

Priority Axes and TEN-E Projects

Priority Axes as decided in the recently adopted TEN-E Guidelines with extensions and additions as envisaged in the Revision of these Guidelines

Introduction

The basic requirements of the energy infrastructure in the European Union can be well described following a few basic principles. At first it need to be emphasised that the energy dependence of the Union, the present EU with 15 Member States (EU15) and even more the enlarged EU with 25 Member States (EU25), on energy imports will increase steadily in the period up to 2010 and 2020. If no significant alterations are achieved to freeze current trends, in the next 20 to 30 years 70% of the Union's energy requirements, as opposed to the current 50%, will be covered by imports (Green Paper). In particular, imports of natural gas and oil will rise.

Next, we point to a significant difference in the energy sector between gas and electricity. Electric energy cannot easily be stored and is, therefore, in contrast to natural gas not a primary energy source, but an energy carrier.

Therefore, the first conclusion concerning the development of networks is that the energy in form of gas and oil needs to be transported from the sources, which lie essentially outside Europe, in particular outside the EU25, via pipelines or maritime transport to the EU. In contrast, electric energy is generated and distributed mainly within the Union.

The main suppliers of natural gas are at present Norway, Russia and Northern Africa. In the future the Caspian Sea, the Middle East and the Gulf region will become important gas suppliers, in addition. These sources define the natural transit routes for gas, where often third countries are crossed. Thus, the choice of the routes for gas pipelines is rather limited. The economic viability will eventually give the edge for the final choice between possible routes. Similar considerations are valid for oil supplies. In the case crude oil, increased flexibility is given by maritime transport.

The electricity networks have historically evolved during the last hundred years following the trend towards centralised generation and monopoly-type, national distribution networks. Some of the present bottlenecks in electricity interconnection are given by natural barriers like the Alps and the Pyrenees and the seas like the Northern Sea and the Mediterranean. A new factor asking for appropriate actions is given by the ongoing unbundling of activities in the energy market, i.e. the separation of generation, transmission and distribution activities.

In addition, the protection of the environment is basically a Community task as was established in form of the Kyoto Protocol. The measures imposed by legislation can increase the costs and need to be applied uniformly throughout the Union. The desired increased utilisation of renewable energy sources, in particular windparks for the generation of electric power, puts new and different requirements on networks, now ranging from centralised generation to distributed generation.

Hierarchy of criteria

The first list of priority projects in the context of Trans-European Networks of Energy (TEN-E) was adopted by the Essen European Council in December 94 and comprised 10 projects, five in the gas sector and five in the electricity sector. In the guidelines to be

adopted in July 2003, 12 priority axes are identified, seven for electricity networks and five for natural gas networks. A series of (detailed) projects are located on these 12 priority axes. With the enlargement of the Union this number of priority projects will need to be further increased. It turned out that many of these projects go through a substantial time-span all the way through feasibility study, environmental approval, construction completion and operation.

In view of European added value of interconnections with the objective to creating a European-wide internal energy market, it appears necessary to focus the Community support on projects with particular high European significance. This leads us to establish - prior to specification of executable projects – the main corridors called “priority axes” and, further, additional generic criteria. In the subsequent step the projects of common interest will be specified. This has led to a separation in the decision making. The priority axes and the additional generic criteria will, once proposed by the Commission, fall under the responsibility of Council and European Parliament (co-decision). By contrast, the detailed description of the projects can be modified by the Commission following a comitology procedure. A full revision of the guidelines by means of co-decision generally takes up to two years, while the technical updating (of relatively small overall impact, but still of substantial local or regional interest) should become feasible at a much faster rate.

Let us establish the main elements. We shall include both decided as well as envisaged Priority Axes / Projects. In the case of already adopted axes, the necessary upgrades - when requested by new main concerns - are made, of course. Thus, some of these agreed axes will increase in scope. New axes will also be proposed.

We proceed sector by sector in turn utilising the findings of relevant studies available at this moment. This will enable us to map out the important aspects.

Priority Axes in the Gas Networks

Important criteria in this assessment are sources for natural gas of relevance to the present and future supply of the European Union and, in particular in the enlarged Union.

In this section, we have also made use of the main findings of document OME GAS STUDY for EC (2001) – ‘support for investment projects?’:

Natural gas demand is expected to increase strongly in European countries. From a level of 386 bcm for the EU15 in 1999 it is expected to grow to some 500 bcm/yr in 2010 and to almost 600 bcm/yr by 2020. This represents an average annual growth rate of 2.6 %. Internal domestic gas production of the EU15, on the other hand, is expected to decline from 224 bcm/yr in 2000 to 196 bcm/yr by 2020. Import dependence is therefore set to increase dramatically. Whereas today some 40% of EU15 gas demand is met by imports, by 2020 the EU15 is expected to import some 67 % of its gas requirements. This proportion is lower for all Western Europe due to the presence of Norway as an internal supplier.

As a conclusion it can be said, that with 65 % of the potential additional supplies in 2010 and 50% in 2020, the current three main suppliers of Europe (Algeria, Norway and Russia) will still account for the bulk of supplies. New gas supply sources will develop, however, in particular in the Middle East and in the Caspian Sea area, stimulated by the large potential market in Turkey. These new sources have a greater impact when the enlarged EU is considered.

Gas Infrastructure Requirements:

Of key importance is the further development and expansion of gas transport infrastructure between Europe (EU15 and EU25) and the key gas suppliers, which are Norway, Russia, Algeria - North Africa, the Caspian Sea countries, the countries of the Gulf and, eventually, the more remote gas suppliers of Africa and the Caribbean. To increase gas exports to Europe from the main suppliers the existing pipelines need to get upgraded and new pipelines and LNG schemes will have to be built. The pipeline projects can be grouped in four main areas:

Russia/Northern Europe/Baltic area; Algeria/North Africa; Caspian Sea/Middle East/Turkey /Balkans; and the Eastern Mediterranean region. In addition, LNG terminals and Underground Gas Storage are essential.

Please note that the labelling is made in accordance with the recently adopted guidelines (NG.1-NG.5).

(NG.1) Russia/Northern Europe/Baltic area (decided priority axis)

- New pipeline across the Baltic Sea from Russia to Germany and countries bordering the Baltic and the networks related to the development of the Shtockmanovskoye gas field in the Barents Sea.
- Expansion / upgrading of the Yamal I gas pipeline from Russia to Germany via Belarus and Poland

(NG.2) Algeria/ North Africa (decided priority axis)

- New pipeline from Algeria to Spain (MEDGAS project)
- New pipeline from Algeria to Sardinia and Corsica and mainland Italy
- Expansion of the GME pipeline from Algeria to Spain via Morocco

(NG.3) Caspian Sea/Middle East/Turkey /Balkans (decided priority axis)

The EU-15 will need to be connected to the Turkish network by 2010 to receive gas from the Caspian Sea region and/or the Middle East. As the Turkish corridor is expected to become a major transit route in the following decade, the possible construction of two Balkan routes, to Austria via Southeast Europe, and the pipeline connection from Turkey to Greece and Italy are foreseen;

- Pipeline from Turkey to Greece
- Pipeline from Turkey to Austria
- Offshore pipeline from Greece to Italy

(NG.4) LNG Terminals (decided priority axis)

Additional re-gasification terminals (or expansion of existing facilities) will be required in Europe to accommodate the development of LNG schemes that are planned in Egypt and the Gulf, as well as the expansion of LNG supplies from Algeria, Nigeria, and Trinidad & Tobago.

A first LNG plant is foreseen in Poland.

(NG.5) Underground Storage (decided priority axis)

As the gas market is expanding, the construction of appropriate underground storage is essential in order to meet demand and control gas supply systems and diversify sources and supply routes.

Extensions of storage are foreseen in Latvia and Poland and the development of underground storage in Lithuania.

(NG.6) Gas Pipelines in the Eastern Mediterranean region (envisaged priority axis)

The new gas sources being developed in North Africa, the Middle East and the Gulf region need to reach Europe via Italy and Turkey. This network will require new pipelines in Libya, Egypt, Jordan and Syria.

Horizontal actions for Gas Infrastructure:

In order to meet all Community targets, the project-related actions are complemented by horizontal actions. It is necessary to improve the functioning of the interconnected gas networks within the internal market and transit countries, in particular, identifying the bottlenecks and missing links, developing solutions in order to deal with congestion and adapting methods of forecasting and of operating gas networks efficiently and safely. The relevant horizontal actions include:

- Identifying the bottlenecks and missing links, especially cross-border, within the gas networks.
- Developing solutions for natural gas flow management in order to deal with the problems of congestion within the gas networks.
- Adapting the methods of forecasting and operating natural gas networks required by the functioning of the internal market, including any equipment or installations essential for the system in question to operate properly, including protection, monitoring and control systems.
- Increase the overall performance, safety and security of the gas networks in transit countries.
- Establishing harmonised high safety and environmental standards.

Priority Axes in the Oil Networks

In view of the growing importance of security of supply in conjunction with concerns regarding maritime safety of oil transport, the need has arisen to widen the scope of the guidelines by taking account of the oil networks. In the context of the energy guidelines this can be achieved by putting emphasis on sustainable development and on protection of the environment among the Community objectives. This applies to the export and reception facilities in ports and includes storage facilities for crude oil and oil products, in ports or connected to the oil pipelines.

The discussion on supply and demand can be held short, since most oil resources are located outside the EU. Often oil resources are linked to natural gas resources. The main supply countries to Europe are, thus, easily identified in accordance to the previous section:

Norway, Russia, Black Sea - Caspian Sea, the Gulf region and North Africa.

Oil Infrastructure Requirements:

In order to increase oil exports to Europe from the main suppliers the existing pipelines need to get upgraded and new crude oil pipelines will have to be built. The projects can be grouped into four main areas: Import pipelines from Russia, from the Black Sea, from North Africa/Near and Middle East/Caspian Sea/Gulf region, and internal pipelines in the EU.

(PE.1) Northern Europe / Russia (envisaged priority axis)

Establishing, extending and upgrading oil pipelines from Russia to the EU; the main infrastructure in place is:

Druzhba pipeline northern route connecting Germany, Poland, Lithuania, Latvia, Estonia and the southern route connecting Hungary, Slovakia, and the Czech Republic and further to Austria and Germany; links to Odessa (Ukraine) and the Baltic Sea port of Gdansk (Poland).

(PE.2) Black Sea (envisaged priority axis)

Establishing, extending and upgrading oil pipelines from the Black Sea to the EU:

Black Sea pipeline from Constanta (Romania) to Omisalj (Croatia) and to Trieste (Italy)- with a possible link to the Trans Alpine Pipeline.

Black Sea pipeline from Burgas (Bulgaria) to Alexandroupolis (Greece).

(PE.4) Caspian Sea / Gulf / Middle East and North Africa (envisaged priority axis)

Establishing, extending and upgrading oil pipelines from North Africa, Near- and Middle East, Caspian Sea and the Gulf region to the EU:

Oil pipelines linking Southern Algeria - Southern Libya – EU.

Oil pipelines linking Near- and Middle-East, Caspian Sea and Gulf region (Egypt, Saudia Arabia, and Iraq) to the EU via Egypt and Turkey.

In addition to the pipeline infrastructure needed to bring oil from the sources to the EU, there is a need for extending and upgrading the existing oil pipelines inside the Union. Consequently, such complementary lines are envisaged, too.

(PE.3) Internal Network (envisaged priority axis)

Establishing, extending and upgrading oil pipelines in the EU; the main infrastructure in place is:

Fos-sur-Mer (France) – Karlsruhe (German), linked at Ingolstadt (Germany) with line starting at Trieste (Italy).

Rotterdam (Netherlands) up the Rhine linked at Godorf – Wesselink (Germany) with the line from Hamburg (Germany).

Rostock (Germany) – Leuna (Germany).

(PE.5) Oil Ports (envisaged priority axis)

Establishing harmonised high safety and environmental standards applicable to exporting and receiving oil ports.

Horizontal actions for Oil Pipelines:

In addition to project related actions, the Community objectives request again complementary horizontal actions.

The following horizontal actions are envisaged:

- Identifying the bottlenecks and missing links, especially cross-border, within the oil pipeline networks:
- Developing schemes for shifting the maritime transport towards pipelines or new safer transport means.
- Actions for improving the functioning, the safety and the environmental protection of the oil transportation system:
- Establishing harmonised high safety and environmental standards for receiving, storing and exporting crude oil and oil products.

- Improving monitoring of the transportation of crude oil and oil products, including any equipment or installations essential for the entire oil transport system to operate properly, including protection, monitoring, control and pollution prevention systems.

Priority Axes in the Electricity Networks

It has been said in the introduction that electric energy is generated and distributed mainly within the Union.

The electricity networks that have evolved in time need to get upgraded and complemented by additional lines. The upgrades aim at removing existing bottlenecks. Additional interconnection capacity is required, in particular, for further developing electricity cross-border trade. Initially, the aim is set to reaching a level of electricity interconnection of at least 10% of the installed power generation capacity in the Member States.

In this section, we have also made use of the main findings of the study carried out by RWTH Aachen and CONSENTEC Consulting. The final report was published December 2001 and is entitled 'Analysis of Electricity network Capacities and Identification of congestions'.

Electricity Infrastructure Requirements:

As pointed out above some of the identified bottlenecks in electricity interconnection are given by natural barriers like the Alps and the Pyrenees and the seas like the Northern Sea and the Mediterranean. A specific bottleneck is given by increased transient electricity flow through Belgium and The Netherlands, which requires community measures.

The accession of ten new states to the Union requires additional infrastructure with respect to the inclusion of these countries in the UCTE distribution network.

Please note that the labelling is made in accordance with the recent revision of the guidelines (EL.1-EL.7).

Thus the following priority axes are identified:

(EL.1) Congestion across the Benelux (decided priority axis)

France – Belgium – Netherlands – Germany:

Electricity network reinforcements in order to resolve congestion in electricity flow through the Benelux.

(EL2-3) Interconnections across the Alps and the Pynenees (decided priority axis)

- Borders of Italy with France, Austria, Slovenia and Switzerland:
Increasing electricity interconnection capacities.
- Increasing electricity interconnection capacities between France – Spain – Portugal and for the Iberian Peninsula and grid development in island regions.

(EL.4) Interconnections across the Balkans (decided priority axis)

Greece – Balkan countries – UCTE System:

Development of electricity infrastructure to connect Greece to the UCTE System and to enable the south-eastern Europe electricity market.

(EL.5-6) Interconnections in the North Sea Region (decided priority axis)

- United Kingdom – Continental Europe and Northern Europe
- United Kingdom - Ireland and

- Establishing/increasing electricity interconnection capacities and possible integration of offshore wind energy.

(EL.7) Interconnections in the Baltic Sea region (decided priority axis)

- Denmark – Germany – Baltic Ring (including Norway – Sweden – Finland Denmark – Germany – Poland – Baltic States – Russia):
- Increasing electricity interconnection capacities and possible integration of offshore wind energy.

The enlargement of the European Union yields the additional axes:

(EL.8) Interconnections across Central - Eastern Europe (envisaged priority axis)

Germany – Poland – Czech Republic – Slovakia – Austria – Hungary – Slovenia:
Increasing electricity interconnection capacities.

(EL.9) Interconnections along the Mediterranean Ring (envisaged priority axis)

Mediterranean Member States – Mediterranean Electricity Ring:

Increasing electricity interconnection capacities between Mediterranean Member States and Morocco – Algeria – Tunisia – Libya – Egypt – Near East Countries – Turkey.

Horizontal actions for Electricity Networks:

In view of environmental arguments (in particular reducing the global CO₂ emissions), increasing the use of renewable electricity generation and asking for distributed generation, forecasting and in-time modelling will become increasingly more important.

In addition to project related actions, horizontal actions will be needed for improving the functioning of the interconnected electricity networks within the internal market and, in particular, identifying the bottlenecks and missing links, developing solutions in order to deal with congestion and adapting the methods of forecasting and of operating electricity networks.

The following horizontal actions are envisaged:

- Identifying the bottlenecks and missing links, especially cross-border, within electricity networks
- Developing solutions for electricity flow management in order to deal with the problems of congestion within electricity networks
- Adapting the methods of forecasting and of operating electricity networks required by the functioning of the internal market and the use of a high percentage of renewable energy sources, including any equipment or installations essential for the system in question to operate properly, including protection, monitoring and control systems.
- Synchronisation of electric networks on a wider scale.

Priority Projects

In the first step the priority axes are identified, which reflects the European-wide importance. In the second step a list of relevant projects of common interest is established, comprising 221 projects in the recently adopted TEN Energy Guidelines. This involves collecting information from all participants in the energy market,

including the Transmission System Operators. From this “long list” priority for funding will be given to projects located on the priority axes. The aim is to provide significant political and, where appropriate, financial support for finalising projects of European interest in the context of the competitive market.

The agreement on “priority axes” and on “priority projects” sets clear targets. The TEN-E funds will give support for the early phase of a project. This support through the TEN-E programme should then create an amplification effect that will boost these projects into the construction phase.

Conclusions

There is a justification for proposing a new revision of the TEN-E Guidelines given by the accession of new Member States to the Union and by the growing importance of the neighbouring countries in the context of an increasing external dependence for energy. The inclusion of the oil sector is a new component justified by safety considerations.

The further extension of the gas transport system to including new sources and external transit countries constitutes a significant element.

Further upgrading and completing the infrastructure is needed in the electric networks for reasons of existing bottlenecks and missing links. In this context the upgrades of internal links also contribute effectively to the enlargement of the electric system.

It is recalled that the electric system throughout Europe is based on a synchronous system. All elements of this synchronous system are tied by electro-magnetic links, governed by the laws of Physics. The extension of the basic synchronous system to new countries with different technical standards constitutes still a major task. A stepped approach based on progressive approximation and harmonisation of standards can lead to a wider electric network of the scale of the European continent, with suitable connections to the neighbouring countries.

APPENDIX: Natural Gas Resources

1. NORTH SEA AND OTHER EUROPE

After the first oil and gas discoveries in the 1960s, the North Sea became in a few decades one of the key world producers of oil and gas, and a major natural gas supplier to the European Union.

In **Norway** the remaining proven and probable reserves are estimated at about 3500 bcm, to which could be added some 2500 bcm additional gas remaining to be discovered. These 6000 bcm of possible natural gas resources leave ample space for future production and exports. Potential exports, supported by a dense network of subsea pipelines, have been estimated at 100 bcm/yr by 2010. For the next decade present export capacity appears sufficient.

The **United Kingdom** rapidly became the most important gas producer and user in Europe, at around 100 bcm per year in 2000. Gas production is expected to decline after 2004-2008. If this decline were confirmed, the UK would become a gas importer.

In the **Netherlands**, the proven gas reserves of onshore and offshore fields are still around 1700 bcm, but domestic gas consumption of 40-45 bcm/yr, continues to increase. Almost 50% of gas production are exported. Forecasts suggest that the Netherlands will maintain its overall level of production and exports during the next two decades, with the growth of domestic demand being covered by increased imports.

Denmark's offshore natural gas production has followed domestic consumption, together with a small export surplus.

Other significant producing countries include Germany, Italy, and Romania. While Germany and Italy produce about one fourth of their demand, Romania covers about 75% of its demand. All three, however, will probably see their production levels decline during the coming decades.

2. NORTH AFRICA

North African countries benefit from long historical relations with European countries, and with respect to their oil and gas export potential, from the major advantage of geographical proximity.

Natural gas reserves in **Algeria** have been estimated at about 4500 bcm/yr in mid 2000. The official objective for gas exports has been recently up-graded to 85 to 90 bcm by 2010. This will be achieved by capacity extension of the existing pipelines to Sicily and mainland Italy via Tunisia and to Spain via Morocco. The construction of new pipelines linking Algeria directly to Spain and Algeria to Sardinia and the Italian mainland will increase export capacities further

Libyan gas production could reach 25 bcm/yr in 2010 and exceed 42 bcm/yr in 2020. The Western Libya Gas Project, a joint venture between Libya's NOAC and AGIP, has the objective to export 8 bcm/yr to Italy from the western onshore and offshore gas fields via a 600 km subsea pipeline to Sicily.

The **Egyptian** "gas boom" started with the discovery of a major new gas province, mostly offshore, the Nile Delta. According to official statements, one third the reserves

estimated as about 1500 bcm are subject to exports, to Europe through LNG. Some 12 bcm/yr of Egyptian gas could reach Europe in 2010 and 25 bcm/yr in 2020.

3. *RUSSIA*

Russia has tremendous natural gas reserves of almost 50 000 bcm and the potential of its Western Siberia super-giant gas fields. Therefore, Russia is on first place in European imports.

Present commitments by Gazprom point to levels around 200 bcm/yr for Europe by 2008. Similar export levels of 200 bcm/yr can be assumed for 2010 and 2020.

Export capacity seems not to present a constraint to the future increase of exports. In fact, present Russian export capacity to Europe is already 180 bcm/yr (150 bcm/yr through Ukraine to Slovakia, Romania, Hungary, and Poland, 21 bcm/yr through Belarus to Poland; and 9 bcm/yr to Finland). The new Blue Stream pipeline across the Black Sea to Turkey with a capacity of 16 bcm/yr is expected to be fully operational in 2003.

Diversification of export routes plays an important role in Russia's natural gas development strategy in order to avoid depending too much on one single transit country, as it was the case with Ukraine. Export capacity increases are planned for the coming years in the Yamal-Europe I pipeline through Belarus to Poland or connecting southwards to the major export corridor through Slovakia. A new pipeline is also to be built from St.Petersburg across the Baltic Sea to Germany and other countries bordering the Baltic Sea. This pipeline could in a first stage transport gas from the Nadym-Pur-Taz gas producing region to Northern Europe, and later also from the fields in the Barents Sea (Shtockmanovskoye).

4. *THE CASPIAN SEA REGION*

The Caspian Sea is surrounded by five states: Russia, Kazakhstan, Turkmenistan, Iran and Azerbaijan. Each of these five states is generously endowed with oil and/or gas resources, but not all of them have easy possibilities to export them.

Iran has the second largest gas reserves in the world after Russia with its very large proven gas reserves of around 24 000 bcm. Iran will export 10 bcm/yr to Turkey in 2010, mostly from the giant South Pars field, while another 5 bcm/yr of Iranian LNG could be channelled to European terminals.

The increasing importance of Turkey as a transit route is evident.

5. *THE GULF REGION*

The natural gas reserves of the Gulf have recently gained the first position in the world regions, with some 51 500 bcm estimated at the beginning of 2000. The Gulf region comprises Iran, Iraq, Oman, Qatar, Saudi Arabia, the United Arab Emirates and Yemen. However, most of this gas is associated gas, linked to fluctuating oil production, and the majority of these Gulf countries plan, for the time being, to develop gas production to meet their rapidly increasing domestic gas consumption before planning any exports to Europe. In 1999, the Gulf had a marginal share (3.5%) in the international gas trade, limited to the flow of LNG exports.

In **Iraq** the gas reserves are used locally at present. In the future, substantial quantities of gas could be exported to the EU via Turkey, or possibly Syria, but would probably not exceed 10 bcm/yr in 2010 and 20 bcm/yr in 2020.