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# Modern Types of Propulsion for Inland Waterway Transportas a Response to Contemporary Challenges in the Logistics Chain across Polish Seaports

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**Abstract:** This paper is devoted to the negative impact of transport activities. Every type of transport comes with negative effects on the environment, people's health, and people's comfort of living. Strategic papers from the European Union's (EU's) acts of law on national, regional, and local political levels have found that water transport is the future. The authors hypothesize that the increase in the use of inland waterway transport over the coming decades will provide an opportunity to increase the capacity of transport; however, without appropriate regulations regarding emission standards, the use of outdated water transport units will not allow us to achieve positive environmental effects. The authors, therefore, indicate good practices related to the use of shipping in conjunction with the use of modern types of propulsion. The literature review method was used to verify current knowledge about the impacts of water transport as well as to find possible alternatives. Moreover, a survey was conducted among experts—decision-makers in logistics companies operating in Polish seaports. The condition of ships, especially those used on inland waterways, needs to be improved, mainly in the aspect of emissions. Furthermore, a strategy should be prepared to include inland shipping as an ordinary part of the logistics chain in Poland, which seems to be a necessary and expected action, though it will bring only partial environmental benefits.

**Keywords:** sustainable transport; energy efficiency; social responsibility



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## 1. Introduction

In the contemporary economy, we encounter the phenomenon of lengthening and increasing the complexity of the logistics chain. At the same time, deriving the idea from M. E. Porter's value chain theory, we must consider that each of the chain's links has an impact on the creation of added value and that each constitutes a cost element, one which will eventually be passed on to the customer. In modern trade, logistics chains connecting points located several thousand kilometers away seem to be normal and commonplace. The reasons for this situation can be found in history, culture, working conditions, or political and legal systems, including free-trade agreements. Others will describe the reasons briefly in terms of the international division of labor. The ultimate determinant of the current state of affairs regarding the shape and distance separating individual links in logistics chains or networks is cost. That is why seaports play an extremely important role in logistics chains globally.

When it comes to costs, we must not only consider the low purchase price in a given location but also the price at which the final goods can be offered to the client, most often operating in conditions of hyper-competition. It is, therefore, the sum of the purchase price, the costs of all logistics and production processes, and the necessary fees such as duties and taxes, meaning there are huge pressures to reduce costs, including for logistics.

This is of particular importance in the context of internalizing costs and the correlation between economic and external costs of transport, to reduce the negative side effects of logistics activities, and to improve fairness among the modes of transport [1].

The impact of transport processes, or, more broadly, logistics processes, on the environment is obvious; however, individual branches affect the environment to different extents. Sometimes, the effects of the impact are experienced by societies empirically or consciously, especially in the case of road transport, in which the interactions of non-professional road users (pedestrians, public transport passengers, or drivers) or even residents with people providing transport services are very frequent. Hence, there is widespread awareness of the consequences of transport (e.g., congestion, noise and exhaust emissions, and a risk of accidents). An understanding of the negative impacts of road transport, including the emission of harmful substances such as carbon dioxide ($CO_2$), particulate matter (PM), sulfur oxides (Sox), and nitrogen oxides (Nox), is increasing. The excessive presence of these substances in the atmosphere causes several negative phenomena, such as acid rain or smog, which directly affect human health and contribute to diseases, especially those related to the respiratory system. The consequence is that authorities and more and more frequently informed consumers, especially those in highly developed countries, expect not only a cheap product but also one whose production and logistics burden the environment as little as possible.

The issues mentioned earlier are no longer just scientific abstractions about the environment. These are the challenges that the logistics industry must face to increase competitiveness in line with the idea of sustainable development. The answer to these challenges is the increasingly accepted idea of green ports being an element of the corporate social responsibility (CSR) strategies of seaports. One of the elements of this idea is promoting more environmentally friendly transportation modes in serving the hinterland as an alternative to road transport [2].

According to the strategic EU documents, which are consistent with scientific research conducted in this field, the road transport of cargo is one of the least environmentally friendly modes, and this negative aspect is especially noticed with longer routes, with distances starting from 300 km being most often indicated. In 2019, the modal split of transportation in Europe was 76.3% road, 17.6% rail, and 6.1% inland water. This is the case even though the commonly known answer for limiting environmental burden is to transport cargo by rail or water [3]. Modes of transport, once associated mainly with handling bulk cargo, are still perfect for handling containers that are extremely important in international trade using intermodal connections. When focusing on water transport, attention should be paid to a few basic issues. Water transport accounts for more than 80% of international trade. It is the main mode of transporting goods from the Far East to the EU and North and South America. Despite larger-scale progress in technology and the construction of units, the dimensions are primarily limited by the parameters of the Suez and Panama Canals. There has been a noticeable increase in the energy efficiency per unit, i.e., a container, and in the better quality of exhausts [4], but we must be aware that this does not abolish the harmfulness of logistics processes, the number of which is constantly growing because the development of global exchanges of goods favors this expansion.

The consequence of the exchange of goods by sea is the necessity for distribution inland. If natural conditions make it possible, the answer to many problems may be inland water transportation. Numerous strategic documents and researchers indicate that it is the most energy-efficient option, and the emissions it produces often indirectly affect health and human life; however, it cannot be said that it is a harmless transport mode. Similar to other modes of transport based on internal combustion engines, inland water transport emits harmful substances into the atmosphere. Assuming general parameters, inland waterway transport has similar characteristics to sea transport, with a fundamental difference in the size of units and the parameters of the waterway, which limits them. Typical parameters are depth, width, bridge heights over the water surface, and the radius of meandering waterway bends.

In recent decades, attempts have been made to find such transport solutions that will make it possible to meet society's expectations in terms of price, availability, and sometimes moderate environmental harmfulness related to the ordering of selected goods, and often these are goods produced in parts of the world far away from the place of purchase.

This problem must be solved on many levels, from local solutions, through regional and national, to an effective trade and transport policy at the World Trade Organization (WTO), EU, or other international levels, depending on the case examined. At the same time, it should be taken into account that shipping in the EU is already responsible for about 13% of emissions from the transport sector and about 2.9% of global greenhouse gas emissions [5]. The possible increase, therefore, in transport using this mode of transport will not be neutral for the environment. The question is not only how much of the current flows of cargo will be taken over by inland waterway transport but also whether, and to what extent, it will be possible to take over the flows of cargo that, according to the forecasts, are to appear.

The use of inland waterway transport instead of other modes, especially road transport, offers numerous combined benefits, some of which will be mentioned here. An obvious and basic effect will be lower fuel consumption per transport unit and the associated smaller footprint per specific cargo. Furthermore, more railways and roadways will be relieved, and thus the need to increase their capacity will be reduced and the need for repairs will occur less frequently. This entails further effects in the form of a reduced need for materials needed for their construction and repair. Lower consumption concerns, among others, will be metal ores, petroleum products (asphalt), aggregates, or limestone. There will also be no need for energy to transport these materials and transform them into an element of transport infrastructure. Less traffic on other roads also means fewer accidents, smoother and safer driving, and lower noise emissions [6].

## 2. Materials and Methods

The authors based their research on several methods. One of them was a review of the literature dealing with the issue. The literature on inland waterway transport is extensive, but there are few publications devoted to the issue of the emissivity of this means of transport and progress in this area, especially in the last decade. The vast majority of authors only emphasize the advantage of the possibility of transporting more cargo using the same amount of energy compared to road or rail transport. The available publications confirm the essence of the problem, which is not only the transfer of cargo flows to inland waterway transport but also this type of transport's appropriate emissivity. However, the fact that it was not possible to find literature relating mainly to the aspect of changing power sources in inland water transport was one of the reasons for taking up this topic by the authors. Another reason was the exceptionally poor up-to-date literature on this topic in the context of Poland, an area that is of particular interest to the authors [4,7–9].

Another approach was the Delphi method using Computer-Assisted Web Interview (CAWI), where the authors asked experts and decision-makers of enterprises operating in Polish seaports. This approach was to verify how a group of leaders in the port industry perceives the theoretical assumptions and forecasts of the government administration regarding the increase in cargo flows, the ways of their movement, and the role of ecological issues in the future of logistics. In addition, the authors verified the results of the projects and empirical attempts to solve the problem of water transport in Poland with the use of special units, including awareness of the potential linearity of connections and the possibility of moving away from combustion engines.

## 3. Results

The expected increase in cargo exchange is a global challenge. Many reasons can be largely expressed in terms of economic growth and the enrichment of societies, as well as on a global scale through demographic growth. In the case of Poland, the issue is strengthening the purchasing power of Poles. There are geographical reasons related to Poland's location on trade routes, and it has strong manufacturing centers. The route connecting the north and south of Europe based on the E65 road, the E59 and CE59 railways, and the E30 waterway should be mentioned here. It connects the Nordic countries, which are some of the richest in the world, with the ports of southern Europe in the Mediterranean; these are the first ports of line connections from Asia that are used after the Suez Canal has been crossed.

There are also strong economic and production centers on this route, such as the Upper Silesian Industrial District in Poland or the neighboring Ostrava-Karvina Industrial District in the Czech Republic. Poland is also situated on the main east-west transport routes, both road and rail. It needs to be highlighted that Poland has a direct railway connection from China to the rail terminal in Małaszewicze, whose reloading capacity is to reach 223,000 TEU per year soon [10]. Nevertheless, the most important hubs are still Polish seaports. In recent years, cargo traffic in Polish ports has been at record levels, which is presented in more detail in Table 1.

**Table 1.** Cargo traffic at selected seaports in thousands of tons in 2018–2020.

| | 2020 | 2019 | 2018 |
|---|---|---|---|
| Gdańsk | 40,574.7 | 45,521.9 | 42,492.1 |
| Gdynia | 21,220.2 | 20,547.7 | 21,112.5 |
| Szczecin Świnoujście | 24,678.2 | 25,518.1 | 26,169.2 |

Source: Own study based on data from the Ministry of Infrastructure.

The data provided by the units responsible for the development of seaports in Poland indicates the forecasted excessive increases in transshipments.

The Szczecin–Świnoujście port complex forecasts an indication that the level of cargo handling will double in the next few years and that the dynamic growth trend will be maintained until 2049—the last year covered by the forecast. Selected years are detailed in Table 2.

**Table 2.** Forecasted transshipments at the ports of Szczecin–Świnoujście in thousands of tons and TEU.

| | Cargo Type | |
|---|---|---|
| **Year** | **General Transshipments without TEU** | **Thousands TEU** |
| 2027 | 48,638 | 961 |
| 2035 | 68,044 | 1724 |
| 2040 | 74,021 | 1984 |
| 2045 | 84,169 | 2284 |
| 2049 | 90,859 | 2559 |

Source: Own study based on data from the Ministry of Infrastructure, Republic of Poland.

In the case of the port of Gdańsk, there is also an upward trend. Details of the forecast are presented in Table 3.

**Table 3.** Forecasted transshipments in the port of Gdańsk in thousands of tons and TEU.

| | Cargo Type | |
|---|---|---|
| **Year** | **General Transshipments without TEU** | **Thousands TEU** |
| 2027 | 31,261 | 35,101 |
| 2035 | 34,418 | 47,550 |
| 2045 | 37,410 | 64,997 |
| 2049 | 39,040 | 72,563 |

Source: Own study based on data from the Ministry of Infrastructure, Republic of Poland.

The data on the port of Gdynia also indicates the forecasted significant increases in transshipments. Details of the prediction are presented in Table 4.

**Table 4.** Forecasted transshipments at the port of Gdynia in thousands of tons and TEU.

| | Cargo Type | |
|---|---|---|
| **Year** | **General Transshipments without TEU** | **Thousands TEU** |
| 2027 | 17,000 | 1500 |
| 2035 | N/A | 2660 |
| 2045 | N/A | 3072 |
| 2049 | N/A | 3595 |
| 2027 | N/A | 4000 |

Source: Own study based on data from the Ministry of Infrastructure, Republic of Poland.

Cargo handling in seaports at the current level is serviced mainly by three modes of transport, which are road, rail, and, to a small extent, inland water transport at a complex of ports in Szczecin and Świnoujście, and marginally the port in Gdańsk. The decarbonization of the economy should also have an impact on the volume and structure of cargo in the indicated ports, which translate into a decrease in coal-related volumes. An open issue remains the transshipment of steel products, for which an increase in imports from Russia has recently been visible due to price competitiveness (there are no charges related to $CO_2$ emissions). Trade with Russia has, of course, been banned, but there are many other countries where there are no additional charges due to air or environmental pollution.

There is also an ongoing discussion, for example, in the context of the UN Climate Change Conference (COP21) or the proposed provisions known as "Fit for 55". One of the postulates is the imposition of a tax to compensate for the costs, which EU companies must bear in connection with emissions from competing products imported from zones where these environmental charges do not occur or are much lower [11].

Nevertheless, the main challenge seems to be the dynamic growth of unitized general cargo, mainly container transport, for both the current and predicted conditions of roads and railroads. From the perspective of the Szczecin and Świnoujście port complex (ZMPSiŚ), the plans to implement the S10 road to Toruń by 2030 and soon to Warsaw can be assessed positively, but it does not seem that it will significantly relieve freight traffic and will only diversify the choice of non-professional road users heading toward central Poland, which today is mainly carried out via the S3 and A2 roads. Gdynia and Gdańsk are focused on improving the road system and ensuring efficient access to ports for freight transport, including the so-called Red Road to the port of Gdynia. There is no information about significant plans to increase the capacity of the most important roads (A1 and S3) to ports (Gdańsk, Gdynia, Szczecin, Świnoujście) along their entire course. The development plans for railways should be perceived in the field slightly more positively. This assumes the possibility of using trains with a length of over 700 m in all ports, an axle load of 221 kN, and an increase in commercial speed, which, for example, in the case of ZMPSiŚ will allow for doubling the number of operated trains per day. As for the development of waterways, there are no specific investment plans. Numerous studies have been carried out, but, at the moment, they have not turned into investment plans or other activities. The Ministry of Infrastructure indicates that the effects of the measures for the Odra Waterway (E-30) should be visible after 2040.

To better understand the most likely changes, a survey was conducted among experts and decision-makers in enterprises operating on quays in the largest Polish seaports, i.e., Szczecin–Świnoujście, Gdynia, and Gdańsk. In respect of the year 2027, over 94% of respondents indicated that they expect an increase in the volume of cargo, and, in the period 2027–2035, nearly 71% of respondents expect increases compared to the period before the year 2027. In respect of years 2035–2045, 65% of respondents expect an increase concerning the period of earlier expectations.

At the same time, over 83% of the respondents indicated that it would not be possible to efficiently handle these flows of cargo with only the use of road and rail transport.

It should be noted that inland navigation is responsible for handling up to 3% of cargo flows, depending on the analyzed period, in the Szczecin–Świnoujście port complex [12] and 0.15% of cargo flows in Poland [13].

More than half of the respondents already use inland water transport to handle cargo, and 71% plan to start using this branch of transport or increase its share in cargo handling. In the opinion of the authors, this shows the awareness of the almost complete use of transport capacity by the two currently dominant modes of transport, as well as the desire to reduce the dependence of the cost of logistics services on fuel per unit. Almost 89% of respondents stated that logistics centers should be created, serving, in addition to roads and railways, waterway transport in places such as Bydgoszcz (crossing of international waterways E-40 and E-70), Nowa Sól, or Wrocław (international waterway E-30). This is even more significant, considering that only 44.4% are convinced that the governmental plans will be implemented and that the waterway conditions on Odra River E-30 and the lower part of Vistula River E-40 will be improved. In addition, the conditions that occur in the indicated sections do not always guarantee stable parameters for the III class waterway. This means that decision-makers in logistics companies throughout Polish seaports are determined to act in transferring cargo flows to inland navigation, regardless of the investments in waterways declared by the government. They must, therefore, be prepared to use barges that are not fully loaded or use special vessels designed to handle linear shipping on specific river sections.

## 4. Discussion

Increases in cargo handling in seaports have several consequences. One of them is the need for an efficient transport service for their facilities. Inland water transport may be an answer to the transport challenges related to the increased exchange of goods, including containerized ones, though it should be noted that more than 95% of inland ships still use diesel engines as the main power source, causing large amounts of greenhouse gases (GHGs) and other pollutants such as emissions of NOx and particulate matter (PM). Due to most of the inland navigable waters being located in economically developed areas, the pollution caused by inland ships significantly affects the ecological environment of the riverside areas [14], as well as impacting population health.

### *4.1. Projects Related to the Transfer of Cargo to Inland Waterway Transport*

Advantages of inland waterway transport in terms of capabilities and efficiency are often indicated by one of the most illustrative studies, "The Power of Inland Navigation", signaling that the use of one set (towboat and one barge) can replace 16–250 trucks in the case of container transport, depending on the waterway class [15]. This result seems to be a satisfactory answer in relation to the flow of cargo between ports. Specific shipping conditions on selected waterways must, however, be considered. The results of this type of analysis also seem optimistic. The analysis carried out some years ago concerning the most popular units on Polish waterways, i.e., the BIZON III pusher with two OBP500 barges, indicated the possibility of a singular transport of 24–30 20-foot containers depending on the method of stacking. It should be emphasized that, here, only one layer of containers is placed [16]. Extrapolating this experience, it can also be assumed that in the case of a single set of BIZON III pushers and one OBP barge, we obtain the possibility of transporting from 12 to 15 TEU. At the beginning of the 21st century, a project was carried out to determine whether it was possible to create a unit with a low draft that could move a large number of containers. The result of the project "Innovative Barge Trains for Effective Transport on Shallow Waters" (INBAT) was the design of a unit with a draft of 0.6 m, length of 48.75 m, and width of 9 m, enabling the transport of up to 42 containers in one layer [17]. In both cases, this equates to replacing 6–21 trucks with semi-trailers, allowing the transport of up to two TEUs.

Thanks to the conducted experiment, we do not have to rely only on theoretical assumptions. In April 2021, a cargo cruise from Gdańsk to Chełm (approx. 150 km) took place. There were six 40-foot containers on board with 300 kg of cargo. The Wisła Cargo 2021 initiative was implemented with the funds of the Interreg Baltic Sea Region as part of the EMMA project, which supports integrated territorial development and cooperation for a more innovative, accessible, and sustainable Baltic Sea Region. Project participants indicate that the potential for container transport exists with the current conditions at the level of 52 TEU for a cruise using the fleet of the following set: the "Tur" pusher and four "Galar" barges. In addition, these values can be easily doubled by stacking containers (the so-called double stack). At the same time, they call for the construction of a river terminal in Solec Kujawski [18].

### *4.2. The Problem of Emissions in Inland Waterway Transport*

Transferring the flow of loads from roads to waterways would undoubtedly have a beneficial effect in terms of reducing road congestion. One barge a day from the port in Gdańsk means fifteen thousand fewer lorries per year on the roads [19]. This is in addition to the reduction in exhaust gas emissions and the harmful substances associated with them, although the effect here is not so significant. The age of the truck fleet in European countries ranges from just a few to over a dozen years, with the average fluctuating at around 13 years. It should also be noted that although the structure of ships is several dozen years old, only properly maintained hulls have a long life. The equipment of a ship, such as engines and propellers, is more sensitive; therefore, it must be replaced every 20 or 30 years [20]. These units were, of course, modernized at that time, but the restrictions on exhaust emissions in this branch of transport appear much later than in road transport. In 2007, a study was presented that shows the differences in the emissions of individual substances from the used fuel, comparing road and inland waterway transport, as shown in Table 5.

Moreover, research carried out in a country known for the use of inland waterway transport, the Netherlands, was conducted under the Dutch Pollutant Release and Transfer Register. This established significant differences in emissions depending on the year of construction of a given engine. Engines manufactured after 2009 in relation to engines manufactured before 1979 emit less NO in (g/kWh) by 43.40%, PM10 by 66.67%, CO by 64.86%, and VOC by 75%. The study average emission factors for diesel engines used in inland shipping (g/kWh) in the years 1990–2010 show a decrease in NOx emissions by 10.48%, PM by 33%, CO by 42.86%, VOC by 50%, $SO_2$ by 99.5%, and $CO_2$ by 8.31% [21].

**Table 5.** Emission of pollutants in road transport and inland navigation (g/kg fuel).

| Substance | Symbol | Road Transport | Inland Waterway Transport |
|---|---|---|---|
| Sulfur dioxide | $SO_2$ | 0.11 | 0.60 |
| Nitrogen oxides | NOx | 3.66 | 12.75 |
| Carbon monoxide | CO | 5.75 | 9.81 |
| Non-methane volatile organic compounds | NMVOC | 2.32 | 4.25 |
| Particulate matter | PM | 0.45 | 2.24 |
| Carbon dioxide | $CO_2$ | 3323.00 | 2700.00 |
| Methane | $CH_4$ | 0.10 | 0.16 |

Source: EPMEP/CORINAR Emission Inventory Guidebook 2007, Technical Report no. 16/2007 as cited in [22].

Since then, the emission standards for road transport have increased significantly. This means that vehicles currently produced must emit five times fewer sulfur oxides, almost three times fewer hydrocarbons, and two times fewer PM [23]. Therefore, preventing the worsening of the condition of the environment and following the principles of sustainable development involves making "development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs [24]. Actions should be taken not only to increase the efficiency of transport, the effect of which should be achieved thanks to the use of inland navigation for their operation, but also to implement low- or zero-emission solutions in this mode of transport.

It seems that more and more circumstances are conducive to this. One way is to move toward liquefied natural gas (LNG) [25] as the entities do and participate in the LNG Master Plan, which aims to introduce LNG, both as cargo and fuel, into inland waterways [2]. This technological progress has effects such as increasing battery capacity, greater efficiency of photovoltaic panels, or the application of hydrogen propulsion. In addition, there are some functional facilitations related to changes in global transport, the standardization of loads such as containerization and logistics centers, and agent-based solutions related to the tracking and handling of cargo.

Technological solutions related to the propulsion system also seem to be important to go beyond the increase in the requirements for the substance content in the exhaust fumes to low-emission and zero-emission solutions. One such drive is hydrogen, which, despite the availability of car models powered by this fuel, is not widespread. The most frequent substantive premises include the lack of a developed network of stations distributing this fuel and problems with obtaining a dynamic engine response. Referring to shipping, including inland shipping, these issues seem to be uncomplicated to overcome. The market for professional users seems simple for development, and with predictable demand corresponding to new vessels and lines, it operates or will operate. The use of this fuel is still rare, but it seems completely feasible to implement and make it available, for example, in river ports. While the transition to hydrogen can be risky in road transport, it is not in inland waterway line connections. The issue of the lack of dynamics in the case of shipping seems to be secondary, due to the completely different nature and conditions of movement of this type of unit compared to cars or even trucks. The proof of the possibilities of operating this drive is in the tests of the same solution used in water trams in Venice—the Hepic project or service boats such as PHEB1 [25,26]. Another is the participation of one of the largest maritime companies, Wilh. Wilhelmsen Holding ASA, in the EU-funded HyShip project related to the supply chain and operation of liquid hydrogen (LH2) units [27]. It is only now that there is an active search for the possibility of widespread use of this propulsion. One of the most advanced projects in this area is PortLiner. Part of this was a proposal to create a unit powered by electricity. In contrast to the Li-Ion solutions used in the automotive industry, which are forced by the necessity to limit the occupied space in shipping, another solution for powering vessels is proposed—namely flow batteries. This is an extremely durable solution. Regardless of the number of operating cycles, the battery maintains over 80% of its efficiency even at a low charge level and 100% of its original capacity, and it is characterized by a long service life (usually estimated at 15,000 to 20,000 cycles) and low maintenance costs. The project assumed two structures. The first one, the PortLiner EC52, is 52 m long, 7.6 m wide, and has a draft of up to 2 m. It is a universal ship that can carry 400 tons of cargo and up to 36 containers at the same time, which can also be adapted to the transport of dangerous goods thanks to the double hull plating. The longer one, the PortLiner EC110, is 110 m long, 11.45 m wide, and will be able to transport up to 280 TEU. The batteries enable navigation for up to 30 h, allowing the implementation of Rotterdam–Antwerp–Duisburg connections. Ultimately, a 135-meter-long PortLiner Anna unit is to be tested [28]. What should be emphasized in this type of vessel is the problem of possible time-consuming charging. This has been solved by placing batteries in containers, which, depending on the needs, may be replaced in the next port visited in line shipping. These types of solutions are undoubtedly important by eliminating one of the biggest shortcomings of factors slowing down the popularization of the electric drive, for example, in the automotive industry.

## 5. Conclusions

A very clear increase in transshipments in Polish seaports is a huge challenge that the currently dominant road transport system will not be able to cope with. The responses are more efficient and environmentally friendly branches, such as inland waterway transport or rail. Investments in these branches are an indispensable condition for maintaining the competitiveness of Polish seaports. Investments in these branches should, however, not be based on economic efficiency but should also consider ensuring safety in the sense of resistance to supply disruptions and usage of ecological fuel. In the case of rail transport, the use of electric propulsion is implemented more and more often. Even in the case of freight transport, old-generation diesel engines still dominate the propulsion of inland ships. This is a timely opportunity to change it in a complex way to very modern, low-emission diesel, electric, or hybrid engines. Data repeatedly cited in the literature can also be considered positive in the effectiveness of, among others, the implementation of the shipping project on the Vistula, where, because of a change in the mode of transport that handles cargo, the number of vehicles on the road can be radically reduced. Cargo forecasts for ports are optimistic; however, to bring about a positive economic effect, it is necessary to intensify efforts to improve the possibility of handling cargo by rail and inland waterway transport. For society not to have to pay a deferred bill in the form of deteriorating health and living standards, it is necessary to implement new transport technologies, also for inland navigation, especially in sections where line service will be possible, such as between the proposed logistics center in the vicinity of Bydgoszcz and the port in Gdańsk. The lack of restrictive requirements regarding the emissivity of inland waterway transport may contribute to filling the Polish market with old-type units that have the transport capacity typical for this branch of transport, but this will make it impossible to minimize the negative environmental effect that such a significant increase in transport activity will have.

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