

## Natural Gas Supply Diversification in Europe – Role of Turkey as a Transit Country

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### Introduction

Natural gas consumption in Europe has been growing at a steady pace of 5.2%/year on average. Demand reached 498.1 Bcm at the end of 2003. High oil prices, environmental policies, and developments in gas fired power generation are expected to increase gas demand in Europe. Natural gas production in Europe has been pretty constant since 1987. Although the demand for gas has increased 66.8%, there is almost no improvement in gas production capacity. Annual gas production was 194 Bcm in 1986 and is now 204.1 Bcm. Norwegian production is expected to climb to 85 Bcm/year by 2010; on the other hand, this will barely offset the substantial decline in British production starting from 2005<sup>1</sup>.

Lack of reserves and production capacities are driving Europe to be a net importer. The tremendous increase in gas demand since 1987, and almost no increase in production capacity is increasing reliance on outside suppliers to supplement European gas. Current gas supplies are pipeline supplies from Russia, and LNG supplies, mostly from Algeria. On the other hand, giant gas reserves with lower production costs and competitive prices in Iran, Middle East and Central Asia may be very attractive for the energy-hungry European countries.

Thinking that competition among the players in the market will reduce prices, Europe decided to diversify the supply paths of its energy needs. A stable, continuous and secure access to energy is one of the primary goals of European industry. As many other countries, Turkey, as a transit country is looking forward to being the energy bridge<sup>2</sup> between the hydrocarbon rich Middle East and Central Asia, and highly developed energy hungry European countries.

### Natural Gas Demand in Europe

Figure 1 shows the gas demand history in Europe since 1965. High oil prices, and environmental policies force European companies and communities to spend more on gas than any other fuel. The three major sectors, which consume 94.8% of the gas in Europe, are residential users, industrial users, and, of course, gas fired power generation. The distribution of consumption among the sectors is given in Figure 2.

Residential consumption accounts for 41.6% of gas demand in Europe. The natural gas distribution networks connecting increasing numbers of customers are the primary reason for this high level of gas demand. Industrial consumption accounts for 28.6% of total consumption. It is highly dependant on price of competitive products, economic activities, and energy saving policies. Developments in gas fired

power generation and restrictions on nuclear power plants are expected to increase gas demand in Europe during the next decade. Gas fired power generation has been substituting<sup>3</sup> for nuclear energy, especially after the accident in Chernobyl. Gas fired power generation accounts for 24.6% of the gas consumed in Europe.

Figure 1. Natural Gas Consumption in Europe

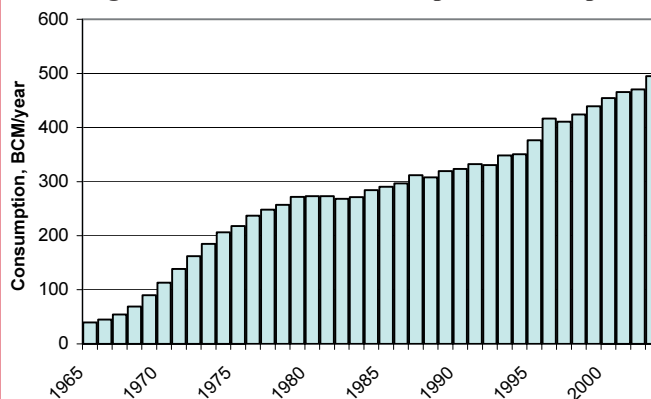
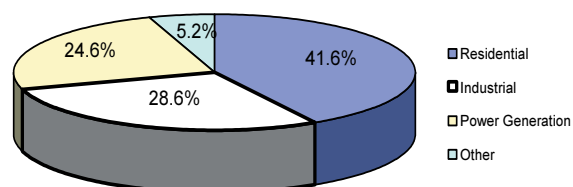


Figure 2. Distribution of Gas Consumption among Sectors

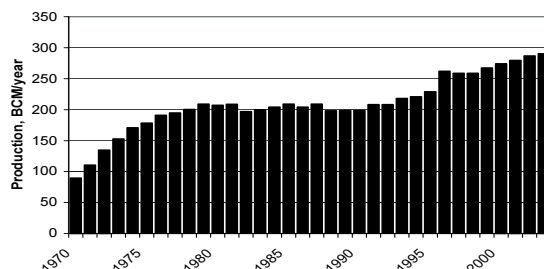


Environmental regulations, especially after the Kyoto Protocol, are forcing automobile manufacturers to build engines that give less emission. Low price as well as low emissions make natural gas a fuel for transportation, too.

### Natural Gas Production in Europe

Natural gas production in Europe was pretty constant between 1976 and 1992. Although the demand for gas has increased 39.6%, the increase in production was only 8.9% during this period. Annual gas production was 191.1 Bcm in 1976 and 208.2 Bcm in 1992. Norwegian production, which started increasing in 1996, is expected to climb to 85 Bcm/year by 2010; on the other hand, this will barely offset the substantial decline in British production starting from 2005. Figure 3 below illustrates natural gas production in Europe since 1970.

Figure 3. Natural Gas Production in Europe

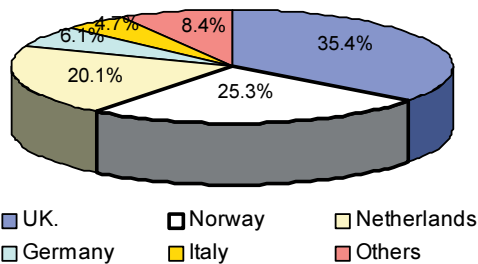


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<sup>1</sup> See references at end of text.

Gas production in Europe has been increasing since 1996. Production reached 290.3 Bcm/year in 2003. On the other hand, despite the increase in Norwegian gas, United Kingdom production has been declining since 2000. UK annual production was 102.7 Bcm in 2003, having peaked in 2000 at 108.4 Bcm. Furthermore, natural gas production in Netherlands has also declined: to 58.2 Bcm/year from high 75.8 Bcm/year production of 1996. The distribution of natural gas production<sup>4</sup> among the European countries is given in Figure 4.

**Figure 4. Distribution of Gas Production in Europe**

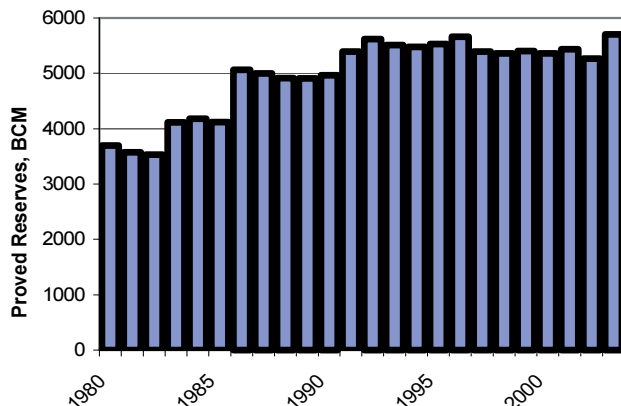


Romania with 4.3%, Denmark with 2.7%, and Poland with 1.4% of total production are other gas producing countries in Europe.

#### Gas Reserves in Europe

Natural gas reserves in Europe as of 2003 were 5.7 Tcm. Compared with world reserves of 175.8 Tcm, Europe is a reserve poor continent. Proved reserves trended upward until 1993 but is now declining. Reserve additions in Norway in 2003 could barely stop the decline and unfortunately the trend for other European countries is still down. Norway reserves account for the biggest amount with 2.46 Tcm followed by Netherlands with 1.67 Tcm. United Kingdom has the third biggest reserve, which is 0.63 Tcm. Figure 5 below presents the history of proved gas reserves in Europe since 1980.

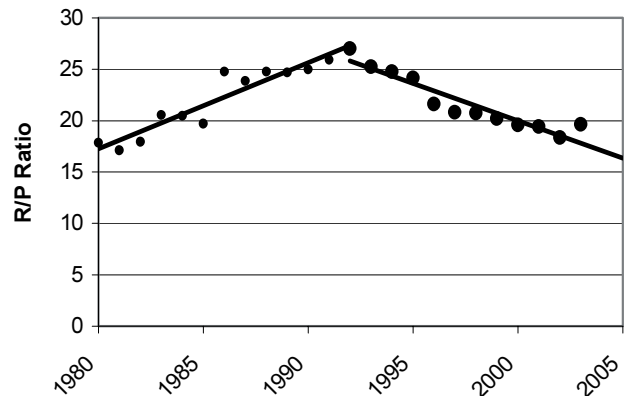
**Figure 5. Gas Reserves in Europe**



Another, perhaps more accurate interpretation of reserves is the Reserve/Production (R/P) ratio. The R/P ratio for European gas reached a maximum in 1992, and has been in decline since then. Reserve additions in 2003 seem to be changing the trend to growth; on the other hand, the R/P ratio

in 2003 is far below the 1992 level. Maintaining the same amount of reserves and producing the same volumes of gas, the latest data shows that Europe will run out of gas in about twenty years. Europe's R/P ratio is less than half of the global R/P. The R/P ratio of European gas since 1980 is shown in Figure 6 below.

**Figure 6. R/P Ratio Since 1980**



#### Current Natural Gas Supply Paths for Europe

Three countries – the United Kingdom, Norway, and the Netherlands – currently account for 80.5% of total production. Annual domestic gas production reached 290.3 Bcm in 2003 accounting for 58.6% of total consumption. 41.4% of consumption (204.7 Bcm)<sup>4</sup> was imported from outside producers, mainly from Russia (130.6 Bcm), Algeria (30.8 Bcm), Nigeria (8.4 Bcm), Iran (3.5 Bcm) and the Middle East (5.5 Bcm).

Existing pipelines have a maximum supply capacity of 365 Bcm/year. Russia has the biggest export capacity with 165 Bcm/year via two export corridors across Ukraine and Belarus. The Norwegian natural gas transport network with six pipelines provides a capacity of 88 Bcm/year. 34.7 Bcm/year come from Algeria. The two pipelines, Pedro Duran Farel to Spain and Portugal, and Enrico Mattei to Italy and Slovenia are running at virtually maximum capacity. The UK-Continent Gas Interconnector, which also offers the possibility of exporting 10 Bcm/year to the United Kingdom, has the capability to provide 20 Bcm/year to the Continent. About 55 – 60 Bcm/year from Netherlands with the capacity extension on the Trans-Europe Naturgas pipeline to Italy also exists

#### Need for Supply Diversification

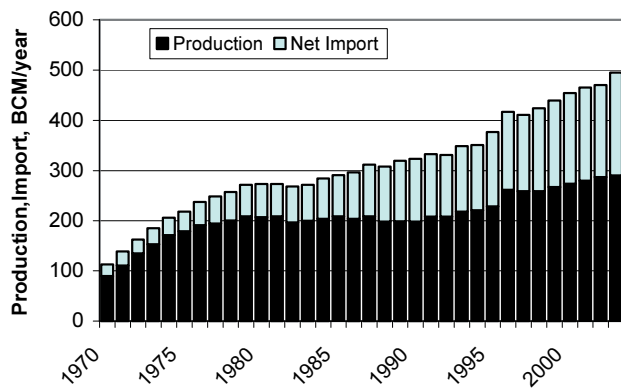
Currently, a large part of the gas consumed in the EU originates from non-EU countries such as Russia, Norway and Algeria. Due to EU enlargement and increasing gas demand in the EU, the gas import dependency on supplies from non-EU countries will increase substantially in the next decades. Dependency on a limited number of countries is, therefore, increasingly undesirable because of the political, economic and physical risks involved in long-distance supply routes. Supply diversification and transport efficiency in supplies are, therefore, necessary to manage and reduce the

risks. As prices are expected to rise, alternative countries and supply routes become viable to supply gas to EU in coming decades.

Europe has been successful diversifying its energy sources. Oil, gas, LNG, coal, nuclear, hydroelectricity, wind and solar energy are the substitutes in the energy mix. Natural gas, with a 22.7% share is now a major component of the European energy mix<sup>5</sup>.

Supply diversification is also as important as the energy source diversification. The growing gap between total consumption and domestic production is driving Europe to be a net importer. Figure 7 below shows the growth in production and net imports since 1970. Knowing that 63.7% of imported gas is supplied by Russia, it can easily be said that Europe is highly dependent<sup>6</sup> on Russia in terms of supply security.

**Figure 7. Europe Gas Production and Import Needs**



Diversification has been a paramount element in strategies for security of gas supply in Europe. New pipelines from new suppliers enhance security of supply through both new routes and new sellers. New pipelines from "traditional" suppliers will contribute to a more reliable environment by both diversifying geographical routes and bypassing or putting the transit countries into competition with each other. New LNG projects for imports from countries with a foothold already in the market (Nigeria, Norway and Egypt), and new LNG projects for import from new players well placed to tap the European market (best opportunities for Middle East projects) will improve supply security and competition.

Energy issues make it critical for Europe, to maintain good relationships with the producer countries. Environmental and political conditions are always considered to be risks between buyers and sellers. Any political crisis between an importer and producer may result in failure to maintain the supply continuity and security. A good example would be Georgia. Georgia is fully dependent on Russian gas, and at politically tense times, the supplies by Russia have not been reliable<sup>7</sup>.

The White Paper for Energy Policy, the departure point of European energy policy, states three main directions. These are: diversification of security of supply, competitiveness, and environmental protection. On this basis, three main dimensions determine energy security: political, economic and environmental. The liberalization of gas and electric-

ity sectors is consequent to the economic dimension, which aims to establish a single and competitive energy market. The implementation of the Kyoto process and the integration of sustainable development affect many aspects of the European Union energy security concept. Finally, the impending enlargement to countries historically dependent on Russia for their energy supply constitutes a major challenge to the geopolitical dimension of energy supply.

### Alternative Supply Paths

Europe historically has been a region with a high reliance on foreign flows. During the last 30 years, many measures have been adopted that taken together have raised supply security to a high level. The major instruments<sup>8</sup> used so far by European gas companies for guaranteeing security of supply could be summarized as follows:

- Long-term Take-or-Pay (ToP) contracts with additional risk management tools;
- Correct investment and regulatory climate;
- Diversification of sources and transit routes; and
- Regular dialogue with producing countries.

Europe's increasing demand for imported natural gas – due to the fact that indigenous production is declining – will confirm the need for strong political and physical links to North Africa and Russia, and increase the attraction of suitable pipeline links to the Middle East and Central Asia. Figure 8 is a brief illustration of the gas reserves<sup>4</sup> around Europe.

**Figure 8. Natural Gas Reserves at Prospective Suppliers**



The primary issue for the natural gas industry in the twenty first century will be that gas consumers are geographically remote from gas producers. 40% of the world's gas resource lies in the Caspian and Gulf states, some thousands of kilometers from 20% of the world's gas consumers in Europe. What will it take to connect the two by pipeline?

The Caspian and Gulf are complex from a geopolitical point of view. However Europe's desire for supply diversification, the prevention of economic dominance by any one

supplier, and resource owners' desire to bring their product to market, provide strong drivers for political solutions. Many of the gas markets along proposed pipeline routes are immature and not readily accessible by alternative gas supply sources. In order to encourage investment and stimulate market growth, and hence encourage the development of a transit pipeline to Europe, gas market liberalization is needed. The extension eastwards of the European Union and its policy instruments provides a driver for market reform. Finally, any pipeline project will require massive capital investment running into billions of euros, hence private capital will be essential. Such capital will require adequate returns; hence the project must be fundamentally economic.

Analysis of Europe's supply and demand shows that by 2010 additional tens of Bcm will be required. This will increase to an additional few hundred Bcm by 2025. This emerging gap is driven by strong annual growth principally because of increased use of gas by the power sector. Thus there will be a growing customer base for additional gas supply sources. Caspian and Gulf pipeline gas will have to compete for this increased demand with the four existing supply sources, namely pipeline gas from the North Sea, Algeria and Russia, and LNG from Africa and the Gulf.

**Table 1. Unit Cost of Energy by Pipeline to Europe<sup>9</sup>**

Supply Point	Transit	Cost (\$/mmbtu)
Russia - Yamal	Belarus	3.31
Russia - Nadym-Pur-Taz	Ukraine	2.79
Russia - Volga Ural	Ukraine	1.92
Russia - Volga Ural	Turkey	2.55
Uzbekistan	Turkey	2.15
Turkmenistan	Turkey	2.12
Azerbaijan	Turkey	2.05
Iran	Turkey	2.17
Iraq	Turkey	1.97

Of course, there are various gas reserves and resources available outside the EU to satisfy the growing demand of European economies, but this requires a further development and expansion of the gas transport infrastructure between Europe and today's key gas suppliers of Norway and Russia, along with countries in North Africa. Beside environmental and political benefits, diversifying the supply will cost something. The economic dimension of supply diversification is very important to the consumer. Building new pipelines, diversifying the supply source and supply routes will cost billions of dollars, on the other hand, continuity and security of supply will be achieved. The production cost of gas varies for different regions. Length and size of the pipeline affects the construction and operational cost of the system. Table 1 shows the cost of energy carried by pipelines to Europe from various sources and via various transit countries. This study<sup>9</sup> was performed by OME (Observatoire Méditerranéen de L'Energie), which is an association of energy companies in the Mediterranean countries. In this calculation, production cost, transport cost and transit fees are taken into consideration while producer country royalties are excluded.

The Caspian and Gulf reserve base is enormous. Some 6

Bcm of proven reserves are available to the states surrounding the Caspian Sea and some 50 Bcm is available in the Gulf. In the case of the Caspian, these reserves could go to market by a pipeline west to Europe, but other options exist: north to Russia, South to Iran, and East to Asia.

Three basic pipeline routes<sup>6</sup> to Europe from the Caspian and Gulf have been proposed:

- Turkey to Austria via Bulgaria, Romania and Hungary
- Turkey to Austria via the Balkans
- Turkey to Italy via Greece.

#### Role of Turkey

Projections performed by various research institutions and energy companies that are future candidates for new projects in the Caspian and the Middle East are giving signals of some 100 BCM natural gas annual throughputs to be transported via Turkey to the European countries in 2020. This is really an encouraging figure that forces Turkish gas companies to work with high motivation on the way to the western markets. An energy importer<sup>10</sup> and itself a major energy market, Turkey's importance lies in its ability and willingness to develop major transit systems for oil and gas thus enabling energy resources to access European markets by pipelines from such diverse regions as the Caspian, Central Asia, and the Middle East. Being between the resources and consumers, Turkey is willing to be the "Energy Corridor" between Europe and Middle East and Central Asia.

Definitely, it is essential for Europe to maintain satisfactory relations with transit countries<sup>11</sup> for providing a stable access to the sources and to the energy products it needs. This is especially true for gas, where the main risk lies in transit conditions and continuing diversification of transport routes, not in the status of proven reserves.

To date, Turkey has managed to make various supply connections with different production points within the aim of supply diversification. While doing that, the diversification strategies of the European Union as well were kept in mind. Table 2 below shows the supply contracts signed between Turkey and the producing nations.

**Table 2. Turkey's Gas Supply Contracts<sup>10</sup>**

	Max. Capacity (Bcm/year)	Term (Year)	Starts (Year)	Ends (Year)
<b>In Operation</b>				
Russian Federation (West)	6.0	25	1987	2011
Algeria (LNG)	4.0	20	1994	2014
Russian Federation (Turusgaz)	8.0	23	1998	2020
Nigeria (LNG)	1.2	22	1999	2021
Iran	10.0	25	2001	2026
Russian Federation (Blue stream)	16.0	25	2003	2027
Turkmenistan	16.0	30	2006	2035
<b>Planned</b>				
Azerbaijan	6.6	15	2006	2020
<b>Total</b>	<b>67.8</b>			

With its existing and planned institutional and technical infrastructure, it is time to play the key role for Turkey as a transit country on the way to Europe with its brand-new, ever-expanding and consistent grid of gas pipelines. Table 3 and Figure 9 shows the Turkish pipeline network. While

working hard to realize extensive investment in gas infrastructure, it was not the sole target of Turkey to transmit gas to every town in Turkey. Together with that mission, it is also determined to open the door of the major gas markets of Europe.

**Table 3. Turkey's Pipeline Network<sup>10</sup>**

Existing System	4700 km
Under Construction	2400 km
Planned	1000 km
Total	8100 km

Together with its existing gas takings from Russia, Algeria, Nigeria and Iran, Turkey is looking forward to increasing supply sources and routes. In this regard, the Shah Deniz Project<sup>2</sup> is planned for the transportation of gas produced in Azerbaijan. Natural gas sales and purchase agreements were signed with Azerbaijan in 2001 and gas deliveries are planned to start in 2006 with 2 Bcm; to reach a plateau volume of 6.6 Bcm in 2009. This project is considered to be the first step in Caspian-Europe gas supplies.

A second step, the agreement with Turkmenistan to buy 16 Bcm of gas for Turkey, and an additional 14 Bcm for European demand is pending at the moment because of some sticking points, which are mostly politically based<sup>2</sup>. However, as soon as those issues are solved, with the completion of the Azerbaijan Project and opening of the route from the

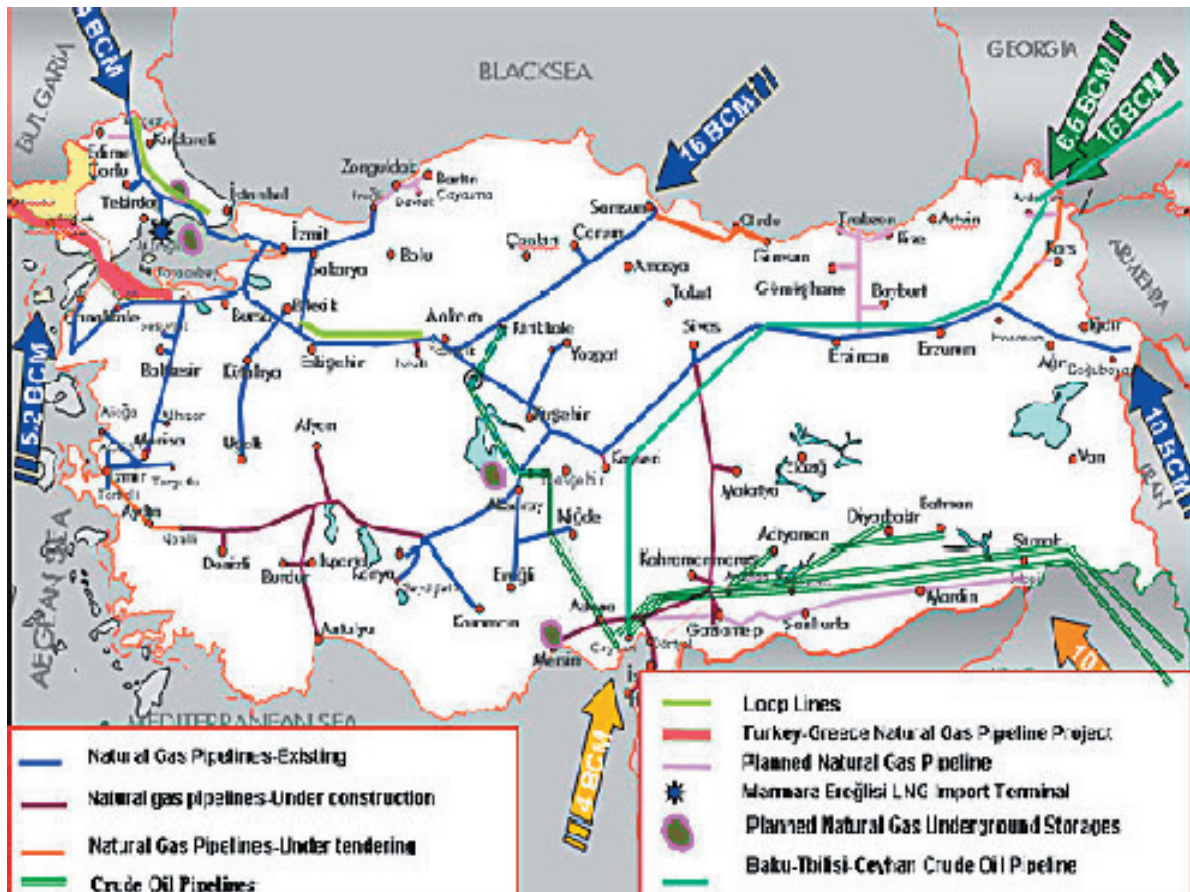
Caspian, Turkmenistan gas will follow.

A natural gas sales and purchase contract for the delivery of 4 BCM/year of Egyptian gas to Turkey by an offshore pipeline is planned with Egypt. This Agreement will be rearranged in case additional gas is required<sup>2</sup>. Another project, 10 Bcm gas from Iraq, is also under consideration. Development of this project has been slowed by UN sanctions so far, but with new conditions in the region, this project is likely to come onto the scene with a new direction towards Europe.

In addition to gas transit pipeline projects, Baku-Tbilisi-Ceyhan<sup>10</sup> crude oil pipeline is also under construction. After the breakup of the Soviet Union, hydrocarbon reserves of the Caspian Region started to attract the attention of the world. International gas and oil companies started to establish joint ventures in order to explore and develop those reserves as well as their transportation. After long negotiations and discussions the Baku-Tbilisi-Ceyhan Crude Oil Pipeline Project came to the fore leaving behind the other alternatives.

The basic and detailed engineering studies were completed successfully and in timely manner. As of September 2002, the "Land Acquisition and Construction Phase" of the Project was initiated. And finally, on 26 September 2002, construction of the Turkish Section of the line was begun. As an "Energy Corridor between the east and the west", Turkey now enjoys the steps taken so far that aims at supplying Caspian oil to the world market through Turkey. This project

**Figure 9. Turkey's Pipeline Network<sup>10</sup>**



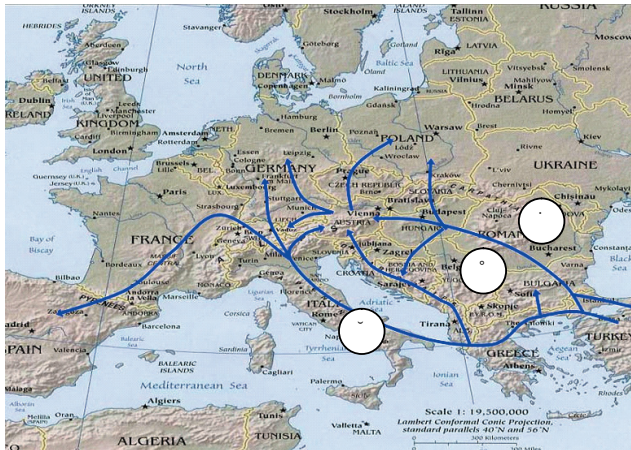
could cement the independence and political stability of the countries in the region.

### Gas to Europe

There are some feasibility studies and negotiations going on regarding projects undertaken internationally for the purpose of transportation of the regions' gas to the European market. The proposed supply routes from the Caspian, Central Asia and Middle East via Turkey are:<sup>6</sup>

1. To Italy via Greece
2. To Austria via Bulgaria, Romania and Hungary
3. To Austria via the Balkans

**Figure 10. Proposed Natural Gas Pipelines to Europe<sup>10</sup>**



These are illustrated in Figure 10. Each of these routes has its own technical challenges, cost bases and transit markets. Detailed economic examination of each of these three pipeline projects allows comparison with both the existing four European supply sources, and the other options Caspian and Gulf states have to bring their gas to market. In this way it is possible to identify those criteria necessary for an economically viable pipeline project from the resource rich Caspian and Gulf to a growing customer base in Europe.

The Turkey-Greece Natural Gas Pipeline Project has been developed to meet European gas demand. Within the framework of the studies conducted, the first step will be the interconnection of natural gas networks of both countries by a pipeline, to form the first and most important section of the South European Gas Ring.

A natural gas sales and purchase agreement was concluded in December 2003 between BOTAS, the Turkish National Pipeline Company, and the Greek company, DEPA. Construction of the pipeline began in September 2004. The total length of the Interconnector, including the Greek section, will be nearly 300 km's and it is expected that gas sales to Greece through this pipeline will start in 2006. Dr. Pala, Head of the Foreign Relations and Strategies Department of BOTAS said<sup>2</sup>, "We believe that this is a very significant development and it is going to be a pipeline of peace and prosperity and coexistence".

Meanwhile, the search for alternatives to transport the gas to the European markets after Greece is in progress. A

further extension of this line is the Italy-Greek Interconnector for which a feasibility study is being made.

European Union TEN funds have been made available for engineering and feasibility studies of these projects and the projects are moving in accordance with that schedule. A gas supply cost analysis made by OME is also being examined by EU TEN for about 35 different route options for European gas supply. The evaluation of the supply costs shows that the supply routes from Turkey are in a very favorable position among the various route alternatives, especially from the Eastern and Northern sources to Europe.

Dr. Pala<sup>2</sup> said, "The OME study report ends up with saying that the European Investment Bank which is currently supporting the TEN projects has a key role in the development of partnerships. It also stresses the importance of political and financial support of the European Commission and the European Investment Bank and importance of the Energy Charter Treaty as a framework for energy trade between the EU and its external energy suppliers".

The Turkey-Bulgaria-Romania-Hungary-Austria<sup>10</sup> Natural Gas Pipeline Project is also under consideration. With all the encouraging developments, the studies for another route to reach the European market have been initiated. This additional route is envisaged to carry the gas coming from Eastern sources together with the route through Greece. The Project called Nabucco aiming to link Turkey to Bulgaria, Romania, Hungary and Austria is moving ahead. This route will be the gate to Europe from another angle. This Project is also receiving financial support from EU funds.

Within this framework, negotiations were initiated between the related gas companies of the countries, OMW Gas of Austria, MOL of Hungary, Transgaz of Romania, Bulgargaz of Bulgaria and BOTAS of Turkey. These five companies signed a cooperation agreement in October 2002 in Vienna and have established a project company. The project company will discuss with all the suppliers for throughput options and will invite the suppliers to use the new route. Initially existing spare capacities of countries will be used to serve the market and full development of the pipeline system will be handled in a step-by-step approach.

The Turkey-Greece-Balkans-Austria<sup>10</sup> Natural Gas Pipeline Project is another alternative, which would also come from Greece and follow a route along the Adriatic Sea. In order to study that additional corridor, on April 2003 BOTAS and DEPA signed a protocol with the respective gas companies of Bosnia-Herzegovina, Croatia, Slovenia, Serbia-Montenegro, Macedonia and Albania in Thessalonica. The expected growth rate of gas demand in Europe, especially beginning in 2015, together with the decline in domestic supplies, indicates the need for a third route option to follow the Turkey-Greece-Italy and Turkey-Austria (Nabucco) Projects. Those dates will probably bring higher demand figures in these potential transit countries as well. An economic and secure supply option will likely be welcomed in the area.

### Discussion

In geographical terms, Turkey is well placed to serve as

a central transit supplier for the anticipated increases in EU demand. In this respect many companies in central, southern and southeastern Europe are actively involving in bringing gas resources from the Caspian and the Middle East to European markets through full commercial pipeline systems transiting Turkey. For European countries, development of Turkey as a transit route helps promote energy security through diversification of gas supply routes.

As Turkey's importance as a gateway grows, so it further increases European energy security by ensuring increased access to Caspian reserves on a commercial basis, as well as offering Middle East producers the option of transporting gas to Europe. It should be noted that such projects would also provide great benefits for the transit countries in terms of their economies and political stabilities<sup>10</sup> as well.

In order to form a proper and suitable source alternative, Turkey has to present reasonable conditions for gas transmission to Europe. This is also the case for the demand markets on the West and the supply countries in the Caspian Region, Middle East and others. Both the countries and the companies have to consider the needs for structuring a new supply source and a new route.

The supplier countries and producer companies in the region have to provide reasonable conditions to open the gate. This is also the case for the transit countries to form the best grounds for the mission, both technically and economically. And last, the demanding countries, together with their organizations, have to support these projects taking into consideration the cost of supply diversification, in order to benefit from more secure, economic and liberalized market conditions in the future.

### Conclusions

Studying the European gas market in terms of reserves, production, consumption, import dependency and the desire to diversify supply, the following conclusions have been reached.

1. Existing proved reserves cannot satisfy Europe's energy needs.
2. Profiles show that European regional gas production is in decline.
3. Natural gas consumption is increasing due to economic-growth and environmental concerns.
4. The growing gap between consumption and production increases import dependency.
5. For the sake of supply security and continuity, it is essential to diversify supply sources and routes.
6. Detailed engineering studies show that building pipelines to Europe via Turkey is feasible.
7. Turkey, as a transit country, is going to be the *Energy Corridor* between the producers in Caspian, Central Asia and Middle East and Europe.

### Nomenclature

Bcm	Billion Cubic Meters
BTC	Baku-Tbilisi-Ceyhan
EU	European Union
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gases
R/P	Reserve/Production Ratio
Tcm	Trillion Cubic Meters

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