

## The Analysis of Natural Gas and Crude Oil Market from the Global and EU Perspective<sup>1</sup>

Saleh Mothana Obadi<sup>2</sup> – Matej Korček<sup>3</sup>

### **Abstract**

*This paper deals with the development of the crude oil and natural gas market in the world and especially in the EU. The analysis of the mentioned energy commodities are based on time serious statistical data and legislative documents and treaties adjusting the energy market. In this paper we analyze how the natural gas and crude oil as the two energy sources that are on the one hand most important in the energy mix and on the other hand least available within the very territory of EU itself therefore meaning the largest threat to the energy security of EU countries. We focus on analyzing of development of the worlds crude oil and natural gas development as the economic environment developed during last 20 year. Then we characterize what has EU done as the reaction on this development and finally we analyze the impact on EU in terms of supply and demand for natural gas and crude oil in first decade of 21st century. We found that, in 2009, the 66 % of EU natural gas imports were from four countries (Russia, Algeria, Norway and Nigeria) and the EU crude oil imports reached about 87 %.*

### **Keywords**

*Crude oil, natural gas, energy market, EU, energy supply and demand*

**JEL Classification:** O13, P28, P48, Q4

### **Introduction**

Two of the three treaties establishing the European Communities are about energy: the European Coal and Steel Community Treaty and the Euratom Treaty. In the Treaty establishing the European Economic Community, however, the Member States chose not to lay the foundations of a common energy policy. Subsequent attempts to include a chapter on energy, during the negotiations on the Maastricht and Amsterdam Treaties, ended in failure. The energy receives no more than a mention in the preamble to the Amsterdam Treaty. Security of supply concerns are not, however, alien to the Treaty, as scope for action at the Community level to remedy supply problems has existed since the Treaty of Rome (EC 2000)

In the Treaty on the Functioning of the European Union, the energy security issues addressed under the article 194 with aiming at ensuring functioning energy market, security of energy supplies, and renewable resources and networks interconnections between EU countries still preserving the possibility of choosing best energy mix

<sup>1</sup> This paper is a part of research project VEGA No. 2/0009/2012.

<sup>2</sup> doc. Ing. Saleh Mothana Obadi, PhD.; Institute of Economic Research, Slovak Academy Sciences, Šancova 56, 811 05 Bratislava; E-mail: ekonbadi@savba.sk

<sup>3</sup> Ing. Matej Korček; Institute of Economic Research, Slovak Academy Sciences, Šancova 56, 811 05 Bratislava; E-mail: matej.korcek@gmail.com

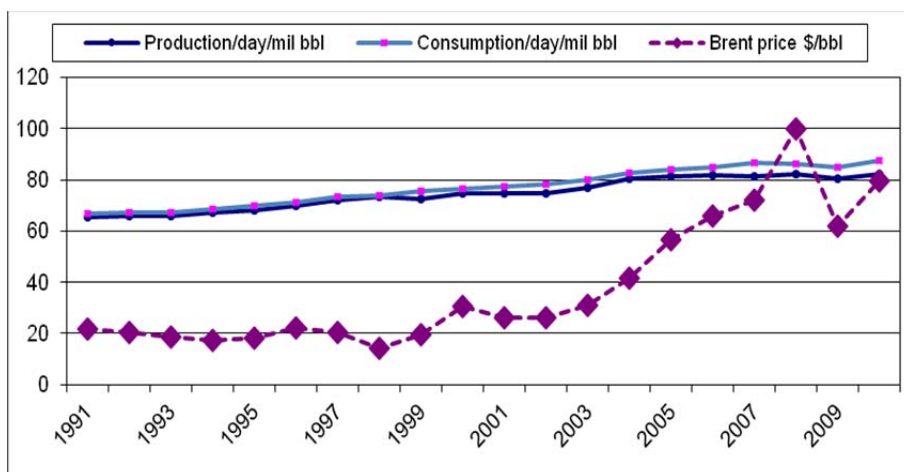
for each with respect to country’s natural resource endowment. We analyze that the natural gas and crude oil as two energy sources are most important in the energy mix and least available in the territory of EU itself therefore meaning the largest threat to the energy security of EU countries. We analyze the development of the world crude oil and natural gas development in relation to economical environment last 20 year. We characterize the reaction of EU to this development and finally we analyze the impact it has on EU in terms of supply and demand for natural gas and crude oil in the first decade of 21st century.

The objective of this paper is to analyze the development of oil and gas markets in the last decade of 20th century and the first decade of twenty first century from the global and EU point of view. We used in our analysis evaluation methods of the quality and quantity, particularly statistical method for identifying not only the percentage increases (decrease) of oil and gas prices but also the EU dependence ratio on oil and natural gas.

### 1 The development of the world market of crude oil and natural gas in relation to the current trends

After a decade of the modest oil price (1991-2000 average of 18,81 USD/bbl for Brent and 20,23 USD/bbl for WTI) the average price in this decade (2000-2010) almost tripled 54,7 USD/bbl Brent and 56,09 USD/bbl WTI. This significant rise in prices has become a fact which was accompanied by 10 % growth in oil production (based on decades average production comparison) when the production has continuously risen from 65,3 mil bbl/day in 1991 to 75 mil bbl/day in 2000 reaching 2010 mil bbl/day in 2010. At the same time the consumption has grown even faster 18 % on decade to decade average comparison, from 66,7 mil bbl/day to 76,6 mil bbl/day 2000 and 87 mil bbl/day in 2010.

**Graph 1** The world oil market development 1991-2010



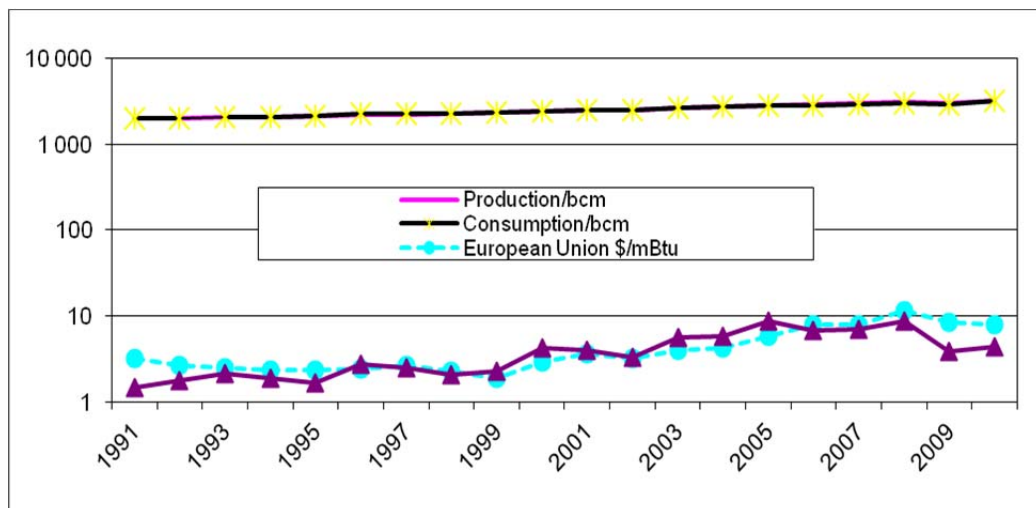
Source: Own base on database of BP statistical review 2011.

However the growth in prices and demand also created incentives for the oil companies to intensify their efforts in oil reserves which led to the impressive growth of the proved oil reserves from 1007 billions bbl in 1990 to 1383 billions bbl in 2010 (1526,3 taking into account Canadian oil sands).

The development on the natural gas market presents increasing trend that was influenced by positive environmental aspects of natural gas in energy production compared to coal. The increasing share of availability of LNG technology and the trade flux of LNG has grown from 142,95 bcm in 2001 to 297,63 bcm in 2011 and development of hydraulic fracturing as a method of shale gas extraction.

The last decade of 20th century average production of the natural gas reached 2 371 bcm/year compared to 2 814 bcm/year for the first decade of 21st century meaning 18,7% growth on decade to decade basis. The consumption grew by the same timeshare from decade average of 2 174 bcm/year to 2799bcm/year in the first decade of 21st century. It represents almost 29 % growth on this basis. The prices development was quite volatile as for European Union. The spot price of the natural gas on the Henry Hub has influence on the natural gas price in long time contract for the US. The prices of the natural gas in Europe has started at the level of 3,19USD/mBtu in 1991 falling to minimum of 1,99 USD/mBtu in 1999 then quickly raising to analyzed period's maximum 11,56 USD/mBtu in 2008 before slight decline to 2010s average of 8,01 USD/mBtu. The price in EU was higher than in the US one for 12 out 20 last years so the average price for the whole period was 22 % higher in EU than in USA. In 1991 the average price on natural gas was 1,49 USD/mBtu, representing also the minimum price for period, the maximum price was reached in 2005 – 8,79 USD/mBtu then falling to 4,39 USD/mBtu in 2010. The rise of natural gas prices has the same effect on findings of it as it happen in case of oil. The world proved reserves increased from 131,2 tcm in 1991 to 187,1 tcm in 2010 meaning increase of 42 % growth.

**Graph 2** The world natural gas market development



Source: Own based on database of Eurostat, September 2011.

The analysis presents the growth of all checked factors. There is acceleration since 2000. The crude oil and natural gas market developed to the current state in the first decade of the 21st century. There is increase of reconnaissance of environmental aspect of fossil fuels usage and their impact on climate. Oil made it to the centre of speculative market investments what has raised the price of oil to 147 USD/bbl (Khan, 2009) in July 2008 before collapsing to 40 USD/bbl in December of the same year. Those high oil prices lead President Bush to lifting an executive order banning US coastal offshore oil drilling. In April 2010, BP's offshore oilrig Deepwater Horizon exploded killing 13 men and causing the largest ecologic catastrophe since Exxon Valdez after releasing around 4,9 mil bbl of oil (Hoch-Maureen, 2010) until on September 19, 2010, when the spill was finally successfully stopped.

The war in Iraq that started in 2003 lead to sharp decline in production and even in 2010 the country with second largest reserves of 115 billion barrels still produce just some 2,4 mil bbl a day due to damaged infrastructure and continuing violence. The Caspian area is the second Saudi Arabia of oil with first estimates of reserves of 200 billion bbl. The data 35 billion bbl (Engadhl, 2004) was later presented. The production of Caspian region is however going to rise from 2,9 mil bbl/day in 2009 to 5,4 mil bbl/day between 2025-2030 for oil and from 159 bcm in 2009 to 310 bcm in 2035 with most incremental production used for export (IEA, 2010). The higher prices and development in technology enabled development of the unconventional sources of oil and natural gas that enlarge the available resource of the base.

The various sources based by the origin and processing technology of the unconventional oil sources:

- The Canadian oil sands: The Bitumen and Extra heavy oil.
- The Venezuelan Orinoco belt: The Extra heavy oil.
- The oil obtained from the kerogen contained in oil shales.
- The oil obtained from coal by coal-to-liquids technologies.
- Oil obtained from the natural gas by gas-to-liquids technologies

The role of unconventional oil is will expand rapidly, enabling it to meet about 10 % of world oil demand by 2035. The Canadian oil sands and the Venezuelan extra-heavy oil dominate in the mixture. The Coal-to-Liquids (CTL), Gas-to-Liquids (GTL) and less extent oil shale create a growing contribution also. (IEA, 2010)

**Table 1** The natural bitumen and extra heavy oil and recoverable oil resources

Natural bitumen and extra heavy oil (billion barrels)				Recoverable resources by shale oil resources of the world <sup>4</sup>	
Country	Proven reserves	Ultimately recoverable resources	Original oil in place	Country	Recoverable Resources (billion bbls)
Canada	170	≥ 800	≥ 2 000	United States	626
Venezuela	60 <sup>5</sup>	500	≥ 1 300	Brazil	300
Russia		350	850 <sup>6</sup>	Russia	41
Kazachstan		200	500	Zaire	38
USA		15	40	Australia	17
United Kingdom		3	15	Canada	16
China		3	10	Italy	13
Azerbaijan		2	10	China	10
Madagascar		2	10	Total world	1,067
Other		14	30		
World		≥ 1900	≥ 5 000		

Source: NPC, 2007. and IEA, 2010.

The development of unconventional natural gas—including tight sands, coal bed methane, and gas shales extraction was marked by Daniel Yergin (2009) as the “The biggest energy innovation of the decade”. In 1990, unconventional gas created about 10 % of total U.S. production. In 2009 it was around 40 %, and growing fast, with shale gas by far the biggest part (Yergin & Ineson, 2009). In most other countries development in this field is not that far. In EU The shale gas presence is confirmed in United Kingdom by Cuadrille, in Poland Haliburton already executed the first successful hydraulic fracturing (Haliburton, 2011), In Hungary the MOL company is investing into this area and Wildhorse Energy plans to develop coal bed methane extraction in southern Hungary but France for instance is planning to issue the legal act forbidding the extraction and exploration of shale gas and oil in October 2011 (Martor & Chétrit, 2011). All the countries also have to cope with the issue of the environmental side of shale gas extraction.

Nevertheless the huge unconventional gas reserves will very likely have growing impact on the natural and energy gas market on worldwide scale.

<sup>4</sup> (37,5 % of estimated in-place resource).

<sup>5</sup> As reported by Oil and Gas Journal, 2009. National oil company of Venezuela PDVSA reports this data as 130 bil. bbl.

<sup>6</sup> From German Federal Institute for Geosciences and Natural Resources (2009), Russian authors reports significantly smaller data in order 250 billion bbl. The same is true for Kazachstan.

**Table 2** The unconventional natural gas resources by territory

Region	Coal bed methane	Shale Gas	Tight-Sand Gas	Total
North America	84	108	38	230
Latin America	1	59	36	97
Western Europe	4	14	10	29
Central and Eastern Europe	3	1	2	7
Former Soviet Union	111	18	25	154
Middle East and North Africa	-	71	23	94
Sub Saharan Africa	1	8	22	31
Centrally Planned Asia and China	34	99	10	143
Pacific (OECD)	13	65	20	98
Other Asia Pacific	-	9	15	24
South Asia	1	-	5	7
World	253	451	207	912

*\* Expressed in Tcm, conversion factor used for calculation 1Tcf=0,028Tcm.*

Source: National Petroleum Council, 2007.

The demand was particularly influenced by dynamic economic development of the emerging economies. In 2001, Jim O'Neill of Goldman Sach identified in paper entitled "Building Better Global Economic BRICs" the group of countries that will shape world economy dramatically in following decades with respect to their size in terms of population, natural resources and growing economic strength. The Brazil and Russia own immense natural resources to their current situations. The China and India are the two countries creating the greatest new thirst for the oil. While China imports approximately 40 percent of its oil, India imports more than 70 percent of its oil. Neither country has domestic oil fields capable of supplying their domestic needs, making them equally dependent on oil from abroad (Hurst, 2007). China with over 1,3 billions inhabitants seems currently to be the major challenge for supply side of crude oil and natural gas to meet growing demand. We need to bear in mind that China becomes the net oil importer only in 1993 after successful economic reform that started in 1978 and during the period 1980 – 2000 the quadrupled GDP (Kambara-Hove, 2007). The growth was accompanied with 150 % growth of oil consumption that almost doubled in next decade and natural gas growth figures for the same period being 91 % and 350 % respectively! For the next 20 years, the consumption of oil should according IEA projections grow by 41 % - 63 % for oil and 144 % to 154 % for gas.

Another growing giant on horizon is India, currently relying on development of use of the coal. However as the standard of living growing and infrastructure development the crude consumption will rise. Just consider that the average per annum growth rate of over 6,2 % between 1980-2010 (Maddison) was accompanied by yearly 5,5 % growth in oil consumption and 15 % gas consumption growth (BP, 2011) i.e. 6 folds growth of GDP led to 5 folds crude oil consumption and natural gas consumption has risen 50 times, staggering data considering Goldman Sachs prediction that "from 2007 to 2020, India's GDP per capita in US\$ terms will quadruple". Moreover, even the advanced technologies may reduce the strength of need for energy, the fact remains

that per capita use of energy in India is three times smaller than in China respectively 14 times smaller than that of USA (WB, 2010).

## 2 EU energy security policies

In November 2000, European Commission issued the Green Paper "Towards a European strategy for the security of energy supply", which has opened a wide debate within the EU on security of supply regarding the diminishing resources of fossil fuels within EU. The strategies were outlined were oriented most importantly from the point of view EU as the second largest energy market of that time on shaping the consumers behavior via taxation system, and promotion of renewable energy with respect to raising environmental issues. The issues of supply were addressed via focusing on diversification of crude oil and natural gas import partners and the transport routes. In addition, the nuclear energy was considered as the potential source of energy for covering rising demand despite the measures aimed at "conserving" the energy and raising energy efficiency after first oil crises the total primary energy consumption due to the economic growth has risen by almost 20 % during the 1973-2010 period. This Green Paper was followed by one called "Energy Efficiency – or Doing More with Less", which stress out the need for increasing the efficiency seeing the potential for 20% reduction in energy consumption until 2020, under the new policies taken, which would relieve 60 billion EUR per year for other investments. The Efficiency gains are in the segments of transportation, energy production and building sector.

The Commission's Green Paper of March 2006: "A European strategy for sustainable, competitive and secure energy represents important further step in quest for enhancing the energy security". The paper presents proposals of six priority areas for implementing the European energy policy. In 2008 as the result of need for raising capital investment as the answer for economic slump resulting from economic crisis European Union launched program from economic recovery, part of which were massive investments into energy sector. The three dominant areas into which 4 billion EUR are realized are – renewable energy sources, particularly wind power plants, CCS technology, and natural gas and electrical infrastructure. In 2009 evaluation of this action plan results we already see first results.

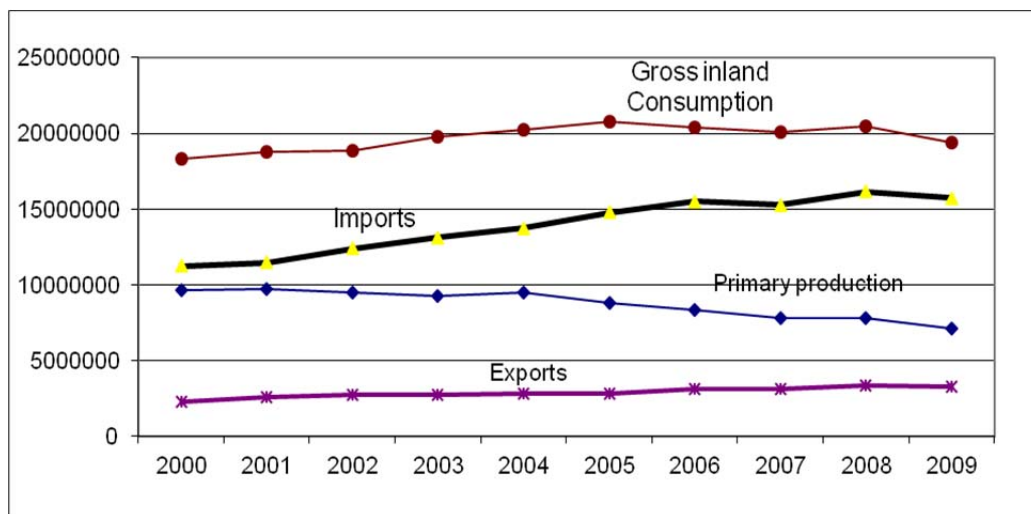
To summarize above measures we can observe some major trends. Firstly, the measures and policies taken by Europe Union are getting more concrete. From vague formulated Common energy policy to direct money inflows into energy sector as the energy issues are gaining more weight and possible threats has materialized (natural gas crises in 2008 or recent development of situation in MENA region. The second is visible within the whole line of policies and it is effort for greater cooperation. The EU must started to act as one player in international affairs, trying to exploit robustness of its demand for energies which must be inevitably bounded with flexibility within the EU itself (emergency stocks, interconnected grids) that would enable to strengthen the negotiation position of EU in case of disruption in energy flows. The external energy policy must gain larger attention to the conservative measures of consumption of energy. The "450" scenario in IEA counts with the fast implementation of environmental regulation and restriction on energy subsidies the demand for energy will decline only 5 % from (1749 Mtoe in 2008 to 1665 Mtoe in 2035) while the share of fossil fuels re-

mains on 50 % level dominated by oil 23 % and gas 21 % of the total (IEA, 2010). However under all the scenarios the external dependence on natural gas and crude oil will rise.<sup>7</sup> Therefore, the external policy must also play crucial role in coping with issue of EU energy security. That is why we will analyze the development of supply of natural gas and oil within timeframe and context of 2000s and 2006s Green Papers.

## 2.1 EU natural gas dependence

European Union dependence on natural gas sources outside its borders has risen by 17,4 % during the last ten years from almost 51 % in 2000 to 68 % in 2009. That is obviously caused by virtually small reserves of natural gas located on its area, concentrated predominantly in Netherlands and Great Britain which in 2010 owned over 60 % of proved natural gas reserves in EU which totally reach 2,5 TCM representing just 1,3 % of world reserves (BP, 2011). These two countries are fourth and seventh largest exporter of natural gas to EU 27 with 72 % share of natural gas production in EU and 84 % of imports in intra Union Trade.

**Graph 3** EU Natural Gas market development (unit in Terajoules)



Source: Eurostat, September 2011.

Although the variety of available sources thanks to development of LNG technology has been growing and growth of shale gas production in USA relieved significant amounts of LNG for export to other territories, the strategically significance of traditional external hegemony in the area of natural gas imports market – Algeria and Russia did not change remarkably. The share on imports developed from 49 % in 2000 to 34 % in 2009<sup>8</sup> for Russia respectively from 20 % to 12 % for Algeria. In case of both countries, this was as the result of 40% growth of EU imports so the stagnant, respectively declining imported volumes from those sources. We need to highlight the fact

<sup>7</sup> It might be vastly influenced by development on field of unconventional gas extraction within EU.

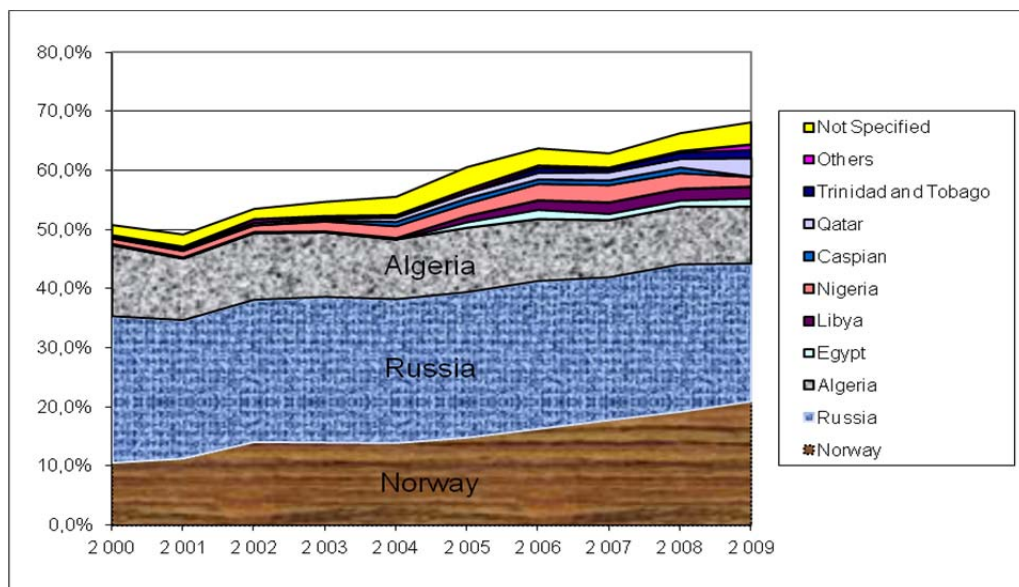
<sup>8</sup> The % share of NG imports from Russia on overall external (excl. intra trade) imports of NG to EU.



the Gross inland consumption<sup>9</sup> has risen only by 5% comparing 2009 against 2000 respectively 12% when compared to 2008 (pre crises year with highest natural gas consumption) while the primary production within EU has been steadily declining.

In case of Russia its overall worldwide 14 % export in natural gas increase was accompanied by 13 % import growths to the EU 27 in period 2000-2008 (EIA)<sup>10</sup>. In case of Algeria we have seen its 6 % overall natural gas export decline even highlighted by 9 % drop of exports to EU. On the other hand, the trend in Norway natural gas supply was opposite. The export in terms of volumes in period 2000-2008 almost doubled while the share on EU imported gas has risen in relative values from 17 % market share in 2000 to almost 26 % market share in 2008. These changes resulted in fact that while in 2000 four suppliers (Russia, Algeria, Norway and Nigeria) supplied the 79 % of EU natural gas imports. In 2009, the very same countries are accounted for "only" 66 % of EU external gas imports, with growing share of Norway, and currently another four countries individually reaching at least more than 1,5 % on EU market of natural gas imports.

**Graph 4** EU Natural Gas imports dependence\*



\* Expressed as ratio of individual external imports on gross inland consumption.  
Source: Eurostat, September 2011.

## 2.2 EU crude oil dependence

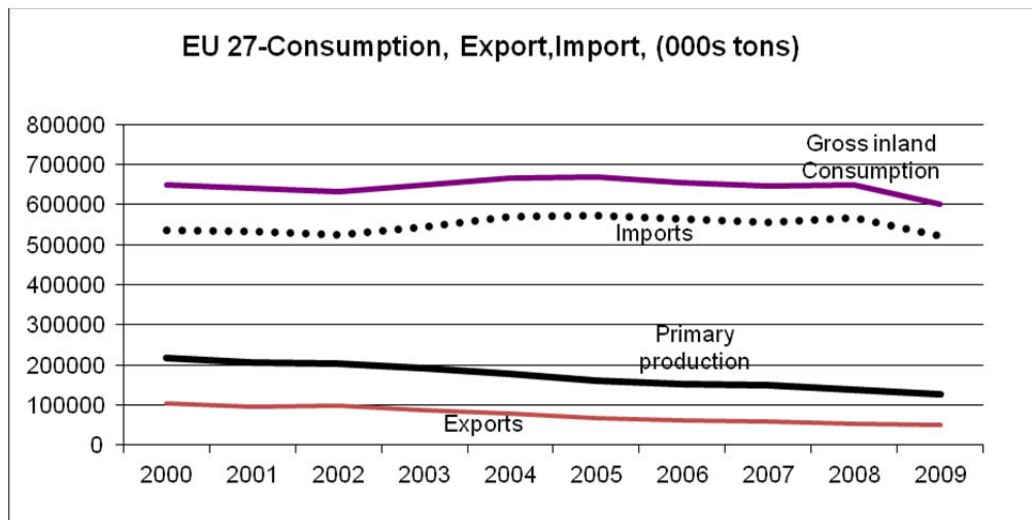
The crude oil gross inland consumption of EU has not barely changed in period 2000-2008 from 659,3 Mtoe to 658,5 Mtoe. In 2009, the consumption fell by almost 8% to (609 Mtoe) on 2008-2009 base comparison, because of world economic crisis.

<sup>9</sup> Import + Production + Changes in reserves – Export = Gross inland consumption.

<sup>10</sup> 2009 was marked by exports drop of almost 28 % with respect to previous year even 2010 did not bring the full exports recovery which stayed below 2005 levels.

The EU 27 primary production of crude oil has declined by 40 % from 157mtoe in 2000 to 95 mtoe in 2010 as the North Sea oil production that in 1998 represented 9 % of overall oil production has reached its peak in around 2000. The most advanced technology employed new fields opening its production is declining rapidly (Blanchard). These factors in other words mean that during the first decade of 21st century the external vulnerability of EU has risen.

**Graph 5** EU Crude oil market development



Source: Eurostat, September 2011.

External import dependence<sup>11</sup> of EU has risen from 82 % in 2000 to 87 % in 2009. During the examined period two changes occurred imports from Middle East and Norway declined and EU is getting more dependent on oil from Russia, and Caspian Region. The importance of other regions in this matter did not shift significantly during this period. The reason of declining crude oil imports from Norway is caused by depletion of North Sea crude oil sources mentioned above leading to 31 % imports decline from 115 Mtons to 79 tons (from 18 % to 13 % of EU crude oil GIC<sup>12</sup>). In case of Middle East countries it is the diversification of export destinations and while in 2000 exports of crude oil from Middle East to Europe created 20.6% of crude its oil exports in 2010 it was only 12,5 %, while the position of Asian and Pacific-Asian changes in the same period from 58,7 % to 74,8 %. Particularly noticeable is China where during 10 years the imports from Middle East increased by 308 % (the data for India from 2000 is not available but since the 2010 Middle East imports were 129,6 Mtons compared to China 118,4 Mton the increase was most likely even bigger). Just to put things into perspective the exports from Middle East during the period has changed only slightly from 941,6 in 2000 Mton to 935,9 Mton in 2010.

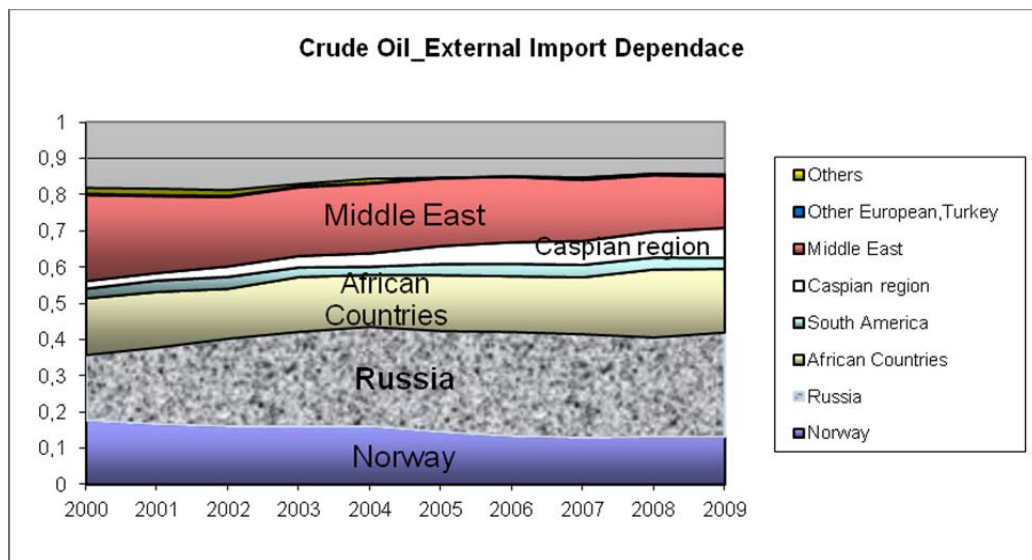
Imports from Caspian Region to EU has increased from 13,4 Mton in 2000 to 49,6 Mton in 2009 (from to 2 % to 8 % on GIC). That was simply caused by overall devel-

<sup>11</sup> Imports to EU from non member’s countries compared to gross inland consumption.

<sup>12</sup> Gross inland consumption.

opment of natural resources in these countries that has led to production growth from 64 Mton to 143,7 Mtons in the same period.

**Graph 6** EU Crude oil imports dependence

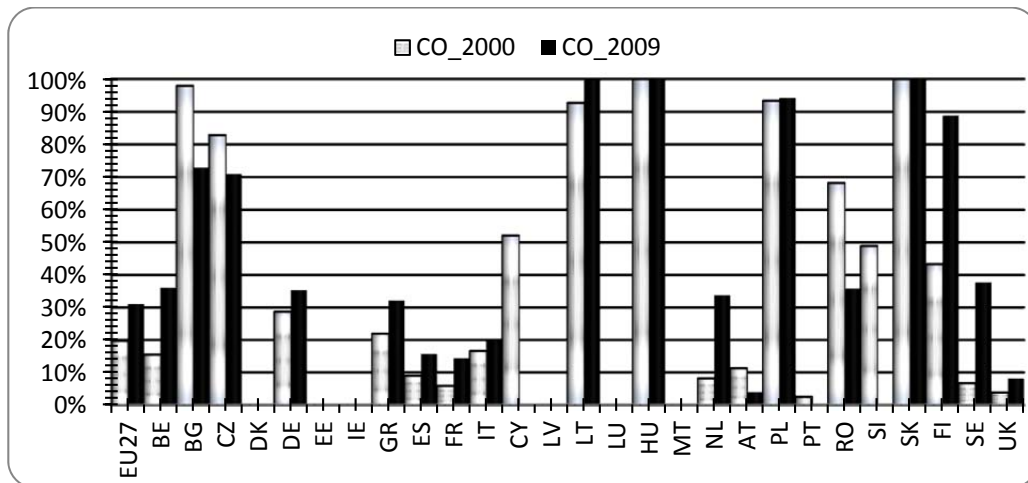


\* Expressed as ratio of individual external imports on Gross inland consumption  
 Source: Eurostat, September 2011.

### 2.3 EU – Russian crude oil and natural gas (inter)dependence

The period 2000 – 2009 is another significant shift occurred that eventually lead to greater energy security of the EU countries. There are eight countries of EU 27 which has reduced their dependence on Russian gas diversify their base of natural gas sources. The EU lately joining countries are still 100 % percent dependent on Russian import of natural gas namely Slovakia, Latvia, Lithuania, Estonia Bulgaria and Romania. This also remains the very case of Finland.

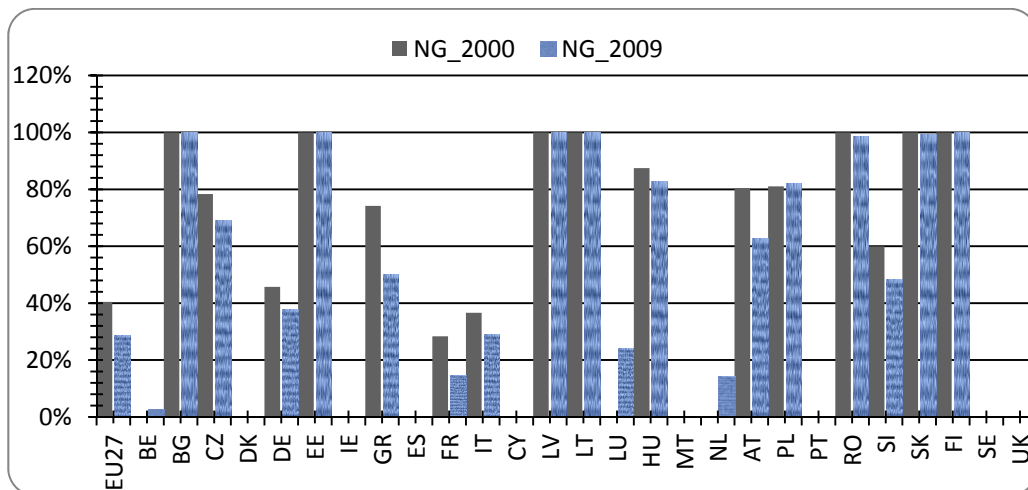
**Graph 7** EU Crude oil imports dependence



Source: Eurostat, September 2011

The EU relation with Russia is the tricky one. The common shared opinion with the energy security is that the security lay within the diversity of sources and transport routes. The dependence on Russia imports with its immense resource base and its political orientation is at least in midterm period inevitable. The politics aimed at exploiting the advantage of fossil fuels exports since presidency of Vladimir Putin. The oil and gas sector share of GDP increased from 8 % to 19 % (2000-2004). The petroleum accounted for more than 50 % of total exports (2000-2004). (Morales, 2008). The growth of prices and fact that Russia owns 24 % of natural gas reserves and almost 6 % of oil proved reserves. The Russia will be the No. 1 exporter of natural gas and No. 2 for crude oil in 2010.

**Graph 8** EU Natural Gas imports dependence



Source: Eurostat, September 2011.

The events in 2006 and 2009 had clearly showed Russia is ready to use the gas as the leverage in international disputes when the flow of Russian gas to Ukraine was interrupted and consequently the middle European countries were cut off. Especially the 2009 experience stressed out the vulnerability of EU newcomers and led EU to intensify the talks on grid security and necessity for enlarging the emergency stocks

The story behind the Russian oil is very similar to the natural gas one. The Russia has ramped up its crude oil production by over 50 %. From (304 Mtons to 505 Mtons during) the last year and increased exports to EU from 18 % to 29 % of EU GIC (117 Mtons to 172 Mtons) when taking into account in relation to the times of the former Soviet Union the EU dependence is rising even faster from 20 % to 37 % (131 Mtons to 233 Mtons). In other view, we can see even stronger dependence from the former Soviet Union countries on EU market. In 2000 78 % of their crude oil exports aimed on European market and during the last ten years, despite the fact the incremental demand is generated by other territories still over 70 % of exports are determined for Europe. The Russian Federation will remain a major and likely quite reliable supplier for next years. The results of the Flame conference attended by representatives of private energy companies, researchers and think tanks of which 65 % consider Russia to be most reliable source for natural gas supplies, on the other hand 73 % share believe that the energy security of European Union (or at least some parts of it are endangered) by over dependence on Russian Gas (Flame, 2011).

## Conclusion

The overall growth of energy consumption, fossil infrastructure, smaller loading capacity of renewable resources and also politics these all are the reasons which strongly suggest that despite all the effort the energy transition to renewable sources of energy will not happen during the first half of 21st century. EU henceforth has no other option but to enhance its external energy politics since its natural resources reserves are simply not adequate. At the same time inelasticity of crude oil and at lesser extent natural gas consumption meaning its irreplaceability especially in the short run could have severe impact on EU economy itself. EU actions toward this issue should therefore further intensify because until now they did not stop the growing hunger for oil and gas and efforts for diversifications energy streams especially from Russia (if ever) should be executed very cautiously. There is a chance that unconventional gas and oil will change the setup however according to various sources it will not happen until after 2020 considering the underdevelopment on this field in Europe and environmental issues it rises.

## References

BP. (2011). *Statistical review of world energy 2001-2011*. Retrieved from <http://www.bp.com/centres/energy>

- CNN. (2008). *Bush lifts executive ban on offshore oil drilling*. Retrieved September 19, 2011 from [http://articles.cnn.com/2008-07-14/politics/bush.offshore\\_1\\_offshore-oil-drilling-fadel-gheit-exploration?\\_s=PM:POLITICS](http://articles.cnn.com/2008-07-14/politics/bush.offshore_1_offshore-oil-drilling-fadel-gheit-exploration?_s=PM:POLITICS)
- DGE. (2010). *A strategy for competitive, sustainable and secure energy*.
- European Commission. (2000). *Towards a European strategy for the security of energy supply*. Retrieved from [http://europa.eu/legislation\\_summaries/energy/external\\_dimension\\_enlargement/127037\\_en.htm](http://europa.eu/legislation_summaries/energy/external_dimension_enlargement/127037_en.htm)
- European Commission. (2010). *Consolidated Version of the Treaty on the Functioning of the European Union*. Retrieved from <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2010:083:0047:0200:en:PDF>
- Engdahl, F. W. (2004). *Iraq and the Problem of Peak Oil*. Retrieved September 25, 2011 from <http://globalresearch.ca/articles/ENG408A.html>
- Flame Conference. (2011). Amsterdam, Presented materials Halliburton web page. *First Shale Fracturing Operation in Poland*. Retrieved September 9, 2011 from <http://www.halliburton.com/ps/default.aspx?navid=1412&pageid=4807&Topic=UnconventionalResources>
- Hoch, M. (2010). *New Estimate Puts Gulf Oil Leak at 205 Million Gallons*. *PBS NewsHour* (MacNeil/Lehrer Productions). Retrieved September 19, 2011 from <http://www.pbs.org/newshour/rundown/2010/08/new-estimate-puts-oil-leak-at-49-million-barrels.html>
- Holditch, S. A. (2007). *Unconventional Gas Reservoirs – Tight Gas, Coal, Seams, and Shale*. Retrieved from [http://www.npc.org/Study\\_Topic\\_Papers/29-TTG-Unconventional-Gas.pdf](http://www.npc.org/Study_Topic_Papers/29-TTG-Unconventional-Gas.pdf)
- IEA. (2010). *World Energy Outlook 2010*.
- IEA. (2011). *Natural Gas Information 2011*.
- IEA. (2011). *Oil Information 2011*.
- International Mining web page. (2011). *Air Liquide supports Wildhorse Energy's underground coal gasification plans*. Retrieved September 19, 2011 from <http://www.im-mining.com/2011/09/09/air-liquide-supports-wildhorse-energys-underground-coal-gasification-plans/>
- Kahn, M. (2009). *2008 Oil price Bubble*. Peterson Institute for International Economics.
- Kambara, T. & Howe, C. (2007). *China and the global energy crisis*. Edward Elgar Publishing.
- Kleinberg, R. L. (2007). *Oil Shale*. Retrieved from <http://www.npc.org>.
- Monaghan, A. (2005). *Russian oil and EU Energy Security*. Conflict Studies Research Centre.
- Monaghan, A. (2006). *Russian – EU Relations: An Emerging Energy Security Dilemma*. Conflict Studies Research Centre.
- Rutledge, I. (2005). *Addicted to Oil*. London: I.B. Tauris & Co. Ltd.
- Smil, V. (2010). *Energy Transitions*. Santa Barbara: ABC-CLIO.
- Yergin, D. & Ineson, R. (2009). *America's Natural Gas Revolution*. Retrieved October 5, 2011 from

<http://online.wsj.com/article/SB10001424052748703399204574507440795971268.html>

<http://ec.europa.eu>

<http://epp.eurostat.ec.europa.eu>