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# Report on alternative scenarios of TRITIA traffic model

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# 1. Introduction

Transport is an important part of each country's national economy, affecting its economic development. A quality transport system has an impact on the distribution of economic growth from the country's strong economic centres towards the less developed regions, which are stagnating due to the lack of territorial accessibility to specific goods. For this reason, the development of transport infrastructure contributes to better social, economic and spatial interdependence of the country and supports the development of the economy on national level.

The traffic model is a strategic tool designed to assess the impact of changes in strategic documents (e.g. transport policy, strategic development plan, etc.) at EU, national and regional level. In this case, the territory of interest is TRITIA, which consists of the Moravian-Silesian Region, the Opole and Silesian Voivodeships and the Žilina Region. The analyses were processed mainly for the main transport network and the main transport relations in the territory of TRITIA. The TRITIA traffic model is not sufficiently detailed to assess infrastructure in and near the cities and it does not have the necessary information value for such evaluation. This is due to the fact that the model is structurally designed as a macroscopic model of long-distance transport relations and the situation near cities have not been sufficiently mapped.

The TRITIA traffic model was processed and calibrated based on the data described in the reports D.T3.1.4. Evaluation of traffic surveys and D.T3.2.2 Report on the zero scenario. The traffic model covers regions in 3 countries (CZ, PL, SK) and the processing of relevant data is a complicated process in terms of organization, cooperation between project partners and other stakeholders. In general, the traffic model is a complex mathematical-traffic tool that is needed to be regularly updated to retain its accuracy. To achieve high accuracy it is necessary to have sufficient time and personal capacities.

Processing package WP T3 Development of TRITIA traffic model in the project, traffic surveys were elaborated for the purpose of obtaining data on the transport demand behaviour and the data also served for validation of the traffic model. Within the project a questionnaire survey for goods transportation was performed at the border crossings, profile traffic surveys were performed at selected points of infrastructure and questionnaires were sent to selected operators. Due to the low number of responses, the results of the inquiry survey were not accepted as a suitable sample for freight transport analysis and the survey was declared unsuccessful.

The purpose of the traffic model of macroscopic relations within the TRITIA area was its application in strategic planning. Within its functionality it enables identification of bottlenecks of transport infrastructure like insufficient technical parameter of existing infrastructure, but it can also describe traffic model preferences on certain transport relations.

The model addresses the shift of road transport to environmentally friendly modes of transport, meaning railway and water transport. The model addresses the infrastructure utilization potential, where the overall potential is understood as a modal shift from roads to other modes of transport without limiting their capacity. The consequences of such a shift may be creating of bottlenecks on the existing infrastructure and the model with its complexity can identify those potential future problems. The model took into account the maximum potential without the differentiations of commodities, and harnessed the potential of usage of universal transfer unit (IPJ - 40´container), which has a wide range of possibilities for the transport of different commodities.

Report D.T3.2.3 describes development and testing of alternative scenarios of TRITIA traffic model based on the results of the zero scenario in 2030. This means the identification of bottlenecks on environmentally friendly transport modes in the TRITIA infrastructure and through alternative scenarios measures were tested for their influence on the modal shift.

# 2. Alternative scenarios of TRITIA traffic model

Mobility of goods is an essential part of the EU internal market and an essential part of maintaining the competitiveness of the European economy. In recent years, the volume of inland freight transport in the EU (including road, railway and inland waterway transport) has stabilized at around 2 300 billion tonne-kilometres per year, with road transport accounting for around 75% of this volume. The EU policy objectives of shifting goods from road to more efficient and sustainable modes of transport (especially freight railway and inland waterway) have been a priority for the EU over the last 25 years.

These principles should be applied from the EU to the regional level. As a result of economic convergence, TRITIA is a particularly suitable candidate for meeting the European transport challenges identified in the White Paper as a roadmap to create a competitive and resource efficient transport system.

Railway transport, together with inland waterway transport, can be the most economical mode of transport. Especially if used with specific transport units and specific commodities:

- Large volume of goods transported, in most cases bulk cargo (mineral fuels, coal, ore, raw materials, chemical products…),
- Intermodal transport units - containers. These are standardized transport handling units adapted for the transport of goods by one or more modes of transport (without the necessity of reloading the cargo itself), and handling of the containers themselves is quick and simple, which is facilitated by the design of the transport unit itself.

The zero scenario of the traffic model potential for the use of the transport infrastructure in the TRITIA region by the year 2030 considered the natural development of the assessed area, which means that the assumption was made that the planned projects defined in the strategic documents will be implemented.

The macroeconomic theory suggests that the natural development of the territory is assessed on the basis of the growth of the country's GDP (region), so it was necessary to estimate GDP development in the TRITIA model by 2030. Since the economic development estimate for the 10-year period is influenced by a number of factors that are very difficult to predict, an optimistic, pessimistic and realistic scenario was considered. The optimistic scenario is based on the assumption that the economy's growth will be higher than estimated in the underlying realistic assumptions. The pessimistic scenario considers the possibility of a slowdown in economic development, and it is estimated that development by 2030 is likely to be realistic.

The main role in modelling alternative scenarios is to examine the impact of changes in the economy and parameters on transport demand in the traffic model. The preparation of modelling alternative scenarios consists of two basic procedures:

- identification of bottlenecks on the infrastructure in the TRITIA areas by identifying those infrastructure objects (sections) where capacity problems occur;
- modelling of the development of the economic parameter (GDP) and testing of individual input parameters (prices for the use of transport infrastructure, prices for transhipment and their combinations) and their impact on the change in the modal split.

## 2.1. Identification of infrastructure bottlenecks and possibilities for increasing its capacity

The description of the complex issue of the transport sector in terms of identifying deficiencies related to transport infrastructure also describes aspects of the organization of operations or strategic planning for the development of transport infrastructure. Based on the identified bottlenecks, proposals were made for measures to eliminate the identified problems. The current and forecasted volume of freight transport (which is dealt with in the TRANS TRITIA project) is performed mainly on the road transport infrastructure network. The aim of the project is to identify the potential of shifting this traffic to alternative modes of transport.

In order to optimize the performance of multimodal logistics chains, including the increased use of more energy efficient modes, the White Paper on Transport envisages shifting 30% of road freight over 300 km to other modes of transport, such as railway or waterway (by 2030), an up to 50% by 2050.

To achieve this, it is absolutely necessary to assess the suitability of existing infrastructure, its capacity parameters (both now and in the future) whether it is able to cover such an increase. As a result, requirements for transport infrastructure capacity are increasing. The constant increase in freight transport has a direct negative impact on the load on the transport network and its facilities, which is reflected both in the rural and in the urban areas of towns and municipalities.

Already at present, the full capacity is reached on parts of the transport infrastructure and there are noticeable congestions that result in insufficient throughput. Based on this data, bottlenecks on the network can be identified.

In terms of general terminology, capacity refers to the maximum amount transport units that a transport infrastructure can let through per unit of time.

In general, the level of capacity also depends on the fulfilment of the basic condition that defines the transport:

$$D_{i,j} = \sum D_{i,j},t,p,u,r$$

i.e. transport from origin 'i' to destination 'j' depends on the transport time (t) in which it is carried out, the purpose of the trip (u), the route chosen (r) and the type of means of transport (p) – (road / railway / water / air).

Due to the exceeding of the capacity of transport infrastructure (or its facilities), the bottlenecks of the infrastructure become evident themselves in negative impacts not only on their direct location, but also on operators and production companies.

Today, the production process uses a variety of production and delivery management concepts, including the Just in Time (JIT) and Just in Sequence (JIS) concepts. Both concepts are about increasing production efficiency and reducing waste of resources in production. The basic idea of both concepts is production based on customer requirements and delivery of components for the line in the required quality, quantity and as soon as possible - so that the product is produced just before the client requests it.

These systems are dependent on flexibility and rapid response from suppliers. The most frequent negative effects are downtime of freight vehicles, which are caused by congestions, poor state of infrastructure, unplanned detour, poor organization of the process on cross-border (downtime at the border crossing point) and other.

Infrastructure bottlenecks in terms of means of transport:

- Have a negative impact on the environment,

- Cause unnecessary costs for the carrier, as they are limiting more efficient use of the transport vehicles,
- May cause late delivery of goods to the customer, which may result in a restrict the production within the just-in-time, just-in-sequence logistics chain,
- May cause distrust in the use of transport mode, which may result in a decline in demand.

The identified bottlenecks play an important role in the choice of transport mode (deciding on the use of a particular mode of transport by the carrier), on which the level of traffic infrastructure load depends. For this reason, it is necessary to define the scope of those measures that will eliminate the identified bottlenecks in the infrastructure, which will result in a more favourable traffic flow in the restricted section and at the same time reallocate the traffic burden between modes of transport with respect to transport costs. The measures are mostly aimed at eliminating infrastructure capacity problems and can be solved by various types of project, which can generally be defined as follows:

- Increasing the capacity of the existing transport infrastructure - expansion of the road (4 lanes, 3 lanes - lane alternation), addition of climbing lanes on the road, completion of grade-separated crossings; increasing railway capacity by technological or infrastructural means; installation of the gantry crane od expansion of storage area in the intermodal terminal.
- Construction of new transport infrastructure - road relocation, construction of a bypass, new road, highway, expressway, construction of a new railway line, construction of a railway siding, construction of a new intermodal transport terminal.

### 2.1.1. Railway transport

The development of railway infrastructure at pan-European level can be considered insufficient compared to the development of road transport infrastructure. The quality and availability of railway infrastructure is significantly lagging behind especially in the eastern regions of the EU (including Slovakia, Czech Republic and Poland), where high-speed railway lines are absent. In the case of conventional railway lines there is a significant modernization deficit, which is reflected in long travel time of passengers and goods transportation.

The following types of bottlenecks are identified on railway infrastructure of these regions:

- Lack of interconnections - the lack of railway lines interconnections represents a serious obstacle to the traffic flow (goods).
- Border crossing points - these are among the most vulnerable areas of the railway infrastructure connections. According to the Commission document “Comprehensive analysis of the existing cross-border railway transport connections and missing links on the internal EU borders” from 2018, 149 (41%) of the 365 EU internal railway border crossings are not functional.
- Maintenance - Inadequate maintenance of existing railway infrastructure has a significant impact on the quality, safety, efficiency and sustainability of the railway transport.
- Speed - the average speed of freight trains is significantly low and does not compete with road transport, but has not increased over the last decade. In Central and Eastern European Member States, the average speed ranges from 20 to 30 km/h. The situation is better on the main railway freight corridors.
- Terminals, marshalling yards - access to terminals, switch infrastructure, reloading terminals and other essential railway infrastructure facilities is a key part of efficient railway transport operation.

Bottlenecks on the railway infrastructure can be solved in the form of:

- Construction / Reconstruction - The construction of new railway lines or the renewal and modernization of existing lines usually involve increasing of the speed and adaptation to interoperability requirements.
- Nodes - upgrading railway junctions, adding rails, or increasing the infrastructure throughput.
- Siding - as railway tracks serve the own needs of the operator (entrepreneur) and are connected to a national or regional railway or other siding in the form of a connection of a railway station with an industrial facility.

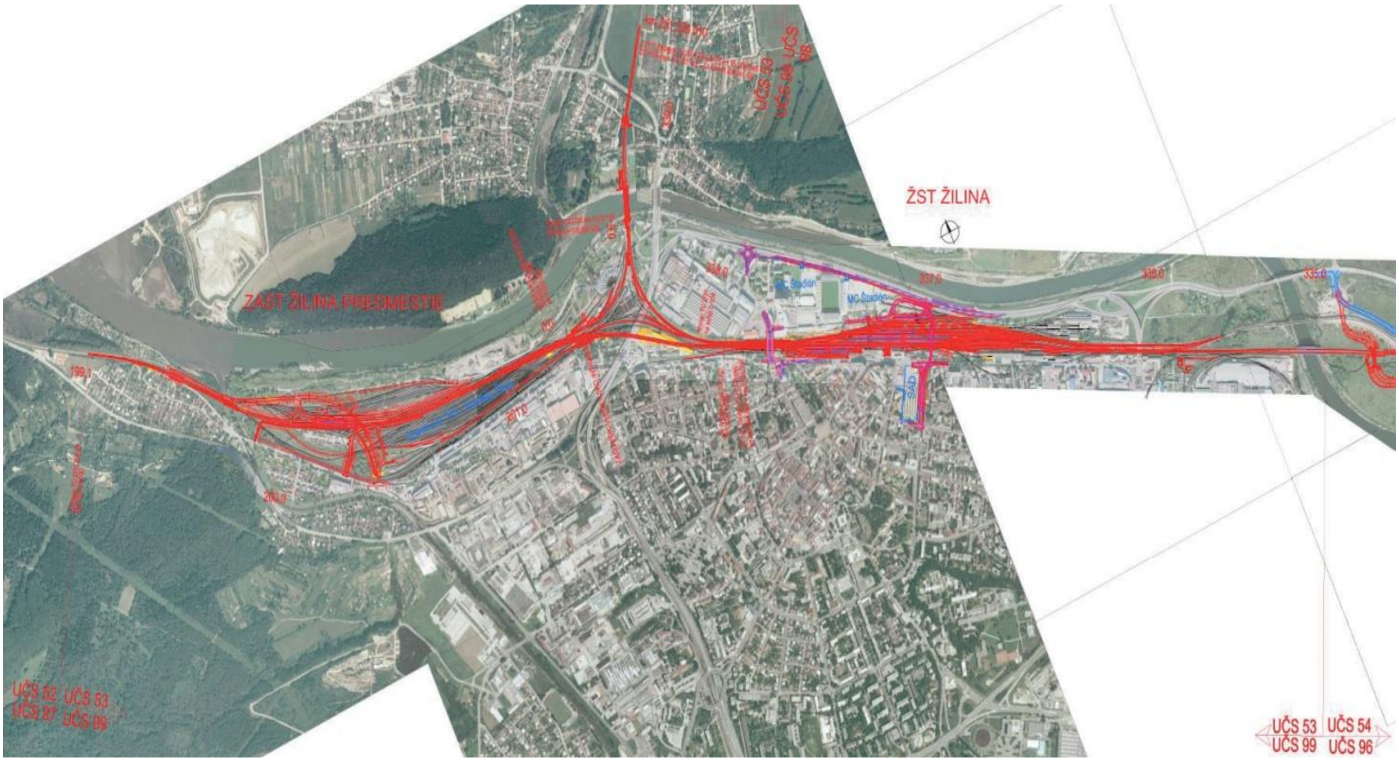



**Figure 1 Example of planned modernization of railway node Žilina.**

In assessing alternative scenarios for transport and modal split on the main transport corridors in the TRITIA region, attention was also paid to developments in railway transport.

The analysis focused on assessment of bottlenecks (sections with insufficient capacity) on railway lines in the Žilina and Moravian-Silesian regions. The project partner from Poland did not provide the necessary data on its railway lines, so these are not included in this version of the analysis.

The input data for the analysis were data for specific sections of the track relating to the number of tracks, weekly capacity and the number of passenger and freight trains in this section bidirectional weekly. All data refer to year 2020.

In addition to this data, the analysis also took into account the planned projects on the individual sections of the railway lines, the task of which is to modernize the railway lines or railway nodes in order to increase the transport capacity of the section or the whole section of the line.

Input data for the Slovak Republic and the Czech Republic are given in the following tables and figures.

**Table 1 Analysed track sections in Žilina region**

| ID | Section name | Tracks (number) | Capacity 2020 (Number of trains/week) | Occupancy rate (%) | Freight/Passenger transport | Number of passenger trains/week (2020) | Number of freight trains/week (2020) | Number of trains/week (2020) | Planned projects on section (project numbers) |
|---|---|---|---|---|---|---|---|---|---|
| SK01-A | Košice (border of Žilina region) - Vrútky | 2 | 2296 | 67,60 % / 70,37 % | Both | 588 | 868 | 1456 | 3, 4, 5, 6, 7, 8 |
| SK01-B | Vrútky - Žilina | 2 | 2611 | 62,70 % / 68,29% | Both | 588 | 868 | 1456 | 1, 9 |
| SK02 | Žilina - Bratislava (border of Žilina region) | 2 | 1771 | 55,90 % / 52,86 % | Both | 287 | 665 | 952 | 1 |
| SK03 | Žilina - Čadca - Mosty u Jablunkova (CZ) | 2 | 2289 | 53,70 % / 42,97 % | Both | 432 | 707 | 1139 | 1, 2 |
| SK04 | Čadca - Skalité - Zwardoň (PL) | 1 | 532 | 19,80 % | Both | 94 | 63 | 157 | |
| SK05-C | Diviaky - Vrútky | 2 | 1106 | 33,80 % / 37,18 % | Both | 312 | 189 | 501 | |


**Figure 2 Railway lines in Žilina region.**[1]

[1] Source: Adapted ŽSR map

The current list of infrastructural railway projects of modernization within the Žilina region is in the following table.

**Table 2 Planned projects for modernization and capacity increase of railway lines in Žilina region till 2030**

| Project ID | Project name | Project type | Planned timeframe of the project (construction) |
|---|---|---|---|
| 1. | Žilina node | Infrastructural, modernization with new line signalling and safety (ETCS 2 with GSMR) and transition to 25kV traction system | 2019 – 2021 |
| 2. | Krásno nad Kysucou – Čadca (border), section Čadca – Krásno nad Kysucou | Modernization of infrastructure, line signalling and safety and transition to 25kV traction system | 2022 – 2025 (approx.) |
| 3. | Poprad – Východná | Modernization of infrastructure, line signalling and safety and transition to 25kV traction system | 2025 - 2028 |
| 4. | Východná – Liptovský Hrádok | Modernization of infrastructure, line signalling and safety and transition to 25kV traction system | 2024 - 2026 |
| 5. | Liptovský Hrádok – Liptovský Mikuláš | Modernization of infrastructure, line signalling and safety and transition to 25kV traction system | 2020 - 2023 |
| 6. | Liptovský Mikuláš – Ružomberok | Modernization of infrastructure, line signalling and safety and transition to 25kV traction system | 2024 - 2025 |
| 7. | Ružomberok – Turany | Modernization of infrastructure, line signalling and safety and transition to 25kV traction system | 2026 - 2029 |
| 8. | Turany – Vrútky | Modernization of infrastructure, line signalling and safety and transition to 25kV traction system | 2024 - 2025 |
| 9. | Vrútky – Varín | Modernization of infrastructure, line signalling and safety and transition to 25kV traction system | 2026 - 2028 |

**Table 3 Analysed track sections in the Moravian-Silesian region**

| ID | Section name | Tracks (number) | Capacity 2020 (Number of trains/week) | Occupancy rate (%) | Freight/Passenger transport | Number of passenger trains/week (2020) | Number of freight trains/week (2020) | Number of trains/week (2020) | Planned projects on section (project numbers) |
|---|---|---|---|---|---|---|---|---|---|
| CZ301A-1 | (SK) st.hr. - Mosty u Jabl. st. border | 2 | 1554 | 42 %/53 % | Both | 294 | 331 | 625 | |
| CZ301A-2 | Mosty u Jabl.st.hr. - Návsí | 2 | 2135 | 40 %/44 % | Both | 450 | 330 | 780 | |
| CZ301A-3 | Návsí - Bystřice n. Olší | 2 | 2338 | 41 %/41 % | Both | 540 | 330 | 870 | |
| CZ301A-4 | Bystřice n. Olší - Třinec | 2 | 1967 | 50 %/48 % | Both | 550 | 284 | 834 | |
| CZ301A-5 | Třinec - Český Těšín freight. st. | 2 | 1687 | 78 %/79 % | Both | 568 | 531 | 1099 | |
| CZ301A-6 | Český Těšín - Chotěbuz | 2 | 1841 | 97 %/47 % | Both | 686 | 436 | 1122 | 6 |
| CZ301A-7 | Chotěbuz - Louky n. Olší | 2 | 1281 | 117 %/47 % | Both | 446 | 274 | 720 | 6 |
| CZ301A-8 | Louky n. Olší - Karviná | 2 | 1533 | 50 %/54 % | Both | 446 | 204 | 650 | |
| CZ301A-9 | Karviná - switch Koukolná | 2 | 1449 | 61 % /53 % | Both | 460 | 213 | 673 | |
| CZ301A-10 | switch Koukolná - Dětmarovice | 2 | 1274 | 56 % /51 % | Both | 460 | 118 | 578 | 3 |
| CZ301A-11 | Dětmarovice - Bohumín passenger st. | 2 | 1834 | 68 % /61 % | Both | 563 | 432 | 995 | 3, 9 |
| CZ305B-1 | Bohumín passenger st. - Bohumín-Vrbice | 2 | 1827 | 108 %/111% | Both | 972 | 401 | 1373 | 9, 10 |
| CZ305B-2 | Bohumín-Vrbice - Ostrava-Hrušov | 2 | 1827 | 108 % /111 % | Both | 983 | 626 | 1609 | 9, 10 |
| CZ305B-3 | Ostrava-Hrušov - Ostrava main st. | 2 | 1827 | 108 % /111 % | Both | 983 | 643 | 1626 | 1 |
| CZ305B-4 | Ostrava main st. - Ostrava-Mar. Hory | 2 | 1918 | 118 %/116 % | Both | 1340 | 416 | 1756 | 1 |
| CZ305B-5 | Ostrava - Mar. Hory - Ostrava entrance switch | 2 | 1918 | 118 %/116 % | Both | 1340 | 541 | 1881 | 1 |
| CZ305B-6 | Ostrava entrance switch - Ostrava-Svinov | 2 | 1918 | 118 %/116 % | Both | 1340 | 599 | 1939 | 1, 7 |
| CZ305B-7 | Ostrava-Svinov - switch Polanka n.Odrou | 2 | 2380 | 73 %/ 79 % | Both | 1090 | 563 | 1653 | 1, 5, 7 |
| CZ305B-8 | Výh. Polanka n. Odrou - Jistebník | 2 | 2499 | 75 %/79 % | Both | 1090 | 683 | 1773 | 5 |
| CZ305B-9 | Jistebník - Studénka | 2 | 2373 | 84 % /79 % | Both | 1090 | 683 | 1773 | |
| CZ305B-10 | Studénka - Suchdol n.Odrou | 2 | 2163 | 81 %/83 % | Both | 934 | 702 | 1636 | 2, 5 |
| CZ305B-11 | Suchdol n.Odrou - Jeseník n. Odrou | 2 | 2191 | 79 %/ 79 % | Both | 930 | 687 | 1617 | 2, 5 |
| CZ305B-12 | Jeseník n.Odrou - Polom (border MSR) | 2 | 2128 | 93 %/ 73 % | Both | 930 | 687 | 1617 | 2, 5 |
| CZ301D-1 | Český Těšín - switch Chotěbuz | 2 | 1967 | 97 %/46 % | Both | 478 | 339 | 817 | |
| CZ301D-2 | switch Chotěbuz - Albrechtice u Č.Těšína | 2 | 1421 | 120 %/ 46 % | Both | 478 | 339 | 817 | |
| CZ301D-3 | Albrechtice u Č.Těšína - Havířov | 2 | 1932 | 47 %/ 52 % | Both | 478 | 346 | 824 | 6 |
| CZ301D-4 | Havířov - Ostrava - Bartovice | 2 | 2009 | 53 %/61 % | Both | 606 | 418 | 1024 | |
| CZ301D-5 | Ostrava-Bartovice - Ostrava-Kunčice | 2 | 2009 | 62 %/ 44 % | Both | 606 | 314 | 920 | 7, 8 |
| CZ301D-6 | Ostrava-Kunčice - Ostrava-Vítkovice | 2 | 2331 | 34 % / 33 % | Both | 482 | 186 | 668 | 7, 8 |

| ID | Section name | Tracks (number) | Capacity 2020 (Number of trains/week) | Occupancy rate (%) | Freight/Passenger transport | Number of passenger trains/week (2020) | Number of freight trains/week (2020) | Number of trains/week (2020) | Planned projects on section (project numbers) |
|---|---|---|---|---|---|---|---|---|---|
| CZ301D-7 | Ostrava-Vítkovice – switch Odra | 2 | 1876 | 44 % / 41 % | Both | 482 | 186 | 668 | 7 |
| CZ301D-8 | Odb. Odra – switch Polanka n.Odrou | 1 | 784 | 21% | Freight | 0 | 128 | 128 | 7 |
| CZ301B-1 | Petrovice u K. state border – switch Závada | 1 | 1652 | 48 % /48 % | Both | 248 | 312 | 560 | 3, 4 |
| CZ301B-2 | switch Závada - Dětmarovice | 1 | 1526 | 44 %/43 % | Both | 248 | 407 | 655 | 3 |
| CZ305A | Bohumín state border (PL) – Bohumín | 1 | 749 | 23% | Both | 161 | 0 | 161 | 9, 10 |
| CZ305C | Bohumín-Vrbice state border (PL) – Bohumín-Vrbice | 1 | 364 | 92% | Both | 12 | 252 | 264 | 9, 10 |
| CZ301C | switch Koukolná – switch Závada | 1 | 665 | 21% | Both | 28 | 95 | 123 | |
| CZ301G-1 | Ostrava main st. (uhelné nádr.) – Ostrava cent. | 2 | 1652 | 79 %/71 % | Both | 762 | 287 | 1049 | 1 |
| CZ301G-2 | Ostrava cent. – Ostrava-Kunčice | 2 | 1764 | 65 %/65 % | Both | 706 | 243 | 949 | 1, 7, 8 |
| CZ302A-1 | Ostrava-Kunčice - Vratimov | 2 | 1925 | 34 %/42 % | Both | 387 | 232 | 619 | 8 |
| CZ302A-2 | Vratimov - Paskov | 1 | 735 | 83% | Both | 386 | 128 | 514 | 8 |
| CZ302A -3 | Paskov – Lískovec u F.Místku | 1 | 679 | 81% | Both | 386 | 81 | 467 | 8 |
| CZ302A -4 | Lískovec u F.Místku – Frýdek-Místek | 1 | 735 | 74% | Both | 386 | 81 | 467 | 8 |
| CZ306A-1 | Studénka – Sedlnice-Bartošovice | 1 | 896 | 50% | Both | 350 | 49 | 399 | 11 |
| CZ306A-2 | Sedlnice-Bartošovice – Sedlnice switch no.1 | 1 | 1015 | 44% | Both | 224 | 49 | 273 | 11 |

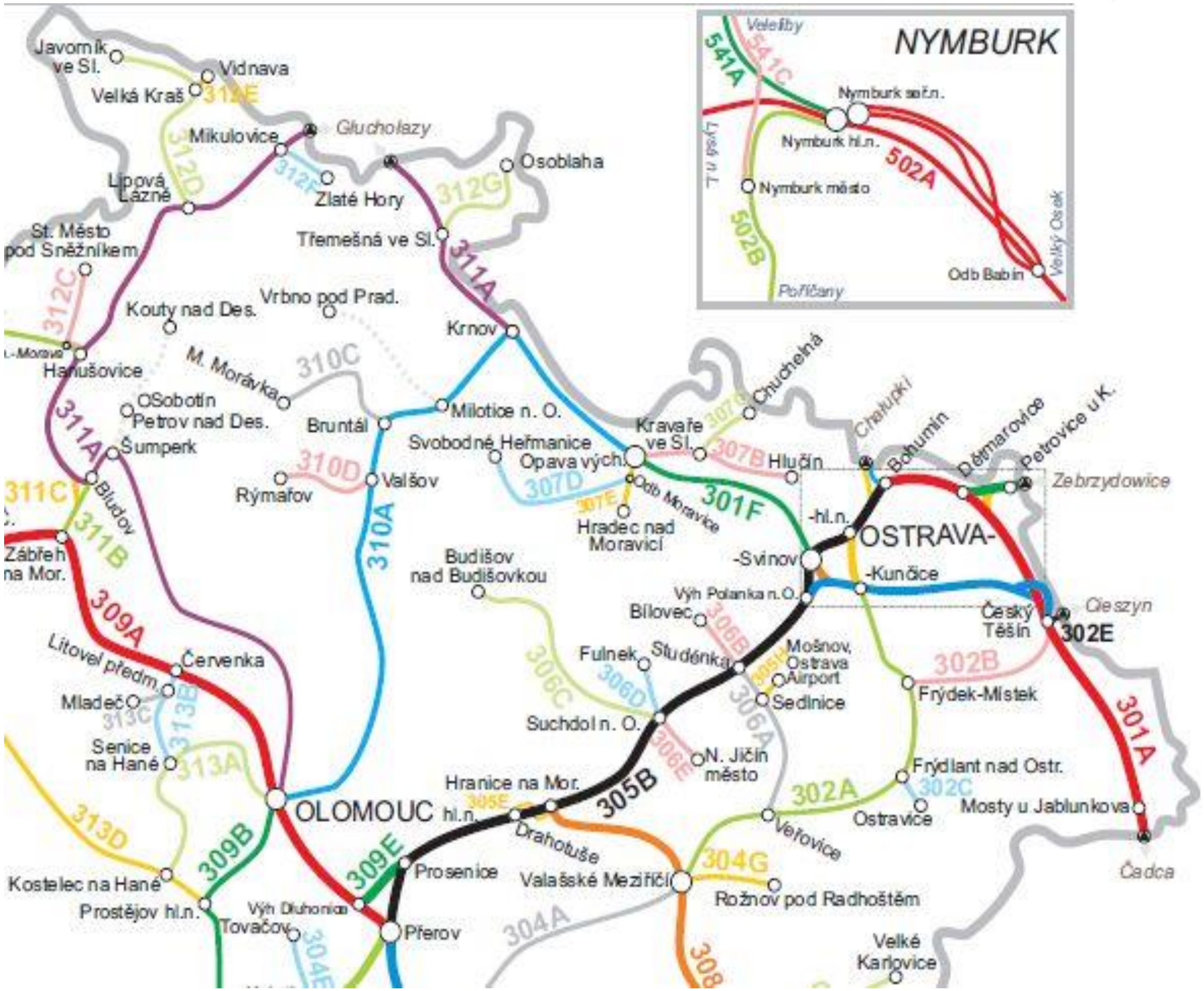



Figure 3 Railway network in the Moravian-Silesian region

The list of current infrastructural railway projects of modernization within the Moravian-Silesian Region is in the following table.

**Table 4 Planned projects for modernization and capacity increase of railway lines in Moravian-Silesian region**

| Project ID | Project name | Project type | Planned timeframe of the project (construction) |
|---|---|---|---|
| 1. | Modernization of Ostrava railway node | modernization and capacity utilization of the railway junction Ostrava main st. and adjacent track sections,<br>triple track of section Ostrava-Svinov-Ostrava main st. (Frýdlantské nádraží)<br>fourth track of section -Ostrava Mar. Hory stop station - Ostrava main st.<br>construction of tracks rearrangement,<br>track section Ostrava (Frýdlantské nádraží) - Ostrava cent. stop station | 07/2025 - 08/2033 |
| 2. | Polom - Suchdol n. O., BC | Reconstruction of 12,525 km of track,<br>new railway turning Vražné (0,200 km) | 3/2022 - 11/2023 |
| 3. | Dětmarovice - Petrovice u K., crossing border PR, BC (□) | reconstruction of 9,8 km of track and railway station Petrovice u. Karviné and Dětmarovice, Increase speed to 100 km/h | 03/2020 - 07/2022 |
| 4. | Reconstruction of railway st. Petrovice u Karviné | track electrification, new safety device ,<br>displacement of Dětmarovice head by 0,176 km, extension of track for freight trains 740 m, new platform | 3/2020 - 7/2022 |
| 5. | HSL Moravská brána (new Hight speed railway line) | diverting long-distance passenger traffic to a new line and thus creating new capacity for freight trains on an existing network | Project 2020-2025 |
| 6. | Optimization section line Český Těšín (outside) - Albrechtice u Českého Těšína (including) | increase speed from 80 km/h to 100 -145 km/h | 03/2022 - 03/2023 |
| 7. | Optimisation of track section Ostrava-Kunčice (outside) - Ostrava-Svinov/Polanka nad Odrou | track reconstruction in the section and station Ostrava-Vítkovice, increase speed to 120 km/h | n/a |
| 8. | Optimization and electrification of railway line Ostrava-Kunčice - Frýdek-Místek | double-track (13,797 km) and electrification of existing tracks in the Vratimov - Frýdek-Místek section, extension of rails at freight train stations 740 m long, increase speed to 120 km/h | 08/2021 - 12/2023 |
| 9. | Reconstruction of head of station Bohumín-Vrbice (for direction Chałupki) and line track in the section Bohumín Vrbice (outside) - Chałupki | track reconstruction in the section Bohumín-Vrbice (outside) - border crossing PR,<br>new railway turning Bohumín-Pudlov | 03/2022 - 10/2022 |
| 10. | track line interconnection -<br>305C Bohumín-Vrbice - Chałupki and 305A Bohumín - Chałupki (railway turning Bohumín - Pudlov) | track line interconnection (305C and 305A) by switches, renewal of the Bohumín - Pudlov railway turning | n/a |
| 11. | new connecting line (connection) between | new connecting line (connection) between line 305B (near Studénka station) and 306A (Sedlnice - Bartošovice station) | n/a |
| | line 305B and 306A in direction Přerov - Mošnov | Sedlnice-Bartošovice station - new track | (est. 09/2020) |
| | and capacity increase of the Sedlnice-Bartošovice and Sedlnice station | Sedlnice - station - new track | |

## Table 5 Analysed track sections in the Silesian and Opole Voivodeship

| ID | Section name | Tracks (number) | Capacity 2020 (Number of trains/week) | Occupancy rate (%) | Freight/Passenger transport | Number of passenger trains/week (2020) | Number of freight trains/week (2020) | Number of trains/week (2020) | Planned projects on section (project numbers) |
|---|---|---|---|---|---|---|---|---|---|
| PL190 | Skoczów - Goleszów | 2 | 399 | 21% | Passenger | 84 | 0 | 84 | 2 |
| PL93-1 | Chrzanów - Oświęcim | 2 | 413 | 47% | Both | 182 | 14 | 196 | 2, 4 |
| PL93-2 | Oświęcim - Czechowice Dziedzice | 2 | 357 | 63% | Both | 84 | 140 | 224 | 2 |
| PL93-3 | Ochodza - Zebrzydowice | 2 | 1050 | 23% | Both | 84 | 161 | 245 | |
| PL131-1 | Chorzów Stary - Bytom Północny | 2 | 791 | 53% | Both | 238 | 182 | 420 | |
| PL131-2 | Radzionków - Tarnowskie Góry | 2 | 1029 | 67% | Both | 238 | 448 | 686 | |
| PL131-3 | Tarnowskie Góry - Zwierzyniec | 2 | 966 | 74% | Both | 322 | 392 | 714 | |
| PL131-4 | Strzebiń - Kalina | 2 | 735 | 63% | Both | 98 | 364 | 462 | |
| PL131-5 | Herby Nowe - Kłobuck | 2 | 511 | 71% | Freight | 0 | 364 | 364 | |
| PL136 | Opole Groszowice - Kędzierzyn-Koźle | 2 | 637 | 64% | Both | 112 | 294 | 406 | |
| PL139-1 | Katowice Ligota - Mąkołowiec | 2 | 1484 | 90% | Both | 1141 | 189 | 1330 | |
| PL139-2 | Tychy - Pszczyna | 2 | 1015 | 79% | Both | 588 | 217 | 805 | |
| PL139-3 | Goczałkowice - Bielsko-Biała Główna | 2 | 910 | 43% | Passenger | 392 | 0 | 392 | 9 |
| PL139-4 | Bielsko-Biała Główna - Żywiec | 2 | 399 | 77% | Both | 301 | 7 | 308 | 9 |
| PL139-5 | Żywiec - Zwardoń | 2 | 357 | 53% | Both | 182 | 7 | 189 | 3, 5, 8 |
| PL140-1 | Rybnik - Rybnik Niewiadom | 2 | 1071 | 23% | Both | 203 | 42 | 245 | 3, 5, 8 |
| PL140-2 | Rydułtowy - Sumina | 2 | 560 | 38% | Both | 203 | 7 | 210 | 3, 5, 8 |
| PL140-3 | Sumina - Nędza | 2 | 889 | 26% | Both | 217 | 14 | 231 | |
| PL151-1 | Stare Koźle - Kuźnia Raciborska | 2 | 966 | 50% | Both | 301 | 182 | 483 | |
| PL151-2 | Kuźnia Raciborska - Racibórz | 2 | 728 | 38% | Both | 210 | 63 | 273 | |
| PL151-3 | Racibórz - Chałupki | 2 | 588 | 48% | Both | 203 | 77 | 280 | 3 |
| PL158-1 | Olza - Wodzisław Śląski | 2 | 434 | 61% | Both | 217 | 49 | 266 | 3 |
| PL158-2 | Wodzisław Śląski - Radlin Obszary | 2 | 574 | 88% | Both | 455 | 49 | 504 | 3 |
| PL158-3 | Radlin Obszary - Rybnik Towarowy | 2 | 987 | 58% | Both | 462 | 112 | 574 | 1 |
| PL-287 | Opole Zachodnie - Nysa | 2 | 224 | 56% | Passenger | 126 | 0 | 126 | 2 |


**Figure 4 Railway network in the Silesian and Opole Voivodeship**

The current list of infrastructural railway projects of modernization within the Silesian and Opole Voivodeship is in the following table.

**Table 6 Planned projects for modernization and capacity increase of railway lines in Silesia and Opole Voivodeship region**

| Project ID | Project name | Project type | Planned timeframe of the project (construction) |
|---|---|---|---|
| 1 | Works on the Line No. 287 section Opole - Nysa | Modernization of infrastructure | 2021 (end of construction) |
| 2 | Works on the Line No. E30/E65 wihin Line No.93, section Będzien-Katowice-Tychy-Czechowice Dziedzice-Zebrzydowcie | Modernization of infrastructure | 2021 (end of construction) |
| 3 | Improving the technical condition of railway lines No. 140 and 158, on the section Rybnik - Chałupki | Modernization of infrastructure | 2023 (end of construction) |
| 4 | Works on the Line No. 93, section Trzebinia-Oświęcim-Czechowice-Dziedzice | Modernization of infrastructure | 2023 (end of construction) |
| 5 | Works on the Line No.140,148,157,159,173, section Chybie-Żory-Rybnik-Nędza | Modernization of infrastructure | 2023 (end of construction) |
| 6 | Reconstruction of the railway conection on section Kędzierzyn - Koźle - Opole Zachodnie (Line No. E30) | Modernization of infrastructure | Reserve project on the KPK list |
| 7 | Works on the Line E59, section Kędzierzyn- Koźle - Chałupki | Modernization of infrastructure | Reserve project on the KPK list |
| 8 | Revitalization Line No. 140 on section Rybnik Towarowy | Modernization of infrastructure | Reserve project on the KPK list |
| 9 | Reconstruction of the railway Line No. 139, section Czechowice Dziedzice - Bielsko-Biała- Zwardoń | Modernization of infrastructure | Reserve project on the KPK list. Section Bielsko-Biała Lipnik - Węgierska Górka (2017-2023) |

The output of the traffic model and assessment is to make the capacity utilization of the railway sections under consideration in 2030 in view of GDP growth. In addition to GDP growth, also the potential shift from road to railway transport is taking into account.

The conclusions of the assessment point out which track sections will be suitable for capacity in 2030 for each option and where additional capacity enhancement measures will be necessary if the assumptions set out in the TRITIA traffic model are met by 2030 or beyond .

Bottlenecks on railway infrastructure with utilization of more than 80% by the year 2030, need to be addressed in near future. For sections with utilization between 70% and 80%, the necessary measures should be considered in the next few years. Sections with utilization below 70% were considered to be capacity-compliant without the need for additional measures. Similarly, the sections where the modernization is planned between the years 2020 and 2030 were considered as capacity-compliant. It was assumed that the planed measures should sufficiently increase the capacity.

The traffic model of the TRITIA region shows that, by 2030, 49.33% of the total potential of road transport could shift on railway. Railway freight transport will naturally evolve by 2030, based on the assumption of GDP growth in individual countries, and at the same time the potential for shifting from road freight transport has been identified, which may further increase the utilization of railway infrastructure.

All these assumptions have been summarized in the assessment of the utilization of railway sections, whose outputs for individual GDP development scenarios (pessimistic, realistic-zero, optimistic) are presented in the following tables.

The tables show only sections that do not meet the capacity condition and enhancement measures should be implemented. The sections are sorted by priority in the following tables.

**Table 7 Railway sections with insufficient capacity in 2030 - realistic alternative**

| Priority | ID | Section name | Tracks (number) | Capacity (Number of trains/week) (2030) | Number of passenger trains/week (2030) | Number of freight trains/week (2030) | Number of containers/day (2030) | Number of container trains/day (2030) | Number of container trains/week (2030) | Number of total trains/week (2030) | Occupancy rate (%) (2030) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | PL131-5 | Herby Nowe - Kłobuck | 2 | 511 | 0 | 419 | 794 | 40 | 280 | 699 | 136,8% |
| 2 | SK05-C | Diviaky - Vrútky | 2 | 1106 | 312 | 218 | 2759 | 138 | 966 | 1496 | 135,3% |
| 3 | PL139-2 | Tychy - Pszczyna | 2 | 1015 | 588 | 250 | 1457 | 73 | 511 | 1349 | 132,9% |
| 4 | PL139-1 | Katowice Ligota - Mąkołowiec | 2 | 1484 | 1141 | 218 | 1457 | 73 | 511 | 1870 | 126,0% |
| 5 | CZ301A-5 | Třinec - Český Těšín nákl. nádr. | 2 | 1687 | 568 | 611 | 2429 | 122 | 854 | 2033 | 120,5% |
| 6 | PL131-4 | Strzebiń - Kalina | 2 | 735 | 98 | 419 | 794 | 40 | 280 | 797 | 108,4% |
| 7 | PL131-2 | Radzionków - Tarnowskie Góry | 2 | 1029 | 238 | 516 | 794 | 40 | 280 | 1034 | 100,5% |
| 8 | CZ301A-1 | (SK) st. border - Mosty u Jabl.st. border | 2 | 1554 | 294 | 381 | 2429 | 122 | 854 | 1529 | 98,4% |
| 9 | PL131-1 | Chorzów Stary - Bytom Północny | 2 | 791 | 238 | 210 | 794 | 40 | 280 | 728 | 92,0% |
| 10 | PL131-3 | Tarnowskie Góry - Zwierzyniec | 2 | 966 | 322 | 451 | 257 | 13 | 91 | 864 | 89,4% |
| 11 | CZ301A-4 | Bystřice n. Olší - Třinec | 2 | 1967 | 550 | 327 | 2429 | 122 | 854 | 1731 | 88,0% |
| 12 | CZ301D-2 | Odb. Chotěbuz - Albrechtice u Č.Těšína | 2 | 1421 | 478 | 390 | 839 | 42 | 294 | 1162 | 81,8% |
| 13 | CZ305B-9 | Jistebník - Studénka | 2 | 2373 | 1090 | 786 | 149 | 8 | 56 | 1932 | 81,4% |
| 14 | CZ301A-2 | Mosty u Jabl.st.hr. - Návsí | 2 | 2135 | 450 | 380 | 2429 | 122 | 854 | 1684 | 78,9% |
| 15 | CZ301A-3 | Návsí - Bystřice n. Olší | 2 | 2338 | 540 | 380 | 2429 | 122 | 854 | 1774 | 75,9% |
| 16 | PL136 | Opole Groszowice - Kędzierzyn-Koźle | 2 | 637 | 112 | 339 | 76 | 4 | 28 | 479 | 75,2% |

**Table 8 Railway sections with insufficient capacity in 2030 - optimistic alternative**

| Priority | ID | Section name | Tracks (number) | Capacity (Number of trains/week) (2030) | Number of passenger trains/week (2030) | Number of freight trains/week (2030) | Number of containers/day (2030) | Number of container trains/day (2030) | Number of container trains/week (2030) | Number of total trains/week (2030) | Occupancy rate (%) (2030) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | PL131-5 | Herby Nowe - Kłobuck | 2 | 511 | 0 | 437 | 829 | 42 | 294 | 731 | 143,1% |
| 2 | SK05-C | Diviaky - Vrútky | 2 | 1106 | 312 | 227 | 2879 | 144 | 1008 | 1547 | 139,9% |
| 3 | PL139-2 | Tychy - Pszczyna | 2 | 1015 | 588 | 261 | 1520 | 76 | 532 | 1381 | 136,1% |
| 4 | PL139-1 | Katowice Ligota - Mąkołowiec | 2 | 1484 | 1141 | 227 | 1520 | 76 | 532 | 1900 | 128,0% |
| 5 | CZ301A-5 | Třinec - Český Těšín freight st. | 2 | 1687 | 568 | 638 | 2535 | 127 | 889 | 2095 | 124,2% |
| 6 | PL131-4 | Strzebiń - Kalina | 2 | 735 | 98 | 437 | 829 | 42 | 294 | 829 | 112,8% |
| 7 | PL131-2 | Radzionków - Tarnowskie Góry | 2 | 1029 | 238 | 538 | 829 | 42 | 294 | 1070 | 104,0% |
| 8 | CZ301A-1 | (SK) st. border - Mosty u Jabl. st.border | 2 | 1554 | 294 | 398 | 2535 | 127 | 889 | 1581 | 101,7% |
| 9 | PL131-1 | Chorzów Stary - Bytom Północny | 2 | 791 | 238 | 219 | 829 | 42 | 294 | 751 | 94,9% |
| 10 | PL131-3 | Tarnowskie Góry - Zwierzyniec | 2 | 966 | 322 | 471 | 268 | 14 | 98 | 891 | 92,2% |
| 11 | CZ301A-4 | Bystřice n. Olší - Třinec | 2 | 1967 | 550 | 341 | 2535 | 127 | 889 | 1780 | 90,5% |
| 12 | CZ301D-2 | Odb. Chotěbuz - Albrechtice u Č.Těšína | 2 | 1421 | 478 | 407 | 876 | 44 | 308 | 1193 | 84,0% |
| 13 | CZ305B-9 | Jistebník - Studénka | 2 | 2373 | 1090 | 820 | 155 | 8 | 56 | 1966 | 82,8% |
| 14 | CZ301A-2 | Mosty u Jabl.st.hr. - Návsí | 2 | 2135 | 450 | 396 | 2535 | 127 | 889 | 1735 | 81,3% |
| 15 | CZ301A-3 | Návsí - Bystřice n. Olší | 2 | 2338 | 540 | 396 | 2535 | 127 | 889 | 1825 | 78,1% |
| 16 | PL136 | Opole Groszowice - Kędzierzyn-Koźle | 2 | 637 | 112 | 353 | 80 | 4 | 28 | 493 | 77,4% |

### Table 9 Railway sections with insufficient capacity in 2030 - pessimistic alternative

| Priority | ID | Section name | Tracks (number) | Capacity (Number of trains/week) (2030) | Number of passenger trains/week (2030) | Number of freight trains/week (2030) | Number of containers/day (2030) | Number of container trains/day (2030) | Number of container trains/week (2030) | Number of total trains/week (2030) | Occupancy (%) (2030) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SK05-C | Diviaky - Vrútky | 2 | 1106 | 312 | 208 | 2639 | 132 | 924 | 1476 | 133,5% |
| 2 | PL131-5 | Herby Nowe - Kłobuck | 2 | 511 | 0 | 401 | 760 | 38 | 266 | 667 | 130,5% |
| 3 | PL139-2 | Tychy - Pszczyna | 2 | 1015 | 588 | 239 | 1394 | 70 | 490 | 1317 | 129,8% |
| 4 | PL139-1 | Katowice Ligota - Mąkołowiec | 2 | 1484 | 1141 | 208 | 1394 | 70 | 490 | 1839 | 123,9% |
| 5 | CZ301A-5 | Třinec – Český Těšín freight st. | 2 | 1687 | 568 | 585 | 2323 | 117 | 819 | 2060 | 122,1% |
| 6 | PL131-4 | Strzebiń - Kalina | 2 | 735 | 98 | 401 | 760 | 38 | 266 | 765 | 104,1% |
| 7 | CZ301A-1 | (SK) st. border - Mosty u Jabl. st. border | 2 | 1554 | 294 | 365 | 2323 | 117 | 819 | 1533 | 98,6% |
| 8 | PL131-2 | Radzionków - Tarnowskie Góry | 2 | 1029 | 238 | 493 | 760 | 38 | 266 | 997 | 96,9% |
| 9 | PL131-1 | Chorzów Stary - Bytom Północny | 2 | 791 | 238 | 201 | 760 | 38 | 266 | 705 | 89,1% |
| 10 | CZ301A-4 | Bystřice n. Olší – Třinec | 2 | 1967 | 550 | 313 | 2323 | 117 | 819 | 1729 | 87,9% |
| 11 | PL131-3 | Tarnowskie Góry - Zwierzyniec | 2 | 966 | 322 | 432 | 246 | 13 | 91 | 845 | 87,5% |
| 12 | CZ305B-9 | Jistebník - Studénka | 2 | 2373 | 1090 | 752 | 142 | 8 | 56 | 2011 | 84,7% |
| 13 | CZ301D-2 | Odb. Chotěbuz – Albrechtice u Č.Těšína | 2 | 1421 | 478 | 373 | 803 | 41 | 287 | 1194 | 84,0% |
| 14 | CZ301A-2 | Mosty u Jabl. st. border – Návsí | 2 | 2135 | 450 | 363 | 2323 | 117 | 819 | 1687 | 79,0% |
| 15 | CZ301A-3 | Návsí – Bystřice n. Olší | 2 | 2338 | 540 | 363 | 2323 | 117 | 819 | 1777 | 76,0% |
| 16 | PL136 | Opole Groszowice - Kędzierzyn-Koźle | 2 | 637 | 112 | 324 | 73 | 4 | 28 | 464 | 72,8% |

The analysis shows that in each variant there are the same sections of railway lines in the Žilina Region, Moravian-Silesian Region, Sielian and Opole Voivodeship, which do not meet the capacity condition. The differences between the variants are reflected only in the order of the individual sections based on the priority of implementation of measures.

In the realistic alternative, the first seven sections have expected utilization above 100%, thus capacity enhancement measures should be started now, the other six sections have an estimated usability of 80% - 100%, so capacity enhancement measures need to be implemented to be completed around 2030 and the last three sections have a projected usability of 70% - 80%, so it can be assumed that capacity shortage may only occur after 2030.

The same rules were applied to optimistic and pessimistic alternatives as to the time and manner of implementing the necessary measures to increase the capacity of the railway sections should be implemented. The only difference is the division of individual sections into groups according to the expected utilization of their capacity in 2030. In the optimistic alternative, the utilization will be expected to exceed 100% in the first eight sections, in the next six sections the expected utilization will be at 80% - 100% and the last group will have an expected utilization of 70% - 80%. In the pessimistic alternative, the first six sections will have an estimated utilization above 100%, the other seven sections will have an estimated utilization of 80% - 100% and the last three sections will have an estimated utilization between 70% - 80%. A further 59 sections analysed in CZ, PL and SK should be suitable for all alternatives by 2030. The 48 sections analysed (out of the 59) are expected to introduce measures that will increase both the capacity and the throughput of the line.

### 2.1.2. Inland waterway transport

Inland waterway transport (river) is an important transport mode in Europe, since it allows the shipping and transport of goods across the continent of Europe, while cargo is carried by ships on inland waterways (rivers, canals and lakes), thereby significantly relieving railway and road transport infrastructure. The characteristics of the European inland waterway according to the Resolution of the European Conference of Ministers of Transport for the planned navigable waterway class are as follows:

**Table 10 Classification of European inland waterways of international importance**

| Class | Type of vessel: motorboats and barges | | | | |
|---|---|---|---|---|---|
| | Minimum height below bridges HH (m) | Maximum length L (m) | Maximum width B (m) | Draught D (m) | Tonnage T (t) |
| IV | 5,25/7,00 | 80-85 | 9,5 | 2,50 | 1000-1500 |
| | Type of convoy: pushed convoys | | | | |
| | Minimum height below bridges H (m) | Length L (m) | Width B (m) | Draught D (m) | Tonnage T (t) |
| | 5,25/7,00 | 85 | 9,5 | 2,50-2,8 | 1250-1450 |
| Class | Type of vessel: motorboats and barges | | | | |
| | Minimum height below bridges H (m)) | Maximum length L (m) | Maximum width B (m) | Draught D (m) | Tonnage T (t) |
| Va | 5,25/7,00/9,10 | 95-110 | 11,4 | 2,50-2,80 | 1500-3000 |
| | Type of convoy: pushed convoys | | | | |
| | Minimum height below bridges H (m) | Length L (m) | Width B (m) | Draught D (m) | Tonnage T (t) |
| | 5,25/7,00/9,10 | 95-110 | 11,4 | 2,50-4,50 | 1600-3000 |
| Class | Type of vessel: motorboats and barges | | | | |

| Class | Type of vessel: motorboats and barges | | | | |
|---|---|---|---|---|---|
| | Minimum height below bridges HH (m) | Maximum length L (m) | Maximum width B (m) | Draught D (m) | Tonnage T (t) |
| | Minimum height below bridges H (m) | Maximum length L (m) | Maximum width B (m) | Draught D (m) | Tonnage T (t) |
| Vb | 5,25/7,00/9,10 | | | | |
| | Type of convoy: pushed convoys | | | | |
| | Minimum height below bridges H (m) | Length L (m) | Width B (m) | Draught D (m) | Tonnage T (t) |
| | 5,25/7,00/9,10 | 172-185 | 11,4 | 2,50-4,50 | 3200-6000 |
| Class | Type of vessel: motorboats and barges | | | | |
| | Minimum height below bridges H (m) | Maximum length L (m) | Maximum width B (m) | Draught D (m) | Tonnage T (t) |
| VIa | 7,00/9,10 | | | | |
| | Type of convoy: pushed convoys | | | | |
| | Minimum height below bridges H (m) | Length L (m) | Width B (m) | Draught D (m) | Tonnage T (t) |
| | 7,00/9,10 | 95-110 | 22,8 | 2,50-4,50 | 3200-6000 |
| Class | Type of vessel: motorboats and barges | | | | |
| | Minimum height below bridges H (m) | Maximum length L (m) | Maximum width B (m) | Draught D (m) | Tonnage T (t) |
| VIb | 7,00/9,10 | 140 | 15,0 | 3,9 | |
| | Type of convoy: pushed convoys | | | | |
| | Minimum height below bridges H (m) | Length L (m) | Width B (m) | Draught D (m) | Tonnage T (t) |
| | 7,00/9,10 | 185-195 | 22,8 | 2,50-4,50 | 6400-12000 |
| Class | Type of vessel: motorboats and barges | | | | |
| | Minimum height below bridges H (m) | Maximum length L (m) | Maximum width B (m) | Draught D (m) | Tonnage T (t) |
| VIc | 9,10 | | | | |
| | Type of convoy: pushed convoys | | | | |
| | Minimum height below bridges H (m) | Length L (m) | Width B (m) | Draught D (m) | Tonnage T (t) |
| | 9,10 | 270-280<br>195-200 | 22,8<br>33,0-34,2 | 2,50-4,00<br>2,50-4,50 | 9600-18000<br>9600-18000 |
| Class | Type of vessel: motorboats and barges | | | | |
| | Minimum height below bridges H (m) | Maximum length L (m) | Maximum width B (m) | Draught D (m) | Tonnage T (t) |
| VII | 9,0 | | | | |
| | Type of convoy: pushed convoys | | | | |
| | Minimum height below bridges H (m) | Length L (m) | Width B (m) | Draught D (m) | Tonnage T (t) |
| | 9,0 | 285 | 33,0-34,2 | 2,50-4,50 | 14500-27000 |

Shifting of goods transportation to more environmentally friendly modes of transport is an objective of the European Union, also in view of the potential cost-savings as the vessel can carry more goods per unit of distance (tkm) than any other type of land transport, thus saving transport costs, reduce emissions, reduce road occupancy and increase road safety. EU strategies define the elimination of infrastructure bottlenecks as a key condition for the development of inland water transport in Europe. The adopted White Paper Strategies of 2001 and 2011, as well as other action programs (NAIADES), have pushed attention at European level to the need to eliminate bottlenecks in transport infrastructure (improving the navigability of rivers and canals), that is hampering the development of inland waterways. The following bottlenecks have been identified in relation to the development of inland waterway shipping:

- Bridges - passability under bridges or the width of the passage between pillars that determines the size of the vessels and the possible height of stacked containers on vessel.
- Fairway - the width and shape of the fairway determine the speed of navigation and the number of vessels passing through the waterway profile.
- Waterway navigability - the depth of water in the fairway is critical to the cost efficiency of inland waterway transport (number of days that the waterways can be operated).
- Missing connections – parts of the future network of inland waterways that do not yet exist.
- Lifts / lock chambers – the capacity of the lock chamber can extend the transport time, since vessels or cargo convoys have to wait due to their size.

**Figure 5 Example of locks restoration - Gabčíkovo**

The planned construction of waterways on the territory of TRITIA will directly meet all the required conditions for the implementation of a Trans-European network of waterways of international importance enabling the passage of vessels with a minimum draught of 2,50 m, with a minimum passage below bridges of 5,25 m and allowing the passage of vessels of at least 80 m in length.

In view of the planned class of navigable waterways of international importance in the territory of TRITIA (Odra waterway), there is no need to consider capacity problems until 2030 and beyond.

## 2.2. Alternative scenarios resulting from the traffic model parameters

Developed alternative scenarios (to assess the potential shift from road to railway and inland waterway transport) were examined in the TRITIA traffic model for 2030, in order to verify the impact of changes in the charges for using infrastructure (or a specific service - handling) on the reallocation of traffic volumes (represented by a relative unit set as 1 intermodal transport unit ITU - 40' ISO 1A container) between the individual modes of transport.

The impact of the change was determined on the basis of the uncertainty in the development of the economy and infrastructure charges, or in the handling of intermodal transport units between individual modes.

The basic parameters entering the testing of the impact of changes on the modal shift are:

- change in GDP,
- change in road infrastructure charges (tolls),
- change in railway infrastructure charges;
- change in handling charges.

The definition of alternative scenarios was based on testing of potential GDP developments that may arise. Subsequently, the individual alternative scenarios and their variants were developed, which are:

1. S0: Assessment of economic development parameters - GDP
    - Pessimistic scenario - this scenario is characterized by a low trend in economic development.
    - Realistic scenario - the scenario is characterized by medium economic development
    - Optimistic scenario - the scenario can be evaluated with a high degree of economic development.
2. S1: Road transport - increase and decrease in the price of the infrastructure charges
3. S2a: Railway transport - increase and decrease in the charges for the use of infrastructure and handling charges
4. S2b: Railway transport - increase and decrease in the charges for the use of infrastructure
5. S3: Water transport - increase and decrease in handling costs
6. Combined scenario - increase in the cost of road infrastructure, railway infrastructure and handling charges

The first level of alternative scenarios is the economic scenario "S0", which is defined by three variants, where pessimistic GDP growth (+ 10% growth), realistic GDP growth (+ 15% growth) and optimistic GDP growth (+ 20% growth) have been considered. In other alternative scenarios "S1", "S2a / S2b", "S3" and "Combined", a change in the redistribution of the number of intermodal transport units between the different transport modes was identified by simulating the change in the infrastructure and handling charges in individual transport modes, or their combinations. The scenarios "S1", "S2a / S2b" and "S3" are prepared for the realistic development of GDP (growth of 15%), while the change of ± 5%, ± 10%, or ± 20% (water transport) was considered concerning the infrastructure and handling charges. The “Combined” scenario also considers realistic GDP + 15%, but it combines various changes in the infrastructure charges, or handling charges as follows: toll +10%, railway +5%, handling +20%.

The following table includes a detailed list of scenarios and their variants that have been tested in the traffic model.

**Table 11 Scenarios and variants considered in the traffic model**

| Scenario | Variant |
|---|---|
| S0 | GDP growth +10% |
| | GDP growth +15% |
| | GDP growth +20% |

| Scenario | Variant |
|---|---|
| S1 | Charges for road infrastructure (toll) increase by 5% |
| | Charges for road infrastructure (toll) decrease by 5% |
| | Charges for road infrastructure (toll) increase by 10% |
| | Charges for road infrastructure (toll) decrease by 10% |
| S2a | Railway infrastructure charges + handling charges increase by 5% infrastructure 10% handling |
| | Railway infrastructure charges + handling charges decrease by 5% infrastructure 10% handling |
| | Railway infrastructure charges + handling charges increase by 10% infrastructure 20% handling |
| | Railway infrastructure charges + handling charges decrease by 10% infrastructure 20% handling |
| S2b | Railway infrastructure charges increase by 5% |
| | Railway infrastructure charges decrease by 5% |
| | Railway infrastructure charges increase by 10% |
| | Railway infrastructure charges decrease by 10% |
| S3 | Charges for handling in inland waterway terminals increased by 10% |
| | Charges for handling in inland waterway terminals decreased by 10% |
| | Charges for handling in inland waterway terminals increased by 20% |
| | Charges for handling in inland waterway terminals decreased by 20% |
| Combined | Toll +10%, Railway +5%, Handling +20% |

The definition of the toll rate was based on current rates, which in the alternative scenarios were changed between ± 5% and ± 10% compared to the current toll rate, thus covering a sufficient price range. The basic toll rate used in the traffic model is € 0.19048 / km. The charges for the use of the railway infrastructure were also based on current charges and in alternative scenarios the simulation of the redistribution of ITUs between individual modes of transport was simulated. The change in railway infrastructure charges ranged between ± 5% and ± 10% compared to the current rate. In the traffic model, the rate of 0.1084 € / km was taken into account, when defining the charge, a reference train with 20 wagons was used. There is no charge for waterway infrastructure. The use of the waterway is generally influenced by the price of handling at terminals, which also affects the use of the railway network. The following table shows the charges for handling of a 40-foot container in terminals in specific countries. Prices were determined based on whether the container is empty or loaded. In some cases, the prices did not differ between the handling of loaded and empty container. This is because the payments have been charged for handling regardless of whether the container is empty or loaded. The current ITU manipulation prices are lower than those considered. In the traffic model for 2030, the cost of handling was 40 €. This is due to the expected growth of the economy. In the alternative scenarios, which simulated changes in loading and unloading charges of ± 10% and ± 20%, sufficient price margins were covered. An intermodal transport unit, represented by a 40' container, is considered in the traffic model because these ITUs can be used in any transport mode (road, railway, water). For the ITUs, the resistance for each transport mode is defined based on the resistance function defined below.

**Table 12 Handling charges in selected EU countries**

| 40' container | | | | | |
|---|---|---|---|---|---|
| Country | Number of terminals | Loaded | | Empty | |
| | | Minimum | Maximum | Minimum | Maximum |
| Slovakia | 9 | 28 | 35 | 28 | 35 |
| Czech Republic | 16 | 22,5 | 30 | 22,5 | 30 |
| Hungary | 11 | 30 | 42 | 25 | 42 |
| Germany | 10 | 23 | 40 | 23 | 40 |
| Poland | 28 | 18,3 | 41 | 18,3 | 38 |
| Austria | 20 | 28 | 33 | 28 | 33 |
| Italy | 16 | 32,5 | 32,2 | 32,5 | 32,5 |
| Average | - | 26,04286 | 36,21429 | 25,32857 | 35,78571 |

The purpose of the resistance function is, based on the selected criteria, to get close to the real behaviour and decision-making of transport on the selection of the optimal route with respect to the route length, price, time and others.

The resistance function used in the traffic model was based on the Czech national model, where the parameters of this function were updated for the relevant area. Resistance function form:

$$f_{imp} = f_{(t,c,d)} \text{ - travel time (t), costs (c), delay (d)}$$

$f_{(t)}$ – function $t_0$ and $t_{cur}$,

$f_{(c)}$ – function of infrastructure charges and handling charges,

$f_{(d)}$ – function of delay based on $t_0$ and on the saturation of the traffic flow.

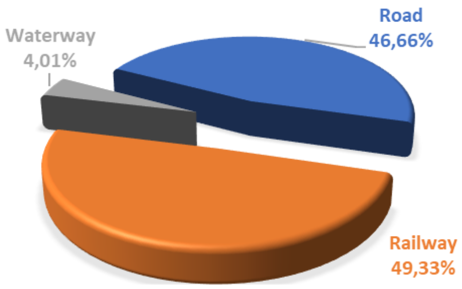
Under alternative scenarios, the values of infrastructure charges and handling charges have changed. The purpose of assessing the change in infrastructure and handling charges was to identify the redistribution and the associated traffic on the sections of the individual transport systems.

By the introduction, modification or facilitation of some measures, it is possible to relieve the heavy traffic sections of the transport infrastructure or to make the currently less attractive modes of transport more attractive.

### 2.2.1. Alternative Scenario S0: GDP growth

In the S0 scenario an economic growth of + 10% (pessimistic scenario), + 15% (realistic scenario) and + 20% (optimistic scenario) was considered. The modal split of the potential transfer of freight (containers) for the each mode of transport is illustrated by the following graphical representation:

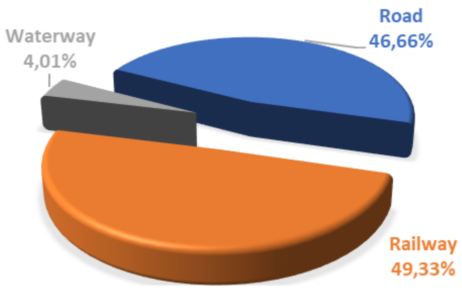
+10%




Outputs in container kilometres

| | |
|---|---|
| Road: | 5 599 502 |
| Railway: | 5 920 472 |
| Waterway: | 480 792 |

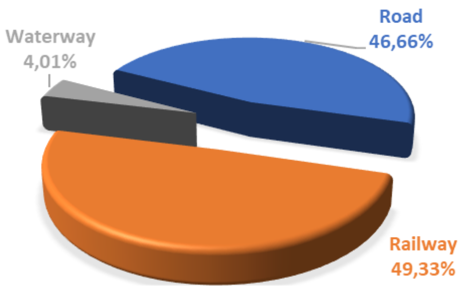
+15%




Outputs in container kilometres

| | |
|---|---|
| Road: | 5 854 025 |
| Railway: | 6 189 584 |
| Waterway: | 502 646 |

+20%




Outputs in container kilometres

| | |
|---|---|
| Road: | 6 108 547 |
| Railway: | 6 458 696 |
| Waterway: | 524 500 |

**Figure 6 Modal split of potential shift in 2030 (Scenario S0)**

Given that we only consider GDP growth in this scenario, the modal split of the potential transfer does not change; only output expressed in container-kilometres are increase (as GDP increases). The chart shows that the waterway transport have the lowest share at 4 percent, which means that 4% of the potential transfer can be attributed to the water infrastructure in addition to the estimated 2030. The remainder of the shift potential is fairly balanced, but slightly in favour of railway transport (almost 50%). The map view of the potential shift from road to railway and inland waterway modelled for the year 2030 under alternative scenarios is presented in the following illustration.

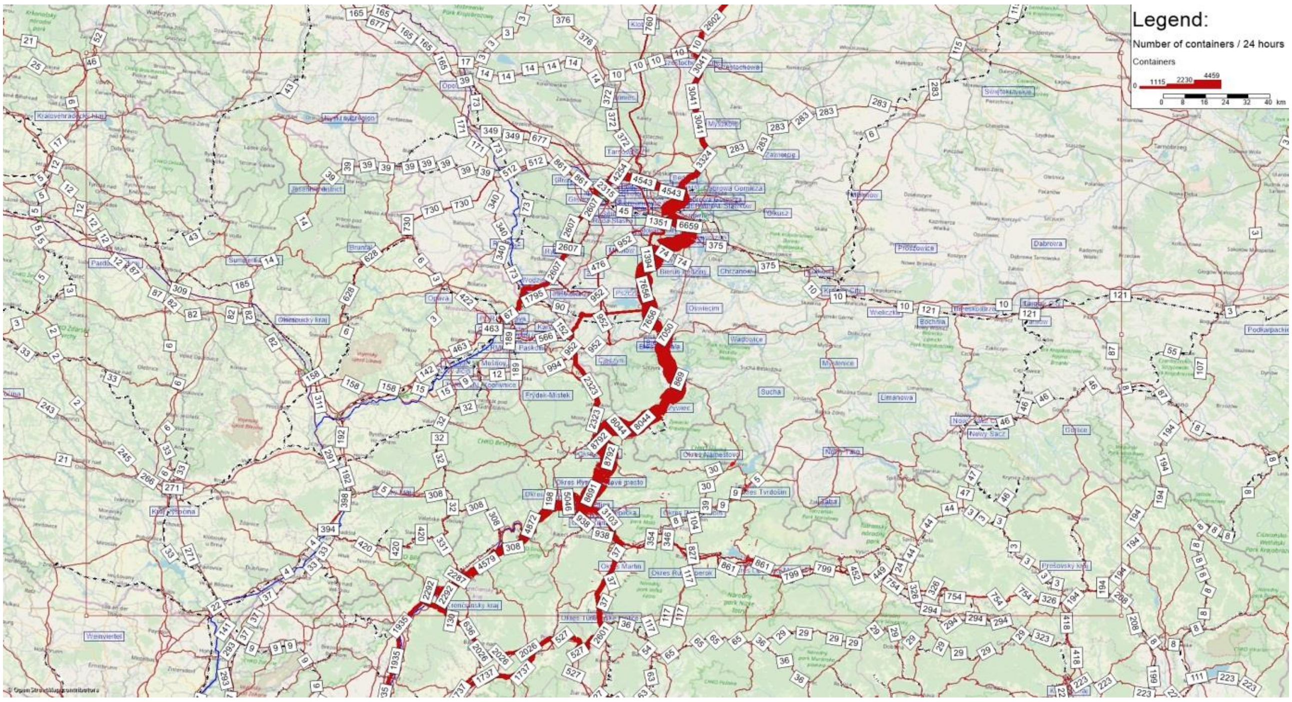



**Figure 7 Pentlogram of potential shifts between transport modes in TRITIA territory year 2030 GDP + 10% (Scenario S0)**

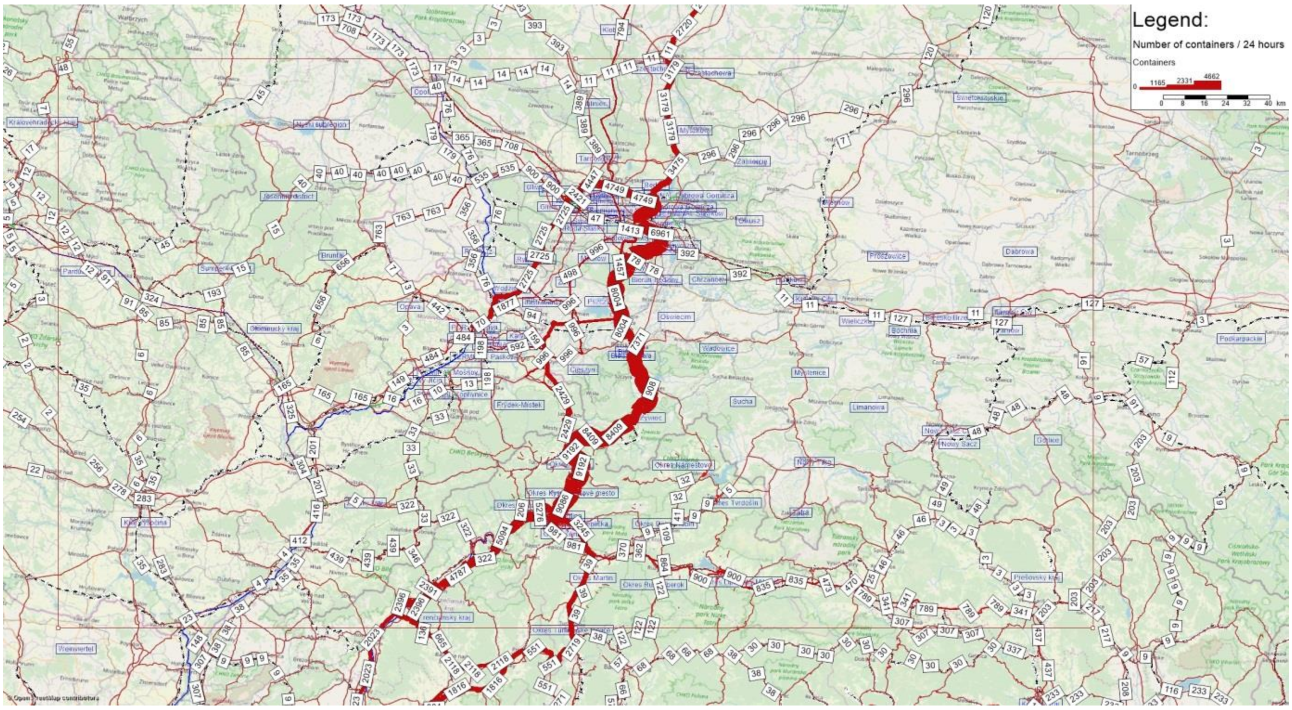



**Figure 8 Pentlogram of potential shifts between transport modes in TRITIA territory year 2030 GDP + 15% (Scenario S0)**

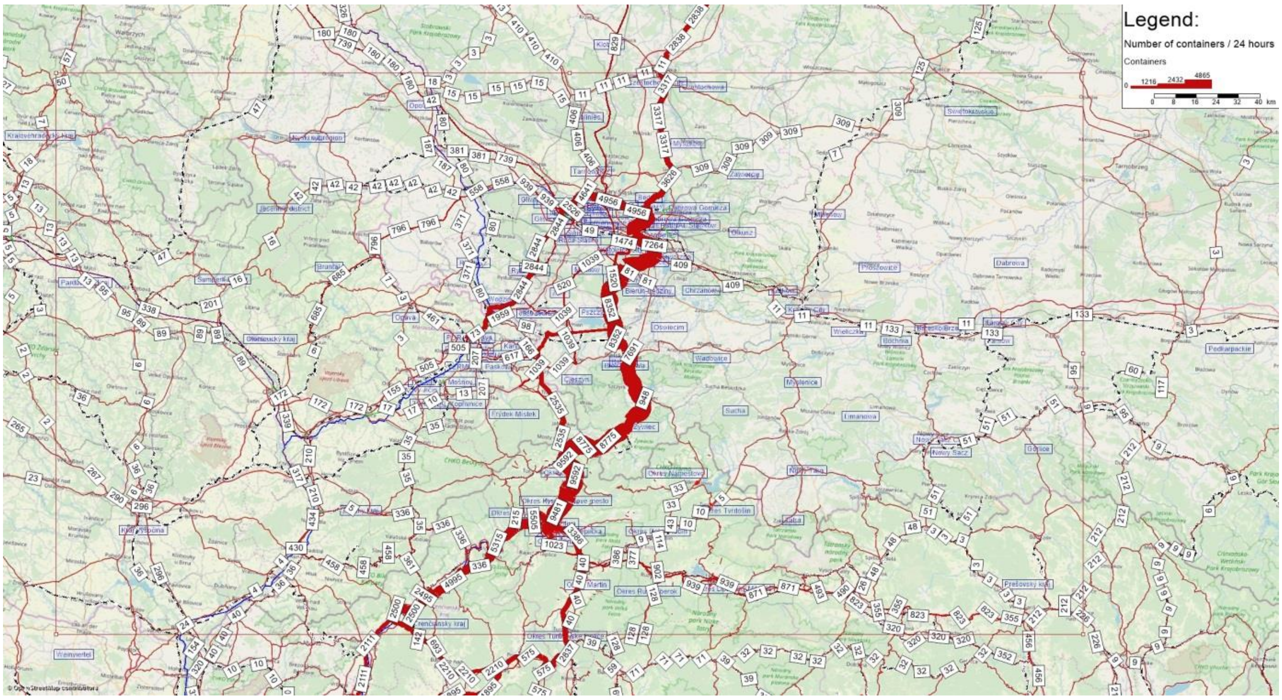
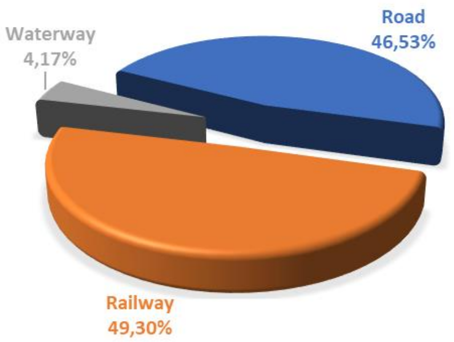



**Figure 9 Pentlogram of potential shifts between transport modes in TRITIA territory year 2030 GDP + 20% (Scenario S0)**

## 2.2.2. Alternative Scenario S1: Road transport

In the S1 scenario, a change in the amount of the road infrastructure charge (toll) is considered, an increase by + 5% and + 10%, or a decrease by -5% and -10%. This change will take effect on the modal split as follows:

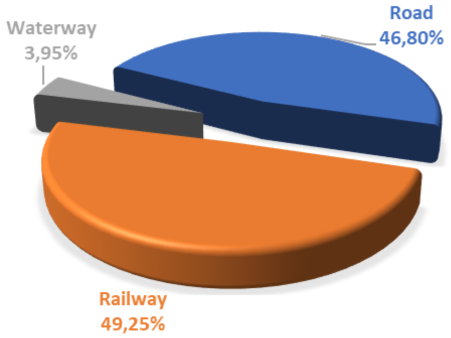
**+5%**




Outputs in container kilometres

| | |
|---|---|
| Road: | 5 870 619 |
| Railway: | 6 220 868 |
| Waterway: | 525 739 |

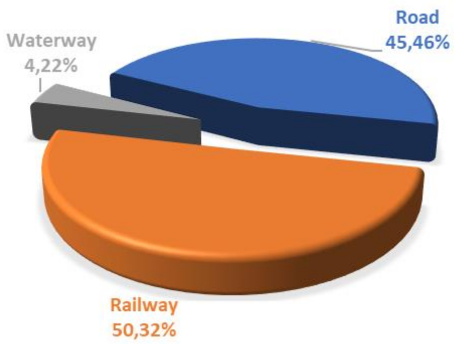
**-5%**




Outputs in container kilometres

| | |
|---|---|
| Road: | 5 867 955 |
| Railway: | 6 174 467 |
| Waterway: | 495 572 |

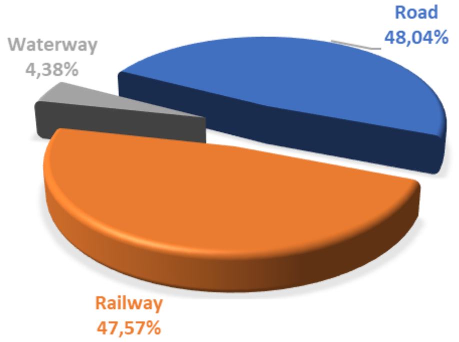
**+10%**




Outputs in container kilometres

| | |
|---|---|
| Road: | 5 660 180 |
| Railway: | 6 264 560 |
| Waterway: | 525 341 |

**-10%**




Outputs in container kilometre

| | |
|---|---|
| Road: | 6 080 196 |
| Railway: | 6 021 063 |
| Waterway: | 554 767 |

**Figure 10 Modal split of potential shift in 2030 (Scenario S1)**

Increasing the cost level for the use of road infrastructure by 5% or 10% will cause a modal split change, with a modest increase in the share of railway transport (up to 50.32%) in the potential shift and it is decreasing in the share of road transport. Otherwise, as the level of road infrastructure charges are decreasing, the share of potential modal shift up to 48% logically increases in modal split. The impact of the change in the cost of using road infrastructure has a negligible impact on the potential transfer to waterways (in tenths of a percent).

The map view of the potential transfer from road traffic to railways and inland waterway modelled for the year 2030 within alternative scenarios is presented in the following illustration.

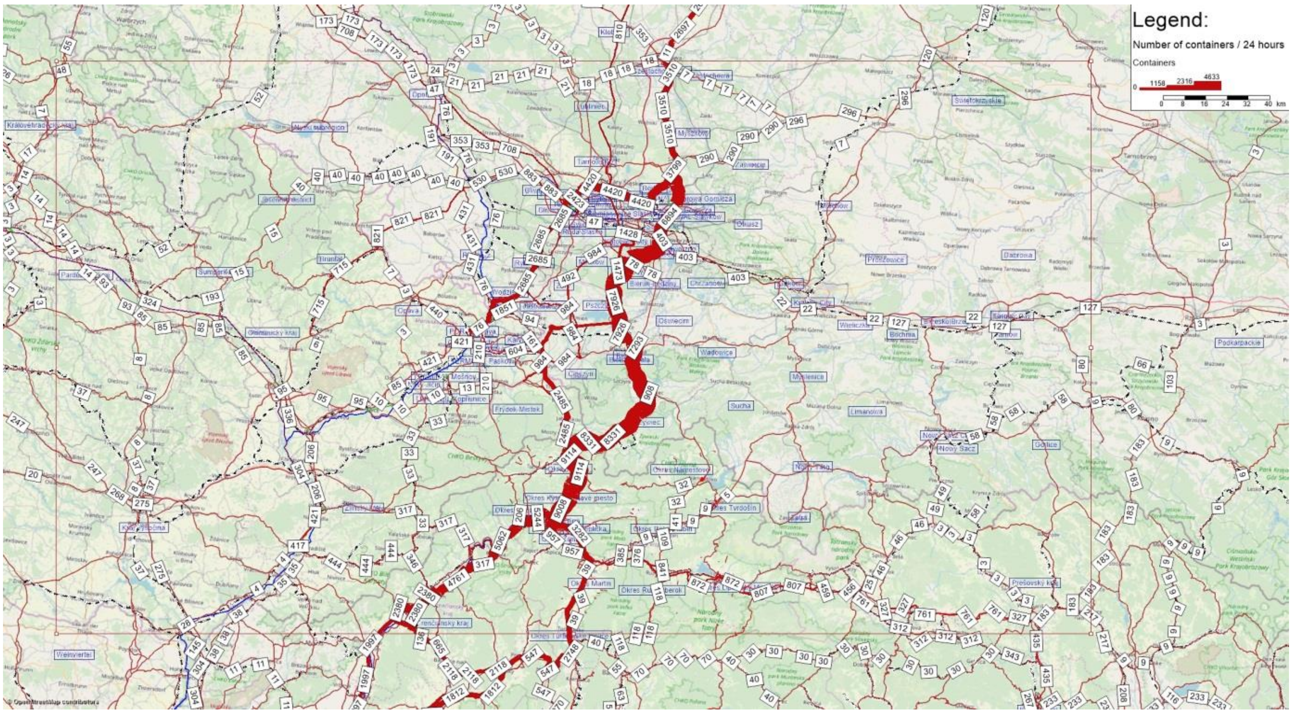



**Figure 11 Pentlogram of potential shift between modes of transport in TRITIA year 2030 Toll growth +5% (Scenario S1)**

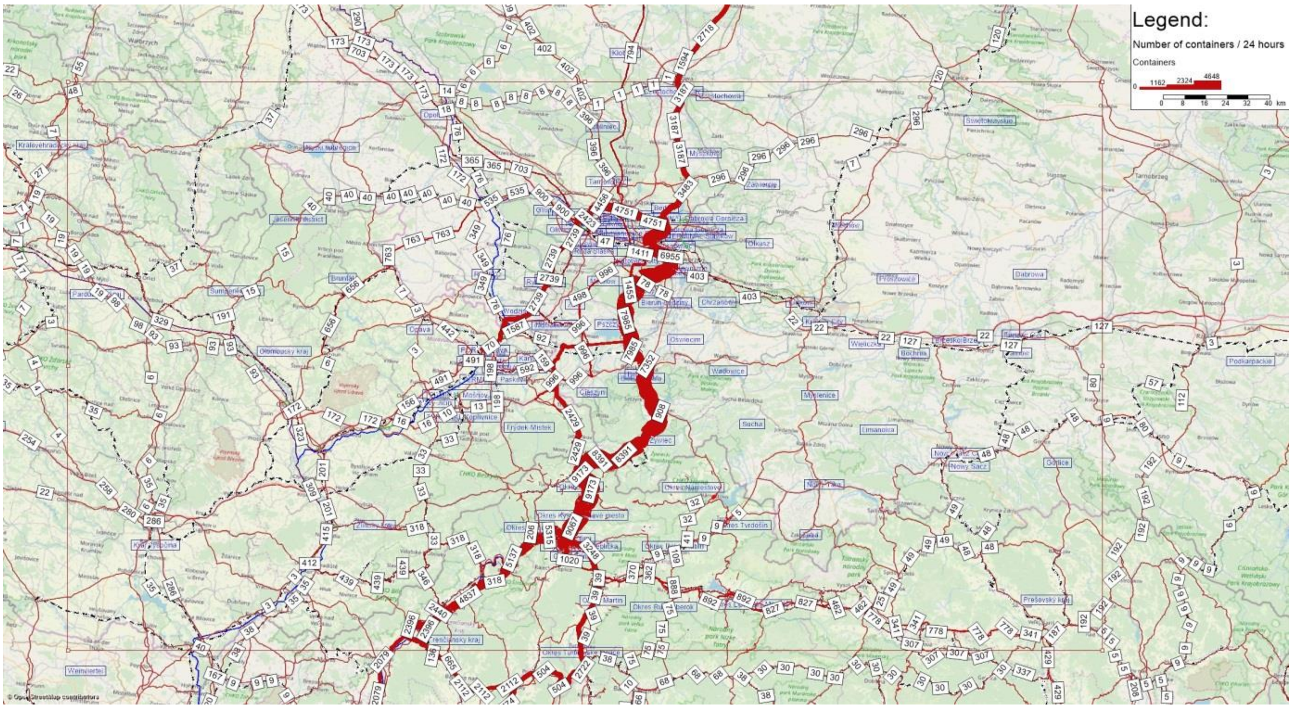



**Figure 12 Pentlogram of potential shift between transport modes in TRITIA year 2030 Toll drop -5% (Scenario S1)**

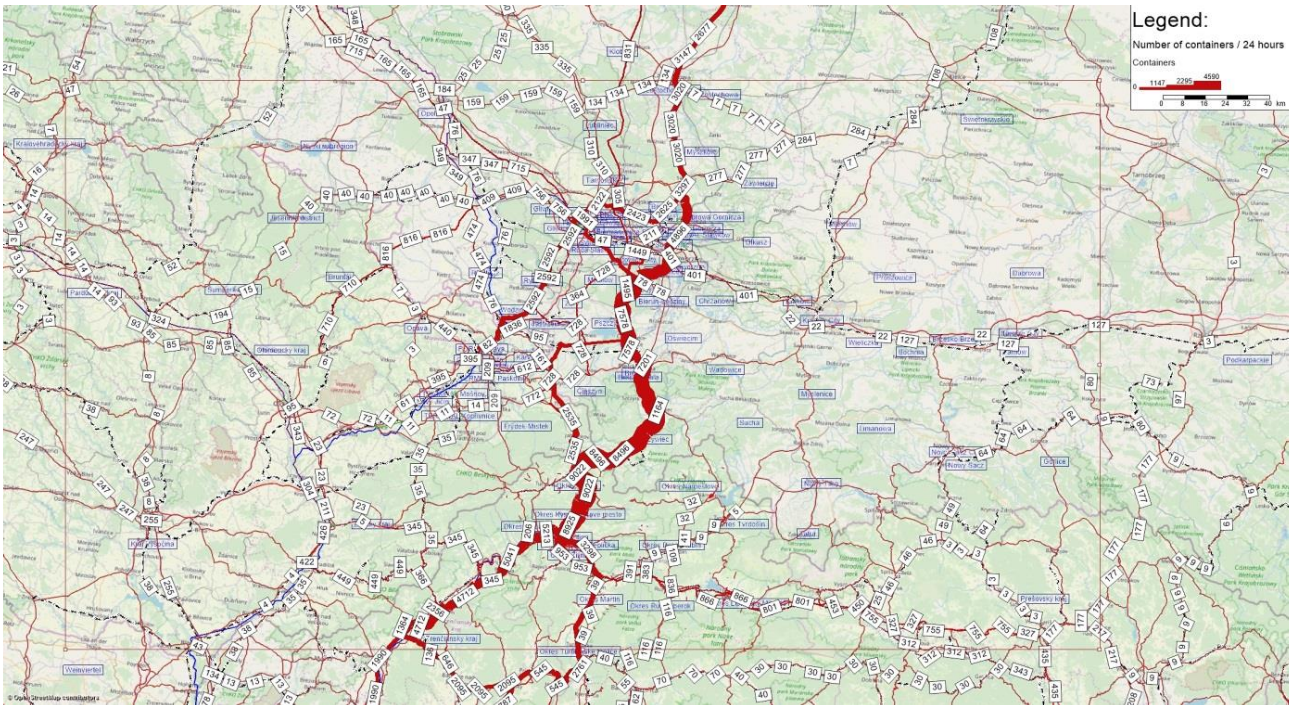



**Figure 13 Pentlogram of potential shift between modes of transport in TRITIA year 2030 Toll growth +10% (Scenario S1)**

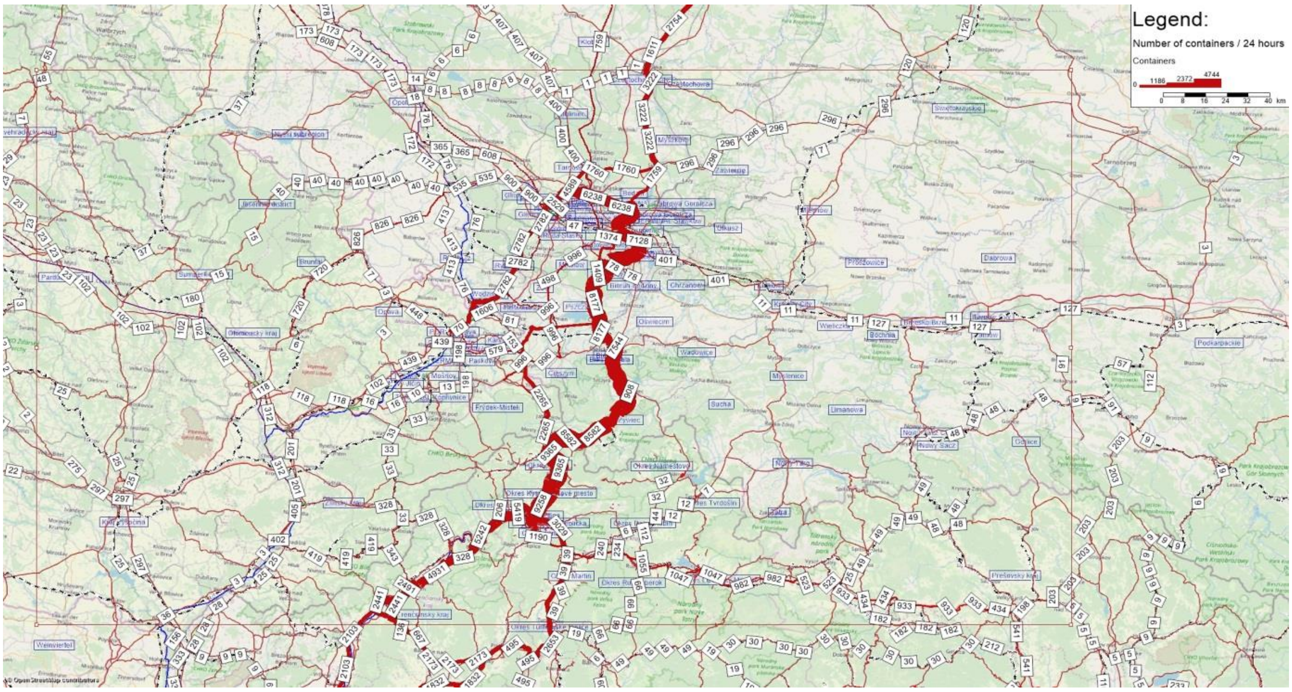
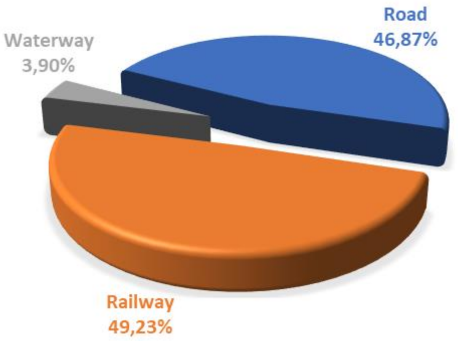



**Figure 14 Pentlogram of potential shift between modes of transport in TRITIA year 2030 Toll drop -10% (Scenario S1)**

## 2.2.3. Alternative Scenario S2a: Railway transport

Within the scenario S2a, the railway infrastructure charge increase by + 5% and + 10%, or decrease by -5% and -10% and the cost of transhipment by + 10% and + 20% or a decrease by -10% and -20% were modelled. This change is reflected in modal split as follows:

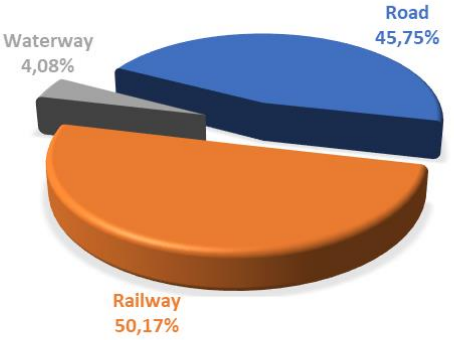
**+ 5% network + 10% transhipment**




Outputs in container kilometres

| | |
|---|---|
| Road: | 5 881 255 |
| Railway: | 6 176 592 |
| Waterway: | 489 738 |

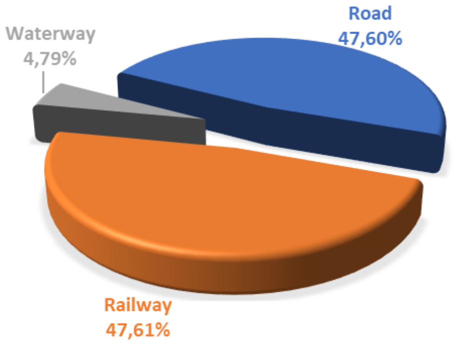
**-5% network -10% transhipment**




Outputs in container kilometres

| | |
|---|---|
| Road: | 5 789 355 |
| Railway: | 6 348 530 |
| Waterway: | 516 100 |

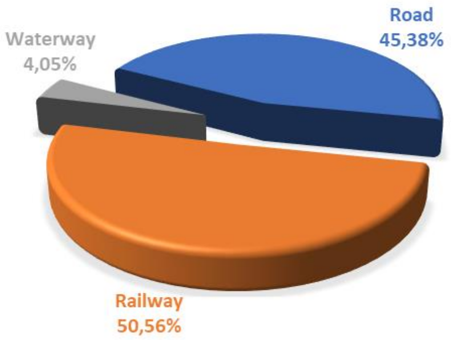
**+ 10% network + 20% transhipment**




Outputs in container kilometres

| | |
|---|---|
| Road: | 5 995 430 |
| Railway: | 5 996 294 |
| Waterway: | 603 024 |

**-10% network -20% transhipment**




Outputs in container kilometre

| | |
|---|---|
| Road: | 5 712 858 |
| Railway: | 6 364 748 |
| Waterway: | 510 246 |

**Figure 15 Modal split of potential shift in 2030 (Scenario S2a)**

In the case of the increase of charges for railway infrastructure use (+ 5% and + 10%) and freight transhipment services (+ 10% and + 20%), a modal split change is evident, with a modest increase in road transport and declining of the share of the railway transport in the potential transfer of intermodal transport units.

Otherwise, when the declining level of charges for the use of railway infrastructure (-5% and -10%) and the transhipment charges (-10% and -20%) the share of the potential transfer to railway transport is increasing and in the most extreme case it exceeds 50.5%. In this scenario, changes in cost parameters have only a modest effect on modal split change.

While maintaining the level of the railway infrastructure charge and changing the terminal charge, it is possible within certain sensitivity limits to achieve the same level of modal split redistribution. This situation occurs in the scenarios S2a and S2b, in which the price for using the railway route decline by -10%. Modal split is no longer affected when the price for transhipment is at -20%. The alteration of rates for transhipment or infrastructure use can result in change of modal split, but changes outside the defined range were not part of the alternative scenarios.

The impact of the change of the price for the use of railway infrastructure (in conjunction with the change in the price for transhipment) has a negligible impact on the potential transfer to the water transport (ranging from tenths of a percentage ranging from 3.9% to 4.79%).

The map view of the potential transfer from the road to railway and inland waterway transportation modelled for the year 2030 within alternative scenarios, is presented in the following illustrations.

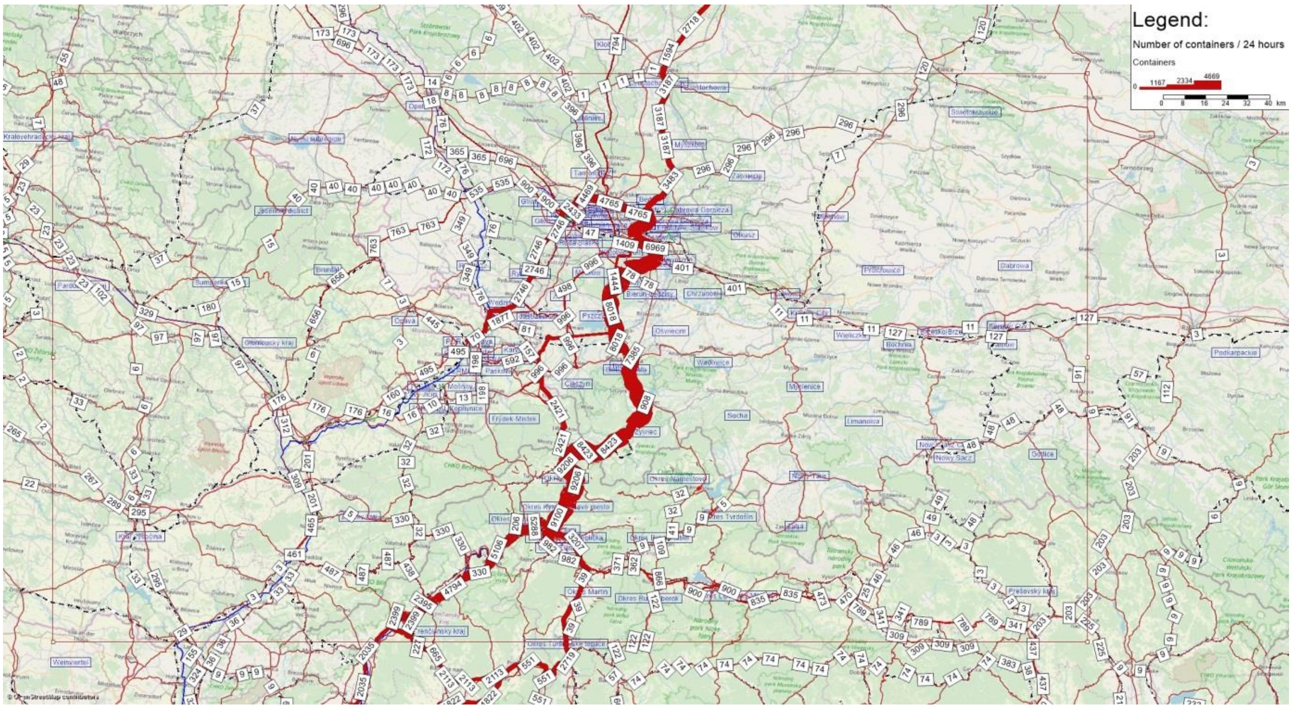



**Figure 16 Pentlogram of potential transfer shift modes of transport in the territory of TRITIA in year 2030, increase of railway charges by + 5% and transhipment + 10% (Scenario S2a)**

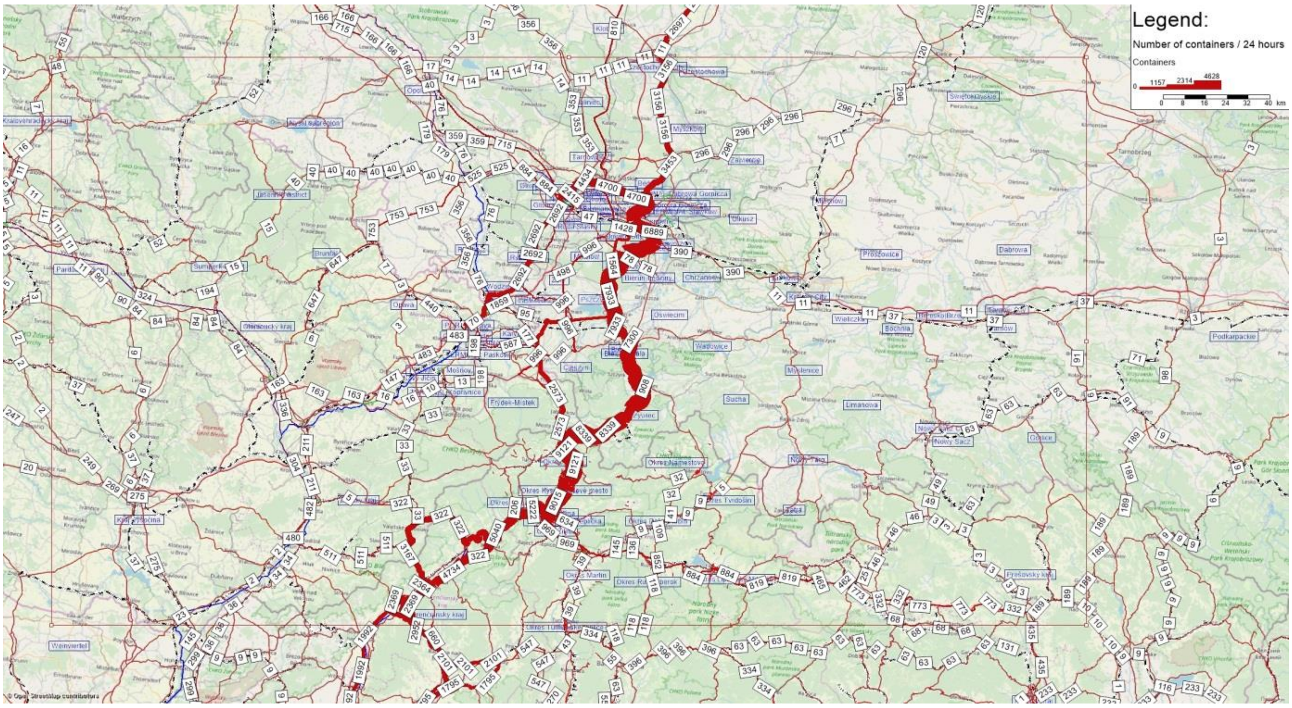



**Figure 17 Pentlogram of potential shift between modes of transport in the territory of TRITIA in year 2030, decrease of railway charges by -5% and transhipment -10% (Scenario S2a)**

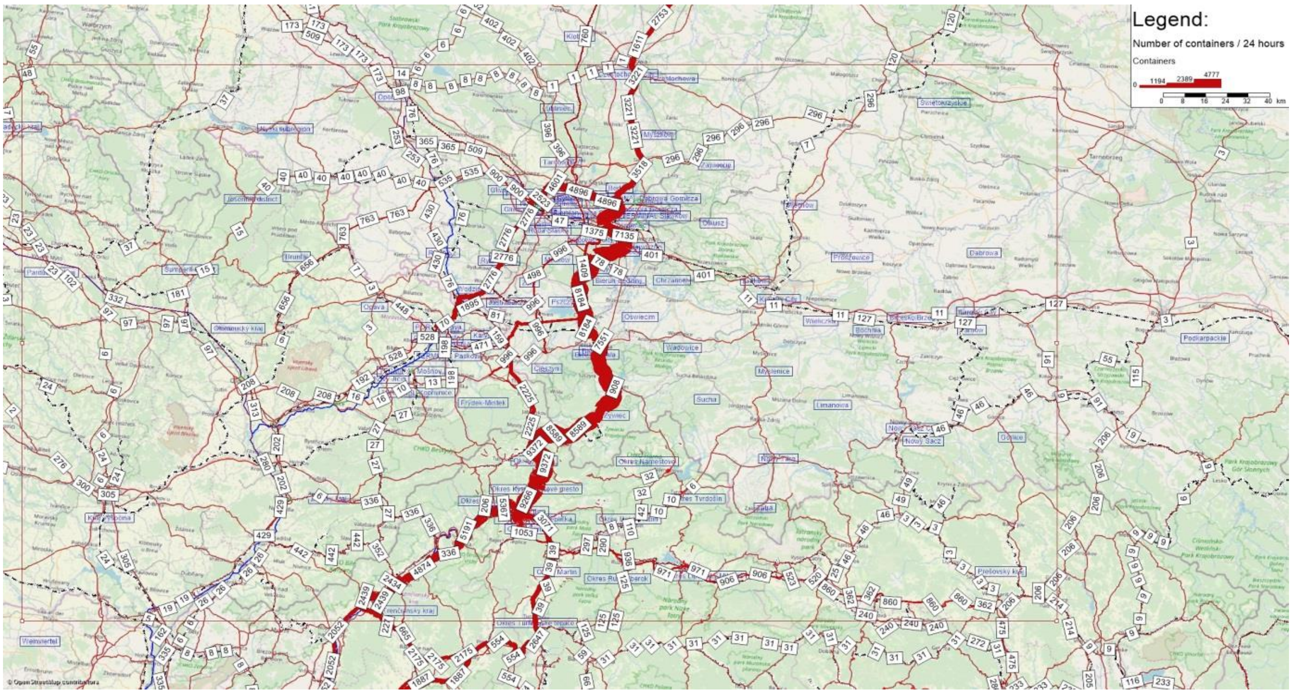



**Figure 18 Pentlogram of potential shift between modes of transport in the territory of TRITIA in year 2030, increase of railway charges by + 10% and transhipment by + 20% (Scenario S2a)**

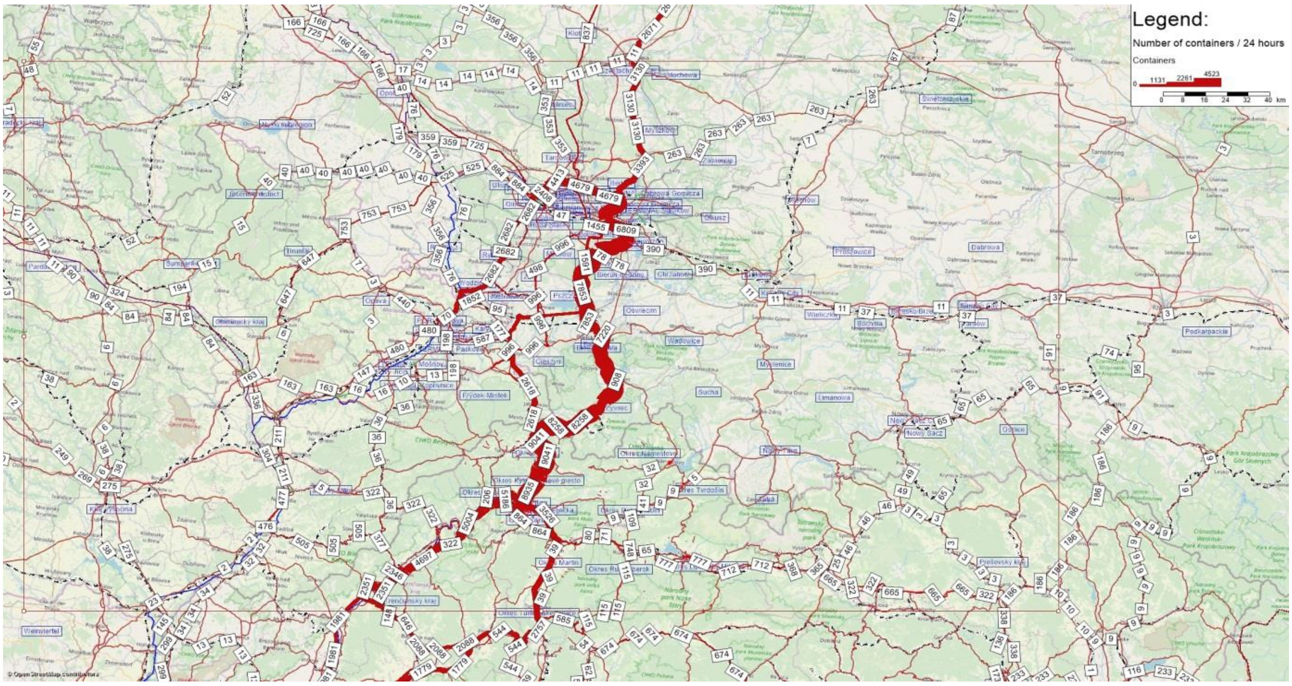
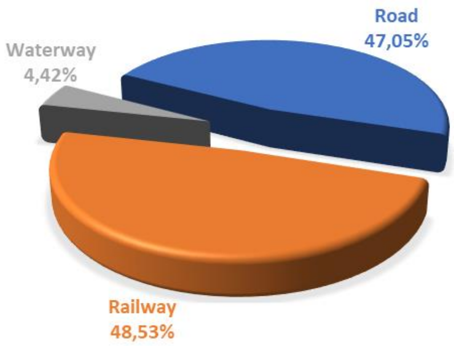



**Figure 19 Pentlogram of potential shift between modes of transport in the territory of TRITIA in year 2030, decrease of railway charges by -10% and transhipment by -20% (Scenario S2a)**

### 2.2.4. Alternative Scenario S2b: Railway transport

Under scenario S2b, only the change of +5% and +10% and a decrease of -5% and -10% of the railway infrastructure charge were envisaged. This change affects modal split as follows:

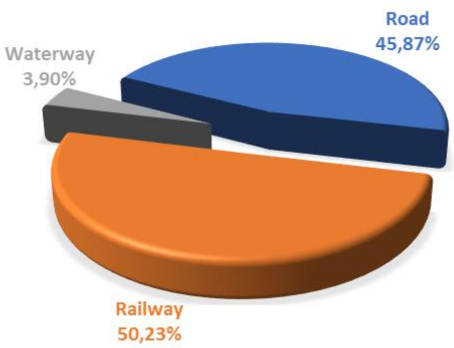
**+5%**




Outputs in container kilometres

| | |
|---|---|
| Road: | 5 921 399 |
| Railway: | 6 107 148 |
| Waterway: | 555 722 |

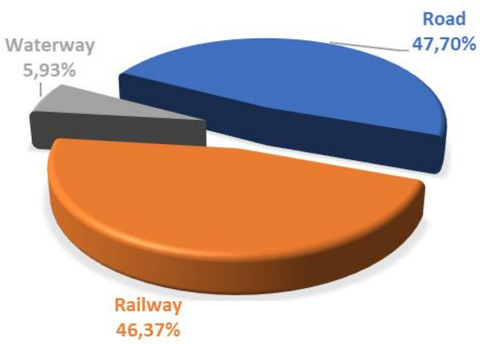
**-5%**




Outputs in container kilometres

| | |
|---|---|
| Road: | 5 800 020 |
| Railway: | 6 351 362 |
| Waterway: | 492 877 |

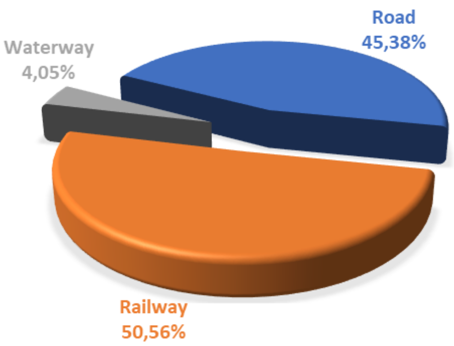
+10%




Outputs in container kilometres

| | |
|---|---|
| Road: | 6 039 845 |
| Railway: | 5 871 690 |
| Waterway: | 750 626 |

-10%




Outputs in container kilometres

| | |
|---|---|
| Road: | 5 712 858 |
| Railway: | 6 364 748 |
| Waterway: | 510 246 |

**Figure 20 Modal split of potential shift in the year 2030 (Scenario S2b)**

This is similar to the S2a scenario, but in this scenario, we only considered the increase / decrease in the charge for the use of railway infrastructure by 5% and 10%. Modal split changes between road and railway modes are similar to the previous scenario S2a, but slightly more modest (changes in potential transfers are in tenths of a percent).

In the case of an increasing of the charge for the use of the railway infrastructure by + 5% and + 10% , the potential transfer of intermodal transport units to road transport is as high as 47% and 47,7%, while the share of railway transport is decreasing slightly to 48,5% and 46,4%). Otherwise, when the level of charges for railway infrastructure usage are decreasing by -5% and -10%, the modal split increases the share of potential transfer to railway transport, up to the 50.56% (-10% variant).

The impact of the change in the charge for the railway infrastructure usage has a limited impact on the potential transfer of freight transport to the waterway mode. The highest potential of modal shift is in scenario with + 10% increase in railway network usage charges.

The map view of the potential shift from road transport to railway and inland waterway modelled for the year 2030 within alternative scenarios is presented in the following illustrations.

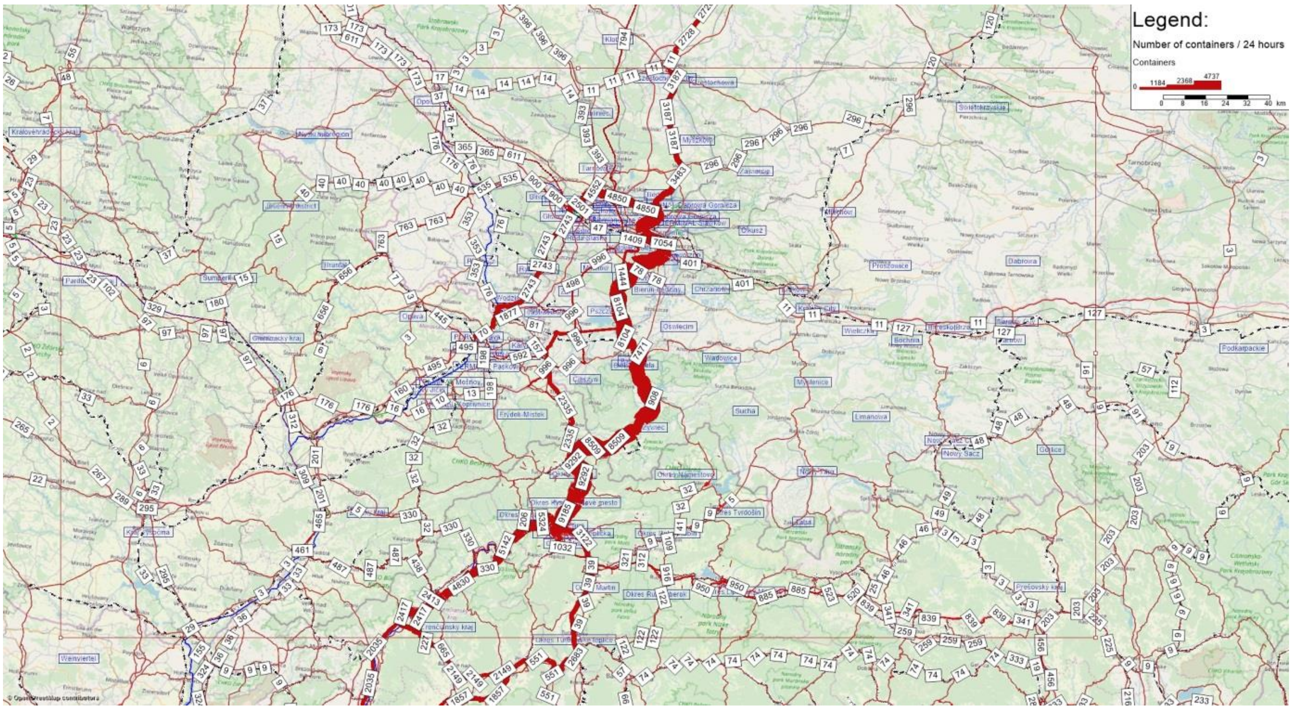



**Figure 21 Pentlogram of potential shift between modes of transport in the territory of TRITIA year 2030 increase of the railway charges by + 5% (Scenario S2b)**

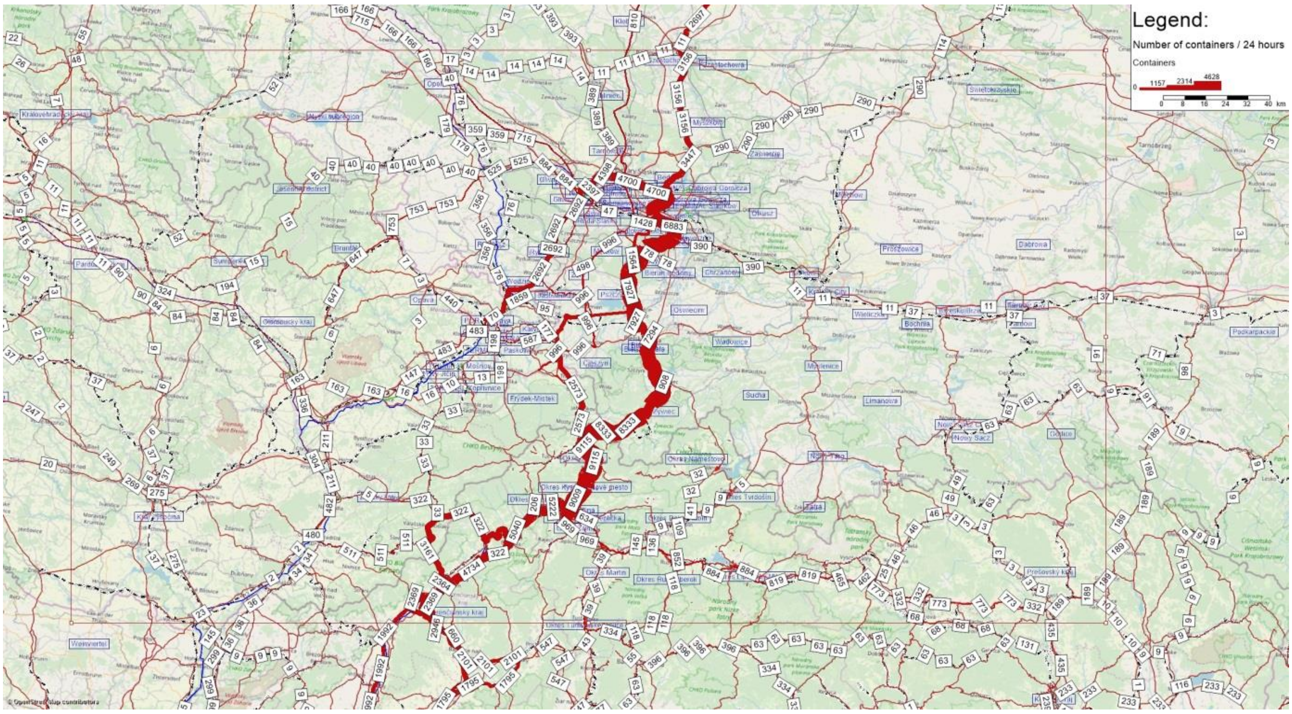



**Figure 22 Pentlogram of potential shift between transport modes in the territory of TRITIA year 2030 decrease of the railway charges at -5% (Scenario S2b)**

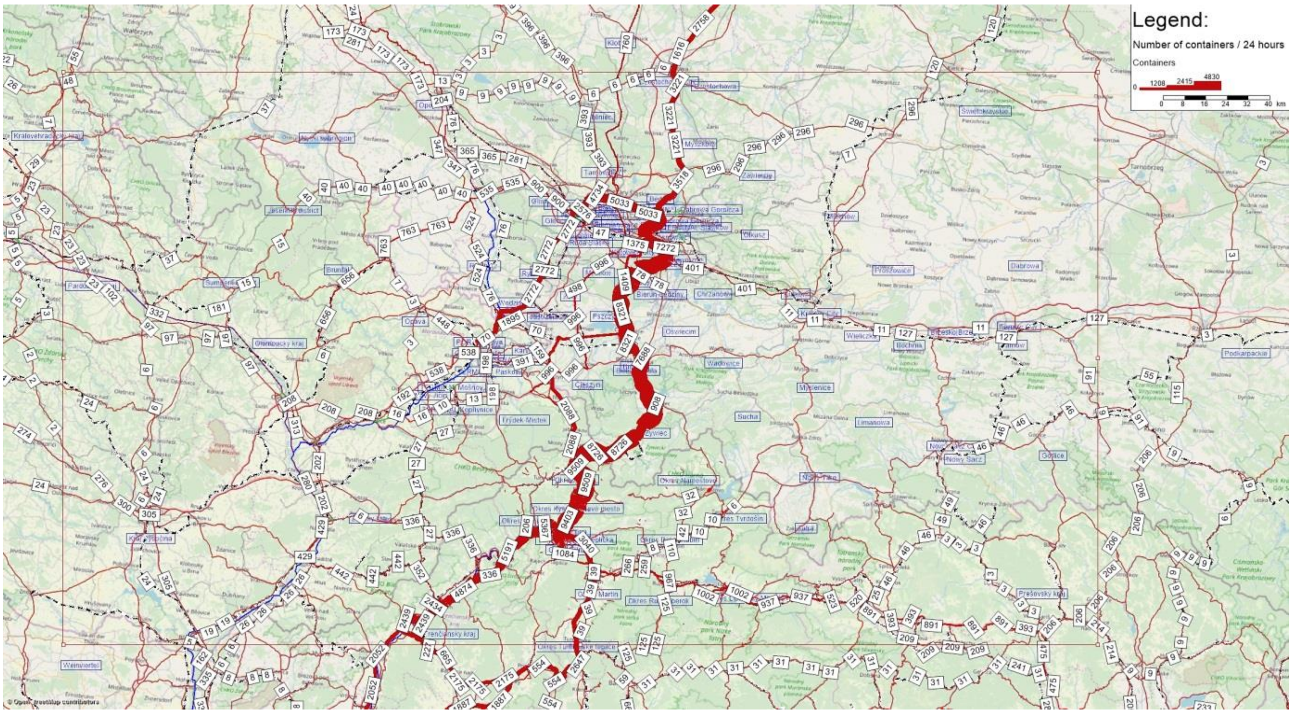



**Figure 23 Pentlogram of potential shift between modes of transport in the territory of TRITIA year 2030 increase of the railway charges by + 10% (Scenario S2b)**

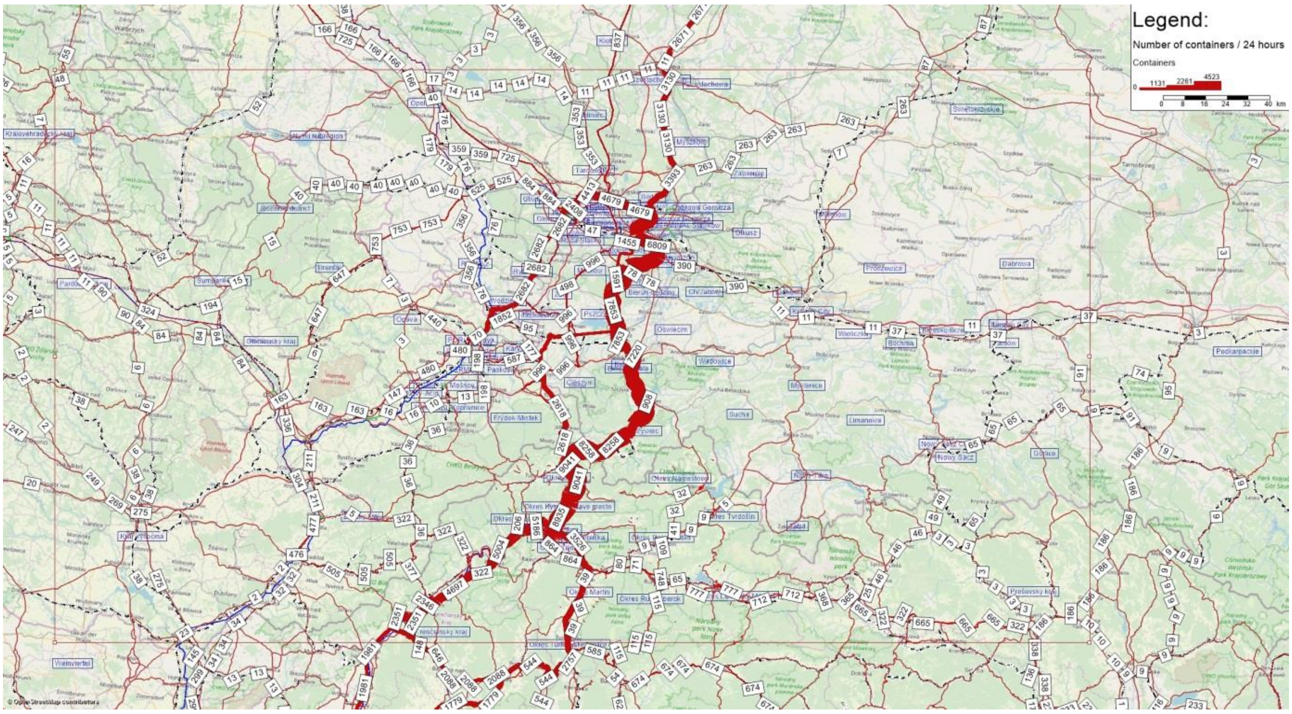
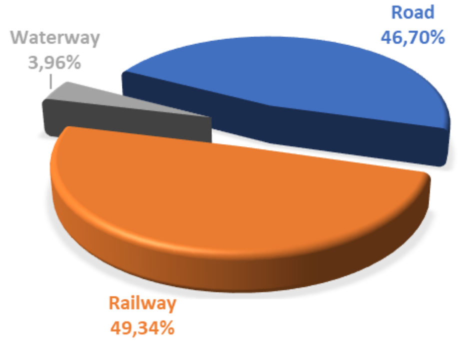



**Figure 24 Pentlogram of potential shift between modes of transport in the territory of TRITIA year 2030 decrease of the railway charges by -10% (Scenario S2b)**

## 2.2.5. Alternative Scenario S3: Inland waterway transport

In scenario S3, the charge for transhipment is increased by + 10%, 20% and decreased by -10%, -20%. This change will affect the modal split as follows:

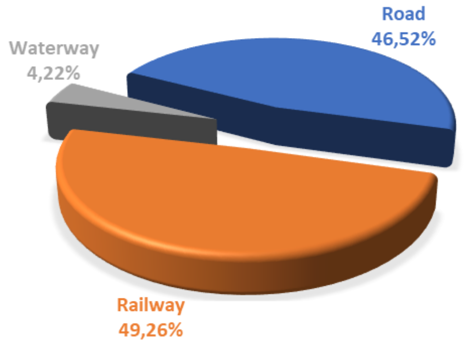
+10%




Outputs in container kilometres

| | |
|---|---|
| Road: | 5 857 695 |
| Railway: | 6 189 163 |
| Waterway: | 497 079 |

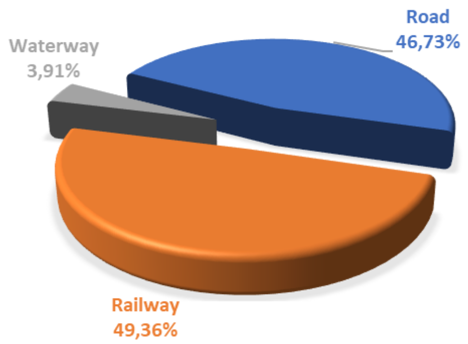
-10%




Outputs in container kilometres

| | |
|---|---|
| Road: | 5 842 198 |
| Railway: | 6 186 562 |
| Waterway: | 530 063 |

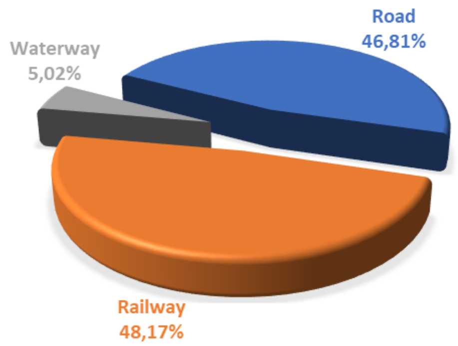
+20%




Outputs in container kilometres

| | |
|---|---|
| Road: | 5 858 875 |
| Railway: | 6 189 430 |
| Waterway: | 489 931 |

-20%




Outputs in container kilometres

| | |
|---|---|
| Road: | 5 898 243 |
| Railway: | 6 069 968 |
| Waterway: | 633 035 |

**Figure 25 Modal split of potential shift in 2030 (Scenario S3)**

In the case of a change of freight transhipment charges in the water transport mode (assessment of combined water and railway transport), the highest share of the transfer potential for waterways was achieved when the transhipment price was reduced by 20%, resulting in a 5% share of water transport in the total shift potential. The change in the price of transhipment waterway / railway (decrease / increase) has little effect on the potential transfer of freight to the railway network, while the ratio between the potential transfer to railway and road infrastructure remains virtually unchanged.

The map view of the potential transfer from road to railway and inland waterway modelled for the year 2030 within alternative scenarios is presented in the following section.

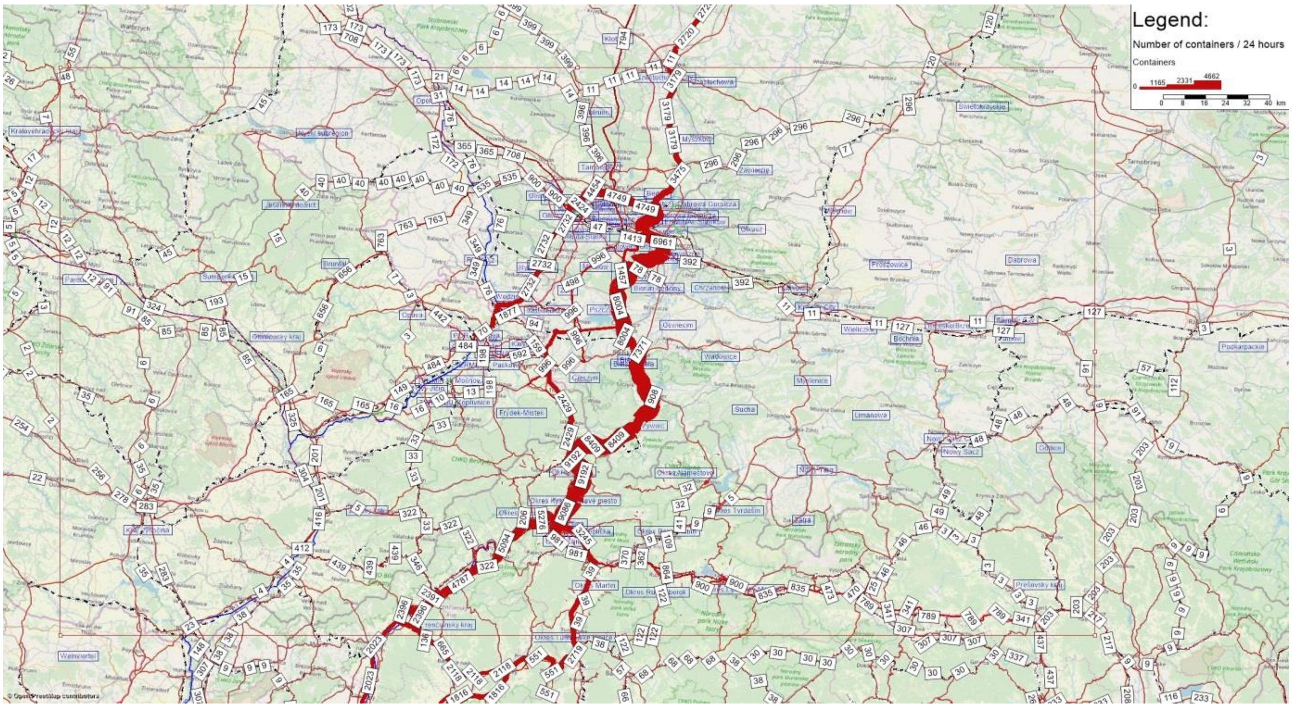



**Figure 26 Pentlogram of potential shift between modes of transport in the territory of TRITIA year 2030 increase of the rates for transhipment of waterway transport (in combination with railway transport) + 10% (Scenario 3)**

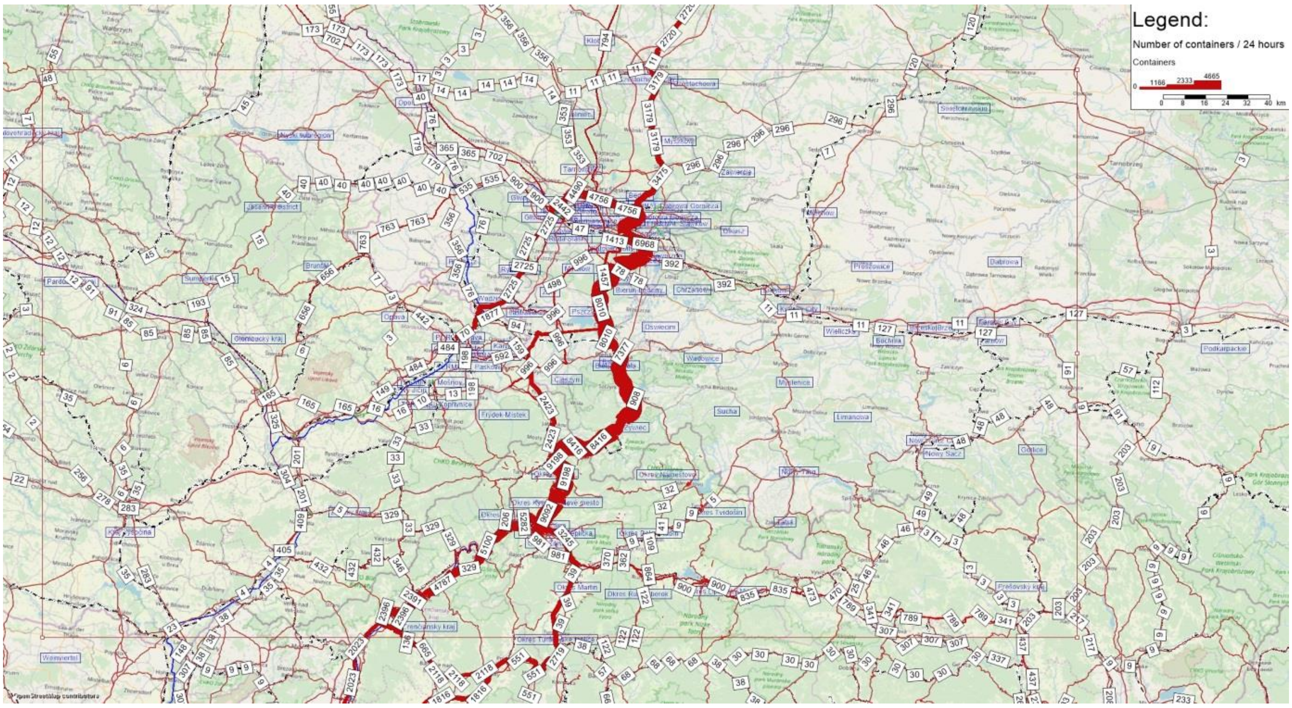



**Figure 27 Pentlogram of potential shift between modes of transport in the territory of TRITIA year 2030 decrease of the rates for transhipment of waterway transport (in combination with railway transport) -10% (Scenario 3)**

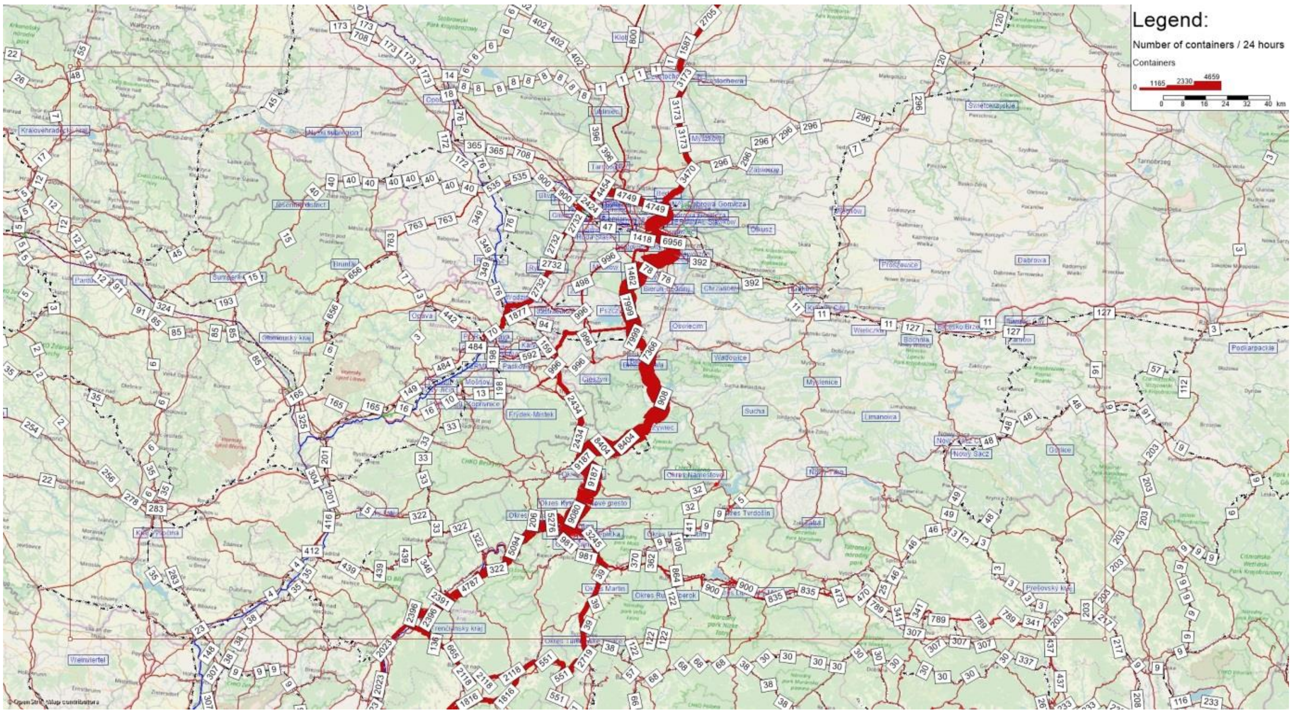



**Figure 28 Pentlogram of potential shift between modes of transport in the territory of TRITIA year 2030 increase of the rates for transhipment of waterway transport (in combination with railway transport) + 20% (Scenario 3)**

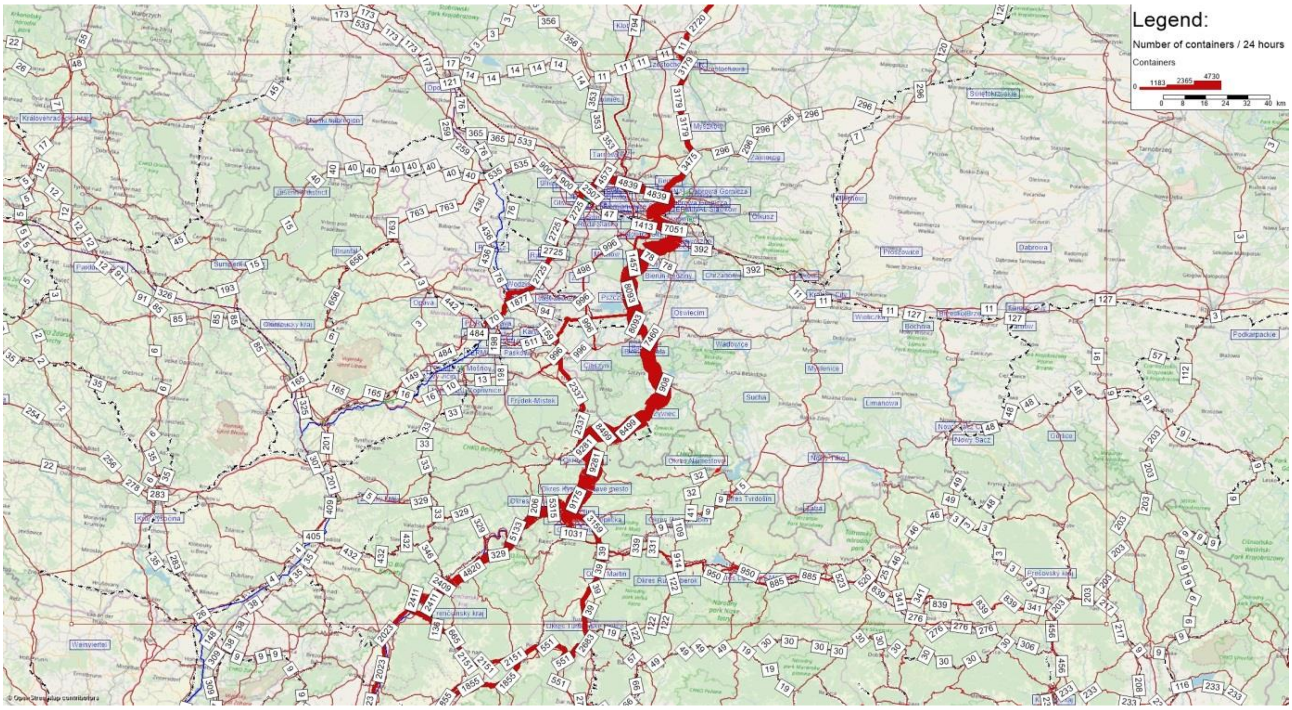
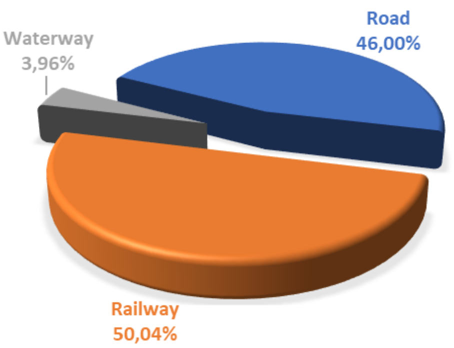



**Figure 29 Pentlogram of potential shift between modes of transport in the territory of TRITIA year 2030 decrease of the rates for transhipment of waterway transport (in combination with railway transport) -20% (Scenario 3)**

## 2.2.6. Alternative “combined” Scenario

Within the “Combined” scenario, the change of costs (growth) for the use of the road network (toll) is +10%, for the use of railway infrastructure is + 5% and the transhipment of goods is + 20% were considered. This change will have following impact on the modal split:

**CD + 10%, ŽD + 5%, reloading + 20%**




Outputs in container kilometres

| | |
|---|---|
| Road: | 5 722 898 |
| Railway: | 6 226 045 |
| Waterway: | 492 453 |

**Figure 30 Modal split of potential shift in 2030 (Combined scenario)**

If prices for road (+ 10%) and railway infrastructure (+ 5%) are increased, as well as freight transhipment services (+ 20%), we register modal split expressing the potential of freight transport. The highest share of this potential transfer is achieved by railway transport 50%, road transport reaches 46% and the lowest share is formed by water transport (less than 4%). The map view of the potential transfer from the road to railway and inland waterway modelled for the year 2030 within alternative scenarios is presented in the following illustration.

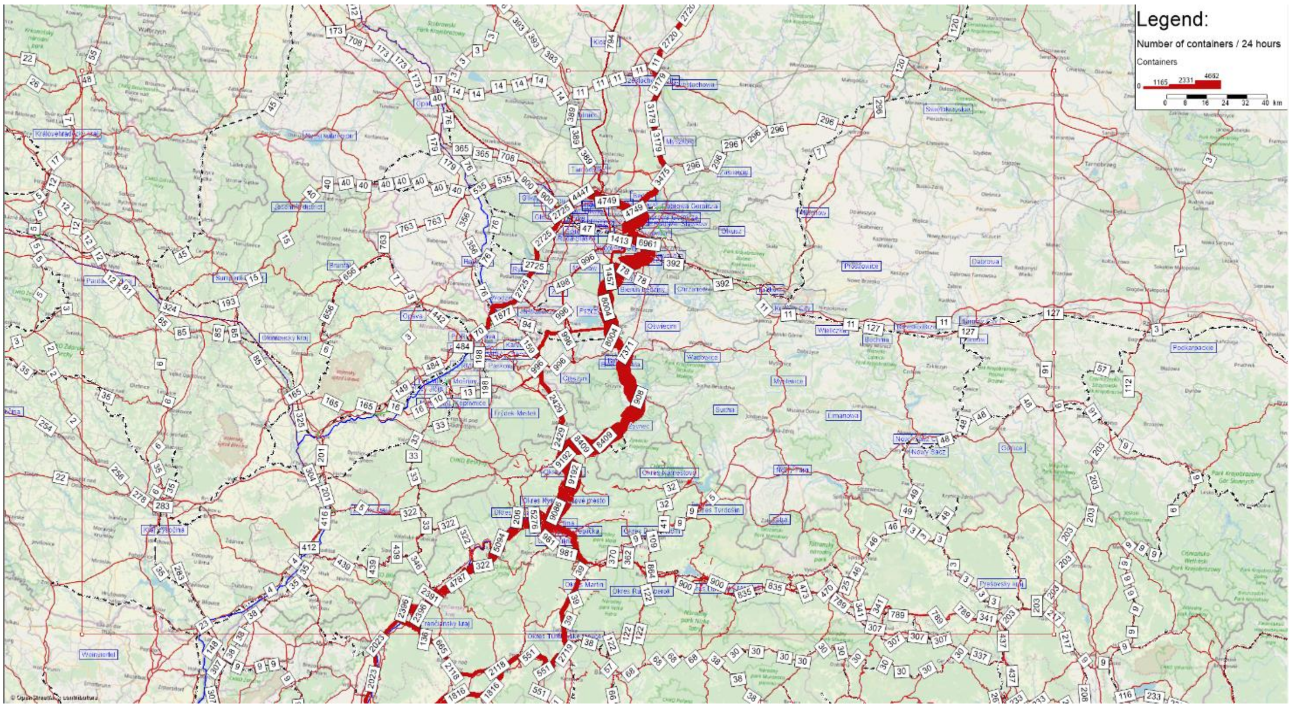



**Figure 31 Pentlogram of potential shift between modes of transport in the territory of TRITIA year 2030 road toll + 10%, railway charges + 5%, transhipment + 20% (Scenario Combined)**

# 3. Conclusions

Transport, as one of the key stone of the economy, requires security of sustainability given the new challenges we are facing and expecting in the near future. Transport is important for EU countries, so the effectiveness of actions requires strong international cooperation. Such an example is the cooperation of the SR, CZ and PL countries within the TRITIA territory with the aim of supporting infrastructure solutions that will be effective, environmentally acceptable, economical and sustainable goods transportation. Transport infrastructure creates mobility, so major changes in transport volumes cannot be achieved without development and support of robust transport systems.

This report summarizes the information that arose from the processed macroscopic transport relation model within the TRITIA territory. The aim was to identify the potential shift of traffic load from road to more environmentally friendly modes of transport, which are railway and inland waterway transport.

Shift in the modal split may create bottlenecks on the existing transport infrastructure. The processed traffic model is able to identify these phenomena, considering and taking into account the defined transport unit (IPJ - 40' container), which represents and generalize the transport of various types of commodities. In the case of requirements for modifying the modal split, it is necessary to verify the suitability of the current infrastructure, its capacity parameters (current and future) in order to assess whether this transport infrastructure will be able to cover the increase of traffic volumes. At present, the transport infrastructure is already fully utilized in many places and congestions arise on a daily basis, therefore it is necessary to identify all the present and future bottlenecks that affect the overall throughput of the entire transport system.

The territorial development (economic, commerce) is assessed on the basis of a change in the country's GDP (or regional). For this reason, in the TRITIA territory model for the year 2030 the GDP was estimated at three levels optimistic, pessimistic and realistic. For the development of other alternative scenarios, a realistic scenario was considered, which represents the most likely development by 2030.

The main task of the traffic modelling of the chosen alternative scenarios was to examine the impact of the change in the development of the economy and parameters (prices for the use of transport infrastructure, prices for transhipment and their combinations) on the change of the modal split.

The outputs of the TRITIA traffic model include a list of reference sections of the modelled road network of the Zilina Region, the Moravian-Silesian Region, Opole and Silesian Voivodeship, which quantify changes in intensities in terms of the number of freight transport units (40´container) for each modelled scenario. The testing concerned the determination of the impact of changes in input parameters (decrease / increase) in the price of charges for the use of the road and railway transport network and the price of transhipment (combined transport) on the level of intensity of universal transport units.

The output is processed in the tabular form of the following table comparison.

**Table 13 List of sections with intensity for each alternative scenario, part I**

| Code | ID | S0 | | | S1 | | | | S2a | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | GDP growth +10% | GDP growth +15% | GDP growth +20% | Road infrastructure charges (toll) increase by +5% | Road infrastructure charges (toll) drop by -5% | Road infrastructure charges (toll) increase by +10% | Road infrastructure charges (toll) drop by -10% | Railway infrastructure charges + transhipment costs + 5% whole network + 10% transhipment | Railway infrastructure charges + transhipment costs drop by -5% whole network -10% transhipment | Railway infrastructure charges + transhipment costs + 10% whole network + 20% transhipment | Railway infrastructure charges + reloading costs drop by -10% whole network -20% transhipment |
| Railway infrastructure | | | | | | | | | | | | |
| SK | 25010240 | 1202,10 | 1256,74 | 1311,38 | 1266,35 | 1256,74 | 1276,90 | 1140,09 | 1246,50 | 1322,40 | 1121,20 | 1342,94 |
| SK | 26015210 | 1504,05 | 1572,42 | 1640,78 | 1584,71 | 1575,59 | 1592,23 | 1487,28 | 1554,84 | 268,52 | 1471,40 | 1756,76 |
| SK | 27015410 | 225,12 | 235,35 | 245,58 | 235,35 | 235,35 | 249,61 | 223,47 | 213,29 | 1588,11 | 187,71 | 273,00 |
| CZ | 2000006354 | 1152,95 | 1205,35 | 1257,76 | 1246,17 | 1205,35 | 1277,93 | 1157,72 | 1203,52 | 1278,50 | 1128,85 | 1302,27 |
| CZ | 2000006537 | 283,00 | 295,86 | 308,73 | 302,03 | 295,86 | 302,03 | 289,71 | 295,86 | 293,68 | 274,96 | 293,68 |
| CZ | 116308459 | 71,20 | 74,43 | 77,67 | 74,43 | 74,43 | 75,18 | 67,91 | 70,46 | 75,18 | 72,78 | 75,18 |
| CZ | 2000006346 | 59,25 | 61,95 | 64,64 | 65,16 | 61,95 | 65,90 | 55,42 | 55,42 | 62,69 | 55,42 | 62,69 |
| CZ | 2000000155 | 17,75 | 18,56 | 19,36 | 19,45 | 18,56 | 19,45 | 15,56 | 15,56 | 19,45 | 15,56 | 19,45 |
| PL | 2000006559 | 122,99 | 128,58 | 134,17 | 128,58 | 128,58 | 129,33 | 123,71 | 123,71 | 84,28 | 123,71 | 84,28 |
| PL | 2000006452 | 957,23 | 1000,74 | 1044,25 | 1008,63 | 1000,74 | 1025,05 | 962,26 | 997,48 | 1056,86 | 943,40 | 1075,26 |
| PL | 2000006558 | 122,99 | 128,58 | 134,17 | 128,58 | 128,58 | 129,33 | 123,71 | 123,71 | 84,28 | 123,71 | 84,28 |
| Road infrastructure | | | | | | | | | | | | |
| SK | 2000006011 | 4339,00 | 4536,23 | 4733,45 | 4507,09 | 4520,29 | 4471,97 | 4660,49 | 4544,68 | 4502,03 | 4651,70 | 4464,72 |
| SK | 4704 | 156,55 | 163,67 | 170,79 | 158,70 | 159,45 | 177,88 | 164,36 | 167,68 | 163,67 | 170,67 | 163,67 |
| SK | 2000006310 | 499,11 | 521,80 | 544,48 | 510,93 | 510,93 | 506,01 | 581,46 | 523,13 | 516,88 | 573,95 | 421,46 |
| SK | 260 | 19,70 | 20,60 | 21,49 | 20,60 | 20,60 | 20,60 | 22,44 | 20,60 | 20,60 | 21,49 | 20,60 |
| SK | 2000003110 | 377,38 | 394,54 | 411,69 | 380,46 | 397,71 | 380,46 | 491,00 | 394,54 | 385,83 | 415,93 | 375,79 |
| CZ | 116309588 | 374,22 | 391,23 | 408,24 | 391,23 | 391,23 | 519,19 | 391,23 | 391,23 | 391,23 | 391,23 | 391,23 |
| CZ | 33410374 | 1168,57 | 1221,68 | 1274,80 | 1252,16 | 1223,25 | 1247,58 | 1272,80 | 1230,29 | 1213,87 | 1235,15 | 1213,87 |
| CZ | 33410966 | 234,37 | 245,02 | 255,67 | 213,37 | 250,63 | 198,41 | 218,98 | 250,63 | 244,27 | 266,67 | 241,54 |
| CZ | 2000006250 | 497,16 | 519,76 | 542,36 | 513,87 | 519,76 | 385,91 | 519,76 | 519,76 | 519,76 | 519,76 | 519,76 |
| CZ | 2000006264 | 313,94 | 328,21 | 342,48 | 354,95 | 328,21 | 354,95 | 359,86 | 328,21 | 323,30 | 328,21 | 323,30 |
| PL | 1000000517 | 1291,84 | 1350,56 | 1409,28 | 1343,49 | 1355,44 | 1302,86 | 1391,69 | 1362,47 | 1334,92 | 1385,69 | 1332,79 |
| PL | 1000000461 | 476,21 | 497,85 | 519,50 | 491,96 | 497,85 | 364,00 | 497,85 | 497,85 | 497,85 | 497,85 | 497,85 |
| PL | 1000000376 | 2294,44 | 2398,73 | 2503,02 | 2249,57 | 2397,62 | 644,87 | 4060,29 | 2407,92 | 2374,99 | 2497,62 | 2367,70 |
| PL | 1000000674 | 1693,43 | 1770,40 | 1847,37 | 2227,09 | 1774,35 | 738,56 | 1791,67 | 1774,35 | 1759,19 | 1791,67 | 1729,17 |
| PL | 1000000114 | 174,51 | 182,44 | 190,37 | 176,55 | 182,44 | 173,37 | 182,44 | 182,44 | 179,26 | 182,44 | 179,26 |
| PL | 1000000899 | 364,76 | 381,34 | 397,92 | 412,99 | 381,34 | 408,07 | 412,99 | 381,34 | 376,42 | 381,34 | 376,42 |
| Water ways | | | | | | | | | | | | |
| CZ | 2000006502 | 154,72 | 161,75 | 168,79 | 161,75 | 164,43 | 161,75 | 165,77 | 164,43 | 161,75 | 165,77 | 161,75 |
| CZ | 2000006500 | 85,95 | 89,86 | 93,77 | 89,86 | 92,53 | 89,86 | 93,87 | 36,55 | 33,88 | 37,89 | 38,40 |
| PL | 2000006568 | 127,62 | 133,42 | 139,22 | 148,16 | 133,42 | 148,16 | 202,46 | 136,68 | 151,48 | 204,51 | 146,32 |
| PL | 2000006569 | 119,63 | 125,06 | 130,50 | 139,81 | 125,06 | 139,81 | 146,23 | 128,33 | 143,12 | 165,09 | 137,96 |

**Table 14 List of sections with intensity for each alternative scenario, part II**

| Code | ID | S2b | | | | S3 | | | | Combined |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Railway infrastructure charges increase by+ 5% | Railway infrastructure charges drop by - 5% | Railway infrastructure charges increase by + 10% | Railway infrastructure charges drop by - 10% | Terminal fees for transhipment increase by + 10% | Terminal fees for transhipment drop by - 10% | Terminal fees for transhipment increase by + 20% | Terminal fees for transhipment drop of - 20% | Toll +10%, railway +5%, transhipment +20% |
| Railway infrastructure | | | | | | | | | | |
| SK | 25010240 | 1178,68 | 1322,40 | 1068,25 | 1342,94 | 1256,74 | 1253,48 | 1254,06 | 1185,65 | 1254,86 |
| SK | 26015210 | 1487,01 | 268,52 | 1471,40 | 1756,76 | 1572,42 | 1572,42 | 1572,42 | 1504,59 | 1562,35 |
| SK | 27015410 | 213,29 | 1588,11 | 187,71 | 273,00 | 235,35 | 232,09 | 235,35 | 232,09 | 216,56 |
| CZ | 2000006354 | 1185,62 | 1278,50 | 1044,84 | 1302,27 | 1205,35 | 1202,09 | 1208,02 | 1184,19 | 1255,11 |
| CZ | 2000006537 | 295,86 | 293,68 | 194,68 | 293,68 | 295,86 | 295,86 | 295,86 | 295,86 | 302,03 |
| CZ | 116308459 | 70,46 | 75,18 | 72,78 | 75,18 | 74,43 | 74,43 | 74,43 | 74,43 | 76,99 |
| CZ | 2000006346 | 55,42 | 62,69 | 55,42 | 62,69 | 61,95 | 61,95 | 61,95 | 61,95 | 61,95 |
| CZ | 2000000155 | 15,56 | 19,45 | 15,56 | 19,45 | 18,56 | 18,56 | 18,56 | 18,56 | 19,45 |
| PL | 2000006559 | 123,71 | 84,28 | 123,71 | 84,28 | 128,58 | 128,58 | 128,58 | 128,58 | 128,58 |
| PL | 2000006452 | 979,57 | 1056,86 | 779,11 | 1075,26 | 1000,74 | 997,48 | 1003,41 | 979,57 | 1008,63 |
| PL | 2000006558 | 123,71 | 84,28 | 123,71 | 84,28 | 128,58 | 128,58 | 128,58 | 128,58 | 128,58 |
| Road infrastructure | | | | | | | | | | |
| SK | 2000006011 | 4612,50 | 4495,92 | 4704,65 | 4464,72 | 4536,23 | 4539,49 | 4533,55 | 4607,31 | 4494,95 |
| SK | 4704 | 167,68 | 163,67 | 170,67 | 163,67 | 163,67 | 166,93 | 163,67 | 166,93 | 177,88 |
| SK | 2000006310 | 573,06 | 516,88 | 573,95 | 421,46 | 521,80 | 521,80 | 521,80 | 571,72 | 510,93 |
| SK | 260 | 20,60 | 20,60 | 21,49 | 20,60 | 20,60 | 20,60 | 20,60 | 20,60 | 20,60 |
| SK | 2000003110 | 394,54 | 385,83 | 447,00 | 375,79 | 394,54 | 394,54 | 394,54 | 394,54 | 382,11 |
| CZ | 116309588 | 391,23 | 391,23 | 391,23 | 391,23 | 391,23 | 391,23 | 391,23 | 391,23 | 519,19 |
| CZ | 33410374 | 1230,29 | 1213,87 | 1315,43 | 1213,87 | 1221,68 | 1221,68 | 1221,68 | 1221,68 | 1248,33 |
| CZ | 33410966 | 250,63 | 244,27 | 277,50 | 241,54 | 245,02 | 245,02 | 245,02 | 245,02 | 199,16 |
| CZ | 2000006250 | 519,76 | 519,76 | 519,76 | 519,76 | 519,76 | 519,76 | 519,76 | 519,76 | 385,91 |
| CZ | 2000006264 | 328,21 | 323,30 | 328,21 | 323,30 | 328,21 | 328,21 | 328,21 | 328,21 | 354,95 |
| PL | 1000000517 | 1362,47 | 1334,92 | 1385,69 | 1332,79 | 1353,87 | 1350,56 | 1353,87 | 1350,56 | 1311,43 |
| PL | 1000000461 | 497,85 | 497,85 | 497,85 | 497,85 | 497,85 | 497,85 | 497,85 | 497,85 | 364,00 |
| PL | 1000000376 | 2475,74 | 2374,99 | 2550,57 | 2367,70 | 2398,73 | 2401,99 | 2398,73 | 2469,81 | 663,67 |
| PL | 1000000674 | 1774,35 | 1759,19 | 1791,67 | 1729,17 | 1770,40 | 1770,40 | 1767,73 | 1770,40 | 757,36 |
| PL | 1000000114 | 182,44 | 179,26 | 182,44 | 179,26 | 182,44 | 182,44 | 182,44 | 182,44 | 176,55 |
| PL | 1000000899 | 381,34 | 376,42 | 381,34 | 376,42 | 381,34 | 381,34 | 381,34 | 381,34 | 412,99 |
| Water ways | | | | | | | | | | |
| CZ | 2000006502 | 164,43 | 161,75 | 165,77 | 161,75 | 161,75 | 161,75 | 161,75 | 161,75 | 161,75 |
| CZ | 2000006500 | 36,55 | 33,88 | 37,89 | 38,40 | 89,86 | 89,86 | 89,86 | 89,86 | 33,88 |
| PL | 2000006568 | 204,51 | 133,42 | 257,46 | 146,32 | 133,42 | 154,74 | 133,42 | 222,56 | 130,11 |
| PL | 2000006569 | 146,23 | 125,06 | 249,10 | 137,96 | 125,06 | 146,38 | 125,06 | 164,28 | 121,75 |

# ANNEXES

Annex 1 TRANS TRITIA traffic model – alternative scenarios (electronic annex – xlsx)

# ANNEX 1

**TRANS TRITIA TRAFFIC MODEL - ALTERNATIVE SCENARIOS (ELECTRONIC ANNEX – XLSX)**