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EU Transport Modal Shift Versus the Regulatory Requirements for Transport Sector's Green Transformation Towards Climate Neutrality

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Abstract:

Purpose: *The main aim of the study is to: 1/ identify and evaluate main trends and structural changes that occurred in the EU transport sector and selected EU countries in the field of its modal shift, 2/ compare the selected EU countries in terms of promoting environmentally friendly transport sector's transformation towards sustainability, 3/ assess whether EU regulatory requirements concerning green transport transformation, expressed in its modal shift, have been met and to what extent.*

Design/Methodology/Approach: *At conducting this research, the following methods were applied: 1. critical analysis of literature (CLA), 2. factor analysis (FA), 3. mining of data obtained mainly from EU statistical sources, 4. market analysis (MA) and 5. comparative analysis (CA).*

Findings: *The research results indicate that the market model of the transport modal split in the EU, established at the end of the 20th century, has not changed significantly. This means that the main goal of the EU's transport policy, set out in the 1991 White Paper, i.e., the reconstruction of the transport system on the principles of sustainable development, has not been achieved. Despite numerous actions taken by the EC to promote the development of environmentally friendly modes of transport, the traditional EU model of transport modal split on land has remained unchanged. Only by taking into account the freight transport performance measured in tonne-km of all modes of transport, i.e., also maritime and air cargo transport, it can it be concluded that the EU regulator has achieved its goal in this respect. This means that the green transport transformation strategy implemented in the years 1991-2019 turned out to be ineffective in the pro-ecological transformation of the EU transport sector. Hence, the need for more radical actions that have been taken in EU since 2020 as part of the concept of the New Green Deal and the Sustainable & Smart Mobility Strategy.*

Practical Implications: *The study reveals the significant inconsistencies existed between the real, regulated by market mechanism transport sphere and the regulatory one, determined by EU transport policy. Therefore, this study, clearly indicating the need to maintain the current model of implementing the sustainable development strategy of transport, based on restrictive administrative rules and tools, determines the most effective path of decarbonization of the EU transport sector.*

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Originality/Value: *The research that may be treated as a kind of case study, highlights the interdependencies that exist between the real and regulatory spheres of transport systems and the significance as well as effectiveness of the last one in the meeting the EU goals in their green transformation towards decarbonization. In this sense, it can contribute to enriching the theory on management and economics sciences in the field of choosing appropriate regulatory tools at the stage of difficult change management in the transport systems, caused by speeding up their transformation towards sustainable and smart development.*

Keywords: *Freight transport modal split, transport decarbonization, real versus regulatory sphere, regulatory mechanisms, green change management.*

JEL classification: *L51, N74, Q01, R40.*

Paper Type: *Research article.*

1. Introduction

The EU transport market is subject to public regulation. It is implemented by a wide range of activities taken within the EU transport policy. Since the recent decade, EU has tried to introduce significant changes in the transport market, aimed at the increase in effectiveness of market processes as well as the efficiency of achieving strongly supported, sustainable mobility goals.

Therefore, the transport policy, with its rich set of legal, administrative, economic and financial instruments, has been playing the key role in correcting the incorporated within the unperfect transport markets their regulatory deficiencies. They relate more to the market for network services than to the market for trans-shipment and other transport services (Grzelakowski, 2013; Kadlubek *et al.*, 2022).

It has been assumed in the EU since 1997 that with the use of proper pricing instruments, this policy should lead to the increase in rationality in selecting the transport operators by shippers, and consequently, better transparency of the transport market through thoughtful impact on its demand side (EC, 2008; Antolini, 2024).

In practice, this meant that the aim of the EU's transport policy was to change the model of already existed demand distribution for transport services, i.e. the transport modal split with the dominant share of road transport in favour of environmentally friendly modes of transport, i.e., rail, inland waterways and short sea shipping.

The change that was to ensure the implementation of the main goal of EU transport policy aimed at pursuing transport sustainable development, came down therefore, to the need to reconstruction of the traditional modal split through price leverage, i.e., through the introduction of new pricing model based on full social costs of transport service provision (full costs recovery).

Therefore, the transport prices should take into account the external costs of transport services provision that currently, within the applicable formula of so called indirect, fiscal internalization of these costs via environmental taxes, burden their providers only partially (Jonkeren *et al.*, 2023). Nowadays, these costs fall mainly on society and the economy. Under this concept, the price for a transport service should be based on full short or long-run marginal social costs, i.e. on social marginal costs pricing (SMCP) formula.

In order to develop and implement the concept of sustainability in transport sectors, this new pricing model for transport services, indicating to shippers the correct from the macroeconomic point of view criteria for selecting the transport route and means of transport, the EU has been developing the new model of modal split (Grzelakowski, 2020a). The modal split, seen as the share of mode of transport in the overall transport market, represents the percentage distribution of transport performance or transport volume among different modes of transport.

It is usually based on transport performance, which is expressed in freight transport in tonne-kilometres and treated as the basic synthetic indicator for implementing the strategic goals of the EU transport policy, leading to the reduction of external costs (DHL, 2024). The implementation of sustainability principles of demand distribution within the EU transport sectors, and the achievement of expected modal split, requires efficient and comprehensive actions. They have been aimed at:

1. developing the new model of transport market organization, which involves separating the operational sphere from the transport infrastructure management sphere, and the latter, from the regulatory one (market regulator),
2. introducing new principles of defining prices for transport services, based on the operator's own costs, increased by the component of its external costs (internalization of external costs),
3. defining prices based on total, real social costs under marginal cost formula, defined as per types of transport under short-run (SRMSC) or long-run (LRMSC) marginal costs. This pricing model allows to introduce basic principles of sustainable mobility, such as: 1/ polluter pays, 2/ user pays and 3/ full cost recovery (Grzelakowski, 2020b; CE Delft, 2020).

In this manner, by applying rather soft regulatory instruments and chiefly by the modified transport market pricing mechanism, EU wanted to speed up significantly the process of transforming the transport sector towards sustainability, regarding it

as a crucial phase of its structural rationalization. However, it should be reflected in "the sustainable modal split".

In this context, the main research question examined on the example of the EU as well as selected member countries, is searching for an answer to the question whether these goals have actually been achieved in the EU member states, and therefore, whether the regulatory sphere has managed to transform the real sphere of transport in the direction consistent with the sustainable mobility strategy.

To answer this question, it is necessary to assess the interconnections existing between the current transport performance, created by market decisions, reflecting the existed modal split in freight transport, and specific regulatory requirements regarding the mandatory transformation of the transport sectors of the EU member countries towards their decarbonization by 2050 (EC, 2023; EUROACTIV, 2024).

Considering that the transport modal split reflects the already achieved level of MSs transport systems sustainability or lack thereof, it is possible to assess the real effects of implementing the main objective of the EU transport policy aimed at building sustainable mobility since 1991 (EC, 1992; EC, 2001; 2011; Finger *at al.*, 2017). In such a way, more realistic is to determine the type and scope of activities necessary to rebuild transport systems' modal split towards achieving climate neutrality, oriented towards meeting the goals of the tough requirements set off by EU after 2019 (EC, 2019; EC, 2020).

2. Methodology and Literature

In order to examine the main trends and structural changes that occurred in the transport sector of selected EU countries and identify as well as evaluate the modal shift taking place on the transport market during the period under study, a number of classic, both quantitative and qualitative research methods and techniques were used.

The following methods were mainly applied as part of the methodological triangulation formula: critical analysis of literature (CLA), factor analysis (FA), mining of data obtained mainly from EU (Eurostat) statistical sources, as well as market analysis (MA) and comparative analysis (CA).

In order to achieve the established research goals, and in particular comparing selected EU countries in terms of their transport sector's transformation towards sustainability, as well as assessing the effectiveness of the EU regulatory system as a mechanism aimed at the green transformation of the transport sectors, manifesting itself in the form of the desired modal shift, it was necessary to applying FA along with MA and CA.

The method of FA was applied because in this case it was regarded as the best efficient tool when used to simplify complexity, that is typical for the conducted

research subject (Shrestha, 2021). In turn, focusing on issues related to changes within the modal shift, it was necessary to conduct a thorough analysis of the transport markets of the studied group of EU countries and to use CA to determine and assess the effects of selected EU countries in pursuing the green transformation of their transport systems.

Examining the relationships existing between the EU transport regulatory system, seen as a public tool determining the EU transport policy objectives, aimed at transforming it towards the sustainability, on one hand, and the effects of this transformation, achieved in form of modal shift changes towards more environmentally-friendly modes of transport, on the other, it was necessary to analyse the data on the transport market contained in EU statistical reports and yearbooks.

In this case, the statistical yearbooks of the EC and Eurostat studies were particularly useful. Moreover, the basis for research and analysis were also studies by European Court of Auditors ACA), EYG (Ernst & Young Global Limited), International Transport Forum (ITF), International Energy Agency (IEA) and International Shipping Council (ISC).

In addition to these publications, it was also necessary, to fully assess the changes that occurred in the transport market of EU countries, taking into account a number of legal acts (regulations, directives, decisions, etc.) issued by the European Commission (EC), the Council and the European Parliament (EP), regarding the promotion and procedures for implementing sustainable development strategies in transport in the period from 1991 to 2001.

This category includes mainly White Papers on the EU's transport policy from 1991, 2001 and 2011, the New Green Deal (NGD) and the Sustainable and Smart Mobility Strategy (SSMS). There were also taken into account official documents and communication from the European Commission from the period 2020 to 2023. All these legal regulatory measures have indicated and set directions for the green transformation of the EU transport sector by 2025 and for further years of the established period of progressive decarbonization of this sector, ending with achieving net zero emissions.

In addition, a number of publications were analysed, mainly articles and studies focusing on both modal shift issues as well as transport policy goals and instruments aimed at boosting sustainable modal shift changes within EU transport market. Among the numerous publications of this type that appeared in the period 2010 - 2023, four categories of studies can be distinguished.

The first one concerns issues such as logistical support for modal shift and the role of green logistics in promotion of sustainable modal split (Eng-Larson and Kohn, 2012; McKinnon, 2015; Havenga and Simpson, 2018). The second category was

focused on identifying the special role of strongly promoted by EC pro-ecological modes of transport and transport hubs in creating a sustainable transport area that meets EU regulatory standards and requirements (Gonzalea-Aregall *et al.*, 2021; Pfoser, 2021; Iannone, 2012; ECA, 2013; 2015).

The third category of publications includes those studies that concern the intermodal (combined) transport and its stimulating role in creating a sustainable modal split on the EU transport market and especially by shifting transport from road to rail (Kurtulus and Cetin, 2020; Islam *et al.*, 2016; Pfoser, 2021).

The fourth category of publications on the examined issue includes activities undertaken within the EU transport policy that are important for the regulatory sphere, such as: legal, administrative and economic instruments used to create sustainable mobility, forms and methods of transport decarbonization, modal shift measures, as well as transport external costs measurement (Kaack *et al.*, 2018; Beyrouty, 2019; CE Delft, 2020; Crabb and Leroy, 2012; Pinchasik *et al.*, 2020).

The literature related to the conducted study is, in fact, quite extensive. However, its specific feature involves the fact that apart from already mentioned numerous publications, EU statistical reports and yearbooks as well as legal documents, there are practically no compact studies, i.e., books directly related to the presented research problem. In author's opinion, however, this does not constitute a significant limitation that would prevent the implementation of this research subject.

3. EU Modal Shift and the Main Transport Market Changes: Research Results

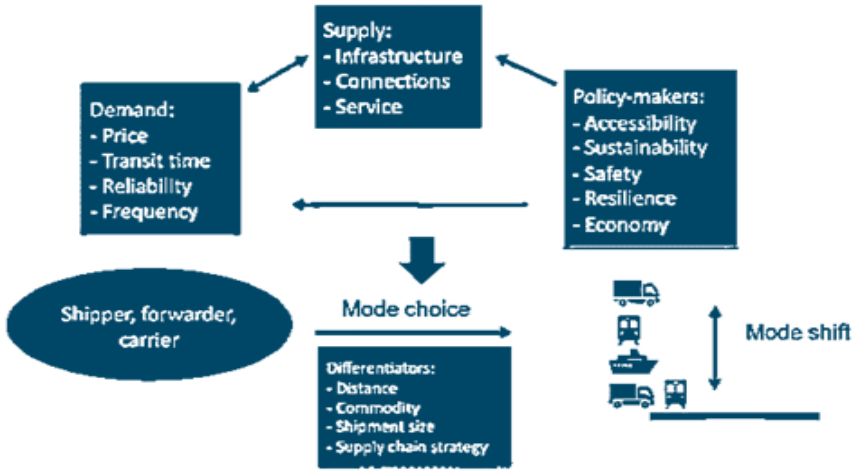
The modal structure of transport in the EU countries results from market decisions taken by shippers or forwarders representing them as well as by logistics operators and carriers themselves. In the last two decades, the choice of transport modes has been increasingly influenced by decisions made by the main EU regulatory bodies, defining strategic goals and forms of implementation of transport policy oriented towards the supply side of the transport market.

Upon selecting the means of transport and transport operators, a wide range of criteria is taken into account, such as: accessibility to preferred transport mode, charges for transport services, delivery time, safety, reliability, comprehensiveness of the offer, etc., which are usually treated by the market decision-makers individually. Figure 1 presents the main determinants for freight transport mode choice.

The final result of these decisions, visible ex post in the transport market of each EU"s country in the form of modal shift, reflects the distribution of effective demand within the potential supply of transport services offered in this market. Since in each transport sector the volume of demand and its structure as well as the capacity of

transport infrastructure network, and transport potential within particular transport sectors usually significantly differ from each other, the modal split of each transport market is also different.

Figure 1. *Dominant factors determining the freight transport mode choice*



Source: *ITF, 2022.*

The differences existing between the selected EU Member States' in this area are presented in Table 2. First, however, it is necessary to analyse and assess the changes that took place on the markets of member countries in the field of modal split in the years 1995-2021 at the level of the entire EU. Data regarding this issue are presented in Table 1. These data indicate the percentage share of individual modes of transport in the total EU freight transport performance, measured in billion tonne-kilometres (tkm).

It should be noted that the presented data were recalibrated twice by DG Move for the period 1995-2004 and 2005- 2020 onwards in order to take into account uniform rules for determining transport work performed for each mode of transport. And so, e.g. for air and sea the transport performance in bl tkm has been determined only within domestic and intra-EU-27 freight carriage and road in national and international haulage by vehicles registered in the EU-27 until 2004 and from 2005 onwards the activity performed by European drivers within the EU territory.

The statistical data in Table 1 allow to determine the scale and rate of changes observed in the analysed 26 years on the EU transport market. In the analysed time, road transport has not only maintained its dominant market position but also strengthened its role, reaching in 2021 more than 54 % of share in the EU transport market.

Table 1. *EU modal split (in %) between 1995 and 2021*

Year	Road	Rail	Inland Waterways	Pipelines	Sea	Air
1995	45,3	13,6	4,3	4,0	32,7	0,1
2000	46,5	12,5	4,1	3,9	32,9	0,1
2005	48,6	11,5	3,8	3,8	32,2	0,1
2010	49,4	11,4	4,5	3,5	31,2	0,1
2011	48,7	12,1	4,1	3,4	31,7	0,1
2015	48,9	11,9	4,2	3,3	31,7	0,1
2019	52,0	12,0	4,1	3,0	28,9	0,1
2020	53,4	11,5	4,0	2,8	28,1	0,1
2021	54,3	11,9	4,0	2,6	27,2	0,1

Source: *EC, 2015, 2018, 2020, 2023.*

The second place, unchanged during that entire time, belongs to short sea shipping with nearly 1/3 of share in the total EU transport market in 1995 and only 27.2 % in 2021. The rail transport ranks third, losing during the analysed time only – 1.7 % of share in the entire EU transport market. Inland waterway transport is also losing its market share, although to a small extent, amounting to ca. 4.0 % these days.

Slightly lower level, namely merely 2.6 % in 2021, refers to the pipeline transport; however, its share in the total transport performance has been regularly decreasing. Insignificant, hardly 0.1 % of share belongs to air transport (cargo transport) and between 1995- and 2021 its share remained on the same level.

The characteristic feature of the EU's transport market is that the existing there modal shift has in fact maintained its shape with virtually little change during this period, despite relatively dynamic rate of growth in the volume of carried goods at that time, which was largely due to the increasing openness of transport markets and their liberalization.

As a result, transport performance in individual transport modes also increased significantly. However, only two branches of transport absorbed the largest part of the growing demand for transport services, i.e., road and sea transport. Despite the increasing growth in air transport, its market share in total cargo transport remained at a minimal level (Table 1). The rate of growth in specific time intervals, related to transport performance as per particular transport sectors is presented in Table 2.

The data presented in Table 2 proves that between 1995 and 2021, the transport performance in tkm achieved by the member countries by 43.0%, i.e. on average the by 1.4 % annually.

The increase was observed, to the largest extent, in road transport (as much as 65.2%),air transport (66.8%) as well as maritime transport (38.9%). The rail

transport was responsible for relatively small part of the increase in demand for transport services (9.3%), recording at that time the increase of only 0.3 % annually, which meant that the year-to-year dynamics was even slightly lower than in inland water transport.

Table 2. *Growth rate of transport performance (bn tkm *) in the EU between 1995 and 2021 as per transport modes and total in %*

Period of time	Road	Rail	Inland Waterways	Pipelines	Sea	Air	Total
1995 – 2021	65.2	9.3	11.6	-14.6	38.9	66.8	43.0
per year	2.0	0.3	0.4	-0.6	1.3	2.0	1.4
2000 - 2021	38.6	5.6	1.8	-23.3	21.2	36.2	24.7
per year	1.6	0.3	0.1	- 1.3	0.9	1.5	1.1
2020 - 2021	6.7	8.6	3.3	- 3.3	1.4	15.8	5.0

Note: **Data presented in table two were prepared on the same principles as the statistical data in Table 1.*
Source: *EC, 2015, 2018, 2020, 2023 and Eurostat, 2023a*.

In the period 2000-2021, however, the EU transport performance's rate slowed down noticeably. The total increase amounted to slightly below 25%. The largest increase within particular sectors referred to road transport (almost 38.6 %) as well as air transport (36.2%), and maritime transport which recorded increase of 21.2%, i.e., slightly below the average for the EU market.

On average, the annual increase in transport performance at that time amounted to 1.1%, and the increase in the typically pro-ecological transport modes, such as maritime and inland waterways slowed down and only in rail freight transport remained unchanged (Table 2).

However, in 2021, compared to 2020, all these transport modes recorded relatively high dynamics of growth in their performance measured in tkm (3.3% to 15.8%), except for pipelines where a significant decrease was recorded (-3.3%). This was the result of a statistically lower base. 2020 was the first year of the pandemic outbreak and imposing the lockdowns which resulted in a drastic decrease in transport in the conditions of increasing supply chain disruptions.

The modal split on the entire EU transport market and its distribution in the examined period 1995-2021, as an average for 27 countries, illustrates the changes in the modal structure of the transport market. However, in individual member states, the market shares of each transport mode are at quite different levels, sometimes differing significantly from the EU average (Table 3). This is due to many diverse reasons, typical for their transport and logistics markets.

Moreover, the number of factors influencing modal shift in each individual transport market, reflecting the selection of transport modes, is in fact widespread. Key

determinants for selecting freight transport modes by shippers or forwarders relate to the shipment characteristics and may depend on cost, time and quality of different transport services, accessibility to high quality infrastructure, etc.

Considering that there is no single, uniform model determining the distribution of demand for transport services and thus the multi-criteria choices of means of transport and service providers are the result of mass market decisions taken by shippers, forwarders and logistics service providers, the modal split patterns that exist there, show features specific to each transport system.

Table 3 presents, based on transport performance in the years 2015 and 2021, modal shift for the segment of land transport in selected six EU countries, comparing them with the US transport modal split.

Table 3. *Modal split of freight transport on land by EU countries and USA in 2015 and 2021 (tkm in %)*

Country	**Road**		**Rail**		**Inland waterways**		**Pipelines**	
	2015	**2021**	**2015**	**2021**	**2015**	**2021**	**2015**	**2021**
EU-27	74.2	74.6	18.8	16.4	6.9	5.4	4.4	3.6
Belgium	73.6	76.8	11.2	9.5	15.2	11.5	2.3	2.3
Czechia	73.6	75.1	26.3	22.3	0.1	0.0	3.4	2.6
Germany	71.9	71.9	19.0	18.6	9.2	7.2	2.8	2.3
Estonia	47.6	59.9	52.4	40.1	---	---	---	---
Netherlands	49.2	49.0	6.2	6.0	44.6	39.7	4.8	5.2
Austria	64.7	61.7	32.5	27.0	2.8	1.9	11.4	9.5
U S A	40.4	43.1	35.3	30.8	6.4	5.9	17.9	20.3

Source: *EU, 2018, 2020, 2023; Eurostat, 2023a*.

The analysis of data in Table 3 indicates that among 8 models of transport modal split, the US modal shift is the most sustainable one. Compared to this model, the obtained European standards in this respect are far away not only from the assumptions and objectives of the EU transport policy, but also the criterion of market rationality of modal distribution of demand, perceived through the logistics efficiency and effectiveness (time and costs of meeting the demand).

The EU country under analysis, that meets the demand of sustainable transport development, to the largest extent, reflected in the form of modal shift is the Netherlands (Statista, 2024). Since the share of road transport reached in that country, in 2015 and 2021, less than 50%, namely ca. 6% more than in the US. It means that other transport modes featuring much lower rate of generating external costs (4-5-times lower) participate in more than 50% in fulfilling the transport needs of this country where inland waterway transport, despite the ongoing decline, reached unprecedented share of almost 40%.

In other countries presented in table 3 the share of road transport, except for Estonia and Austria, amounts to 70% and more (IRU, 2024). The share of rail transport in the total transport market of these countries varies and ranges from 6 (Netherland) to 40% (Estonia). Other countries ranges from 10% to 27%. Apart from the Netherlands, Belgium and Germany, inland waterway transport plays a minor role in the transport systems of the surveyed countries (Eurostat, 2023a). Whereas, the share of pipeline transport amounts on average to ca 4% and is five times lower than on the US market.

The analysis of currently existing transport modal shift in the whole, integrated EU freight market and passenger one as well as selected member countries with high, medium and less developed transport systems, leads to the conclusion that due to several reasons, significant shift to less carbon intensive transport modes is still far from being fully achieved.

The results of analysis conducted for the purpose of this study clearly highlighted that road freight is the dominant transport mode. Moreover, current projections and trends seem to confirm that no particular, expected by the EC shift between transport modes occurred between 1995 and 2021, and what is more, over the last 8 years there has been a constant increase in road transport in the total EU transport performance.

This also applies to most countries in the EU except for Austria, the Netherlands and Germany. The long-term prognoses for 2050 suggest that road transport will maintain its dominant position for both freight and passenger transport (IRU, 2024).

The strong position of road transport on the European market results not only from the high accessibility and flexibility of this mode of transport in terms of adapting to customer needs, but also from its role in handling goods traded in the EU with third countries.

Its importance in the transport of the EU international trade in goods, compared to other modes of transport, is presented in table 4. These data show its huge advantage over rail transport and other land modes of transport in terms of its EU freight market share in servicing extra-EU trade.

Table 4. *EU international trade in goods by mode of transport in terms of value and volume in 2002 and 2023 (% of total)*

	Exports*		**Exports****	
	2002	**2023**	**2002**	**2023**
Sea	42.0	43.9	69.0	74.1
Air	25.9	26.2	1,1	2.5
Road	20.3	24.1	16.6	16.0
Rail	1.9	1.5	5.1	3.7

Other modes 9.9 4.3 8.2 3,8
* Value of extra-EU trade (exports) in goods by mode of transport (% of total)
** Quantity of extra-EU trade in goods, by mode of transport ((% of total, based on tonnes)
Source: *Eurostat, 2024.*

Apart from sea transport, it is the only land mode of houlage of key importance for ensuring effectiveness and efficiency of carriage of EU external trade in goods in logistics terms. Moreover, in terms of value, its share in total transport is gradually increasing, approaching the level achieved by air transport, whose share in terms of transport volume is over three and a half times smaller than that of road transport.

This should be taken into account when forming rational relations between individual modes of transport in the EU transport market, i.e. its modal split, taking into account their strengths and weaknesses in ensuring high quality transport and logistics services in handling both intra- and extra EU trade in goods.

4. Discussion

The analysis of the share of individual modes of transport in the total EU's transport market performance in the years 1995-2022 indicates that the model of freight transport modal shift, which has existed for over 30 years, has not been changed in a significant way. The changes taking place in the structure of the EU modal split in the total transport market clearly indicate the successively growing importance of sea and road transport and the simultaneous decline in the share of inland waterways and pipelines. They are quite distant from the projections and expectations set out in the transport policy of the EC as the regulator of the transport market.

Transport policy objectives aimed at ensuring an increase in the market share of environmentally friendly modes of transport have not been achieved or, at most, only slight progress has been achieved in certain areas. The influence of the transport market as a regulator of activities in this sector, turned out to be much stronger than that of the EU as public regulator.

Moreover, the regulatory tools used, such as environmental taxes and charges, infrastructure fees, special funds i.e. Marco Polo, numerous subsidies, development of TEN-T corridors and integrated freight corridors and so on, turned out to be insufficient and not effective enough to meet the requirements of rebuilding the modal structure of EU's transport sector and redirecting it to the new, strongly political oriented development paths towards decarbonizations.

As a result, during the period 1990 - 2019, total emissions of greenhouse gases in the EU through fuel combustion in transport increased 23.8%, or 160 million tonnes of CO_2-equivalent (EC, 2023; Eurostat, 2023b). It should be emphasized that these values do not include international aviation or international shipping.

What is more, transport was the only fuel combustion source sector which recorded an increase during this period. In 2020, as the COVID-19 crisis hit the transport sector, these emissions decreased 13.5% compared with 2019. In 2021, there was a partial rebound, as emissions of greenhouse gases in the EU through fuel combustion in transport increased 8.6%.

Overall, fuel combustion in transport per inhabitant was 16.1% higher in 2019 than it had been in 1990. This means that the average use of powered transport per inhabitant in the EU increased at a faster pace than any improvements achieved in terms of fuel efficiency (Eurostat, 2023b). As for the overall level of emissions from fuel combustion in transport, the ratio of emissions per inhabitant decreased strongly in 2020 compared with 2019 (down 13.5%) and partially rebounded in 2021 (up 8.7%).

The growing disproportions between the created market modal split and the expected one, defined under the EU transport policy, forced the need to fundamentally change the approach to this issue. Recognizing that the reconstruction of the current modal shift is a long-term process and difficult to achieve using a rather soft transport policy instruments, the EU has radically redefined the goals, assuming that within the formula of equal treatment of all modes of transport, that all of them must meet international requirements regarding the need to ensure climate neutrality by 2050 (EC, 2023; EUROACTIV, 2024).

This means that their share in the overall transport performance on the European market will ultimately depend on the ability of carriers committed in each individual mode of transport to adapt to the requirements of the fuel transformation and switch to green alternative power sources.

Basic principles, forms and requirements as well as stages of implementation of the goals of the transport decarbonization process set out in the applicable legislation in the perspective of 2050, have been defined by the EU as an international public regulator (EC, 2023).

This means that it took full initiative in this respect, limiting the role of the transport market as an autonomous regulator of the real sphere in EU transport sector. As a result, the future modal split on the European Union transport market will be strongly influenced by the mechanism of public regulation. The dominant tool for its potential reconstruction, if at all, will be the decarbonization strategy of this sector, aimed at achieving its full climate neutrality.

5. Conclusions

The EU regulatory standards concerning sustainable transport development have been set out since 2019, paving a new path towards acceleration of the meeting this strategic objective via decarbonization and energy transformation. It means that the

strategy of achieving environmentally-friendly, fully sustainable transport system has been significantly evolved as compared to the previous one (1991-2018).

EU transport policy no longer aims at a deep reconstruction of the existing, not sustainable enough modal split, as this turns out to be impossible in the nearest future, but at a fundamental technological, operational and structural change in each mode of transport.

The new strategy, based on equal treatment of all transport modes, tries to transform them from the currently used fossil fuels towards the full implementation of new alternative green sources of propulsion. It is also assumed that the use of low or zero-emission fuels in each mode of transport should occur at the same pace, thus setting the rate for the transformation of the EU transport sector towards established zero-emission standards.

Such a transformation strategy, supported by a set of economic and financial tools, used in the form of incentives and sanctions, such as ETS, taxes and subsidies, makes it possible, while ensuring the uninterrupted availability of alternative fuels, to achieve the established decarbonization goal by 2050. In this way, the main regulatory goal can be achieved.

Currently, however, during the transformation period, the main challenge is to ensure all necessary conditions for the sustained, effective functioning of the transport market and supply chains. Therefore, an important and urgent issue is the need to identify not only the opportunities for the sector, but also the potential effects of its energy transformation, i.e., the threats and risks that the implementation of this strategy at an accelerated pace, without a guarantee of an continuous access to cheap alternative fuels, may cause for the transport sector itself as well as transport service providers.

In addition, it is very likely that not all carriers will be able to adapt to these requirements specified by the EU regulator. As a result, accelerated decarbonization of the transport sector may cause waves of insolvencies and bankruptcies of companies, especially in the freight road transport. This may, in turn, intensify the processes of horizontal and vertical integration of markets and companies, mainly in form of capital concentration through mergers and acquisitions.

Moreover, the carriers will attempts to shift the extra costs of adapting to regulatory requirements onto shippers or final service consumer. This may result in significant increase in transport costs and intensify inflationary processes in the economies of the EU countries. The implementation of such a strategy, may also result in a decline in their competitiveness on global commodity market, what can significantly slow down the growth rate of the GDP. All these effects must be taken into account when managing a change of this nature.

To sum up, it can be stated that the currently implemented sustainable transport development strategy will not significantly change the currently existing modal division with a relatively high share of road transport in the total EU transport performance, but only, if road carriers quickly and efficiently adapt to the requirements and standards of the energy transformation.

However, not everyone will be able to achieve these goals. Therefore, only the supply structure of this market may change as a result of intensifying capital integration both within and between individual modes of transport. Hence, it will be necessary to intensify the activities of the market regulators in order to stronger support the further development of operationally effective and logistically reliable intermodal supply chains.

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