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THE ROLE OF TURKEY IN THE ENERGY SUPPLY OF THE EU AND ITS ECONOMIC EFFECTS

Master Graduation Thesis by

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ABSTRACT

This study aims to analyze Turkey's role as an energy transit country for the energy supply of the European Union (EU). Having scarce fuel energy resources, the EU and Turkey are both dependent on imports to meet their energy demand. Therefore, they have similar strategies and concerns for the future of their energy supply.

Most of the natural gas and crude oil suppliers of the EU and Turkey are countries that are economically and politically unstable. Although its share in the energy imports of the EU has been decreasing, Russia has been and is still the biggest supplier of both natural gas and crude oil of the EU. The energy suppliers of the EU and the statistical information about them are explained in detail within this study. Diversifying the energy supply and making it as secure as possible is essential for the EU. This has been demonstrated on numerous occasions throughout this study.

Being a candidate country to join the EU, Turkey has a very important role in the EU's energy supply security. Its strategic georaphical location and rapidly growing energy infrastructure shows this fact clearly. Energy relations between the EU and Turkey are analyzed in this study. As a result, it seems inevitable for them to collaborate in the energy issues for their mutual benefits.

In addition, some numerical analysis were made in this study to observe and understand better the structure and the conditons of the imported natural gas and crude oil markets of the EU and Turkey.

Finally, the relationship between GDP growth rate and some energy related indicators were analyzed, focusing on Turkey and the EU's major energy suppliers. For this purpose, some statistical and econometric tools were applied to the set of data collected.

Key words: EU, Turkey, Energy Supply, Natural Gas, Crude Oil

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1. INTRODUCTION

The non-renewable energy resources of the world are not equally distributed geographically. Energy reserves like natural gas and crude oil are mainly clustered in the regions which can be said to be politically and/or economically insecure or instable. European Union (EU) member countries are not situated in areas where there are rich energy resources like natural gas and oil. However, the natural gas and the oil consumption is very high and is still increasing in Europe. Therefore, the presence of the scarce crude oil and natural gas reserves, the downturn in their production level and the increasingly growing demand caused the EU to be increasingly dependent on primary energy imports in order to satisfy its demand. In order to guarantee its energy supply security, the EU has been trying to diversify its energy suppliers.

The main objective of this study is identifying and proving the importance of Turkey both quantitatively and qualitatively in the EU's energy supply. Turkey is located on a strategic geographic location being in the middle of the countries with very rich natural fuel energy reserves on one side, and the EU that is a growing energy market on the other side. This makes Turkey a very important energy transit country. Being an candidate country for the EU, Turkey has always been close to the Western nations and collaborated with them. Therefore, Turkey has an important role in diversifying the energy suppliers of the EU and its energy supply security thanks to its strategic location. Turkey and the EU have same kind of energy related concerns and strategies. Therefore Turkey and many EU countries are members of some energy related organizations.

Especially after the Ukranian- Russian gas conflicts in the last decade and the Arab Spring movements in some of the energy suppliers of the EU and Turkey, concerns rose even more in both the EU and Turkey about the future of their energy supply. Therefore, Turkey and the EU collaborate and move in the same direction in energy issues. Moreover, its growing energy infrastructure and the existing and planned pipelines crossing its territories makes it a potential energy hub between the Middle East and Europe.

The study begins with observing the status quo of the energy situation of the EU by analyzing its natural gas and crude oil suppliers and analyzing the energy market structure of the EU. It continues with analyzing the relationships between Turkey and the EU with special focus on energy issues. In Chapter 4, the current situation in Turkish energy market and Turkey's role

in the energy supply of the EU are analyzed in detail. Eventually, the correlation and regression analysis are made using the set of the data collected for selected years and selected countries to see the relationship between GDP growth rate and energy related indicators.

This thesis ends up with the conclusion of the whole study in which the ideas and discussions are summarized and the expectations are mentioned about the future of the energy relationships between Turkey and the EU.

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2. NATURAL GAS AND OIL SUPPPLIERS OF THE EU

2.1. Current energy situation of the EU

The energy supply of the EU has been dependent on imports because the EU has scarce mineral fuel and oil resources and the indigenous production do not meet the growing demand. The dependency of the EU on energy imports rises the political concerns relating to the security of the energy supplies. The main reasons of these concerns are:

- most of the exporter countries have instable economies and politics, which makes it hard to predict the future of the mutual relationships.
- Energy is not a commodity but is crucial for everyone, which makes it far more strategical than most of the other services and goods.
- The EU does not have bargaining power to negotiate the price of energy, since it is a market where there are limited suppliers and it is not easy to switch the suppliers.

Table 1 shows the energy statistics of the EU by the end of 2009. It is seen that the EU is highly dependent on imports to meet its energy need. Gross Inland Energy Consumption of the EU member states are 1702,75 Mtoe (million tonnes of oil equivalent), which is much more than its indigenous production. Therefore a significant amount of energy has to be imported from other countries.

Energy import dependency shows the extent to which a country relies upon imports in order to meet its energy needs. It is calculated using the following formula:

$$\text{import dependency} = \frac{\text{net imports}}{\text{gross inland consumption+bunkers}}$$

As seen in Table 1, the import dependency of energy of the EU, that is calculated according to the formula above was 53.9% in 2009. This means that more than half of the energy consumed in the EU was supplied from imports. The import dependency for gas and petroleum fuels were even more for the same year, which were 64.2 % and 83.5 % respectively. Thefore, it can be said that petroleum and gas products are critical sources for the EU since significant amounts of them cannot be supplied within the EU.

Table 1: Energy Statistics of the EU by the end of 2009. (All energy units are Mtoe (Million tons of oil equivalent)).

Gross Inland Energy Consumption	1702.75
Solid fuels	267.91
Petroleum products	622.86
of which Crude and NGL	624.26
Gases	416.79
of which Natural Gas	416.72
Others (nuclear, renewables, electricity, municipal wastes)	663.1
Energy Imports	1407.18
Solid fuels	132.07
Petroleum products	905.48
of which Crude and NGL	575.89
Gases	338.17
of which Natural Gas	338.17
Others (renewables and electricity)	163.53
Net Energy Imports	943.60
Solid fuels	110.09
Petroleum products	560.22
of which Crude and NGL	521.85
Gases	267.72
of which Natural Gas	267.72
Others (renewables and electricity)	115.66
Import dependency %	53.9 %
of solid fuels	41.1 %
of petroleum fuels, %	83.5 %
of which of Crude and NGL %	83.6 %
of gases %	64.2 %
of which of Natural gas, %	64.2 %

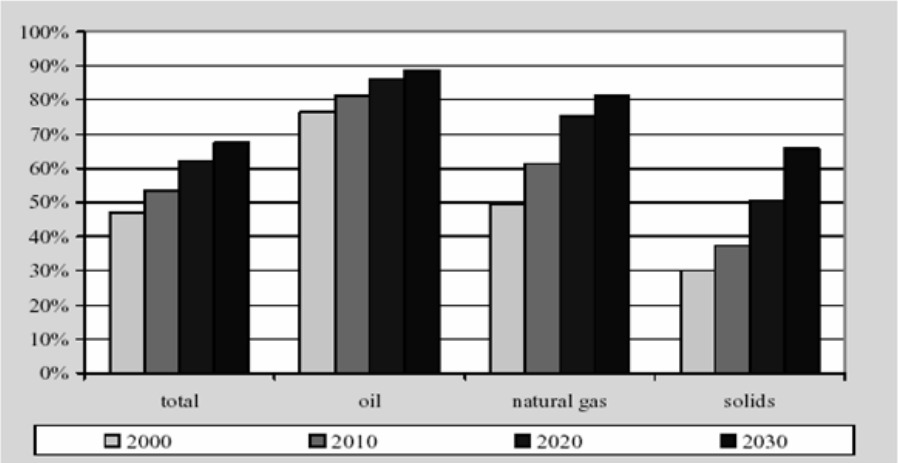
Source: http://epp.eurostat.ec.europa.eu NGL: Natural gas liquids

According to Figure 1, by 2010 the EU supplied less than half of its natural gas and less than a quarter of its oil consumption from indigenous production. The rest of the demand was met

by imports from major suppliers. The EU will be more and more import dependent on non-renewable energy sources in the near future according to the forecasts and estimations for different years seen in Figure 1. According to these estimates, although there will not be a sharp increase in oil import dependency, natural gas dependency will increase significantly. The reasons why natural gas is preferred over other fossil fuels like coal and oil are:

- restrictions on CO_2 emission, and lower emissions and greenhouse gas generation of gas plants compared to coal and oil-fired power plants,
- being a cleaner burning source than coal or oil,
- the nuclear phase-out of some EU member countries,
- barriers to widespread use and rapid development of renewable technologies.

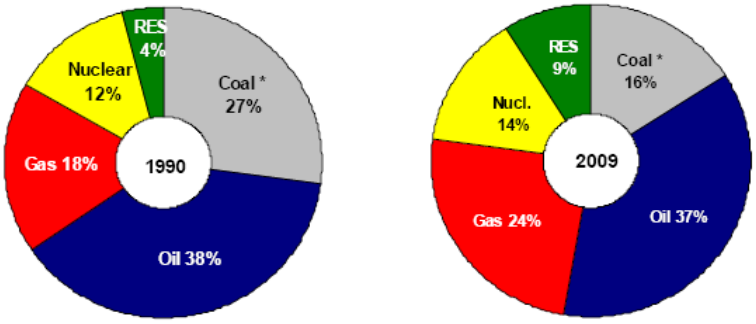
Figure 1: Import dependency of the EU on oil, natural gas and solid fuels, between 2000 and 2030.



Source: http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home/

As seen in Figure 2, the EU is relying or more natural gas for its energy need. Its share in the total energy consumption of the EU increased 50% while the share of coal and oil decreased from 1990 to 2009. Therefore, it can be said that natural gas has been prefered over other types of non-renewable resources to generate power and to deal with environmental problems like climate change and low air quality. Moreover, the EU set energy targets to be met by 2020; which are reduction of greenhouse gas emissions by 20%, increasing the share of renewables in the energy consumption to 20% and improving energy efficiency by 20%. The EU energy strategy highly involves natural gas and will involve it even more in the future as it is feasible to use it considering economic and environmental effects. Hence, natural gas is likely to become the most significant energy source in Europe in near future.

Figure 2: Share of energy types in total energy consumption of the EU in 1990 and 2009.



Source: Eurostat, (2011) *RES: Renewable Energy Sources

2.2. Major Energy Suppliers of the EU

2.2.1. An overview of European natural gas and crude oil supply

As it has already been mentioned, energy demand of the EU, especially for fuels and gas cannot be met by indigenous resources and production. The consumption is high and has been increasing continuously. The scarce natural gas and crude oil resources in Europe are not sufficent to meet this demand. Therefore the excess demand has to be supplied by outside the EU.

The major natural gas suppliers of the EU are Russia, Norway, The Netherlands (considered as indigenous production within the EU), Algeria, Qatar, Nigeria and other Middle East countries. Table 2 shows the main natural gas suppliers of the EU in terms of the percentage of the world's proven natural gas reserves between the years 2004 and 2010. The total of the natural gas reserves of these countries corresponded to 91.2 % of the world's proven gas reserves in 2010, which was 91.8 % in 2004. This shows that the share of natural gas reserves in the countries that supply natural gas to the EU did not change significantly in the past 7 years. The only significant increase in the share of gas reserves between 2004 and 2010 was in Former Soviet (Natural gas rich Former Soviet States are Turkmenistan, Kazakhstan and Azerbaijan) and American countries. This is because of the discovery of the large Yolotan gas field in Turkmenistan in 2007 and continuous natural gas findings in Venezuela. However the EU does not import gas from Post Soviet countries except Russia yet. In Table 2, these are considered among EU's major gas suppliers because they could be important potential suppliers in the future thanks to the ongoing pipeline projects that would transfer gas from these countries to the EU and the increasing share of their proven gas reserves.

Except Yolotan and the other findings in Venezuela, there have not been significant findings of new natural gas fields in the natural gas supplying countries to the EU. The shares of the gas reserves of Russia, Qatar and the EU decreased between 2004 and 2010. This fact is another proof that the EU has become and seems to be more dependent on natural gas exports if new gas fields are not found. Besides, other supplier countries either maintained or had slight decreases in their share.

Table 2: Major natural gas suppliers of the EU with the percentage of the world's proven natural gas reserves.

Country or region	**% of the world's proven natural gas reserves in different years**						
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Middle East*	26.2 %	25.8 %	26.5 %	26.9 %	27.2 %	27.1 %	27.0 %
Russia	26.7 %	26.6 %	26.3 %	25.2 %	23.4 %	23.7 %	23.9 %
Qatar	14.4 %	14.3 %	14.0 %	14.4 %	13.8 %	13.5 %	13.5 %
Norway	1.3 %	1.3 %	1.6 %	1.7 %	1.6 %	1.1 %	1.1 %
Nigeria	2.8 %	2.9 %	2.9 %	2.8 %	3.0 %	2.8 %	2.8 %
Algeria	2.5 %	2.5 %	2.5 %	2.4 %	2.5 %	2.4 %	2.4 %
Libya	0.8 %	0.8 %	0.7 %	0.8 %	0.8 %	0.8 %	0.8 %
Other Africa	1.7 %	1.8 %	1.8 %	1.9 %	1.9 %	1.9 %	1.8 %
Total EU	1.6 %	1.5 %	1.6 %	1.7 %	1.6 %	1.2 %	1.3 %
The Netherlands	0.8 %	0.8 %	0.7 %	0.7 %	0.8 %	0.6 %	0.6 %
Former Soviet Union**	5.7 %	5.7 %	5.7 %	5.1 %	7.5 %	7.4 %	7.3 %
Americas	8.1 %	8.0 %	8.2 %	8.9 %	8.8 %	9.2 %	9.3 %

*excluding Qatar , **excluding Russia and the Baltic States

Source: BP Statistical View of World Energy 2011

Table 3 shows the main natural gas suppliers of the EU according to their percentages of the total natural gas imports to the EU in different years. As it is seen, having rich natural gas

reserves, Russia has been and is still the most important natural gas supplier of the EU, even though its share in EU's natural gas imports declined from 37.28 % in 2004 to 26.15 % in 2010. The share of Algerian gas declined from 14.9 % in 2004 to 11.83 % in 2010, too. As it is clearly seen in Table 2, the Middle East has richer natural gas reserves than Russia. However not a significant amount of natural gas is imported from this region except Qatar of which gas imports share increased sharply from 1.1 % in 2004 to 8.07 % in 2010. Other sharp increase was in the share of African gas imports except the ones of Algeria and Nigeria. Besides, EU imported 1.75 % of its natural gas from American countries while it had not imported any gas from these continent until 2005. The other supplier countries remained unchanged or had very slight changes in terms of the share of natural gas imported by the EU.

It can be stated that geographical proximity to the supplier is a very important criteria to import energy. That is why EU is importing significant amount of its natural gas from Russia, Norway, The Netherlands and Algeria which are relatively closer countries to the EU territories. Moreover, obviously there are many other factors in selecting the suppliers such as presence of pipelines or LNG terminals, unit price of energy, mutual political relationships between importing and exporting parties; and stability,security and reliability of the supplier. On the other hand, the changes in natural gas reserves and changes in the amount imported natural gas are not necessarily linked as it can be observed from Table 2 and Table 3. For instance, the share of natural gas imports from Qatar increased sharply although the share of its gas reserves had a slight decrease between 2004 and 2010. However, the share of both the reserves and the imports of Russia and Algeria decreased. Therefore, it is not easy to estimate whether the decrease and increase of the imports depend on the changes in reserves since there are many other parameters.

Table 3: Major natural gas suppliers of the EU with the percentage of the total natural gas imports to the EU.

Country or region	% of the total natural gas imports to the EU in different years						
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Russia	37.28 %	34.55 %	33.12 %	32.03 %	31.09 %	28.60 %	26.15 %
Norway	21.21 %	21.37 %	21.86 %	22.96 %	23.41 %	24.11 %	23.42 %
The Netherlands	13.7 %	12.34 %	12.44 %	13.20 %	13.47 %	12.45 %	12.60 %
Algeria	14.9 %	15.28 %	14.23 %	13.03 %	12.56 %	11.83 %	11.83 %
Qatar	1.1 %	1.23 %	1.40 %	2.0 %	1.96 %	4.70 %	8.07 %
Nigeria	3.05 %	2.9 %	3.5 %	3.85 %	3.40 %	2.43 %	3.44 %
Libya	0.32 %	1.44 %	2.19 %	2.66 %	2.59 %	2.52 %	2.30 %
Other EU	8.02 %	8.92 %	7.8 %	8.02 %	8.87 %	8.02 %	8.94 %
Other Africa	-	1.24 %	2.20 %	1.52 %	1.56 %	1.71 %	1.45 %
Americas	-	0.17 %	0.98 %	0.70 %	1.25 %	1.90 %	1.75 %
Other Middle East	0.16 %	0.55 %	0.26 %	0.03 %	0.04 %	0.37 %	0.25 %

Source: BP Statistical View of World Energy 2011

The major crude oil suppliers of the EU are Russia, other former Soviet Union countries, Norway, Libya and the Middle East countries. Table 4 shows the crude oil suppliers of the EU in terms of their percentages of the world's proven crude oil reserves. Saudi Arabia is the country with the richest proven crude oil reserves of the world, even though its share in oil reserves has decreased from 22.1 % in 2004 to 19.1 % in 2010. The share of the oil reserves in the Middle East decreased, as well as those of Saudi Arabia. The shares of the other suppliers remained stable or slightly changed between 2004 and 2010. The only significant increase was in the reserve share of American countries that rose from 13.6 % in 2004 to 22.7 % in 2010. This is because of the already mentioned continuous new crude oil findings in Venezuela.

Table 4: Major crude oil suppliers of the EU with the percentage of the world's proven crude oil reserves.

Country or region	% of the world's proven crude oil reserves in different years						
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Americas	13.6 %	13.6 %	13.6 %	14.6 %	15.4 %	20.4 %	22.7 %
Saudi Arabia	22.1 %	22.0 %	21.9 %	21.3 %	21.0 %	19.8 %	19.1 %
Iran	11.1 %	11.5 %	11.4 %	11.2 %	10.9 %	10.3 %	9.9 %
Iraq	9.7 %	9.6 %	9.5 %	9.3 %	9.1 %	8.6 %	8.3 %
Other Middle East	18.8 %	18.8 %	18.7 %	19.2 %	18.9 %	17.9 %	17.1 %
Russia	6.1 %	6.2 %	6.6 %	6.4 %	6.3 %	5.6 %	5.6 %
Former Soviet Union*	4.1 %	4.1 %	4.1 %	4.0 %	4.0 %	3.7 %	3.7 %
Libya	3.3 %	3.3 %	3.4 %	3.3 %	3.5 %	3.3 %	3.4 %
Nigeria	3.0 %	3.0 %	3.0 %	2.9 %	2.9 %	2.8 %	2.7 %
Other Africa	3.1 %	3.2 %	3.3 %	3.3 %	3.6 %	3.5 %	3.4 %
Asia Pasific	3.5 %	3.4 %	3.4 %	3.3 %	3.3 %	3.2 %	3.3 %
Norway	0.8 %	0.8 %	0.7 %	0.7 %	0.6 %	0.5 %	0.5 %
EU	0.6 %	0.5 %	0.5 %	0.5 %	0.5 %	0.4 %	0.5 %

* excluding Russia and the Baltic states *Source: BP Statistical View of World Energy 2011*

As seen in Table 4, the proven crude oil reserves of the world are mainly clustered in the Middle East Region and in the countries in America continent. However; Table 5 shows that the main crude oil suppliers of the EU are Russia, other former Soviet Union countries excluding Baltic States, Norway and Libya. This can be explained by the importance of geographical proximity to the supplier to decrease transport costs. Therefore, it would not be convenient to import large quantities of oil from Americas even though they have rich

reserves. Between 2004 and 2010, the share of Saudi Arabian and Norwegian crude oil imports decreased, whereas Russian and other Former Soviet oil import share increased significantly. The shares of other suppliers in EU's crude oil imports has either remained unchanged or have slightly changed.

Table 5: Major crude oil suppliers of the EU with the percentage of the total crude oil imports to the EU.

Country or region	% of the total crude oil imports to the EU in different years						
	2004	2005	2006	2007	2008	2009	2010
Russia	25.92 %	31.12 %	30.87 %	31.49 %	29.02 %	28.89 %	29.70 %
Former Soviet Union*	6.18 %	7.28 %	8.36 %	9.54 %	9.39 %	11.65 %	12.70 %
Norway	20.02 %	16.84 %	16.28 %	15.36 %	14.56 %	14.34 %	13.09 %
Libya	9.55 %	8.87 %	9.15 %	10.10 %	10.26 %	9.40 %	10.71 %
Nigeria	3.09 %	3.43 %	3.42 %	2.74 %	3.96 %	4.36 %	4.37 %
Other Africa	7.14 %	7.08 %	6.40 %	6.96 %	9.01 %	8.25 %	6.54 %
Saudi Arabia	12.78 %	10.46 %	8.92 %	7.10 %	6.78 %	5.63 %	6.01 %
Iran	6.55 %	6.01 %	5.98 %	5.84 %	4.92 %	4.65 %	5.66 %
Iraq	2.64 %	2.18 %	2.83 %	3.50 %	3.52 %	3.78 %	3.15 %
Other Middle East	2.84 %	2.94 %	3.04 %	2.87 %	2.61 %	2.06 %	2.27 %
Europe (non EU)	0.53 %	0.53 %	0.40 %	0.47 %	2.43 %	2.93 %	2.50 %
Americas	2.76 %	3.19 %	3.88 %	3.60 %	3.48 %	3.04 %	3.30 %
Asia Pasific	-	0.08 %	0.21 %	0.44 %	0.07 %	0.03 %	-

* excluding Russia and Baltic states

Source: European Commision Directorate General for Energy

On the other hand, another reason of why EU supplies its energy by various countries is that, diversifying the geographical origin and the transit routes of energy is extremely important since energy is an essential thing, not a commodity. By diversifying the suppliers, bargaining power in negotiating the energy price and energy security are increased. Also other strategic precautions must be taken beforehand in case unexpected and undesirable things happen.

2.2.2. Analysis of European imported natural gas and crude oil markets

The natural gas and crude oil import markets of the EU are composed of many suppliers as it has already been mentioned. It is useful to analyze these markets to see the level of concentration and thus competition. In this regard Herfindahl Index is appropriate to be applied to these markets. The Herfindahl index is a measure of the size of firms in relation to the industry and an indicator of the amount of competition among them. In this case, firms are countries that export natural gas and crude oil to the EU. It is defined as the sum of the squares of the market shares of the 50 largest firms (or summed over all the firms if there are fewer than 50) within the industry, where the market shares are expressed as fractions. The result is proportional to the average market share, weighted by market share. As such, it can range from 0 to 1.0, moving from a huge number of very small firms to a single monopolistic producer. There are three possibilities in terms of market concentration:

1. If Herfindahl Index is below 0.1; this means that the market is low concentrated.
2. If it is above 0.18; this means that the market is highly concentrated.
3. If it is between 0.1 and 0.18; this means that the market is moderately concentrated.

Increases in the Herfindahl index generally indicate a decrease in competition and an increase of market power, whereas decreases indicate the opposite.

Herfindahl Index is calculated using this formula: $H = \sum_{i=1}^{N} si^2$ where si is the market share of firm *i* in the market and *N* is the number of firms. In this case, the firms are countries and market shares are % of the total natural gas/crude oil imports to the EU. The concentration of the imported natural gas and crude oil markets of the EU are calculated applying Herfindahl Index for the 7 years range for which the data available in Table 3 and Table 5 are used. Thus, the market concentration trend between 2004 and 2010 is observed.

First, Herfindahl Index of the EU natural gas import market for each year between 2004 and 2010 are calculated. In this case, the market shares are the percentages of each country's natural gas imports to the EU which have already been given in Table 3. Applying the already

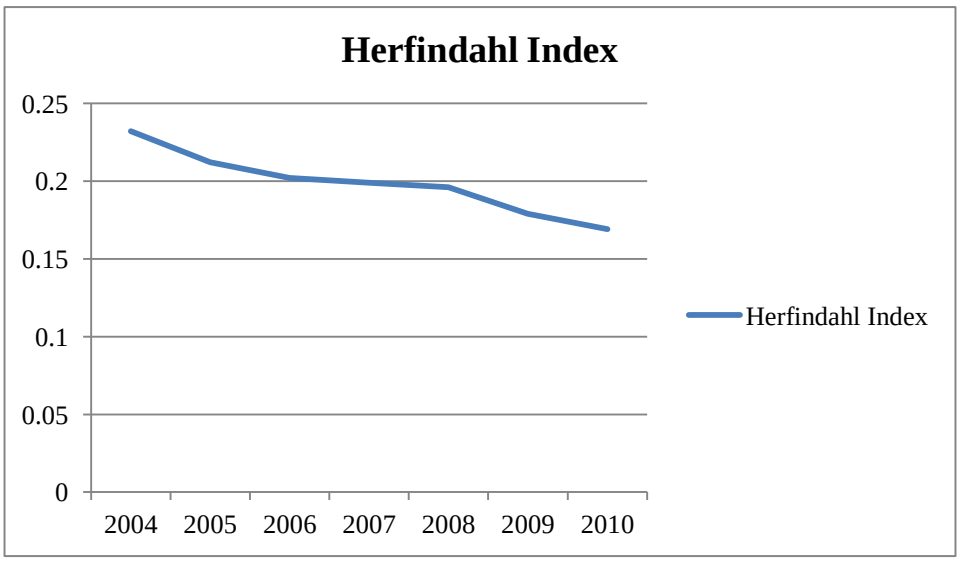
mentioned formula to these numbers, Herfindahl Indexes are calculated as seen in Table 6. Calculations are given in detail in Appendix.

Table 6: Herfindahl Index of imported natural gas market of the EU between 2004 and 2010

Years	2004	2005	2006	2007	2008	2009	2010
Herfindahl Index	0.232	0.212	0.202	0.199	0.196	0.179	0.169

As seen in Figure 3, Herfindahl Index of imported natural gas market of the EU decreased gradually from 0.232 in 2004 to 0.169 in 2010. It was above 1.18 from 2004 until 2009; and it is between 0.1 and 1.8 in 2009 and 2010. Therefore in 2004 the imported natural market of the EU was highly concentrated and the market leader, Russia was the dominant player in the market. However, in the following years, from 2005 and onwards the market concentration decreased and in 2009, it turned out to be a moderately concentrated market from a highly concentrated one. Because by the time, the differences between market shares decreased and therefore the market became more competitive. Having less market share than in 2004, the market leader was still Russia in 2010 but was followed by its biggest rival Norway with a slight difference.

Figure 3: Trend of Herfindahl Index of imported natural gas market of the EU between 2004 and 2010.



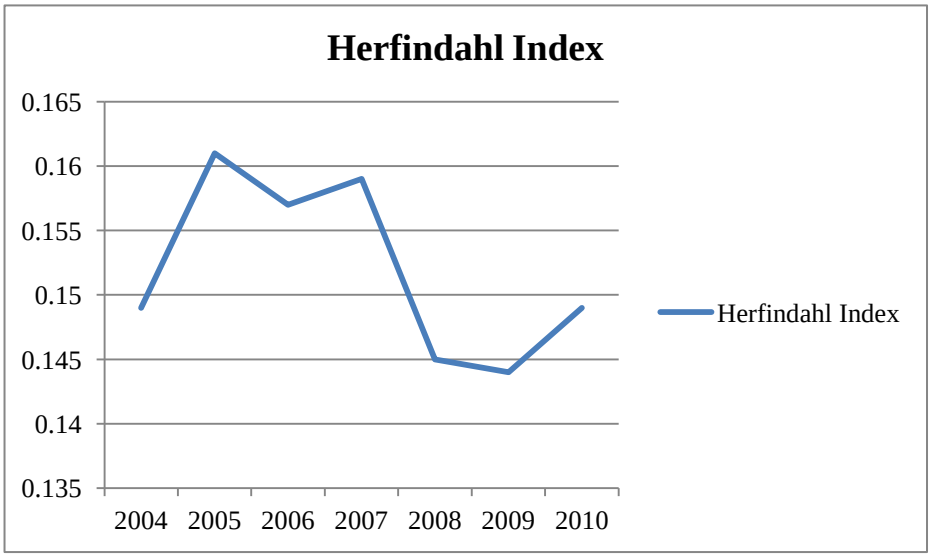
Second, Herfindahl Index of the imported crude oil market of the EU for each year between 2004 and 2010 are calculated. In this case, the market shares are the percentages of crude imports to the EU which have already been given in Table 5. Applying the already mentioned formula to these numbers, Herfindahl Indexes are calculated as seen in Table 7. Calculations are given in detail in Appendix.

Table 7: Herfindahl Index of imported crude oil market of the EU between 2004 and 2010

Years	2004	2005	2006	2007	2008	2009	2010
Herfindahl Index	0.149	0.161	0.157	0.159	0.145	0.144	0.149

Since the Herfindahl Index has always been between 0.1 and 1.18, the crude oil import market of the EU was moderately concentrated between 2004 and 2010. As seen in Figure 4, it reached its minimum point of 0.144 in 2009 and its maximum value of 0.161 in 2005. In other words, there are not big differences between market shares and the market structure is not monopolistic, and there is not one single dominant player. Russia has always been the market leader in this time interval and followed by its rival Norway. Therefore, the level of the competition and the concentration in this market remained almost unchanged between 2004 and 2010.

Figure 4: Trend of Herfindahl Index of imported crude oil market of the EU between 2004 and 2010.



2.2.3. The major natural and crude oil suppliers of the EU

In this section energy related bilateral relations between the EU and its major natural and crude oil suppliers are observed. These major supplier countries are Russia, Norway, Netherlands, Algeria, Libya, some countries in the Middle East and in the Gulf region, some Former Soviet Union countries, Nigeria and some countries in America.

2.2.3.1.Russia

Russia is the largest exporter of both natural gas and crude oil of the EU. In 2010, 26.15 % of the EU's total natural gas imports and 29.70 % of its total crude oil imports were supplied by Russia. However, Russia is the only natural gas exporter of many EU countries. Romania, Bulgaria, Slovakia, Finland, Estonia, Latvia and Lithuania are the EU countries which are % 100 dependent on Russia for their gas supply. Obviously for these countries Russia is in an extremely important position. Russia has territories in Europe but has no plans to join the EU, and is not a member of the World Trade Organization yet. Therefore, It can be considered as a partially isolated state from the Western World. Russia has only one liquefied natural gas (LNG) terminal which is near Japan and this terminal is used mainly in trade with Asia Pasific countries. With the rest of the world, Russia prefers to make the natural gas trade through pipelines rather than through LNG terminals. Because Russia has a developed gas pipeline infrastructure and in most cases pipeline gas trade is far more economical than LNG trade. All the natural gas exported from Russia arrives in the EU mainly through pipelines shown in Figure 5. These pipelines arrive in the EU in Poland, Slovakia, Greece and Romania; passing through the non-EU countries like Turkey, Ukraine, Belarus and Moldova. These third countries of which territories Russian gas pass through are also very important for the EU's energy security.

There are also proposed gas pipelines from Russia to the EU. The most important one is the South Stream Project that would enable Russia to export its gas to the EU without any third countries. These facts show that the energy relationship between EU and Russia will probably be more important and critical in the future.

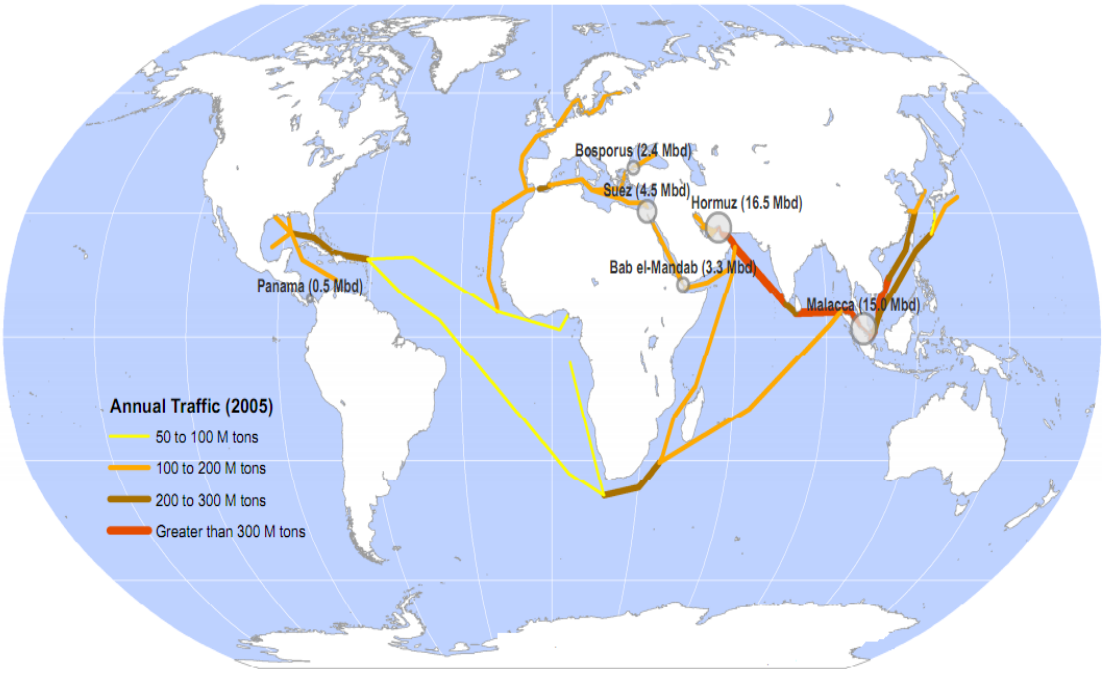
Figure 5: Major Russian natural gas and crude oil pipelines to Europe.

Source: http://www.acus.org/

Russian oil arrives in the EU mainly by oil pipelines and maritime transport. The crude oil arrives from Russia in the EU mainly through pipelines shown in Figure 5. These pipelines arrive in the EU in Latvia, Lithuania, Poland, Slovakia, Greece and Romania; passing through the non-EU countries like Turkey, Ukraine and Belarus. Beside pipelines, maritime transport is also important to supply Russian crude oil to the EU. As seen in Figure 6, there are two main maritime oil flow routes from Russia to the EU. First is through the Black Sea- Bosphorus Strait- Mediterranean; the second is through Baltic Sea- North Sea- Gibraltar Strait- Mediterranean. For the past few years, Russia has shifted its crude oil exports towards the Baltic ports rather than the Black Sea ports, as it is economically and physically more convenient. The main reason of this change is the existence of Bosphorus in the first route. Bosphorus is a waterway in Turkey on which it is hard to navigate because of its geographical structure, and the ships crossing it are obliged to pay transit fees. Because of these geographic

and economic difficulties, the second maritime route has been preferred more and more over the first one and thus has gained more importance.

Figure 6: Major oil flows and chokepoints in the world.



Source: http://people.hofstra.edu/

Russia has become the EU's major energy supplier. However, the direction of the energy relations between Russia and the EU changed due to two unexpected and unpleasant incidents. The dispute between Russia and Ukraine over natural gas supplies, prices and debts in January 2006 and January 2009 caused the pressure to drop in gas pipelines in Hungary, Austria and some other EU countries. Besides, another dispute occured between Belarus and Russia on natural gas prices in 2007. Since significant amount of Russian gas arrive in the EU through Belarus and especially through Ukraine, these led to a gas shortage in some European countries for some days. After these incidents Russia's monopolistic natural gas company Gazprom lost its reputation and Russia's reliability as a source of energy for the EU was started to be questioned. It was thought that Russia could use its powerful situation in energy over the EU as a strategic weapon considering also the non-perfect political relationships between the EU and Russia.

Moreover, Russia is also accused of having anti-competitive strategy and tactics such as signing long term contracts with the EU countries to lock in demand, consolidating Russia's oil and gas sector in the hands of state-controlled entities and thus creating a monopoly, trying

to prevent the construction of new pipelines, the most importantly Nabucco Pipeline, that will decrease the EU's dependence of natural gas on Russia.

The EU is looking alternative ways to diversify its energy suppliers not to experience this kind of unpleasant incidents anymore and especially to be less dependent on Russia for its energy supply. For this purpose, the share of Russian natural gas in gas imports of the EU has been gradually decreased from 37.28 % in 2004 to 26.15 % in 2010. However, the share of Russian crude oil in crude oil imports of the EU was 25.92 % in 2004, reached its pick point of 31.49 % in 2007 and 29.70 % in 2010 although its share of proven crude oil reserves has decreased slightly in the past few years. This can be explained by two facts. The first fact is that no crude oil related disputes have happened between Russia. The second one is that it is economical to import crude oil from Russia than importing it from many other suppliers since it is located very close to some of the EU countries which makes the transport costs less.

Unfortunately, in the EU there is not a central government that can make some regulations to protect it from Russian market power. Therefore the only protection could be developing competitive alternatives. However the energy export from Russia to the EU is inevitable because of its rich proven reserves, rapidly developing pipeline system, geographic location and technical skills. Therefore, the relations with Russia are extremely important for the energy security of the EU.

2.2.3.2. Norway

Norway is the most important non-OPEC (Organization of Petroleum Exporting Countries) oil and natural gas exporter to the EU after Russia. In 2010, 23.42 % of the total natural gas imports of the EU and 13.09 % of its total crude oil imports were supplied by Norway. According to the meetings and aggreements between the EU and Norway, both sides are interested in cooperating in energy issues. In this context, however, Norwegian supplies of the EU can be considered as part of the domestic production of the EU, due to Norway's membership of the European Economic Area (EEA) and EFTA (European Free Trade Association)

The significant amount of Norwegian natural gas that is exported to the EU arrives through pipelines in UK, Germany, Belgium and France as seen in Figure 7. Norway also exports some of its natural gas in LNG form. The natural gas is liquefied in Nordic (Skangass) LNG Plant on the south west coast of the country and Snohvit LNG Plant near Oslo. Natural gas is then transfered from the ports of these plants to the destination where it is regasified. Its crude

oil arrives in the EU in UK through pipelines shown in Figure 7, or by maritime transport from its major ports following the route that passes from Norway shown in Figure 6.

Figure 7: Major Norwegian gas and oil pipelines to the EU.

Source: http://www.321energy.com/

Although Norway rejected the EU membership in two referandums, it has always been closely associated with the European Union thanks to its membership in the European Economic Area (EEA). Norway's real incomes per capita are amongst the highest in the world and the unemployment rate is low. Moreover, no energy trade related problems occured between the EU and Norway until now. Therefore it can be said that it is quite a reliable energy supplier for the EU. However, by 2010 Norway had only 1.1 % of the world's total proven natural gas and 0.5 % of world's total proven oil reserves which were 1.3 % and 0.8 respectively in 2004. Its share in EU's crude oil imports decreased from 20.02% in 2004 % to 13.09 % in 2010, whereas its share in EU's natural gas imports increased from 21.21 % to 23.42 % between the same years. However, The Norwegian Petroleum Directorate has confirmed the discovery of a new oil field in the Barents Sea, on the north of the country. According to the researches, it is believed that the new discovered field might be larger than

the existing Goliath Oil Field and could mark the beginning of a real petroleum boom for the country. Therefore, the decreasing oil exports from Norway to EU might increase in the near future whereas no significant increase is expected for natural gas exports unless new fields are discovered.

2.2.3.3. The Netherlands

The Netherlands is the third largest exporter of natural gas of the EU. In 2010, 12.6 % of the EU's total natural gas imports, that was 13.7 % in 2004, were supplied by the Netherlands. However, the natural gas that comes from the Netherlands should actually be considered a part of the EU's indigenous production rather than export, since the Netherlands is an EU member state. The Netherlands does not have any LNG terminals. Therefore, the country makes its natural gas trade through the pipelines. The Netherlands is a founder member of the EU, has stable economy and politics. Therefore it is very unlikely that there will be energy related disputes between the Netherlands and other member states, which makes it a quite reliable supplier of energy. However it had only 0,6 % of the world's proven natural gas reserves in 2010. Therefore, the EU cannot rely on the Netherlands in the long term to meet its rapidly growing gas demand, even though it could have been very good in terms of relatively lower costs and risks.

2.2.3.4. Algeria

Algeria is the largest outside Europe continent exporter of natural gas to the EU. In 2010, 11.83 % of the EU's total natural gas imports were supplied by Algeria. Algeria has two LNG terminals which are called Sonatrach and Bethioua on the Mediterranean coast of the country. Significant amount of Algerian natural gas arrives in the EU from these LNG terminals. Beside LNG trade, as seen in Figure 8, the rest of it arrives in the EU through the major pipelines at two points: through Maghreb-European and Medgaz gas pipeline in Spain and through Trans Mediterranean gas pipeline in Italy.

Algeria is not a member of WTO yet, but is in the process of association. It is a member of the Euro-Mediterranean Partnership, which is a union that mainly aims to improve trade partnerships between the non-EU Mediterranean countries and the EU.

In 2004 Algeria had 2.4 % of the world's proven natural gas reserves and it remained unchanged for the following years. In October 2003, it was announced the discovery of a major natural gas field in the Reggane Basin in southwestern Algeria. Moreover, further developments in existing gas fields could increase its natural gas production since they are not

being used very effectivelly. However the share natural gas imports from Algeria to the EU dropped from 14.9 % in 2004 to 11.83 % in 2010. Algeria does not have stable politics and might be affected from the disputes of 2011 in many Arabic states from which its neighbours Tunisia, Libya and Morocco have already been affected. Considering all these facts, it would not be easy to estimate the future state of natural gas exports from Algeria to the EU.

Figure 8: Major gas pipelines accross Mediterranean.

Source: http://en.wikipedia.org/

2.2.3.5. Libya

Libya is an important trade partner of the EU in the Mediterranean area. It is not a member of WTO and Euro-Mediterranean Partnership yet, but is negotiating accessions for both. Currently due to the recent disputes and violence, the country is in a very unstable state both economically and politically. In 2010, 10.71 % of the EU's total crude oil, that was 9.55 % in 2004 and 2.3 % of its natural gas imports, that was 0.32 % were supplied by Libya. Libya had 3.3 % of the world's proven crude oil reserves in 2004 and had 3.4 % of them in 2010.

Therefore, its share in the EU's oil imports remained stable whereas its share in the EU's natural gas exports increased between 2004 and 2010. However, Greenstream Pipeline, which is the only pipeline connecting Libya and the EU as seen in Figure 8, has been closed in February 2011 due to the recent disputes in Libya. Unlike Algeria, Libya does not prefer to export its natural gas to the EU in LNG form, although it has one LNG terminal called Marsa El Brega. Therefore, currently, by August 2011, no Libyan gas is being exported to the EU.

After the recent severe disputes in the country, like the civil war and coalition intervention, the relations between EU and Libya in the near future does not seem to be very positive. There have been very serious threats by Libya both for gas and oil supply, like blowing up the energy pipelines and cutting off the contracts with Western companies. Therefore, obviously like the natural gas, the amount of oil that is exported from Libya to the EU is expected to have a decrease due to the status quo in Libya, unless Libya turns out to be a peaceful and stable democratic state.

2.2.3.6. Middle East and the Gulf Region

The Middle East and the Gulf Region are the world's richest areas in terms of non-renewable energy resources. In 2010, it had 40.5 % (of which 13.5 % is in Qatar despite its relatively small territories) of the world's proven natural gas and 54.4 % (of which 19.1 % was in Saudi Arabia) of its proven crude oil reserves. Between 2004 and 2010, the natural gas reserve share of the Middle East remained the same whereas its crude oil reserve share dropped from 61.7% to 54.4 %. Beside Saudi Arabia, Iran and Iraq has also significant amount of oil reserves. Except Iran and Iraq, all the countries in the region which have significant energy reserves are WTO members. Qatar, Saudi Arabia, United Arab Emirates, Bahrain, Kuwait and Oman are the members of The Cooperation Council for the Arab States of the Gulf (GCC). The EU established relations with the GCC countries through an agreement in 1998 to contribute to strenghten the stability of this highly strategically important region.

In 2010, 8.32 % (of which 8.07 % was from Qatar) of the EU's total natural gas imports and 17.09 % (of which 6.01 % was from Saudi Arabia) of its total crude oil imports were supplied by Middle East and the Gulf countries. However in 2004 the share of the Middle East in EU's natural gas imports were only 1.26 % (of which 1.1 % was from Qatar) and its share in EU's crude oil imports were 24.81 % (of which 12.78 % was from Saudi Arabia). As it is seen, the natural gas imports from this region increased significantly, thanks to the sharp increase in the share of gas imports from Qatar which was 8 times more in 2010 than it was in

2004. It is also interesting to observe that this increase occured despite the fact that the share of proven natural gas reserves of Qatar slightly decreased between 2004 and 2010. This fact clearly shows that there is no direct correlation between the changes of the reserves and import- export levels. Unlike natural gas, the share of crude oil imports from the region to the EU decreased because of the decrease in Saudi Arabian oil imports share which was 2 times less in 2010 than it was in 2004. However, Saudi Arabia is still the world's largest crude oil exporter. Therefore, in terms of energy trade with the EU, Saudi Arabia has lost a little importance while Qatar has become a much more important and a strategic country for EU's energy supply.

The world's largest natural gas field is in the Gulf Region. It is called The South Pars / North Dome field, located in Persian Gulf and shared between Iran and Qatar. All the natural gas exported from this region arrive in the EU in LNG (Liquefied Natural Gas) form. This is not surprising because there are 9 LNG terminals in the Gulf Region of which 6 are in Qatar. Despite its relatively small territories, Qatar is the second country in the world after Russia, in terms of its proven natural gas reserves. It is a very rich country, has the highest GDP per capita in the world by 2011, has relatively more stable politics than other Middle East countries, is the largest exporter of LNG in the world, and Qatargas is the world's largest LNG company. It is planning numerous new projects such as building new gas pipelines to make it easier to transport the gas that is performed only by LNG terminals currently. Therefore, the natural gas exports from Qatar to the EU is expected to continue its gradual increase also in the near future. Beside Qatar, Europe has not been importing significant amount of gas from other countries in the region like Iran and Iraq although they have rich gas reserves so that only 0.16 % of the natural gas imports in 2004 and 0.25 % of them in 2010 was supplied by other Middle Eastern countries. The main reasons of this can be said to be the lack of developed pipeline infrastructure in the region that would transport the gas easily to the EU and other problems in the region related to politics, democracy and human rights.

As seen in Figure 6, there are two main maritime oil flow routes from Middle East and Gulf countries to the EU. First is through the Red Sea- Suez Canal- Mediterranean; the second is through the Persian gulf- Hormuz Strait- Red Sea- Suez Canal- Mediterranean. Saudi Arabian oil arrives in the EU territories mainly via the first route whereas Iraqi and Iranian oil arrive mainly via the second route.

Over the last century and currently, many of the Middle East and the Gulf countries have been regions where there have been many disputes, conflicts, wars, instable politics and economics, lack of democracy, human rights and a modern law system. Saudi Arabia and Iran are the strictest states appyling the religious laws of Islam to all the aspects of the life. Although also the other states in the region have Islamic rules in the state level, they are more tolerant and have exceptions in their constitutions. There are also ongoing unpleasant incidents in this region. For instance, currently there are serious disputes against government in Syria; in Iraq many people die in terrorist attacks almost every week; Iran threatens the Western states using the presence of its nuclear weapons.

No energy related disputes have been experienced between the EU and the Middle East and the Gulf Region countries until now. However it is also hard to consider these countries as realiable energy suppliers. Because of the factors mentioned in the previous paragraph and the recent Arabic protests uprising almost all over Arabic nations, it would not be easy to estimate the future of the energy trade relations between Middle East and the EU.

2.2.3.7. Former Soviet Union (excluding Russia and the Baltic States)

Former Soviet Union countries had 3.7 % of the world's proven crude oil and 7.3 % of its proven natural gas reserves in 2010. 12.70 % of the EU's total crude oil imports were supplied by Former Soviet Union countries, especially from Azerbaijan and Kazakhstan in 2010, while no natural gas has been imported from these countries. In 2004 the crude oil import share of these countries in the EU imports were 6.18 %. Therefore it doubled in 6 years. As seen in Figure 5, Azerbaijan oil arrives in Europe in two major routes. The first route is through pipelines to Turkish Mediterranean coast and from there by maritime transport to the EU. The second is through pipelines to Russian Black Sea coast and then either by maritime transport to the EU or all the way through the pipelines until the EU. Kazakh oil arrives in the EU following the second route mentioned above. Azerbaijan, Kazakhstan and other post Soviet countries except Russia and the Baltic States are partners of Interstate Oil and Gas Transportation to Europe (INOGATE) programme. This energy programme will be discussed in more detail in Section 3 under the title of of Energy relations between the EU and Turkey.

Currently no natural gas is imported from these countries although their share of proven natural gas reserves gradually increased between 2004 and 2010. There are some pipeline projects that will highly affect the energy relations between these states and the EU. For

instance Nabucco Pipeline Project is currently in development phase and once initiated, the EU will start to import natural gas especially from Azerbaijan and thus will be less dependent on Russia. Nabucco Pipeline Project will be discussed in detail in Section 4 under the title of Turkey's Energy Infrastructure. Hence, the crude oil exports from Post Soviet States to the EU is expected to increase and natural gas import from these countries to the EU is expected to start in the near future.

2.2.3.8. Nigeria

In 2010, 3.44 % of the EU's total natural gas and 4.37 % of its crude oil imports were supplied by Nigeria. In 2004 these shares were 3.05 % for natural gas and 3.09 % for crude oil imports. Despite the increase in the share of the EU imports, the share of Nigeria in terms of the world's proven natural gas and crude oil reserves did not change significantly between these years. It remained around 3.0 % both for natural gas and crude oil.

All the natural gas coming from Nigeria arrive in the EU in LNG form. However, currently there are no LNG terminals in Nigeria. Nigerian gas first arrives in Algeria through Trans Saharan Pipeline as seen in Figure 8, and then shipped towards the EU after being liquefied at Algerian LNG terminals. Two LNG terminals are planned to be built on the Atlantic coast of the country. This would enable Nigeria to make LNG trade totally independently. If these terminals are built Nigeria could export more natural gas to the EU. Nigerian crude oil is shipped from the major Nigerian ports through Gibraltar Strait and then arrives in the EU.

There have been serious pipeline related security problems and incidents in the country. Nigeria has suffered from pipeline vandalism. The most severe one was when more than 250 people were killed in a pipeline explosion in the fishing village of Ilado in 2006. Besides, there have been many other similar disasters in the country over the last ten years. More than 1000 people in Nigeria died in recent years in the explosions or fires arising from pipelines. Because of these attacks, some oil refineries in Nigeria were shut down temporarily and thus the country's oil production decreased. Therefore, Nigeria's oil production rate is fluctuating due to frequent pipeline disasters. Even though Nigerian gas and crude oil share in EU's imports have increased in the last decade, it would be hard to estimate the future bilateral energy relations due to the frequent unpleasant incidents in Nigeria.

2.2.3.9. Americas

The countries in America continent had 9.3 % of the world's proven natural gas and 22.7 % of its proven crude oil reserves in 2010. Compared to 2004, the share of natural gas reserves

increased slightly while the share of crude oil reserves almost doubled. This was because of the continuous crude oil findings in Venezuela. The EU has been importing natural gas from this region since 2005, and the share of American natural gas in EU's gas imports slightly increased since then. The only natural gas exporting American country to the EU was Trinidad Tobago until when in 2010 also Peruvian gas started to be exported. All the natural gas from this region to the EU arrive in LNG form.

The share of American crude oil in the EU's crude oil imports remained almost the same between 2004 and 2010 despite the significant increase in the oil reserves. The crude oil importing countries from this region to the EU are Mexico, Brazil and Venezuela.

The majority of the oil and gas supplying countries in this region can be said to be the most stable extra EU energy suppliers of the EU in terms of politics and relations with the EU. However, long distances make the trade harder and less economical. Therefore, no significant increases are expected in natural gas and crude oil trade between the EU and American countries in near future.

2.3. Oil and Natural Gas Organizations

Some organizations were formed by oil and natural gas exporting countries for their mutual interests. The best knowns are OPEC (Organization of Petroleum Exporting Countries) and GECF (Gas exporting countries forum).

2.3.1. OPEC

This petroleum cartel was founded in Iraq in 1960. Its objective is to coordinate and unify petroleum prices between member countries to guarantee fair and stable prices; efficient and regular supply of petroleum to importer nations. Most of the EU's crude oil supplier countries are OPEC members with the exceptions of Russia and Norway that are observers; and Former Soviet oil exporting countries. OPEC member countries are: Algeria, Angola, Ecuador, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, United Arab Emirates and Venezuela. In 2010, these 12 member countries had 77 % of the world's proven oil reserves together. The headquarters of OPEC is in Vienna, Austria. The Statute stipulates that "any country with a substantial net export of crude petroleum, which has fundamentally similar interests to those of member countries, may become a full member of the organization.

Its decisions have had considerable influence on international oil prices. For example during 1973 energy crisis, OPEC refused to ship oil to Western countries that had supported Israel in

its war against Egypt and Syria. This refusal caused a fourfold increase in the price of oil. Despite it seems like supporting fair trade, OPEC has been criticized since it became effective in determining oil prices and production. Most of the member countries are non-democratic states with unstable politics. Therefore, one day these countries might use the oil as a strategic weapon against the importer countries.

2.3.2. GECF

It was established in Iran in 2001. It is an intergovernmental organization of some of the world's leading natural gas producers. The member countries are Algeria, Bolivia, Egypt, Equitorial Guinea, Iran, Libya, Nigeria, Qatar, Trinidad and Tobago and Venezuela. In 2010 these member countries had 64 % of the world's proven natural gas reserves together. Its headquarters is in Doha, Qatar. Its objective is to strenghten the collaboration between members and to promote a stable and transparent gas market. GECF exchanges views and information on worldwide gas development projects, gas supply and demand balance, gas exploration, production and transportation technologies, the associated costs, ways and means of improving the share of gas in the energy mix as well as other utilizations of gas, Kyoto Protocol and other international conventions and its impact on gas consumption.

Most of the EU's natural gas suppliers are members of GECF except Norway and the Netherlands that are observer countries. Unlike OPEC, GECF is not a gas cartel. However especially Iran and Russia intend to create a gas cartel equivalent to OPEC in order to set gas quotas and prices which have caused speculations since GECF was founded. This could be the reason why Norway and the Netherlands doubt whether to become full members and therefore not to support the possible unfair trade.

2.4. Means of energy transport

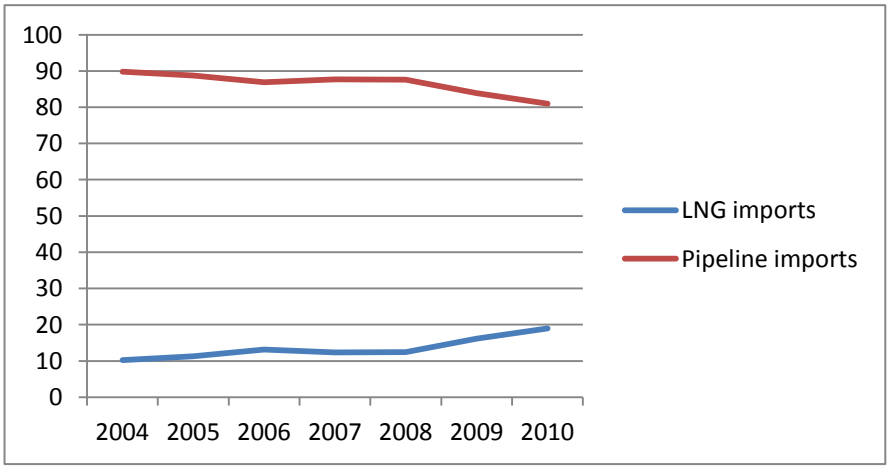
Since oil and natural gas consumption and production are not at equal quantities in the same places, international oil and natural gas trade is a necessity to compensate the inequalities between supply and demand. An extensive transportation system is required for the effective movement of natural gas from production regions to consumption regions. Natural gas or crude oil from a particular resource usually have to travel long distances to reach its point of use. Natural gas and crude oil are resources of strategic importance. Therefore, the most efficient and effective means of transport must be chosen depending on logistics, economics and location, as well as environmental considerations.

2.4.1. Modes of natural gas transportation

Natural gas is transported in liquified natural gas (LNG) form or through pipelines. Until now, pipeline flows between countries or continents have largely dominated the international gas trade. Therefore, generally natural gas trade by pipelines are preferred over LNG trade if pipelines exist between trading partners. The mode of transportation differs according to where natural gas comes from. Nearly all the natural gas imported by the EU from Americas, Africa, Middle East and the Gulf countries arrive in Europe in LNG form. However, those coming from inside Europe, Russia and other former Soviet Union countries arrive through pipelines. These changes can be explained by the infrastructure and costs. Generally, natural gas trade by pipelines are preferred over LNG trade.

As seen in Figure 9, in the EU natural gas trade through pipelines was much more common than LNG trade that more than 80% of natural gas imports arrived in the EU through pipelines between 2004 and 2010. Therefore, pipeline trade is preferred over LNG trade. However, LNG trade has gained more importance and its share in natural gas transport has increased from 10.2 % in 2004 to 19% in 2010. Currently there are 18 already in operation, 3 under construction and 8 planned LNG regasification terminals in the EU. The increasing percentage of LNG trade over the past recent years and the regasification terminal projects clearly show that LNG trade is becoming more common in the EU.

Figure 9: The percentages of LNG and pipeline natural gas imports of the EU between 2004 and 2010.



Source: BP Statistical View of World Energy

The economics accordingly represent the most important criteria in the setting up of natural gas imports and exports. However, political and technical parameters of each project also finally determine where the economic breakeven point between transportation by pipeline or LNG. Therefore they are always applied in the choice of any large natural gas export scheme.

2.4.1.1. Liquified natural gas (LNG) form

Liquefied natural gas (LNG) is natural gas that has been converted temporarily to liquid form to facilitate the storage or transport. The volume of LNG is up to 1/600 of the volume of natural gas in the gaseous state. This reduction of volume makes it much more cost effective to transport over long distances where there are no pipelines. Natural gas can be transported by specially designed LNG carriers when it is not possible or economical to move it by pipelines. A typical LNG process is composed of three main steps: First of all, the gas is extracted and then transported to a processing plant where it is purified by the removal of the substances like water, oil, mud, mercury and other gases like H_2S and CO_2. Second, the gas is cooled down to the temperatures and stages until it is liquefied. Finally, LNG is stored in storage tanks where it can now be loaded and shipped. In order to move natural gas, LNG terminals are used. These terminals are ports that are built and used exclusively to export or import LNG. There are two types of LNG terminals: liquefaction terminals and regasification terminals. In essence at liquefaction terminals, LNG is loaded onto ships and then delivered to a regasification terminal, where the LNG is reheated and turned into gas.

LNG projects are very much capital intensive. A single-train plant normally costs around $1 billion, although actual costs vary geographically according to land costs, environmental and safety regulations, labour costs and other local market conditions. Adding a second train once a plant is built can reduce the overall unit cost of liquefaction by 20-30%. Transport costs are largely a function of the distance between the liquefaction and regasification terminals and the size of the vessel. Using a larger number of smaller carriers offers more flexibility and reduced storage requirements but raises unit shipping costs. LNG costs vary considerably in practice, largely as a function of capacity, particularly the number of trains in liquefaction plants and shipping distance.

2.4.1.2. Pipeline

The transport of natural gas and crude oil through pipelines have the same principles. The transportation system for natural gas/crude oil consists of a complex network of pipelines, designed to transport natural gas/crude oil from its origin to consumption areas efficiently.

Pipelines are the most efficient method to transport natural gas/crude oil and refined products. They are made of steel or plastic tubes. Pipelines are used to move natural gas/crude oil from its origin to field gathering systems and processing facilities, and from there to refineries and tanker loading facilities. There are three main types of pipelines along the transportation route: the gathering system, the pipeline system, and the distribution system. Basically, natural gas/crude oil is collected from field gathering systems which consist of pipelines that move oil from the origin to storage tanks and treatment facilities. From the gathering system the crude oil is sent to a pump station where the natural gas/crude oil is delivered to the pipeline. The pipeline may have many collection and delivery points along the route. The delivery points may be refineries, where the natural gas/crude oil is processed into products, or shipping terminals, where the oil is loaded onto tankers.

A pipeline may handle several types of crude oil. The pipeline schedules its operation to make sure that the right crude oil is sent to the correct destination. Crude oil may also move over more than one pipeline system as it journeys from the oil field to the refinery or shipping port. Storage is located along the pipeline to guarantee smooth continuous pipeline operation.

Large-diameter and long distance pipelines imply very high capital investment. They require both large, high-value markets and substantial proven reserves to be economically viable. Capital charges typically make up at least 90% of the cost of transmission pipelines. The key determinants of pipeline construction costs are diameter, operating pressures, distance and terrain. Other factors, including climate, labour costs, the degree of competition among contracting companies, safety regulations and population density. These factors may cause construction costs to vary significantly from one region to another. Since pipeline transportation is less complex than the LNG process, cost reductions have been less impressive. However, substantial improvements have been achieved in optimizing project design and construction, inspection activities, laying and welding methods, steel quality and weight, thus reducing material costs and the period of construction. Increased competition among inspection service companies also contributed to reduce the overall cost. In short, despite their high capital costs which are much higher when pipelines are built under water, pipelines provide the lowest unit costs among all crude oil transport methods as seen in Figure 10.

2.4.2. Modes of crude oil transportation

Figure 10: Comparison of the modes of crude oil transportation.

	Pipeline	Marine	Rail	Truck
Volumes	Large	Very large	Small	Large
Materials	Crude / Products	Crude / Products	Products	Products
Scale	2 ML+	10 ML+	100 kL	5-60 kL
Unit costs	Very low	Low	High	Very high
Capital costs	High	Medium	Low	Very low
Access	Very limited	Very limited	Limited	High
Responsiveness	1-4 weeks	7 days	2-4 days	4-12 hours
Flexibility	Limited	Limited	Good	High
Usage	Long haul	Long haul	Medium haul	Short haul

Source: http://www.petrostrategies.org/Learning_Center/Oil_Transportation.htm

2.4.2.1. Pipeline

As the transportation of natural gas and crude oil through pipelines have the same principles, they have been explained together in the section of "Modes of natural gas transportation" of this chapter.

2.4.2.2. Marine

Crude oil tankers are used for commercial journeys between a port of origin and destination. As seen in Figure 10, the largest volumes of crude oil can be transported via marine transport. They transport crude oil from the world's major oil fields in the Middle East, the North Sea, Africa, and Latin America to refineries around the world. In the second step, product tankers carry refined products from refineries to terminals. Tankers are various in size. Small ones are used to transport refined products while crude oil carrying ones are much bigger. Tanker sizes are considered in terms of cargo tons or deadweight. The smallest tankers are called "General Purpose" and used to transport refined products. The bigger ones that are called "Large Range" and "Very Large Crude Carriers" are used in international crude oil trade. The larger the ship is, the unit cost of transport crude oil is reduced. The size of these tankers depend on the tanker's length, its loaded depth and the size of the loading and unloading ports. The size of the ship depends on the length of the journey and the quantity demanded. Unit transportation costs might vary depending on the loading and unloading ports, they are not the same all around the world.

Reliable transport is extremely important for the international energy market. Maritime transport of crude oil is considered to be quite safe and convenient. However, there are some risks. During maritime transport, ships usually have to pass along the narrow waterways that are called chokepoints. World's major chokepoints were already seen in Figure 6. The blockage of a chokepoint, might lead to substantial increases in total energy costs even though it is temporary. In addition, at the chokepoints oil tankers might experience undesirable and unexpected incidents like theft from pirates, terrorist attacks, hostilities and shipping accidents that can lead to oil spill disasters.

2.4.2.3. Rail and truck

The main advantage of truck and rail transport is that the delivery time is much shorter than other transport methods. These are conventional methods, especially trucks are accessible all around the world. These are generally used only as a complementary part of the crude oil journey after pipelines and marine transport. As they carry very small quantities of crude oil products, unit costs are high and thus the efficiency is low. However, trucks and trains are widely used all around the world as a part of oil transport.

3. TURKEY – EUROPEAN UNION RELATIONS

3.1. Brief history of Turkey- EU Relations

Turkey is the only pluralist secular democracy in the Islam world and has always attached great importance to develop its relations with other European countries. In the history, Turkish culture has had an important impact over much of Eastern and Southern Europe. Turkey began "westernising" its economic, political and social structures in the 19th century. Following the First World War and the proclamation of the Republic in 1923, it chose Western Europe as the model for its new secular structure.

After the World War II, Europe was divided into two blocks which are East and West. Turkey has ever since closely aligned itself with the West and has become a founding member of the United Nations, a member of NATO, the Council of Europe and the OECD. During the Cold War, Turkey was a part of the Western alliance, defending freedom, democracy and human rights. In this respect, Turkey has played and continues to play a vital role in the defence of the European continent and the principal elements of its foreign policy have converged with those of its European partners. Having entered into very close cooperation with Western Europe in the political field, it was therefore only natural for Turkey to complete this in the economic area.

3.1.1. Turkey's application to the EU and current situaiton

Full membership of the European Union has always been one of the most important objectives of Turkish foreign policy and the strategic goal of Turkey. Turkey has always been interested in the accession to the EU. The first applications for the union dates back to 1950's which European Economic Community (EEC) was just founded. The union was called EEC until it renamed as the EU in 1993. In September 1959, for the first time Turkey applied for associate membership to the EEC, which is now the EU. This attempt resulted in associate membership in Ankara Treaty signed in 1963. The main objective of Ankara Treaty was to promote the continuous strengthening of trade and economic relations between the parties, while taking into account the need to ensure accelerated development of the Turkish economy to improve the level of living conditions and employment of the Turkish people. However, because of the problems in Turkish foreign policy such as the Cyprus conflict and the internal political turbulence of the country in the 1970s until the early 1980s, Turkey's application for full membership was delayed until when it applied for full EEC membership in 1987. However it was recognised as a candidate country for the EU in Helsinki European Council in

December 1999, twelve years after the application. This was a very important milestone in Turkey-EU relations.

Besides, the EU established a Customs Union with Turkey in 1995. Thus, a common trade policy was implemented to guarantee the free movement of goods between the parties without any barriers. As well as the free movement of goods, Custom Union brought some certain EU policies to Turkey such as Intellectual Property Law, fair competition and technical regulation of products. In essence, Turkey is the only candidate country that has a customs union with the EU. At least considering the trade in goods, Turkey can be considered as almost a part of the Single Market of the EU. This union is a very important step in terms of the modernization of the Turkish economy and its integration into the world trade system. The Customs Union is considered to be the most important progress in Turkish economy, since the economic liberalization measures launched in the country in 1980s. The main aim of the union is the establishment and improval of long term mutual economic and commercial relations.

Between the years 2000-2004 significant reforms were realized in many aspects in Turkey and as a result, in October 2004 European Commision declared that Turkey sufficiently meets the Copenhagen political criteria and thus recommended the opening of accession negotiations. Finally, the European Council, held in Brussels in December 2004, decided to open accession negotiations with Turkey in 3 October 2005, when the accession process was formally initiated. This incident was a very important milestone in the EU integration process of Turkey. After this important step, Turkey gradually shifted from the candidacy to accession process.

Since the negotiations started, many chapters were opened. Some of these chapters are: Enterprise and Industry, Trans-European Networks, Science and Research, Consumer and health protection, Financial Control and Statistics, Intellectual property, and Company law. However, only one of the chapters, Science and Research was closed by the EU since then.

In December 2006, Turkey was asked to implement a trade pact between Turkey and the EU, that requires the Turkish Government allow Greek Cypriot vessels to use its air and sea ports. When Turkey rejected it, the EU froze the opening of eight new chapters and the closing of the already opened chapters until the continued dispute in Cyprus is resolved. The eight chapters are: Right of Establishment and Freedom to Provide Services, Free Movement of Goods, Agriculture and Rural Development, Fisheries, Customs Union, External Relations,

Financial Services and Transport Policy. Therefore, currently the EU accession process of Turkey has decelerated.

3.1.2. Key dates in Turkey's path towards the EU

September 1959 - Turkey applies for associate membership of the European Economic Community (EEC).

September 1963 - An association agreement (known as the Ankara Agreement) is signed, aiming at bringing Turkey into a Customs Union with the EEC and to eventual membership. A first financial protocol to the initial agreement is also signed.

November 1970 - The Additional Protocol and the second financial protocol are signed in Brussels, preparing the ground for the establishment of the customs union.

April 1987 - Turkey makes an application for full EEC membership.

May 1995 - Turkey-EU Association Council finalises the agreement creating a customs union between Turkey and the EU.

December 1997 - At Luxembourg European Council, Turkey is declared eligible to become a member of the European Union.

December 1999 - EU Helsinki Council recognises Turkey as an EU candidate country on an equal footing with other candidate countries.

March 2001 - The Council adopts the Accession Partnership for Turkey.

May 2003 - Adoption by the Council of a revised Accession Partnership for Turkey.

October 2004 - The Commission presents its Recommendation on Turkey's Progress towards accession along with its paper Issues Arising from Turkey's Membership Perspective.

December 2004 - The European Council defines the conditions for the opening of accession negotiations.

June 2005 - The Commission adopts a Communication on the civil-society dialogue between the EU and Candidate countries. This communication sets out a general framework on how to create and reinforce links between civil society in the EU and candidate countries.

October 2005 - Adoption by the Council of a Negotiating Framework setting out the principles governing the negotiations followed by the formal opening of Accession negotiations with Turkey.

October 2005 - Starting of the screening process concerning the analytical examination of the acquis.

December 2005 - Adoption by the Council of a revised Accession Partnership for Turkey.

June 2006 - Negotiations are opened and closed on the chapter Science and Research

December 2006 - Due to the Turkish failure to apply to Cyprus the Additional Protocol to the Ankara Agreement, the Council decides that eight relevant chapters will not be opened and no chapter will be provisionally closed until Turkey has fulfilled its commitment. The eight chapters are: Free Movement of Goods, Right of Establishment and Freedom to Provide Services, Financial Services, Agriculture and Rural Development, Fisheries, Transport Policy, Customs Union and External Relations.

March 2007 - Negotiations are opened on the chapter Enterprise and Industry

June 2007 - Negotiations are opened on two chapters: Financial Control and Statistics.

December 2007 - Negotiations are opened on two chapters: Trans-European Networks and Consumer and health protection

February 2008 - Adoption by the Council of a revised Accession Partnership for Turkey.

June 2008 - Negotiations are opened on two chapters: Intellectual property and Company law.

3.2. Turkey- EU economic relations

3.2.1. An overview of the economy of Turkey

Turkey's economy is increasingly driven by its industry and service sectors, although its traditional agriculture sector still accounts for about 30% of employment. An aggressive privatization program has reduced state involvement in basic industry, banking, transport, and communication, and an emerging cadre of middle-class entrepreneurs is adding dynamism to the economy. Oil began to flow through the Baku-Tbilisi-Ceyhan pipeline in May 2006, marking a major milestone that will bring up to 1 million barrels per day from the Caspian to

market. Several gas pipelines also are being planned to help move Central Asian gas to Europe via Turkey, which will help address Turkey's dependence on energy imports over the long term. After Turkey experienced a severe financial crisis in 2001, Ankara adopted financial and fiscal reforms as part of an IMF program. The reforms strengthened the country's economic fundamentals and ushered in an era of strong growth - averaging more than 6% annually until 2008, when global economic conditions and tighter fiscal policy caused GDP to contract in 2009, reduced inflation to 6.3% - a 34-year low - and cut the public sector debt-to-GPD ratio below 50%. Turkey's well-regulated financial markets and banking system weathered the global financial crisis and GDP rebounded strongly to 7.3% in 2010, as exports returned to normal levels following the recession. The economy, however, continues to be burdened by a high current account deficit and remains dependent on often volatile, short-term investment to finance its trade deficit. The stock value of FDI stood at $174 billion at year-end 2010, but inflows have slowed considerably in light of continuing economic turmoil in Europe, the source of much of Turkey's FDI. Further economic and judicial reforms and prospective EU membership are expected to boost Turkey's attractiveness to foreign investors. However, Turkey's relatively high current account deficit, uncertainty related to policy-making, and fiscal imbalances leave the economy vulnerable to destabilizing shifts in investor confidence.

3.2.2. An overview of the economy of the European Union

The European Union has the largest wealthiest economy, and is the first trade power in the world. Trade within the EU accounts for more than one-third of the world total. Internally, the EU has abolished trade barriers by adopting a common single market that enables the free movement of goods between member countries. It also adopted a common currency called euro that is used by a majority of the member countries. The Stability and Growth Pact (that is an agreement between the countries in the euro zone) sets out the fiscal criteria to maintain for stability and economic convergence. It applies to all member states, with specific rules which apply to the euro zone members that stipulate that each state's deficit must not exceed 3% of GDP and its public debt must not exceed 60% of GDP. The EU is striving toward convergence of living standards. Internationally, the EU aims to bolster Europe's trade position and its political and economic power. However there are some problems. Because of the great differences in GDP per capita income among member states (from US $7,000 to US $78,000) and in national attitudes toward issues like inflation, debt, and foreign trade, the EU faces difficulties in devising and enforcing common policies. Nevertheless, significant risks to

growth remain, including, high official debts and deficits, aging populations, over-regulation of non-financial businesses, and doubts about the sustainability of the EMU. However, Turkey would like to join the EU mostly because of economic motivations. Because the EU offers many economic benefits to its members. The member states can move goods and capital from one member country to another without any restriction or barrier thanks to the common single market policy. Also the residents of any EU member state are free to offer their services to other member states. The EU members have to follow unified economic laws and their economies are protected against hyperinflation and volatility in the monetary market. Moreover, all farm zones of member states are provided with better equipment that enables improved efficiency in agriculture. Besides, it is observed that the twelve new member states of the European Union (EU 12) that became members over the past years have enjoyed a higher average percentage annual GDP growth rate than their elder members of the EU. Therefore it is obvious that Turkey's economy would benefit from a possible EU membership.

3.2.3. Economic relations and trade between Turkey and the EU

Outward-looking economic policies appeared in Turkey in 1980, however the military coup that occured in the same year damaged Turkey-EU relations and obviously caused a decline in bilateral exports and imports. After the reactivation of Association Agreement between EU and Turkey in 1986, trade between two parties increased significantly. Turkey's trade policy aims to effectuate the free and fair trade principle in its relations. For this purpose, Turkey is a member of the World Trade Organization (WTO). Currently, Turkey has an important trade relationship with the EU so that half of Turkey's entire trade is made with the EU. It can be said that Turkey's economy is highly dependent on the trade with the EU, since EU has been Turkey's largest and most important trade partner over the years. Therefore, Turkey has been trying to implement the preferential trade agreements and relations that EU prefers, in order to prevent possible trade differences. For this purpose, Turkey became one of the countries that European Free Trade Agreement (EFTA) have established preferential trade relations.

Turkey has been implementing an export-oriented strategy since 1980. The main objective of this strategy is to constitute an outward oriented economic structure in the framework of free market economy and to be integrated with world markets. With this new strategy, export intensive measures consisting of various supportive components and arrangements were directed to the foreign trade liberalization.

According to the statistics of 2010, being Turkey's number one major trade partner, EU ranks number one in both exports and imports of Turkey, whereas Turkey ranks 7th in the EU's top import and 5th in its export markets. Therefore, it can be said that economy of Turkey is dependent on the trade with the EU to a great extent, and not necessarily vice versa.

As seen in Table 8, the EU exported to Turkey more than it imported from Turkey between 2006 and 2010. There have not been significant differences in Turkey's share in European Union's imports and exports. However, the total volume of exports and imports increased except in 2008 and 2009. In 2009, both exports and imports decreased sharply both in Turkey and in the EU due to the economic recession that occured as a result of the global financial crisis.

Table 8: European Union's trade with Turkey between 2006 and 2010.

Period	Imports	Turkey's share in total EU imports (%)	Exports	Turkey's share in total EU exports (%)	Balance
2006	41720	3.1	50038	4.3	8318
2007	47028	3.3	52643	4.2	5615
2008	46020	2.9	54136	4.1	8116
2009	36163	3.0	44123	4.0	7690
2010	42088	2.8	61190	4.5	19102

* The numbers of the exports and imports are in millions of euros

Source: http://trade.ec.europa.eu/doclib/docs/2006/september/tradoc_113456.pdf

As seen in Table 9, between 2006 and 2010, Turkey imported from the EU more than it exported to the EU in terms of the trade volume. This caused a trade deficit by Turkey's trade with the EU. This trade deficit almost doubled from 2008 to 2010. Besides, the volume of both EU imports and exports increased except in 2008 and 2009. The EU share of total imports from Turkey decreased whereas its share of total Turkish exports decreased between 2006 and 2010.

Especially thanks to the Customs Union, the volume of trade between Turkey and the EU member states has significantly increased. Within the Customs Union, Turkey applies the

same common commercial policy measures with the EU. The preferential trade regime is considered as the most important part of the trade policy with the Common Customs Tariff. For this purpose, Turkey provides a common external tariff for the products covered. The average of Turkey's weighted rates of protection through custom duties on industrial imports from the European Union and EFTA countries dropped from approximately 10% to 0%, while the average protection rate decreased from approximately 16% to 4.2% as of 2010 for products imported from third countries.

Table 9: Turkey's trade with the European Union between 2006 and 2010.

Period	Imports	EU's share in total imports to Turkey (%)	Exports	EU's share in total exports from Turkey (%)	Balance
2006	47192	43.1	38111	56.4	- 9081
2007	49910	40.8	43974	56.8	- 5937
2008	50559	37.3	42916	47.9	- 7643
2009	40432	40.5	33585	45.9	- 6848
2010	54606	39.3	39788	46.3	-14818

* The numbers of the exports and imports are in millions of euros

Source: http://trade.ec.europa.eu/doclib/docs/2006/september/tradoc_113456.pdf

In addition to this, the Customs Union foresees that Turkey is to align to the "acquis communautaire" (the accumulated legislation, court decisions and legal acts that constitute the body of European Union law) in several essential internal market areas, notably with regard to industrial standards. Shortly after the Customs Union came into force, in 1996 a free trade area was established between Turkey and the European Union for products covered by the European Coal and Steel Community. Turkey is also a member of the Euro-Mediterranean partnership and as such should conclude free trade agreements with all other Mediterranean partners, with a view to the creation of a Euro-Mediterranean free trade area with all the countries that have Mediterranean coastline, including the EU states.

3.2.4. Foreign Direct Investment (FDI) from the EU to Turkey

When The Association Agreement was signed between the EU and Turkey in 1986, FDI from the EU to Turkey had a significant increase until 1991. However in 1991, a sharp fall occured due to the breakdown of the Soviet Union. Obviously, the EU shifted its investments to changing Eastern and Central European states when it became possible to invest in these countries due to the fall of their socialist regimes. In 1996, when Turkey joined the Customs Union, European FDI in Turkey reached the peak level that was 85.61 %. Because the economic regulations of Turkey have become more smilar to those of the EU, and this made it easier for European firms to invest in. Currently, Turkey is the 15th most attractive destination for Foreign Direct Investment (FDI) in the world according to UNCTAD World Investment Prospects Survey, and Ireland is at the top of the list.

As seen in Table 10, both total net FDI inflow and FDI from the EU to Turkey fluctuated between 2005 and 2009. Total net FDI inflows from the EU reached its maximum point in 2007 thanks to the continuous liberalization of investment policies and trade regimes. It reached its minimum level in 2009 due to the global economic crisis. However, it is interesting to observe that FDI in energy has continuously increased significantly even during the crisis period. Energy FDI inflows to Turkey increased about 400 times between 2005 and 2009, even though the total net inflows decreased.

Table 10: FDI inflows to Turkey in Million US $ between 2005 and 2009.

Years	**2005**	**2006**	**2007**	**2008**	**2009**
Total net FDI inflow	8535	17639	19137	14733	5694
of which energy	4	112	568	1068	1646
Total net FDI inflow from the EU	4267	12665	10946	8928	3337
% of EU in total net FDI inflow	50 %	71.8 %	57.2 %	60.6 %	58.6 %

Source: http://www.yased.org.tr

Unfortunately, Turkey has always attracted very low inflows of FDI relative to other comparable countries and as seen in Table 10, these inflows have not been increasing to desired levels. Several reasons for this low performance can be listed as structural barriers, heavy bureaucratic requirements, macroeconomic instability, corruption and political instability.

As seen in Table 11, between 2005 and 2009 FDI inflows to Turkey were gradually shifted from service to industry sector, especially to energy industries. The share of energy investments in total FDI to Turkey increased rapidly from 0.04 % in 2005 to 28.9 % in 2009.

Table 11: Percantage FDI Inflows to Turkey in different sectors between 2005 and 2009 in Million US $.

Sectors	**2005**	**2006**	**2007**	**2008**	**2009**
Industry (except energy)	9.7 %	11.4 %	23.7 %	27.6 %	32.3 %
Energy	0.04 %	0.6 %	2.97 %	7.25 %	28.9 %
Services	90.2 %	88.0 %	73.2 %	64.8 %	38.0 %
Agriculture, Forestry, Fishing	0.06 %	0.01 %	0.13 %	0.35 %	0.8 %

Source: http://www.yased.org.tr

Although total FDI inflows to Turkey are not at desired level, the continuous increase in FDI energy inflows despite the economic crisis shows the incresing attractiveness of Turkey in energy investments. The main reasons of this attractiveness are:

- Turkish energy market offers a wide range of activities, from crude oil exploration to distribution and export of oil and petrochemical products, and from electricity generation based on all known energy sources to machinery and equipment manufacturing.
- Turkey functions as an important energy terminal in its region due to its strategic location between Asia and Europe.
- Turkey possesses a significant number of rivers and lakes (with approximately 36,000 MW of energy potential), which offers ideal opportunities for the small and large-scale energy companies.
- In terms of its geothermal energy potential, Turkey ranks 7th in the world and 3rd in Europe. Once all planned investments in the geothermal energy sector are made, the total value-added amount to the economy will be US $ 16 billion per year.
- With its high potential in agriculture and installed capacity in biodiesel and bio-ethanol, Turkey can be the bio-fuel supply center of Europe.

- According to a survey conducted by the General Directorate of Energy Affairs, the electricity demand in Turkey will increase from 196,000 GW in 2008 to 363,000 GW in 2017, while the total installed capacity will double up to 96,000 MW until 2023 to meet the demand.
- In order to establish a common energy market with the EU, Turkey plans to interconnect its energy system with UCTE (Union for the Coordination of Transmission of Electricity) grid.
- The government provides feed-in tariff incentives for the renewable energy investments.
- Turkey ranks 1st in the world in terms of highest growth rate in wind energy plants and only 15 % of its potential has been utilized up until now.

3.3. Energy relations between EU and Turkey

Turkey is becoming a very important worldwide energy hub as a natural result of its geographical location. Although it does not have rich fuel energy resources, its location makes Turkey very important geopolitically. This is because of its lucky location between countries that have 70 % of the world's oil and gas reserves to its east, north and south and together with one of the world's biggest energy markets to its west. Turkey's role is very important as it forms a natural corridor through which natural gas from a wide variety of suppliers, from the Caspian through the Middle East and the Gulf to Egypt, can access the growing EU market by pipelines. As it was mentioned in detail in Chapter 2, currently the EU is supplied large volumes of natural gas from three main regions which are Russia, the North Sea and North Africa. Turkey's goal is to become Europe's fourth main artery indirectly. These factors make Turkey inevitable for the EU's energy supply security.

Moreover, the Turkish Straits, Bosphorus and Dardanelles, are among the busiest major chokepoints of the world. Bosphorus by itself is the 5th busiest waterway in the world in terms of the tons of oil shipped. Millions of tons of crude oil coming from Black Sea ports, especially the majority of Caspian oil production, have to pass through these waterways to arrive in the EU or elsewhere. This shows how important Turkey's role is as a transit point in the EU's crude oil supply.

The EU and Turkey cooperates in energy issues. This cooperation covers, the establishment and development of Trans-European energy networks and the promotion of proper

interconnection of national networks of both parties. However, according to the statistics, it cannot be said that Turkey and the EU are partners in energy trade because both sides have scarce sources of non-renewable energy. Only 0.46 % of Turkey's imported natural gas is supplied by the EU. More than 75% of this amount is imported from Norway while the rest comes from Belgium. On the other hand, Turkish natural gas imports corresponds to only 0.16 % of total natural gas imported to the EU. All this natural gas coming from Turkey arrives in the EU in Greece through pipelines.

Like natural gas, only 0.33 % of Turkey's imported crude oil is supplied by the EU, of which all comes from Italy; whereas no crude oil is exported from Turkey to the EU. Turkey is surrounded by countries like Iran, Iraq, Syria and relatively close to others like Russia and Saudi Arabia, which have very rich natural gas and oil reserves. These countries are Turkey's major natural gas and/or oil suppliers. Therefore it is not surprising that Turkey prefers making energy trade with its neighbouring or geographically closer countries with the richest reserves in the world as it is more feasible, rather than making it with the EU.

Turkey makes electrical energy trade only with few countries of which non of them are members of the EU. This is because Turkey is self sufficient in electricity. It exports electrical energy to Iraq, Azerbaijan and Syria; while imports it from Turkmenistan and Georgia. The total quantity of electrical energy that Turkey exports is more than that of it imports. Therefore, Turkey's trade balance of electrical energy has always been positive for the past couple of years even though the quantities have been fluctuating as seen in Table 12.

Table 12: Turkey's trade balance of electrical energy in megawatt hours (MWh) between 2006-2010

Years	2006	2007	2008	2009	2010
Balance in quantity	4640919	1177426	1559009	2947192	3305435

Source: http://www.trademap.org

The volume of energy and electricity trade between Turkey and the EU is low. However this is not surprising and does not mean that Turkey is not in good relations with the EU in energy trade. In short, Turkey is a very important transit country for EU's energy supply rather than a trade partner.

Since Turkey and EU has similar energy strategies and policies, they have been collaborating in energy issues for their mutual benefits. For this purpose, Turkey and the EU countries are members or in observer status in many international energy organizations together. The most important ones of these organizations are Energy Community, Euro-Mediterranean Cooperation, IEA (International Energy Agency), INOGATE (Interstate Oil and Gas Transportation to Europe) and ERRA (Energy Regulators Regional Association).

3.3.1. Energy Community

In 2005, Energy Community was established between the EU and a number of third countries, that are called contracting parties on the European continent. The main purpose of this community is to extend the EU internal energy market to South East Europe and beyond, and to create a regional electricity and natural gas market in South East Europe. The Energy Community aims at establishing a common regulatory framework for energy markets in contracting parties by the import of the EU energy policy into non-EU countries. It covers the relevant fields of energy, environment, and competition of the EU legislation. The community deals with electricity, natural gas, and petroleum products. The members of the Energy Community are all EU states, all former Yugoslavia states, Ukraine, Moldova and Albania. Currently Turkey is in observer status with Norway and Geogia. Turkey's membership would bring these mutual benefits for South-Eastern Europe, the EU and Turkey:

- The Treaty provides energy connections with South East Europe, and then through the region to the Middle East, Caspian Region, Central Asia and the Mediterranean for the EU. Therefore, the EU would have new alternative suppliers and energy routes for diversification of its energy market.
- Thanks to the interconnections, the EU will have a fully integrated single energy market, which provides more competitiveness for its consumers. On the other hand, this integration brings Turkey and the South-Eastern Europe an efficient and stable market with the energy principles of the EU.
- The dominant Russian energy dependency of the EU, all the other community members and Turkey can be reduced. Thus, the security of energy supplies of all the parties will be enhanced by diversification and reducing import dependency.

3.3.2. Euro – Mediterranean Cooperation

Turkey is also a member of the Euro-Mediterranean Cooperation. This cooperation covers the EU and all the countries that have a Mediterranean Sea coastline except Libya which is in

observer status. The main objectives of the cooperation are to achieve a common area of peace and stability based on respect for human rights and democracy, to establish an economic and financial partnership and the gradual construction of a free-trade area and to cooperate in social, cultural and humanity issues to encourage understanding between people and cultures. Moreover under this partnership, energy is a very important sector for collaboration linked to the energy supply security of the EU because of these reasons:

- The geographical proximity of the Mediterranean countries of which many of them are energy exporters or potential exporters to the EU.
- The existence of significant oil and gas reserves in some partner countries which offer an important security of energy supply for the EU, as it depends on external energy sources.

3.3.3. International Energy Agency (IEA)

IEA was established in the framework of the Organisation for Economic Cooperation and Development (OECD) in 1974 as a response to the 1973/74 oil crisis. Turkey is one of the founding members of this organization. The initial target was to help countries deal with major disruptions in oil supply together, through the release of emergency oil stocks to the markets. IEA member countries are composed of OECD member countries except Mexico, Chile, Slovenia, Iceland, Estonia and Israel. Most IEA countries are considered as developed countries with high-income economies and with a high Human Development Index (HDI). The members have agreed to share energy information, to coordinate their energy policies and to cooperate in the development of their energy programmes that ensure energy security, encourage economic growth and protect the environment. Today IEA focuses on four main areas which are energy security, economic development, environmental awareness and engegament worldwide.

3.3.4. INOGATE (Interstate Oil and Gas Transportation to Europe)

INOGATE is an international energy cooperation programme between the EU, Turkey and post-Soviet states except Russia, Estonia, Lithuania and Latvia. It was established in 1995 and was particularly concerned with the development and enhancement of gas and oil pipelines running through and from Eastern Europe, Caucaus and Central Asia to the EU. By the time it evolved to be a broad energy partnership between member countries beyond concerning oil and gas pipelines only. It is also concerned with broad energy security strategies of member states. The main objectives of INOGATE are: enhancing energy security, converging energy

markets according to the principles of the EU energy market, supporting sustainable energy development and attracting investment towards the energy projects of common interest.

INOGATE is quite important for the EU's energy security since it is the only energy cooperation programme that enables the EU to cooporate in energy with countries like Kazakhstan, Turkmenistan and Azerbaijan. There countries have natural gas and crude oil reserves, but they are not EU's main energy suppliers. Having closer energy relations with these countries, the EU could diversify its energy suppliers by using these alternative countries and thus could reduce its dependence on Russia.

3.3.5. Energy Regulators Regional Association (ERRA)

The Energy Regulators Regional Association (ERRA) is a voluntary organization comprised of independent energy regulatory bodies primarily from the Central European and Eurasian region, with affiliates from Asia, the Middle East and the USA. ERRA has 24 full member countries of which eight of them are in the EU. These EU countries are: Bulgaria, Estonia, Hungary, Latvia, Lithuania, Poland, Romania and Slovakia. Other ERRA members are: Albania, Armenia, Azerbaijan, Bosnia and Herzegovina, Croatia, Georgia, Kazakhstan, Macedonia, Moldova, Mongolia, Montenegro, Russia, Serbia, Turkey and Ukraine. It is interesting to observe that almost all the member countries are Former Soviet Union, Former Yugoslavia and Eastern Bloc states. The Association's main objective is to increase exchange of information and experience among its members and to expand access to energy regulatory experience around the world.
The Founding Members identified the purpose of ERRA as follows:

- To improve national energy regulation in member countries,
- To foster development of stable energy regulators with autonomy and authority and to improve cooperation among energy regulators.
- In addition, the Association strives to increase communication and the exchange of information, research and experience among members and increase access to energy regulatory information and experience around the world and promote opportunities for training.

ERRA has also carried out training for regulators on behalf of the INOGATE programme that has already been mentioned in this chapter.

4. THE ROLE OF TURKEY IN DIVERSIFYING THE ENERGY SUPPLY OF THE EU

4.1. Introduction

European Union countries do not have rich energy resources and obviously its energy production do not meet the excess demand of highly industrialized member coutries. As it was mentioned in Chapter 2, the EU imports its energy from few number of countries. In this chapter, Turkey's position in the need to diversify the energy supply of the EU is analyzed.

4.2. Diversifying the energy supply of the EU

In the global energy market there are few suppliers, however the demand is very big, especially in Europe. The most important energy supplier of the EU is Russia. Other important suppliers are some of the countries situated in the Middle East, Gulf region, Former Soviet Union territories and Africa. As it was mentioned in Chapter 2, around a quarter of the EU's natural gas imports come from Russia currently. Besides, according to the forecasts, natural gas demand and the EU's import dependency on energy will increase at the same time. Therefore, the EU is dependent on Russia for its natural gas supply.

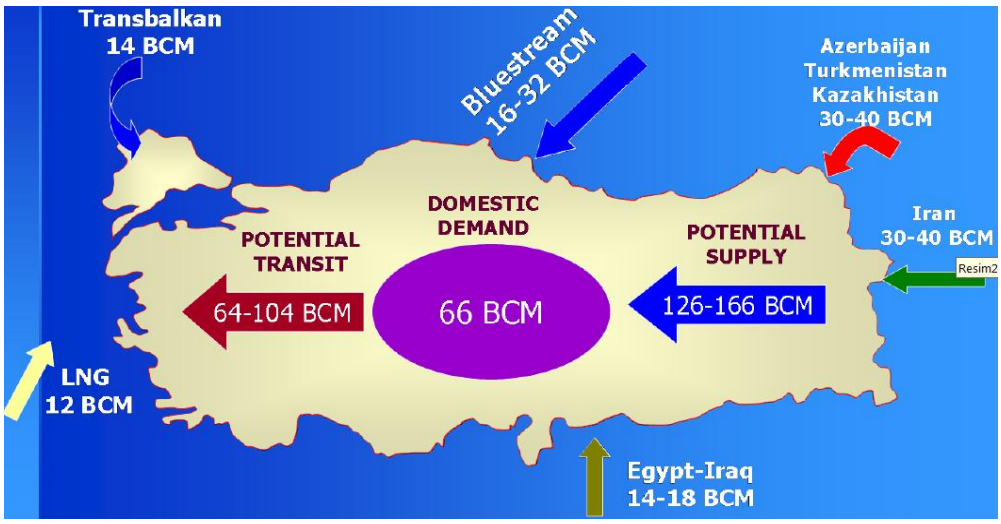
Diversifying the suppliers is very important for energy supply security. When there are numerous suppliers having close market shares, the suppliers can be switched if unexpected things happen. This is even more important for the EU when the state of its main energy suppliers is considered. Most of the supplier countries have instable economics and politics and therefore they are not reliable suppliers. Concerns and tensions arose in the EU especially after the Ukranian- Russian gas dispute in January 2006. Gazprom temporarily cut off gas supplies going through Ukraine and hence pressure dropped in gas pipelines in the EU countries. and this caused temporary natural gas shortages. Before this incident the EU never worried much about its dependence on Russian natural gas. Moreover, Russia's foreign policy reacts against a Western dominated world order in general. It is seen that one day natural gas might even be used as a political weapon against the EU taking advantage of its dependence. No energy related problems occured with other suppliers until now except Russia, even though most of them are not predictable countries, either. Therefore, considering the current situation, diversifying the energy supply for the EU mostly means to decrease its dependency on Russia. The EU is vulnerable in the energy world and needs to secure additional stable energy supplies at least from less unpredictable countries to meet its increasing demand. In

short, it is urgently needed for the EU to diversify its gas supplies to obtain energy security in the future and to reduce its dependency on one source.

4.3. Importance of Turkey's location

Turkey is situated between Asia and Europe. On its north-west, Turkey has borders with the EU thanks to Greece and Bulgaria. On the south, east and south-east its neighbours are Syria, Iran and Iraq which have rich natural gas and crude oil reserves. To the north further The Black Sea, there is Russia, which is the biggest energy supplier of the EU. Turkey is also relatively closer to other energy rich countries like Azerbaijan, Kazakhstan, Saudi Arabia, Qatar and United Arab Emirates. Therefore Turkey is in a lucky location, right in the center of a very big energy market which is the EU and its suppliers that have 70 % of the world's proven natural gas and 85 % of crude oil reserves. This fact makes Turkey a natural energy corridor. Moreover Bosphorus Strait which connects the Black Sea with the Mediterranean is one of the major chokepoints in the world's oil flow. Every year around 10,000 tankers pass through this strait. Turkey would like to become a major Eurasian energy hub considering its geopolitical standing through the Bosphorus Strait and several existing and new pipelines that link it to Russia and the Caspian, and smaller existing pipelines to import oil from Iraq and Iran. As it is seen in Figure 11, Turkey is very likely to be a major energy hub by 2020 thanks to its energy rich neighbours and by the completion of the new pipelines that will be mentioned in this chapter.

Figure 11: Turkey's estimated gas supply and transit potential by 2020.



Source: http://www.lngpedia.com/ * BCM = Billion cubic meters

4.4. Turkey's energy suppliers and its energy infrastructure

4.4.1. An overview of Turkey's natural gas and crude oil suppliers

Turkey's domestic natural gas production meets only 3% of its demand. Industrialization and population has been rapidly increasing in Turkey. Concordantly, natural gas requirement is increasing. Therefore, Turkey will be even more dependent on natural gas imports since it does not have large proven reserves. Interestingly, Russia supports the existence of Turkey's role along Black Sea-Mediterranean energy corridor, even though the dependence of many countries on Russia will probably decrease because of this. Currently, Russia exports much of its oil to Europe through Ukraine with whom it had some disputes especially related to natural gas trade. Therefore, Russia prefers to export its oil through Turkey bypassing Ukraine.

As seen in Table 13, 45.3 % of Turkey's natural gas imports came from Russia in 2010, whereas 26.15 % of the EU' s natural gas imports came from this country in the same year as it has already mentioned in Section 2. Therefore, Turkey is more dependent on Russia in natural gas than the EU is. Like the EU, Turkey decreased Russian natural gas share in its natural gas imports from 64.7 % in 2004 to 45.3 % in 2010, too. Especially between 2008 and 2009 there was a sharp decrease due to the already mentioned gas dispute between Ukraine and Russia that caused natural gas shortage for few days in Turkey and in some EU countries as well. The gas coming from Iran, Azerbaijan and Russia arrive by the existing pipelines that will be mentioned in this chapter. The remaining gas imports from all other countries arrive in Turkey in LNG form.

Another interesting thing is that the number of natural gas suppliers of Turkey increased significantly between 2004 and 2010. In 2004 Turkey imported natural gas from only 4 countries that were Nigeria, Algeria, Russia and Iran. Between 2004 and 2010 Azerbaijan, Qatar, Egypt, Trinidad and Tobago and some other Soviet countries were gradually added to the list. This shows that it is important for Turkey to diversify its energy suppliers and it was successful in this in the past recent years.

Turkey has similar concerns with the EU for its dependency on Russia, to diversify its energy suppliers and for its energy security. Therefore, Turkey and EU should cooperate in energy issues which would probably bring lots of benefits for both parties.

Table 13: Major natural gas suppliers of Turkey with the percentage of the total natural gas imports to Turkey.

Country or region	% of the total natural gas imports to Turkey in different years						
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Russia	64.7 %	65.96 %	63.26 %	63.25 %	62.62 %	52.03 %	45.3 %
Iran	16.05 %	15.98 %	18.32 %	16.83 %	15.42 %	15.82 %	21.2 %
Azerbaijan	-	-	-	3.50 %	7.84 %	14.95 %	12.0 %
Algeria	14.61 %	14.24 %	14.81 %	12.15 %	11.3 %	12.66 %	10.6 %
Qatar	-	-	-	-	-	0.96 %	5.2 %
Nigeria	4.64 %	3.81 %	3.60 %	3.88 %	2.60 %	2.83 %	3.4 %
Egypt	-	-	-	0.02 %	0.02 %	0.02 %	0.45 %
Trinidad and Tobago	-	-	-	0.016 %	-	0.01 %	0.25 %
Other Former Soviet	-	-	-	0.34 %	0.19 %	0.72 %	1.5 %

Source: BP Statistical View of World Energy 2011

As seen in Table 14, Turkey's crude oil suppliers and their shares in Turkey's crude oil imports have not been stable between the 2004 and 2011. Iran has been Turkey's leader supplier of crude oil since 2008. 43.2 % of Turkey's crude oil imports came from Iran in 2010. Iranian share in Turkey's crude oil imports doubled by increasing gradually between the years 2004 and 2010. Therefore, Turkey is highly dependent on Iran for its crude oil supply and no energy related problems occured between Turkey and Iran until now. However in 2004 Russia was the leader in Turkey's crude oil imports. Russia's share in Turkey's crude oil supplies fluctuated between 2004 and 2010. It reached to its peak if 41.5 % in 2007, then decreased sharply to 19.4 % in 2010. Unlike it happened in its imported natural gas market, the number of Turkey's crude oil suppliers decreased between 2004 and 2010. The crude oil imports arrive in Turkey through Baku-Tbilisi-Ceyhan and Kirkuk-Ceyhan crude oil pipelines that will be mentioned in this chapter and by maritime transport.

Table 14: Major crude oil suppliers of Turkey with the percentage of the total crude oil imports to Turkey.

Country or region	% of the total crude oil imports to Turkey in different years						
	2004	2005	2006	2007	2008	2009	2010
Iran	22.1 %	27.6 %	34.1 %	35.6 %	35.9 %	39.9 %	43.2 %
Russia	26.5 %	29.7 %	28.5 %	41.5 %	33.1 %	24.9 %	19.4 %
Iraq	5.3 %	4.5 %	2.4 %	4.5 %	7.6 %	13 %	12.5 %
Kazakhstan	0.4 %	-	-	-	3.0 %	1.8 %	11.2 %
Saudi Arabia	14.4 %	15.0 %	15.2 %	14.5 %	15.4 %	14.2 %	11.0 %
Syria	4.4 %	1.5 %	-	1.0 %	2.0 %	1.7 %	2.2 %
Libya	23.5 %	20.7 %	19.2 %	1.2 %	-	0.7 %	-
Other Africa	2.7	0.6 %	-	-	-	2.3 %	-
Other Former Soviet Union	0.5 %	0.7 %	0.4 %	-	0.4 %	0.6 %	-
EU	0.5 %	-	0.1 %	1.8 %	2.5 %	1.2 %	0.7 %

Source: http://www.trademap.org

4.4.2. Analysis of the imported crude oil and natural gas markets of Turkey

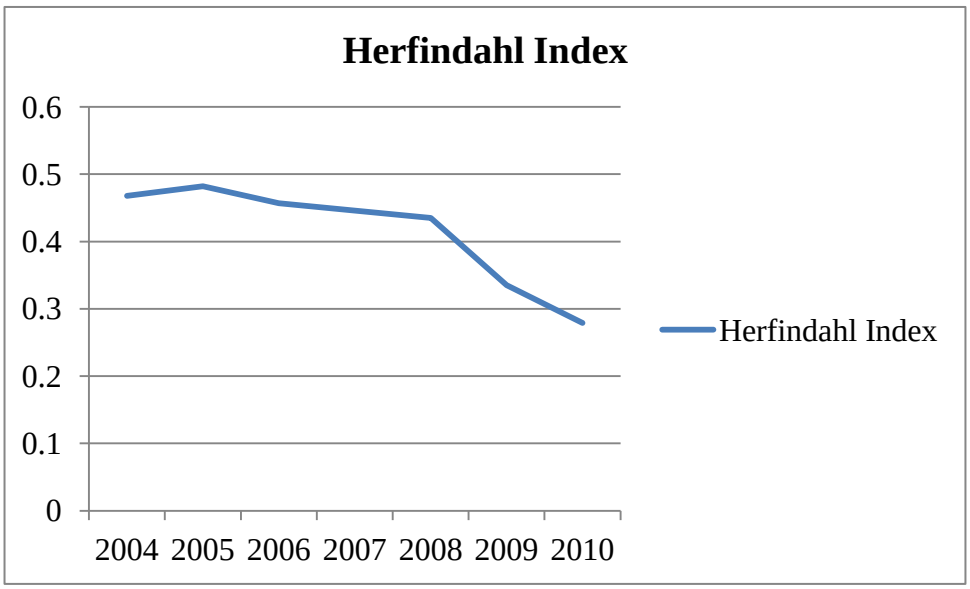
In order to see the trend of Turkey's imported natural gas and crude oil markets in terms of concentration and competition, it is useful to calculate Herfindahl Index of both markets. The data given in Table 13 are used to calculate Herfindahl Index of imported natural gas market of Turkey between 2004 and 2010 . Herfindahl Indexes are obtained as seen in Table 15, by applying this formula: $H = \sum_{i=1}^{N} si^2$ where si is the market share of firm i in the market and N is the number of firms. Calculations are given in detail in Appendix.

Table 15: Herfindahl Index of imported natural gas market of Turkey between 2004 and 2010.

Years	2004	2005	2006	2007	2008	2009	2010
Herfindahl Index	0.468	0.482	0.457	0.446	0.435	0.335	0.279

As it is seen in Figure 12, Herfindahl Index of Turkey's imported natural gas market gradually decreased from 0.468 in 2004 to 0.279 in 2010. As it was mentioned in Section 2, the fact that Herfindahl Index is above 0.18 means that the market is highly concentrated. Therefore Turkey's imported natural gas market has been highly concentrated, even though the level of concentration has decreased gradually. There has been lack of enough competition in the market as it approached monopoly. The market leader has always been Russia in this time interval. Russia's market share has always been high, that was 4 times more than that of its following competitor, Iran, in 2004. Even though the difference between their market shares has gradually become less and new suppliers were added to the list, there is still lack of competition in Turkey's natural gas market.

Figure 12: Trend of Herfindahl Index of imported natural gas market of Turkey between 2004 and 2010.



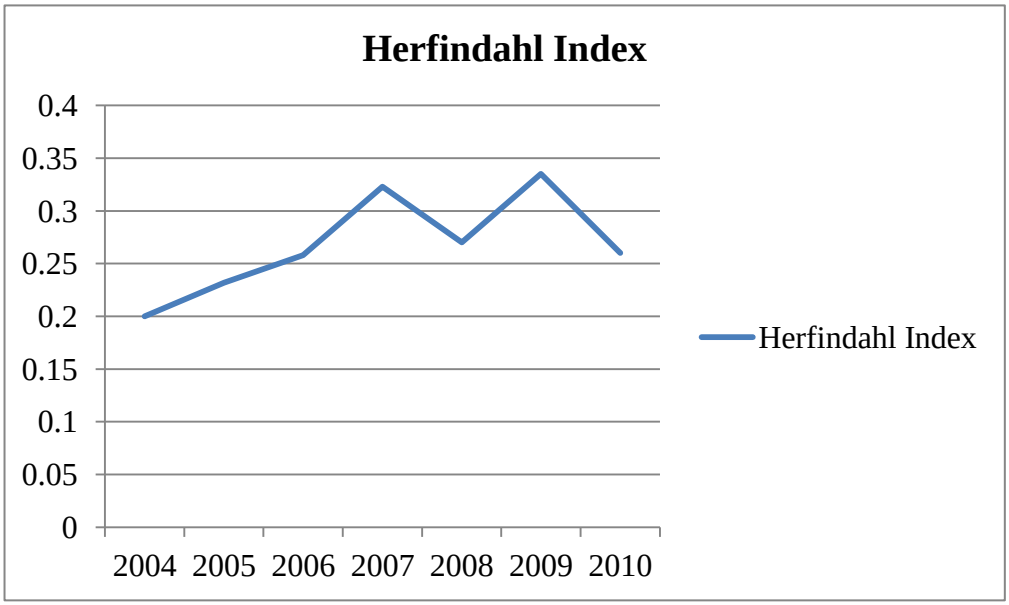
Herfindahl indexes are calculated also for the data given in Table 14, in order to see the trend of Turkey's imported crude oil market in terms of concentration and competition. As a result, the data in Table 16 are obtained. Calculations are given in detail in Appendix.

Table 16: Herfindahl Index of the imported crude oil market of Turkey between 2004 and 2010.

Years	2004	2005	2006	2007	2008	2009	2010
Herfindahl Index	0.2	0.232	0.258	0.323	0.27	0.335	0.26

As it is seen in Figure 13, Herfindahl Index of the imported crude oil market of Turkey has always been over 1.8 between 2004 and 2010. This shows that this market is highly concentrated, and not enough competitive, like the imported natural gas market of Turkey. The trend in the market is approaching to monopoly as Herfindahl Index in 2010 is more than it was in 2004. Because the market shares were more equally distributed and there were more players in the market in 2004.

Figure 13: Trend of Herfindahl Index of the imported crude oil market of Turkey between 2004 and 2010.

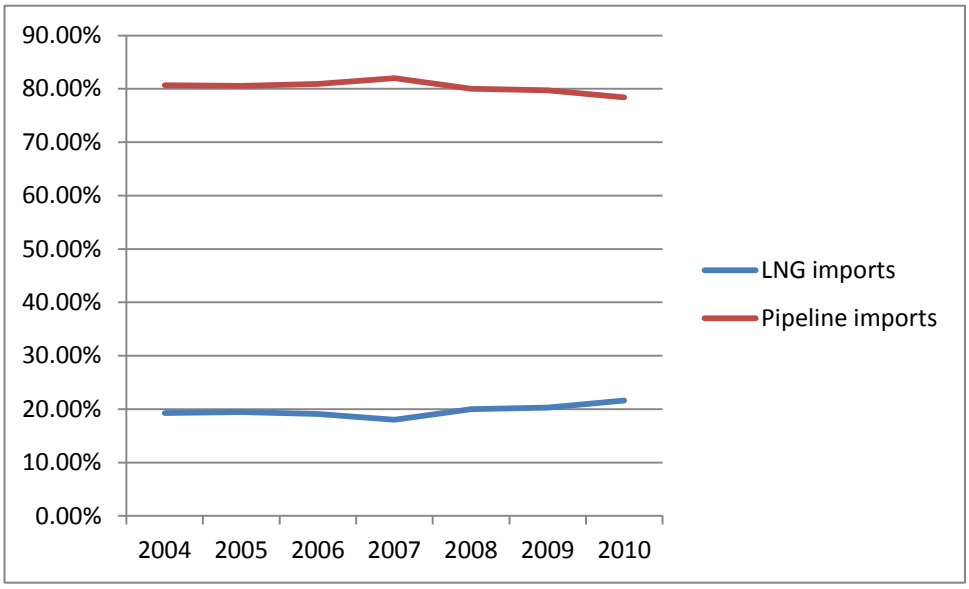


4.4.3. Turkey's energy infrastructure

Turkey is quite likely to become a major energy hub, it should expand its natural gas grid, consumption and storage for this purpose. Natural gas is becoming more accessible thanks to

new and existing international and local pipelines and thus its grid expands and its consumption increases. Currently has 2 LNG regasification terminals in Turkey, one is in Izmir on the Aegean Sea coast and the other is near Istanbul on the Marmara Sea coast. Unlike in the EU, currently there are no regasification terminals that are under construction or planned in Turkey. However as seen in Figure 14, LNG trade in Turkey's natural gas imports increased from 19.3 % to 21.6 % between 2004 and 2010. There was a significant increase in the share of LNG imports between 2009 and 2010 due to the sharp increase of natural gas imports from Qatar that all arrive in LNG form.

Figure 14: The percentages of LNG and pipeline natural gas imports of Turkey between 2004 and 2010.



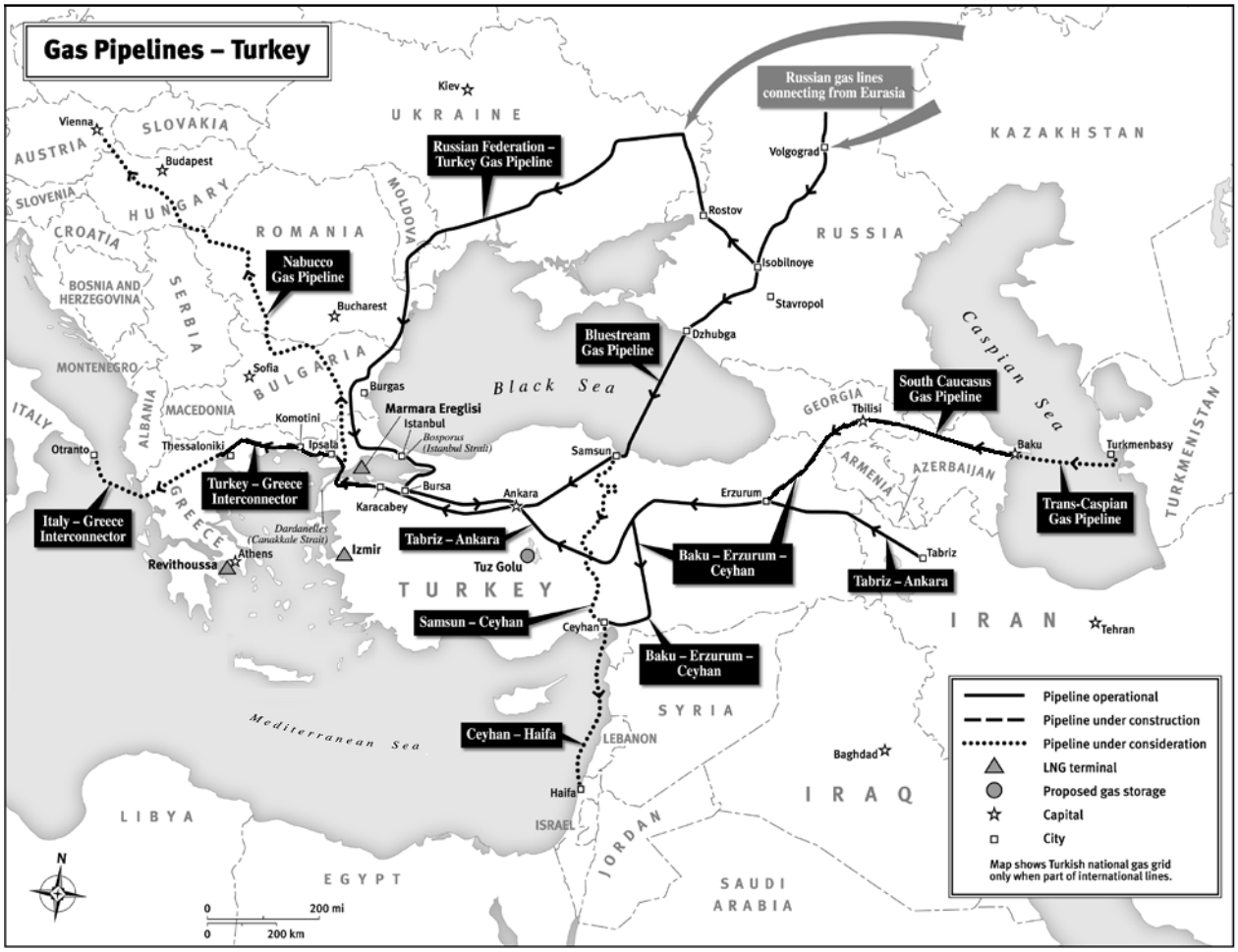
Source: BP Statistical View of World Energy 2011

Besides, Turkey has one underground natural gas storage facility that covers 4% of its annual natural gas consumption, which is not sufficient. Currently, there is an ongoing project that is supported by World Bank Gas Sector to build a huge gas storage facility in Tuz Golu region in Central Turkey.

There are numerous important oil and natural gas pipelines in Turkey. In addition to the existing international pipelines there are also pipelines under construction and under consideration. These pipelines are of strategic importance for the EU as well. Because they come from various supplier countries, therefore the EU has the opportunity to diversify its suppliers by taking the advantage of potential pipeline trade with these new suppliers. Turkey is in a very important position in this fact. Figure 15 shows the international natural gas

pipelines that are operational or projected, LNG terminals and the proposed gas storage in Turkey.

Figure 15: International natural gas pipelines in Turkey.



Source: http://www.washingtoninstitute.org/templateI01.php

The major existing pipelines are:

4.4.3.1.Blue Stream natural gas pipeline

Blue Stream is a major trans-Black Sea subsea gas pipeline that carries Russian natural gas to Turkey bypassing any third countries. It was opened in 2003. By 2010, Blue Stream operated at full capacity and delivered 16 billion cubic meters of natural gas per year. Total length of the pipeline is 1213 kilometres. Russia's land section is 373 km, the offshore section is 396 km and Turkey's land section is 444 km long. It is considered one of the deepest pipelines in the world. It is laid in depths as far as 2.2 km which exceeds the average depths of well known subsea pipelines. The total cost of the Blue Stream pipeline was about US$3.2 billion, including US$1.7 billion for its submarine segment.

Building the Blue Stream pipeline was intended to be the foundation for a strategic partnership between Russia and Turkey, with joint participation in energy and transport projects. However, the existing gas transit route to Turkey went through Ukraine, Moldova, Romania, and Bulgaria as an extension of this pipeline, as seen in Figure 15 under the name of "Russian Federation- Turkey Gas Pipeline". This land route made the gas substantially more expensive. One of the political goals of the Blue Stream project was said to be to block the path of rival countries aiming to use the territory of Turkey to bring gas from the Caspian region to Europe. As a result, in 1999 the presidents of Turkmenistan, Turkey, Azerbaijan, and Georgia signed a four-party inter-governmental agreement on building a rival Trans-Caspian gas pipeline. Currently Russia plans to double its capacity. However, concerns rise in Turkey against this idea. Because it might cause Turkey to be even more dependent on Russian natural gas, while Turkey is trying to decrease its dependency on Russia.

4.4.3.2.Tabriz- Ankara natural gas pipeline

It transports Iranian natural gas from Tabriz in North-West Iran to Ankara in Turkey. It is 2577 km long. The Turkish section cost US$600 million. The Turkish annual import consists normally 11 billion cubic meters of natural gas. Since the pipeline was opened in 2001, parts of it was blown up several times by a terrorist organization due to Kurdish conflict in the east of Turkey. In 2008 Iran reduced gas supplies to Turkey then gas supplies were stopped because of the cut-off of the supplies from Turkmenistan. The supplies were restored back after 20 days. The supply was cut off again in February 2008 due to bad weather conditions.

4.4.3.3.Baku-Tbilisi-Erzurum (South Caucasus) natural gas pipeline

This pipeline transports the natural gas in Shah Deniz Field of Azerbaijan section of the Caspian Sea in Baku to Turkey. It was opened in 2006 and runs paralel to BTC Oil Pipeline until Turkish city of Erzurum. It was constructed on the same route to minimize the environmental and social impact. It is 692 km long, of which 442 km is laid in Azerbaijan and 248 km in Georgia. The initial capacity of the pipeline is 8.8 billion cubic meters (bcm) of gas per year, and after 2012 its capacity could be expanded to 20 bcm per year. In Erzurum, South Caucasus Pipelie is linked to Tabriz- Ankara pipeline. In 2008 the pipeline was closed for 2 days due to South Ossetia conflict.

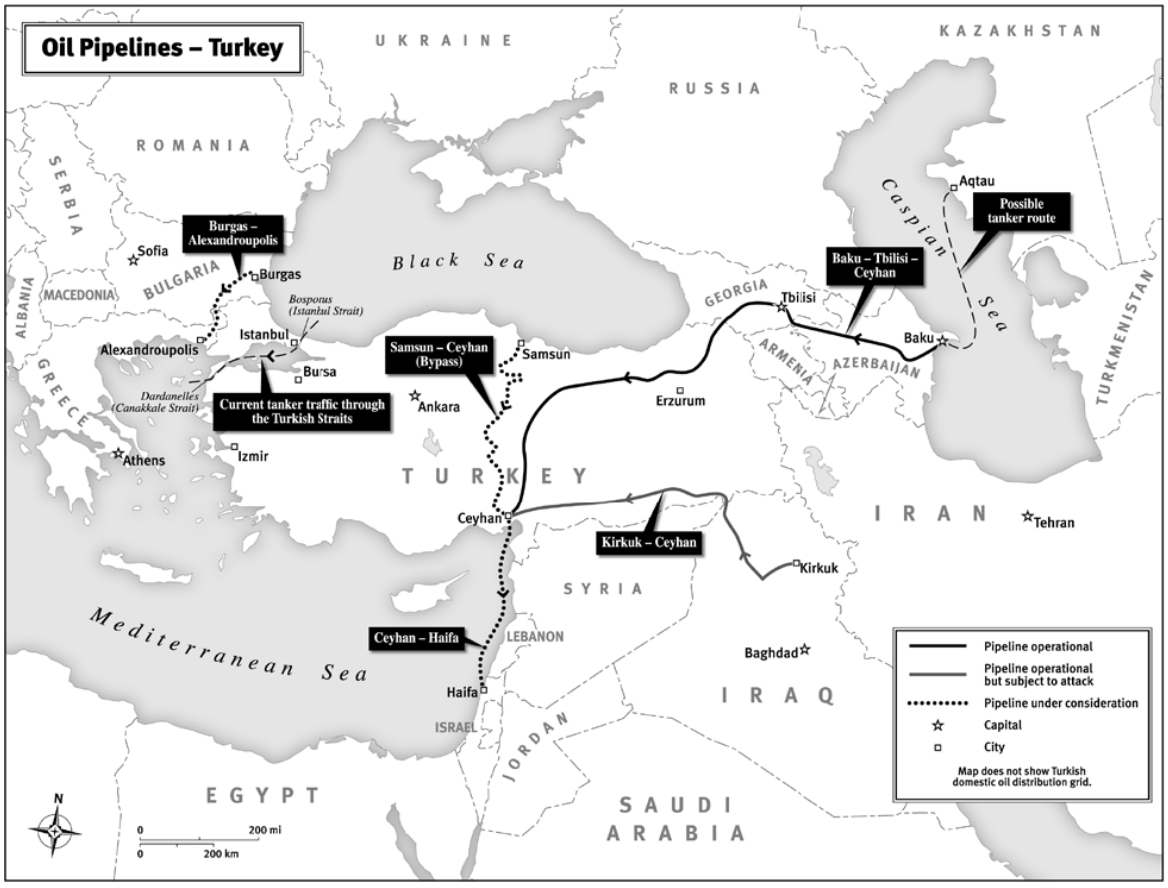
This pipeline might potentially be lengthened to Turkmenistan and Kazakhstan in the future. Thus, Turkey will be able to import more crude oil from these countries. In the long term,

South Caucasus Pipeline will supply Caspian natural gas to the EU through the planned Nabucco pipeline.

4.4.3.4.Turkey-Greece natural gas pipeline (The interconnector to Greece)

It is a natural gas pipeline that connects Turkish and Greek natural gas grids passing through Canakkale Strait (Dardanelles). It began operation in 2007. It is 296 km long, of which 210 km is laid in Turkey and 86 km in Greece. Its capacity is 7 billion cubic meter (bcm) of natural gas per year. In 2012 the capacity will be expanded to 11 bcm, of which 8 bcm will be delivered to Italy when Greece-Italy pipeline becomes operational. This pipeline is very important not only for Turkey but also for the EU. Because for the first time, it allowed the delivery of Caspian gas to the EU without crossing Russian territories. Possible capacity expansion and construction of new sub-branch pipelines in the future would make it possible to deliver more amount of Caspian gas to the EU, and thus being less dependent on Russia. Figure 16 shows the international crude oil pipelines in Turkey in two categories: the operational ones and the ones that are operational but subject to attack.

Figure 16: International crude oil pipelines in Turkey.



Source: http://www.washingtoninstitute.org/templateI01.php

4.4.3.5.Kirkuk- Ceyhan oil pipeline

This pipeline transports Iraqi oil to Turkey in Ceyhan, a city on the South coast of Turkey. This 970 km long pipeline is Iraq's largest crude oil export line. It is also the oldest international pipeline in Turkey that was opened in 1970. The pipeline consists of two pipes having designed capacity of 1,100 thousand and 500 thousand barrels per day respectively.

The pipeline was damaged and closed several times due to the tension in Iraq in the past 20 years. In 1990's it was closed due to the United Nation's embargo on Iraqi products and then reopened with some agreements after a few years. Moreover since 2003, Iraqi part of the pipeline has been a principal sabotage target due to the war and conflict in Iraq. Therefore, its usable capacity decreased to 300 thousand barrels per day. Hence, it became totally unusable in 2009. Finally in 2011 it was repaired and started to be used with full capacity. Currently Iraq is considering to build a new Kirkuk–Ceyhan pipeline through Arbil and Dahuk governorates to bypass the attack-prone areas.

4.4.3.6.Baku- Tbilisi- Ceyhan (BTC) oil pipeline

Baku–Tbilisi–Ceyhan pipeline is a 1768 km long crude oil pipeline from the Azeri-Chirag-Guneshli oil field in the Caspian Sea to the Mediterranean Sea. Its maximum capacity is 1 million barrels of oil per day. It connects Baku, the capital of Azerbaijan; Tbilisi, the capital of Georgia; and Ceyhan, a port on the south-eastern Mediterranean coast of Turkey. It is the second longest oil pipeline in the former Soviet Union. The pipeline cost US$3.9 billion. The opening of this oil pipeline in 2006 was a milestone for Turkey's profile as an energy hub. The United States supported its opening since it is the first pipeline that enables to export the Caspian oil without going through Russia. Thanks to BTC pipeline, 1 million barrel of oil a day can be transported from Azerbaijan through Georgia to Ceyhan port in the South of Turkey. Since 2008, Kazakh oil flows through this pipeline, too.

This pipeline brought numerous advantages.The South Caucasus region, previously seen as Russia's backyard, is now a region of great strategic significance. The project also constitutes an important branch of the East–West energy corridor, enabling Turkey to gain greater geopolitical importance. The reduction of oil tanker traffic in the Bosphorus will contribute to greater security for Istanbul. The BTC pipeline also supports Georgia's independence from Russian influence. Turkey benefits from an increase of commerce in the port of Ceyhan and other parts of Eastern Anatolia, the region which had experienced significant decrease in economic activities since the Gulf War in 1991. However, there have been some politics,

economy, security ,environment and human rights related controversial aspects about this pipeline. Although the BTC pipeline was thought to have eased the dependence of the US and other Western nations on oil from the Middle East, it supplies only 1% of global oil demand. Concerns have also been addressed about the security of the BTC pipeline as it goes through the edges of the Kurdish region of Turkey. In 2008, a major explosion and fire in eastern Turkey closed the pipeline for 20 days. The Kurdistan Workers Party (PKK) claimed responsibility for the attack. Human rights activists criticized the support of Western governments for the pipeline, due to reported human and civil rights abuses in Azerbaijan.

The major under construction and planned pipelines are:

4.4.3.7.Trans-Caspian natural gas pipeline

This proposed submarine pipeline would be an extension of the existing South Caucasus gas pipeline. It would link Baku in Azerbaijan and Turkmenbasi in Turkmenistan under Caspian Sea with a total length of 1210 km. The Trans-Caspian Gas Pipeline project if built would transport natural gas from Kazakhstan and Turkmenistan to Central Europe, putting out of action both Russia and Iran. The projected capacity of the pipeline is 30 billion cubic metres of natural gas per year at an estimated cost of US$5 billion. Having 4.3% of the world's proven reserves, Turkmenistan has richest natural gas reserves among Central Asian countries. However, neither the EU nor Turkey buys natural gas from this country currently. With possible further extensions, this pipeline is planned to be connected to the Nabucco pipeline. Thus, Turkey and the EU would be able to access natural gas from Turkmenistan and Kazakhstan, bypassing two unpredictable neighbours: Iran and Russia. In January 2006, as a result of the Russia-Ukraine gas dispute, interest in the Trans-Caspian Gas Pipeline project regained importance. Therefore, if Nabucco and Trans Caspian pipelines are built, it would be a milestone for both the EU's and Turkey's energy supply security.

The project is heavily criticized by Russia and Iran that are current transit countries for Turkmen gas. Russia stated that a major gas pipeline would pose a serious, dangerous risk to the prosperity of the entire region. According to the Russian Natural Resources Ministry, any gas or oil pipelines across the ground of the Caspian Sea would be environmentally unacceptable. Russia has also taken the legal position that a potential pipeline project, regardless of the route it takes on the seabed, would require the consent of all five Caspian littoral states in order to proceed.

4.4.3.8.Greece- Italy natural gas pipeline

This is a part of the interconnector Turkey-Greece-Italy for transportation of natural gas from Caspian region to Italy. Turkey-Greece interconnector section of the pipeline is already in operation. The length of Greece–Italy pipeline will be more than 807 km, of which 590 km will be onshore pipeline in Greece, and more than 217 km will be laid on the seabed of Ionian Sea. Its capacity is expected to be 8 billion cubic meters of natural gas per year. The offshore section will cost €500 million and the Greek section will cost €600 million. In 2005, the intergovernmental agreement was signed between Greece and Italy for the construction of the pipeline. It is expected to be opened by 2012. It will enable Italy and the rest of the EU to have Caspian gas without crossing Iran or Russia.

4.4.3.9.Samsun- Ceyhan (Trans Anatolian) Pipeline

It is a planned crude oil pipeline that would cross Turkey all the way from the Black Sea on the north to the Mediterranean on the south. The length of the pipeline will be 550 kilometres with a designed capacity of 1.5 million barrels of oil per day. The project costs are expected to be around $2 billion. The main goal of this project is to reduce the congested tanker traffic in the Bosphorus and the Dardanelles by providing an alternative route for Kazakh and Russian crude oil. This project is also a very important step for Ceyhan (Turkish town on Mediterranean coast) that enables it to become the major energy hub of Southern Mediterranean. Starting from Central Anatolia, this pipeline will follow the route of Baku-Tbilisi- Ceyhan oil pipeline. Beyond the security of energy supply, this pipeline is extremely important for Turkey especially for the security of the inhabitants of Istanbul. Because the Bosphorus is in Istanbul which is Turkey's most populated city. Every year around 10000 oil tankers pass through this waterway and it is considered as one of the most difficult waterways to navigate because of its narrow and curved geographical structure. A ship crash and an oil spill would be a disaster for 13 million residents of Istanbul. Therefore, Turkey is seeking alternative ways to reduce tanker traffic in Bosphorus, even though it is quite good for Turkey's economy in terms of transit fees paid by the crossing ships. Samsun- Ceyhan Pipeline is expected to be opened by 2012.

4.4.3.10. Nabucco Pipeline

This is the most important pipeline project of the EU now. The Nabucco Pipeline construction is scheduled to start in 2013 and first gas is expected to flow in 2017. Its projected capacity is 31 billion cubic metres of natural gas per year. This project will connect the world's richest gas regions to European gas market. This 3,893 kilometres long pipeline will run from Ahiboz

near Georgian border in Turkey through Bulgaria, Romania, and Hungary to Baumgarten an der March, a major natural gas hub in Austria. In Ahiboz, it will be joined with two feeder lines, one connecting to Georgia in the north (South Caucasus Pipeline), and the other connecting to Iraq (pipeline to be built) in the southeast. It could be fed also from the Tabriz–Ankara pipeline. 2730 km of the pipeline will be laid in Turkey, 412 km in Bulgaria, 469 km in Romania, 384 km in Hungary, and 47 km in Austria. In additon to these, also Germany became a shareholder although this pipeline will not cross its territory. Gas will be supplied from the Caspian region especially from Azerbaijan and Turkmenistan, from the Middle East especially from Iraq and from Egypt and probably from Iran in the long term. The longest section of the pipeline will be in Turkish territories. The pipeline, initially estimated at € 7 billion, is in 2011 estimated to cost € 12–15 billion. The final investment decision is expected to be clear by 2012.

Nabucco is the largest European infrastructure Project in terms of the countries involved. This will support European integration and would be an important step forward for Turkey's accession to the EU. Moreover, this pipeline will make a significant contribution to the security of energy supply of Turkey and the EU by reducing their dependency on Russia and diversifying their suppliers. However, concerns have raised against the project. The most significant ones are:

- The pipeline will pass through South East of Turkey where there is Kurdish conflict and terrorist attacks; through South Caucasus which are politically instable areas.
- The disputes related to Iran's alleged nuclear weapons programme should be resolved in order to involve it as a reliable supplier for the EU.
- Having Turkmen gas in the EU is heavily critized since Turkmenistan is one of the worst countries in terms of human rights.
- Turkey wants the approval for opening of the energy chapters of its EU accession talks, linking this issue to Nabucco Project. However, this does not look possible for the EU until the dispute in Cyprus is resolved.

Despite all these drawbacks, the profits of the project seem to surpass its risks and disadvantages, and this pipeline was agreed to be built by partner countries.

The main rival of Nabucco project is South Stream project that is a proposed gas pipeline to transport Russian natural gas through Black Sea to Bulgaria and further to Greece, Italy and Austria bypassing Turkey and Ukraine. Thus it would enable Russia to send its gas to the EU

without any third country. According to the feasibility studies, it would cost twice as much as Nabucco Project. Therefore, some think that this is a more political than an economic project that Russia supports to expand its presence in European energy sector.

4.4.3.11. Persian pipeline (Iran- Europe pipeline)

Persian Pipeline (also known as Pars Pipeline and Iran–Europe pipeline) is a proposed natural gas pipeline to transfer Iranian gas from the Persian gulf to European markets. The overall length of the pipeline would be 3300 km and the capacity would be around 37–40 billion cubic meters of natural gas per year. This planned pipeline will connect Iran's South Pars gas field to Turkey and then to European markets. The Turkish section will be 660 km long and cost about one billion euro. The pipeline would cross the difficult geographic environments, notably mountainous areas. It is expected to be operational by 2014.

The pipeline will cross Turkey, then pass to Greece and Italy. In Italy the pipeline would split into two branches so that the northern branch will run to Switzerland, Austria and Germany, while southern branch will supply France and Spain. This pipeline is seen as an alternative to the Nabucco Pipeline, hence rival to South Stream project. Currently the EU does not import any natural gas from Iran. Thanks to this pipeline the EU will have another natural gas supplier. It also would contribute to Turkey's plans of being an energy hub between the Middle East and the EU.

4.4.3.12. Arab gas pipeline

The Arab Gas Pipeline is a natural gas pipeline in the Middle East. It has a total length of 1,200 kilometres at a cost of US$ 1.2 billion. It exports Egyptian natural gas to Jordan, Syria and Lebanon, with a separate line to Israel. The pipeline is composed of three main sections. The first section of the pipeline runs from Arish in Egypt to Aqaba in Jordan. The second section extended the pipeline in Jordan from Aqaba through Amman to the Syrian border town called El Rehab. The third section runs from Jordan to Syria. Arab gas pipeline is connected with Israel through a submarine gas pipeline called Arish–Ashkelon pipeline. In March 2006; Egypt, Syria, Jordan, Turkey, Lebanon and Romania reached an agreement to build the pipeline's extension through Syria to the Turkish border. From there, the pipeline will be connected to the possible Nabucco Pipeline for the delivery of gas to Europe. With these connections Turkey expects to buy up to 4 billion cubic metres of gas per year from the Arab Gas Pipeline. During 2011 Egyptian protests, an explosion was reported at the pipeline

near the El Arish natural gas compressor station, which supplies pipelines to Israel and Jordan. As a result, supplies to Israel and Jordan were temporarily stopped.

5. ANALYSIS OF THE EFFECTS OF ENERGY RELATED INDICATORS ON GDP GROWTH RATE

5.1. Introduction

In Chapter 4, the improvements in Turkey's energy infrastructure and the fact that Turkey is a very important energy transit country were mentioned in detail. In numerous occasions it was emphasized that Turkey would be a very important energy hub and Turkey would benefit a lot from this. In this chapter, the possible results of the developments in energy related ectivities will be analyzed by using numerical data and methods. The motivation behind this analysis is to find out whether GDP growth is a function of the energy indicators, especially for the energy transit countries which is the case of Turkey. In other words, it is adressed the question: "Does the increase in energy activities bring wealth?". Because there are mixed opinions and examples about this. For example the economic boom in Qatar and The United Arab Emirates in the last decade is obviously highly related to their richness in natural gas and crude oil. On the other hand, in economics there is a concept called Dutch disease, called also the resource curse. It is the damaging effect on an economy as a result of the exploitation and export of natural resources. Therefore, even though the increase in energy activities seem to have positive effect on economy, it is useful to apply numeric analysis to understand this fact better and in detail.

The relationship between GDP growth rate and energy related indicators are analyzed for different countries. These indicators are the annual growth rates of GDP, trade volume, energy use, energy production and net energy imports. *GDP* is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. *Trade volume* is the sum of exports and imports of goods and services. *Energy use* refers to use of primary energy before transformation to other end-use fuels, which is equal to indigenous production plus imports and stock changes, minus exports and fuels supplied to ships and aircraft engaged in international transport. *Energy production* refers to forms of primary energy--petroleum (crude oil, natural gas liquids, and oil from nonconventional sources), natural gas, solid fuels and combustible renewables and waste-and primary electricity, all converted into oil equivalents. *Net energy imports* are estimated as energy use less production, both measured in oil equivalents. A negative value indicates that the country is a net exporter.

Moreover, it is addressed whether the extent of this relationship differs for energy poor, energy rich and important energy transit countries. Turkey is analyzed in this analysis as an energy poor but an important energy transit country. Correlation and regression analysis are used to see to what extent these indicators and GDP growth are affected from each other for different countries.

5.2. Correlation analysis

Dependence refers to any statistical relationship between two random variables or two sets of data. Correlation refers to any of a broad class of statistical relationships involving dependence. Correlation coefficients are between -1 and 1. Two random variables or two random set of variables are positively correlated if the correlation coefficient is more than zero, and are negatively correlated if it is less than zero. The level of correlation increases when the numbers are approaching 1 or -1. The correlation analysis is held as following:

First of all, the data for 10 years, from 1999 to 2008 for all indicators that have already been mentioned, were collected for 10 selected countries and Tables between 17-22 were prepared according to these data.[1] The selected countries are Turkey, Netherlands, Italy, Norway, Russia, Nigeria, Saudi Arabia, Poland, Ukraine and Turkmenistan. Most of these countries have already been mentioned in the previous chapters in terms of their energy issues. It is aimed to see how GDP growth is affected in countries with different level of energy resources. The location of these countries were also considered in the selection so that the sample size covers a large geographical area. Second, the numbers in the data were converted to annual growth rates in order to obtain the correlation between these numbers and the GDP growth rates. For instance the trade volume growth rate of Turkey in 2005 is obtained as following:

$$trade\ volume\ growth\ rate\ in\ 2005 = \frac{Trade\ volume\ in\ 2005 - Trade\ volume\ in\ 2004}{Trade\ volume\ in\ 2004}$$

The same equation was applied to all the indicators of each country for each year. Second, correlation analysis is applied to the 10 years data of each selected country for all the indicators, being GDP growth is the constant indicator and all the others are variable indicators.

[1] *http://data.worldbank.org/*

Finally, 4 correlation coefficients were obtained for each country in Excel. The correlation coefficients are between the annual growth rates of the following indicators: GDP - Trade volume, GDP – Energy use, GDP – Net energy imports and GDP - Energy production. Hence, 40 numbers were obtained, being 4 correlation coefficients for each of the 10 countries. The tables 17, 18, 19, 20 and 21 show the annual growth rate of each indicator for each country between 1999 and 2008; and the correlation coefficients between the set of data for these years.

5.2.1. Correlation Analysis of the countries

The selected countries will be focused one by one to see the correlations between their GDP growth rates and other indicators. The reasons of these correlations will also be identified.

As seen in Table 17, the correlation coefficients between the 10 years set of data of GDP growth rate and all the other factors are positive for Turkey. They are between 0.31 and 0.41 which means, the growth rates of trade volume, energy use, energy production and net energy imports are fairly correlated with GDP growth rate. These indicators showed similar trend for Turkey between 1999 and 2008. All the indicators increased from 1999 to 2008 despite the decreases in some years and thus positive correlations were obtained between them. This could be due to the fact that Turkey is a developing country that causes a rapid increase in energy consumption.

Table 17: Indicators and correlation coefficients of Turkey between 1999- 2008

TURKEY	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
GDP Growth Rate	-3.4%	6.8%	-5.7%	6.2%	5.3%	9.4%	8.4%	6.9%	4.7%	0.7%
Trade Volume growth rate	10.30%	17.75%	11.84%	2.04%	1.00%	16.38%	1.90%	13.72%	4.70%	4.73%
Energy use growth rate	10.73%	-3.81%	-7.79%	5.46%	4.83%	3.89%	4.35%	10.26%	7.49%	-1.50%
Energy production growth rate	-5.44%	-5.94%	-5.58%	-1.23%	-2.18%	2.21%	-0.75%	10.10%	3.51%	6.26%
Net energy imports growth rate	14.49%	4.07%	-9.19%	10.33%	7.91%	3.89%	7.34%	10.26%	8.98%	-4.20%
CORRELATION COEFFICIENT BETWEEN GDP GROWTH RATE – TRADE VOLUME GROWTH RATE : 0.37										
CORRELATION COEFFICIENT BETWEEN GDP GROWTH RATE – ENERGY USE GROWTH RATE : 0.31										
CORRELATION COEFFICIENT BETWEEN GDP GROWTH RATE – ENERGY PRODUCTION GROWTH RATE : 0.37										
CORRELATION COEFFICIENT BETWEEN GDP GROWTH RATE – NET ENERGY IMPORTS GROWTH RATE : 0.41										

As seen in Table 18, GDP growth rate of the Netherlands is highly correlated with its trade volume growth rate and it is fairly correlated with its net energy imports growth rate. However, the growth rates of its energy use and energy production are not correlated with its GDP growth rate. It can be said that this is due to these reasons: First, although it has some energy resources, its economy does not highly depend on energy. Second, the Netherlands is a developed country with stable economics and politics which makes it unlikely the indicators to fluctuate for the years observed.

Table 18: Indicators and correlations of the Netherlands between 1999- 2008

NETHERLANDS	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
GDP Growth Rate	4.7%	3.9%	1.9%	0.1%	0.3%	2.2%	2.0%	3.4%	3.9%	1.9%
Trade Volume growth rate	6.45%	14.97%	2.63%	5.33%	-1.34%	6.46%	6.90%	8.93%	5.41%	5.54%
Energy use growth rate	-1.08%	2.50%	3.26%	0.11%	3.03%	1.35%	-0.34%	-2.54%	4.51%	-0.69%
Energy production growth rate	-6.47%	-3.24%	6.75%	1.32%	-3.19%	15.83%	-8.56%	-1.83%	0.22%	8.76%
Net energy imports growth rate	40.14%	26.61%	6.58%	5.38%	28.79%	43.25%	49.49%	-7.18%	25.41%	-33.79%
CORRELATION COEFFICIENT BETWEEN GDP GROWTH RATE – TRADE VOLUME GROWTH RATE : 0.75										
CORRELATION COEFFICIENT BETWEEN GDP GROWTH RATE – ENERGY USE GROWTH RATE : -0.09										
CORRELATION COEFFICIENT BETWEEN GDP GROWTH RATE – ENERGY PRODUCTION GROWTH RATE : -0.18										
CORRELATION COEFFICIENT BETWEEN GDP GROWTH RATE – NET ENERGY IMPORTS GROWTH RATE : 0.23										

As seen in Table 19, GDP growth rate of the Italy is highly correlated with its trade volume growth rate and it is a little bit correlated with its energy use and net energy imports growth rates, whereas it is negatively correlated with its energy production growth rate. Except the correlation between its GDP and energy production growth rates, it is interesting to observe that the other correlations are similar to those of Turkey. These could be due to the fact that they are both very important energy transit countries with poor energy resources and their energy supply mainly depends on imports.

Table 19: Indicators and correlations of Italy between 1999- 2008

ITALY	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
GDP Growth Rate	1.5%	3.7%	1.8%	0.5%	0.0%	1.5%	0.7%	2.0%	1.5%	-1.3%
Trade Volume growth rate	1.50%	16.94%	1.80%	-5.19%	2.00%	3.57%	4.73%	9.85%	5.12%	-1.30%
Energy use growth rate	1.54%	1.90%	0.36%	0.15%	4.08%	1.21%	1.25%	-0.96%	-1.65%	-1.71%
Energy production growth rate	-3.52%	-3.60%	-4.67%	2.24%	1.42%	1.97%	-1.92%	-1.51%	-3.81%	2.12%
Net energy imports growth rate	2.78%	3.13%	0.36%	0.15%	4.08%	1.21%	2.46%	-0.96%	-1.65%	-1.71%
CORRELATION COEFFICIENT BETWEEN GDP GROWTH RATE – TRADE VOLUME GROWTH RATE : 0.78										
CORRELATION COEFFICIENT BETWEEN GDP GROWTH RATE – ENERGY USE GROWTH RATE : 0.15										
CORRELATION COEFFICIENT BETWEEN GDP GROWTH RATE – ENERGY PRODUCTION GROWTH RATE : -0.67										
CORRELATION COEFFICIENT BETWEEN GDP GROWTH RATE – NET ENERGY IMPORTS GROWTH RATE : 0.25										

When Table 18 and Table 20 are observed together, it is seen that the correlation coefficients of Norway are similar to those of Netherlands. This similarity could potentially be due to the facts that these countries are both very developed, both have stable economics and politics, are both important energy suppliers of the EU and have similar energy strategies.

Table 20: Indicators and correlations of Norway between 1999- 2008

NORWAY	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
GDP Growth Rate	2.0%	3.3%	2.0%	1.5%	1.0%	3.9%	2.7%	2.3%	2.7%	0.8%
Trade Volume growth rate	-0.79%	10.57%	0.66%	-6.62%	-0.46%	8.48%	5.59%	5.10%	4.07%	3.45%
Energy use growth rate	4.86%	-1.70%	2.98%	-6.46%	8.46%	-2.19%	1.16%	1.32%	1.33%	8.08%
Energy production growth rate	1.79%	8.38%	-0.24%	4.02%	0.00%	-2.50%	-2.05%	-3.97%	-0.16%	1.86%
Net energy imports growth rate	1.36%	9.75%	-0.60%	5.39%	-0.91%	-2.57%	-2.52%	-4.70%	-0.27%	0.84%
CORRELATION COEFFICIENT BETWEEN GDP GROWTH RATE – TRADE VOLUME GROWTH RATE : 0.68										
CORRELATION COEFFICIENT BETWEEN GDP GROWTH RATE – ENERGY USE GROWTH RATE : -0.57										
CORRELATION COEFFICIENT BETWEEN GDP GROWTH RATE – ENERGY PRODUCTION GROWTH RATE : -0.08										
CORRELATION COEFFICIENT BETWEEN GDP GROWTH RATE – NET ENERGY IMPORTS GROWTH RATE : 0.009										

Russia is the only country which does not have a significant positive correlation between its GDP growth rate and trade volume growth rate and which has a negative correlation between its GDP growth rate and net energy imports growth rate amongst the countries observed. Because its trade volume growth rate has been fluctuating, while its GDP growth rate has been fairly stable between 1999 and 2008 as seen in Table 21. This could be because Russia started to implement free trade only about 20 years ago, after the fall of the Soviet Union. Therefore some more time is required to have stable international trade. The other indicators are either fairly correlated or not correlated with its GDP growth rate. This could be because of the fact that Russia is one of the richest countries in the world in terms of its energy production and energy exports. Therefore net energy imports of Russia is not correlated with its GDP growth rate.

Table 21: Indicators and correlations of Russia between 1999- 2008

RUSSIA	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
GDP Growth Rate	6.4%	10.0%	5.1%	4.7%	7.3%	7.2%	6.4%	8.2%	8.5%	5.2%
Trade Volume growth rate	31.10%	8.41%	-5.72%	2.98%	23.40%	-11.44%	6.40%	4.40%	2.58%	7.22%
Energy use growth rate	3.58%	1.69%	1.09%	-0.47%	3.57%	0.32%	0.67%	2.91%	0.29%	2.11%
Energy production growth rate	2.38%	1.65%	3.09%	3.78%	6.99%	4.72%	2.64%	1.97%	0.99%	1.19%
Net energy imports growth rate	0.13%	1.69%	6.32%	10.96%	11.18%	11.31%	5.64%	0.49%	1.49%	0.89%
CORRELATION COEFFICIENT BETWEEN GDP GROWTH RATE – TRADE VOLUME GROWTH RATE : 0.08										
CORRELATION COEFFICIENT BETWEEN GDP GROWTH RATE – ENERGY USE GROWTH RATE : 0.2										
CORRELATION COEFFICIENT BETWEEN GDP GROWTH RATE – ENERGY PRODUCTION GROWTH RATE : -0.18										
CORRELATION COEFFICIENT BETWEEN GDP GROWTH RATE – NET ENERGY IMPORTS GROWTH RATE : -0.33										

All the indicators of Nigeria except energy use growth are correlated with its GDP growth rate. Therefore, energy use, energy production and net energy imports of Nigeria have been on similar trend with its GDP growth. Indicators and correlations of Nigeria are given in Appendix.

When the set of data for the indicators of Saudi Arabia and Nigeria are considered together, it is observed the similarity of correlation coefficients of Saudi Arabia between those of Nigeria, with the exception of their GDP growth- energy use growth correlation. This could be because of the fact that they are both rich countries in terms of the natural energy resources they have. However, Saudi Arabia is far more developed and has a more stable economy than Nigeria. Like Nigeria, Saudi Arabia's GDP growth is positively correlated with the growth rates

of its trade volume, energy production and net energy imports. Moreover the correlation coefficients are higher than those of Nigeria. Indicators and correlations of Saudi Arabia are given in Appendix.

When the set of data for the indicators of Poland and Italy are considered together, it is observed the similarities in correlation coefficients of Poland between those of Italy. The slight differences between the data of Poland and Italy are; Poland's GDP growth is much more correlated with its net energy imports growth rate while it is less correlated with its trade volume rate. The reasons of this similarity could be becauuse of the fact that they are both EU member countries which means that they have similar energy policies and they are both poor countries in terms of their natural energy resources while they are important energy transit countries. Indicators and correlations of Poland are given in Appendix.

When the set of data for the indicators of Ukraine and Turkey are considered together,it is observed that all the correlation coefficients of Ukraine are are quite similar to those of Turkey. All of its correlation coefficients are positive but not high, exactly like those of Turkey. This could be because they are both developing countries with poor natural energy resources while they both play a very important role in energy transit. Indicators and correlations of Ukraine are given in Appendix.

The similarity in Turkmenistan's correlation coefficients are observed to be similar with those of Nigeria, when their indicators are considered together. The reasons of this could potentially be these factors: they are not developed countries, both have rich energy reserves but do not have stable economics and politics. Indicators and correlations of Turkmenistan are given in Appendix.

5.2.2. Results of the correlation analysis

Table 22 shows the values when all of the observed countries are considered altogether. The growth rates of indicators were derived from absolute numbers which are of the sum of GDP, trade volume, energy use, energy production and net energy imports of all the countries observed. As it is seen, GDP growth rate is fairly correlated with the growth rates of net energy imports, energy production and a little bit correlated with trade volume growth rate. However, it is not correlated with energy use growth rate.

Moreover, as it was observed in the correlation analysis, the countries observed can be clustered into 4 groups in terms of their correlation coefficients. The groups are Nigeria- Saudi Arabia- Turkmenistan; Ukraine- Turkey; Italy- Poland and Netherlands- Norway. With the exception of Saudi Arabia, it can be said that these clusters are quite significant.

Nigeria and Turkmenistan are not very developed countries and have serious problems related democracy, human rights, corruption and have rich fuel energy resources. The second cluster, Ukraine and Turkey are developing countries that are not in the EU, they are poor in terms of energy resources but they are important energy transit countries. The third cluster, Italy and Poland are EU member countries that have similar energy policies, are both poor in terms of energy resources but they are important energy transit countries. The final cluster is Netherlands and Norway that are both very developed countries and are important energy suppliers of the EU. Hence it can be said that the correlations between GDP growth rate and the growth rates of energy use, trade volume, net energy imports and energy production are affected from socioeconomic and political factors as it is observed in the correlation analysis.

When each indicator's correlation with GDP growth rate is considered for each country instead of the values in Table 22, it is seen that GDP growth is correlated with trade volume growth and net energy imports growth, with the exception of Russia. However the growth rates of energy use and energy production do not show a common correlation for different countries.

Table 22: Average values of indicators and their correlations of all the countries observed between 1999– 2008

TOTAL	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
GDP growth rate	3.29%	6.90%	4.56%	4.36%	7.13%	8.51%	5.94%	6.58%	6.68%	4.70%
Trade volume growth rate	14.97%	23.46%	0.05%	-4.30%	13.00%	10.75%	4.49%	6.62%	8.99%	7.29%
Energy use growth rate	2.78%	1.01%	0.84%	1.03%	3.88%	1.03%	1.55%	1.97%	1.04%	1.97%
Energy production growth rate	-0.58%	4.40%	1.53%	1.55%	6.95%	3.54%	2.19%	0.50%	-1.00%	2.55%
Net energy imports growth rate	-6.13%	10.25%	2.93%	2.52%	11.74%	7.68%	3.35%	-2.89%	-1.72%	2.29%
CORRELATION COEFFICIENT BETWEEN GDP GROWTH RATE – TRADE VOLUME GROWTH RATE : 0.37										
CORRELATION COEFFICIENT BETWEEN GDP GROWTH RATE – ENERGY USE GROWTH RATE : -0.075										
CORRELATION COEFFICIENT BETWEEN GDP GROWTH RATE – ENERGY PRODUCTION GROWTH RATE : 0.49										
CORRELATION COEFFICIENT BETWEEN GDP GROWTH RATE – NET ENERGY IMPORTS GROWTH RATE : 0.59										

5.3. Regression Analysis

The general equation of linear regression is : $Y = \alpha + \beta X + \varepsilon$ where Y is the dependent (measured) variable, X is the independent (predictor) variable, α is the constant (intercept), β is the coefficient of the variable X and ε is the noise term reflecting other factors that influence Y other than X.

A common statistic associated with regression analysis is the R^2 that is the coefficient of determination. R^2 statistic is a measure of the extent to which the total variation of the dependent variable is explained by the regression. R^2 statistic necessarily takes a value between zero and one and a high value of R^2 shows that the regression model explains the variation in the dependent variable well.

Beside correlation analysis, regression analysis is applied to the same set of data for which correlation analysis were made, to find the relationship between the same factors and to obtain an equation for each country. In this case, the dependent variable is GDP growth rate and the independent variables are trade volume growth rate, energy use growth rate, energy production growth rate and net energy imports growth rate. Since there are more than one independent variable, it is called multiple regression. Therefore in this case the general equation is:

$$GDP\ growth\ rate = \alpha + \beta\ Trade\ volume\ growth\ rate + \gamma\ Energy\ use\ growth\ rate + \delta\ Energy\ production\ growth\ rate + \theta\ Net\ energy\ imports\ growth\ rate + \varepsilon$$

Other things being constant, this equation means that one unit of increase/decrease in trade volume growth rate causes GDP growth rate to increase/decrease by β; one unit of increase/decrease in energy use growth rate causes GDP growth rate to increase/decrease by γ; one unit of increase/decrease in energy production growth rate causes GDP growth rate to increase/decrease by δ; and finally one unit of increase/decrease in energy production growth rate causes GDP growth rate to increase/decrease by θ.

5.3.1. Regression analyis of the countries

Regression analysis were made in Excel for each country according to the set of data seen in all the tables between Table 17 and Table 22, also for the tables in the Appendix. In multiple regression equations of each country, the first number is the constant (intercept) of the equation. All the other things are assumed to be constant when the effects of coefficients and variables are explained. The other numbers are the coefficients of the independent variables.

They show the relationship between the independent variables and the dependent variable which is GDP growth rate. A negative coefficient of an indipendent variable means there is an inverse relationship between that variable and GDP growth rate, while a positive coefficient of an indipendent variable means that GDP growth rate increases when the indipendent variable increases that is a direct relationship. The intercepts show what the GDP growth rate is with zero energy use growth rate, zero trade volume growth rate, zero net energy imports growth rate and zero energy production growth rate. The noise term is assumed to be zero in the following equations.

Multiple regression equation of Turkey:

*GDP Growth Rate= -0.006-1.018*energy use+0.263*trade volume growth rate+1.172*net energy imports growth rate+0.572*energy production growth rate*

$R^2_{Turkey} = 0.68$

Multiple regression equation of Netherlands:

GDP Growth Rate= 0.013- 0.106 energy use +0.252* trade volume growth rate+ 0.013* net energy imports growth rate+ 0.014* energy production growth rate*

$R^2_{Netherlands} = 0.63$

Multiple regression equation of Italy:
GDP Growth Rate= 0.005- 0.511 energy use+ 0.160* trade volume growth rate- 0.301* net energy imports growth rate- 0.182* energy production growth rate*
$R^2_{Italy} = 0.742$

Multiple regression equation of Norway:

GDP Growth Rate= 0.020- 0.156 energy use+ 0.17* trade volume growth rate- 2.172* net energy imports growth rate- 2.454* energy production growth rate*

$R^2_{Norway} = 0.879$

Multiple regression equation of Russia:

GDP Growth Rate= 0.082- 3.031 energy use- 0.047* trade volume growth rate- 2.166* net energy imports growth rate+ 5.0* energy production growth rate*
$R^2_{Russia} = 0.506$

Multiple regression equation of Nigeria:

GDP Growth Rate= 0.076- 1.051 energy use+ 0.111* trade volume growth rate- 0.001* net energy imports growth rate+ 0.197* energy production growth rate*

$R^2_{Nigeria} = 0.775$

Multiple regression equation of Saudi Arabia:

GDP Growth Rate= 0.022-0.216 energy use+ 0.095* trade volume growth rate- 0.380* net energy imports growth rate+ 0.815* energy production growth rate*

$R^2_{Saudi\ Arabia} = 0.896$

Multiple regression equation of Poland:

GDP Growth Rate= 0.022+ 0.338 energy use+ 0.029* trade volume growth rate+ 0.034* net energy imports growth rate- 0.594* energy production growth rate*

$R^2_{Poland} = 0.873$

Multiple regression equation of Ukraine:

GDP Growth Rate= 0.068- 3.843 energy use+ 0.011* trade volume growth rate+ 1.881* net energy imports growth rate+ 1.723*energy production growth rate*

$R^2_{Ukraine} = 0.193$

Multiple regression equation of Turkmenistan:

GDP Growth Rate= 0.138- 0.181 energy use+ 0.013* trade volume growth rate- 0.194* net energy imports growth rate+ 0.499*energy production growth rate*

$R^2_{Turkmenistan} = 0.277$

Multiple regression equation of all the countries together:

*GDP Growth Rate= 0.053+0.266*energy use+0.048*trade volume growth rate+0.421*net energy imports growth rate-0.709*energy production growth rate*

$R^2_{all\ countries\ together} = 0.444$

5.3.2. Results of the regression analysis

When the multiple regression equation of all the countries together is observed, it is seen that GDP growth rate is positively and slightly affected from the growth rates of energy use, trade volume and net energy imports; and negatively and moderately affected from the energy production growth rate. The factor that GDP growth is affected from most is energy production growth rate, the factor that GDP growth rate is affected from least is trade volume growth rate because its coefficient has the lowest absolute value.

The intercept is 0.053 that is more than zero but a small number. This means that GDP growth increases slightly even when all the independent variables are equal to zero. The coefficient of determination, R^2, that takes values between 0 and 1 is 0.444. This means that the regression model for all countries together explains the GDP growth rate fairly well since it is neither low nor high.

6. CONCLUSION

The EU has been trying to diversify its oil and gas suppliers to guarantee its energy supply security. The concerns has been rising in the EU since its import dependency on energy has continuously increased and will increase even more in the future according to the forecasts because of the the growth in demand and downturn in the production of mineral fuels and oils. Due the energy related disputes and threats from Russia, that has been the most important and the biggest energy supplier of the EU, the concerns concentrated on being less dependent on Russian oil and gas imports. The EU succeeded in both diversifying its energy suppliers and being less dependent on Russia in the last decade, especially for its natural gas supply. The number of the countries that supply energy to the EU have gradually increased. Russia's market share in the imported natural gas and crude oil of the EU has gradually decreased in the last decade. The imported natural gas market of the EU became more competitive. Besides, LNG trade has gained more importance in natural gas transportation in the EU.

In this scenario, Turkey could play an important role for the EU in energy issues since they have similar energy related strategies and concerns. A closer collaboration between Turkey and the EU would bring benefits to both parts. Turkey did not make significant steps in its EU accession process mostly due to Cyprus conflict in the last decade. However, the EU and Turkey has been important trade partners. Especially the share of energy FDI inflows in total FDI inflows from the EU to Turkey sharply increased even in the economic crisis period.

Turkey experienced quite similar things with the EU in its energy supply with few exceptions. The number of its natural gas suppliers have increased, while the number of its crude oil suppliers have decreased. The market shares of the suppliers fluctuated, however Russia's market share in both crude oil and natural gas decreased. Turkey gained more importance for EU's energy supply security, especially after the EU had started to be concerned about its dependency on Russia since it started to search potential suppliers that are close to Turkish territories. Besides, Turkey's energy infrastructure has been rapidly developing in the last decade. If the projected pipelines, especially the Nabucco pipeline, become operational, Turkey will be a key player in the energy supply of the EU.

In the results of the correlation analysis, it was seen that generally, GDP growth rate was fairly correlated with the growth rates of net energy imports and energy production; a little bit

correlated with trade volume growth rate and it is not correlated with energy use growth rate according to the set of data used in the analysis. Interestingly, the countries with similar the similar richness of energy resources have similar correlations.

The results of the regression analysis, that was applied to the same sample, were different than those of correlation analysis. GDP growth rate is positively and slightly affected from the growth rates of energy use, trade volume and net energy imports; and negatively and moderately affected from the energy production growth rate. Eventually, it was observed that the energy related indicators do not have a strong impact on the GDP growth rate of neither Turkey nor the sample when the countries are considered together.

When this study was on progress, the energy world did not stay stable. Some of the energy suppliers of the EU and Turkey has had remarkable changes. The Arab Spring caused lots of changes in Libya and the situation in Syria is still a conundrum. Besides, an important natural gas field was discovered near Cyprus, that is a very critical state for Turkey and the EU relationships. These show how rapidly things are changing in the world of energy.

Turkey has gained more importance not only for the energy supply of the EU but also for the global energy world. Therefore, it seems that Turkey will achieve its goal to be the major energy hub between Asia and Europe. The factors like the developments in democracy and economics in the Middle East, other Arab and Former Soviet countries; better reciprocal relationships of these countries with the EU and Turkey; and the solution of Cyprus conflict will contribute to Turkey's potential position of being a very important energy hub.

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APPENDIX

Calculations of Herfindahl Indexes of the EU's imported natural gas market between 2004-2010

$H_{2004} = 0.3728^2 + 0.2121^2 + 0.137^2 + 0.149^2 + 0.011^2 + 0.0305^2 + 0.0032^2 + 0.0802^2 + 0.0016^2 = 0.232$ (in 2004)

$H_{2005} = 0.3455^2 + 0.2137^2 + 0.1234^2 + 0.1528^2 + 0.0123^2 + 0.029^2 + 0.00144^2 + 0.0892^2 + 0.0124^2 + 0.0017^2 + 0.0055^2 = 0.212$ (in 2005)

$H_{2006} = 0.3312^2 + 0.2186^2 + 0.1244^2 + 0.1423^2 + 0.014^2 + 0.035^2 + 0.0219^2 + 0.078^2 + 0.022^2 + 0.0098^2 + 0.0026^2 = 0.202$ (in 2006)

$H_{2007} = 0.3203^2 + 0.2296^2 + 0.132^2 + 0.1303^2 + 0.02^2 + 0.0385^2 + 0.0266^2 + 0.0802^2 + 0.0152^2 + 0.007^2 + 0.0003^2 = 0.199$ (in 2007)

$H_{2008} = 0.3109^2 + 0.2341^2 + 0.1347^2 + 0.1256^2 + 0.0196^2 + 0.034^2 + 0.0259^2 + 0.0887^2 + 0.0156^2 + 0.0125^2 + 0.0004^2 = 0.196$ (in 2008)

$H_{2009} = 0.286^2 + 0.2411^2 + 0.1245^2 + 0.1183^2 + 0.047^2 + 0.0243^2 + 0.0252^2 + 0.0802^2 + 0.0171^2 + 0.019^2 + 0.0037^2 = 0.179$ (in 2009)

$H_{2010} = 0.2615^2 + 0.2342^2 + 0.1260^2 + 0.1183^2 + 0.0807^2 + 0.0344^2 + 0.0230^2 + 0.0894^2 + 0.0145^2 + 0.0175^2 + 0.0025^2 = 0.169$ (in 2010)

Calculations of Herfindahl Indexes of the EU's imported crude oil market between 2004-2010

$H_{2004} = 0.2592^2 + 0.0618^2 + 0.2002^2 + 0.0955^2 + 0.0309^2 + 0.0714^2 + 0.1278^2 + 0.0655^2 + 0.0264^2 + 0.0284^2 + 0.0053^2 + 0.0276^2 = 0.149$ (in 2004)

$H_{2005} = 0.3112^2 + 0.0728^2 + 0.1684^2 + 0.0887^2 + 0.0343^2 + 0.0708^2 + 0.1046^2 + 0.0601^2 + 0.0218^2 + 0.0294^2 + 0.0053^2 + 0.0319^2 + 0.0008^2 = 0.161$ (in 2005)

$H_{2006} = 0.3087^2 + 0.0836^2 + 0.1628^2 + 0.0915^2 + 0.0342^2 + 0.064^2 + 0.0892^2 + 0.0598^2 + 0.0283^2 + 0.0304^2 + 0.004^2 + 0.0388^2 + 0.0021^2 = 0.157$ (in 2006)

$H_{2007} = 0.3149^2 + 0.0954^2 + 0.1536^2 + 0.101^2 + 0.0274^2 + 0.0696^2 + 0.071^2 + 0.0584^2 + 0.035^2 + 0.0287^2 + 0.0047^2 + 0.036^2 + 0.0044^2 = 0.159$ (in 2007)

$H_{2008} = 0.2902^2 + 0.0939^2 + 0.1456^2 + 0.1026^2 + 0.0396^2 + 0.0901^2 + 0.0678^2 + 0.0492^2 + 0.0352^2 + 0.0261^2 + 0.0243^2 + 0.0348^2 + 0.0007^2 = 0.145$ (in 2008)

$H_{2009} = 0.2889^2 + 0.1165^2 + 0.1434^2 + 0.094^2 + 0.0436^2 + 0.0825^2 + 0.0563^2 + 0.0465^2 + 0.0378^2 + 0.0206^2 + 0.0293^2 + 0.0304^2 + 0.0003^2 = 0.144$ (in 2009)

$H_{2010} = 0.297^2 + 0.127^2 + 0.1309^2 + 0.1071^2 + 0.0437^2 + 0.0654^2 + 0.0601^2 + 0.0566^2 + 0.0315^2 + 0.0227^2 + 0.025^2 + 0.033^2 = 0.149$ (in 2010)

Calculations of Herfindahl Indexes of Turkey's imported natural gas market between 2004-2010

$H_{2004} = 0.647^2 + 0.1605^2 + 0.1461^2 + 0.0464^2 = 0.468$ (in 2004)

$H_{2005} = 0.6596^2 + 0.1598^2 + 0.1424^2 + 0.0381^2 = 0.482$ (in 2005)

$H_{2006} = 0.6326^2 + 0.1832^2 + 0.1481^2 + 0.036^2 = 0.457$ (in 2006)

$H_{2007} = 0.6325^2 + 0.1683^2 + 0.035^2 + 0.1215^2 + 0.0388^2 + 0.0002^2 + 0.00016^2 + 0.0034^2 = 0.446$ (in 2007)

$H_{2008} = 0.6262^2 + 0.1542^2 + 0.0784^2 + 0.113^2 + 0.026^2 + 0.0002^2 + 0.0019^2 = 0.435$ (in 2008)

$H_{2009} = 0.5203^2 + 0.1582^2 + 0.1495^2 + 0.1266^2 + 0.0096^2 + 0.0283^2 + 0.0002^2 + 0.0001^2 + 0.0072^2 = 0.335$ (in 2009)

$H_{2010} = 0.453^2 + 0.212^2 + 0.12^2 + 0.106^2 + 0.052^2 + 0.034^2 + 0.0045^2 + 0.0025^2 + 0.015^2 = 0.279$ (in 2010)

Calculations of Herfindahl Indexes of Turkey's imported crude oil market between 2004-2010

$H_{2004} = 0.221^2 + 0.265^2 + 0.053^2 + 0.004^2 + 0.144^2 + 0.044^2 + 0.235^2 + 0.027^2 + 0.005^2 + 0.005^2 = 0.2$ (in 2004)

$H_{2005} = 0.276^2 + 0.297^2 + 0.045^2 + 0.15^2 + 0.015^2 + 0.207^2 + 0.006^2 + 0.007^2 = 0.232$(in 2005)

$H_{2006} = 0.341^2 + 0.285^2 + 0.024^2 + 0.152^2 + 0.192^2 + 0.004^2 + 0.001^2 = 0.258$ (in 2006)

$H_{2007} = 0.356^2 + 0.415^2 + 0.045^2 + 0.145^2 + 0.01^2 + 0.012^2 + 0.018^2 = 0.323$ (in 2007)

$H_{2008} = 0.359^2 + 0.331^2 + 0.076^2 + 0.03^2 + 0.154^2 + 0.02^2 + 0.004^2 + 0.025^2 = 0.27$ (in 2008)

$H_{2009} = 0.399^2 + 0.249^2 + 0.13^2 + 0.018^2 + 0.142^2 + 0.017^2 + 0.007^2 + 0.023^2 + 0.006^2 + 0.012^2 = 0.26$ (in 2009)

$H_{2010} = 0.432^2 + 0.194^2 + 0.125^2 + 0.112^2 + 0.11^2 + 0.022^2 + 0.0045^2 + 0.007^2 = 0.265$ (in 2010)

Indicators and correlation coefficients of selected countries between 1999 – 2008

NIGERIA	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
GDP Growth Rate	1.1%	5.4%	3.1%	1.5%	10.3%	10.6%	5.4%	6.2%	6.4%	6.0%
Trade Volume growth rate	9.53%	16.21%	-10.09%	-13.39%	43.05%	-0.06%	9.62%	-3.33%	0.41%	12.33%
Energy use growth rate	6.13%	2.82%	3.37%	3.31%	4.12%	0.66%	3.71%	-0.32%	0.13%	5.54%
Energy production growth rate	-0.15%	7.51%	4.75%	-7.08%	9.94%	5.99%	1.35%	0.79%	-7.86%	5.17%
Net energy imports growth rate	-4.82%	11.01%	5.91%	-14.87%	15.24%	10.38%	-0.44%	-6.96%	6.38%	-7.76%
CORRELATION COEFFICIENT BETWEEN GDP GROWTH RATE – TRADE VOLUME GROWTH RATE : 0.51										
CORRELATION COEFFICIENT BETWEEN GDP GROWTH RATE – ENERGY USE GROWTH RATE : -0.42										
CORRELATION COEFFICIENT BETWEEN GDP GROWTH RATE – ENERGY PRODUCTION GROWTH RATE : 0.53										
CORRELATION COEFFICIENT BETWEEN GDP GROWTH RATE – NET ENERGY IMPORTS GROWTH RATE : 0.66										

SAUDI ARABIA	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
GDP Growth Rate	-0.7%	4.9%	0.5%	0.1%	7.7%	5.3%	5.6%	3.2%	2.0%	4.2%
Trade Volume growth rate	2.85%	24.79%	-6.78%	1.66%	15.98%	18.84%	18.97%	10.16%	10.59%	6.22%
Energy use growth rate	1.56%	4.59%	2.48%	10.22%	0.87%	7.38%	6.60%	4.80%	3.49%	9.10%
Energy production growth rate	-7.57%	7.52%	-2.40%	0.02%	12.54%	3.09%	5.26%	-0.93%	-3.27%	4.89%
Net energy imports growth rate	-9.81%	8.18%	-3.48%	-3.07%	16.39%	1.78%	4.97%	-2.68%	-5.51%	3.11%
CORRELATION COEFFICIENT BETWEEN GDP GROWTH RATE – TRADE VOLUME GROWTH RATE : 0.79										
CORRELATION COEFFICIENT BETWEEN GDP GROWTH RATE – ENERGY USE GROWTH RATE : -0.008										
CORRELATION COEFFICIENT BETWEEN GDP GROWTH RATE – ENERGY PRODUCTION GROWTH RATE : 0.9										
CORRELATION COEFFICIENT BETWEEN GDP GROWTH RATE – NET ENERGY IMPORTS GROWTH RATE : 0.9										

POLAND	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
GDP Growth Rate	4.5%	4.3%	1.2%	1.4%	3.9%	5.3%	3.6%	6.2%	6.8%	5.1%
Trade Volume growth rate	-1.00%	17.82%	-3.78%	6.64%	17.53%	17.51%	0.91%	17.53%	8.09%	5.10%
Energy use growth rate	-2.62%	-4.16%	0.69%	-0.98%	2.53%	0.35%	1.04%	5.32%	-0.31%	0.91%
Energy production growth rate	-4.20%	-5.16%	0.88%	-0.11%	-0.43%	-1.29%	-0.22%	-0.96%	-6.54%	-1.94%
Net energy imports growth rate	21.72%	5.42%	0.69%	-9.98%	23.04%	17.07%	8.26%	40.43%	24.61%	8.99%
CORRELATION COEFFICIENT BETWEEN GDP GROWTH RATE – TRADE VOLUME GROWTH RATE : 0.47										
CORRELATION COEFFICIENT BETWEEN GDP GROWTH RATE – ENERGY USE GROWTH RATE : 0.21										
CORRELATION COEFFICIENT BETWEEN GDP GROWTH RATE – ENERGY PRODUCTION GROWTH RATE : -0.62										
CORRELATION COEFFICIENT BETWEEN GDP GROWTH RATE – NET ENERGY IMPORTS GROWTH RATE : 0.8										

UKRAINE	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
GDP Growth Rate	-0.2%	5.9%	9.2%	5.2%	9.4%	12.1%	2.7%	7.3%	7.9%	2.1%
Trade Volume growth rate	18.37%	24.59%	-0.81%	2.30%	16.62%	14.08%	-8.91%	0.99%	6.78%	-3.27%
Energy use growth rate	-0.47%	-0.94%	0.23%	1.12%	6.65%	-0.52%	-0.68%	-3.89%	0.01%	-0.87%
Energy production growth rate	1.30%	1.18%	-0.16%	0.56%	3.54%	0.93%	0.96%	2.52%	-1.70%	-0.38%
Net energy imports growth rate	-2.68%	-3.19%	0.23%	1.12%	11.61%	-2.73%	-2.94%	-10.59%	2.51%	-3.29%
CORRELATION COEFFICIENT BETWEEN GDP GROWTH RATE – TRADE VOLUME GROWTH RATE : 0.18										
CORRELATION COEFFICIENT BETWEEN GDP GROWTH RATE – ENERGY USE GROWTH RATE : 0.25										
CORRELATION COEFFICIENT BETWEEN GDP GROWTH RATE – ENERGY PRODUCTION GROWTH RATE : 0.11										
CORRELATION COEFFICIENT BETWEEN GDP GROWTH RATE – NET ENERGY IMPORTS GROWTH RATE : 0.28										

TURKMENISTAN	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
GDP Growth Rate	16.5%	18.6%	20.4%	15.8%	17.1%	17.2%	13.0%	11.4%	11.8%	10.5%
Trade Volume growth rate	58.35%	49.10%	8.09%	10.58%	14.22%	19.17%	5.53%	6.47%	18.01%	14.38%
Energy use growth rate	18.39%	1.41%	4.23%	1.64%	11.73%	-8.83%	5.53%	0.76%	9.50%	3.21%
Energy production growth rate	45.35%	74.58%	9.62%	4.90%	10.76%	-0.64%	5.08%	-0.99%	9.63%	3.42%
Net energy imports growth rate	98.89%	161.96%	11.92%	6.44%	10.36%	2.90%	4.75%	-1.48%	9.50%	3.60%
CORRELATION COEFFICIENT BETWEEN GDP GROWTH RATE – TRADE VOLUME GROWTH RATE : 0.28										
CORRELATION COEFFICIENT BETWEEN GDP GROWTH RATE – ENERGY USE GROWTH RATE : -0.03										
CORRELATION COEFFICIENT BETWEEN GDP GROWTH RATE – ENERGY PRODUCTION GROWTH RATE : 0.44										
CORRELATION COEFFICIENT BETWEEN GDP GROWTH RATE – NET ENERGY IMPORTS GROWTH RATE : 0.43										