



## **EXPORT AND IMPORT OF COAL IN UKRAINE: EXISTING PRACTICE AND NEW LOGISTICS SCHEMES**

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**Abstract** The existing practice of Ukrainian export-import of coal was explored. Major problems of coal industry of Ukraine in connection with the complication of political and economic situation in 2014-2015 are defined. One of the ways of solving the problem of coal shortage in the country is stressed – formation of new logistic chains of coal import using the capacities of sea ports of Azov and Black Sea basins of Ukraine. Key problems of technical, technological and economic state of sea ports and actual ways of their solution are highlighted. Scientific problem of necessity for the world scientific community to study the example of preventing and operative solution of Ukrainian unique problem of rebuilding country's logistics from the country-exporter to country-importer is set.

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## 1. INTRODUCTION

In 2013 at the world market Ukraine took the 7<sup>th</sup> place for coal resources and the 12<sup>th</sup> for its extraction. Listed resources of coal in Ukraine are 33,9 billion tons, of which 15,4 billion tons – black coal, 18,5 billion tons – brown coal. This makes 14% of coal resources of the USA, 21% of Russian resources and 42% of Australian resources (Credit Swiss). Distribution of coal extraction among the largest energetic companies of Ukraine in 2014 looks as follows: 3,16% – "MetInvest", 5,19% – "Donetskstal", 4,7% – the other companies, 17,72% – "Minenergougol", 34,21% – DTEK.

It is known that world's industry uses three types of coal: thermal, coking and anthracite coal. All these three types are extracted in Ukraine. Moreover, one of the most rare types – the anthracite, apart from Ukraine is extracted only in Russia (Rostov and Novosibirsk regions, Kuzbass) and in Vietnam (the so called type A). Geography of coal types in Ukraine: anthracite coal (types A and T) – Lugansk and Donetsk regions, thermal coal (types Д, ДГ, Г and CC) – Lviv-Volyn basin, coking coal – mainly in Donbass region.

In Ukraine coal consumers are: thermal power plants (TPP), thermoelectric plants (TEP), ferroalloy and metallurgical enterprises (ME), sugar, cement and other types of production, which require melting any materials.

Technical and technological characteristics of Ukrainian enterprises that consume coal presently possess the following specificities, which define economic and production indices of their work as well as the specificity of building/changing logistic chains of the energetic branch:

1. Strict territorial connection of thermal power plants in Ukraine with the sources of energy has historically led to the appearance of technological/technical dependencies of equipment on certain marks of coal. Today 22 TPPs operate in Ukraine and all of them work only on anthracite coal. Only power plants of the enterprise "ZapadEnergo" uses coal of type Г, which is extracted in Lviv and Volyn regions. Usage of coal marks that do not correspond with the set technologies of an enterprise, is almost impossible (according to the estimations of experts, after one month of operation the equipment of a TPP will burn down).
2. To support the processes of burning (melting), metallurgical enterprises of Ukraine use the so called coke charge, which is the mix of different types of coal (coke group, rich group and emaciating supplements) in a certain proportion. Technological equipment of metallurgical combines is also set for a particular quality (proportion) of coke charge. Any changes in its structure significantly influence the quality of cast iron, produced by metallurgical combines.

Thus, high degree of dependence of the prevailing consumer sector of coal production of Ukraine on particular coal marks sets forth the necessity to develop a system of flexible and effective logistic system of raw materials supplies.

Totally during 6 month (2014-2015) logistic chains of energy sources in Ukraine, which seemed to be quite stable, have changed dramatically. Being the exporter of energy coal Ukraine has become its importer.

This paper sets an objective to study the existing state of coal market in Ukraine and to reveal main tendencies of its development from the point of view of possibility of influence of new logistic solutions on its condition.

## 2. EXPORT-IMPORT OF COAL: EXISTING PRACTICE

Export of coal in Ukraine started in the beginning of 21<sup>st</sup> century, when the government was thinking about how to use the advantages of resource and geographical position of the country to receive economic benefit. Search of markets to sell coal begins and the modern metallurgical industry establishes. At the same time begins the process of privatization of mines and metallurgical combines. First large companies appear: MetInvest, SKM and DTEK. At that time all types of coal were exported in an approximate proportion: anthracite (70%), energy coal (20%), coking coal (10%).

With the end of formation of the company MetInvest (2005-2006) the following changes in the structure of export of coal from Ukraine happen (source: [www.metalexpert-group.com](http://www.metalexpert-group.com)):

- energy coal of a very low quality (up to 42% of cinder, more than 1% of sulfur) appeared to be completely uncompetitive at the world market;
- export of coking coal gradually stopped because of its lack for inner consumption. Structure of its supplies during the period from 2003 to 2007 slowly changed from the ration 70% for inner supplies / 30% import from Russia to the ration 30% / 60% respectively;
- major consumers of the unique anthracite coal in these years become: TPPs of Bulgaria (port Varna) – supplies were conducted on the basis of long-term contracts by small-sized vessels in parts of 15-40 tons; municipal enterprises of Turkey (brown coal); Marocco – export was realized from the Southern port by vessels of type Panamax (minimum size of the batch – 60 tons); TEP of Israel as one of the largest energy producers in the East (periodical supplies); cement plants in Italy (very seldom).

However at the same time new problems of coal export in Ukraine are revealed:

- most mines in Ukraine are very old and in a bad condition. Besides, Ukrainian mines are one of the deepest in the world (depth up to 1,5 km). These facts significantly influence the net cost of coal extraction (for comparison, of the cost of coal extraction at Kuzbass (Russia) is around 15\$ per ton, in Ukraine before the military conflict of 2014-2015 it used to be around 45\$ per ton). With the high supply of coal at the world market often market price of Ukrainian coal was lower than its economic net cost;
- quality of Ukrainian coal is rather low. Energy coal contains up to 42% of cinder (i.e. its efficiency is not more than 58%) and more than 1% of sulfur (according to world norms, if by the results of port expertise this norm of sulfur

in coal is exceeded, the vessel that came to the port from any country, will go back to the port of the country-exporter undischarged). Existing technologies of coal refining still do not allow to solve the problem of changing the percentage of sulfur in coal, which, respectively, does not allow to increase its quality significantly.

In the first decade of 21<sup>st</sup> century at the same time coal export development there comes understanding of the necessity to reduce the development of country from the coal import from Russia. Major variant of countries-importers at that time were Australia, which imported coking coal, the USA and Poland.

Within a long time the cost component of coal freight from Australia stopped Ukrainian consumers (in the beginning of 21<sup>st</sup> century the cost of freight was nearly 50-60\$ per ton, presently it reduced to 15\$ per ton). However from the beginning of 2004-2005 Ukraine started improving Australian coal. It also led to some complications connected with the fact that Ukrainian ports have always been oriented at export. Its performance as an importer reduced by 3-6 times. Besides, only one sea port of Ukraine ("Southern" port) could receive vessels of the type Panamax.

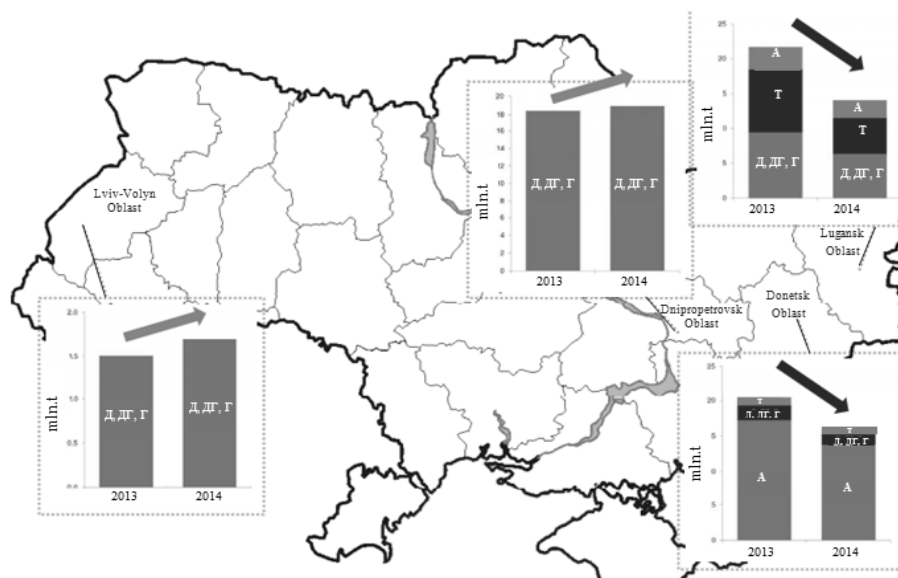
Stable supplies of energy coal were conducted for the need of Russian metallurgy (Kuzbass).

### **3. KEY PROBLEMS OF COAL INDUSTRY OF UKRAINE WITHIN THE PERIOD 2014-2015**

Complications in the east of Ukraine, situation with separation of Crimea, economic blockade from Russia – all of this force participants of the transportation process to review and develop regional transport-distributing and information-analytical logistics centers to improve managements of cargo traffic system both in Ukraine and for her interaction with the world.

Military actions in Ukraine have led to a dramatic decrease of coal extraction.

According to the state for the beginning of 2015: at the territories that are *controlled* by the government of Ukraine there are 65 mines: Donetsk region (6 enterprises), Dnipropetrovsk region (1 enterprise), Lugansk region (2 enterprises), Lviv region (2 enterprises), Volyn region (1 enterprise); at the territories that are *not controlled* by the government of Ukraine there are 85 mines: Donetsk region (8 enterprises), Lugansk region (6 enterprises) (Goshovskii, 2014). In the year 2014 coal extraction reduced by 22 million tons (to 64 million tons) (Fig. 1).



**Fig.1.** Coal Extraction in Ukraine (source: www.metalexpert-group.com)

The following tendencies of coal industry development are highlighted (Bystitskaia, 2014); (Grigoriev, 2014); (Moskovchuk, 2014):

- in the production of *energy* coal marks the most significant decrease happened in the segment of marks A and T. We need to consider that in the extraction of A and T types Lugansk and Donetsk regions have 60% and 40% respectively;
- extraction of *coking* coal decreased almost twice and the capacity of coke-chemical plants were loaded at around 40%.

Thus, according to the last data, in 2015 inner deficit of energy coal (types T and A), which provide the work of TPPs, is estimated at 11-12 million tons; of coking coal for the metallurgical branch – 12-13 million tons.

Existence of dependencies of coal consumers on specific coal marks as well as intensification of economic and political situation in Ukraine have the following ways of solution (Dikalenko, 2015); (Goshovskii, 2014); (Isaiev, 2014):

- deficit of anthracite coal – reconstruction of TPPs, oriented at the particular mark of coal and/or resumption of its import from Russia;
- deficit of coking coal – import of the particular mark from countries-exporters – Russia/Australia/the USA/Canada.

Formation of the plan of reconstruction of TPPs with the aim to transfer it from anthracite to gas (energy) is currently being done only by one enterprise – Zuievskia TPP. Thus process is long-term and expensive.

That is why the major effective solution of the problems, which arose in Ukraine, especially at the time of coming autumn-winter period, is the formation of new logistic chains of coal supply.

#### 4. LOGISTIC PROBLEMS OF COAL MARKET IN UKRAINE. COAL IMPORT BY SEA

Military actions in the south-east of Ukraine and massive destructions of railway infrastructure in a few weeks broke traditional production (logistic) chains (Bystitskaia, 2014); (Grigoriev, 2014):

- because of mass damages of railway infrastructure today there is no traffic at main directions of Donetsk railway. Completely open remain only the directions through Yasinovata and Mariupol and from Volnovakha to Pridneprovsk railway. Besides, border crossings with Russia are closed (Krasnaya Mogila and Kvashino). Because of that the cargo traffic that went to Russia and through its territory to Middle Asia has now reoriented. Cargo is sent through the passage Topoli-Solovei. This has led to the increase of distance almost by 500 km. Exploitation costs on running one train increased by 73 thousand UAH, which is more than 12 million UAH per month;
- raw materials for metallurgical enterprises of Donbass needs to be supplied from three Ukrainian ports – Berdiansk, Nikolaev and Southern – to the port of Mariupol by coaster vessels. Logistics of supplies by coaster fleet to the port of Mariupol – is a high-cost decision, but the most effective in the current conditions;
- complications in political relations which *Russia* do not allow an operative solution of the issues of importing required marks of coal from the Eastern neighbor. Annexation of *the Crimean peninsula* put under threat the established transport infrastructure as well as the principles of functioning of sea ports at the peninsula. In 2013 the share of 5 sea trade ports (STP) of the Crimea peninsula in the total cargo traffic of national port industry was only 6,5%. From the first sight, especially considering that Ukrainian STPs in the recent years work with an obvious underloading, this share could be neglected. But now almost all cargoes, serviced in Crimean ports, were "pulled over" by the capacities of Big Odessa – Odessa STP, STP "Southern" and Ilyichevskii STP (<http://ccb.at.ua/publ/analitika>).

At the same time by the results of 2013 loading of bulk capacities in the ports Southern, Odessa and Nikolaevski exceeded 90%. The highest reserves in the previous year had the port TIS (TransInvestService) – loads on the level of 78% and around 4 million tons of unused capacity reserve. However today possibilities of ports to take additional cargo traffic of imported coal are significantly limited.

The similar situation is observed in the port "Southern". Its capacities are now loaded almost to 100% - it handles significant volumes of raw iron ore (RIO) and coke. Besides, capabilities to take additional volumes of coal import are limited by the low carrying capacity of railway infrastructure.

Moreover, complicated procedures of registering cargoes in ports have led to exclusion of Ukraine from the scheme of supplies from China and South-Eastern Asia into Europe. In particular, this concerns the procedure of registering transit container cargoes, which all around the world are not inspected (like in Ukraine) but scanned. Now the flow goes around Europe, and then through Baltic States – to Ukraine. Ukrainian ports are excluded from this scheme, such cargoes bypass them.

For real diversification of supply sources of energy resources to Ukraine even in the shortest perspective it may be necessary to secure its logistics component – expand port capacities of Azov and Black Sea basins for bulk cargoes, attract funds for development and modernization of terminal capacities, extend narrow places in the railway infrastructure of portside stations.

Timely technical, technological and economic condition of Ukrainian sea ports allows to define the main problems, which appeared in the formed situation at coal market: technical depth limitations; technological limitations of coal transshipment; coal transshipment cost.

#### **4.1. Technical Depth Limitations**

Ports in Ukraine are limited in transshipment growth because of small depths, which do not allow unloading deep-drawing modern vessels at the specialized terminals. Distance of the main countries-exporters defines the minimal size of vessel batches of 30-40 thousand tons, however the most economical from the point of view of logistics is the use of vessels of type Capesize with the displacement of 150 thousand tons. This causes limitations of the depth of ports, where coal will be unloaded. For the batches of 30-40 thousand tons the passing depth must be not less than 11 meters, and for the vessel of type Capesize – not less than 18 meters (Moskovchuk. & Dikalenko, 2015); (Dikalenko, 2015); (Goshovskii, 2014).

Only the ports of Big Odessa possess the sufficient depth, having the capacity of 40 million tons per year. But only the port "Southern" can unload Capsize vessels at the berth wall (Mikhailova & Kareva, 2013).

The current situation clearly shows that construction of new powerful terminals for coal transshipment is of great importance for energetic safety of Ukraine. Nevertheless the cost of works on bottom deepening makes some STPs simply unprofitable. According to the estimations of Administration of Sea Ports of Ukraine (ASPU) nearly one third of national trade ports cannot cover even the costs of annual "cleaning" of the bottom at the expense of port fees (not taking into consideration another important infrastructure projects).

Besides, the complexity of maintaining passport depths remains one of the important problems of national STPs. In order to just start the works, which require

to be done annually, each of 18 ports (13 after annexation) should register a very large, almost project volume of documentation. This includes evaluation of works influence on the environment, permission of State Agency of Land Resources, of local administration, State Fishing Agency, Ministry of Nature etc. (Isaiev, 2014); (Isaiev, 2012).

## 4.2. Technical Limitations of Coal Transshipment

In Ukraine the capacities of bulk cargo transshipment have a universal loading technology, transshipment is done with gantry cranes. The only exception is TIS, where special complexes for raw iron ore and coal transshipment are built. In the Southern port there is also a coal-ore complex with specific equipment at stocks and at the point of wagon acceptance, however the unloading of imported coal from vessels both at TIS and Southern port is done with gantry cranes.

Solution of this problem could consist in transshipping coal on the capacities of general cargoes. Indeed, in Ukraine bulk and general capacities are interchangeable, because cargoes are moved by gantry cranes. After replacing a hook by a clamshell it is possible to pour the coal out at terminals for general cargoes. The first coal bulk carrier in Ilyichevsk was unloaded at container terminal.

However such replacements have a few disadvantages (Demianchenko, 2013); (Navrozova, 2011); (Chekalovets, 2014); (Demianchenko, 2013):

1. Net cost of transshipment at a non-specialized terminal is higher than at the specialized one.
2. Usage of gantry cranes for coal transshipment at the berth line determines low paces of transshipment – 15-25 thousand tons per day, increasing the time of stay and, respectively, the cost of vessel freight. To compare, paces of unloading in the terminal EMO in Rotterdam are 175 thousand tons per day, which allows to unload any Capesize vessel within maximum two days.
3. Losses during unloading at the non-specialized terminal is higher and that leads to the increase of batch cost for the consumer.
4. Open transshipment of coal leads to a serious environment pollution.

## 4.3. Coal Transshipment Cost and the Procedure of Cargo Registration

It may seem that the appeared volume of import of energy coal to Ukraine is not big for the world market and cannot have a significant influence on its balance in a long-term perspective. However the main factors which form the price on imported coal in Ukraine are as follows:

- Ukraine rather "suddenly" stopped export and came to the market of anthracite coal as a customer, being forced to purchase coal at the spot, which is always more expensive than deals with delayed delivery;



- prices on delivery to Ukraine are increased by allowances for military risk, which are added both to the coal and freight prices;
- military risks in Ukraine have also led to the refusal of banks to finance deals and Ukrainian customers have to purchase coal on the terms of 100% prepayment of the cargo and freight cost;
- nevertheless, expenses, even considering the sea freight cost, will be comparable to the money that Ukraine would spend on purchasing the same amount of coal at the mines of Donbass, because, for example, in South Africa or New Zealand coal is extracted in open pits.

## 5. CONCLUSION

Thus, during half a year (2014-2015) logistic chains of energy sources in Ukraine, which seemed to be rather stable, have changes dramatically. Being the exporter of energy coal Ukraine has become its importer (Table 1).

**Table 1.** Ukraine: Export-Import of Coal, thous. Ton; source: www.metalexpert-group.com

Coal types	2007	2008	2009	2010	2011	2012	2013	2014	2015 Forecasting
<b>Export</b>									
<b>Anthracite</b>	2 688	3 455	3 071	5 070	5 714	5 552	5 887	4 234	0
<b>Coking</b>	118	197	453	257	285	164	680	959	418
<b>Thermal</b>	815	1 136	1 752	836	959	362	1 474	1 315	130
<b>Import</b>									
<b>Anthracite</b>	156	40	10	12	18	14	20	2 041	1 161
<b>Coking</b>	8 565	7 173	5 341	7 747	9 909	11 640	11 998	10 851	10 502
<b>Thermal</b>	4 425	5 563	2 342	3 801	2 782	2 780	1 963	1 673	2 928

Such situation at the world market is almost unique and becomes the object:

- on the one hand, of a close attention and research of largest world analysts from the point of view of necessity to develop additional strategic plans, which allow to foresee the occurrence of such situations in separate companies as well as in the whole country. One of the major research directions is the formation of flexible logistic chains; development of flexible production technologies that allows to avoid strict dependence on certain fuel marks; creation of reliable strategic reserves of raw materials;
- on the other hand, of an operative intrusion and fast actions from the side of politicians and specialists of the most influential energetic companies of Ukraine with an aim to find the most profitable (sometimes once-only) solutions with an objective to stabilize the situation of Ukrainian energetic dependence on import. In this connection most attention is paid to the

creation of new logistic strategies, which consider major links of production process – from the search of importing countries, formation of transport routes of importers and discussion of the economic profit of the taken decision to the organizational and technological reconstruction of intermediate links of logistic network (ports, railway, automobile transport, river transport) as well as of coal consumers.

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