional transport of natural gas via pipeline. Further potential transport options of natural gas as listed by the IEA (2005) are transportation as compressed natural gas (CNG), as Micro-LNG and in form of technically generated gas hydrate. To what extent these additional options will prevail, remains to be seen.

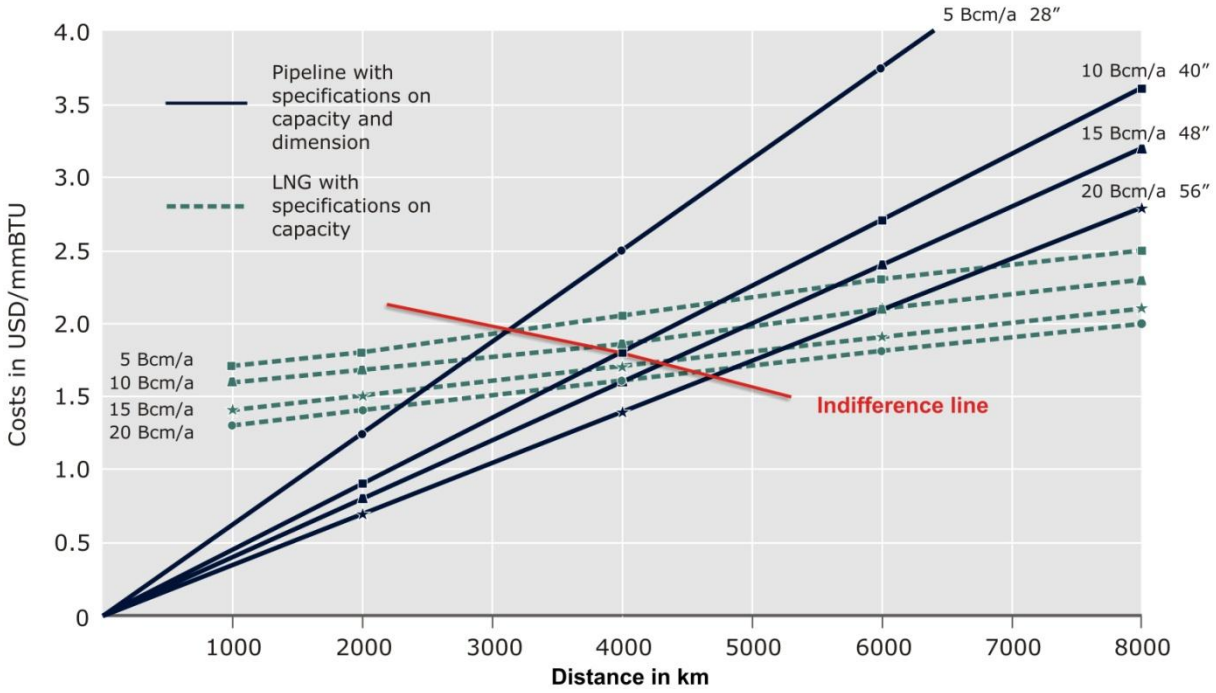

Figure 1: Transportation costs for natural gas via pipeline and as LNG as a function of the capacity (according to Schwimmbeck, 2008).

For LNG-transportation, the liquefaction of natural gas requires already considerable amounts of energy. For this reason, the specific transportation costs for short distances are significantly higher than for transportation via pipeline. Transportation of LNG only becomes economically favorable in comparison to pipeline transportation for distances of more than approximately 3000 km. Transport as LNG has the advantage of greater flexibility, as it is not bound to a rigid piping system with fixed starting and end points as for pipeline transport. If no direction clauses have been contractually stipulated, LNG-tankers can operate between any loading facility and landing terminal. This also provides the possibility of establishing a larger spot market for natural gas. On the other hand, the LNG trade is tied to the oceans, which results in two large markets in the Atlantic and Pacific area. For delivering the LNG market, fields close to the coast or offshore-fields are preferable. Darley (2004) has specified the erection costs for a complete LNG-chain at USD 3 to 10 billion. The specific energy consumption within the LNG-chain is approximately 15 % for instance for the transport from Qatar to the east coast of the US in relation to the total amount transported.

In 1964, liquefied natural gas was delivered for the first time from Algeria to Great Britain. The LNG trade has skyrocketed since. Based on the existing trends, a strong increase of the LNG trade is expected in the medium term. It is assumed that the liquefaction capacities will be doubled in the course of the next five years. A similar development is also to be expected for the expansion of the landing terminals. The IEA (2006) expects investments of nearly USD 100 billion for this period. Capital expenditure for new LNG-tankers has been specified at USD 32 billion, for regasification plants at USD 31 billion. For the year 2030 the IEA (2004) estimates an LNG-proportion of the trade in natural gas of more than 50 %.

A trend of the past years is the construction of larger units referring to liquefaction plants and tankers. This way the LNG-trade was expanded and the costs were reduced. In addition, there

are technical developments in particular in the offshore-area, which may positively influence an expansion of the LNG-trade (Cox 2006). The following are to be mentioned:

- FPSO (Floating Production, Storage and Offloading Units) for LNG (FLNG) for greater water depths, which are used offshore for production, liquefaction, storage and loading,
- LNG-platforms for water depths of 20 to 50 m, where natural gas is taken over from producing platforms and liquefied,
- FSRU (Floating Storage and Regasifi cation Units), which restores the liquefied natural gas on board to the gas phase and
- GBS (Gravity Based Structures) for storage and regasification in water depths less than 30 m.

These developments are accompanied by the emergence of new suppliers on the LNG market, such as Russia, Iran, Norway, Angola, Cote d'Ivoire (Ivory Coast), Yemen and Peru. On the other hand Pakistan, Chile, Brazil, Jamaica, but also European countries such as Croatia, Poland and Germany might become new LNG customers. The largest increases in demand for LNG are to be expected in India and China, but also in Great Britain and Japan. Thus, in the long run the proportion of LNG in the supply of natural gas of the European and Asian markets for natural gas will increase. In principle, however, it can be assumed that the supply of pipeline gas from Russia, Norway, and North Africa and possibly from Iran will remain dominant for Europe. LNG will however have its share in the diversification of the supply of natural gas.

References

Cox, P. (2006): The rise of offshore LNG technology. Offshore Engineer. H. 9, p. 83-90.

Darley, J. (2006): High noon for natural gas: the new energy crisia. 266 p.; Chelsea Green Publishing Company, Vermont.

IEA (2004): World Energy Outlook 2004. 570 p; Paris.
– (2005): Resources to Reserves: Oil & Gas Technologies for the Energy Markets of the Future. – 124 p, Paris.
– (2006): World Energy Outlook 2006. 596 p; Paris.

Schwimmbeck, R.G. (2008): LNG and Pipeline. Vortrag auf der 3rd Pipeline Technology Conference – 2008, Hannover.

Steinmann, K. (1999): Erdgas Transport und Verteilung - Gegenwart und Zukunft. Erdöl Erdgas Kohle 115: 517-520.