

BRIEF PRESENTATION OF THE WORLD FOSSIL ENERGY MARKET

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The beginning of the third millennium brought the globalization of the worldwide energy market. The fossil fuels, especially petroleum resources are, generally, limited and concentrated in few regions and the world energy market becomes more and more dependent of some “key regions”: the Middle East, the Caspian Sea Region, Russian Federation-Siberia. The great consumers try to consolidate their position in the regions reach in energy resources. And this is happening while growing economies, such as China and India begin to dominate the global demand for energy and push higher the oil prices worldwide.

World market energy consumption is projected to increase by 57 percent from 2004 to 2030. China and India together account for 45 percent of the increase of the energy demand.

Keywords: fossil fuels, reserves-to-production (r/p) ratio, producers, suppliers, consumption.

The Geographic Distribution of the Global Fossil Energy Resources

The energy resources are generally limited and distributed unfairly. Most of the economically advanced states prove to have not enough oil and gas reserves to sustain their economies and their growing fuel consumption, and the states less developed, especially in the Middle East, are reach in energy resources.

The largest world fossil fuel reserves are located in: Asia (Middle East, the region of the Caspian Sea, Russia – Siberia) and in America (United States, Canada, Mexico, Alaska, Venezuela). Other smaller reserves are located in Europe (the North Sea) and in the North of Africa.

The proved world oil and gas reserves as of the 1st of January 2007 as reported by Oil & Gas Journal¹⁰⁵ are the followings:

Level per Region	State/Region	Oil (bill. barrels)	Natural Gas (trillion cubic meters)
1	Canada	179.2	58.0
2	United States	21.8	204.0
3	Mexico	12.4	15.9
TOTAL	North America	213.4	277.9
1	Venezuela	80.0	152.0
2	Brazil	11.8	11.5
TOTAL	Central and South America	91.8	163.5
1	Norway	7.8	82.0
2	United Kingdom	4.029	18.750
3	Denmark	1.328	2.786
TOTAL	Europe	13.157	103.536
1	Russia	60.0	1,680.0
2	Kazakhstan	30.0	100.0
3	Turckmenistan	-	100.0
4	Azerbaijan	7.0	30.0

¹⁰⁵ Estimated quantities that can be recovered under present technology and prices.

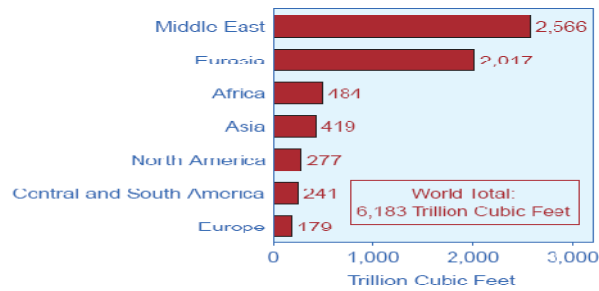
5	Uzbekistan	-	65.0
TOTAL	Russia and ex Soviet Union	97.0	1,975.0
1	Saudi Arabia	262.3	240.0
2	Iran	136.3	974.0
3	Iraq	115.0	112.0
4	Kuwait	101.5	55.0
5	United Arab Emirates	97.8	214.0
6	Qatar	15.2	911.0
TOTAL	Middle East	728.1	2,506.0
1	Libya	41.5	52.65
2	Nigeria	36.2	182.0
3	Algeria	12.3	162.0
4	Angola	8.0	-
5	Egypt	-	59.0
TOTAL	Africa	98.0	455.65
1	China	16.0	80.0
2	India	5.8	39.0
3	Indonesia	4.3	98.0
4	Malaysia	-	75.0
TOTAL	Asia and Oceania	26.1	292.0
Rest of World		49.843	409.414
TOTAL WORLD		1,317.40	6,183.00

Source: Worldwide Look at Reserves and Production, Oil & Gas Journal, Vol 104, No.47, December 18, 2006, pp. 24-25, Energy Information Administration – International Energy Outlook 2007

The large oil and natural gas reserves are concentrated in states/regions less developed, some of them without democratic regimes, with internal disputes, crisis and conflicts, areas where the great global energetic consumers confront and cooperate as well, in the process of access, control and extraction of these fossil energy resources.

In the Middle East, there are over 55 percent out of the proved world crude oil reserves. Saudi Arabia has 20 percent (around 262.3 bill. barrels) out of the world reserves, Iran has 10 percent (136.3 bill. barrels), Iraq has about 9 percent (115 bill. barrels), the Caspian basin has about 3 percent, and the Russian Federation has about 4.6 percent (60 bill. barrels) out of the world reserves.

For the natural gas, the leader is Russia with over 1,680 trillion cubic meters (about 27 percent of the world's natural gas reserves), followed by Iran with 974 trillion cubic meters (about 16 percent), Qatar with 911 trillion cubic meters (about 15 percent) and Saudi Arabia with 240 trillion cubic meters (about 4 percent). Almost three-quarters of the world's natural gas reserves are located in the Middle East and Eurasia (the following figure). Russia, Iran and Qatar combined accounted about 58 percent of the world's natural gas reserves as of 1st of January, 2007.



Source: "Worldwide Look at Reserves and Production," *Oil & Gas Journal*, Vol. 104, No. 47 (December 18, 2006), pp. 22-23.

World Natural Gas Reserves by Geographic Region as of 1st January, 2007

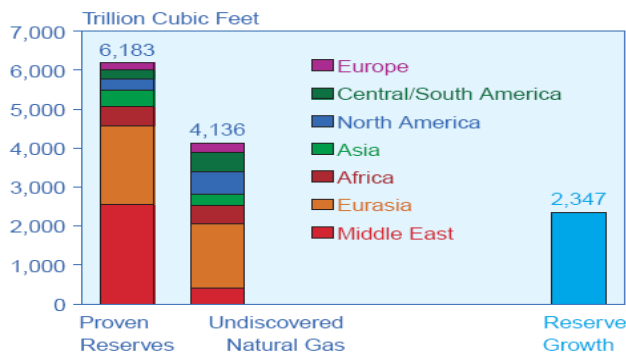
Source: International Energy Outlook 2007

The most common measure of the adequacy of proved reserves to annual production is the reserves-to-production (r/p) ratio, which describes the number of years of remaining production from current proved reserves at current production rates.

The United States r/p crude oil ratio has been between 9 and 12 years, and the top 40 countries in conventional crude oil production rarely have reported r/p ratios below 8 years. The major oil producing countries of OPEC have maintained r/p ratios of 20 to 100 years.

Despite high rates of increase in natural gas consumption, particularly over the past decade, most regional reserves-to-production (r/p) ratios for natural gas reserves are substantial. Worldwide reserves-to-production ratio is estimated at 65 years. Central and South America has a reserves-to-production ratio of about 52 years, Russia 80 years and Africa 88 years. The Middle East's reserves-to-production ratio exceeds 100 years for natural gas.

The United States Geological Survey (USGS) periodically assesses the long-term production potential of worldwide petroleum resources (oil, natural gas and natural gas liquids). According to most recent USGS estimates, released in the World Petroleum Assessment 2000 and adjusted to reflect current proved reserves, a significant volume of natural gas remains to be discovered. Worldwide undiscovered natural gas is estimated at 4,136 trillion cubic feet (the following figure). Within the natural gas resource base, an estimated 3,000 trillion cubic feet is in „stranded” reserves, usually located too far away from pipeline infrastructure or population centers for its transportation to be economical. Of the new natural gas resources expected to be added through 2025, reserve growth accounts for 2,347 trillion cubic feet:



Source: U.S. Geological Survey, World Petroleum Assessment 2000;

“Worldwide Look at Reserves and Production”, *Oil & Gas Journal*, Vol. 104, No. 47, December 18, 2006, pp. 22-23; and Energy Information Administration estimates.

The total recoverable coal reserves around the world are estimated at approx. 998 billion tons, reflecting a current reserves-to-production ratio of 164 years. Although coal deposits are widely distributed on the globe, 67 percent of the world's recoverable reserves are located in four countries: The United States (27 percent), Russia (17

percent), China (13 percent) and India (10 percent).¹⁰⁶ The world recoverable reserves of coal at the 1st of January 2003 are the followings:

Region/Country	Bituminous and Antracite	Subbituminous ¹⁰⁷	Lignite ¹⁰⁸	Total
United States ¹⁰⁹	123.7	110.3	33.5	267.6
Russia	54.1	107.4	11.5	173.1
China	68.6	37.1	20.5	126.2
India	99.3	-	2.6	101.9
Other Non-OECD Europe and Eurasia	51.5	20.7	39.4	111.6
Australia and New Zealand	42.6	2.7	41.9	87.2
Africa	55.3	0.2	-	55.5
OECD Europe	19.5	5.0	18.8	43.3
Brazil	-	11.1	-	11.1
Other Central and South America	8.5	2.2	0.1	10.8
Canada	3.8	1.0	2.5	7.3
Other ¹¹⁰	1.8	0.4	0.1	2.3
World Total	528.8	298.1	170.9	997.7

Sources: For USA: Energy Information Administration, unpublished data from the Coal Reserves Database (April 2007). Other countries: World Energy Council, 2004 Survey of Energy Resources, Eds. J. Trinnaman and A. Clarke (London, UK: Elsevier, December 2004).

Historically, estimates of world recoverable coal reserves have declined gradually from 1,174 billion tons in 1990 to 1,083 billion tons in 2000 and 998 billion tons in 2003. In particular, the most recent assessments of the recoverable coal reserves of Germany have revealed that they have declined from 73 billion tons to 7 billion tons.

The Great Global Energy Producers and Consumers

For the crude oil output and exportation the member states of the Organization of the Petroleum Exporting Countries (OPEC) are on top, with an important position ensuring the consumption and formatting the world prices for the fossil fuels. In 2005, OPEC provided 31.85 million bpd, meaning 44.1 percent out of the total world oil production. Some data as of 2005 are provided hereunder:

Country	2005 Production [millions bpd]	2005 Share of World Production [%]	Reserve-to-production Ratio (r/p) [years]
Saudi Arabia	9.55	13.3	75
Russia	9.04	12.6	18
United States	5.18	7.2	11
Iran	4.14	5.7	83
China	3.61	5.0	14

¹⁰⁶ For USA - Energy Information Administration, unpublished data from the Coal Reserve Database (April 2007); For the other countries - World Energy Council, 2004 Survey of Energy Resources, Eds. J. Trinnaman and A. Clarke (London, UK: Elsevier, December 2004);

¹⁰⁷ Caloric power 5600-7600 kcal/kg, used for the metallurgic coke and for thermo-energy;

¹⁰⁸ Energetic coal with caloric power 2600-4100 kcal/kg;

¹⁰⁹ Data for the United States represent recoverable coal estimates as of the 1st of January, 2006;

¹¹⁰ Includes Mexico, Middle East, Japan and South Korea

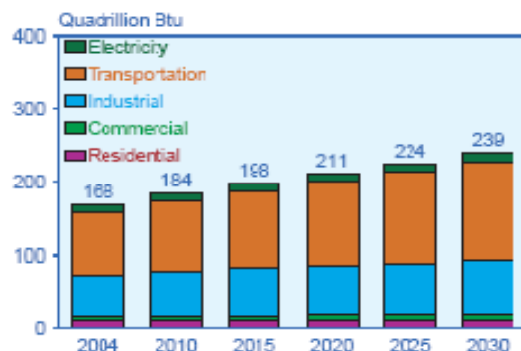
Mexico	3.33	4.6	12
Norway	2.70	3.7	9
Nigeria	2.63	3.6	37
United Arab Emirates	2.54	3.5	106
Kuwait	2.53	3.5	110
Venezuela	1.98	2.7	107
Irak	1.88	2.6	168
Algeria	1.80	2.5	18
United Kingdom	1.65	2.3	7
Brazil	1.63	2.3	18
Libya	1.63	2.3	65
Canada	1.28	1.8	10
Angola	1.26	1.7	12
Indonesia	1.07	1.5	12
Kazakhstan	1.05	1.5	23
Qatar	0.84	1.2	50
Oman	0.77	1.1	19
Malaysia	0.75	1.0	11
Argentina	0.70	1.0	10
India	0.66	0.9	22

Sources: *Production 2005: Energy Information Administration, Short-Term Energy Outlook (October 2006). Reserves: "Worldwide Look at Reserves and Production," Oil & Gas Journal, Vol. 104, No. 47 (December 18, 2006), pp. 24-25.*

Russia, on the second level, with an output of over 9.04 million bpd takes efforts to enhance its capacity similar to that of Saudi Arabia, by using an additional reserve of approx. 3 million bpd, by which can influence the international oil prices. In spite of that, the production costs in Russia are almost similar to those from the other countries while the transport costs for the Russian oil are much higher, which might affect the margin of profit.

The most representative world consumers are United States, China, India and the European Union. The total world consumption of crude oil is reaching 85 million bpd per year, for natural gas raises at about 2,700 billion square meters per year, and for solid coal it has grown to 5,000 million tons per year.

According to the U.S. Department for Energy - International Energy Outlook 2007 – despite the high level of the world oil prices which is projected to persist further into the mid-term outlook, world consumption of petroleum and other liquid fuels increases in 2030 to 118 million bpd (equivalent to 239 quadrillion (10¹⁵) Btu), compared to 83 million bpd in 2004. For 2008, the consumption is projected at approx. 87 million bpd and for 2015 for approx. 97 million bpd. Two-thirds of the increment in world liquids consumption in the reference case is projected for use in the transportation sector, where there are few competitive alternatives to petroleum. The industrial sector accounts for a 27 percent share of the projected increase, mostly for use in chemical and petrochemical processes. Further on, it is presented the world liquids consumption by sector, 2004-2030, in quadrillion Btu:



Sources: 2004: Derived from Energy Information Administration (EIA), *International Energy Annual 2004 (May-July 2006)*, Projections: EIA, *System for the Analysis of Global Energy Markets (2007)*.

To meet the increase in the world energy liquids consumption, liquids production is projected to increase by 15 million bpd from 2004 to 2015 and by an additional 20 million bpd from 2015 to 2030, meaning that from 2004, until 2030, production will increase per total by 35 million bpd. Nevertheless, 65 percent of this are expected to be provided by the OPEC producers (about 23 million bpd). In 2030, OPEC is expected to produce 57 million bpd, and non-OPEC producers are expected to reach an output of 61 million bpd, representing 48.3 percent for OPEC and 51.7 percent for non-OPEC liquid producers. High oil prices, new exploration and production technologies, aggressive cost-reduction programs by industry and the emergence of unconventional resources contribute to the outlook for continued growth in non-OPEC liquids production.

The leading world producers and suppliers of natural gas are Russia, United States and the Middle East countries. Hereunder, it is presented the World Natural Gas Production by regions and countries, 2004 – 2030 in trillion (10¹²) cubic feet:

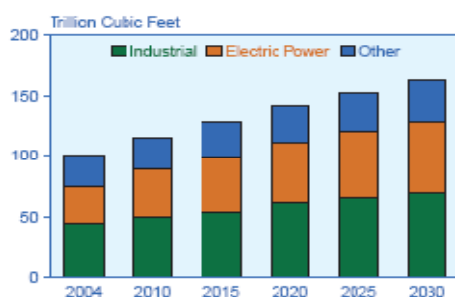
Region/Country	2004	2015	2020	2025	2030	Average Annual Percent Change, 2004-2030
United States	19.0	19.7	20.9	20.7	20.7	0.3 %
Canada	6.5	6.4	6.0	5.9	6.0	-0.3 %
Mexico	1.5	2.0	2.4	2.6	3.0	2.7 %
<i>OECD North America</i>	26.9	28.2	29.3	29.2	29.6	0.4 %
<i>OECD Europe</i>	11.4	11.2	10.7	10.5	10.1	-0.4 %
<i>OECD Asia</i>	1.6	3.1	3.8	4.3	4.7	4.2 %
Japan	0.1	0.1	0.1	0.1	0.1	0.4 %
South Korea	0.0	0.0	0.0	0.0	0.0	-
Australia/New Zealand	1.5	3.0	3.7	4.2	4.6	4.3 %
Total OECD	39.9	42.5	43.8	44.1	44.5	0.4 %
Russia	22.4	27.4	30.0	32.6	35.2	1.7 %
Other	6.3	9.1	9.5	9.8	10.0	1.8 %
<i>Non-OECD Europe and Eurasia</i>	28.6	36.4	39.5	42.4	45.2	1.7 %
China	1.4	3.1	3.5	4.0	4.3	4.1 %
India	1.0	1.7	2.1	2.4	2.5	3.5 %
Other non-OECD Asia	8.1	11.5	13.5	15.8	18.4	3.1 %
<i>Non-OECD Asia</i>	10.5	16.4	19.1	22.2	25.2	3.3 %

<i>Middle-East</i>	9.9	17.4	20.1	21.8	24.1	3.3 %
<i>Africa</i>	5.3	9.5	11.1	13.0	15.1	4.0 %
Brazil	0.3	0.7	0.8	0.9	1.0	4.1 %
Other Central/South America	4.2	6.3	6.9	7.6	8.2	2.5 %
<i>Central/South America</i>	4.5	7.0	7.7	8.4	9.2	2.7 %
Total non-OECD	58.9	86.7	97.4	107.8	118.8	2.6 %
TOTAL WORLD	98.9	129.2	141.2	151.9	163.3	1.9 %

Note: Totals may not equal sum of components due to independent rounding.

Sources: for 2004: EIA, International Energy Annual 2004 (May-July 2006), web site www.eia.doe.gov/iea. 2010-2030: SUA: EIA, Annual Energy Outlook 2007, DOE/EIA-0383(2007) (Washington, DC, February 2007), web site www.eia.doe.gov/oiaf/aeo. Others: EIA, System for the Analysis of Global Energy Markets (2007).

Worldwide consumption of natural gas increases from 100 trillion cubic feet in 2004 to 163 trillion cubic feet in 2030. The World Natural Gas Consumption by End-Use Sector, during 2004 to 2030 period is the following:



Sources: 2004: Derived from Energy Information Administration (EIA), International Energy Annual 2004 (May-July 2006), web site www.eia.doe.gov/iea.

Projections: EIA, System for the Analysis of Global Energy Markets (2007).

By energy source, the projected increase in natural gas consumption is second only to coal. Natural gas remains a key fuel in the electric power and industrial sectors. In the power sector, natural gas is an attractive choice for new generating plants because of its relative fuel efficiency. Natural gas also burns more cleanly than coal or petroleum products. Much of the world's natural gas use is for industrial sector process.

Russia has an extensive pipeline network reaching into Europe and has proposed the construction of pipelines to China and South Korea.

World coal production by regions and states, projected for the period 2004 to 2030, is the following:

Region/Country	2004	2015	2020	2025	2030	Average Annual Change 2004-2030	Percent
United States	22.8	25.8	26.7	30.4	33.9		1.5 %
Canada	1.5	2.1	2.2	2.4	2.5		2.0 %
Mexico	0.2	0.4	0.4	0.5	0.5		3.3 %
<i>OECD North America</i>	24.6	28.3	29.4	33.3	3.0		1.6 %
<i>OECD Europe</i>	7.9	7.7	7.1	6.6	6.6		-0.7 %
<i>OECD Asia</i>	8.1	10.4	11.2	11.9	12.7		1.7 %
Japan	0.0	0.0	0.0	0.0	0.0		-
South Korea	0.1	0.1	0.1	0.1	0.1		0.9 %

Australia/New Zealand	8.1	10.2	11.1	11.9	12.6	1.7%
Total OECD	40.6	46.4	47.7	51.9	56.2	1.3 %
Russia	5.9	7.5	7.9	8.2	8.5	1.4 %
Other	4.1	5.0	5.3	5.4	5.3	0.9%
<i>Non-OECD Europe and Eurasia</i>	<i>10.0</i>	<i>12.5</i>	<i>13.3</i>	<i>13.6</i>	<i>13.7</i>	<i>1.2%</i>
China	43.0	64.6	74.3	83.4	93.4	3.0 %
India	7.3	9.5	10.8	12.0	13.0	2.3 %
Other non-OECD Asia	4.9	8.3	9.6	10.0	10.3	2.9 %
<i>Non-OECD Asia</i>	<i>55.2</i>	<i>82.4</i>	<i>94.7</i>	<i>105.4</i>	<i>116.7</i>	<i>2.9 %</i>
<i>Middle East</i>	<i>-¹¹¹</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>-1.2 %</i>
<i>Africa</i>	<i>5.9</i>	<i>7.7</i>	<i>8.0</i>	<i>8.6</i>	<i>8.9</i>	<i>1.6 %</i>
Brazil	0.1	0.2	0.2	0.2	0.2	3.3 %
Other Central and South-America	1.7	2.9	3.8	4.1	4.1	3.4 %
<i>Central and South-America</i>	<i>1.8</i>	<i>3.1</i>	<i>4.0</i>	<i>4.3</i>	<i>4.3</i>	<i>3.4 %</i>
Total Non-OECD	72.8	105.7	120.1	131.9	143.7	2.6 %
TOTAL WORLD	113.4	152.1	167.7	183.8	199.9	2.2 %

Sources: for 2004: Energy Information Administration (EIA), *International Energy Annual 2004 (May-July 2006)*, web site www.eia.doe.gov/iea. Projections: EIA, *System for the Analysis of Global Energy Markets (2007)* and National Energy Modeling System run IEO2007.D032707B.

Increase demand for international trade is expected to support production growth in Australia/New Zealand, Russia, other non-OECD Asia, Africa and Central and South America (excluding Brazil).

The top four exporters of steam coal in 2005 were Australia, Indonesia, China and South Africa. Projections for 2030 show that Indonesia is expected to surpass Australia as the largest exporter of steam coal, and China, due to increase in the domestic consumption, will not export at the same level and will be ranked as the sixth-largest world exporter of steam-coal in 2030. Indonesia has low-cost reserves of low-sulfur coal, many ports-some with the capability to take capsized ships, and proximity to expanding markets of Asia. For the coking coal, Australia, Canada and the United States will continue to be ranked among the top three exporters over the projection period.

Europe and particularly United Kingdom, has increasingly sought Russia's low-sulphur coal as its own mines have closed. Russia is continuing to increase the capacity of its coal ports, current plans call for an additional increase in export capacity from about 72 million tons (1.6 quadrillion (10^{15}) Btu) in 2005 to 97 million tons (2.1 quadrillion (10^{15}) Btu) by 2008.

World coal consumption increases by 76 percent over the projected period, from 113.4 quadrillion (10^{15}) Btu in 2004, to 199.9 quadrillion (10^{15}) Btu in 2030. Moderate increases in coal consumption are projected for most of the OECD countries, including South Korea, Canada, Australia/New Zealand and Mexico. Coal consumption in OECD Europe declines by 1.7 quadrillion (10^{15}) Btu (representing 13 percent) from 2004 to 2030, in the reference scenario of International Energy Outlook; however, the region is and will continue to be a major market for coal. Coal consumption in OECD Europe, at 13.1 quadrillion (10^{15}) Btu in 2004, represented 28 percent of total OECD coal use. For 2030, this coal consumption in OECD Europe is projected to drop to 11.5 quadrillion (10^{15}) Btu. The major coal-consuming countries of the region, all with consumption of 0.7 quadrillion Btu or more in 2004, include Germany, Poland, United Kingdom, Spain, Turkey and the Czech Republic. Although OECD Europe relies heavily on imports of hard coal, low Btu lignite represents an important domestically produced source of energy.

Plans to replace or refurbish existing coal-fired capacity in a number of the countries of OECD Europe are an indication that coal will continue to play an important role in the region's overall energy mix. In addition to some

¹¹¹ Less than 0.05 quadrillion Btu

recent additions of coal-fired capacities, electricity producers in Germany, Spain, France, Italy, Poland, the Czech Republic and Slovakia have revealed plans to upgrade or replace existing coal-fired generating facilities over the next two decades. Power producers in Germany plan to build nearly 11 giga-watts of new coal-fired generating capacity by 2012, primarily to replace existing-less efficient coal-fired capacities.

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