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## Article

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## Global Refining Industry in Retrospect, and Evaluation of Russia-European Union Petroleum Products' Trade Perspectives

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### ABSTRACT

Oil-refining industry plays a significant role in the development of the world fuel and energy complex. In the meantime, at the current stage of this industry's development quality changes are taking place in it. Taking into account the traditional siting of refinery capacity close to consumption centers, many countries consider the possibility of building their own oil refineries to satisfy the growing domestic demand for oil products. Other countries consider the possibility of developing refineries not only for the national market, but also for export of petroleum products. Such a tendency can be observed in Russia. The article deals with current state and relevant issues of development of oil refining industry on the global scale, with the latter being largely driven by consumer demand changes. Particular attention is given to Baltic Sea region countries that are considered as potential markets for diesel fuel exports in the context of the capacity increase of oil refining in Russia.

**Keywords:** Russia, Oil, Petroleum Products, Diesel, Refining, International Trade, European Union, Energy Market

**JEL Classifications:** F16, F63, O52, R12, L16, L71

## 1. INTRODUCTION

An important prerequisite for this study is the fact that currently the production of diesel fuel in Russia exceeds domestic consumption, providing an opportunity to export nearly half of the produced goods. In this context, the projects "North" and "South" of JSC "Transneft", which provide for the development of pipeline transport capacity in the direction of the seaports of the Baltic sea and the Black sea to 15 and 6 million tons per year respectively, acquire particular relevance for further export deliveries of oil products by sea. As part of this article a more detailed analysis of the markets in the region of the Baltic Sea basin will be given, including such countries as Germany, Denmark, Latvia, Lithuania, Norway, Poland, Finland, Sweden and Estonia. The analysis will be carried out in the context of global changes taking place in the present time in the field of oil refining.

## 2. LITERATURE REVIEW

The review of bibliography reveals that in a 10 year perspective we should expect intensive development of oil refining industry on a global scale, as well as a change in the role of the countries and the balance of power on the global oil market. At least by 2025 growth in demand for oil products will combine to be 1.2%, with the share of diesel fuel in the structure of consumption reaching no less than 37% (LUKOIL, 2013). The key factor ensuring this change will remain the developing countries of the Asia-Pacific Region (APR), especially China and India, and the main consumer in the global dimension - the transport sector. It should be emphasized that the development of the global refining industry occurs largely due to the changes in the demand for fuel used in the transport sector. In recent decades, a change in the oil consumption patterns can be observed, which is expressed primarily in growing proportion of diesel fuel.

### 3. METHODOLOGY FOR ASSESSMENT

The economic crisis of 2008 led to a distortion of the previous development trends of the global refining industry. There has been a decline in oil prices and, consequently, in the price for the processed products. Refineries' profit declined sharply to the level of 2001, and at some plants with a depth of recycling less than 85% has reached the threshold of profitability. At the same time, in some regions, especially in the APR, new capacities were commissioned. As a result, in the global refining industry in the APR excess capacity was formed, and the existing plants in Eastern Europe and Eurasia dropped their load.

With regard to the development of the petroleum sector in Asia one cannot but note the refinery put into operation in 2008 by Reliance Industries in Jamnagar (Gujarat, India) with a capacity of 33 million tons per year, which is one of the largest in the world. In 2013, the volume of diesel fuel supplies from India to Europe amounted to 16 million tons, which is 76% more than in 2011 (Argus, 2014). Thus, an increase in diesel fuel supply from refineries in Jamnagar to the European market is expected, given a better strategic position in relation to European and American markets as compared to the main competitors in the Asian market, particularly Japan and China. However, the rapid growth in demand for diesel and other fuels from developing countries shows that this supply will be carried out only in the short term (Sheppard, 2008). Despite the fact that for private companies (as opposed to government) it is not profitable to sell oil products inside the country with a view to India's policy of setting domestic prices for petroleum products below the cost of production, it is expected that over time export refineries will be reoriented to domestic markets (Guliyev and Litvinyuk, 2017).

Thus, the gradual folding of stable trade relations could threaten adequate supply of oil to regions that lack their own processing capacity and which are forced to carry out imports of refined products. In such a situation, for instance, find themselves the European countries characterized by a range of structural problems in the industry, together threatening the sustainability of their economies.

For example, in Europe in the recent years a steady increase in oil consumption can be observed, particularly of diesel fuels. According to some forecasts, it is expected that in 2015 the deficit of diesel fuel in the region will exceed 55 million tons (Salyginet al. 2016). Mass closings of refineries in Europe (since 2008, 16 factories have announced that they are closing refining capacity or are planning to do so) taking place against this background and caused by the fiscal policy of the European Union (EU) clearly open European markets to foreign supplies of oil.

### 4. ANALYSIS

Globally, the structure of production of petroleum products varies only slightly and depends mainly on the development of technologies that provide a certain depth of oil refining<sup>1</sup>. In this

<sup>1</sup> Refining depth - one of the characteristics of the refineries, showing oil yield based on the oil, in % by weight, less fuel oil and gas.

regard, it seems quite reasonable to introduce a worldwide output structure of the refineries as it is graphically depicted in Figure 1.

From the presented information it is obvious that the proportion of residual oil in the output structure decreases during the period under review, which takes place against the background of a gradual increase in the share of diesel fuel. Despite the regional trends of changes in petroleum products consumption patterns on a global scale increase in the share of gasoline issue can be noticed. Moreover, in the global structure of petroleum products issuing a trend of growth in demand for jet fuel and kerosene can be seen due to the development and intensification of air traffic. We would like to emphasize that the current stage as a whole is characterized by a decrease in the proportion of heavy oil products in the structure of consumption, which is caused by the gradual transition of power and heat generating plants to coal, natural gas and nuclear fuel as a primary energy source. As noted, the regional trend is a gradual decline in the proportion of gasoline and a growing importance of diesel fuel to in satisfying the demand for petroleum products by the end users unfolding against this backdrop. It should be noted that this technological transition will require changes in the configuration of the existing refineries.

Following the dynamics of demand, refining capacity is also expanding, as shown in Figure 2.

It is interesting to note that the capacity utilization, calculated as the ratio of release of petroleum products to the installed capacity, comprised on average 91% in the world, ranging from 62% in Africa and 100% in North America, which preserves the maximum load during the whole period under review. The dynamics of utilization of production capacity quotient by regions is shown in Table 1.

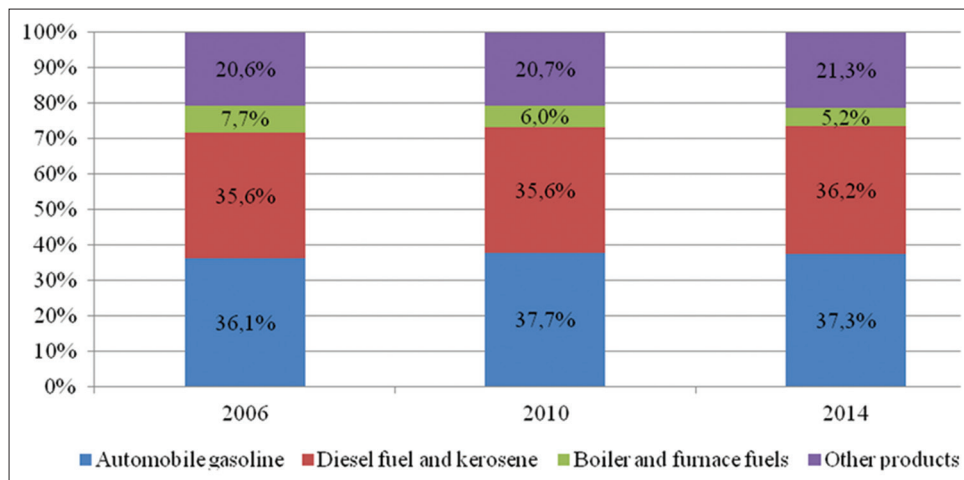
Change in the volume of petroleum products output index, calculated on the basis of the data in Figure 2 and Table 3, is presented graphically in Figure 3.

As seen from the graph, the leading petroleum producers are the regions of Asia-Pacific and North America. Within these regions China and the United States occupy the leading position, producing, as of 2013, 4302.4 and 6.5026 billion barrels of oil products per year respectively, representing more than 34% of total world output. The largest producers are also Russia (2100.2 million barrels per year), Japan (1584.0 million barrels per year) and India (1576.4 million barrels per year).

The dynamics of growth in capacity of oil refineries, illustrated in Figure 4, confirms the general trend towards increasing the volume of oil production.

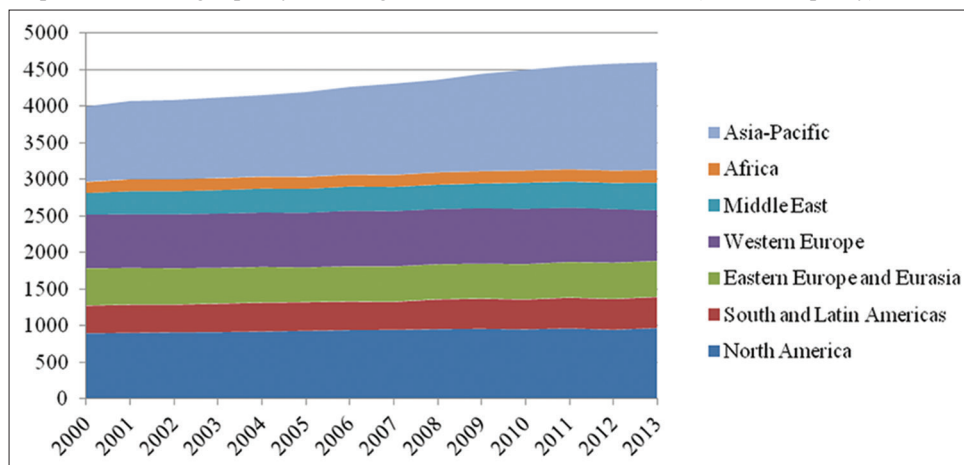
Very obvious, based on the graph, is a steady increase in refining capacity, but in a regional context its structure is not too homogeneous. With the world average increase in capacity by 15% during the period 2000-2013, the regions of Asia-Pacific (43%) and Middle East (27%) show a significant increase. Other regions analyzed in this research, having increased the refinery capacity in the period up to 2005, in 2005-2013 mostly reduced

**Figure 1:** Global structure of output of oil refineries in the period 2006-2014, %



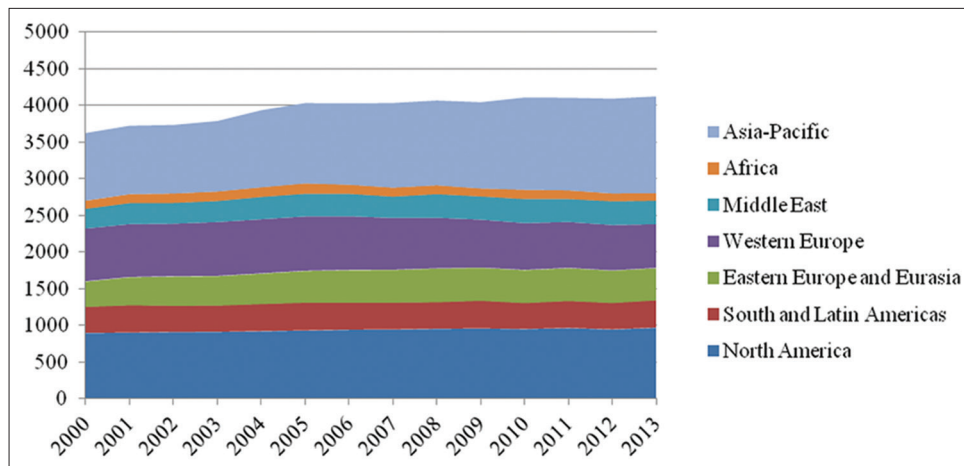
Source: Manolov 2015; authors' calculations

**Figure 2:** Development of refining capacity in the regions of the world in 2000-2013 (installed capacity), million barrels per year



Statistical Bulletin – Oil and gas data (OPEC, 2014)

**Figure 3:** Dynamics of petroleum products release by the regional refineries in 2000-2013, million barrels per year



Source: Authors' calculations based on Annual Statistical Bulletin – Oil and Gas data (OPEC, 2014)

their pace or, as in the case of the regions of Western and Eastern Europe, showing a decrease in the reporting period by 6 and 3% respectively.

To assess the share of diesel fuel in the total volume of oil products of the Baltic region, to determine its role for the largest consumer - the transport sector - and to identify the largest

**Table 1: The dynamics of utilization of production capacity quotient by regions in the period 2000-2013**

Region	Year													
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
North America	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
South and Latin Americas	0.94	0.97	0.95	0.92	0.94	0.97	0.95	0.96	0.89	0.92	0.87	0.88	0.86	0.88
Eastern Europe and Eurasia	0.68	0.76	0.80	0.82	0.85	0.91	0.92	0.92	0.96	0.94	0.93	0.92	0.89	0.89
Western Europe	0.99	0.99	0.98	1.00	1.00	1.00	0.97	0.94	0.92	0.87	0.85	0.85	0.85	0.87
Middle East	0.90	0.90	0.89	0.88	0.92	0.93	0.91	0.87	0.95	0.92	0.91	0.87	0.90	0.84
Africa	0.75	0.77	0.81	0.82	0.83	0.90	0.80	0.78	0.75	0.67	0.78	0.72	0.65	0.62
Asia-Pacific	0.89	0.87	0.86	0.87	0.94	0.94	0.92	0.92	0.91	0.88	0.91	0.89	0.88	0.89
World	0.91	0.92	0.92	0.93	0.96	0.97	0.95	0.94	0.94	0.91	0.92	0.91	0.91	0.91

Source: Authors' calculations based on Annual Statistical Bulletin – Oil and Gas data (OPEC 2014)

**Table 2: Diesel fuel consumption in the countries under review in 2012, million tons**

Country (region)	Total domestic consumption <sup>2</sup>	Ultimate consumption <sup>3</sup>	Including transport sector		The share of diesel fuel in total consumption, %	The country's share in total consumption in the EU, %
			Abs.	%		
Denmark	7081.3	3613.9	2523.0	69.81	51.03	1.41
Germany	108297.3	50111.2	28332.0	56.54	46.27	19.59
Latvia	1382.0	833.2	713.0	85.57	60.29	0.33
Lithuania	2466.7	1110.0	943.0	84.95	45.00	0.43
Norway	12174.2	3839.8	2886.0	75.16	31.54	1.50
Estonia	1109.2	660.7	462.0	69.93	59.57	0.26
Finland	8952.0	4048.2	2386.0	58.94	45.22	1.58
Poland	24832.8	12513.1	9854.0	78.75	50.39	4.89
Sweden	12693.8	4489.0	4138.0	92.18	35.36	1.75
Total	178989.3	81219.1	52237.0	64.32	45.38	-
EU	569220.4	255813.0				
The share of countries of the region	31.44%	31.75%				

Source: Authors' calculations based on Energy balances statistics (International Energy Agency 2017)

consumers of diesel fuel as part of the region is possible on the basis of Tables 2 and 3.

The growth in diesel fuel consumption in Europe increases due to the increased number of vehicles. Currently, the share of diesel fuel in the region of the Baltic Sea countries is 45.38% compared to 44.94% in Europe on the whole, with the lowest in Norway (31.54%) and Sweden (35.36%), and the largest - in Latvia (60.29%) and Estonia (59.57%). This characteristic is very representative in terms of cross-country analysis, but it cannot be applied without regard to the countries in terms of the capacity of their diesel markets. Thus, the largest market in absolute terms of the volume of diesel consumption in total ultimate consumption among the considered countries is objectively the German market, where more than 50.1 million tons of diesel fuel or, respectively, 19.59% of the total European consumption is currently implemented. Currently, the domestic consumption of diesel fuel by a group of European countries of the Baltic region is more than 179 million tons of fuel per year, providing 31.44% of the total demand for it on the part of the European Union. More

information about diesel fuel markets within the Baltic countries is presented in Table 3.

In 2012, for the first time since 2009, a decline in diesel consumption was recorded, which was caused by the effects of the initiative on the transfer of heating systems to natural gas. However, as a massive shift to diesel fuel is typical for the transport sector of the European Union, the total volume of its consumption in recent years is restoring.

While in 2000 there was a relative balance between diesel fuel and motor gasoline, currently the latter has a stable long-term downward trend. Basically, thanks to tax preferences for diesel fuel, its share in the market of motor fuel in some EU countries is currently around 70%. At the same time, because of the high long-term growth in the share of diesel consumption in the transport sector, today markets of countries like France or Spain, where the share of diesel vehicles is around 80%, the saturation stage is approaching, which implies slowdown in consumption growth. In addition, among the factors influencing the decline in growth, it is necessary to take into account the economic situation in the countries under consideration, namely the fact that in some of them there is a very high unemployment rate, which is especially noticeable in Germany (6%) and Poland (11%), as well as some other EU countries - Italy (12%), Greece (27%) and some other. This factor, which leads to a decrease in real disposable income of the population unfolding against the background of continued growth in diesel fuel prices for consumers, is negatively

2 Calculated as the sum of primary production, reduced products, total imports, fuel variations, net of total exports, and the volume of bunker fuel. This corresponds to the addition of the ultimate consumption, losses during distribution, losses during the transformation and statistical differences.

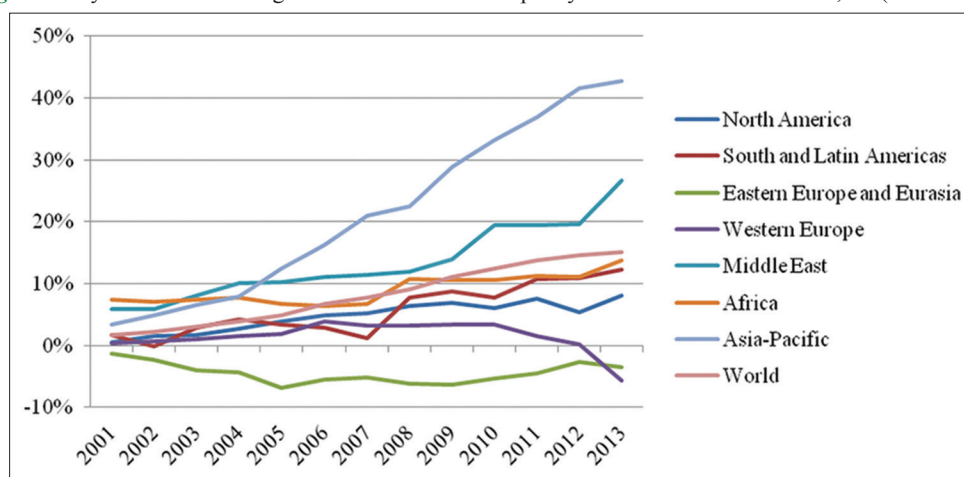
3 Includes all supplies to final consumers (industry, transport, households and other sectors of the economy) for various energy purposes. Excludes deliveries for processing and / or own use of the energy sector enterprises, as well as network losses.



**Table 3: Structure of the market of diesel fuel in the Baltic region in 2012, million tons**

Indicator	Germany	Sweden	Norway	Lithuania	Denmark	Poland	Estonia	Latvia	Finland
Production	43.58	7.966	6.161	3.025	3.411	11.289	0	0	6.401
Import	13.549	2.080	1.471	0.461	1.968	1.422	0.713	1.177	2.360
Export	6.235	5.099	2.524	2.986	1.48	0.337	0.013	0.211	3.123
Sent to the international marine fuel storage	0.433	0.237	0.148	0.02	0.244	0.066	0.086	0.087	0.042
International aviation fuel storage	0	0	0	0	0	0		0	0
Changes in inventory levels	+0.58	+0.066	-0.088	+0.042	+0.036	-0.04	-0.004	-0.051	0.11
Intermediate consumption, generation	0.565	0.073	0.019	0.001	0.061	0.072	0.001	0.003	0.036
Electric power plants	0.127	0.004	0.004	0	0.017	0	0	0	0.01
CHPP	0.091	0.029	0	0	0.009	0.012	0	0	0.006
Heating installations	0.128	0.04	0.014	0.001	0.035	0.009	0.001	0.003	0.02
Oil refineries	0	0	0	0	0	0	0	0	0
Other	0.219	0	0.001	0	0	0.051	0	0	0
Ultimate consumption	49.481	4.363	4.110	1.079	3.274	11.997	0.654	0.821	3.960
Industrial sector	1.145	0.241	0.38	0.022	0.201	0.365	0.051	0.047	0.459
Transport sector	29.116	3.654	2.827	0.977	2.269	9.394	0.481	0.612	2.295
Housing sector	11.903	0.039	0.062	0.012	0.29	0.087	0.005	0.025	0.453
Commercial and public services sector	6.696	0.295	0.177	0.003	0.056	0.426	0.039	0.039	0.194
Agriculture and forestry	0	0.111	0.132	0.043	0.349	1.725	0.078	0.09	0.355
Fishing	0	0.023	0.485	0.002	0.109	0	0	0.007	0.036
Other	0.048	0	0.047	0	0	0	0	0.001	0.168
Non-energy consumption	0.573	0	0	0	0	0	0	0	0
Of which chemical	0.567	0	0	0	0	0	0	0	0

Source: Authors' calculations based on energy balances statistics (International Energy Agency, 2017)

**Figure 4: Dynamics of annual growth of oil refineries capacity in the world in 2000-2013, %.** (2000 = base)

Source: Authors' calculations based on Annual Statistical Bulletin – Oil and gas data (OPEC, 2014)

affecting both the sales volumes of transport means and the fuel consumption volume, leading to a reduction in the market of gasoline and diesel fuel.

However, according to forecasts of the International Council on Clean Transportation (ICCT), as well as on the basis of forecasts of world energy produced by leading international agencies - the World Energy Council and the International Energy Agency, in the next 15 years the number of both passenger and commercial vehicles is expected to increase in all regions of the world, except Japan (ICCT, 2013). Herewith, it should be noted that among the regions mainly represented by developed countries (European Union, North America), the largest percentage of this growth is in North Europe. At the same time, according to the forecasts of

the European Commission (2013), diesel fuel consumption in Europe will increase up to 2015 and will stabilize during the period between 2015 and 2050 becoming the main fuel for passenger transport and continuing to be the main fuel for the truck. Thus, one should expect a significant increase in the volume of diesel consumption in the global market as a whole, in the European market one of the regions with the highest growth will become Northern Europe, presented by countries of the Baltic region.

However, the current state of the market is not without deep structural problems. Despite the overall decline in domestic consumption, European producers of petroleum products are not able to cope with the increasing demand for diesel fuel - both due to lack of capacity, and due to low profitability caused by

**Table 4: Undercapacity of refineries in the Baltic region in 2012, %**

Country	Total refining volume in 2012, mln tons (Unione petrolifera 2014; BP 2014)	Potential maximum processing volume, mln tons <sup>4</sup>	Undercapacity of refineries, %	The number of operating refineries	Average undercapacity of refineries, mln tons
Germany	104.4	131.42	20.56	14	1.93
Denmark	8.7	9.09	4.29	2	0.19
Latvia	-	-	-	-	-
Lithuania	9.5	13.44	29.31	1	3.94
Norway	16.14	15.84 +	Min	2	Min
Poland	24.7	26.12	5.44	7	0.2
Finland	13.0	13.49	3.63	2	0.25
Sweden	20.7	26.21	21.02	4	1.38
Estonia	-	-	-	-	-

Source: Authors' calculations based on Scenario internazionale (Unione petrolifera 2014); Statistical review of world energy 2014 (BP 2014).

the previously mentioned tax policy of the EU. As of 2012, the situation in the region's oil refining industry is set out in Table 4.

Due to the orientation of the majority of the considered refineries to produce gasoline, there is overproduction of that, which, due to insufficient domestic demand, results in the need for their deliveries to the external market - mainly in the US. However, this effect leads to the need to close some refineries, the yield of which could not be achieved in the current economic situation.

In the context of the impossibility of conversion of refineries to produce diesel fuel and taking into account the long-term stability in the diesel demand with gradually rising prices, it is extremely important for the countries to ensure reliable supplies of imported diesel fuel. Thus, in the markets under review there is a significant dependence on imported diesel fuel supply, which is presented in Table 5. Dynamics of imports (United Nations, 2017) for the period of 2009-2014 are shown in Table 6.

## 5. DISCUSSION

This situation, of course, can vary greatly under the influence of a number of parameters, such as changes in demand, changes in the volume of car sales, reducing of total refinery capacity, and, importantly, a possible substitution of conventional diesel with biodiesel, which in theory, at full replacement, will reduce the demand for traditional diesel fuel by 20%. Despite the general trend towards growth in the share of diesel fuel in the next 10 years, dictated by the EU energy policy aimed at reducing the negative impact on the atmosphere, some countries are characterized by a very low profile on this issue. In particular, Germany's energy concept encourages the substitution of a significant proportion of conventional diesel fuel by biodiesel over a 10-year period.

Based on the tabulated data on the diesel fuel consumption in transport sector, one can conclude about diesel market capacity of the Baltic region countries, from a potential provider's perspective.

There are objective prerequisites for changes in the oil markets where diesel fuel could potentially be exported through the

**Table 5: Ranking of countries of the Baltic region in terms of energy dependence on diesel fuel supply, 2012**

Country	Supply dependence index <sup>5</sup>
Latvia	1.43
Estonia	1.09
Finland	0.59
Denmark	0.59
Sweden	0.47
Lithuania	0.43
Norway	0.36
Germany	0.27
Poland	0.12

Source: Authors' calculations based on Tables 2-4

**Table 6: Dynamics of imports of diesel fuel by the Baltic countries, 2009-2012, million tons**

Country	Years			
	2009	2010	2011	2012
Germany	14.509	15.595	13.580	13.549
Denmark	2.222	2.219	2.276	1.968
Latvia	1.036	1.056	1.063	1.177
Lithuania	0.133	0.203	0.381	0.461
Norway	1.705	1.135	1.206	1.471
Poland	2.196	2.116	1.946	1.422
Finland	2.283	1.829	2.443	2.360
Sweden	1.992	2.138	2.198	2.080
Estonia	0.576	0.545	0.597	0.713

Source: Authors' calculations based on UN Comtrade data (United Nations, 2017)

Russian ports of the Baltic Sea. One of the main reasons for the change is, first, the constant increase in fuel prices in Europe, and, secondly, the observed imbalance of production and consumption of petroleum products in the region. The long-term crisis in the oil-refining industry of the countries in question, caused by the lack of supply and demand for gasoline and diesel fuel, has a structural character. Perspective diesel fuel market development in the countries reviewed by 2025 will determine, first, the degree of substitution of conventional diesel with biodiesel (which will probably only reduce the traditional supply deficit) and, secondly, the refinery capacity to carry out the reorientation toward production of a modern diesel class.

4 Calculated as the sum of the potential volume of the country's oil refineries processed per day by the number of calendar days in the year (365), translated in million tons.

5 Calculated as the quotient of the volume of imports of diesel fuel and the amount of the final consumption of diesel fuel in the country, intermediate consumption and generation.

The key factors that will determine the development of the world oil-refining in the future are: Increasing demand for the products of developing countries, high growth rate of introduction of new refining capacity in the countries with minimal costs, the deepening integration of oil-refining companies through mergers and acquisitions, the concentration of small and medium-sized refineries on the production of innovative products. In the countries where the demand for products of oil refining industry is reducing, petroleum products not consumed by domestic surplus can be exported, but one should take into account the increasing competition in the market and the lack of access to this strategy for some countries. In the period up to 2035 closure of some refineries (mainly in Europe) with insufficient depth of crude oil processing is expected.

In the OPEC's review of the world oil market for the period until 2030 (OPEC, 2015) it is reported that the "golden age" of oil refining, which occurred during the period of 2004-2008 when the demand for oil was growing steadily, which provided for a high level of capacity utilization, ended. As a result, such problems as availability of free capacity, chronic underutilization and the subsequent decline in enterprises' yields were revealed.

In this regard, contrasting trends are expected to grow. Thus, in developed countries existing plants will be closing and new projects will be canceled, while in the developing economies of the Asian region new modern refineries will be built. The rejection of a number of projects will especially affect the US and the EU, which is an additional factor in the growth strategy of the efficiency of the transport sector on the basis of biofuels use and alternative types of car engines. Petroleum industry of developing countries will be developed under the influence of the state economic policy. For example, the energy policies of India and China, providing for duty-free import of raw materials and tax preferences for companies, are truly remarkable.

## 6. CONCLUSION

Given the expected increase in Russian refining capacity of 35-40 million tons of diesel fuel per year, as well as the increase in the production of diesel fuel of Euro-5 standard and the mass closings of refineries in Europe, it is possible to judge the potential of increasing the volume of export of diesel fuel to the European market. In this regard, it seems about time to carry out market research of European oil products in order to develop recommendations for optimization and improvement of the export policy of the enterprises of oil refining sector of the Russian fuel and energy complex.

There is already an obvious trend of diversification in the structure of oil and gas exports. This diversification is associated with the fact that Russia is gradually shifting from the export of crude oil to the export of high value-added petroleum products. Thus, continuing the existing trend, the share of oil products relatively crude oil rose in the total exports of liquid fuels from 30.6% to 38.6%, primarily due to a record volume of domestic crude oil distillation, constituting 219.5 million tons in 2014, which is 5.6% higher than a year earlier. In the structure of exports supply of Russian diesel fuel abroad reached the highest growth.

Current economic and political situation in the energy markets makes it necessary to review the existing model of exporting energy raw materials that has for many years been the general practice and to move towards exporting high value-added goods. High value-added goods provide significant additional public revenue through increased export earnings and the use of export duties, which, in turn, is intended to generate another round of spending and to stimulate further development of the real sector of the Russian economy.

Accelerated development of Russian oil-refining will, in turn, be conditioned mainly by the demand for the products in European countries that remain the key export market for Russian petroleum products. Taking into account a long-term program of development of the oil-refining industry in Russia and the introduction of a new processing facility with total capacity of up to 40 million tons per year that is scheduled for this year, stable exports of petroleum product to the West appears to be achievable. However, this demands an appropriate energy infrastructure - pipeline transport systems for petroleum products that able to cost-effectively transport products to the largest Russian sea ports for export supplies by sea. Due to the fact that construction of the pipeline infrastructure is a really major long-term investment project, it needs a stable cash flow generated by the constant demand for the products from ultimate consumers in Europe, which calls for further studies.

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