

15<sup>th</sup> Northeast Asia Economic Forum  
September 5–7, 2006, Khabarovsk, Russia  
Energy Session

A.G. Korzhubaev

The international tendencies of energy supply and a role of Russia in stabilization of the world markets of oil and gas

А.Г. Коржубаев

Международные тенденции в сфере энергообеспечения и роль России в стабилизации мировых рынков нефти и газа

In XX century there was the global annual consumption of commercial energy resources has increased in 15-folds. At growth of a population of the Earth in 3.8-folds, annual consumption of energy per capita has increased almost in 4 times, measured up to 1.5 tones oil equivalent (toe).

In the beginning of XXI century (2001-2006) the annual level of global consumption of energy has increased for 1.5 billion toe, it has exceeded 10 billion toe. For last thirty-five years the annual level of global consumption of primary energy has increased almost in 2-folds.

Prior to 1980 the basic gain of energy consumption appreciably occurred due to the developed countries (European Union, USA, Japan, etc.). For example, during 1965-1979 (15 years) annual consumption of oil in the Western Germany has increased in 2-folds measured up to 163 million tones; in France it has increased in 2.2-folds up to 119 million tones, in Italy it has increased in 2-folds up to 103 million tones.

Last decades global consumption of energy increases, first of all, due to the Asia Pacific – China, India, South Korea, etc., where demand for energy resources grows as a result of growth of a population, developments and changes of a technological level of economy, fast motorization. Demand for energy grows in this region without strong dependence from change of a price level.

During 1980-2005 the annual consumption of energy resources has increased in Asia Pacific almost for 2.3 billion toe. Energy consumption in Thailand has increased in 7-folds, in South Korea – 5.8-folds, in Indonesia – In 4.4-folds, in India – in 3.8-folds, in China – in 3.7-folds.

Global cumulative energy consumption for 1970-2005 has exceeded cumulative energy consumption for all previous period of development of a human civilization. During

1970-2005 cumulative consumption of energy resources in the world has made up at 269 billion toe, whereas with 1901-1970 it has made up at only 124 billion toe, and since the end of a Paleolithic (15 thousand years B.C.) prior to the beginning XX century global energy consumption has made energy consumption 40 billion toe.

During the same period (last decades) the steady rules of energy supply appreciably influencing modern economic development were generated. There were large shifts in technologies of energy production, transportation and using; internationalization of power supply took place. Since 1960th the global new energy demand by 76 % has been caused by change of a population and by 24 % has been caused by change individual level (per capita) energy consumption. The tendency to alignment energy consumption between large groups of the countries distributed by level per capita energy consumption took place.

Hydrocarbons began to dominate in structure of global energy consumption by fuel: during XX century the share of oil has increased from 4 % up to almost 40 %, gas – from 1 % up to 23 %. The majority of the technological systems that have received mass distribution in power and on transport are based on use of petroleum and gas. After some reduction of quantity and share of petroleum in energy consumption in 1980th, caused by reaction of the advanced countries (USA, Japan, European Union) on a rise in prices and faults with deliveries of petroleum during energy crisis's of 1970th, in the world is kept the tendency to increase of petroleum consumption. The great bulk of mineral oil is used in vehicles, and also in the industry (metallurgy, chemistry), in power generation, in construction. To the beginning of XXI century annual consumption of petroleum in the world has exceeded 3.5 billion tones; in 2005 it has exceeded 4 billion tones. For petroleum, as well as for primary energy, significant polarization of the canters of consumption takes place: more that 30 % of global petroleum is used in Asia Pacific; almost 30 % of global petroleum is used in Northern America and, more than 20 % is used in Europe.

Russia is the largest world producer and exporter of petroleum and gas. In 2005 the oil production in Russia has made 470 million tones, oil refining has made 207 million tones, crude and mineral oil export has made 317 million tones, including 222 million tones crude export and 95 million tones mineral oil export; in 2006 oil production will exceed 480 million tones, refining will achieve 210 million tones, export crude and mineral will achieve about 325 million tones. In 2005 gas production in Russia has made 641 billion cubic meters, in 2006 it will achieve 650 billion cubic meters. Export of gas has made in 2005 171 billion cubic meters, in 2006 export 175 billion cubic meters is expected.

*The share of Russia in a global oil production makes about 12 %; the share in a global gas production makes more than 22 %.*

Now a mainstream of deliveries of crude, mineral oil and gas from Russia is the European Union. The countries of the European Union it is accounts over 80 % of crude export, over 80 % of mineral oil export and 76 % of gas export. Deliveries of petroleum and gas to the European Union are carried out mainly from deposits of Western Siberia – the largest oil and gas production region of the Russia.

In conditions of a petroleum supply manipulation by OPEC, the oil policy of Russia is presented constant escalating of production of energy carriers and increase of the offer on the international markets. Since 2000 the annual oil production in Russia has increased on 175 million tones or 3,5 million barrels daily. Only that new production exceeds total consumption in Germany and Netherlands. At the same time, the level of an oil production in Russia yet has not achieved a historical maximum of 1988. There was oil production has achieved 569 million tones yearly or 11.4 million barrels daily. In 1987-1988 the oil production in the USSR made 625-623 million tones yearly or 12.5 barrels daily that exceeded 20 % of global production. In 2001-2006 annual gas production in Russia has increased almost on 70 billion cubic meters, having exceeded a historical maximum of 1991.

*Stabilizing role of Russia in global system of energy supply consists in the organization of reliable, large-scale and constantly growing deliveries of energy carriers on the world market.*

Most effectively to satisfy demand on domestic and the international markets it is necessary to take into account modern steady tendencies and rules of development of energy sector. The analysis of a lot of factors on the basis of the dynamic data more than 100 countries specifies that in the most significant parameters for typification of countries on energy consumption model are a level of economic development, an availability natural energy resources, a climate.

Rather high per capita consumption of energy and high efficiency of use of energy resources at creation of unit of GDP in the countries of the European Union account for a high level of development of economy and favorable climatic conditions. By virtue of severe climatic conditions by production of unit of gross national product Russia should spend more energy, than USA in 1.6-fold and in 2.0-2.5-fold it is more than the countries of the European Union and Asia Pacific.

At the end of 1960th – the beginning of 1970th in most countries the significant linear dependence between GDP and consumption of energy with high factor of determination ( $R^2$  for the data on 77 countries for 1968 has exceeded 0.83) took place. Experts of the Roman club have paid attention to presence of this interrelation by one of the first [Meadows et al., 1972]).

Energy crisis's 1973-1974 and the 1979 which have expressed in restriction of deliveries of petroleum and substantial increase of the energy prices, promoted deterioration of an economic situation in countries-importers of energy carriers. Delay of economic growth, increase of costs, increase of inflation took place.

To the beginning XX century there was a differentiation of the countries by models and efficiency energy consumption. The advanced countries have sharply increased energy consumption efficiency; have diversified energy consumption by fuel and have diversified geographical structure of energy trade movements.

In the some countries these processes developed differently, that is caused by distinctions in availability of natural energy resources, a geographical position and a state policy in power sector. However the general rule is reduction of a share of petroleum by production of the electric power.

In the countries having significant minerals and power resources and having an advanced mining industry, without dependence from a level of economic development, high power intensity of GDP and high per capita consumption of energy.

Reduction of power intensity of GDP occurred as a result of development energy-saving technologies, energy consumption rationalization, and transformations of energy demand structure.

In 1980-1990th in world energy balance some reduction of a share of petroleum took place at outstripping increase of consumption of gas and an atomic energy.

In 2000-2006 in the world fast growth of demand for all basic kinds of fossil fuel has renewed: petroleum (2,2 % per year), gas (2,8 % per year) and coal (5,7 % per year), and, since 2003, basically as a result of growth of consumption of energy carriers in China and USA, global petroleum consumption grew by 4,5 % per year, and coal consumption grew by 7,3 %. World gas consumption was increased last three years on the average by 3 % per year, especially, due to growth of demand in Asia Pacific, Middle East and the European Union.

Properties of modern economy are diversifying energy sources and increase of the total energy consumption. At steady increase of cost of concrete energy carriers in structure

of the relative prices there is their replacement from commercially least effective technological systems. Within the framework of this rule in 1970th there was a reduction of use of petroleum as boiler fuel in electric power industry as a result of a rise in prices on oil that has resulted in the general reduction in demand for petroleum and the subsequent falling of the prices. To the beginning of the second decade XXI century in the advanced countries similar processes are expected in a segment of motor fuel.

In the countries–importers of petroleum, it is especial in Japan, Korea, USA, European Union, became more active investigations and industrial projects on reduction of petroleum consumption as motor fuel, to development of alternative kinds of fuel for motor transport: gas fuel, dim ethyl ether etc. However even under condition of successful realization of these programs mass distribution of kinds of motor fuel alternative to petroleum can take place not earlier, 2020.

It is predicted, that the high oil prices conjuncture (50-70 dollars per barrel) will be kept approximately till 2010-2011 though the tendency to reduction of prices should be designated already in 2008-2009. It is connected with sluggishness petroleum consumption technological systems, which are now used in the advanced countries and continue wide application to production in developing countries. For example, the largest world automobile concerns (Ford, Daymler-Craysler, BMW, Toyota, Nissan etc.) have constructed the factories in China, and it conducts to growth of demand for mineral oil in this country.

At the same time, now in the world there is a recurrence of a situation of 1973-1981 when for eight-nine years petroleum basically was superseded by gas, coal and an atomic energy from commercially least effective segment of its use – electric power industry. In the beginning of the second decade in developing countries there will be a technological saturation by traditional motor transport; therefore global growth of demand for petroleum will be slowed down. In the advanced countries replacement of fuel oil and average distillates from systems of heating of houses will proceed. All this will result in delay of rates of growth of demand and reduction of prices on petroleum up to a level of 40-45 dollars per barrel that in view of inflation of dollar corresponds to modern 35-40 dollars per barrel.

The majority of forecasts of demand are constructed or on the basis of formalization before processes having a place, or on a qualitative substantiation and a quantitative estimation of expected changes in system of key parameters determining speed and a trend of long-term processes. If duration of the forecast of 50 years and more there is the probability of significant discrepancies connected to factors, not giving in to forecasting, but essentially

influencing on parameters energy demand. To these factors concern: (1) basic discoveries and technological development, (2) large man-caused and natural accidents, (3) cardinal political changes and military conflicts, (4) irreversible climatic shifts, (5) abnormal medical and biologic and ecological changes, (6) cardinal changes of the relative prices etc. Besides steady processes in the certain period in the long term no synchronously can be accelerated or slowed down and also change trends of development.

For the energy consumption forecast the technique based on the covariance analysis is used, providing an opportunity a priori in the formalized kind to estimate energy demand changes in view of change of parameters of economic development. In a technique the aggregated and detailed approaches are combined.

According to the forecast of development of world economy, global consumption of primary energy in 2010 will make 12,8 billion toe, in 2015 will make 13,6 billion toe, in 2020 will make 15 billion toe, in 2025 will make about 16,4 billion toe, in 2030 will make 17,1 billion toe. Mid-annual rate of a gain energy consumption will make for the period of 2006-2025 about 2 %. In the regional plan most quickly use of energy will grow in the Asia Pacific the average on 3 % per year. Most slowly demand for energy will grow in the Western Europe and Japan (0.5 % per year).

By 2030 it is expected, that in global structure of primary energy consumption by fuel the share of gas will be kept at a modern level of 23 %. Absolute consumption of gas in the world will make 4,6 billion cubic meters. Development of the gas industry and an opportunity of increase of the of gas supply on the international markets, including to the Asia Pacific, will depend on realization of investment projects on development of peninsula Yamal, the Arctic shelf of Russia, Eastern Siberia (including Republic Sakha), a shelf of sea of Okhotsk, and also from an opportunity of stabilization of a political situation on Middle East and the organization of production and deliveries of the pipeline gas and LNG from this region.

At growth of consumption of petroleum by 2030 up to 6 billion tones its share in total energy consumption will decrease and will make 35 %. The share of coal by 2030 will increase up to 30 %. The role of other energy carriers (hydraulic power, a biomass, wind, solar etc.) in structure energy consumption essentially will not change.

Development of the nuclear industry will depend on a safety of work and increase of technological efficiency of nuclear stations, the decision of questions of processing and a burial place of the fulfilled nuclear fuel.

*Global consumption of petroleum will grow basically due to increase of it) use in Asia Pacific.* Consumption of petroleum in the Western Europe practically will not increase. Growth of demand for petroleum in the European Union will occur due to the countries of the East Europe where per capita consumption will be leveled with the countries of the Western Europe. In Russia it is supposed, that the increase of petroleum consumption will average with rate of 1.4 % per year and will achieve 175 million tones by 2025.

*Use of gas in the nearest decades, as well as petroleum, will grow most quickly in the Asia Pacific (on the average on 3.6 % per year).* In Russia the program of gasification supposing increase of gas consumption is accepted is mainly in east and northwest regions of the country. It is supposed, that gas demand in Russia will make 580 billion cubic meters by 2030 (a mid-annual gain of 1.3 %), and gas demand in the former USSR will make 930 billion cubic meters by 2030 (1.5 % per year).

Oil production in Russia will be determined by the crude prices, a domestic demand, a development of a transport infrastructure, tax conditions and scientific and technical achievements in investigation and development of deposits. The bottom oil price level will be determined by a level of costs on deposits in large regions of production with trailing expenditures, and top oil price level will be determined by costs for mass alternative to petroleum motor fuel. The major factors influencing a price level on petroleum are presence and a condition of a transport infrastructure from the largest centers of production up to the centers of refining and consumption that determines the size of transport costs and reliability of deliveries.

For a substantiation of decisions on the organization of deliveries of petroleum and gas on export the analysis forecast of a situation in the basic international markets – European, Asian – Pacific and North American is executed is given.

Under forecast IPGG (Institute of Petroleum Geology and Geophysics of the Siberian Branch of the Russian Academy of Science) *consumption of petroleum in Europe* in 2010 can make 788 million tones, in 2020 – 825 million tones. Petroleum consumption in Northern Europe: in 2010 can make 315 million tones, in 2020 – 317.6 million tones. In Southern Europe: in 2010 – 368 million tones, in 2020 – 374 million tones. In the East Europe: in 2010 – 104.6 million tones, in 2020 – 133 million tones. In view of predicted levels of production and consumption a gain net import of Europe can make in 2010 – 48 million tones, in 2020 – 140 million tones. In Northern Europe in 2010 new net import will make 16.8 million tones, in 2020 – 73 million tones. In Southern Europe: in 2010 new net import will make 17.6

million tones, in 2020 – 22.4 million tones. In the East Europe in 2010 new net import will make 17.1 million tones, in 2020 - 133 million tones.

*Annual petroleum consumption in USA* by 2010 will make 965 million tones, by 2020 – 1033 million tones. Consumption of petroleum in area of East coast will make by 2010 – 298 million tones her year, by 2020 – 320 million tones per year. Annual petroleum consumption in the Middle West by 2010 will make 248 million tones, by 2020 – 269 million tones. Annual petroleum consumption in Southeast coast by 2010 will make 239 million tones, by 2020 – 247 million tones. Annual petroleum consumption in Rocky Mountains area by 2010 will make 31 million tones, by 2020 34 million tones. At the Western coast of USA annual petroleum demand by 2010 will make 149 million tones, by 2020 163 million tones. In view of predicted levels of production and consumption net import of crude and mineral oil USA by 2010 will make up to 618 million tones per year, by 2020 – 731 million tones per year. By 2010 the new net import will make 74 million tones per year, by 2020 – 187 million tones per year. The USA petroleum Atlantic market net import by 2010 will make 568 million tones per year, by 2020 – 644 million tones per year. The gain of net import by 2010 can make 51 million tones, by 2020 – 127 million tones. The USA petroleum Pacific market net import by 2010 will make 50 million tones, by 2020 – 87 million tones. Thus the new net import by 2010 can make 23 million tones, by 2020 – 60 million tones.

*Annual demand for petroleum in Asia Pacific* will increase by 2010 up to 1490-1530 million tones, by 2020 – up to 1940-2000 million tones. Consumption of petroleum in China will increase by 2010 up to 390-410 million tones per year, by 2020 – up to 560-580 million tones, in Japan – by 2010 up to 290-310 million tones per year, by 2020 – up to 320-330 million tones, in South Korea – by 2010 up to 140-150 million tones per year, by 2020 – up to 180-200 million tones. Net import of crude and mineral oil in Asia Pacific by 2010 will make 1000-1100 million tones per year, by 2020 – 1500-1600 million tones per year. China petroleum net import by 2010 will achieve 220-230 million tones per year, by 2020 – 400-430 million tones per year. Japan petroleum net import by 2010 will achieve 295-305 million tones per year, by 2020 – 320-330 million tones. South Korea petroleum net import by 2010 will achieve 140-150 million tones per year, by 2020 – 185-195 million tones. The increase of net import in Asia Pacific concerning 2005 by 2010 will make 435-455 million tones, by 2020 – 920-960 million tones. Most considerably new import will increase in China – 130-140 million tones by 2010 and 320-330 million tones by 2020.

Under forecasts of US EIA and the European energy program (Green Paper) *annual consumption of gas in Europe* by 2010 can make 570-608 billion cubic meters, by 2020 – 660-717 billion cubic meters, by 2030 – 727-786 billion cubic meters. Under IPGG forecast gas consumption in Europe by 2010 can make 645 billion cubic meters, by 2020 – 788 billion cubic meters, by 2030 – 816 billion cubic meters. According to various forecasts consumption of gas in Europe by 2030 will increase approximately twice. It is caused by growing requirements for heat and electric power industry will be satisfied due to use, first of all gas as the most effective and non-polluting product. Thus replacement of coal and fuel oil by gas from this sector of economy will proceed. Gas production perspectives of Northern Sea and Norwegian Sea cannot satisfy growing demand in European region. Deliveries of Russian pipeline natural gas by 2010 can make 200 billion cubic meters, by 2020 – 220 billion cubic meters, by 2030 – 250 billion cubic meters.

*Under US EIA estimations* annual gas consumption in USA by 2010 can to make 743 billion cubic meters, by 2020 – 875 billion cubic meters, by 2030 – 896 billion cubic meters. Under forecasts IPGG in view of production and consumption of gas in USA net import by 2010 can make not less than 185 billion cubic meters per year, by 2020 – 255 billion cubic meters per year, by 2030 – 375 billion cubic meters per year. The basic part of gas import will be delivered to USA in LNG kind. The share of deliveries LNG in the general import will increase with 15 % up to 80 %. US annual LNG import by 2010 will make more than 114 billion cubic meters (In recalculation on initial substance), by 2020 – about 215 billion cubic meters, by 2025 – above 260 billion cubic meters, by 2030 – more than 306 billion cubic meters.

*Gas demand in Asia Pacific will increase* by 2010 up to 530-550 billion cubic meters per year, by 2020 – up to 770-820 billion cubic meters per year, by 2030 – up to 1000-1100 billion cubic meters per year. By countries *gas demand will increase* (billion cubic meters per year): in China by 2010 – up to 80-100, by 2020 – up to 190-220, by 2030 – up to 320-380; in Japan by 2010 – till 90-95, by 2020 – up to 100-120, by 2030 – up to 120-150; in South Korea by 2010 – till 40-45, by 2020 – till 50-60, by 2030 – up to 80-100. Discovering last years in China (Ordos basin, Tarim basin, Bohai Gulf etc.), Australia (Timor Sea), Papua (Papuan basin), India (Bay of Bengal), Vietnam (South China Sea), and other Asia Pacific of some large deposits of hydrocarbons is the factor promoting development in region of an infrastructure of transportation, processing, delivery and use of gas. However to satisfy growth of energy needs of China and others Asia Pacific now, in the future these new

discovering of oil and gas fields cannot. Net import (deliveries from regions outside of Asia Pacific) gas in Asia Pacific will increase by 2010 up to 200-220 billion cubic meters per year, by 2020 – up to 450-500 billion cubic meters per year, by 2030 – up to 750-800 billion cubic meters per year.

*Thus, long-term energy market tendencies: Europe – stagnation, USA – slow growth, Asia Pacific – fast growth. Oil and gas production tendencies: there are a drop out of Northern sea, Alaska, Songliao, Shengli, leaving gulf of Mexico and appearance of East Siberia, Arctic and Far East shelf are expected.*

*Accordingly, for increasing of Russian oil and gas export: Baltic direction (Primorsk terminal etc.) gives an exit Northern Europe for replacement of Northern Sea deliveries, Northern direction (Murmansk terminal, Indiga terminal, tankers - stores etc.) gives a direct exit to Northern America.*

*Eastern direction(oil pipeline “East Siberia – Pacific ocean”, gas pipelines “Russia – China”, “Russia – South Korea”, Nakhodka terminal, De Castry terminal etc.) – direct exit on Asia Pacific where under all forecasts new import demand will grow most quickly, first of all, due to China.*

In these conditions in Russia as a whole growth of oil recovery though its rate in Western Siberia will be slowed down will proceed, and in the European part of the country absolute parameters will decrease also. The annual oil production in the country can be making up by 2010 up to 500 million tones, by 2020 – up to 550 million tones, by 2030 – up to 600 million tones. The important role for export deliveries to the Asia Pacific and to the Pacific coast of USA will be played with development of deposits Western and Eastern Siberia and Okhotsk Sea shelf.

The major necessary conditions for escalating of oil and gas production in Russia are expansion of investments for exploration works and development of systems of transport.

Besides there will be an increase of an oil and gas production by the Russian companies abroad, first of all, in the countries of the Caspian region – Kazakhstan, Turkmenistan, Uzbekistan, Azerbaijan. From these countries deliveries of petroleum by the Russian operators to the Asia Pacific also are expected.

*By 2030 the share of Russia in a global oil production will be 10-12 %, and the share of the CIS will be not less than 15 %, that is enough for satisfaction of domestic requirements, expansion of deliveries to the traditional and new international markets.*

Natural gas resources allow by 2010 annual gas production in Russia making up 681 billion cubic meters, by 2020 – up to 890 billion cubic meters, by 2030 – up to 910 billion cubic meters. The bottlenecks are pipeline gas and LNG transport systems.

*The share of Russia in global gas production will make 23-25 %, and the share of CIS will make not less than 28-30 %. It allows to satisfy of domestic requirements and provide increase of deliveries at the traditional markets (to Europe) and to organize new large-scale deliveries on Asia Pacific and Northern America markets.*