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## ENERGETIC RAW MATERIAL PRICES IN THE ASPECT OF DEFINING MUTUAL INTERACTIONS AND RELATIONS

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### 1. Introduction

An analysis of raw materials markets, in the sense of capital and asset management, stresses the need of focusing the attention on several important issues that are crucial to financial and material flows in the scale of the world, in the context of allocation of the finite financial resources. In those meaning raw materials markets — crude oil, gas and coal, in general, can be taken into consideration as complementary financial investments. This last statement allows thinking that allocation of finite financial resources in a given period of time (shifts in a production process, distribution, sales and consumption) must initiate a chain of dependences relating to price movements.

In this study the authors decided to estimate the development tendencies in a particular raw materials markets and also to examine the existence or lack of particular dependences between them. The analysis of further development presented here concerns both solid and liquid energy carriers, i.e. oil, natural gas and coal sectors [6].

### 2. Crude oil market analysis

Throughout 2003 and 2004, the upward turn in crude oil prices was brought about by a combination of a few simultaneously existing factors:

- first was a general strike in Venezuela;
- second, conflicts in Nigeria;
- third, military warfare in Iraq;

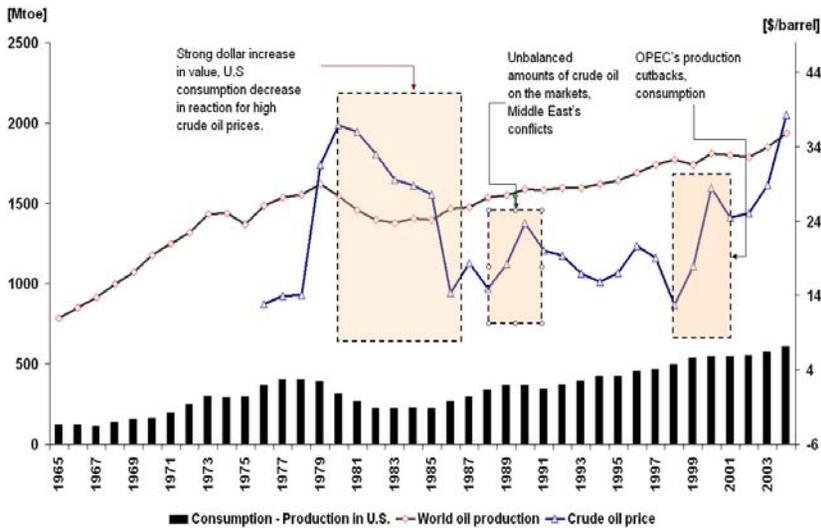
which caused reductions in the total OPEC (Organization of Petroleum Exporting Countries grouping the world's largest oil producers) export to non-OPEC countries. Despite the fact that in the mentioned period of time other OPEC countries agreed to increase their

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outputs to 90% of their production capacities to make up for the lost output, crude oil prices were forced to remain high by the disparity between the supply and demand.

Dynamic development of the Asian markets as well as boom at the raw materials market that took place in that time, strengthened the uncertainty as to the availability of sufficient crude oil volumes that could balance the still growing world demand. This had its reflection in a significant growth of prices. It is important to remember that it is the dynamics of change rather than the changes of a factor's value itself (for example, of demand or reserves level), which causes price movements and fluctuations (in short time). That way of thinking led the authors to express their postulates and their understanding of the crude oil markets, at present, and in the “potential” future.

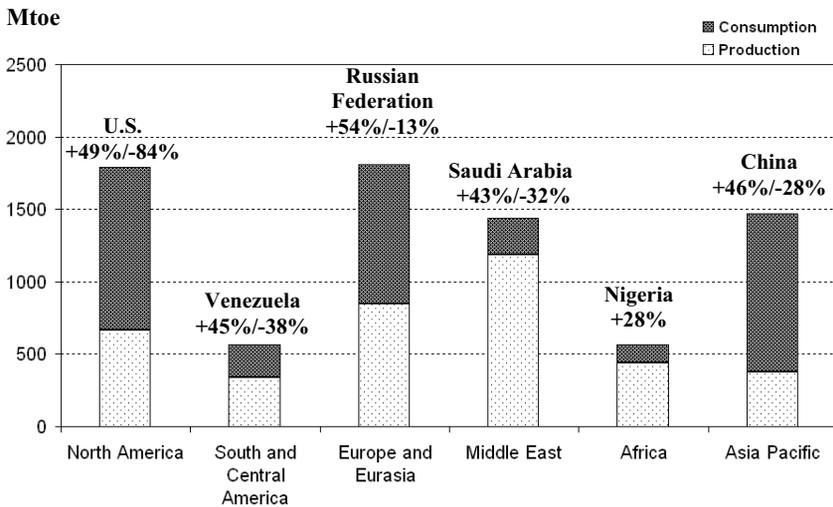


**Fig. 1.** World crude oil prices and differences in consumption during 1965–2004.  
Source: own study based on BP data ([www.bp.com](http://www.bp.com))

The volumes of production and consumption in the United States of America influence shifts in the world oil prices. This country possesses unfavourable balance of those two factors — it consumes more than produces. Figure 1 reflects that scenario using the USA as the best example. Of course it is impossible to unambiguously affirm that only the USA exerts the influence on the world petroleum prices. A decrease in the US “Consumption-Production Ratio” (K-P) causes reduction of crude oil prices. In a group of potential reasons for this effect we can name: increase in oil production, and/or slump in its consumption. It is also worth mentioning that during 1979–1981 comparatively high oil prices (36,5 \$/barrel at the contemporary inflation level) dominated, which caused a decrease in consumption, a reduction of the market’s surplus reserves, production cutbacks and a price decrease again. The increase of value of the US dollar versus the European currencies also had its impact. After 1991, a modest and sustainable growth in the world oil production corresponded to the increase of the world crude oil consumption. The dynamics of production was slightly higher than consumption in that period of time causing the pressure

for the price to go down. Robust demand for oil and a slump in supply (caused by a decrease in production by its strategic producer — OPEC), existing in the aftermath of the low price environment, initialised the strong price upward move after 1998. The beginning of the 21st century is dominated by a rapid economic Asian expansion, pushing the consumption higher and higher. Strong demand pressure drives oil prices to historical peaks.

A comparison between the regions of crude oil production versus its utilization reveals considerable disproportions. Particularly in Europe, North America as well as in highly developed Asian countries the use of oil is significantly higher than domestic production. Opposite relationship characterises the Middle East, Africa and Latin America. The lack of balance is neutralized by international trade, embracing 57% of the total world production (Fig. 2).



**Fig. 2.** Crude oil balance of production and consumption by region in 2004.

Source: own study based on BP and EIA. “Plus” before the name of a country describes production, “minus” indicates total consumption. When there is no consumption annotation that means “data unavailable” or “insignificant”

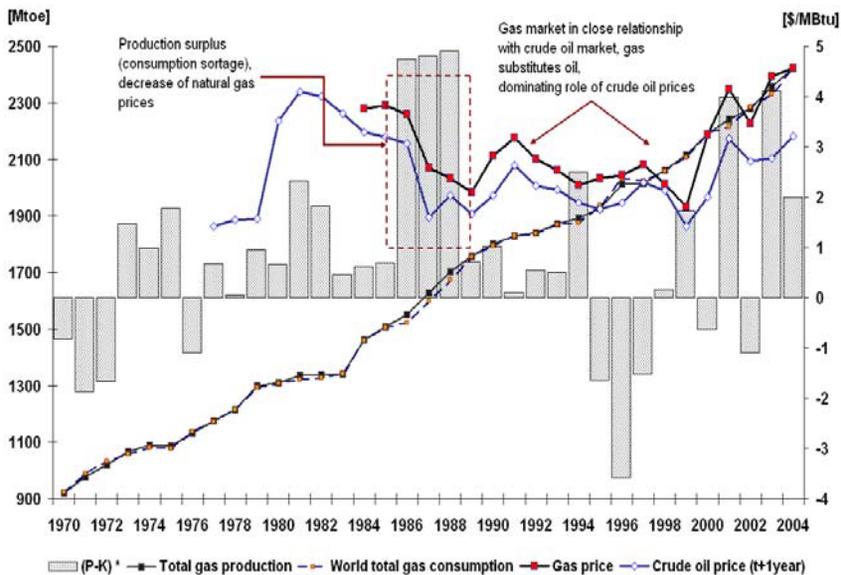
Let’s draw our attention to the structure of the world fuel economy. Undoubtedly the predominant producers of petroleum are: Saudi Arabia, the former Soviet Union countries, the USA. The world biggest crude oil fuel fractions consumers are: the USA, China, Japan and Germany. Although the USA production constitutes 51% of the total output in North America, its consumption reaches 84% of all petroleum products coming from that region. This emphasises the negative structure of the supply-demand figure which is typical of the United States of America. Direct translation of the above facts encourages assuming that the USA as the world’s biggest economy and the world’s biggest oil products (especially crude oil — petroleum and fuel fractions) consumer will strive to have oil prices maintained at a relatively low level. We are therefore entitled to conclude that until now the major contributor to the world oil price tendencies and fluctuations are the USA and the demand-supply ratio on its market.

## 2.1. Forecast of crude oil production and consumption

Following forecasts done by the EIA (Energy Information Administration) in its “International Energy Outlook 2004” [8] indicate that the total volume of oil export till 2025 will rise to more than double of the current, especially from the OPEC producers, and will be kept at the maximum production capacity levels by other producers as well. The basis for the prediction was the assumption that the transport sector, the biggest user, will grow at an average annual rate of 2.1%. Additional assumption made stressed that there will be no other technical developments and energy legislation intended to reduce oil use, and having the power to compete with the traditional fuels used in vehicles. It is also clear that China, India and Indonesia are the key markets that will drive regional consumption growth. Their fuel economy predictions for the light-duty vehicle sector estimates its possible growth rate at 25% per annum by 2025. The countries of Africa, the former Soviet Union and Mexico are placed further down in the estimate. Taking all the facts and predictions into account one is allowed to conclude that prices of petroleum products should rise systematically until new reserves are opened up or until oil is replaced by another energy source.

## 3. Natural gas market

Natural gas seems to be achieving more and more distinguished role in the creation of the world demand for energy. Nowadays, it is also more often treated as an important source of energy being produced at a competitive price (Fig. 3).



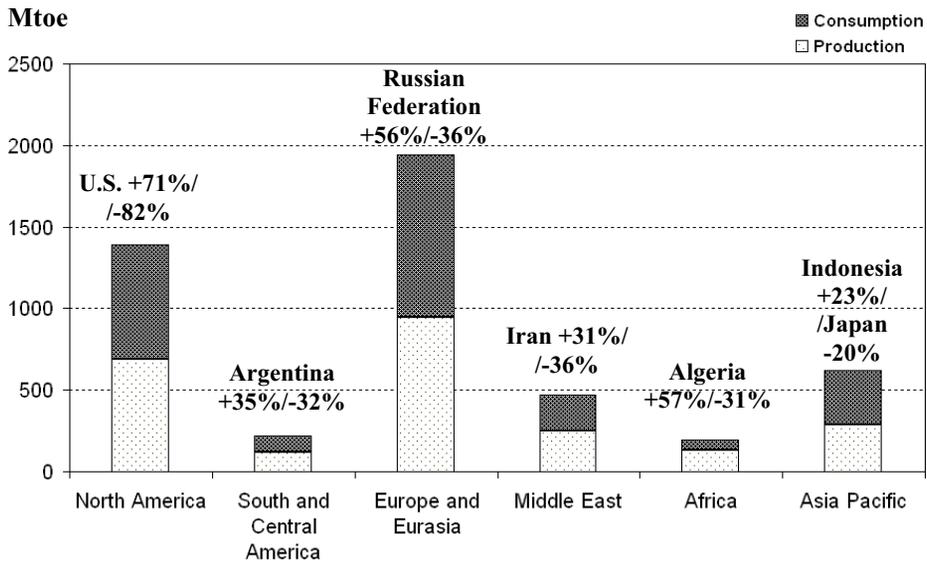
**Fig. 3.** World crude oil and natural gas prices during 1970–2004.

P — world total gas production, K — world total gas consumption,  
(P-K)\* — difference between the two. Source: own study based on BP data

Presenting gas prices along with those of crude oil indicates the existence of a “demonstrative” dependence (Fig. 3). The mentioned “dependence” has been highlighted by shifting in time, one-year forward ( $t + 1$  year), annual prices of crude oil. The conclusion, taken from the observation, suggests close relationship between the prices of crude oil and gas, which could be treated as an alternative source of energy.

Crude oil prices were rescaled to facilitate easy comparison with gas prices. The value of the “P-K coefficient” (the world production minus world consumption of natural gas) reveals periods when differences, deviations from the average level occurred. Both total world consumption and total world production of gas have a positive slope coefficient parameter and an almost equal rate of increase. Accelerated growth of the world’s economy, expressed by the amounts of GDP, was anticipated in 2000, together with political changes in the former SU (with all other consequences caused by the Asian crisis). Important influence had also been exerted by the Asian (China, India) economics boom, adding extra value to the US and the FSU GDPs. Improperly balanced demand for energetic raw materials (as a consequence of insufficient changes to the technology of oil production and limited or lack of spare production capacities, as well as the conflicts among the OPEC countries) causes concerns and pushes the prices to peak levels.

Differentiation in the volumes of production and consumption of natural gas selected by regions has been presented in Figure 4. Similarly to crude oil, consumption in the US outstrips the level of production, which makes the United States one of the biggest natural gas importers in the world. In the group of major exporters a dominating position is held by the Soviet Federation with its 20% of surplus production being sold worldwide. Positive balance (production vs. consumption) shows the countries of Africa, Asia and South and North America respectively.



**Fig. 4.** Natural gas balance of production and consumption by region in 2004.  
Source: own study based on BP and EIA data

### 3.1. Forecast of economic and production parameters characterising the world gas market

In the forecast of energy production and consumption, natural gas is expected to play a fundamental role in building and extending the world's primary energy source reserve base. By the year 2025 the global use of natural gas is projected to increase to nearly 70% of total consumption of all energetic raw materials. It is also expected that it is the demand for natural gas that will exert significant influence on the process of establishing capital relationships typical for raw materials and financial markets of rapidly developing countries. More and more often opinions are presented which suggest that the growth of the world total gas consumption will increase by an average of 2.2% annually till 2025. This is particularly notable if compared to the projected future oil (crude oil) and coal price growth rates (1.9% for crude oil, 1.6% for coal, average annual increase).

The “popularity” of natural gas arises from many reasons. Of the main importance are: firstly, some geological, ecological and mining aspects (huge resources located worldwide and the possibility of potential use in production processes, low sulphur and carbon dioxide emissions); secondly, low energy prices based on the primary natural gas components (lower labour and material intensity of gas boilers and heaters).

Fastest rate of consumption is expected among the nations of the developing world estimated at a level of 2.9% per annum (Fig. 5 and 6).

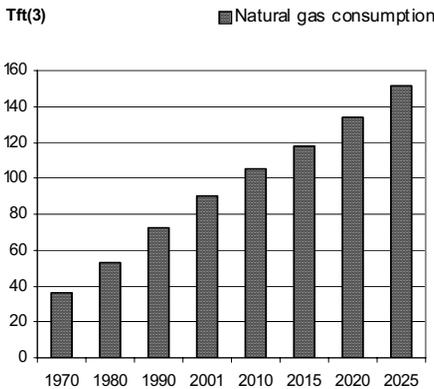


Fig. 5. The dynamics of world natural gas consumption 1970–2025 (Tft<sup>3</sup>). Source: EIA

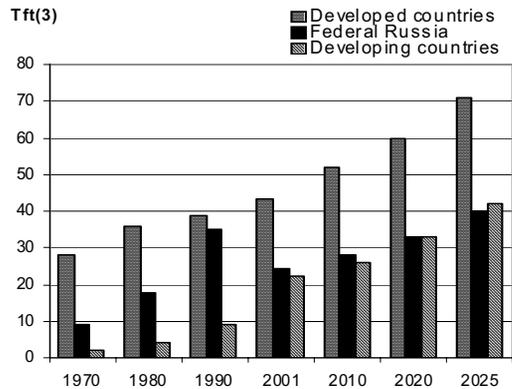
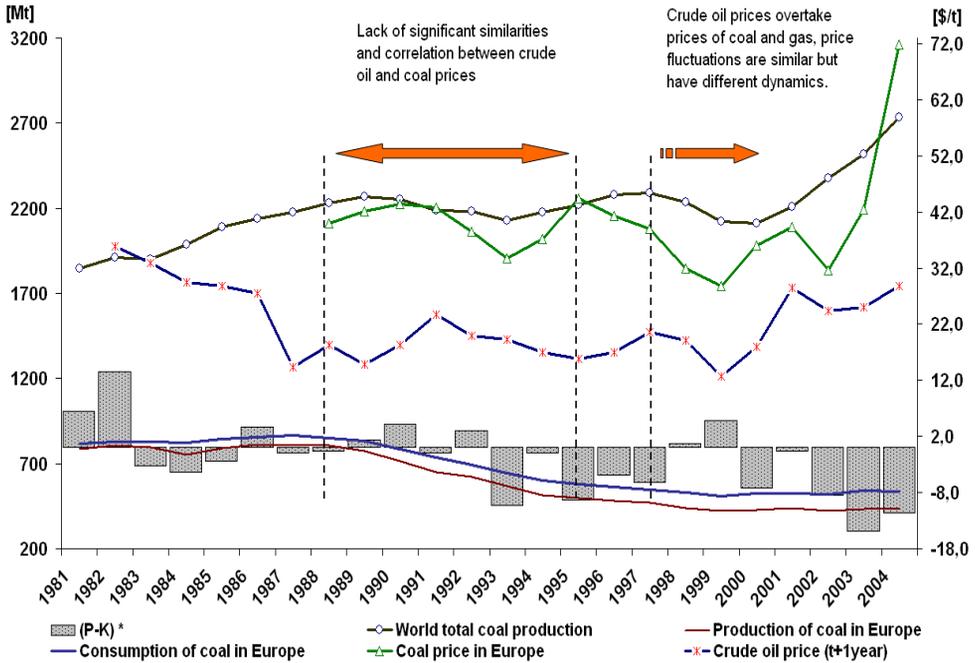


Fig. 6. Historical gas consumption with a forecast 1970–2025 (Tft<sup>3</sup>). Source: EIA

## 4. Coal market

Since 1980 the world coal consumption has been growing. Despite a significant expansion of the economy of the Asian countries, the total world coal usage shows a growth in the region of 0.2% per annum (the figures for 1998 and 1999). One of the important reasons of this growth was statistically high consumption decrease in China, caused by closure of small, ineffective and illegal mining pits. If China is excluded from the statistics, the average growth rate amounted to 1.4–1.5% annually during the monitored period.

The analysis on Figure 7 reveals the existence of two separate phases of coal market trends along with tendencies describing crude oil and gas markets as well. The first period (till 1997) reflects no analogy and similarities between the prices of the mentioned above primary energy sources. After 1997 annual crude oil price “index” (shifted one year forward for the purpose of this comparison) overtakes both gas and coal prices.



**Fig. 7.** World crude oil and European coal prices during 1980–2004.

P — world coal production, K — world coal consumption.

(P-K)\* — differences between the two. Source: own study based on bp.com

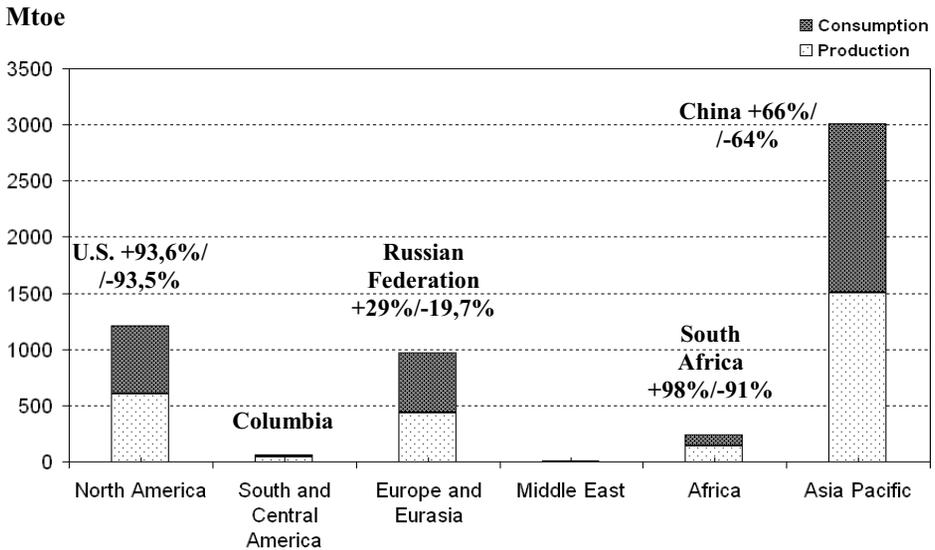
This fact emphasises the dominating nature of crude oil among all the raw materials in the energy source market. Both 1993–1997 and 2000–2003 periods show unbalanced supremacy of consumption vs. production of coal. In the last period, the difference is additionally increased as a consequence of raw materials markets boom and robust demand coming from the developing Asia. It is also worth mentioning that downward movement of price was observed despite domination of demand over supply. Explanation for this is the following: the lack of a uniform world coal price, the existence of separate distribution centres with their own individual pricing policies typical to the region they operate in, the trends towards getting better quality and limiting pollution to the environment.

The above reasons lead us to think “market forces” have no prevailing position determining coal price levels.

Non-market positioning of coal prices is additionally caused by a “battle” fought with this raw-material product on ecological grounds. The European Union countries, for many

years, for the sake of global environment safety, reduce coal output and burning. Coal-burning power generation plants are being punished by additional taxes and fares, which have the effect of raising the total costs of energy production.

Figure 8 presents a balance of production and consumption by regions. Negative structure (total consumption exceeds total production) characterises Europe, whose total use of coal is greater than its output. Other world's regions are in a better situation. Most of the surplus production is transported to the USA, China, Japan and Germany.

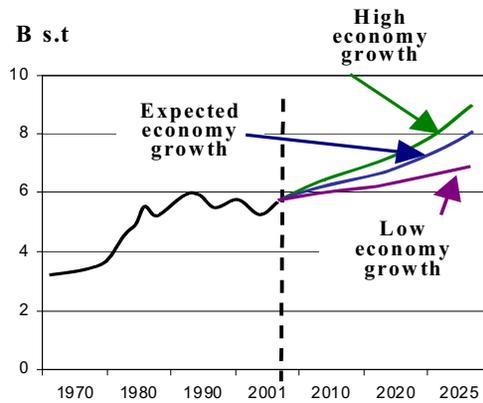


**Fig. 8.** Balance of coal production and consumption by region in 2004.

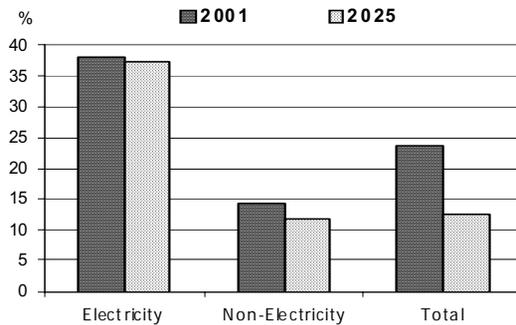
Source: own study based on [www.bp.com](http://www.bp.com)

#### 4.1. Coal market development outlook

Economic predictions for the coal market, in the document quoted above (reference), suggest that the increase in the rate of coal consumption will be maintained. For instance, the total world consumption of coal in 2001, at 5.26 billion tonnes, was more than 27% higher than the total in 1980. Despite the fact that coal will be partially substituted by natural gas in some regions (e.g. the EU), the forecast predicts a steady growth of the total demand till 2025, because two very large countries in terms of both population and area, China and India, are projected to account for 30% of the world's total increase in energy consumption over the forecast period, with their energy based mainly on coal (70% of total predicted consumption). Let us stress however that the share of coal as an energy source in developing Asian countries will systematically decrease as it is replaced by other primary energy sources. The former Soviet Union countries and Europe noticed a decrease in coal production of 40% in the period 1990–2000. Further predictions and analyses suggest that this trend of continuing decline in mining output there will be maintained. Figures 9 and 10 illustrate the relatively high usage of coal in general.



**Fig. 9.** World coal consumption — forecasts for 1970–2025 in billion tonnes [B s.t.]. Source: EIA



**Fig. 10.** Share of coal in the world energy consumption by sectors during 2001–2025. Source: EIA

## 5. Summary

Raw materials markets analysis aiming to confirm or deny the existence of relationships between the prices of common primary energy sources proved:

- the existence of significant relationship between crude oil and natural gas prices;
- the existence of interdependence of crude oil, natural gas and coal prices since 1997;
- the dominant role of the crude oil market in defining the prices of other energy carriers;
- the existence of other than market factors influencing the fluctuations of raw material prices;
- crude oil will remain the most popular primary energy source in the power generation and transport sectors until 2025;
- natural gas production and consumption will be characterised by the highest rate of growth;
- the total coal consumption until 2025 will be increasing.

Technical developments in the area of electrical energy production from primary energetic raw materials stimulate a tendency to implement more sophisticated and universal designs and solutions. Thus, there is a possibility of establishing a global, well coordinated and properly organised market allowing a free trade of energetic raw materials. World energy safety must be guaranteed by keeping appropriate balance between the use of primary energy sources and preventing a monopoly and domination of one source over others [7].

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