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Hydrocarbon Market in Countries with Developing Economy: Development Scenario

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ABSTRACT

Hydrocarbon resources represent cumulative wealth of a country because they form for many millions of years. At the same time, the use of such resources is taking place all the time, from year to year. These two circumstances have predetermined two aspects of the hydrocarbon market research – a tactical aspect connected with the annual use by a country of its resources, and a strategic aspect connected with accounting for the remaining the raw material given exploration of new deposits. The undertaken study of the qualities of resource prices confirmed the synchronization effect of international countries-exporters' losses because of unfavorable prices at the international raw materials markets. The scientific research offers to use indicators of tactical, strategic and integral dependence of a national economy on natural resources, taking into consideration the fact that emerging countries are multiresource producers. Taking a comprehensive strategic resource assessment of a country's dependence as a basis, we are offering an order of weighing local resource characteristics, which, in turn, will help a wider practical use of monitoring of emerging countries' resource dependence.

Keywords: Resource Dependence of an Economy, Emerging States, Development Strategy, Coal Production, Oil and Gas Exports, Budget
JEL Classifications: E6, F3

1. INTRODUCTION

In the last several decades the order of assessing resource dependency of countries with transitional economies has been described from many points, including the key ones – growth of the national economy and the state of natural resources, political trends and postindustrial development, the specifics of building a resource-based economy and dependence of the state budget on international hydrocarbon prices, etc.

We should single out an econometric research by Sachs and Warner (1999) that proves the hypothesis about a slower development of economies with vast natural resources compared with economies with moderate resources. At that, the authors revealed in their research special features of economic systems functioning of resource-based countries from the point of view of their institutions' efficiency. In its turn, a research by Polterovich et al. (2007) demonstrates that state policy instruments aiming at decreasing economic dependency on natural resources can only be efficient on condition of existence of a developed institutional system. At that, institutional underdevelopment cements and advances when there are such resources galore (Solow, 1974).

Works by Mau and Belyakov (2014) represent a deeper research, in particular, that a significant resource rent deprives the government of the incentives to develop institutions. At that, bureaucrats ensure their positions in the government through redistribution of the resource rent, destroying institutions, which encourage their dedicated work in countries with abundant and stable incomes from natural resources exports. Thus, in the period between 2015 and

2016 such institutions as the freedom of press and elections were seriously eroded in Mexico and Venezuela in a similar situation.

Researches made by Robinson et al. (2001) note that resource abundance triggers their excessive exploitation, meaning that the existing authorities enhance their position at the expense of the future well-being of the nation. The most inefficient spending of the resource rent takes place before elections being seriously detrimental to a lot of industries (Baland and Francois, 2000; Krugman, 1987; Gylfason 2001; Kontey, 2013).

As a way to solve the problem through capping the use of the incoming rent by creation of special funds which are to be used for the benefit of future generations, in particular, the Abu-Dhabi Investment Authority in the UAE, the State Reserve Fund and the Reserve Fund for Future Generations in Kuwait, the State Pension Fund in Norway is suggested. A specific feature of Russian analogues (the Reserve Fund and the National Welfare Fund, which were merged into one fund in 2017) is their relatively modest size as percentage of gross domestic product (GDP) (8.3% in 2012), while in the UAE, Kuwait and Norway the funds amounted to 174%, 170% and 106% respectively in the same period.

Scientific research by Brunnschweiler and Bulte (2008) offers an approach, according to which connection between the quality of institutions and the depth of resource dependence of economies is only one-sided, while condition of institutions is unaffected by the resource orientation of the economy.

The importance of institutional factors was also proved when assessing social and economic benefits from the national resource regime. The end volume of the social and economic benefits, calculated as a sum of rental taxes and social benefits (demonstrated in employment of the population) less losses of oil reserves in-situ amounted to approximately U.S.$35 billion in the U.S. by the end of 2007 (Vasilyeva, 2011).

Researches on political systems of countries with a rich resource potential, which support the hypothesis of the inclination to the authoritarian form of rule in resource dependent states is worth mentioning Corden (1982).

As a result of modeling the researches have established both positive and negative influence of resource wealth on human capital; economists came to quite an unambiguous and definite conclusion – if the country can boast a high educational level by the time deposits are discovered, revenues received from their exploitation are more likely to be used for a good cause boosting both economic growth rates and incomes. However, if the educational level is low, the resource wealth is more likely to trigger corruption growth, degradation of economic structures and low growth rates, although per capita spending may grow in the short-term. This conclusion widely repeats the characteristic of the resource wealth impact on the institutional environment and economic growth. At that raw materials orientation of a national economy means employment of the majority of the population in the industries, which do not require a lot of expertise from their employees being detrimental to children's ambition to have a good education, which is also backed by the lack of family funds (Mehlum, 2006; Bykanova 2017).

We should note that an alternative direction in researching the resource dependence of an economy clearly ignores the importance of institutional environment, while considering a direct impact of the rate of natural resources use on the macroeconomics of a country. In particular, Guriev et al. (2010) has researched one of the important negative consequences of a high degree of economic dependence on natural resources – a strong volatility of macroeconomic indicators, conditioned by a high sensitivity to international prices for energy resources. Similar conclusions were drawn when building regressions, which studied connection between GDP growth and the oil price; besides, dependence between export volumes and the oil price was discovered Kryukov and Pavlov (2012).

The Dasgupta-Hill-Solow-Stiglitz model based on the Cobb-Douglas production function can be viewed as another possible variant of modeling economic resource dependence without a direct influence of institutions. The use of the method helps us evaluate self-sufficiency and self-sustainability of a national economy with non-renewable resources. At the same time, the researches do not deliberate on the possibility of falling resource dependence because of global technical progress, including thanks to the appearance of alternative or green energy. The appearance of a safe and relatively cheap new energy source can upend the market for natural energy sources. At the same time constant monitoring of the usability of new technological solutions to take the gilt off new myths about a perpetual engine.

2. MATERIALS AND METHODS

The current research focuses on non-renewable natural resources – oil, gas and coal and their influence on various aspects of economic existence. Hydrocarbon resources represent cumulative wealth of a country, because they have been forming for many millions of years. At the same time, spending of the resources is constant, from year to year. These two facts predetermine two aspects of the hydrocarbon market research:

a. Tactical (Ir), connected with the annual spending by a country of resources it has;
b. Strategic (Jr), connected with accounting for the remaining resources of the material given exploration of new deposits.

Strategic dependence of a country from a natural resource (r) is a general longstanding dependence, which covers the possibility of using the stock of resources both for internal needs of the economy and for exports. This is why strategic dependence can be calculated with the help of the formula:

$$Jr=R/[Cr+Er] \tag{1}$$

Where R is the volume of explored and proven reserves of the resource (in natural units);
Cr is annual consumption of the resource in the country (in natural units);
Er – annual exports of the resource (in natural units).

At that, financial indicators (1) are calculated in years and show the span of time, when a country can exploit its natural resource in its established internal and external consumption regime.

Tactical dependence of a country on a natural resource (r) is its annual potential of an income received from exports of the resource with allowances made for volatility of international prices for the resource under consideration. In this case tactical dependence (Ir) may be calculated to a formula:

$$Ir=(Er/Y)[1+|\lambda|]100\% \tag{2}$$

Where Er is an annual amount of exports of the resource (in monetary terms);
Y is the gross domestic product (GDP) volume of a country;
$\lambda = \Delta Pr/PR$ is an annual growth rate for resource r.

The share of exports in GDP in formula (2) points to the dependence of a country's foreign trade on the natural resource, while the price multiplier takes into account the resource price volatility in a given year, which makes dependence of a country on the resource stronger. It is supposed that dependence grows in line with price volatility regardless of the price flexibility. This factor predetermines the input price growth module (Stiglitz, 1974).

At that, we should distinguish two types of natural resource dependence – dependence on the shortage of resources and dependence on its abundance. In case of a deficit a country has to buy it and in this sense it becomes dependent on exporting countries and on prices for the resource. In this case, the tactical dependence index (2) uses the figure of imports of the resource instead of exports, while a strategic resource dependence for such countries has no sense. If a country has abundance of the resource, the country depends on it from the point of view of its self-provision and the receipt of additional revenue from the sales on the international market. In this case, we can talk about tactical and strategic resource dependence of a country.

At the same time, since many countries are poly resource polities, meaning countries having two or three energy resources at the same time, one should undertake a comprehensive assessment of their resource dependence taking into account all the hydrocarbon markets. We can suggest a following procedure of assessing comprehensive strategic resource dependence (J):

$$J=\alpha Jp1+ßJp2+ÝJp3 \tag{3}$$

Where Jp1, Jp2, Jp3 are local indices of strategic dependence of a country on oil, gas and coal respectively;

α, ß, Ý are weighted coefficients, which are calculated by taking into account the structure of energy balance in application to the three hydrocarbon resources.

At that, the weighted coefficients account for the share of each resource market in the overall hydrocarbon energy consumption of a country. In some cases, we may limit ourselves to accounting for only internal consumption. Similarly, we can suggest the following procedure of calculating a comprehensive tactical resource dependence (I):

$$I=Ip1+Ip2+Ip3 \tag{4}$$

Where Ip1, Ip2 and Ip3 are subscripts of tactical dependence of a country on oil, gas and coal respectively.

In this case, simple adding of subscripts is predetermined by the monetary character of their measuring, which is why the overall index is a sum of all incomes from the sales of the resources. The presence of a tactical or strategic resource dependence drives us to the need of building an integral indicator, which would unite both components. Let's introduce an integral resource dependence index (H) to this end:

$$Ht = \int_0^{jt} I\tau e^{9} d\,t \tag{5}$$

In this case formula (5) researches the following: A country may receive an income It for a jt period of time taking into account a discounting function, which demonstrates a rising (falling) need for the exported resource. If we do not take into consideration annual fluctuations of export revenue and, consequently, ignore the discount effect, and suppose that the tactical and strategic dependence indices are constant, formula (5) allows us to make simple integrating receiving the required integral indicator in a multiplicative form relative to the measures it comprises:

$$H=JI \tag{6}$$

At that, the H indicator becomes quite clear pointing to the number of annual GDPs, which the country can receive thanks to exploitation of its resource potential. This means that technical, resource dependence demonstrates the scale of hydrocarbon sales, while strategic dependence shows the period of such exploitation of the resource. This means that indicator (6) measures a potential foreign trade revenue of a country from owning natural resources in annual GDP terms.

The integral indicator can be used for each hydrocarbon resource separately for analytical purposes. However, constructed indicators presuppose a kind of logic of interdependence. In particular, a large figure of strategic dependence of a country is a long-term boon, while a large figure of tactical dependence demonstrates a short-term boon. At the same time long-term and short-term goals may clearly contradict each other, in particular, a large figure of tactical dependence leads to a fast exhaustion of reserves and a lesser strategic resource dependence in the future, consequently, one kind of a boon is achieved at the expense of the other.

3. STATISTICAL METHODOLOGY

Retrospective data of aggregated individual indicators of the oil resource dependence based on analytical data of British Petroleum and U.S. Energy Information Administration in Table 1 allowed us to formulate the following presumptions.

Table 1: Assessment of international oil resource dependence

Countries of the world	Strategic dependence (Jp), years		Tactical dependence (Ip), %		Integral dependence (Hp), GDP	
	2002	2012	2002	2012	2002	2012
Venezuela	64.5	266.3	28.2	17.0	18.2	45.5
Canada	144.4	110.9	0.6	2.3	0.8	2.5
Iran	64.3	98.7	40.5	17.1	26.0	16.8
Kuwait	123.4	87.9	53.8	48.6	66.4	42.7
UAE	103.0	73.3	28.6	26.8	29.5	19.7
Saudi Arabia	80.5	65.9	54.7	42.1	44.0	27.7
Qatar	63.0	57.0	57.3	12.6	36.1	7.2
Kazakhstan	22.2	50.2	45.1	25.0	10.0	12.5
Russia	28.2	25.9	19.2	9.5	5.4	2.4
Norway	9.0	13.2	28.2	10.4	2.5	1.3
Mexico	14.9	9.4	4.4	4.5	0.6	0.4
Argentina	9.8	8.9	1.4	0.6	0.1	0.1
Malasia	13.0	7.8	3.7	0.9	0.4	0.1
Columbia	8.7	6.5	6.2	12.6	0.5	0.8

Our own calculations based on BP Statistical Review of World Energy 2014, 2015, U.S. Energy Information Administration database data. GDP: Gross domestic product

Several countries with similar characteristics can be singled out among strategic international oil exporters. Thus, Venezuela and Canada, whose raw materials stocks amount to a three-digit figure and exceed a 100 years, comprise the first group in 2012. The second group consists of Iran, the Arab monarchies and Kazakhstan, which boast a potential exceeding half a century. Russia and Norway, whose reserves support the current trade regime for over 10 years, make the third group. This is why Russia is a significant player of the oil market, but not among the most long-time actors.

From the point of view of current oil sales, the countries can be split into two types of dependence. The first includes Venezuela, Iran, Kazakhstan, Norway and the Arab states, whose tactic oil dependence ranges between a quarter to a half of GDP. Russia, Columbia and Canada, whose sales intensity is less than a quarter of GDP, but is a significant macroeconomic figure, fall into the second group. Here Russia does not come unique too and occupies a modest second place among the exporting countries.

According to integral dependence on the oil resource, the countries also form three provisional groups. The first group comprise the countries with a corresponding indicator above 10 GDP – Venezuela, Iran, Kazakhstan and the Arab states. The second group consists of Russia, Canada, Norway and Qatar, whose dependence amounts to between 1 and 10 GDP. Russia occupies a modest position according to the indicator and cannot be considered a record setting country. This leads us to a conclusion that Russia's total dependence on oil is not abnormal and is the same as with the developed oil producing states (Canada and Norway) rather than with the developing economies. Besides, our assessment allows us to formulate a preliminary, but very categorical conclusion that the oil needle off which Russia cannot get rid of is a myth deeply rooted in the public mentality. The basis of the myth comprises perception of the country as an oil-dependent state, which is blown out of proportion and is not totally true, because as seen from Table 1, Russia makes it to the second or even third group of countries, not the first one, according to all the resource dependence indicators.

From the point of view of dynamics of the strategic oil dependence, all countries can also be split into three groups. The first group comprises the states, which can be considered "oil centers" for a good reason, which in the 12 years of the XXI century have increased their producing abilities bucking the general trend of oil reserves depletion (Hodler, 2006). This group is represented by Venezuela, Iran, Kazakhstan and Norway. The second group is represented by Russia and Argentina, for which an insignificant loss of strategic oil dependence is typical. The third group is comprised of all the other countries, where a significant depletion of the "black gold" could be seen. This means that this criterion also puts Russia into the second group of countries and cannot be a strategic benchmark for the international oil market.

Retrospective data of aggregated individual indicators of gas resource dependence based on the analytical data of British Petroleum and U.S. Energy Information Administration in Table 2 allowed us to formulate the following presumptions.

We should note that the strategic international gas exporters can also be broken into several groups. In 2012, the first group, which is characterized by gas reserves that would last for more than a 100 years is comprised by only Qatar, although it was only in 2000 that it was also comprised by Kazakhstan. The second echelon groups Kazakhstan and Australia, which have a potential for more than half a century. The third echelon is made of the other gas producing states, including Russia, whose gas reserves will last for more than 10 years. Given the fact that Russia falls very short of 50 years by the strategic gas dependence indicator, we can say that it tends to be in the second group and thus is among significant international gas market players.

Secondly, from the point of view of the current gas sales, grouping is not that clear. Thus, the first echelon comprises Qatar by a significant margin compared with other states – its current gas dependence exceeds a quarter of GDP. The second group unites all the other gas exporters, including Russia; their sales intensity amounts to <10% of GDP. Russia occupies a veritable median position.

Thirdly, the countries of the world are stratified weakly according to their integral dependence. Qatar makes a special group, whose corresponding indicator is above 10 GDP. All the other exporters,

Table 2: Assessment of gas resource dependence by country

Countries of the world	Strategic dependence (Jp), years		Tactical dependence (Ip), %		Integral dependence (Hp), GDP	
	2002	2012	2002	2012	2002	2012
Qatar	609.4	178.8	12.5	25.2	76.5	45.0
Kazakhstan	146.7	82.9	4.4	1.5	0.9	0.2
Australia	72.0	81.7	0.4	0.5	0.3	0.5
Russia	54.2	49.8	10.9	3.5	5.9	1.8
Indonesia	40.7	41.5	3.5	1.6	1.4	0.7
Norway	23.8	18.0	4.5	9.3	1.1	1.7
Malasia	50.6	15.9	3.7	0.1	1.8	0.0
India	12.1	14.2	1.2	0.4	0.1	0.1
Columbia	21.6	13.1	0.0	0.3	0.0	5.8
Canada	8.7	10.7	2.1	1.3	0.2	0.1

Our own calculations based on BP Statistical Review of World Energy 2014, 2015, U.S. Energy Information Administration database data. GDP: Gross domestic product

including Russia, fall into the second category, where the integral dependence does not exceed 10 GDP. This indicator puts Russia into a veritable third place in the world, but it is far from market leaders. Taking into consideration the fact that Russia's integral gas dependence is even slightly less than the integral oil dependence, we can say that the fear of a "gas needle" is also strongly exaggerated.

Fourthly, from the point of view of strategic gas dependence dynamics, all the countries can also be split into two groups. The first group is comprised by the states, which slightly increased their producing ability in the first 12 years of the XXI century -- Australia, Canada, India and Indonesia. The second echelon consists of the other countries, including Russia, which are characterized by a slight decrease of strategic gas dependence. This means that Russia gradually loses its position, according to this feature, although it continues to be a serious player on the international gas market.

4. RESULTS

While preparing a strategic resource dependence forecast (Jr) based on formula 1 for a mid- and a long-term period, the resource intensiveness and export intensiveness of country can be extrapolated on the basis of exiting trends, while reserves can be recalculated to recurrent formula (8) taking the year of 2000 as a basis, depending on expected GDP dynamics, which can be defined by different forecast scenarios:

$$R(t+1)=R(t)-C(t)-Ex(t) \quad (7)$$

Where R(t) is the volume of discovered and proven reserves of a resource (in natural terms) in the year of t;
C(t) is energy intensiveness of a national economy in the year of t in natural terms;
Ex(t) is net exports calculated as a difference between exports and imports of a resource in the year of t.

The forecast of the strategic resource indicators is based on factual data on the reserves of natural resources (crude oil, natural gas and coal) provided by BP company as well as Rosstat reports on the volume of their consumption, exports and imports. Forecasts for GDP and energy resource prices in the period from 2015 to 2018 are based on the key and optimistic scenarios of socio-economic development forecasts compiled by the Economic Development Ministry of the Russian Federation and Vnesheconombank. The first forecast scenario – the pessimistic one – is calculated to the following rule: The parameters of the pessimistic scenarios differ from the basic scenario as much as the basic scenario differs from the optimistic scenario, but in a different direction (Table 3).

Collective results of the forecast calculations are shown in Table 2 (only forecast GDP growth rates are used). At that, all resource dependence indicators diminish faster under the optimistic scenario than under the other scenarios. This can be explained by the fact that a faster economic growth leads to a more active inner consumption of resources and more intensive export sales (Table 4).

When compiling long-term forecast scenarios, the order of their compilation remains the same taking into account their connection to the key parameters of "The Russian Federation Long-term Social and Economic Development for the Period until 2030" (dated 30.04.2013). At that the average GDP growth rates will amount to 2.3% under a pessimistic scenario until 2030, 3.6% under a basic scenario and 5.2% under an optimistic scenario (Table 5).

We should note that the optimistic scenario provides for a more noticeable fall in strategic resource dependence than in the pessimistic scenario. However, inversion of this dependence takes place for the oil market in 2025-2030 and the optimistic scenario becomes preferable. At the moment, the optimistic scenario becomes better than the basic one on the gas market. Thus, the strongly warped economic growth trajectories can have an ambiguous impact on resource dependence of a country on their own (Khvostova 2014; Knobel 2013).

Thus, the assessment of the scale of consequences of all the dynamic shifts in Russia's resource dependence given assessment of its integral size in the mid- and long-terms are presented in Tables 6 and 7.

In particular, a stable trend to a shrinking integral dependence is seen for oil and gas, and the conclusion is true for all the forecast scenarios. The coal situation is uncertain in the midterm and depends a lot on the scenario, while it stabilizes in the long-term period and a trend of the country's dependence on the resource becomes clear. This is why the long-term forecast allows us to reveal an uneven strategic importance of different energy sources.

At the same time integral dependence on coal becomes stronger in the future than on oil and gas. Consequently, we may speak about a forthcoming change of importance between the three resources.

5. DISCUSSION

Alternative energy sources have been known for quite a long time as well as the technologies of their use. But a technological breakthrough is yet to happen. The very idea of using alternative energy sources is quite attractive, because its implementation will allow the world to start a new life, a life free from traditional energy sources and political and economic interests of purchasing countries and countries-owners of the resources (Matsuyama, 1992).

At the same time, the share of alternative energy sources (wind power, solar power, and biological fuel) has been maintained at quite a low level in the consumption structure for the last 15 years.

Table 3: Mid-term forecasts of GDP changes

Economic development scenarios	Years			
	2015	2016	2017	2018
Pessimistic	−4.1	0.8	1.5	2.2
Basic	−3.8	1.7	1.9	2.9
Optimistic	−3.4	2.6	2.3	3.6

GDP: Gross domestic product

Table 4: Midterm forecast scenarios of strategic resource dependence

Resources	Scenario	Years			
		2015	2016	2017	2018
Oil	Pessimistic	34.4	33.2	31.9	30.2
	Basic	34.2	32.8	31.3	29.5
	Optimistic	34.1	32.4	30.8	28.9
Gas	Pessimistic	51.8	51.0	49.8	48.3
	Basic	51.6	50.4	49.0	47.2
	Optimistic	51.4	49.7	48.2	46.1
Coal	Pessimistic	607.3	605.1	598.5	587.4
	Basic	605.1	597.5	588.7	573.9
	Optimistic	602.9	590.2	579.1	560.8

Our own calculations based on data provided by BP Statistical Review of World Energy 2015, U.S. Energy Information Administration database

However, their growth looks impressive enough in the sphere of small numbers (Table 8).

Thus the share of wind power, which started at practically zero, exceeded 1% within one and a half decade and settled firmly at this mark. Biological fuel expansion looks more modest (0.9% in 2014 compared with 0.5% in 2000), while solar power keeps lagging behind (0.3% in 2014). At the same time, developed countries demonstrate high commitment to alternative energy, which is in sharp contrast with international data (Table 9).

In particular, Denmark is the leader of their use thanks to its wind turbine parks installed in the sea (24% in the energy balance of the country). Only Germany with a 10% dependence on alternative energy can be noted among the industrially developed states.

We should note that according to the estimates of the authors of report "Global Trends in Renewable Energy Investment, 2015" (Frankfurt School School of Finance and Management - UNEP Centre with assistance from Bloomberg), the share of alternative renewable energy sources (wind, sun, biomass, geothermal power, small hydropower, wave power, the power of tides) collectively amounted to 9.1% in 2014 (8.5% in 2013) in the volume of power generated internationally. At that, the solar and wind power stations were key in the overall alternative energy sources. The other areas of alternative energy sources can be overlooked as insignificant both by the scale and investment volumes.

6. CONCLUSION

The use of alternative energy sources has its natural limits due to the limitations of the space which accepts flows of solar power in acceptable volumes and (or) characterized by a wind force. Such opportunities are exhausted each year, but their total scale remains unclear both for the states and for investors. This is why building a strategy or a development programme for alternative energy sources at a government level seems problematic, while managerial and investment decisions are taken either in connection with individual projects, or for mini-directions (for instance, state subsidies for the placement of solar panels on the roofs of apartment houses). At the same time, the existing technologies of alternative energy sources use ensure no technological breakthrough. Decades of alternative energy sources development have not changed the energy generation structure and failed to push power prices down for consumers.

Table 5: Long-term forecast scenarios of strategic resource dependence dynamics

Resources	Scenario	Resource dependence growth			
		2018-2020	2020-2025	2025-2030	2018-2020
Oil	Pessimistic	−3.3	−7.8	−6.6	−3.3
	Basic	−4.2	−8.3	−6.5	−4.2
	Optimistic	−4.9	−9.1	−6.0	−4.9
Gas	Pessimistic	−3.4	−8.0	−6.5	−3.4
	Basic	−4.8	−9.5	−7.4	−4.8
	Optimistic	−6.2	−11.4	−7.3	−6.2
Coal	Pessimistic	−26.3	−59.8	−40.8	−26.3
	Basic	−44.9	−82.7	−60.4	−44.9
	Optimistic	−61.8	−111.3	−65.5	−61.8

Our own calculations based on data from BP Statistical Review of World Energy 2015, U.S. Energy Information Administration database

Table 6: Midterm forecast of integral resource dependence, GDP

Resources	Scenario	Resource dependence growth			
		2015	2016	2017	2018
Oil	Pessimistic	2.5	2.5	2.2	2.4
	Basic	2.8	2.6	2.5	2.7
	Optimistic	3.1	2.7	2.9	3.0
Gas	Pessimistic	1.2	1.2	1.0	1.1
	Basic	1.4	1.2	1.2	1.3
	Optimistic	1.5	1.3	1.3	1.4
Coal	Pessimistic	3.5	2.9	2.6	3.1
	Basic	3.4	3.0	3.1	3.5
	Optimistic	3.4	3.1	3.5	3.8

Our own calculations based on data from BP Statistical Review of World Energy 2015, U.S. Energy Information Administration database. GDP: Gross domestic product

Table 7: Mid-term forecast of integral resource dependence, GDP

Resource	Scenario	Resource dependence growth		
		2018-2020	2021-2025	2026-2030
Oil	Pessimistic	−0.0	−0.1	−0.2
	Basic	−0.1	−0.2	−0.4
	Optimistic	−0.2	−0.4	−0.4
Gas	Pessimistic	−0.0	−0.1	−0.0
	Basic	−0.0	−0.1	−0.1
	Optimistic	−0.1	−0.2	−0.1
Coal	Pessimistic	0.2	0.8	1.1
	Basic	0.1	0.7	0.8
	Optimistic	0.0	0.4	0.6

Our own calculations based on data from BP Statistical Review of World Energy 2015, U.S. Energy Information Administration database. GDP: Gross domestic product

Against the background of the insignificant contribution of alternative energy to the overall energy picture, we have to agree with Bill Gates, who said that much more funds should be invested in the alternative energy research and study of new energy sources to attain a serious effect. Nevertheless, even if non-traditional energy flourishes (for instance, a hypothetical increase of its share to 50% in the overall power generation volume) systemic risks will only strengthen and the energy will require backup in the form of traditional energy sources. With the current share of alternative energy sources of about 10% in the total generation amount such backup is irrelevant (Osipov and Kosov, 2016).

This is why growth of this industry is limited from the point of view of the need to keep reserve generating capacities working on traditional energy and the energy itself. An international oil price slump of 2014 and price stabilization at a low level have undermined the economy of Russia's producing industry and at the same time rendered a blow to its macroeconomic stability. Breakthrough technologies, which would make the use of, for example, traditional engine fuel unnecessary, may become a reason for a long-term decline of the industry. The lower monetary volume of oil exports predetermined a national currency devaluation on a scale comparable with the international oil price fall. Our research allows us to formulate the following:

1. The analysis of figures of strategic, tactic and integral resource dependence on oil, gas and coal for different countries of the world revealed that all the countries can be split into two or three echelons depending on the level of dependence we have revealed. In particular, Russia makes part of the third echelon by one characteristics of the oil and gas market, and of the second by three other characteristics. Russia falls into the first category for the coal market by two features and to the second category by two other features.
2. There are only 5 states in the world, which export all the three hydrocarbon resources - oil, gas and coal. This group of countries comprising Canada, Russia, Norway, Columbia and Kazakhstan is the backbone of the resource producing states. It is these countries that are strategic hydrocarbon exporters with a diversified raw materials production. At that, the strongest producers are Russia and Kazakhstan. This way we arrive at a kind of a paradox: Russia does not make to the first echelon of countries with outstanding drilling activities as a rule, but a comprehensive assessment of all the resources raises the country to a higher notch. The effect of the complexity of the Russian resource base is the root of this paradox. This feature demonstrates the national economy's advantage, its polyresource natural resources basis, which allows it to be participant of all the three markets at the same time.
3. The assessment of the speed of change of integrated resource dependence shows that this advantage of Russia and Kazakhstan is dwindling fast. Calculations show that the country will transfer to a completely new resource dimension in the middle term. This means that Russia's resource dependence is dwindling at a catastrophic rate triggering new challenges and problems (Wantchekon, 1999).
4. The international consumption balance is shifting towards a higher share of such unpopular hydrocarbon raw material as coal, the unexpected trend is developing in international energy

Table 8: Energy consumption structure by type, %

Energy source	Years			
	2000	2005	2010	2014
Oil	38.2	35.9	33.4	32.6
Natural gas	23.3	22.9	23.8	23.7
Coal	25.3	28.6	29.8	30.0
Nuclear power	6.2	5.7	5.2	4.4
Hydropower	6.4	6.1	6.5	6.8
Wind power	0.1	0.2	0.6	1.2
Solar power	0.0	0.0	0.1	0.3
Biological fuel	0.5	0.6	0.7	0.9

Our own calculations based on data from BP Statistical Review of World Energy 2015

Table 9: Countries with the highest share of renewable energy resources in energy balance structure in 2014

Country	Renewable energy source, mln tonnes of oil equivalent	Share of renewable energy sources,%
Denmark	4.1	23.8
Portugal	3.6	14.6
Spain	16.0	12.0
Finland	2.9	11.0
New Zealand	2.3	10.9
Germany	31.7	10.1
Italy	14.8	9.9
Sweden	5.0	9.6
Ireland	1.3	9.2
Greece	2.0	7.7

Our own calculations based on data from BP Statistical Review of World Energy 2015 consumption priorities. The effect can easily be explained by China's role in the international coal consumption. However, such an explanation does not change the global ranging of different types of raw materials. A long-term forecast has allowed us to reveal different strategic importance of various resources for Russia. In particular, integral dependence on coal in the future becomes higher than from oil and gas. Presumably, we can talk in this case about a forthcoming change in importance of the three resources.

5. Many alternative energy projects are financed on the asset finance condition, similar to rent, leasing and other instruments, which do not presuppose an instantaneous acquisition of generating capacities. This fact allows us to adjust the optimistic data on investment in this branch of energy production. Also, there has been a decline in inventor activity in alternative energy in recent years – the annual number of issued patents in the sphere fell by 42% in 2011-2014, demonstrating a lower investment attractiveness of alternative energy sources projects. All this allows us to come to a conclusion that alternative energy sources cannot be a full replacement for traditional sources of energy for industrial facilities, which represent a producing economy.

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