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# Rail and shipping as elements of sustainable transport in Poland

## Kolej i żegluga jako elementy zrównoważonego transportu w Polsce

### ABSTRACT

The article presents the problems of the Polish transport market, which, in accordance with the requirements of the European Union, must reduce the share of wheeled transport to 30% in 2030 and to 50% in 2050. Based on available data and knowledge, this article presents the importance of railroads and inland waterways for Poland. The benefits of investing in both modes of transportation are considered, along with indicative maintenance costs. Everything is to be done while maintaining the competitiveness of the economy, and this requires a lot of long-term investment in both rail and inland waterways. This article presents projects, project proposals and ongoing work aimed at increasing the importance of these transport modes in the freight market.

**Keywords:** rail transportation, inland waterways, investment, rail network, waterways.

### 1. INFRASTRUCTURE DEVELOPMENT PLANS

According to Eurostat data, the European Union achieves an average 24 to 25% share of sustainable transport modes in total transportation, exactly 17.9% of the rail market share and about 7% of inland waterways (Greene & Wegener, 1997). Poland, unfortunately, does not even achieve similar shares – the importance of rail is less than 11% while shipping does not even reach one percent. This state of affairs is the result of many years of infrastructure neglect, which is caused by economic transformations and a long period when the state budget did not allow investment plans in this area. Sustainable transportation is the transportation of goods and people while ensuring economic and social well-being and reducing undesirable environmental and social impacts (Greene & Wegener, 1997). Currently, it is possible to receive funding from the

### STRESZCZENIE

Artykuł przedstawia problematykę polskiego rynku przewozowego, który w zgodzie z wymogami Unii Europejskiej musi ograniczyć udział transportu kołowego do 30% w roku 2030 oraz do 50% w roku 2050. W oparciu o dostępne dane oraz wiedzę w niniejszym artykule zaprezentowano znaczenie kolei oraz żeglugi śródlądowej dla Polski. Rozważone zostały korzyści płynące z inwestycji w obie gałęzi transportu wraz z orientacyjnymi kosztami utrzymania. W artykule przedstawiono projekty, propozycje projektów oraz trwające prace mające na celu zwiększenie znaczenia tych gałęzi transportu na rynku przewozów towarowych.

**Słowa kluczowe:** transport kolejowy, żegluga śródlądowa, inwestycje, sieć kolejowa, drogi wodne.

Union's cohesion program. In 2017, the President of Poland signed the European Agreement on Main Inland Waterways of International Importance (AGN Convention), in which we, as a country, pledged to build waterways of international importance and adapt the entire infrastructure, along with the navigation information system in order to enable standardized navigation. The scope of work covered by the convention includes:

- Construction of the E-30 road to connect the Baltic Sea via the Oder River with the Danube River Bratislava. The road will provide the Czech Republic with access to, among others, Polish ports in Swinoujście and Szczecin;
- Construction of the E-40 road, which aims to provide a link between the Baltic Sea, Baltic Sea with the Dnieper River. It includes three rivers within Poland: the Vistula, the Narew

and the Bug. The road has the starting point in Gdansk, then runs through the Chernobyl region, through Kyiv and ends in the Black Sea port of Kherson;

- Construction of the E-70 road, which will connect three countries: The Netherlands, Russia and Lithuania. In Poland, it runs through the Oder River, to the mouth of the Warta River, through the Bydgoszcz Canal and the lower Vistula River and the Szkarpada River.



Figure 1. Map of waterways of the AGN Convention

Source: Babak, 2019

## 2. ESTIMATED COSTS AND BENEFITSE

According to initial government estimates, the cost of this investment estimated at 76 billion zlotys. The scope of these investments is very extensive and, according to some estimates, could reach as much as 237 billion zlotys. In government brochures one can find a note stating the fact that the cost is only an estimate, and its exact value is not yet known, since the competence for proper valuation will be held by specially appointed studies for each project. Because of this, some issues may have been overlooked in the preliminary estimates, such as the need to raise engineering structures caused by raising the water table as a result of the river's regulation, or the drainage of areas with peat substrate located on the Oder-Vistula connection. Returning to the potential that Poland currently possesses, there are 3767 kilometers of waterways, of which those of international importance amount to only 205.9 kilometers (Statistics Poland, 2022), or about 5.4% of the total, and more than 19,000 kilometers of railroads. For reasons of marginal importance of inland shipping, there is no need to cite transport costs and time, as it is currently primarily an all-terrain transport, and use in intermodal terms is non-existent. This is in contrast to railroads, which have long made history by providing their services to the freight market. The average communication speed of freight trains is between 23 and 25 km/h (Urząd Transportu Kolejowego, 2017), moreover, when planning transportation, one must add a possible delay, which averages 12-13h (Urząd Transportu Kolejowego,

2022). This makes railroads a difficult participant in the supply chain, as it is impossible to plan deliveries exactly on time. By 2030, speeds are to be increased to 35-40km/h, while shipping is capable of about 10km/h upstream and 15km/h downstream. This contributes to rail's greater competitiveness in terms of the speed of goods delivered. However, this poses a question: Is it better to transport cargo for longer, but have a guaranteed delivery time, or get it faster, but on an uncertain date, which can be extended up to twice as long? Knowing that in the second quarter of 2022 only 44.2% of trains arrived at the terminal station on time, one can expect difficulties in planning combined transportation. Turning to the question of the necessary investments to achieve the highest possible share of sustainable transport, it is necessary to consider the entire spectrum of effects that will be translated into the economy. An important difference in the development of the two branches is the scope of their impact, rail translates into passenger transport as well as freight, so any economic gains will be due to the increased availability of freight services, while the investment in shipping benefits not only logistics, but also agriculture, hospitality, tourist ship owners, cities. In principle, listing all the beneficiaries of such a project is difficult due to the interconnectedness of numerous industries with waterways. An important problem is a kind of seasonality of waterways, because by climate change Poland is facing droughts, and many years of neglect in this area cause the retention capacity to be lower than the needs while in winter rivers and canals are frozen. According to the AGN Convention, waterways should be available for 240 days a year, while today they amount to about a hundred in Poland. By subjecting water pans to regulation, a constant water level is ensured and it is possible to control the flow of water. This contributes to the fact that in a high water situation, neighboring regions can be protected from flooding, farmers can be assured of a water level that allows them to irrigate their fields, and the surrounding vegetation can be provided with a constant supply of water. In addition, you can avoid the phenomenon of suffocation, which occurs during the summer season. With the raising temperature of water body the amount of air drastically decreases, causing the fish living in particular sections to suffocate and die out. Such a phenomenon occurred, in conjunction with the pollution of the Oder River, in 2022, where the water temperature in Wroclaw reached 29 degrees, and the water level below the Malczyce water stage was 15 centimeters, compounding the effect of the sun. Such and many other situations can be avoided by regulating the Oder and the Vistula, along with taking care of retention facilities. Regarding railroads, the current National Railroad Program (NTP) provides for an investment of at least 67 billion zlotys by the end of 2023. The money will be used to expand railroads and revitalize them, while waterways should be mostly completely rebuilt.

## 3. THE SYMBIOSIS OF SUSTAINABLE TRANSPORT MODES

It doesn't take much knowledge of transportation to conclude that river transportation cannot compete with wheeled trans-

portation; only rail can be partially substituted by shipping. If only railroads are developed, their capacity must be significantly increased to ensure adequate route capacity and meet market expectations. However, when analyzing the effects of the development of river and rail transportation, not only in logistical terms, but economically and environmentally, it is more rational to invest in the development of both rail and shipping. This will then increase the possibility of shifting some cargo to the rivers and freeing up space on the railroads for those that are moved by road today. A basic and important fact is the lack of substitutability of water transport with certain groups of cargo. Due to its parameters, inland water transport enables the movement of much wider, higher and heavier goods than when using other modes of transportation. Railroads have an advantage in terms of massiveness, being able to carry several times more cargo than wheeled transport, respectively, with a single transport job; by the way, they are less carbon-intensive both in terms of energy consumption and noise. All this at the expense of a slightly longer transport execution time. Therefore, it is necessary to push for the even development of both branches with the aim of their symbiotic action and cooperation in building a new transport thought.

#### 4. THE AMOUNT OF INVESTMENT IN SHIPPING

Investment of the largest possible budget is particularly important in the coming years so that most of the costly stages are completed before 2030, as Poland can currently seek reimbursement of up to 85% from the European Cohesion Fund, while in subsequent years the maximum reimbursement threshold will be between 20 and 40%, and with such significant financial outlays it is worth receiving the largest possible co-financing, especially looking at the wide range of impact of each zloty spent. Unfortunately, due to the long-standing emphasis placed on the development of highways and roads combined with the lack of adequate funding for the other branches has contributed to their degradation. However, the problem of underinvestment in waterways is much older than recent decades. The First and Second World Wars contributed to a significant reduction in development work on the Oder River, while the Vistula was never adequately funded. Therefore, the current development of the Vistula is much more expensive, it does not have an adequate retention resource, which translates into difficult water management during both floods and droughts. The situation is different on the Oder River. Currently, consideration could be given to converting the Racibórz retention reservoir from dry to wet. Such a change would help ensure navigation during dry periods when water is scarce in the river. An additional problem is the degradation of the transverse dams, which allowed controlling the transit depth by trapping spoils carried by the river. The discontinuation of the construction of successive grades has also translated into a process of bottom erosion, which greatly restricts navigation. The lack of inland ports on the waterways is also an important fact. Therefore, it is almost necessary to build the entire branch practically from scratch. Looking at it from another point of view, how-

ever, it creates an extraordinary opportunity to tailor the infrastructure and rolling stock exactly to the needs. This applies to location, as well as facilities and their size depending on demand. Analyzing the amount of work needed to be undertaken and the costs of shipping development, looking only at the transportation function alone, it is likely that not even a break-even point will be reached, but the benefits in other sectors of the economy could be significant (Table 1).

Table 1. Economic benefits of inland waterway development

No.	Economic sector	Benefits received
1.	Agriculture	Permanent access to water for irrigation of fields
2.	Agriculture	No loss of fields due to meandering of the river
3.	Agriculture	Cheaper transportation of agricultural products
4.	Logistics	Additional branch of transportation with lower energy-intensive parameters
5.	Logistics	Provision of water to production facilities
6.	Logistics	Additional facilities for seaports
7.	Tourism	Provision of tourist shipping in areas where this is currently difficult
8.	Tourism	Enabling so-called hoteliers to operate
9.	Environment	Flood protection, drought prevention
10.	Environment	Construction of hydroelectric power plants
11.	Environment	Creation of nesting sites in river bends
12.	Shipbuilding industry	Construction of professional fleet
13.	Shipbuilding industry	Increase demand for recreational vessels
14.	Entrepreneurs	Increase competitiveness by facilitating over-the-road transportation
15.	Social	Price competitiveness of transportation

Source: own elaboration

It is also worth focusing on the problems associated with inland transportation development. In addition to the long list of tasks, there is also the long process of obtaining all approvals, environmental interviews, etc., in addition, the location of nine damming structures on the border section of the river makes it necessary to cooperate with our German neighbor, which does not express a desire to invest in this waterway. However, these are not problems that cannot be solved. It is necessary to focus on action and create teams responsible for the formation of the structures in question. The key is to carry out as many works simultaneously as possible in order to shorten the network development process as much as possible. It seems appropriate to start with the Oder River, since more than half of the goods transported in Poland originate in Silesia and Lower Silesia. Some of the water stages, among others, correspond to Class III navigable waterways, this is due to their parameters, as the Różanka lock in Wrocław has a gate

width of 9.6 m, while Class IV requires a width of 12 meters. However, the starting point should be the construction of new water stages downstream in order to restore their navigability in the first stages of navigation development. The lower class of the remaining stages should not pose a significant obstacle. Such prioritization will make it possible to make the river navigable relatively quickly, thereby ensuring its competitiveness and relieving the burden on other modes of transport. It is important to offer as many of them as possible to ensure diversification of cargo, which will help reduce congestion, which translates into cleaner air and shorter delivery times.

### 5. SHIPPING A THREAT TO RAILROADS?

By overlapping the rail freight network along with waterways, it is often said that the advent of shipping will cause railroads to regress. The fact is that the cargo groups currently on the railroad's shipping list are of interest to shipping as well, since these are raw materials, timber, cement, ores, etc., i.e. bulk goods that generally use full-vehicle carriage. Through the railroad's long delays and its low speed of movement, these are the groups of goods that are able to provide income to rail carriers due to their nature and lack of the need to make deliveries exactly on time. However, such a measure will do nothing to encourage the public and logistics operators to use rail freight. For this, a fundamental change in the transport policy of railroad companies is needed. It seems that through the monopolization of the rail market, there are numerous delays, if not of the carriage itself then of the work on the line. There is a highly anticipated change in this style of management so as to improve intermodal carriage as well, and shift priority from customers such as mines, steel mills or power plants to logistics centers, intermodal service and smaller loads using one or a few railcars rather than the entire train set. Loading the railroads with a large amount of cargo translates into the number of trains, and it translates into track availability, so moving some contractors to river transport will increase the capacity of the railroads, which are heavily overloaded today. It should be noted that rail transportation is also responsible for moving passengers; it is often the only window to the world especially in small towns. Hence, there are many risks, because with the current situation that prevails in the Polish transport market, it is aviation that is competing both in terms of time and price competition in passenger transportation. In that case, the sudden introduction of shipping could put the industry in an extremely difficult situation. However, this is a long process that should be considered over a period of several years, as even taking increased action in this regard would achieve waterway stability in about 10 years at the earliest. Showing such a long time horizon, organizational measures can be taken to adapt the railroad to the new specifics of the business. Shifting only a portion of cargo to another branch will help free up some rolling stock that can be used in other regions of the country, thus providing an opportunity for the development of the entire area of Poland, and not just certain currently well-connected places. This is why the development of the infrastructure of individual

modes of transport should not be considered as a threat, but more in the larger sense as an opportunity for the whole country, many industries, cities and society as a whole.

### 6. CONCLUSIONS

The division of transportation into different branches makes it possible to select the appropriate mode of transport for a given specific commodity. The more the availability of diverse modes of transportation in the freight market increases, the greater the economic development in a region. Because of this basic relationship, investment in transportation cannot be viewed through the prism of a single branch, but should instead emphasize the sustainable development of all. With the current inefficient rail market and overcrowded and carbon-intensive wheeled transport, it is necessary to look for opportunities to transfer some cargo groups to another branch. The Polish waterways overlap with the main freight streams and are able to relieve the burden on railroads to a considerable extent. In order to reduce wheeled transport on routes over 300 kilometers, it is required to develop railroads in such a way as to enable, first of all, on-time deliveries, but also the shortest possible transportation time. These tasks require fundamental changes in all three branches, and only by betting on cooperation and sustainable investment will it be realistic to achieve the goals of the White Paper. The development of waterways, which in the initial phases will focus on regulation and retention, and only in the future will begin the reconstruction of already existing infrastructure, will allow for accelerated development. With the development of shipping, it will be necessary to invest in railroads to adapt them to handle goods that require fast and timely delivery, while wheeled transportation should be improved by focusing on routes of up to 300 kilometers from loading to destination.

### REFERENCES

- Babak, M. (2019, 29 August). *MGMiŻŚ: Program Rozwoju Odrzańskiej Drogi Wodnej ma być gotowy w 2021 r.* PortalMorski.pl. <https://www.portalmorski.pl/wiadomosci/zegluga/43261-mgmizs-program-rozwoju-odrzańskiej-drogi-wodnej-ma-byc-gotowy-w-2021-r>
- Greene, D.L., & Wegener, M. (1997). Sustainable transport. *Journal of Transport Geography*, 5(3), 177–190. [https://doi.org/10.1016/S0966-6923\(97\)00013-6](https://doi.org/10.1016/S0966-6923(97)00013-6)
- Komisja Europejska (2011). *Biała Księga – Plan utworzenia jednolitego europejskiego obszaru transportu – dążenie do osiągnięcia, konkurencyjnego i zasobooszczędnego systemu transportu*. 144 wersja ostateczna. EUR-Lex. <https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0144:FIN:pl:PDF>
- Statistics Poland. (2022). *Inland waterways transport in Poland in 2020 and 2021*. Statistics Poland, Statistical Office in Szczecin. [https://stat.gov.pl/files/gfx/portalinformacyjny/pl/defaultaktualnosci/5511/2/6/1/zegluga\\_srodladowa\\_w\\_polsce\\_w\\_lat\\_ach\\_2020\\_i\\_2021.pdf](https://stat.gov.pl/files/gfx/portalinformacyjny/pl/defaultaktualnosci/5511/2/6/1/zegluga_srodladowa_w_polsce_w_lat_ach_2020_i_2021.pdf)
- Urząd Transportu Kolejowego. (2017, 11 Jule). *Pociągi towarowe w Polsce coraz szybsze*. <https://utk.gov.pl/pl/aktualnosci/13224,Pociągi-towarowe-w-Polsce-coraz-szybsze.html>
- Urząd Transportu Kolejowego. (2022, 17 August). *Punktualność pociągów w II kwartale 2022 r.* <https://utk.gov.pl/pl/aktualnosci/19105,Punktualnosc-pociagow-w-II-kwartale-2022-r.html>