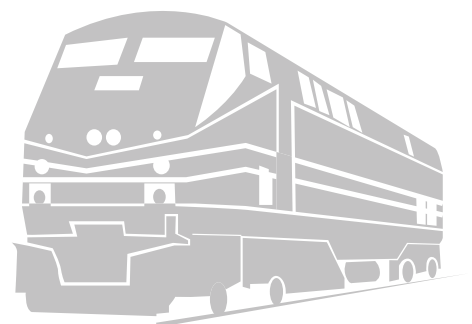




**IMF Group Ukraine**

Special Research

Locomotive power  
sufficiency for grain  
transportation by rail in  
light of increasing grain  
harvests, restoration of  
Ukraine's economy by  
2023



The purpose of this study is to analyze whether Ukraine's state railway monopoly Ukrzaliznytsia (UZ) will be able to cope with the growing demand for grain transportation through 2023 and the percent of UZ's locomotive power deficit could arise owing to failure to further reform UZ and stoppage of the current UZ reform program to purchase new locomotives. In addition, the study looks at potential consequences the deficit of locomotive capacity could have on Ukraine's economy. Special attention is paid to current logistical problems of Ukraine's Agricultural Industrial Complex (AIC).

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06	Grain and cereal production forecasts through 2022
08	AIC transport and logistical infrastructure
09	Current status of UZ railway grain wagon fleet
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27	Technical aspects of locomotive purchasing
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# Glossary

Ukrzaliznytsia, Ukrainian State Railway	<b>UZ</b>
Agricultural Industrial Complex	<b>AIC</b>
Hryvnia	<b>UAH</b>
State-run Produce and Grain Corporation of Ukraine	<b>SPGCU</b>
National Security and Defense Council	<b>NSDC</b>
Ministry of Economic Development and Trade	<b>MEDT</b>
Gross Domestic Product	<b>GDP</b>
Billions, Millions, Tons	<b>bn, mn, t</b>

## Main conclusions

Despite significant interruptions, Ukrzaliznytsia (UZ) in 2017 managed to meet 97% of demand for freight rail transportation. The shortfall of 3%, or 10.5 million tons, of cargo turnover was compensated by agrarians, who were forced to transport their grain by more expensive means. According to our estimates, the negative effect on agriculture from the need to replace railway transport by road transport amounted to \$321 million.

According to the forecasts of the AIC representatives confirmed by our calculations, by the year 2022 the volume of grain production in Ukraine could grow from the current 62 to 80 (+33%), or 100 (+67%) million tons, depending on the intensity of use of chemical fertilizers. Obviously, due to the limited internal market, the entire crop increase will be exported.

At the same time, the demand for rail transportation already in 2018 will also increase from metallurgists and other heavy industry enterprises, which use coal and oil products as their main source of energy, as well as manufacturers of mineral building materials and a number of other industries.

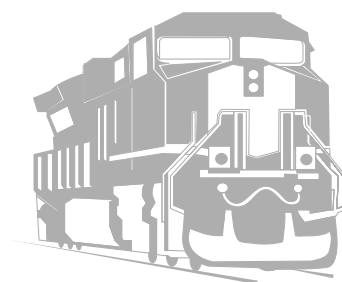
According to our forecast, the potential demand for rail transport, depending on the scenario of yield growth and the reduction of GDP energy intensity, may grow from the current 339.5 to 393-456 million tons over the next five years. But UZ's capacity volume in terms of cargo turnover is currently diminishing. Despite the existing number of problems with the deterioration of wagons, the main reason for the potential shortage of transportation capacity is the state of UZ's locomotive fleet.

So, even with the already signed contract for the supply of the first 30 locomotives of General Electric, the total number of UZ's thermal and electric locomotives intended for freight traffic is currently only 579 units and is annually diminishing by an average of 4.4%, or 25 locomotives. While maintaining current performance and dropout rates, by 2022 UZ will have only 504 locomotives capable of transporting 0.58 million tons per year. That is, the total volume of annual capacity of UZ for cargo turnover will amount to 291 million tons per year.

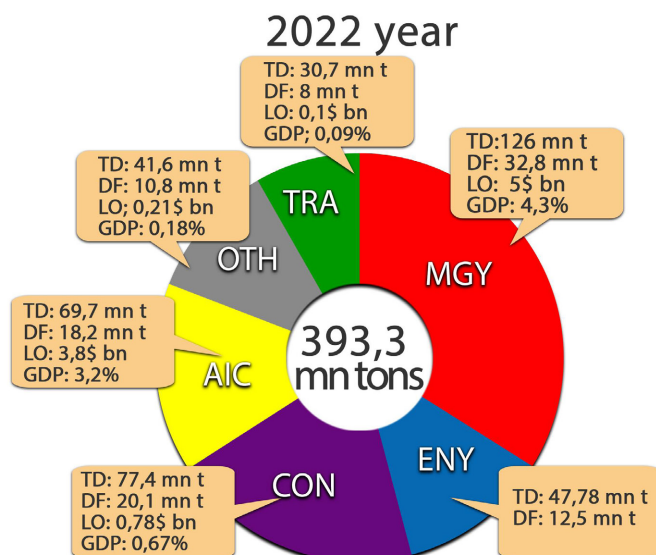
The resulting shortage of capacities for relatively cheap freight traffic will lead to the fact that such industries as metallurgy, agro-industrial complex and production of building materials will be forced to reduce production volumes. The transit of goods through Ukraine will be reduced forcibly. As for energy, the potential shortage of coal and oil products to heavy industry can be replaced with natural gas without significant losses. The higher profitability in other industries, representing the demand for rail transportation today, though it will allow them not to reduce production volumes, but, due to the forced transition to more expensive vehicles, will be substantially reduced.

According to our calculations, if government steps back from the current program for updating and modernizing UZ's locomotive fleet, the average annual loss for the economy, depending on the scenario, will be from 4.8% to 7.1% of GDP per year. Cumulatively over five years, that equals from \$27.8 to \$41.3 billion in 2017 prices. The current program for renewing UZ's locomotive fleet provides for purchasing 262 critically-needed locomotives for only \$1 billion.

Our work is not intended to protect the expediency of choosing a particular contractor for the production or purchase of locomotives and is only an econometric calculation of the potential losses for Ukraine's economy from the shortage of locomotive capacities of the railway and the absence of a single potentially permissible tool for servicing a variety of industries.



## Forecast deficit of locomotive power in 2022 and potential economic losses by economic sector



**2022 deficit:**  
 \* 178 locomotives  
 \* 102,4 mn tons not shipped  
 \* -8,5% GDP; \$10 bn

\* TD – Total demand  
 DF – Deficit  
 LO – Loss (\$bn)  
 GDP – % GDP

Metallurgy  
 Energy  
 Construction  
 Agrarian and industrial complex  
 Other  
 Transit

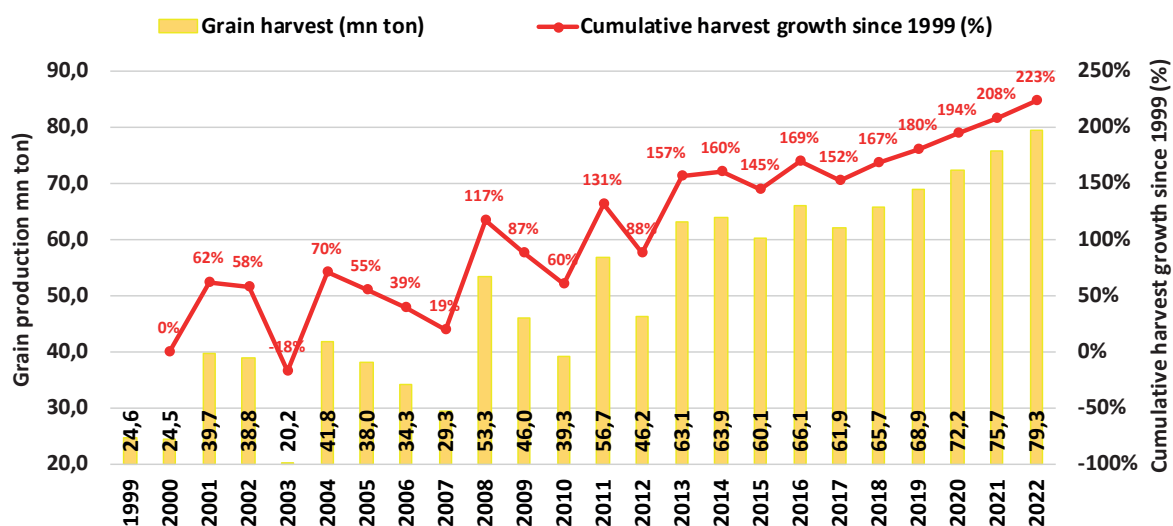
# 01 Grain and cereal production forecasts through 2022

According to our forecasts, Ukraine will increase grain crop harvesting to 80 million tons (+29%) by 2022, and, according to the optimistic scenario — to 100 million tons (+ 61.3%).

production amounted to an unprecedented 102%, or a 4.81% annual increase. If agrarians can continue to maintain current harvest growth rates, then in 2022 Ukraine will harvest 79.3 million tons of grain crops a year, or 26.5% more than today. And this is a pessimistic scenario for the development of Ukraine's AIC.

In 1999-2001, the average gross harvest of grain in Ukraine was only 29.5 million tons. By 2015-2017, or 15 years, harvested crops reached 62.7 million tons. Adjusted for seasonality, the growth in cereal

## UKRAINE'S GRAIN PRODUCTION FORECAST (MN TON) BASED ON CURRENT GROWTH TRENDS



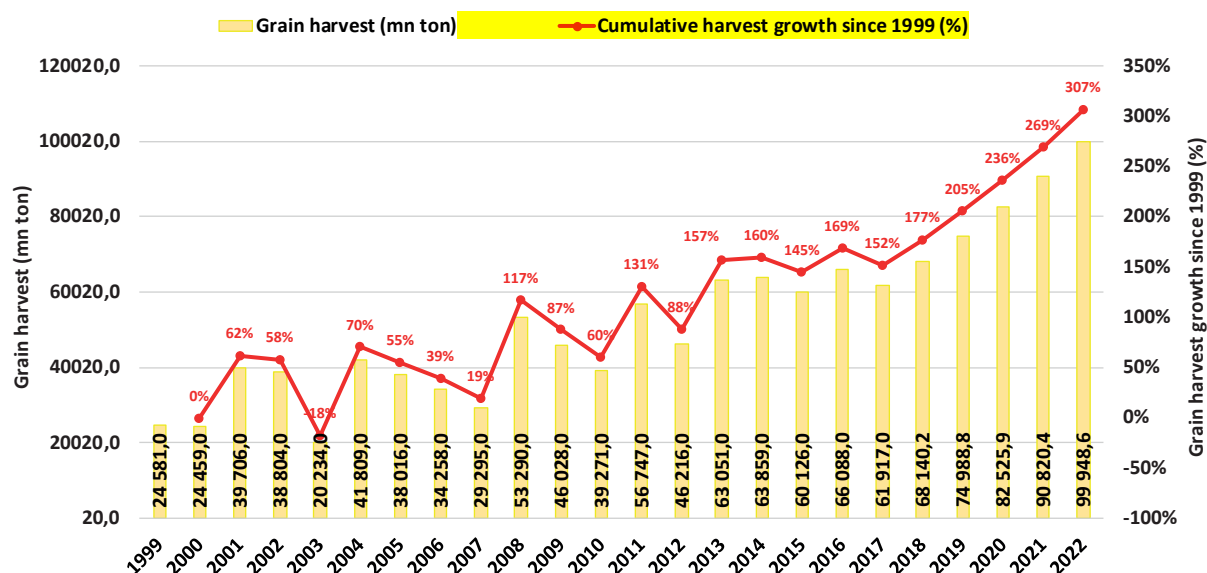
Source: State Statistics Service of Ukraine, IMF Group of Ukraine

The second, optimistic scenario for the development of the agroindustrial complex presupposes the possibility of matching growth of the leading world domestic agrarians by importing leading technologies and experience. For example, according to the results of 2017, the average grain yield in Ukraine was only 42.5 centners per hectare. China is one of the main importers of Ukrainian food. But Chinese farmers reap 60 centners per hectare, American farmers —

81 centners, German farmers — 71.8 centners, Austrian — 72.5 centners and French — 56.9 centners, thanks to use of seeders with precise sowing, or no-till plowing technologies.

If Ukrainian agrarians over the next five years introduce existing advanced agritechnologies, the country by 2022 could boost annual grain harvests by 61.4%, or up to 100 million tons.

## UKRAINE'S GRAIN PRODUCTION FORECAST (MN TON) BASED ON LEADING COUNTRY GRAIN PRODUCERS



Source: State Statistics Service of Ukraine, IMF Group of Ukraine

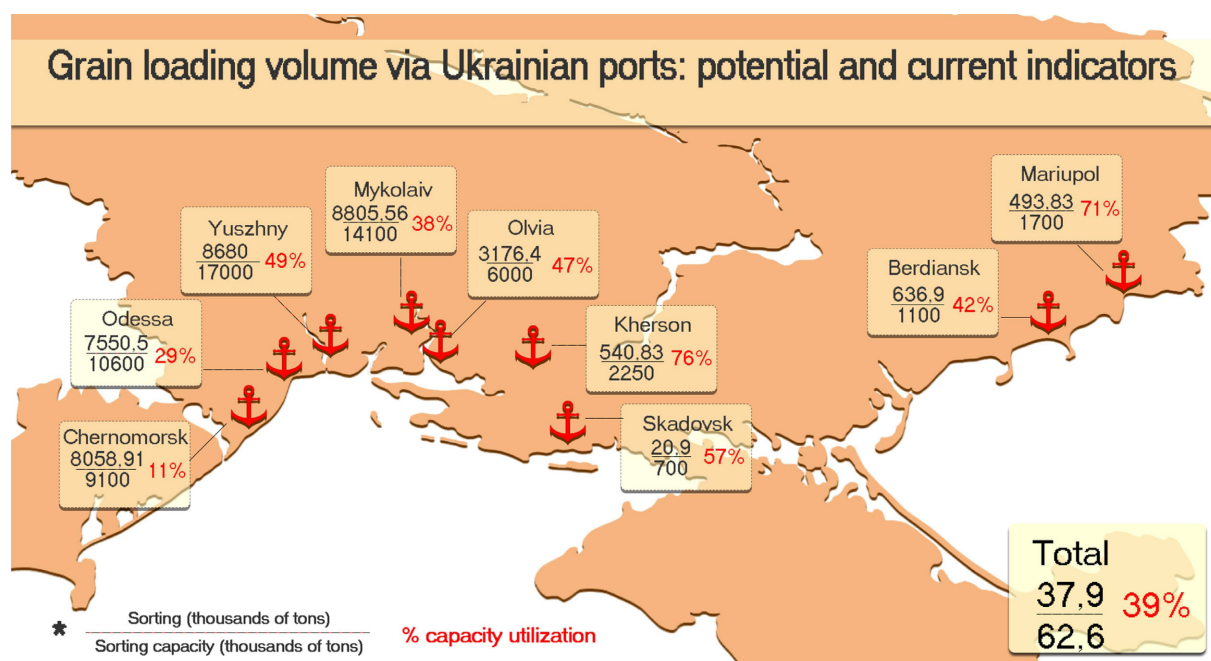
## 02 AIC transport and logistical infrastructure

The increase in grain yields under each scenario should be accompanied by a corresponding increase in infrastructure capacities for grain transshipment. Today we can observe the prevailing rule since the 18th century, namely that the market form of ownership is more effective than state ownership. The private sector is responding to the market's demands immediately: Nibulon, Cargill, Kernel and other grain traders are leading the way, opening of new grain storage facilities throughout the country, buying train wagons and building ships to deliver grain to ports. They are already building new

terminals for shipping, and in the course of several years, will start building their own ports.

**The port and elevator infrastructure of Ukraine is already ready today to increase the volume of grain transshipment for export.**

According to the company BlackSeaTrans, starting in 2018 the total capacity of all grain terminals was 3.2 million tons of one-time grain storage of grain and 62.5 million tons of annual grain transshipment. After the Cargill terminal in the port of Yuzhny is completed in 2019, this figure will grow to 68 million tons of annual grain transshipment.



Source: Administration of seaports of Ukraine, IMF Group of Ukraine



### 03 Current status of UZ railway grain wagon stock

Unfortunately, another, no less important, component of Ukraine's AIC — Ukrainian Railways, or Ukrzaliznytsia) — is in decline.

Ukrzaliznytsia (UZ) currently is not able to provide up to 20% of the demand for grain transportation, forcing agrarians to use the services of auto carriers, whose average tariff is 11 times higher than that offered by UZ. Out of 41.8 million tons of grain exports in 2017, UZ delivered to ports only 31.2 million tons, or 74.6% of the total. Remaining cargos used river transport, while 10.3 million tons were delivered by motorways, which, incidentally, are not designed for freight traffic on such a scale.

As forecasts show, if reform of UZ is not started immediately, by the year 2022 the share of the railway transportation of grain may drop to 50%. Or agroholdings

will be forced artificially reduce grain harvests because they will unable crops to foreign markets.

In order to fully assess the extent to which the delay in reforming UZ can be detrimental to agrarians and how much they require railway transportation capacity, it is important to understand the place UZ occupies in agricultural sector logistics.

In 2017, Ukraine's AIC harvested 61.9 million tons of grain. Of this volume, only 33% went to domestic consumption and processing. The remaining 42 million tons went to export. Future growth of grain production is for the foreign export market. Domestic cereal consumption will not increase after the level of incomes of citizens and depends solely on the number of people. Over the next five years, domestic cereal consumption will remain approximately at the level of 2016, 24.6 million tons, and the growing harvest volumes will be exported.

Period	Grain production (thousands tons)		Grain export (thousands tons)		Domestic consumption		
	Scenario 1 (79,3)	Scenario 2 (100)	Scenario 1 (79,3)	Scenario 2 (100)	Total (thousands tons)	Weight (%)	
						Scenario 1 (79,3)	Scenario 2 (100)
2000	24459		1330		23129		
2005	38016		12650		25366	66,7%	
2010	39271		14239		25032	63,7%	
2012	42216		27798		14418	34,2%	
2013	63051		27836		35215	55,9%	
2014	63859		33423		30436	47,7%	
2015	60126		38338		21788	36,2%	
2016	66088		41451		24637	37,3%	
2017	61917		41800		24637	39,8%	
2018	65725	68140	42021	44436	23704	36,1%	34,8%
2019	68886	74989	45182	51285	23704	34,4%	31,6%
2020	72198	82526	48494	58822	23704	32,8%	28,7%
2021	75669	90820	51965	67116	23704	31,3%	26,1%
2022	79307	99949	55603	76245	23704	29,9%	23,7%

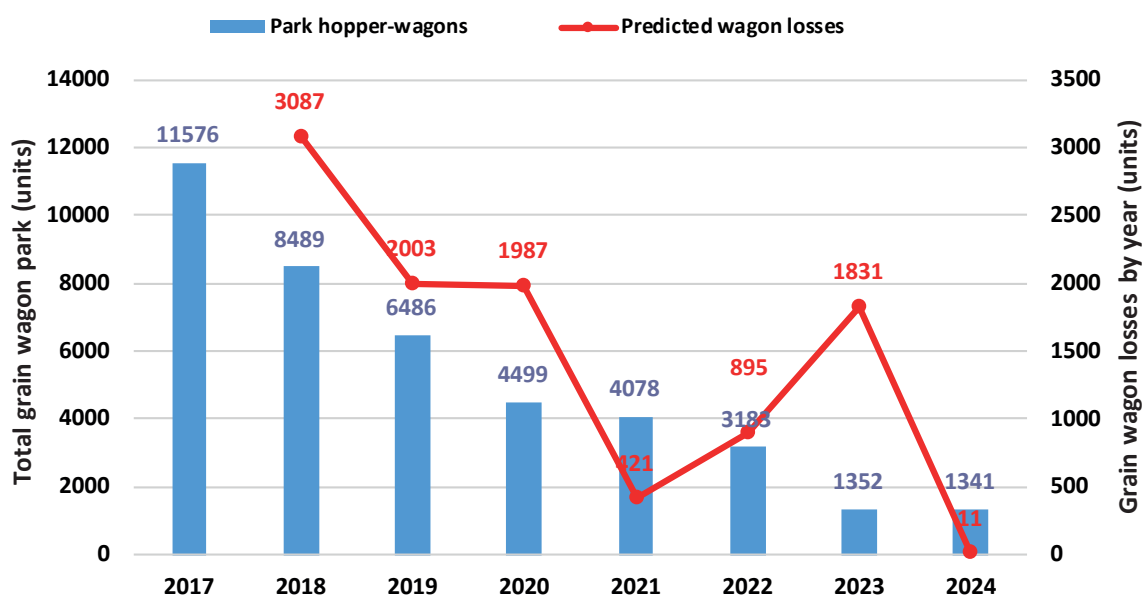
Source: State Statistics Service of Ukraine, IMF group of Ukraine

Rail transportation of one ton of grain using UZ will cost an average of \$44 on average: 9.1%, or \$4 from taking grain from the truck to the elevator, 6.8%, or \$3 for intermediate grain storage, 34.1%, or \$15, for grain elevator services, 22.7%, or \$10, for rail delivery to the port and 27.3%, or \$12, for loading grain on the ship. When delivering the same ton of grain by road, the cost of transportation will increase from \$10 to \$41.3.

UZ officials today say they are not yet ready to increase grain transshipment. Every day the company can provide only 1,056 hopper-grain wagons, while 6,000 are required during peak market demand. According to UZ officials, almost the entire current fleet, or 97.8%, of the railway monopoly's grain wagon fleet, will be unusable by 2025.

Payment of the \$31.3 difference, taking into account the average export price of a ton of wheat last year of \$160, will, at best, only allow the domestic farmer to break even.

### WAGON PARK OF UZ GRAIN CARS



Source: Ukrzaliznytsia

The last time UZ put new grain cars into service in 1993, but the volume of the procurement lot consisted of only two grain carriers. Over 26 years of Ukraine's independence, 171,000 units were removed from UZ's fleet of grain wagons, and only 25,500 new wagons were purchased, including 15,000 open wagons.

At the end of 2017, the entire fleet of UZ grain wagons numbered 11.5 thousand units, with private companies owning 3,000. Agrarians say that at least 22,000 hopper-grain wagons are needed to fully transfer grain by rail. But officials at Ukraine's Infrastructure Ministry say it will be enough to «optimize» the use of the existing fleet of grain wagons, by, for example, prohibiting the use of wagons for land exports of grain and limiting their use in the direction to the south of Ukraine, to the Black Sea ports. Another idea is prohibiting grain trucks from travelling distances exceeding 200-300 kilometers. At the same time, they propose improving the system of distributing grain wagons between market participants.

In early 2017, The State-run Produce and Grain Corporation of Ukraine (SPGCU) announced plans to purchase 3,000 grain carriers using funds provided by its Chinese benefactors. Some 500 were to be delivered during the second half of 2017. The reason for such investments, according to the management of the company, was a regular shortage of rail wagons. SPGCU's grain transportation requests were fulfilled only by 40%, and the purchase plan was scuppered following the resignation of SPGCU head Oleksandr Hryhorovych in April 2017.

According to UZ's 2017 financial plan, the state enterprise was supposed to buy 1,076 new grain wagons. In March of the same year, the management of the state enterprise announced a change of plans: UZ would instead receive 1,076 grain carriers rebuilt from mineral wagons. In July 2017, ex UZ head Wojciech Balchun resigned and UZ had refurbished only 70 mineral carriers into grain carriers.

In May 2017, Ukraine's National Security and Defense Council (NSDC) banned the work in Ukraine of several hundred Russian companies, including logistics companies. According to preliminary reports, the decision would have prevented about 2,000 grain wagons from

operating on the market and left market players relying exclusively on UZ's grain wagon fleet. However, freight forwarding companies managed to bypass the NSDC ban and by the end of 2017 there were 11,500 UZ grain carriers and 6,000 wagons belonging to private companies in operation.

The shortage of grain wagons also precipitated the launch in September 2017 of an automated wagon distribution system, which was set up to allocate wagons in proportion to applications made by grain transshipment market players. The system, however, was flawed, catering primarily to agrarians in Ukraine's southern regions closest to Black Sea ports.

According to UZ daily logs, Odesa Railway consistently had about two thousand «available» grain carriers, while agrarians in Ukraine's northern regions complained about constant wagon shortages. To increase their odds of receiving grain wagons, grain traders started duplicate their bids. As a result, according UZ's logistics office, applications for 50 grain wagons out of the 1,050 actually provided, were cancelled daily.

Ukraine's railway monopoly experiences problems with the deficit and wear of all types of freight cars, constraining business growth in agriculture and other sectors of the economy. UZ managers announced their intention to systematically update UZ's rolling fleet in May 2017 during the presentation of the Strategy for the Development of Railways for 2017-2021, announcing that for the next five years, UAH 18 billion would be spent on the purchase of 20,000 new freight cars. The plan has yet to be approved by Ukraine's Ministry of Economic Development and Trade (MEDT) and the Cabinet.

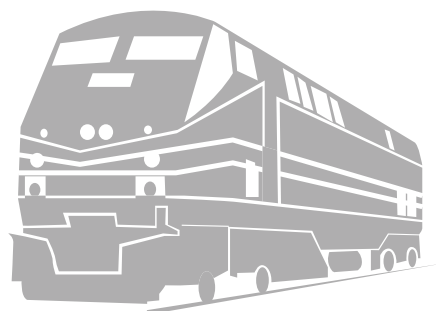
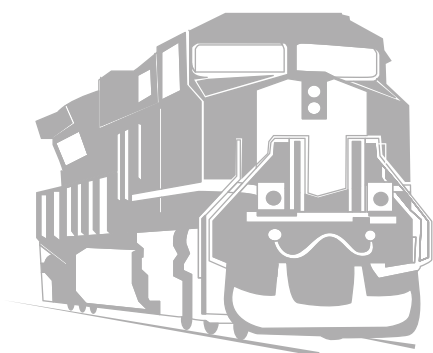
New UZ top managers in September 2017 updated the monopoly's strategy, announcing that until 2022 UZ's share in cargo transportation would increase from 33.2% to 45.1%, with transportation capacity of one freight car growing from 0.9 million tons-kilometers (tkm) to 1.8 million tkm annually, and the productivity of freight locomotive — from 157.9 million tkm to 171 million tkm annually.

To accomplish same by 2021, Ukraine's Cabinet would need to spend USD848 million for 15,000 new grain wagons and for the modernization of 46,000 used wagons.

Emphasis was placed on procuring gondola wagons in UZ's plan, which has yet to be approved by Ukraine's Cabinet. Currently, there is no guarantee government and UZ will abide by the draft strategy. Election results in 2019 may change UZ's plans and the cost of upgrading the monopoly's rolling stock.

In the short term, however, UZ is ahead of the temporary modernization map presented in the strategy. According to the indicators of the financial plan approved for 2018, UZ will purchase

7,368 wagons, 7,050 of which are gondola cars, 100 fitting platforms for transportation of freight containers and 137 grain trucks. The deficit between the out-of-service wagons and the volume of new purchases will, in turn, be covered by major repairs and updating the inventory of grain wagons over 2018. Some UAH 7.1 billion was approved for the modernization of the freight fleet of wagons.



## 04 Ukrzaliznytsia: forecast for increased demand for rail transportation

UZ's grain wagon dilemma is not the only obstacle to increasing grain transshipment for export. Agrarians will not be able to withdraw their cargo from storage because of the chronic shortage of locomotives. According to UZ managers, wear of the locomotive fleet is 97%, and of electric locomotives — 90%. Due to a shortage of power traction, railcar productivity today is from 40-60% below its potential. Current grain transshipment through railway stations amounts to only 38.5 million tons, of 48.9 million tons required. UZ' locomotive park is in critical condition.

The state is responsible for updating the monopoly's obsolete locomotives, according to Article 10 of the law «On Rail Transport,» adopted in 1996. In practice, however, the State Budget since Independence has never earmarked funds for purchasing new UZ freight transportation rolling stock.

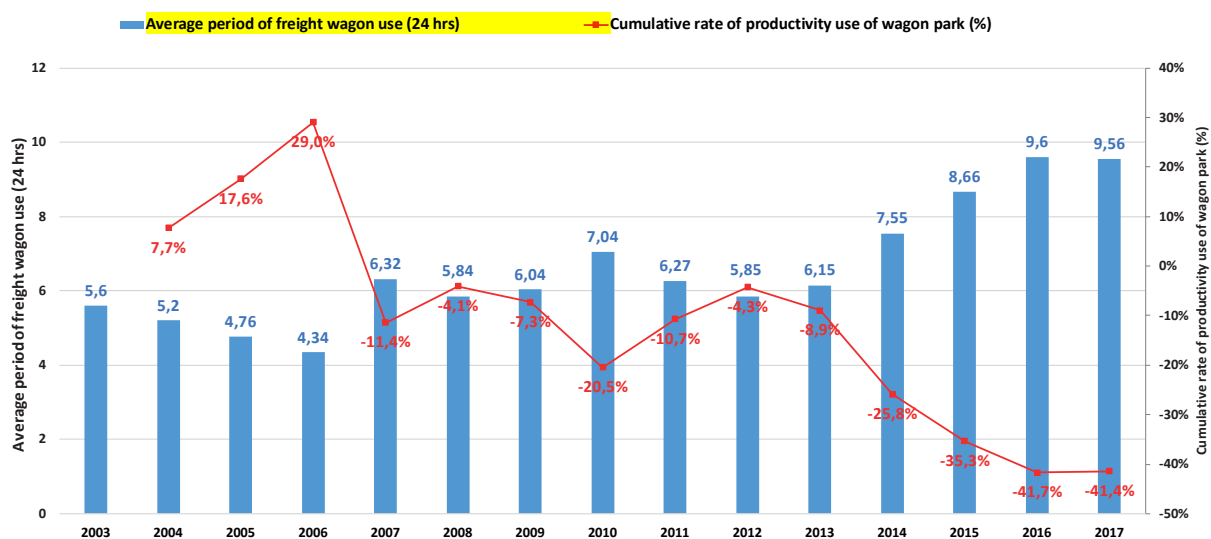
UZ bought cargo locomotives in 2008, 45 electric DE-1 locomotives produced at the Dnipropetrovsk Electric Locomotive Plant. At the same time, the state company was unable to fulfill its initial plan to purchase 145 electric locomotives and 25 diesel locomotives for transshipment of goods in 2008-2010. In 2011-2015, UZ planned to write off its 195 electric locomotives and 340 diesel locomotives, replacing them with 250 electric locomotives and 25 diesel locomotives. The plan would have cost UAH 12 billion, with Luhanskteplovoz plant (privatized by Russian Transmashholding in 2010) fulfilling the entire order. But during negotiations, the Russians insisted that locomotives for UZ would be manufactured by factories located inside Russia. Ural Plant of Railway Engineering produced 50 freight electric locomotives 2ES10 for the Lviv railway in 2012. But by early 2014, the Russians produced only seven locomotives, which UZ did not buy, due to Russia's annexation of Crimea and invasion of eastern Ukraine.

PJSC Ivano-Frankovskcement during the first half of 2010 was the only buyer of the new long-distance freight diesel locomotive. In 2013, UZ bought a diesel locomotive TE33A from the Kazakh plant Lokomotiv Kurastyr Zauyty produced under a General Electric license. The plant began producing American diesel locomotives in 2009. By 2018, 311 diesel locomotives TE33A came off the plant's assembly line. Kazakhstani Railway was the sole owner of Lokomotiv Kurastyr Zauyt until 2013, when on April 29 Russia's Transmashholding bought 50% of the plant. General Electric bought the remaining shares in January 2017.

Following Russia's invasion of Ukraine in 2014, Luhanskteplovoz continued operations in temporarily occupied territories of the region beyond Ukraine's control. Ukraine SBU Security Service reported in 2015 that Luhanskteplovoz equipment was shipped off to Russia, leaving Ukraine without a single domestic diesel locomotive manufacturer ... and the unresolved problem of updating the country's locomotive park.

The chronic deterioration of UZ's traction power is vividly reflected in the productivity of UZ's rolling stock. Since 2003, this indicator has increased from 5.2 to 9.6 days, with the efficiency of wagon transportation dropping 41.4%. This makes it obvious that the lack of locomotives for UZ is a much bigger problem than the monopoly's shortage of railcars.

## PRODUCTIVITY USE RATE OF UZ WAGON PARK, 2003-2017

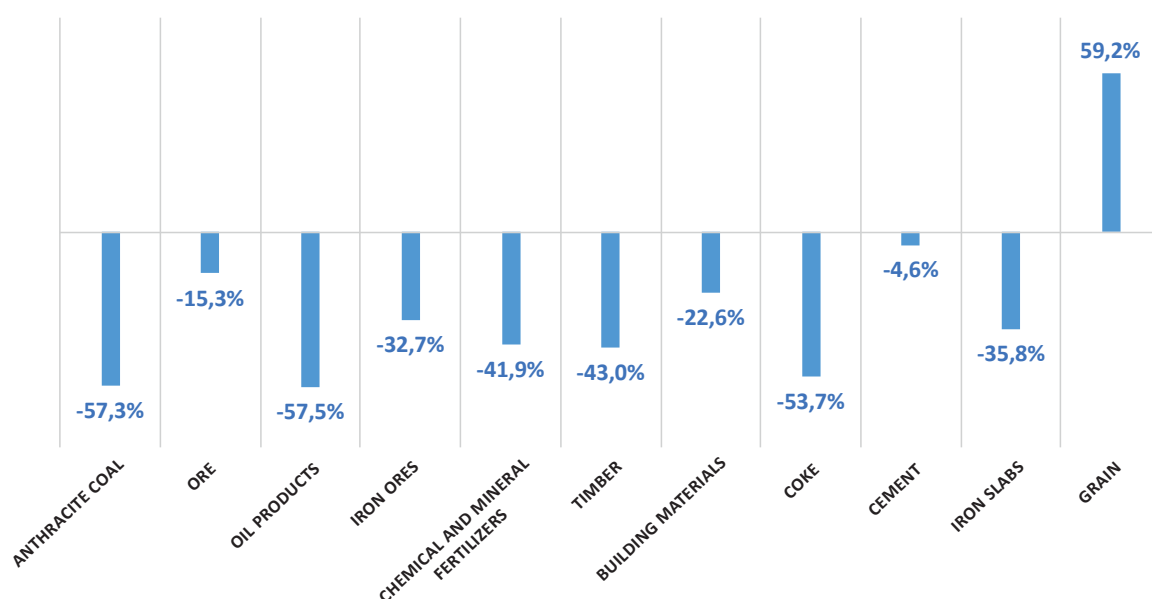


Source: Ukrzaliznytsia

Although agrarians have in recent years been the main source of complaints about railroad capacity, it is important to understand that another 26% of the Ukrainian economy also actively uses railway transportation. Only because of external economic factors and a sharp decline in prices

for fossil fuels and metals (and the subsequent collapse related-industries), have agrarians had the opportunity to export at least 70-75% of their crops by rail. As industrial output is restored, competition for limited railway resources will intensify.

## RAILWAY TRANSSHIPMENT BY ECONOMY SECTOR TREND 2013-2017 (%)

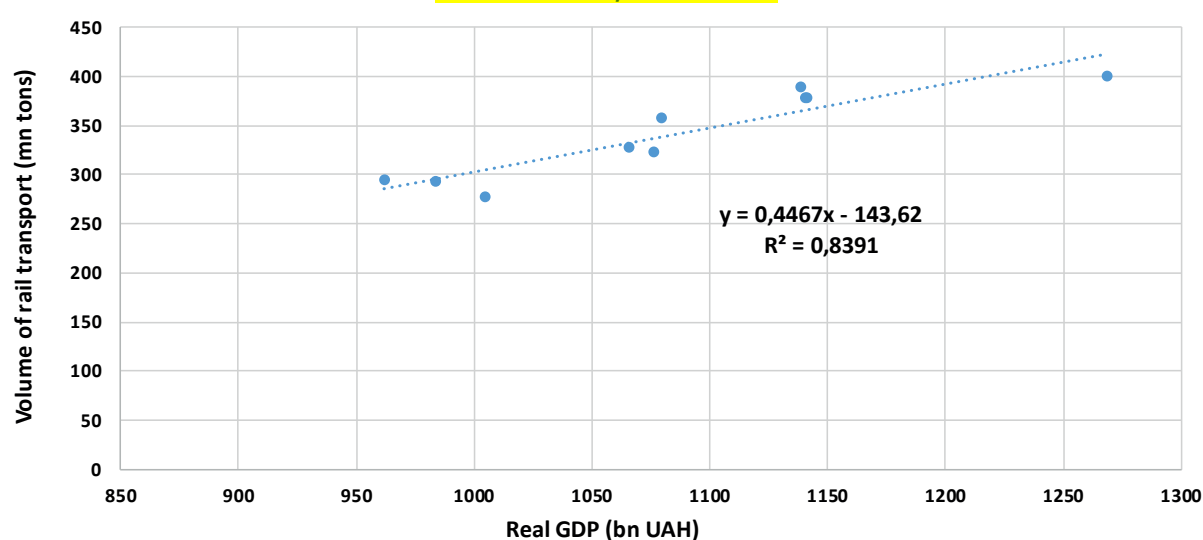


Source: State Statistics Service of Ukraine

In order to predict correctly the shortage of locomotive traction over the next five years it is necessary to take into account not only the expected growth in grain production, but also the growth in demand for rail transportation as Ukraine's economy recovers. According to the official forecast of the International Monetary Fund (IMF), by 2022 Ukraine's real GDP will grow to

UAH 1,195 billion (in 2010 prices), or by 19.6%. It is obvious that, following the volume of real GDP, the demand for freight transportation of the railway will also grow. If we build a correlation model based on data for 2008-2017, we can see that real GDP growth of 1 billion UAH. is accompanied by an increase in the freight turnover of the railway by an average of 0.59 million tons.

### CORRELATION OF VOLUME OF REAL GDP AND VOLUME OF RAIL FREIGHT TRANSPORT, 2008-2017



Source: State Statistics Service of Ukraine, IMF group of Ukraine

Total	Total completed rail shipments, 2017	
	Mn tons	Total industry share (%)
	339,55	
Anthracite coal	67,08	19,8%
Oil and oil products	13,87	4,1%
Iron and manganese ore	70,21	20,7%
Ore colored	4,50	1,3%
Black metals	22,45	6,6%
Non-ferrous metals and their products	0	0,0%
Timber	3,67	1,1%
Chemical and mineral fertilizers	12,53	3,7%
Chemicals	3,60	1,1%
Cars	0	0,0%
Vehicles and equipment	0	0,0%
Grain	36,86	10,9%
Coke	6,51	1,9%
Ferrous metal scrap	3,09	0,9%
Mineral construction materials	62,69	18,5%
Cement	6,42	1,9%
Salt	1,75	0,5%
Other	24,12	7,1%

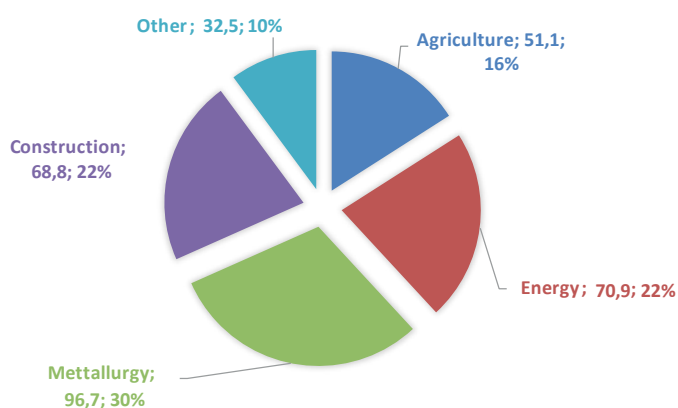
Source: Ministry of Infrastructure of Ukraine

In order to fulfill the most accurate forecast for increasing the demand for freight transportation by rail, we consider it expedient to forecast the growth of potential freight turnover separately for each of the industries.

Ukraine's Infrastructure ministry provides official transport statistics for 16 commodity items, but it is easy to see that they represent the final products and components for the production of only four industries that form 90% of the demand for rail transportation. Thus, coke and iron ore are internal transportation to smelting plants and ferrous metals products. Similarly,

chemical and mineral fertilizers are used in the production of cereals, and cement and mineral building materials are used in construction. Thus, all freight turnover by rail is divided into four main branches: energy, agriculture, metallurgy and construction. Other industries account for only 32.5 million tonnes, or 10.1% of the total, excluding transit.

### RAILWAY TRANSPORT BY ECONOMY SECTOR 2017 (MN TONS, %)



Source: Ministry of Infrastructure of Ukraine

#### 4.1 Power Engineering

According to preliminary estimates, in 2017 Ukraine consumed 25.3 million tons of oil, the coal equivalent of 44.1 million tons and the equivalent of 12.9 million tons of raw crude oil and petroleum products amounting to 4.8 million tons.. The volume of rail transportation (excluding transit) of these energy resources in 2017 was 59.1 and 11.8 million tons, respectively.

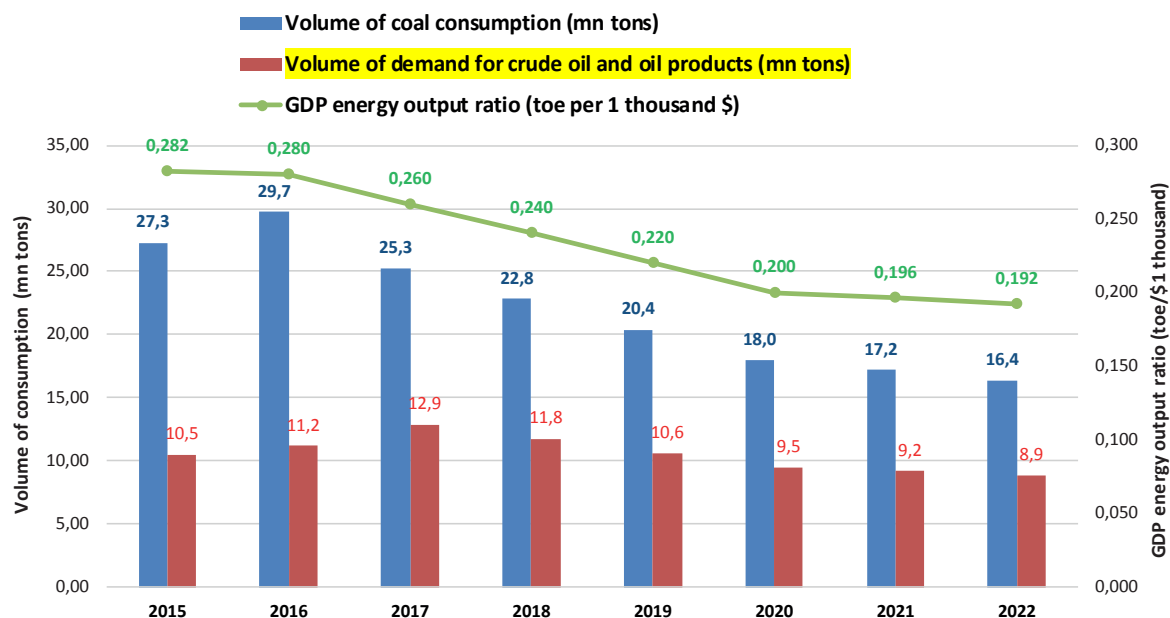
To forecast the potential load of the energy sector on the railway, it is important to understand how the energy intensity of Ukraine's GDP and the volume of real GDP will change in the next five

years. Our group forecasted an increase in the turnover of coal and crude oil with petroleum products in two scenarios: a reduction in the consumption of these energy resources, respectively, the government's energy strategy until 2035, while maintaining the current level of energy intensity and the structure of the energy balance.

Energostrategy-2035 provides for changing the structure of the energy balance towards renewable energy sources and reducing consumption of coal and oil products by 2022 by 35% and 31%, respectively.



## FORECAST VOLUME OF ANTHRACITE COAL AND OIL PRODUCTS TO 2022, ACCORDING TO ENERGOSTRATEGY-2035

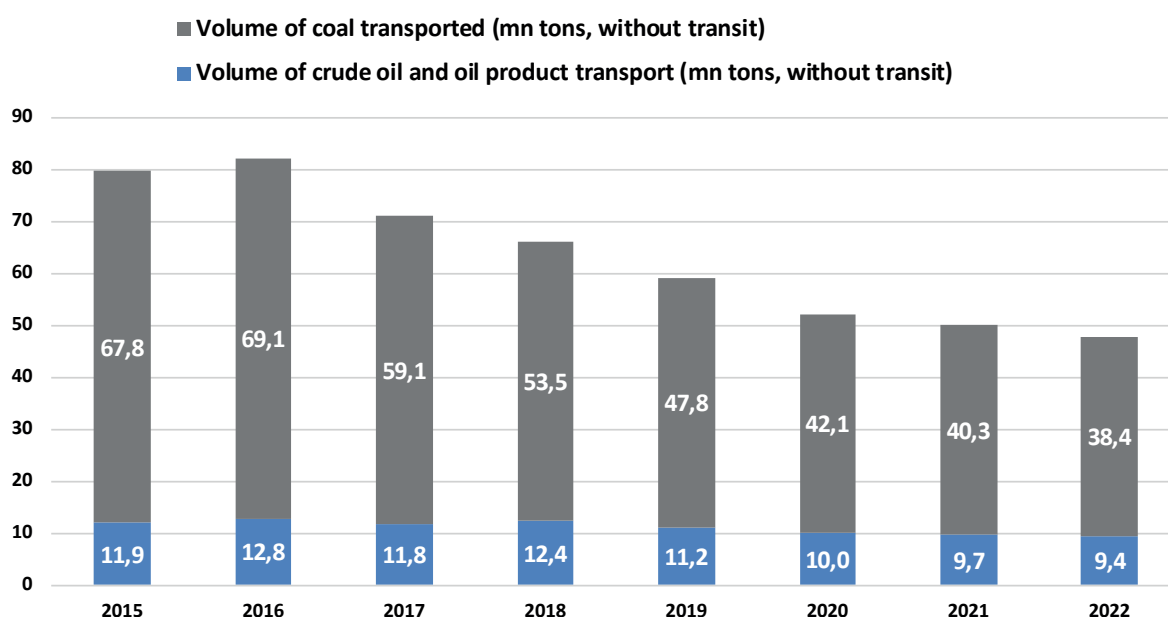


Source: Energy Ministry, Energy Strategy-2035, IMF group of Ukraine

It is obvious that at such volumes of falling consumption of coal and crude oil with oil products, the volumes of their turnover will accordingly decrease. According to our

calculations, the volume of transportation of these energy resources (without transit) will decrease from 70.9 million tons in 2017 to only 47.8 million tons in 2022 or 32.6 percent.

## TRANSPORT VOLUME FOR ANTHRACITE COAL AND OIL PRODUCTS AS PER ENERGY STRATEGY-2035 (MN TONS)

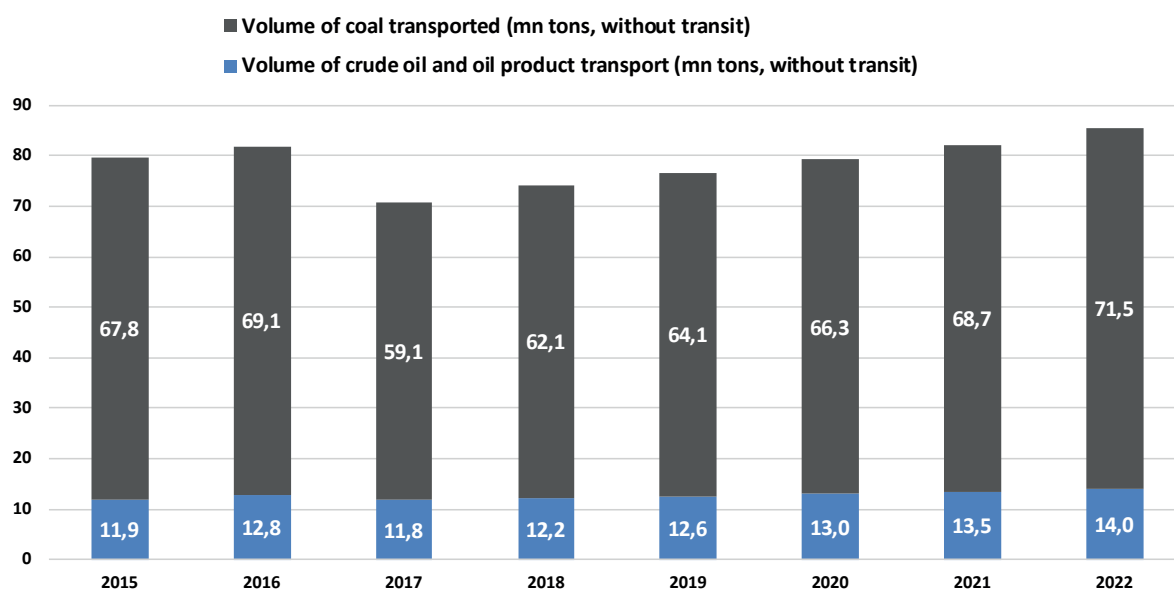


Source: State Statistics Service of Ukraine, IMF group of Ukraine

But in view of the fact that the Ministry of Energy lags behind the announced plans, we have fulfilled an alternative forecast of the potential load of the energy sector for the railway, while maintaining

the current level of energy intensity of GDP, the structure of the energy balance and the share of industry in GDP.

### TRANSPORT VOLUME FOR ANTHRACITE COAL AND OIL PRODUCTS, KEEPING CURRENT GDP ENERGY OUTPUT RATIO (MN TONS)



Source: State Statistics Service of Ukraine, IMF group of Ukraine

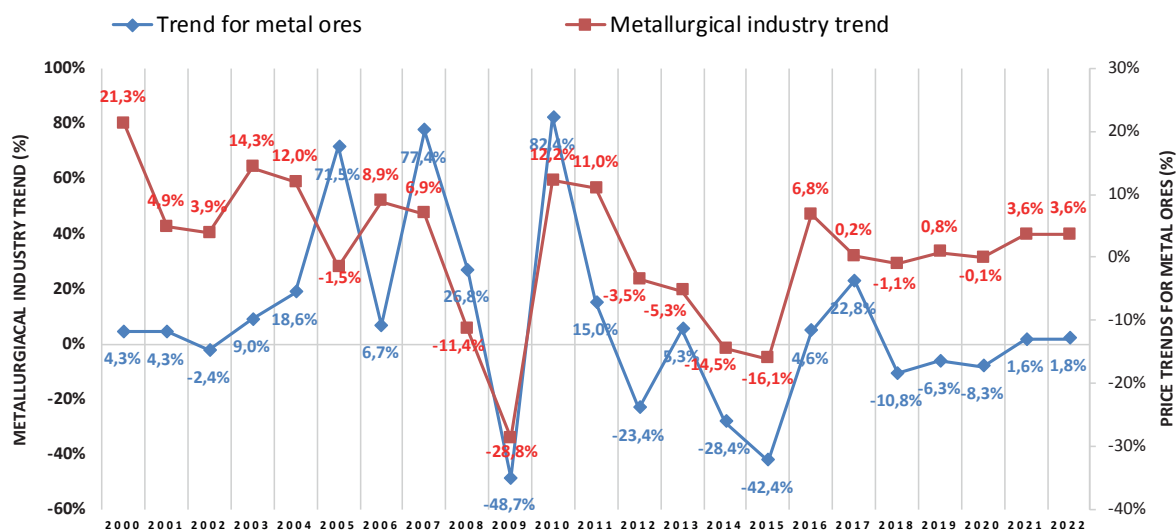
Under this scenario, the volumes of transportation of hard coal and crude oil with oil products will grow from the current 59.1 and 11.8 million tons to 71.5 (+ 21%) and 14 (+ 18.6%) million tons in 2022 - th year respectively. The total increase in the load on the railway will increase by 11.3 million tons of cargo turnover per year.

## 4.2 Metallurgy

The volume of transportation of iron ore, coke and ferrous metals by the railway today is 96.7 million tons or 30.2% of the total volume of cargo turnover. At the same time, Ukrainian metallurgy is now simultaneously in two crises: external economic, connected with the cycle of falling metal prices and internal, caused by the

aggression of the Russian Federation. The basic assumption for forecasting the increase in the demand of the metallurgical industry for rail transportation is the World Bank's forecast for world metal prices, namely, iron ore, whose price is most closely correlated with the growth rate of metallurgy in Ukraine.

## WORLD PRICE TRENDS FOR METALS AND RATE OF GROWTH OF METALLURGY SECTOR (%)



Source: World Bank, State Statistics Service of Ukraine

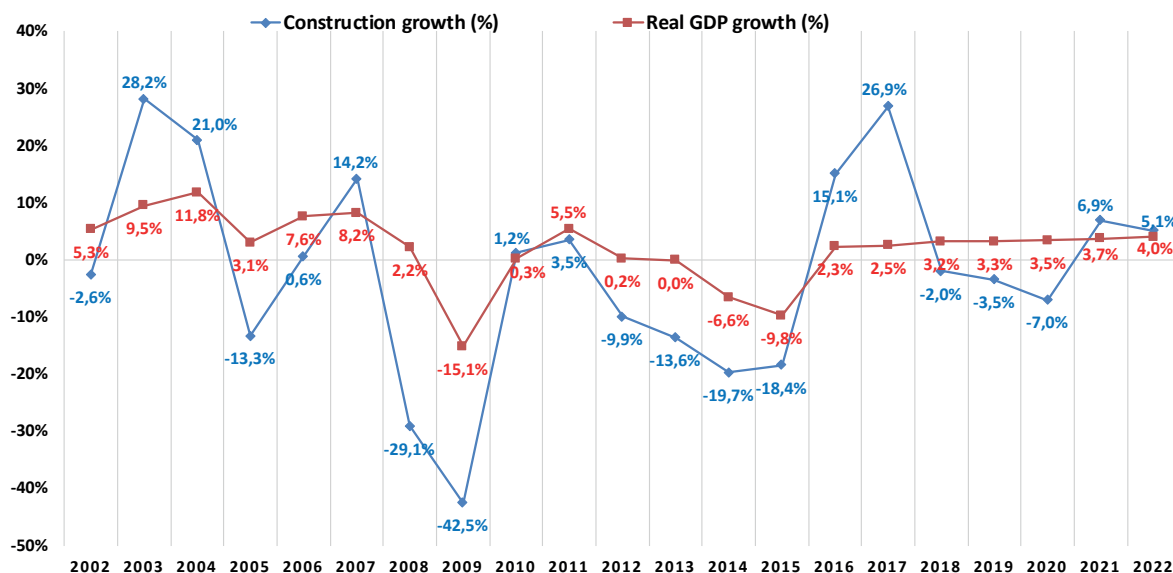
Thus, according to the forecast of the World Bank, by 2022 the world prices for iron ore are expected to decrease smoothly from the current 65 to 56.9 dollars per ton. Accordingly, from the world conjuncture Ukrainian metallurgy expects a decrease in profitability and production volumes in the next 5 years. However, the stabilization of the conflict in the East, the ownership of business processes, excessive capacity in this industry and cheap labor, according to our assumption, will allow Ukrainian metallurgists in the unoccupied territories in the next 5 years to increase production volumes to the level of 2013. Thus, we will see the average annual rate of growth in the smelting of metals and products from them at 5.4%, and the volume of potential demand for rail transportation by metallurgists will grow from the current 96.7 million tons to 126 million tons in 2022 year.

### 4.3 Construction

In the last 3 years, Ukraine has been experiencing a construction boom, which led to a corresponding increase in volumes of internal cement transportation — up to 6.4 million tons (+ 15.2% by 2015) and mineral building materials — up to 62.4 million tons. (+ 11.6% by the 2015th year).

As the previous statistics for the year 2018 show (-0.8% for January-April), this year we can face a reduction in construction volumes by about 2%. Starting in 2019, the construction industry in Ukraine is likely to face the need to raise prices to a new level of production costs. So, for today up to 80% of real estate in the primary market is sold at a cost, calculated even on the basis of 8 UAH / USD. Therefore, in 2019-2020 we will face the same situation as in 2011-2012, when with the general growth of the economy — construction will be in a state of recession. Recovery, according to our forecast will begin in 2021, and will traditionally be higher than the growth rate of real GDP. With our assessments agree and the CEO of the largest development companies in Ukraine.

## GROWTH TRENDS FOR REAL GDP AND CONSTRUCTION (%)



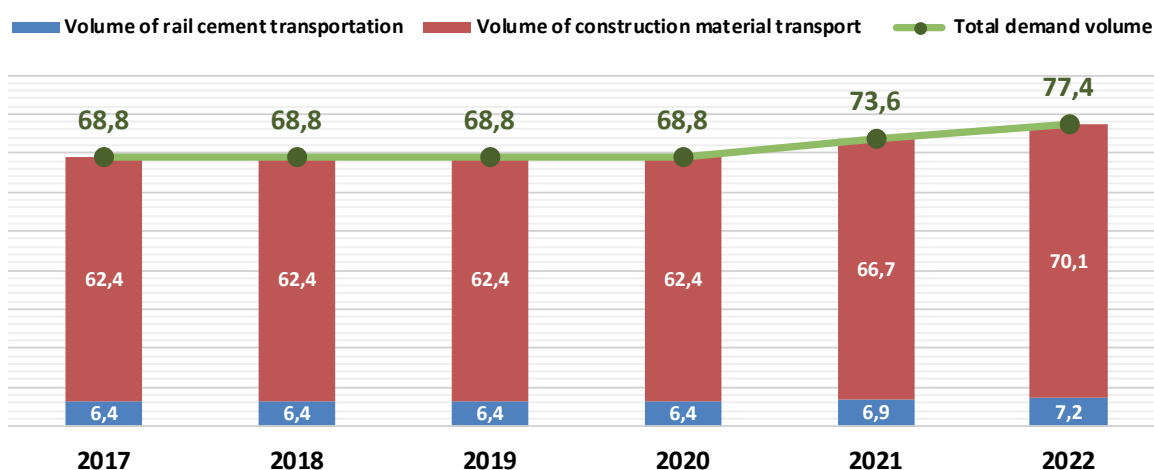
Source: IMF, State Statistics Service of Ukraine, IMF group of Ukraine

Accordingly, domestic demand for building materials and their transportation by rail within the next five years should not exceed current values. But the Ukrainian producers of building materials have already managed to gain a foothold in foreign markets. In 2017, out of 62.4 million tons of cargo turnover of construction materials — 17.4 million tons or 27.8% of mineral building materials were exported. For cement, the share of shipments for exports is lower and only 4.2%, but the existing potential for increasing its export

supplies will completely cover the difference between the shrinking domestic demand and current production volumes.

In the end, according to our forecast, producers of cement and mineral building materials, which form 21.5% of the freight turnover of the railway, will be able to reorient to foreign markets in 2018-2020, and starting from 2021 — to increase production volumes, respectively, to the growth rates of construction volumes.

## POTENTIAL VOLUMES OF RAIL TRANSPORTATION OF CONSTRUCTION MATERIALS AND CEMENT (MN TONS)



Source: State Statistics Service of Ukraine, IMF group of Ukraine

#### 4.4 The agricultural sector

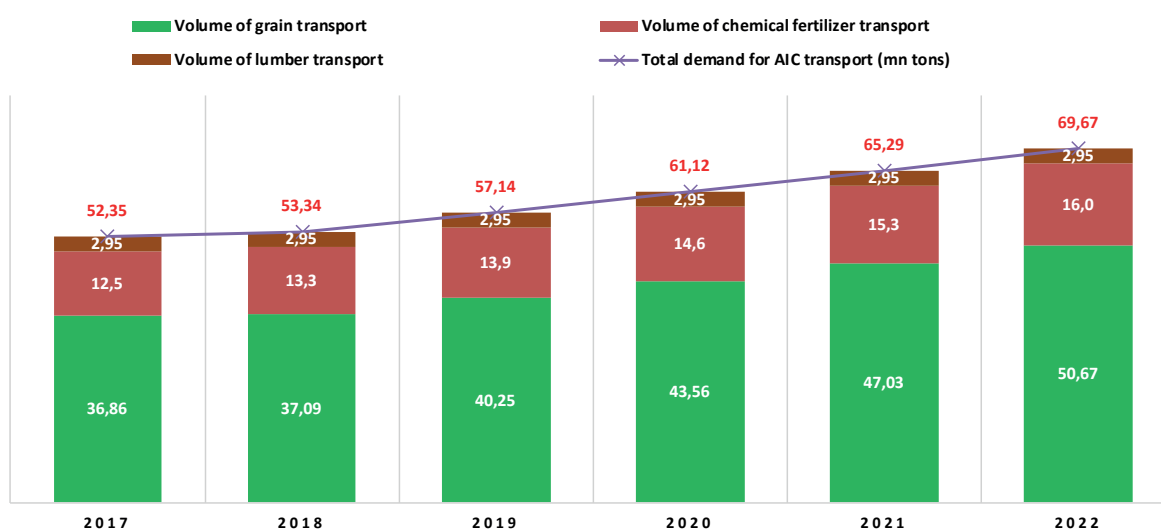
According to the common methodology, we attributed to the demand of agriculture for rail transportation: domestic and export volumes of grain transportation, volumes of timber exports and internal freight turnover of chemical and mineral fertilizers used in the production of cereals.

Obviously, due to the current moratorium on the export of round timber and the government's intention to limit deforestation — the volume of demand for the transportation of timber cargo will

not increase and will remain at the current level of 3.7 million tons. And the domestic cargo turnover of chemical and mineral fertilizers of 11.6 million tons will grow in direct proportion to the level of cereals production, and by 2022, depending on the scenario of yield increase, it can grow to 16 (+ 37.9%) or 20.2 (+ 74.1%) million tons.

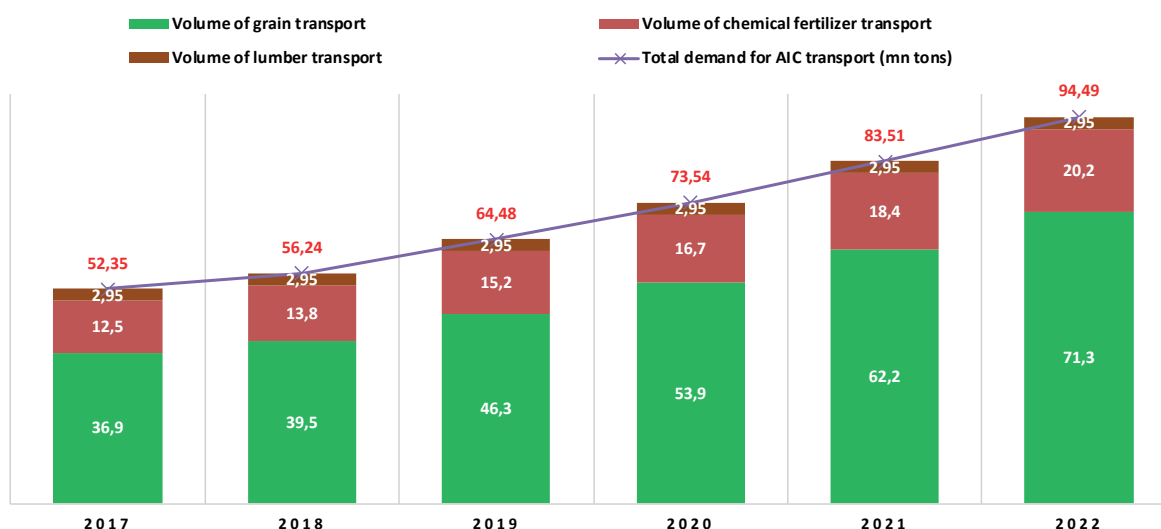
Thus, the total volume of potential agricultural demand for rail transport by the year 2022 can grow from the current 52.4 to 70 or 95 million tons of annual traffic.

#### VOLUME OF POTENTIAL DEMAND FOR RAIL TRANSPORT IN AGRICULTURE (MN TONS, SCENARIO 1: 79,3 MN TONS GRAIN HARVEST)



Source: Ministry of Infrastructure of Ukraine , IMF group of Ukraine

#### VOLUME OF POTENTIAL DEMAND FOR RAIL TRANSPORT IN AGRICULTURE (MN TONS, SCENARIO 2: 100 MN TONS GRAIN HARVEST)



Source: Ministry of Infrastructure of Ukraine , IMF group of Ukraine

#### 4.5 Other

For the year 2017, the volume of railway transportation of other cargo, excluding transit, amounted to 32.4 million tons.

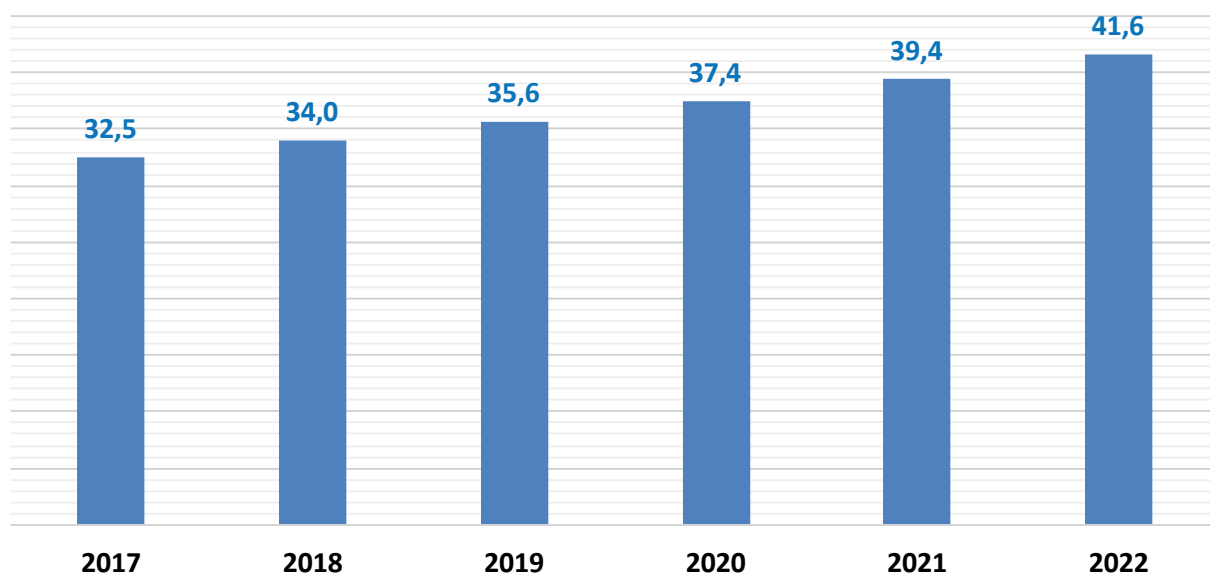
Using the regression equation presented at the beginning of this section, which shows the relationship between the volume of real GDP and freight traffic, we calculated the potential growth in the turnover of other industries for rail transportation by 2022.

#### Volume of transport of other materials in 2017 (mn tons)

Total	Mn tons	Weight (%)
	32,41	
Colored ore	4,50	13,9%
Non-ferrous metals and their products	0	0,1%
Chemical substances	3,60	11,1%
Cars	0	0,2%
Vehicles and equipment	0	0,3%
Other loads	24,12	74,4%

Source: Ministry of Infrastructure of Ukraine

#### POTENTIAL VOLUME DEMAND GROWTH FOR RAIL TRANSPORTATION OF OTHER SECTORS (MN TONS)



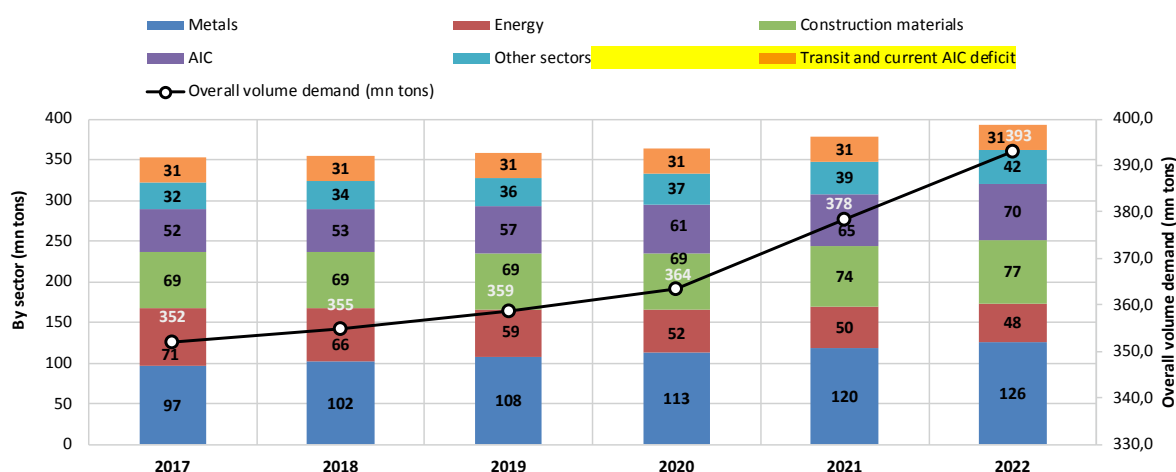
Source: Ministry of Infrastructure of Ukraine, IMF group of Ukraine

#### 4.6 Forecast of the total volume of demand for rail transportation by 2022

Thus, summing up the forecast freight turnover of the railways in each of the key industries, we can calculate the total volume of potential load on Ukrzaliznytsya under each scenario of yield

growth and GDP energy intensity dynamics. Thus, with the growth of grain yield to 79.3 million tons and the follow-up of Energostrategy-2035 by 2022, the volume of demand for rail transportation will amount to 393.3 million tons. [+15.8%].

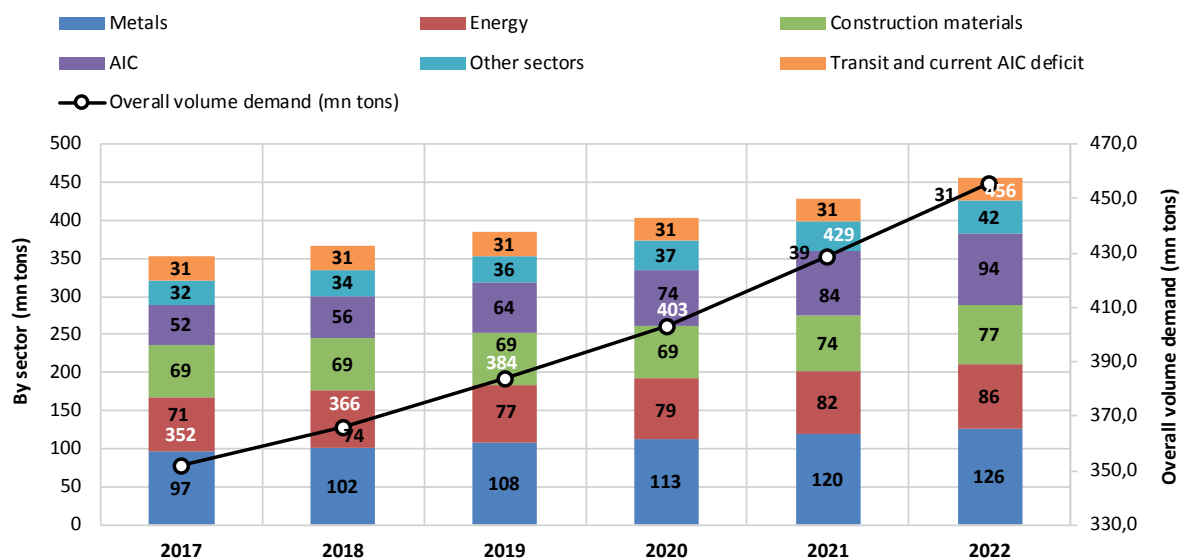
#### SCENARIO 1: FORECAST OF THE TOTAL VOLUME OF DEMAND FOR RAIL TRANSPORTATION BY 2022



Source: IMF group of Ukraine

With the growth of grain yields to 100 million tons and the maintenance of the current energy intensity of GDP and the structure of the energy balance, the potential volume of railway traffic will grow to 455.7 million tons (+ 34.2%) by 2022.

#### SCENARIO 2: FORECAST VOLUME DEMAND FOR RAIL FREIGHT SHIPMENTS (MN TONS)



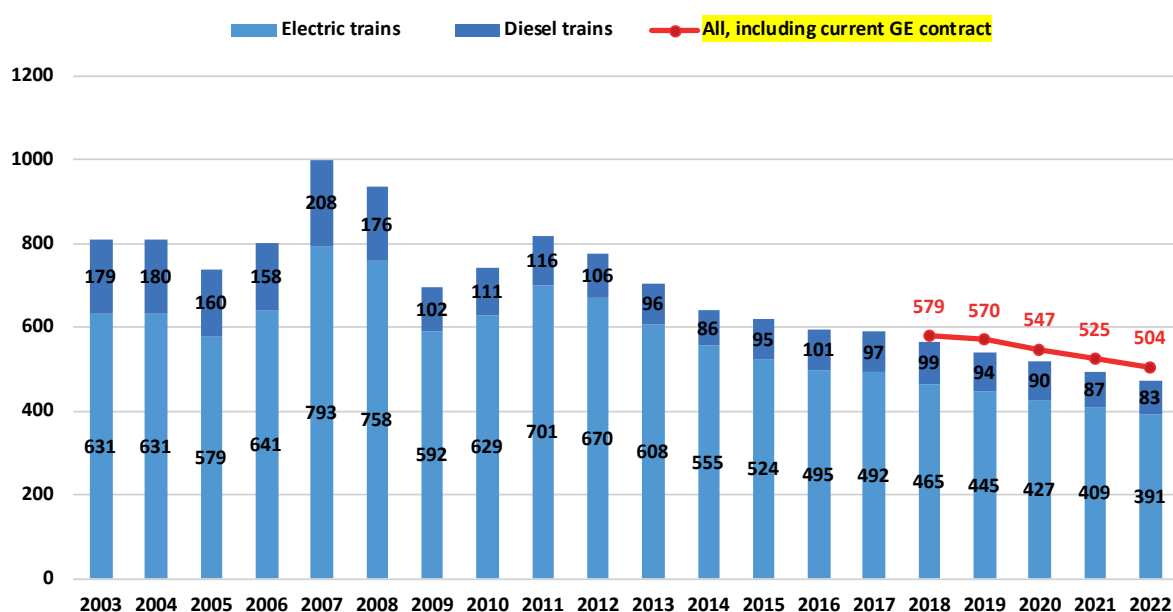
Source: IMF group of Ukraine

## 05 Ukrzaliznytsia capacity forecast for grain transportation

Ukraine's locomotive park is already operating at full capacity. Due to the deterioration of locomotives, most will be out of use in five years time. If we assume the locomotive dropout rate remains at the level of 2012-2017, which

is generally an optimistic assumption, by 2022 only 474 locomotives will remain at UZ's disposal (leaving 504, because UZ has already contracted with General Electric for the supply of 30 diesel locomotives). That's brings railway potential transportation capacity to 290 million tons per year.

### UKRZALIZNYTSIA LOCOMOTIVE PARK, 2003-2022



Source: Ukrzaliznytsia, IMF group of Ukraine

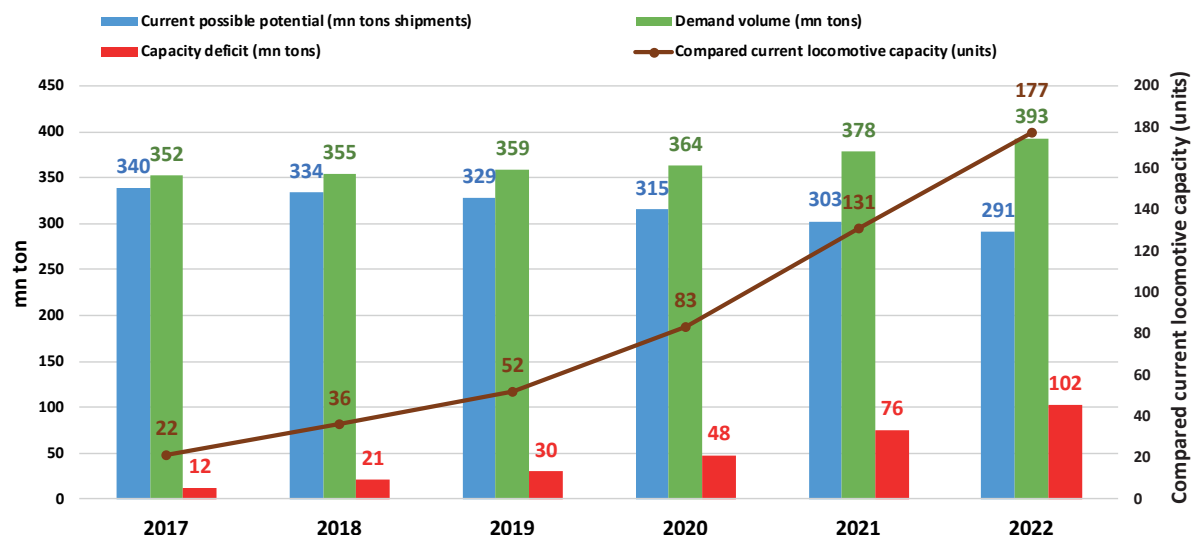
At the current rate of decline and degradation, UZ's locomotive fleet could face possible collapse if demand for transportation increases as early as 2019 or 2020.

If cereal production grows according to the pessimistic scenario — up to 79.3 million tons of gross harvest and 55.6 million tons of exports

in 2022 — and a number of sub-industries will continue to use rail transportation in a ratio below the standard, UZ will not be able to provide cargo transportation for 102.4 million tons, or 26% of the potential volume. The deficit of traction capacity will equal 177 locomotives.



### LOCOMOTIVE TRACTION DEFICIT (MN TONS) SCENARIO 1: 80 MN TON OF GRAIN, ENERGO STRATEGY 2035

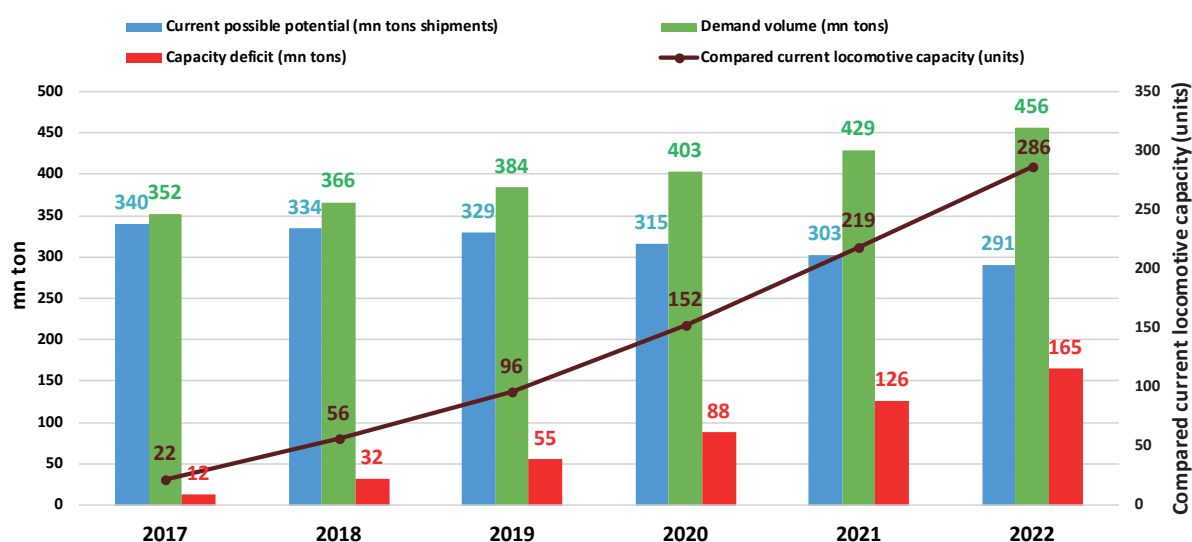


Source: IMF group of Ukraine

If grain production proceeds according to the optimistic scenario — up to 99.9 million tons of gross harvest and 76.2 million tons of exports in 2022 — and industries resume using the railways as they did during 2012-2015, the current 10%

discount, UZ by 2022 will not be able to satisfy 187 million tons of extra freight forwarding demand. UZ's traction capacity deficit will equal be 397 locomotives.

### LOCOMOTIVE TRACTION DEFICIT (MN TONS) SCENARIO 2: 100 MN TONS OF GRAIN



Source: IMF group of Ukraine

A special Railways Development Strategy for 2017-2022 was drafted in order to avoid such a scenario and update UZ's rolling stock. The public saw the document in May 2017 and MEDT received it for approval in July 2017.

According to the Strategy, UAH 150 billion will be spent by 2021 for 52 freight diesel locomotives and 170 electric locomotives (10 of which are two-system passenger locomotives, 75 cargo alternating current locomotives, 85 freight DC and 40 two-system cargo cars).

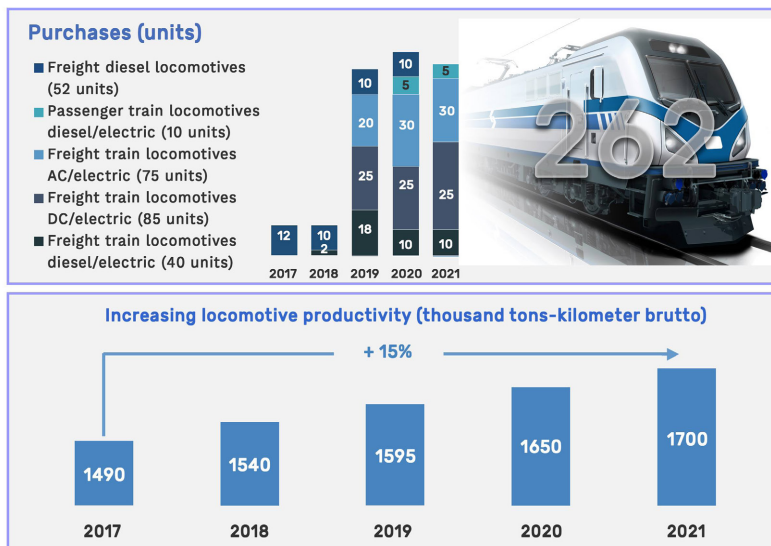
UZ managers, however, in September 2017 withdrew the document for revision. Details of

the revised strategy were presented to the public last fall, but only in general terms. It is only known that by 2021, USD4 billion has been earmarked to replenish railways rolling stock. MEDT and the Cabinet have not received the revamped strategy for approval..

UZ's financial plan for 2018 provides for the purchase of 25 diesel locomotives from General Electric on the terms of financial leasing, as well as five electric freight locomotives, with delivery in 2019. At the same time, the Cabinet has reported that during 2017 13 locomotives literally burned up on the tracks, due to obsolescence of the equipment or violations of operation rules.



## 1. REPLENISHING UZ LOCOMOTIVE PARK



### Optimizing locomotive park

- Decommissioning most dilapidated electric locomotives (598) and long/short-haul diesel locomotives (575)
- Replenishing locomotive fleet using new dual-system electric locomotives, mono-system freight locomotives of permanent and temporary current, as well as long-haul diesel freight locomotives with synchronized drive units
- Remotorizing short-haul and long-haul locomotives with modern power blocks

Source: [Ukrzaliznytsia](#)

Calculations in this report coincide with UZ's forecasts. According to same, the planned increase in the productivity of locomotives by 2021 will increase by 15% [due to the fact that new locomotives will be able to withstand a much greater load] and purchase of 262 locomotives, will prevent capacity shortage of capacities under both scenarios. Moreover, excess capacity of locomotive capacity will allow fulfilling orders for transport even during the peak months of grain export (February-March).

Period	Railway capacity deficit (mn tons) under Strategy 2017-2021	
	Scenario 1: (79,3 mn tons grain harvest)	Scenario 2: (100 mn tons grain harvest)
2018	-11,6	-22,8
2019	+26,9	+2,0
2020	+68,6	+29,2
2021	+98,7	+48,2
2022	+85,7	+23,2

Source: [Ukrzaliznytsia](#), IMF group of Ukraine

## 06 Technical aspects of locomotive purchasing

Renewal of UZ's locomotive fleet is complicated — and not only because of insufficient funds for such purchases on the state company's account. Most of the world's companies produce railway equipment for the European track width of 1,455 millimeters. In Ukraine, as in other countries of the former USSR, the track gauge is 1,520 millimeters (why the post-Soviet railways were called «1.520 space»). General Electric at its plants in the United States produces bodywork for the Ukrainian TE33A together with all the equipment and 1,520mm-track wheelbase will be joined by the Krukovka Carriage Works.

Theoretically, Ukraine can buy in the post-Soviet countries a number of modern locomotives for the «1520 space,» produced in cooperation with Western firms. Under the license of the French company Alstom, the electric locomotive KZ8A, designed for work with cargo trains with a mass of up to 9,000, is produced at the Kazakh plant, with the EP20 passenger electric locomotive at Russia's Novocherkassk plant. Freight electric locomotives 2ES6, 2ES7 and 2ES10 are produced under the license of Siemens at Russia's Ural Locomotive plant. Russia's machine-building giant Transmashholding owns in all these enterprises, from which the NSDC banned purchases until 2020.

Ukraine theoretically can buy a number of electric locomotives VL11M6, a modification of the Soviet locomotive, in Georgia. In 2008-2011, Ukrzaliznytsia bought 26 such locomotives from the Tbilisi Electric Locomotive Plant. Production there now belongs to the Russian company Dortechnik, which was not put on the NSDC sanctions list. The purchase of locomotives from a plant owned by a Russian owner may not be welcomed by Ukraine's public. Moreover, the VL11M6 locomotive is already obsolete with a carrying capacity 40% lower than the Russian 2ES10.

General Electric offered its services for the supply of diesel locomotives in 2016 to UZ, which tested the TE33A mentioned earlier. The locomotive hauled 32 cargo shipments between July and September 2016.

In October of the same year, General Electric, Ukraine's Infrastructure Ministry and UZ officials signed a memorandum of cooperation. The agreements were approved finally in February 2018, when UZ signed a multi-stage contract with General Electric, which must be completed by 2025. The first stage is the delivery of 30 locomotives TE33A with localization of production in Ukraine at the level of 10%. The first locomotive should be delivered at the end of September 2018, with the remainder by spring of 2019.

Under the second stage, General Electric has to supply 150 diesel locomotives, with localization of production at 40% in Ukraine. The third stage provides for the modernization of 75 diesel locomotives 2TE116 «Soviet-made.» All works from the assembly of American diesel locomotives and the modernization of Soviet 2TE116 will be carried out at the Ukrainian Kriukov Carriage Works.

UZ managers say the first three dozen TE33A produced by General Electric will be assigned to the Melitopol depot to serve both grain transportation to Odesa ports and work on exporting metallurgical products from Donbas through Kamysh-Zorya-Volnovaha.

However, the problem of purchasing electric locomotives for freight transportation remains unresolved. It was planned that in June 2017 the Chinese Datun Electric Locomotive Plant would transfer to Ukraine a test cargo locomotive of alternating current with the possible subsequent purchase of a consignment of electric locomotives. Belarusian Railways In 2012-2017 received from this Chinese enterprise 30 electric locomotives with a capacity of 13.05 thousand horsepower of the brand BKG (Belarusian-Chinese cargo).

Also in July 2017, the Ministry of Infrastructure planned to negotiate with its Georgian counterparts about the lease of 40 electric locomotives produced by the Tbilisi Electric Locomotive Plant. Nothing yet has come of the plans.

UZ managers in March 2018 planned talks with Siemens on the joint production of electric locomotives. However, Siemens' representative office in Kyiv, mindful of the unsuccessful cooperation experience with Ukraine during

the 2000s, backed out of the talks. The German Dnipropetrovsk Carriage Works previously was under contract to build 120 passenger electric locomotives.. In reality, the railway ordered only 21 locomotives, most of which are idle or non-operational

Come what may, UZ managers expect to purchase 225 electric locomotives by 2025. According to the National Infrastructure Development Strategy until 2035, the railways will have 100% new locomotives supplied by the world's largest manufacturers of railway machinery Alstom, Bombardier, and the aforementioned Siemens and Kriukov Carriage Works.

## 07 Potential economic losses due to deficit of railway transport by industry sector

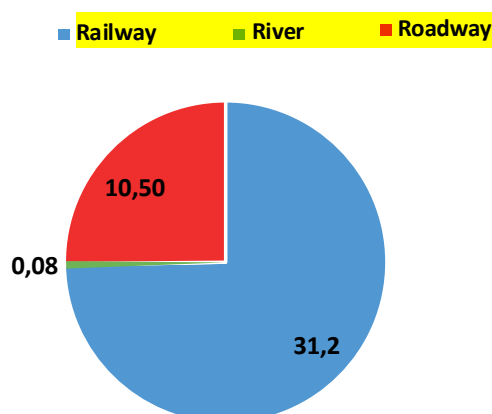
The average weighted length of grain transportation from local elevators to ports today is 631 km. The cost of railway transportation for this distance is traditionally tied to the dollar rate and is about \$10 per ton. At the same time, logistics companies can offer the farmer an alternative in the form of delivery by road, with an average tariff of UAH 1.7/km. per ton.

Based on the initial data, it is easy to calculate that for a similar distance, road delivery will cost the farmer \$41.3, or 4-fold more than by rail.

In 2015-2017, due to UZ's shortage of capacities in grain transshipment, agrarians on average were forced to deliver up to 27% of their export crops by road.

Indeed, in parallel to rail and road, there is also river transport, the tariffs of which are quite acceptable for agrarians. However, due to the low level of the merchant fleet, the volume of annual transshipment using internal grain transportation by river transport is on average 385,000 tons annually.

### GRAIN EXPORT DELIVERY STRUCTURE BY TYPE OF TRANSPORT (MN TONS), 20



Source: Ukrzaliznytsya, State Statistics Service of Ukraine

In our opinion, it will be quite correct to calculate the amount of profit received by farmers from the overpayment for the delivery of grain by road as a negative effect of the shortage of the UZ transshipment capacity for the AIC. In 2017 year, this amounted to USD320.7 million.

Period	Grain loading volume for road transport (mn tons)	Overpayment by agrarians due to UZ capacity deficit	
		bn UAH (mn USD)	USD equivalent
2013	4,23		132,5
2014	7,52	2,67	225,5
2015	10,62	7,24	332,5
2016	11,97	9,57	374,7
2017	10,25	8,52	320,7

Source: Ukrzaliznytsia, IMF group of Ukraine

Already today, the lost profit due to problems with logistics makes for the AIC \$321 mn, or 2.5% of the added value that the industry generates. The low level of labor costs still allows agrarians to raise grain collections. However, due to competition with recipient countries of labor migrants from Ukraine, this competitive advantage will soon disappear. With this development of the situation — Ukrainian farmers will have to reduce production volumes, to a level that will ensure the former profitability.

To calculate the potential losses of agriculture and the Ukrainian economy as a whole from the refusal of the Government and the leadership of Ukrzaliznytsia to adhere to the current program for the modernization and renewal of the locomotive structure, we make the basic assumption that the negative effect of a traction deficit will be evenly distributed among all sectors that form demand for freight.

### 7.1 The agricultural sector

According to our calculations, the average profitability of grain production in Ukraine for 2000-2016 in dollar terms was 11%. We believe that with a long-term deviation of the actual profitability from this level, medium-sized enterprises and large agro-holdings will begin to reduce investment in the agro-industrial complex and move capital to other sectors, with a more optimal ratio of profitability to risk.

With a potential reduction in the capacity of agrarians to transship grain to ports through the railway (due to an even distribution of the deficit of locomotive capacities across all sectors) and increase in grain production to 79.3 or 100 million tons by 2022, which will be wholly exported, — the specific gravity of grain handling by trucks will start to grow at an accelerated rate: up to 58-73%, depending on the scenario of yield growth. Obviously, with an average price gap between the cost of delivering grain by rail and road train by 4 times — the specific weight of logistics costs will increase and reduce the final profitability. We believe that farmers will balance the volumes of production and delivery of grain, by reducing them, to a level that will allow them to return to profitability of 11%.

Under the first scenario — an increase in the production of cereals by 2022 to 79.3 million tons. the potential volume of grain transshipment by road trains in the next five years will grow from the current 10.3 to 28.9 million tons (+180%).

#### SCENARIO -1 79,3 MN TONS GRAIN HARVEST TO 2022

Period	Export (mn tons)	By means of delivery (mn tons)	
		Rail	Auto
2013	27,8	23,2	4,6
2014	33,4	25,8	7,6
2015	38,3	27,3	11
2016	41,5	29	12,4
2017	41,8	31,2	10,6
2018	42	29,4	12,6
2019	45,2	28,6	16,6
2020	48,5	27,1	21,4
2021	52	25	27
2022	55,6	23,1	32,5

Source: State Statistics Service of Ukraine, IMF group of Ukraine

Even taking into account the positive forecast of the dynamics of world grain prices, (+17.8% by 2022), the ratio of costs for the delivery of crops to ports in the total cost of its purchases in the domestic market will grow from the average for the years 2000-2016 in 10% — up to 19,3% in 2022.. Although traders mainly deal with the delivery to the ports and sale of the harvest, in the absolutely competitive market, in the end, additional logistics costs will still fall on the producer.

Under the first scenario, increasing the grain yield to 79.3 million tons by 2022, the ratio of the cost of grain delivery to their purchases in the domestic market will grow to 19.3%, reducing the potential profitability of farmers from an average of 11% to 1.7%. Obviously, in practice, profitability will be balanced by a decrease in production and will remain at the current level. The forecast volume of underproduction of cereals in 2022 will be 18.4 million tons, or \$3.77 billion. .

### SCENARIO 1 - POTENTIAL DECLINE IN GRAIN EXPORTS, DUE TO A SHORTAGE OF LOCOMOTIVE CAPACITY

Period	As proportion of transport cost to domestic purchase (%)	Profitability	Balancing profitability export decrease
		(%)	(mn tons)
Average in previous timelines	10%	11,0%	
2015	13,0%	8,0%	
2016	16,2%	4,8%	
2017	14,4%	6,6%	
2018	14,3%	6,7%	6,0
2019	15,5%	5,5%	8,4
2020	16,8%	4,2%	11,4
2021	18,3%	2,7%	15,0
2022	19,3%	1,7%	18,4

Source: State Statistics Service of Ukraine, IMF group of Ukraine

When implementing the second scenario and increasing grain production to 100 million tons by 2022, as well as maintaining the energy intensity of GDP and the structure of the energy balance at the current level — the potential volume of transportation of the harvest by road will increase to 56.3 million tons or 74% of the volume of transshipment grain for export.

### SCENARIO 2 - 80 MILLION TONS OF GRAIN HARVEST BY 2022

Period	Export (mn tons)	Grain export (mn tons)	
		By rail	By road
2013	27,8	23,2	4,6
2014	33,4	25,8	7,6
2015	38,3	27,3	11,0
2016	41,5	29,0	12,4
2017	41,8	31,2	10,6
2018	44,4	28,5	16,0
2019	51,3	26,7	24,6
2020	58,8	24,4	34,4
2021	67,1	22,0	45,1
2022	76,2	19,9	56,3

Source: State Statistics Service of Ukraine, IMF group of Ukraine

The volume of the export-reducing export profitability under such a development of the situation will already reach 34.1 million tons of grain, or \$7 bn, of non-receipt of export earnings.

## SCENARIO 2 - POTENTIAL REDUCTION IN GRAIN EXPORTS, DUE TO A SHORTAGE OF LOCOMOTIVE CAPACITY

Period	As proportion of transport cost to domestic purchase (%)	Profitability	Balancing profitability export decrease
		(%)	(mn tons)
Average in previous timelines	10%	11,0%	
2015	13%	8%	
2016	16,2%	4,8%	
2017	14,4%	6,6%	
2018	15,7%	5,4%	8,3
2019	18%	3%	13,8
2020	20%	1%	20,2
2021	21,6%	-0,6%	27,1
2022	22,6%	-1,6%	34,1

Source: State Statistics Service of Ukraine, IMF group of Ukraine

Thus, depending on the scenario for increasing grain production and the dynamics of energy intensity of GDP, the accumulated volume of under-received export earnings of cereals by the year 2022 will amount to from \$11.8 billion to \$17.2 billion. .

Period	Potential volume of unreceived export revenues (\$bn)*	
	Scenario 1 (73,3 mn tons grain harvest)	Scenario 2 (100 mn tons grain harvest)
2018	1,1	1,2
2019	1,6	2,2
2020	2,2	3,3
2021	3,0	4,6
2022	3,8	5,9
Total	11,8	17,2

Source: IMF group of Ukraine  
\* in 2017 prices

## 7.2 Metallurgy

The basic assumption in calculating the potential losses of metallurgists from the deficit of UZ's locomotive capacities is the impossibility of

transporting metallurgical products by road. The volume of products that metallurgical enterprises will not be able to ship will proportionately reduce their income.

Shortfall production volume in metallurgy (\$bn) at UAH 26,6* to \$1 rate			
Period	Potential production volume (\$bn)	Scenario 1 Production shortfall (\$bn)	Scenario 2 Production shortfall (\$bn)
2017	14,7		
2018	15,5	0,9	1,4
2019	16,3	1,4	2,3
2020	17,2	2,3	3,7
2021	18,2	3,6	5,3
2022	19,2	5,0	6,9
Total		13,2	19,7

Source: IMF group of Ukraine  
\*in 2017 prices



### 7.3 Construction

Similarly, to the metallurgical industry, in the construction industry — the basic assumption in calculating potential losses from a shortage of locomotive capacities, is the impossibility of transporting mineral building materials

and cement for export by road, because of the acquisition of logistics costs by the entire profitability of the producers. Accordingly, the volume of production of cement and construction materials will begin to decline starting from 2019.

**Shortfall production volume in construction materials (\$bn) at UAH 26,6\* to \$1 rate**

Period	Potential production volume (\$bn)	Scenario 1 Production shortfall (\$bn)	Scenario 2 Production shortfall (\$bn)
2017	2,7		
2018	2,7	0,2	0,2
2019	2,7	0,2	0,4
2020	2,7	0,4	0,6
2021	2,8	0,6	0,8
2022	3,0	0,8	1,1
Total		2,1	3,1

Source: IMF group of Ukraine  
\*in 2017 prices

### 7.4 Energy

In view of the fact that coal, oil products and gas for heavy industry are interchangeable energy resources, and also taking into account the potential underloading of Ukrtransgaz's transit capacities, the deficit of coal and oil products will be compensated by an increase in natural gas consumption. Thus, the industry will be able to maintain the necessary energy supplies for its operations and not reduce production. The negative effect of a shortage of locomotive capacities — will be compensated by the possibilities of additional imports of natural gas.

### 7.5 Other industries

As for other industries forming the demand for freight transportation by rail, the volume of potential losses from the shortage of locomotive capacities for them is calculated as additional logistics costs caused by the need to use more expensive road transport for the part of the freight turnover that the railway can not provide.

**Shortfall production volume in other sectors (\$bn) at UAH 26,6\* to \$1 rate**

Period	Potential production volume (\$bn)	Scenario 1 Production shortfall (\$bn)	Scenario 2 Production shortfall (\$bn)
2017	35,4		
2018	37	0,03	0,05
2019	38,6	0,05	0,09
2020	40,4	0,09	0,15
2021	42,4	0,14	0,22
2022	44,6	0,21	0,3
Total		0,52	0,81

Source: IMF group of Ukraine  
\*in 2017 prices

## 7.6 Transit

In 2017, the volume of UZ's transit freight turnover amounted to 19.6 million tons, or 5.7% of the total volume of freight traffic. The income received by UZ from transit traffic was approximately \$372 million, or UAH 510 per one ton toned cargo. Taking into account that the main transit transportations of Ukrzaliznytsia are connected with the export of goods from the CIS countries to the EU, in particular from Russia, the basic assumption of the forecast is the preservation of the volumes of transit traffic at the level of the average value of 2015-2017 in the amount of 20.2 million tons per year.

Period	Potential volume of unreceived transit profit (\$bn)*	
	Scenario 1	Scenario 2
2018	0,023	0,034
2019	0,032	0,055
2020	0,051	0,084
2021	0,077	0,113
2022	0,100	0,139
Total	0,283	0,425

Source: IMF group of Ukraine  
\* in 2017 prices

It is important to note that the authors equate the amount of lost revenue for each of the industries to the added value generated by them. Although this assumption on the surface may seem erroneous, it is important to understand that if agrarians or metallurgists can not sell their products for export, they will accordingly reduce the demand for the products of other industries used in production. Thus, the economy will launch a multiplier effect, which equates the amount of lost revenue to added value in this and related industries.

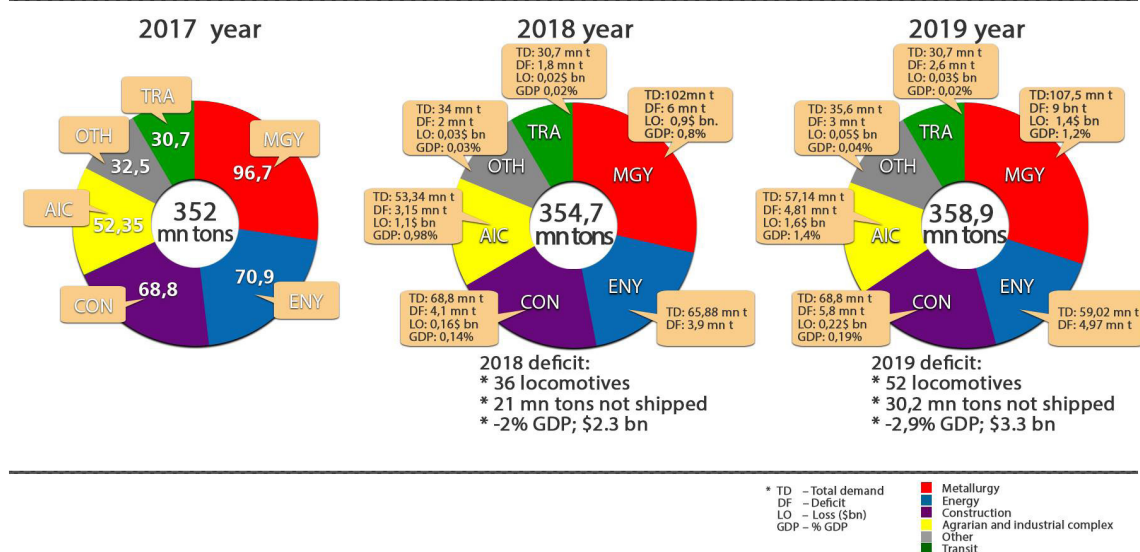
## 7.7 Total volume of losses for the economy

Summing up the potential losses of the economy from the deficit of UZ's locomotive capacities for each of the industries in the baseline scenario, (an increase in grain yields to 79.3 million tons and a reduction

in the energy intensity of GDP, according to Energo Strategy-2035) — one can see that cumulatively for 5 years, from the program for updating and modernizing the locomotive fleet can cost the Ukrainian economy up to \$27.8 billion (in 2017 prices). On average, this is 4.8% of GDP per year.

## POTENTIAL VOLUME DEMAND FOR RAIL TRANSPORT DEMAND 2017-2019 (MN TONS)

Scenario 1: Volume of grain crop by 2022 - 80 mn tons, Energy Strategy 2035 fulfilled

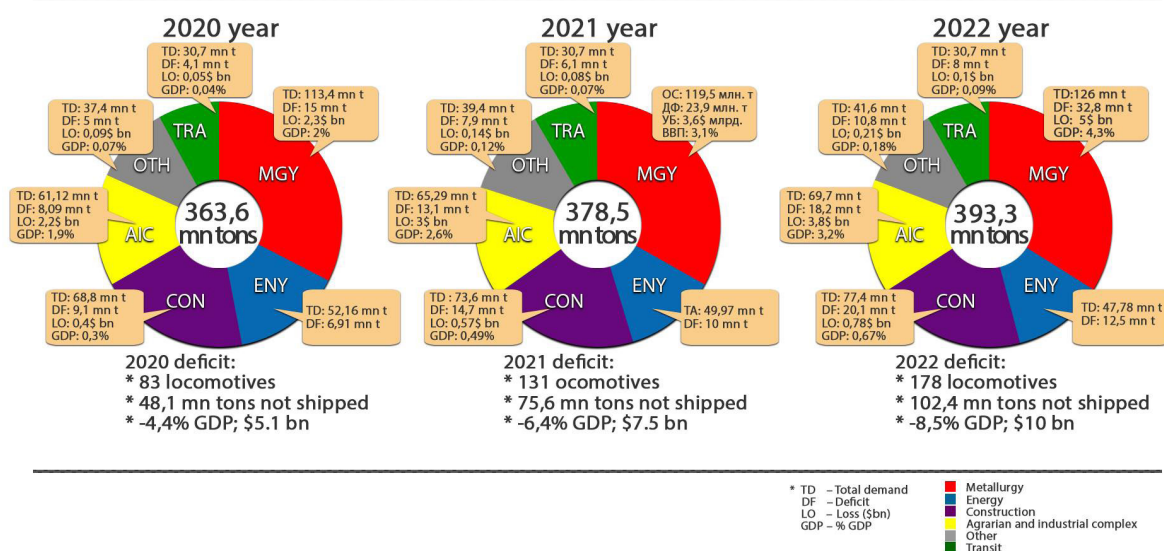


Source: IMF group of Ukraine, \*in 2017 prices

When implementing an alternative scenario and increasing grain collections to 100 million tons and maintaining the current energy intensity of GDP and the structure of the energy balance, the potential losses from the deficit of UZ's capacities will be even higher: up to 7.1% of GDP per year, or cumulatively \$41.3 billion (in 2017 prices).

## POTENTIAL VOLUME DEMAND FOR RAIL TRANSPORT DEMAND 2020-2022 (MN TONS)

Scenario 1: Volume of grain crop by 2022 - 80 mn tons, Energy Strategy 2035 fulfilled



Source: IMF group of Ukraine, \*in 2017 prices

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