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Implementation plan for TRITIA region

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1. Introduction

The transport is a key element of the economic and social development and the mobility of goods is very important for the internal market and for the standard of living in individual regions. For these reasons the EU market is opened with free movement of goods and residents. Transport helps the economic growth and job creation and it needs to be sustainable in regard of the new future challenges that it encounters. Transport is global in nature, so that the effectiveness of actions requires strong international cooperation. The TRANS TRITIA project follows these principles and is about cooperation of partners from the Czech Republic, Poland and Slovakia, specifically in the border area of these states formed by the Zilina Region, Moravian-Silesian Region, Silesian and Opole Voivodship.

The continuous development of the transport sector is a necessary condition for the successful development of the TRITIA territory as a whole. The consistent planning, continuous preparation and implementation of development projects are setting direction in all areas of the transport sector. In this sense, it is a basic necessity for linking development activities with the current possibilities of the economy as one of the limiting factors. Transport development must therefore target and prioritize areas and aspects that will support a sustainable transport system in the mid - term horizon. The result of this process must be a transport system that supports economic growth and development of the Czech Republic, Poland and Slovakia and not to hinder their national economies.

The common task of the countries of Western, Central and Eastern Europe was to ensure trade exchange and economic development, respecting the democratic values and social standards of individual national cultures. With this in mind, the European Commission has elaborated the concept of transport routes - corridors - with the link of Western Europe towards the east on the basis of multimodality. Today - more than ever - it is effective, that the transport is absolutely vital to the European economy. Without good infrastructure, the Europe will neither grow nor prosper. By the year 2050, it is expected that the freight transport will increase by 80% and passenger transport by more than 50%. Missing links, mainly on cross-border sections, are a major obstacle to the free movement of goods and residents within and between Member States and neighbouring countries. There are still significant differences in the quality and availability of infrastructure between and within Member States. That is the reason why 9 core TEN-T core network corridors has been created with the comprehensive network of connecting routes at regional and national level that supports the core network. The aim is to ensure that, by the year 2050 the majority of European citizens and businesses will not be more than 30 minutes away from this comprehensive network. Overall, this new transport network will allow safer and faster transport as well as less traffic congestion. At the same time, the investment into transport infrastructure should contribute to achieving the targets for reducing of greenhouse gas emissions in transport by 60% by the year 2050.

The multimodal TEN-T core network and corridors have the task to contribute to the cohesion of Europe and to strengthen the internal market in order to ensure the free flow of goods and residents with goal of supporting the EU economic growth, employment and competitiveness. Strengthening of multimodality on railways, inland waterways and maritime infrastructure within the TEN-T multimodal network and using innovative transport technologies, will influence the modal split, lighten the road traffic, reduce GHG and pollutant gas emissions, and reinforce the transport safety and environmental protection.

The TRITIA region is crossed by two multimodal TEN-T corridors - the Baltic-Adriatic and Rhine-Danube. Based on that fact the concerned region has an advantageous strategic position. The Baltic-Adriatic Corridor is a north-south connection, which provides direct access of Central European countries to the maritime ports as Ravena, Koper, Trieste, Gdansk, Gdyna, Szczecin are. The Rhine-Danube Corridor is the west-east connection from France to the sea port of Constanta in the Black Sea. Outside the TRITIA territory, both corridors are crossing with other TEN-T corridors, so that Central European countries have access to the rest of TEN-T core corridors.

The TRITIA traffic model developed in the framework of the project considers the natural development of the territory by 2030 within which the planned development projects on transport infrastructure are taken into account. These development projects were mainly aimed at modernizing and upgrading infrastructure in order to promote the sharing of transport work in favour of more environmentally acceptable modes of transport, namely railway and waterway transport. It was necessary to identify the potential of shifting transport work from road transport to railway and water, primarily within the multimodal TEN-T corridors. In freight transport, this process mainly concerned the transport of ISO containers. Consequently, infrastructure bottlenecks have been identified that limit the economic development of the territory and, from the perspective of individual countries in TRITIA, will need to be incorporated into other measures to support the achievement of the objectives in the European strategy papers. These measures should aim at increasing the capacity of bottlenecks on railways or waterways resulting from the transport model and, last but not least, on the construction of multimodal terminals, or to increase the capacity of existing terminals within TRANS TRITIA.

2. European strategy context for development of environmentally friendly transport modes

For the development of the TRITIA project region, there are planned railway, road, water and intermodal transport projects until 2030.

For the road transport, the construction of new highways, expressways and first class roads, as well as bypasses and modernization of the motorway are planned. The implementation of these projects will result in a reduction in the traffic load on the affected area and increase the attractiveness of the region for potential investors. Building new roads will increase the quality of life in the territories concerned. Modern infrastructure will be adapted to the use of new alternative fuels and thus contribute to reducing transport emissions. Traveling will be faster to adjacent cities, reducing the burden on existing roads and the amount of congestion and the road transport will become more attractive for passenger and transport operators.

The planned modernization of the railway infrastructure will increase the railway infrastructure capacity and the interconnection of existing railway lines. The modernized lines will have the new signalling systems (ERTMS), which will increase the safety and compatibility of railway transport and enable to increase the frequency of trains on the lines while trains can travel at higher speeds, making railway transport more attractive. The electrification and transition to AC current will contribute to more reliable transport with fewer emissions which will lead to improvement of the air quality in affected region.

In the Moravian-Silesian Region, in Mošnov, the construction of a new road-railway intermodal public terminal is planned. The aim of this project is to enhance the usage of railway and local road network with resulting reduction of noise and emissions from the transportation.

Two projects in the TRITIA region are planned for the inland waterways. First project is a connection of Ostrava to the Polish waterway network. Second project will support the first one and should be consisting of the connection Danube – Oder – Elbe.

The European Union gives the direction for the development of transport, safety, environment, etc. Through conceptual and strategic documents that each Member State implements in its national policies, they seek to achieve the framework objectives:

- White Paper: Roadmap to The Single European Transport Area Plan - Towards a competitive and resource efficient transport system
- Europe 2020 - A strategy for smart, sustainable and inclusive growth
- Roadmap for moving to a competitive low carbon economy in 2050

- Directive 2014/94/EU of the European Parliament and of the Council of 22 October 2014 on the deployment of alternative fuels infrastructure
- European Strategy for Low - Emission Mobility

2.1. White Paper: Roadmap to The Single European Transport Area Plan - Towards a competitive and resource efficient transport system[1]

Over the next decades, oil reserves will be more uncertain and this mineral will become scarcer. The International Energy Agency (IEA) argues, that the price of oil will rise by more the world is able to reduce its carbon emissions. EU oil import costs amounted to around 210 billion EUR in 2010. The world's dependence on this energy source can affect the population's ability to travel and our economic security. The consequences for the inflation, trade balance and overall competitiveness of the EU economy, could be catastrophic.

The international community has supported the EU in its call for a significant reduction in greenhouse gas emissions worldwide, with goal not to exceed the 2 °C temperature rise caused by the climate change. The EU goal can achieve this by reducing emissions by 80-95% of 1990 levels by 2050. Transport is a significant source of greenhouse gases and based on the results of the analysis of the various sectors, the Commission concluded that transport needs to reduce greenhouse gas emissions by at least 60% by 2050 (compared to 1990 levels). The intermediate targets in this sector are quantified by 2030 and represent a reduction of greenhouse gases of approximately 20% (compared to the 2008 level). At the turn of the 21st century, there was a significant increase in transport emissions, so this target would mean that, despite efforts, emissions would exceed the 1990 level by 8%.

Although transport has become more energy efficient, 96% of its energy needs in the EU are still dependent on oil and its derivatives. Technological progress has made transport more environmentally friendly, but its increased volumes are a major source of noise and local air pollution.

Accessibility of air and road transport is endangered by their heavy congestion. In addition, the unevenly developed transport infrastructure in the eastern and western parts of the EU needs to be unified. The situation increases the pressure on public sources of financing for infrastructure projects and a new approach of financing and pricing needs to be developed.

Looking forward to the upcoming years, it is clear that the development of transport cannot proceed as it has been until now. Applying the previous approach, the dependence of transport on oil would still be close to 90% and renewable energy sources would only slightly exceed the 10%, as it was targeted till 2020. Compared to 1990, CO_2 emissions in 2050 would be one third higher. Congestion will cause costs to rise by almost 50% by 2050. The accessibility gap between central and peripheral areas would be increasing. The social costs of accidents and noise would also increase.

It is necessary to minimize or even eliminate the dependence of the transport system on oil without compromising efficiency of the system and mobility. Together with the initiative "A resource-efficient Europe" launched under the Europe 2020 Strategy and in line with the new Energy Efficiency Plan 2011, European transport policy is becoming a major task of helping to create a system that fosters economic progress in Europe mobility and strengthen competitiveness. It is desirable for the transport sector to reduce energy usage and to utilize environmental friendly resources to eliminate the negative impact on the environment and to start using modern infrastructure more efficiently.

We need to create new traffic models that will allow the transport of a higher volume of cargo and a higher volume of passengers at the same time or using the most efficient modes of transportation or combination

[1] European Commission, 2011. WHITE PAPER - Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system. Brussels, 28.3.2011, COM (2011) 144 final.

of these. For the last mile of the delivery (largely by road) the environmentally friendly transportation should be preferred. Transport is easier and more reliable thanks to information technologies. With all the measures the citizens will pay full shipping costs in exchange for less congestion, more information, better quality services and higher security.

For distances up to 300 km (short and medium distances), freight will be mostly transported by trucks. In addition to promoting alternative transport solutions (railway and waterborne), the freight transport need to be more efficient by developing and using new engines and greener fuels, intelligent transport systems and other measures to strengthen market mechanisms.

Transporting freight in long-distance road transport has more limited options for eliminating carbon emissions. The use of the multimodality of freight transport is conditional on its economic attractiveness for shippers and this process requires an effective combination of multiple modes of transportation. It is necessary to develop special freight corridors in EU that will be optimized in term of energy use and emissions for minimal environmental impact. Reliability, limited congestion and low operating and management costs make them attractive.

For freight transport, the railway is often unattractive, nevertheless in some Member States this mean of transportation is viable due to quality of services. Still the railways can be competitive with road transport, and can take over a large share in medium to long distance freight. Modernizing of railway capacity will require significant investments and there is expectation for gradual modernization of rolling stock with goal of introducing quieter breaking and automatic coupling mechanism.

The interconnection of long-distance haul and last mile delivery could be worked on and be more efficient, thus reducing the number of individual deliveries and to shorten the delivery as much as possible. With intelligent transport systems, it is possible to manage traffic at the current time, shorten delivery times and reduce congestion in the last mile distribution segment. The final part of freight transport could be carried out by low-emission urban trucks with reduction of road congestions through the use of night transport using electrical, hydrogen and hybrid technologies, which are reducing not only air emissions but also noise.

The document outlines the following optimization of the performance of multimodal logistics chains, taking into account wider use of more energy efficient modes:

- 30% of road freight over 300 km should shift to other modes such as railway or waterborne transport by 2030, and more than 50% by 2050. Efficient green freight corridors and the development of appropriate infrastructure should help to achieve this goal.
- The multimodal TEN-T corridor should be operational across the EU in a 'core network' by 2030, by 2050 with a high-quality and high-capacity network and an appropriate set of information services.
- All airports in the core network should be interconnected with the railway network (preferable high-speed) by 2050 and sufficient interconnection of major seaports or inland waterway ports with railway transport.

The Single European Transport Area should facilitate movement of residents and goods, reduce transport costs and strengthen the sustainability of transport sector.

Europe needs a "core network" of corridors that will allow large quantities of freight and passengers to be transported in an efficient, with low-emission manner by using a multimodal combination of efficient transport modes and the spatial application of advanced technologies and infrastructure with mitigation of environmental impact of the transport sector.

The importance of the core corridor network should ensure the application of modern information technologies, which will ensure fast and reliable tracking of trains and rolling stock and enable the simplification of administration.

The completed core network will ensure effective multimodal interconnection between EU capitals and other major cities, airports, ports and major economic centres. To establish a cohesive and highly efficient network states have to build missing connections at cross-border sections and have to address bottlenecks / bypasses. The maritime aspect of the core network will be the motorways of the sea. Transporting freight over long distances requires improvement or construction of the connections between the railway and the airport.

For the development of EU infrastructure to be at level that can meet the transport demand, infrastructural project are being implemented with financial expenses in amount of 1,5 trillion EUR in 2010 – 2030 time period. Investments to finalize TEN -T network will be approximately 550 billion EUR and 215 billion EUR will be used for major problem areas. The funds do not include investments in vehicles, equipment and charging infrastructure to achieve emission reductions in the transport sector. By including these expenditures, the financial value may be additionally increased by 1 trillion EUR.

List of planned initiatives related to the present study:

- Introduction of a single authorization by type of vehicle and a single safety certification of railway undertakings by strengthening the role of the European Railway Agency (ERA).
- Develop an integrated approach to the management of freight corridors, including track access charges.
- Use of monitoring tools by all competent authorities. Between communication and information technology systems in the water transport sectors, guaranteeing vessel and cargo monitoring and the establishment of appropriate port facilities.
- For inland waterway transport, create an appropriate framework to optimize the internal market and remove barriers to greater use of water transport. Reviewing and defining the roles and mechanisms needed to operate this mode of transport in a wider European context.
- Ensuring intermodal accountability, establishing an appropriate framework to track cargo at the current time and promoting green freight. Creation and implementation of a single electronic transport document, thus putting into practice the 'one-window' and 'one-stop-shop' concepts and creating an appropriate framework for the use of freight tracking and tracing technologies. Ensuring the promotion of rail, water and intermodal transport.
- One of the areas that will bring the greatest European added value is integrated transport management and information systems. They will serve to facilitate the provision of intelligent mobility services, better use of infrastructure and vehicles and information systems in real time, enabling movement detection and tracking and freight traffic flow management.
- The technology plan will also deliver the intelligent infrastructure (both land and space) needed to ensure maximum monitoring and interoperability of multiple modes of transport and communication between infrastructure and vehicles.
- In the core network, the creation of multimodal freight corridors in order to synchronize investment and infrastructure development and support transport services including inclusive rail services at medium and long distances.
- Encouraging multimodal and single freight transport, stimulating the integration of inland waterway transport into the transport system and promoting eco-innovation in freight transport. Facilitating the renovation of old vehicles and vessels and encouraging the development of new ones.

2.2. Europe 2020 - A strategy for smart, sustainable and inclusive growth[2]

The document focuses on three basic objectives: sustainable, smart and inclusive growth. To achieve the set of objectives it will need to take a number of different national, European and international measures. One of the seven main objectives proposed by the Commission is the 'Resource efficient Europe' initiative. The program aims to support the transition towards a low-carbon economy, make greater use of renewable energy, modernize the transport sector and promote energy efficiency. This objective (along with other objectives for other sectors) represents a commitment for both the EU and the Member States.

Inefficient use of raw materials and dependence on fossil fuels cause price shocks for consumers and thus jeopardize economic security and contribute to climate change. Global population growth brings a struggle for natural resources and represents a deteriorating environment. The EU will achieve energy and climate change by addressing climate challenges not only in its territory, but throughout the world.

To achieve the EU strategy successfully, greenhouse gas emissions must be reduced by at least 20% by 2020 compared to 1990 or by 30% under favourable conditions. The share of renewable energy sources in final energy consumption should be increased by 20% and energy efficiency increased by at least 20%.

It will help the environment by investing states in cleaner low carbon technologies, while helping to combat climate change and create new employment and entrepreneurship alternatives for the population.

Transport and emissions areas where Europe must act:

- Competitiveness: Europe needs to improve its competitiveness vis-à-vis its major trading partners through higher productivity. Europe has a leading position in the green technology market, which it should strive to maintain.
- Combating climate change: In the upcoming period, emphasis must be placed on reducing emissions faster than ever before and making greater use of the potential of new technologies. Resource efficiency would reduce emissions, reduce costs and promote economic growth.
- Clean and efficient energy: Till 2020, the expenditure on oil and gas imports could be reduced by EUR 60 billion, meeting the energy-related targets. This would also promote energy independence and could ultimately increase GDP by 0.6-0.8%. It would be created at least 600 000 jobs and only during the EU's target of 20% renewable energy. Along with an increase in energy efficiency of 20%, more than 1 million new jobs could be created. In reducing emissions, consideration must be given to minimizing costs and achieving a more efficient use of resources in the economy.

The aim of the "Resource efficient Europe" initiative is to promote a shift towards a more inclusive and low-carbon economy. Economic growth should not depend on the use of resources and energy. The challenge is also to reduce CO_2 emissions, increase competitiveness and promote greater energy security.

The Commission's efforts at EU level will inter alia:

- Improve the framework for the use of market-based instruments (eg emissions trading, energy taxation adjustment, promoting the wider use of green public procurement);
- Put forward proposals to modernize and reduce carbon emissions in the field of transport in order to contribute to increased competitiveness. A number of measures can help in this (eg in infrastructure - within the framework of electric mobility, the deployment of network infrastructures, intelligent system-driven transport, improved logistics, aviation and maritime transport to reduce CO_2 emissions, use of clean vehicles),

[2] EUROPEAN COMMISSION, 2010. COMMUNICATION FROM THE COMMISSION – EUROPE 2020 A strategy for smart, sustainable and inclusive growth. Brussels, 3.3.2010, COM(2010) 2020 final

- Create a vision of the structural and technical changes that will be needed to create a low-carbon, resource-efficient and climate-resilient economy by 2050.

At national level, States' tasks will include:

- Stop providing state grants for activities that are harmful to the environment, in addition to providing subsidies to people with social needs;
- Build better, more intelligent and fully interconnected energy and transport infrastructures and make full use of ICTs;
- Ensure coordinated implementation of infrastructure projects within the EU core network to improve transport in the EU;
- Focus on the urban dimension of transport, which is involved in congestion and emissions production.

One of the 5 headline targets is a reduction of at least a 20% reduction in greenhouse gas emissions from 1990 levels or, in the case of favourable conditions, a 30% reduction; a 20% increase in energy efficiency and a 20% increase in the share of renewable energy sources in final energy consumption.

2.3. Roadmap for moving to a competitive low carbon economy in 2050[3]

In the framework of the Europe 2020 strategy, the Commission presented a leading initiative for a resource-efficient Europe and proposes long-term policy plans, including in the areas of transport, energy and climate change. The Communication includes the essential elements to ensure that the EU as whole is a competitive low carbon economy by 2050. The concept is based on the view that more emphasis should be placed on energy efficiency policies.

One of the five main targets of the Europe 2020 strategy concerns energy and climate. The EU is on track to achieve a 20% greenhouse gas reduction and a 20% increase in the share of renewable energy. Achieving an energy efficiency improvement of 20% is not possible without further actions and the achievement of all 3 targets remains a priority in 2020.

In February 2020, the European Council confirmed its target of reducing greenhouse gas emissions by 80-95% compared to 1990 by 2050. The set objective is to keep the temperature rise caused by climate change below 2 °C.

In order to move to a competitive low carbon economy, the EU should reduce its emissions by 80% in 2050 compared to 1990. The Commission's analysis of the various scenarios shows a gradual reduction of emissions compared to 1990 levels by 25% in 2020, by 40% in 2030 and by 60% in 2040. This analysis represents an annual emission reduction of approximately 1% in the first decade (2010-2020) compared to 1990 levels, 1.5% in the next decade (2020-2030) and 2% in the remaining years (2030-2050). The abovementioned emission reductions envisage progressively available efficient technologies that will make it possible to increase the reduction effort.

In 2009, estimated emissions were 16% lower than 1990 levels (including international aviation). If current policy plans are implemented, the EU should achieve its emission reduction target (30% in 2030), while the EU would only achieve its half of its energy efficiency improvements. If the EU could meet its 2020 commitments (achieving a 20% share of renewable energy sources and improving energy efficiency by 20%), the target of reducing emissions by 2020 should exceed 5%; reduce emissions by 25%. This is envisaged with the full implementation of the energy efficiency plan, which contains the measures necessary to achieve the energy efficiency plan.

[3] EUROPEAN COMMISSION, 2011. COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS - A Roadmap for moving to a competitive low carbon economy in 2050. Brussels, 8.3.2011, COM(2011) 112 final

Table 1 contains an analysis by the Commission on the reduction of greenhouse gas emissions compared to 1990 in the transport sector, including CO_2 from aviation, excluding the maritime transport.

Table 1 Planned reduction of GHG emissions in transport sector compared to 1990

Year	2005	2030	2050
Transport	+30%	+20% to -9%	-54% to -67%

Source: EUROPEAN COMMISSION, 2011. COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS - Roadmap for moving to a competitive low-carbon economy in 2050. Brussels, 112.2011, COM (2011).

Electricity will play an important role in the low-carbon economy. Although electricity will be increasingly used in the transport and heating sector, it will not affect overall consumption due to newer and more modern technologies. In the future, electricity can replace fossil fuels and contribute to an almost total reduction in CO_2 emissions by 2050.

Improving fuel efficiency will play a decisive role in preventing greenhouse gas emissions from rising. Achieving reductions in road, inland waterway and railway emissions in 2030 to pre-1990 levels is possible through measures such as infrastructure charging, improved public transport, air pollution pricing and congestion.

In heavy goods vehicles and in air transport, biofuel would find use as an alternative fuel. Biofuels and other alternative fuels have an important role to play in reducing emissions in transport, unless there is a widespread introduction of electrification. Second and third generation biofuels need to be developed as their use can help to reduce net greenhouse gas savings and increase pressure on biodiversity, the environment and water management.

Electrification of transport and the expansion of public transport play an important role in improving air quality in the EU. Combining the effects of air quality measures and reducing greenhouse gas emissions could reduce the air pollution rate by more than 65% in 2030 compared to 2005. The annual cost of eliminating common air pollutants could save more than EUR 10 billion in 2030 and nearly EUR 50 billion in 2050. Improving air quality would also contribute to lower mortality rates (annual benefits of € 17 billion in 2030 and € 38 billion in 2050) and to improving public health.

2.4. Directive 2014/94/EU of the European Parliament and of the Council of 22 October 2014 on the deployment of alternative fuels infrastructure[4]

The Directive deals with the main alternative of oil fuels like electricity, natural gas, biofuels, hydrogen, liquefied petroleum gas (LPG) and other.

Autogas = Liquefied Petroleum Gas (LPG) is an alternative fuel that can be used for all distances in road transport and also can be used to fuel ships. The infrastructure of this fuel is well developed in the EU, even if the stations are unevenly distributed and in some countries not that spread.

EU member states have to ensure that electric charging stations for vehicles are established in adequate quantities by 31 December 2020. Taking in the account development of the electric car market, the Commission is proposing to amend the Directive with the aim to introduce a sufficient number of publicly accessible charging stations by 31 December 2025, at least within of TEN-T core network and in densely populated areas.

An adequate number of hydrogen filling stations shall ensure EU member states by 31 December 2025.

[4]Directive 2014/94/EU of the European Parliament and of the Council of 22 October 2014 on the deployment of alternative fuels infrastructure, EU L 307, 28.10.2014, p. 1 – 20.

Liquefied natural gas (LNG) stations are to be built on the TEN-T core network in seaports until 31 December 2025 and inland ports until 31 December 2030. Member States shall ensure an adequate number of publicly accessible LNG gas stations by 31 December 2030 within the TEN-T core network by 31 December 2025, in such an extent that it would be possible to operate LNG-powered heavy trucks across the EU.

2.5. European Strategy for Low - Emission Mobility[5]

The biggest air polluter in cities is the transport sector. It is responsible for almost a quarter of Europe's greenhouse gas emissions. Transport emissions are necessary to be reduced rapidly by moving to low carbon and air pollutant transport. The target includes reducing greenhouse gas emissions from transport by at least 60% in 2050 compared to 1990 levels and gradually eliminating them to zero. There is a high potential for reducing emissions in the transport sector.

Road pricing should take into account the distance actually travelled. The Commission is developing standards for interoperable electronic toll systems in the EU to facilitate market access for new toll service providers. The Commission intends to adjust the fees for freight vehicles in the Directive to take account of CO_2 emissions and to extend the application of certain principles to supplies, coaches, buses and passenger cars.

The biggest energy source of the transport sector is oil (94% of energy needs). There is necessity to accelerate transition to low-emission alternative energy sources in transport while the transition requires the construction of the relevant infrastructure and significant investment.

The biggest options to use alternative fuels are currently for buses and cars while in railway transport, the electrification is the solution. Biofuels will have an important role to play in air transport, lorries and coaches in the medium term. The alternative to diesel in trucks and coaches is natural gas, which at the present times in shipping is an alternative to marine fuels. The use of synthetic methane and bio methane can help increase the potential of natural gas.

The implementation of alternative fuels in transport is not possible without changes in the infrastructure covered by the Alternative Fuels Infrastructure Directive.

There will be necessary to place on the market vehicles with zero or low emissions for these vehicles to have a significant market share. The change will require different measures at different levels (local, regional, national, EU).

For the years following 2020, the Commission is setting CO_2 standards for vans and cars. At the same time, it assesses standards in terms of their costs and benefits, and addresses their impact on competitiveness and policy development in European and world industry.

One quarter of CO_2 emissions from road transport are emissions from trucks, coaches and buses. They are estimated to increase by 10% between 2010 and 2030. There is a lack of standards in the EU regarding fuel economy and how to monitor CO_2 for these types of vehicles.

The issue of certification of CO_2 emissions and fuel consumption of trucks, coaches and buses, is addressed by the Commission, as well as ways of monitoring and reporting this data. These measures will assist in determining road use charges.

The EU wants to allocate 70 billion EUR to transport sector. From this sum 39 billion EUR should be allocated to support the shift to low-emission transport (12 billion EUR should be allocated for the development of low-carbon, multimodal sustainable urban mobility). In total 24 billion EUR shouldn't be used for the

[5] EUROPEAN COMMISSION, 2016. COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS - A European Strategy for Low-Emission Mobility. Brussels, 20.7.2016, COM(2016) 501 final.

Connecting Europe Facility and for the transport research and innovation part of Horizon 2020 includes 6.4 billion EUR should be allocated to support development of low-carbon mobility.

3. Zero scenario results of the TRITIA traffic model

The aim of the project was to strengthen interregional cooperation by reinforcing the economic and social cohesion. In general, the project was focused at identifying the possibility of achieving the objectives defined in the strategic documents Europe 2020 and White Paper - Roadmap to a Single European Transport Area. The project was principally divided into two main parts:

A. TRANS TRITIA Multimodal freight transport strategy and action plans.

B. Model of the TRANS TRITIA multimodal potential.

The need for development of the traffic model has arisen from the current situation in the regions. The role of the model was to find and test the solutions for cross-border problems of transport modes. The aim of the solutions was to increase transport efficiency and development of the concerned regions. The increasing demand for transport shows the infrastructure bottlenecks in individual regions and also in cross-border interconnections. The main goal of the traffic model is to point out the need for the development of transport infrastructure in regions and in cross-border interconnections and to promote the unification of procedures in the concerned countries. For this reason, two main objectives have been defined in the traffic model development:

1) Quantification of the potential for modal shift of traffic load from road freight transport to alternative transport modes (railway and inland waterway) in relation to the aims defined in the White Paper (shift of road freight over 300 km to the other modes of transportation within range of more than 30%).
2) Identification of bottlenecks on the transport infrastructure and proposal of typological measures to increase its capacity in order to increase the potential for modal shift to more environmentally friendly modes of transportation.

The aim and purpose of the project is reflected in the TRITIA traffic model solution and is divided into two sub models:

- Sub model that describes intra-zonal and inter-zonal transport relations.
- Sub model that describes the surrounding territory, including international roads and international transport.

The traffic model takes into account the infrastructure of road, railway, inland waterway and intermodal transport (intermodal terminals). Air transport is not considered as the TRITIA region is not large enough for efficient use of aircrafts.

The model was created in the VISUM® program, which is part of the PTV-VISION® transport planning software package of PTV Karlsruhe.

The originally proposed process of creating a four-stage model with a given structure of commodity groups for freight transport was modified to a model quantifying the potential for shifting part of the traffic load from road freight transport to other modes due to the absence of relevant data inputs characterizing transport demand. The lack of input data is mainly due to the minimum response from carriers in the framework of the questionnaire survey of good flows, as well as incomplete documents characterizing the routing and volume of freight transported by railway. As a result, it was not possible to quantify the volume and routing of transport flows for railway and inland waterway transport in the TRITIA traffic model. The developers thus proceeded to modify the methodological procedure while maintaining the original purpose and objectives of the traffic model in accordance with the available data inputs.

The determination of the transfer load potential was based on the general assumption that long-distance trips are particularly suitable for railway and inland waterway transport so the model used data of long-distance transit traffic which passes through that territory as well as a destination / origin transport whose beginning or end is located in that area. In this context, the role of traffic modelling was to obtain an output in the form of a calibrated unimodal road traffic model, from which it would be possible to derive precisely these types of trips for the subsequent redistribution of traffic loads to other modes of transport. The relevance of this approach is also evidenced by the fact that it was also used in other freight traffic models that corresponded to the TRITIA region in terms of their area of interest. The simplified approach to modelling transport relations within road freight transport through the allocation of transport to the network was based on the basic assumptions of the modelled relations in the territory of interest, which allow the application of this procedure. There were following common characteristics:

- Suitability for projects, where no significant change in traffic flow on the transport network is expected, but only a part of the traffic is expected to shift to alternative mode;
- A basis in analogous approaches where actual data on traffic intensities and directions were obtained from traffic surveys and by using outputs from other traffic models.

After the validation of the model for the current state of 2020 it was possible to proceed with the forecasting of transport relations by 2030, which represents the zero state of the TRITIA model. With regard to the development of transport infrastructure, the planned network is based on the strategic documents up to 2030 has been incorporated into the model network. Demand for freight transport has been forecasted on the basis of the expected long-term GDP growth, as the existing studies in this field have shown a strong correlation of this macroeconomic indicator with the evolution of freight transport performance. This was based on the reference values of forecasted GDP growth, which were applied in the creation of the national traffic model of the Czech Republic. Related differences resulting from different GDP growth in individual countries participating directly in the project (SK and PL) were eliminated in the modelling of alternative scenarios where the effects of variable GDP development on the development of transport relations on the TRITIA model are analysed.

Table 2 GDP prognosis applied in the road freight traffic model

Year	2010	2020	2035	2050
GDP growth	1.00	1.27	1.74	1.88

Although the level of GDP development for the Czech Republic appears to be slightly optimistic in the context of current developments, this estimate can be considered realistic, as the dynamics of growth in international and long-distance road transport are higher than in the case of transport on shorter-distance transport relations. The higher dynamics of transit traffic is linked to the ever-increasing effect of globalization and its related trade links within the EU. To quantify the forecasted trend in road freight transport for 2030 a linear interpolation calculation between relativized valued of reference years 2020 and 2050 has between applied.

3.1. Quantification of usable potential for modal shift

The application of the forecasted development on the calibrated model of the current situation resulted in an output of road network traffic load by heavy-duty vehicles for scenario zero in the reference year 2030. This output represents the maximum potential of modal shift from road freight transport to more environmentally friendly transport modes.

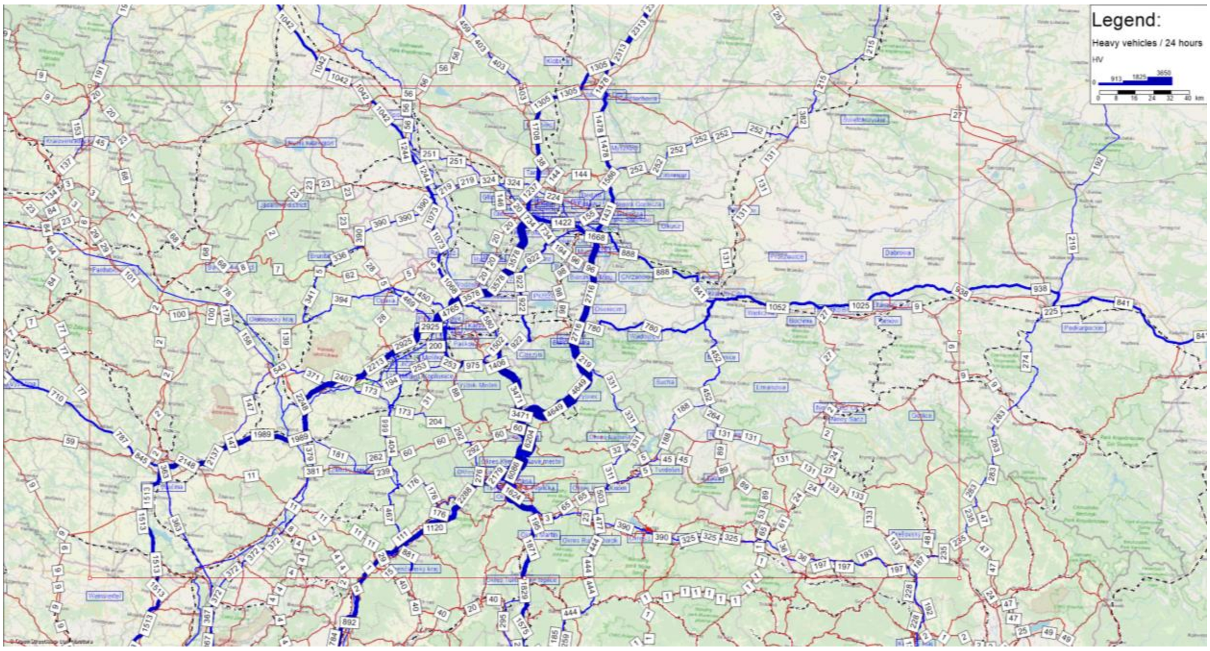


Figure 1 Road network load by freight traffic in the TRITIA model, zero scenario /2030/

For the purpose of modelling the road transport shift to the other modes, the layer of the infrastructure network of railway and inland waterway transport (multimodal transport network) was used in the PTV VISUM. In this context, it was necessary to convert the primary outputs of road transport volumes (heavy goods vehicles) into intermodal transport units (containers), which can be transported over the entire multimodal network of the TRITIA model. The conversion from road vehicles to containers was carried out in a 1:1 ratio, as the model of road freight transport was modelled for trucks whose carrying capacity corresponds to the parameters of a 40 foot ISO container.

Subsequent allocation of the traffic load to the multimodal network was carried out by calculation algorithm of the resistance (impedance) function, which was used within the national traffic model of the Czech Republic with updated values of parameters for the TRITIA region. It is a composite function ($f_{imp} = f_{(t, c, d)}$) which takes into account the resistance of the multimodal network sections in the following structure:

- $f_{(t)}$ as a function of transit time;
- $f_{(c)}$ as a cost function (infrastructure usage fees and handling costs);
- $f_{(d)}$ as a function of the impact from saturation of the transport network due to its capacity constraints;

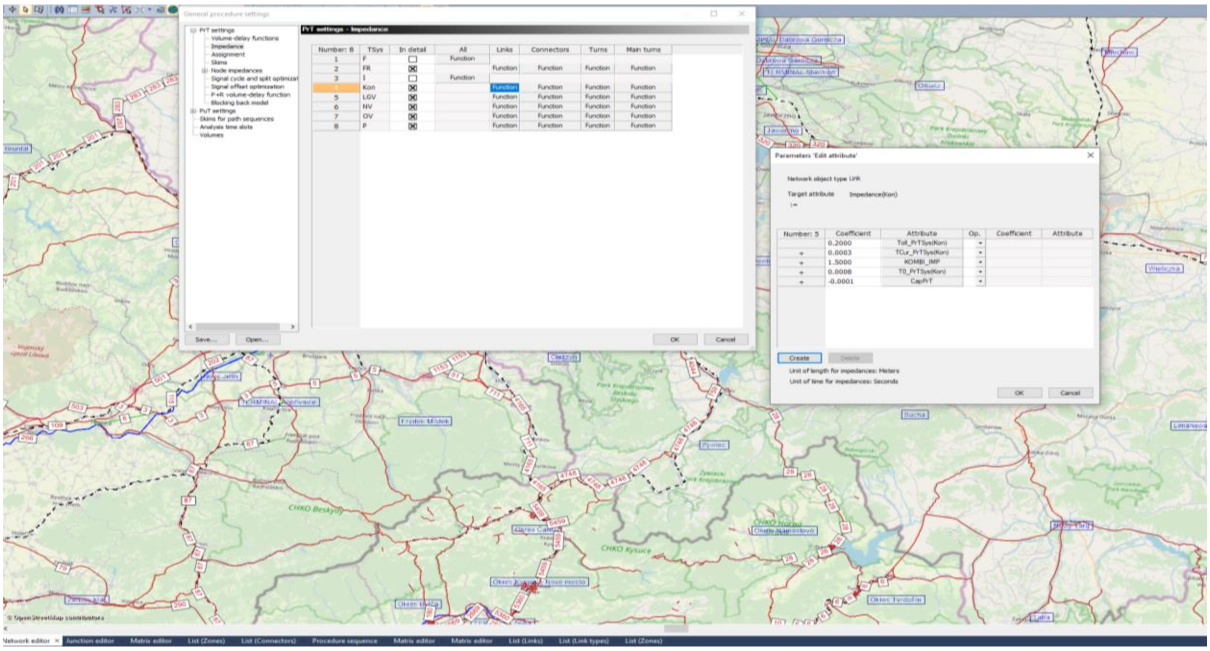


Figure 2 Parameterization of the impedance function of the TRITIA model, zero scenario /2030/

In the TRITIA model, the impedance is defined for each section of the transport network based on different variables for which the BPR (Bureau of Public Roads) resistance function is defined. The BPR resistance function is calculated according to this mathematic formula:

$$t_{cur} = t_0 * \left(1 + a * \left(\frac{q}{q_{max} * c}\right)^b\right) \quad [1]$$

,where:

t_{cur} current transit time with network load

t_0 transit time without network load

q traffic volume

q_{max} infrastructure capacity [vehicle / time]

a, b, c parameters

The total resistance of a given route consists of individual resistors for communication, connectors, turns and other objects. Resistors are largely dependent on road traffic and are expressed in terms of volume-delay functions.

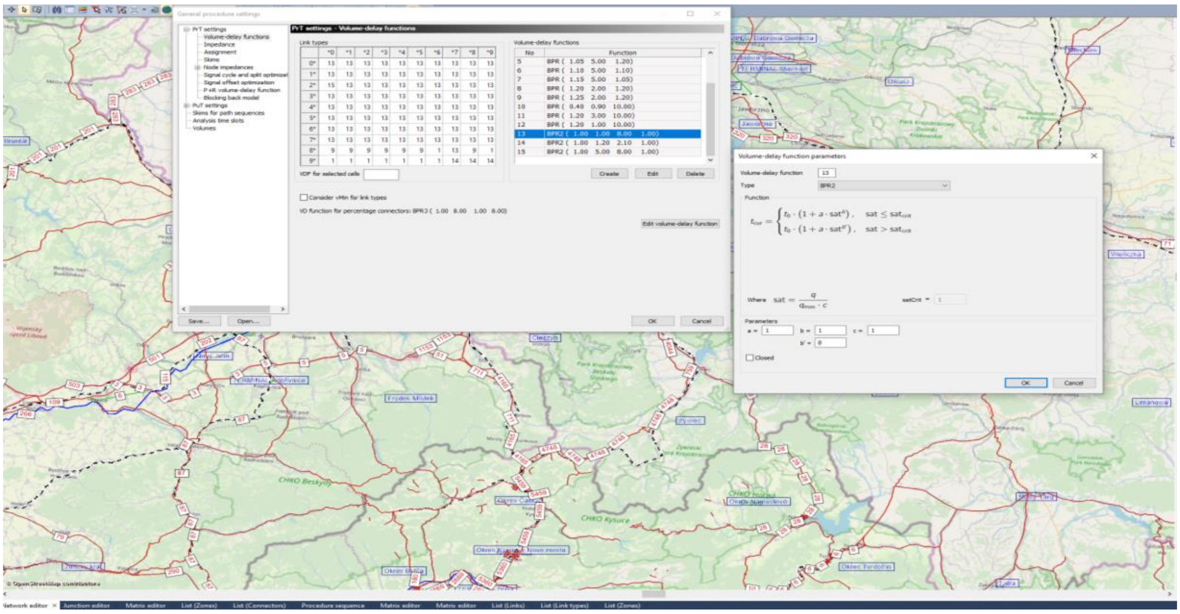


Figure 3 Resistance functions of TRITIA model in PTV VISUM, zero scenario /2030/

Inputs for the cost component of the resistance function were unit rates of charges for the use of transport infrastructure, which amounted to € 0.1905 / km for road transport (toll) and € 0.1084 / km for rail transport. In the case of railway infrastructure charges, the quantification of costs was based on the so-called "reference train" of 20 wagons. The infrastructure of the inland waterway network is not subject to a charge, as the amount of transhipment at terminals, which also affects the use of the rail network, has a fundamental impact on its amount. In some cases, the prices did not differ between the loaded container and the empty container because the fees were charged for handling, regardless of whether the container is empty or loaded. The unit price of transhipment was set at 40 € / container.

Based on the aforementioned procedures for the assignment of traffic to the TRITIA multimodal network, the output is a redistribution model for zero scenario (2030), which is shown in the following figure.

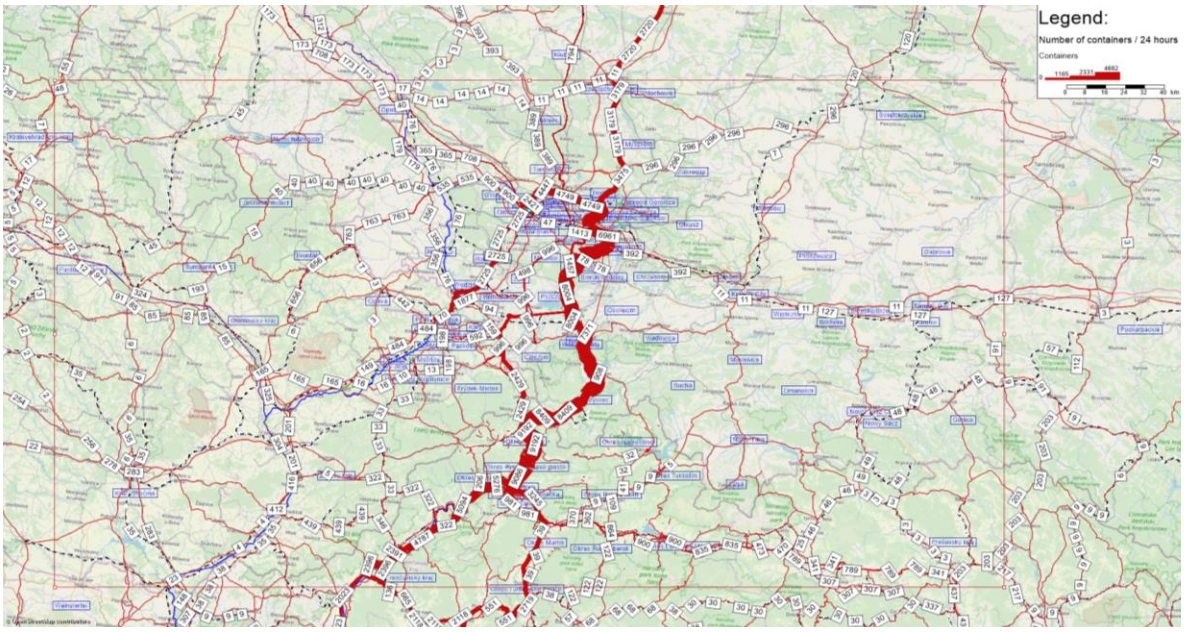


Figure 4 Model of redistribution of traffic load to multimodal transport network of TRITIA territory, zero scenario /2030/

The outputs of the TRITIA multimodal potential model, following the redistribution of traffic load, show that from the total volume of road freight transport of 12,546,256 container-kilometres per year (total potential) almost half of this load shifts towards the railway and around 4% to the inland waterway. In the modelling of the transport load shift, capacity constraints have not been taken into account in the case of railway and inland waterway infrastructure. The remaining part of the modelled transport load (46.7%) remains on the road infrastructure, where it is transported by heavy goods vehicles.

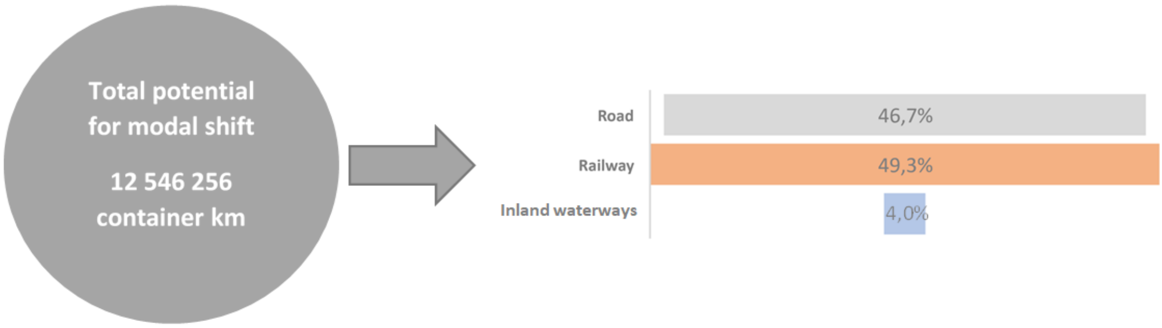


Figure 5 Shift of total transport load potential to individual transport modes, zero scenario /2030/

3.2. Identification of bottlenecks on railway infrastructure network

After the redistribution of the overall transport load potential to the infrastructure of other transport modes, its capacity parameters were analysed to identify bottlenecks. No overcapacity has been identified for inland waterway infrastructure. For the railway transport, the assessment was carried out by comparing the technical capacity of individual sections with the level of the modelled load, with the railway passenger transport also contributing to this load.

Railway sections with an occupancy rate of at least 70% were considered as bottlenecks. Despite the fact that the sections with 70% to 80% utilization rate of the railway line do not exceed the capacity, in practice it is usually considered to implement necessary measures in the medium or long term at this stage. For bottlenecks, where more than 80% of the line utilization has been identified, measures should be sought and implemented in a short term.

However, railway line sections, where the capacity in the zero scenario for 2030 would be exceeded in the event of a potential shift of traffic from road, can be considered as the most important ones. In such cases, the necessary infrastructure measures need to be implemented as soon as possible in order to increase the potential for shifting freight from road transport, in line with the common direction of the transport policy.

Table 3 Bottlenecks on the railway infrastructure after redistribution of transport load in zero scenario /2030/

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%

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)
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%

Detailed information about the methodology of zero scenario development in traffic model TRITIA is available in the project output D.T3.2.2 Report on the zero scenario of the TRITIA traffic model.

4. Results of alternative scenarios of TRITIA traffic model

Mobility of goods is an essential part of the EU internal market and a part of maintaining the competitiveness of the European economy. The EU policy objectives of shifting goods from road to more efficient and sustainable modes of transportation (primary railway and inland waterway) have been a priority for the EU over the last 25 years.

These principles must apply top down 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 transportation in particular when transporting:

- Large volumes of goods, in most cases bulk / loose cargo (solid mineral fuels, coal, ores, 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 macroeconomic theory suggests that the natural development of the territory is assessed on the basis of the growth of the country's GDP (regional) 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 may 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.

4.1. 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 of the charges for using infrastructure (or a specific service - handling) on shift of traffic volumes (represented by a relative unit set as 1 intermodal transport unit ITU - 40' ISO 1A container) between the modes of transportation.

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 modes.

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

- 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 occur. Subsequently, the individual alternative scenarios and their variants were developed as follows:

Table 4 Scenarios and variants considered in the traffic model

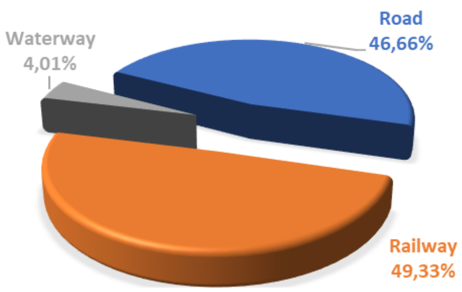
Scenario	Variant
S0	GDP growth +10%
	GDP growth +15%
	GDP growth +20%
S1	Charges for road infrastructure (toll) increase by 5%
	Charges for road infrastructure (toll) decrease by 5%
	Charges for road infrastructure (toll) increase by 10%
	Charges for road infrastructure (toll) decrease by 10%
S2a	Railway infrastructure charges + handling charges increase by 5% infrastructure 10% handling

Scenario	Variant
	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%

4.1.1. 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:

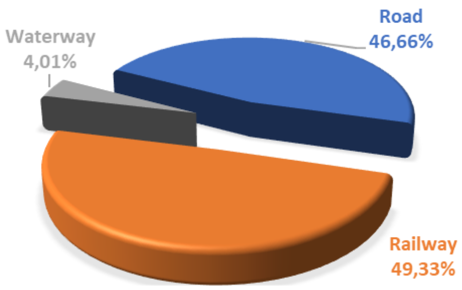
+10%



Outputs in container kilometers

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

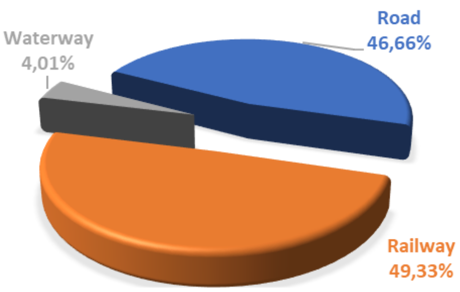
+15%



Outputs in container kilometers

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

+20%



Outputs in container kilometers

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.

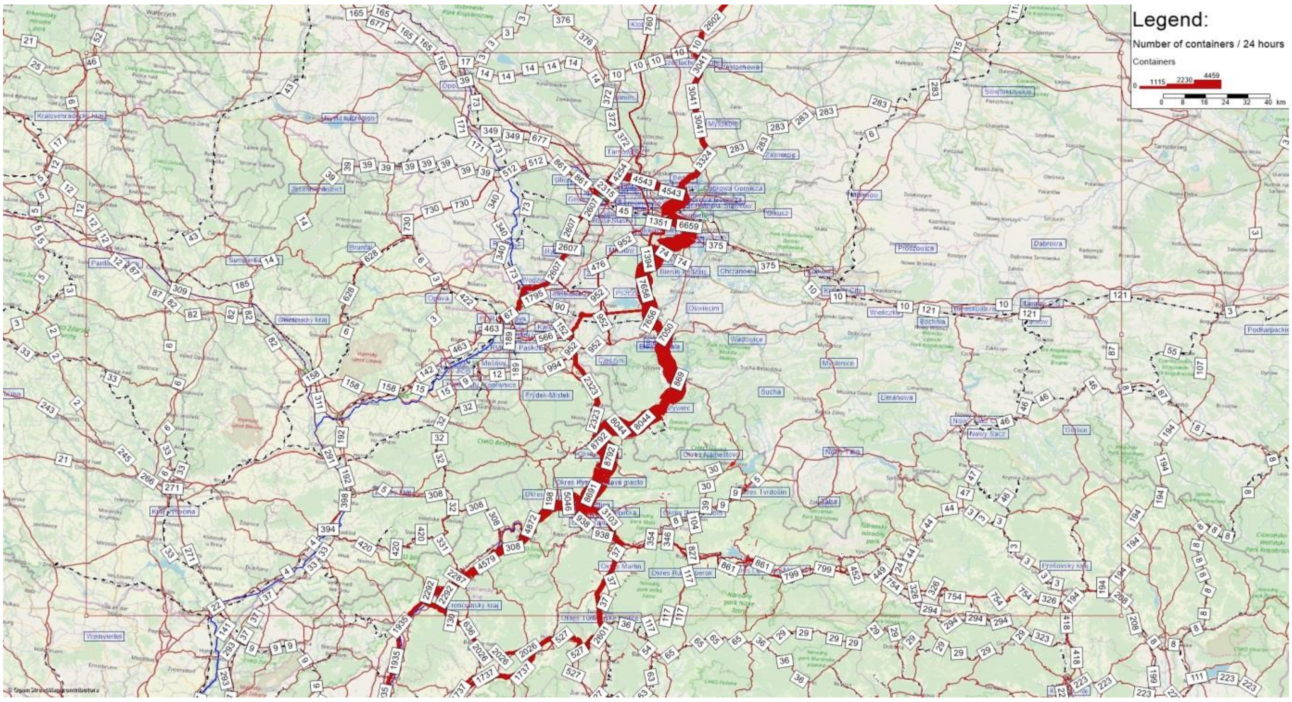


Figure 7 Pentlogram of potential shift between transport modes in TRITIA territory year 2030 GDP + 10% (Scenario S0)

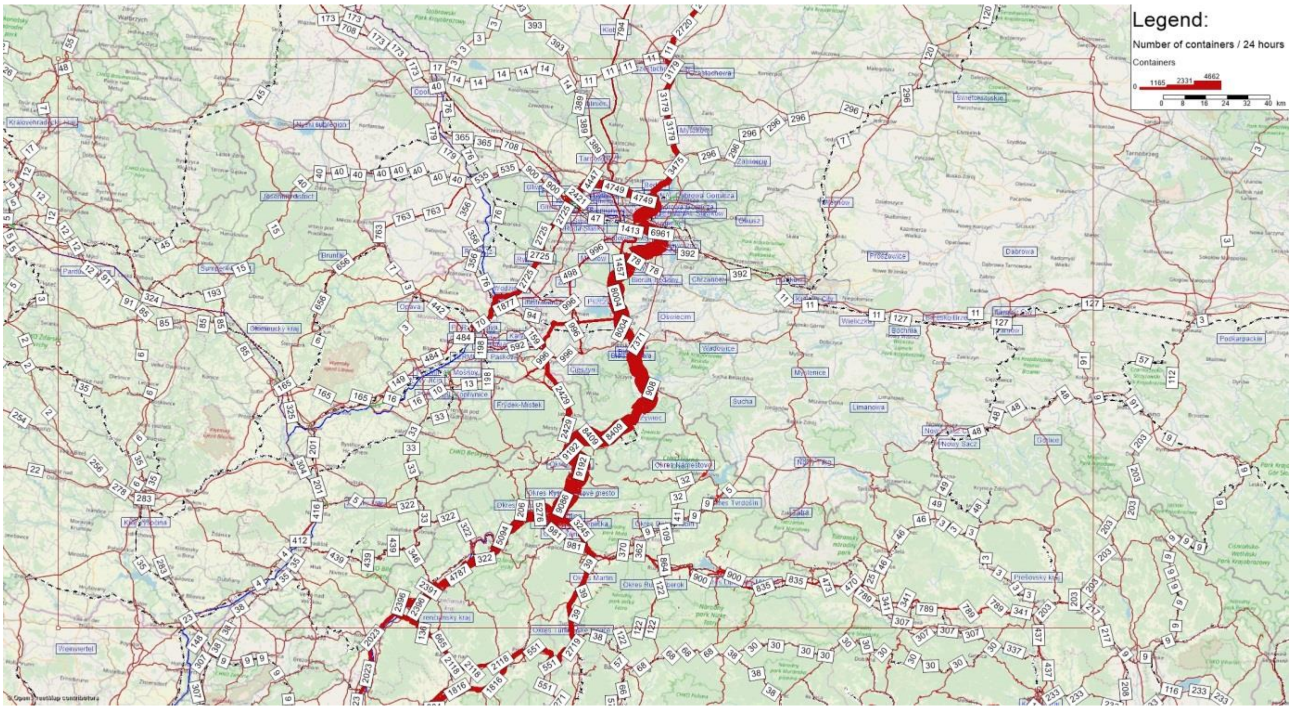


Figure 8 Pentlogram of potential shift between transport modes in TRITIA territory year 2030 GDP + 15% (Scenario S0)

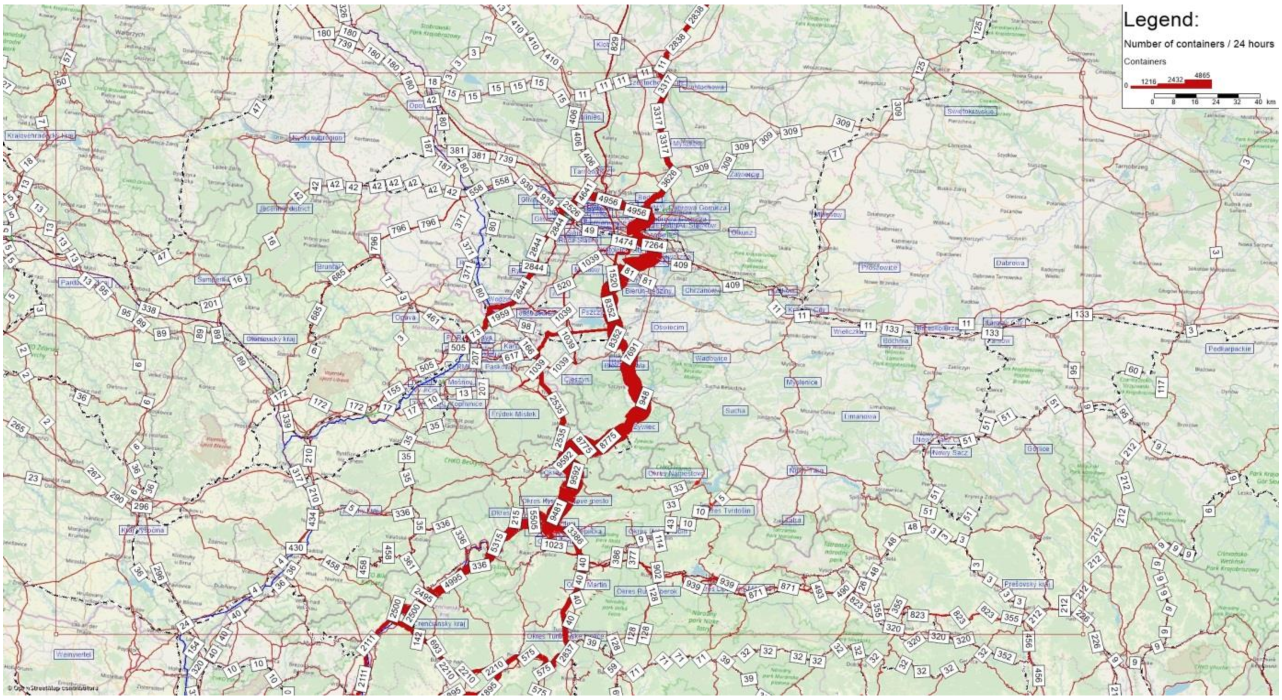
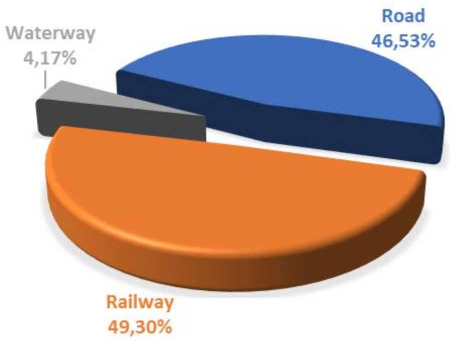


Figure 9 Pentlogram of potential shift between transport modes in TRITIA territory year 2030 GDP + 20% (Scenario S0)

4.1.2. Alternative Scenario S1: Road transport

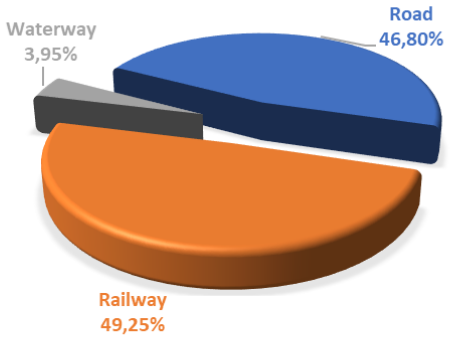
In the S1 scenario, a change in the amount of the road infrastructure charge (toll) is considered, an increase by + 5% and + 10%, or a decrease by -5% and -10%. This change will take effect on the modal split as follows:

+5%



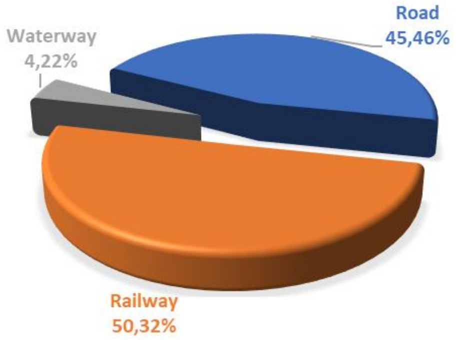
Outputs in container kilometers	
Road:	5 870 619
Railway:	6 220 868
Waterway:	525 739

-5%



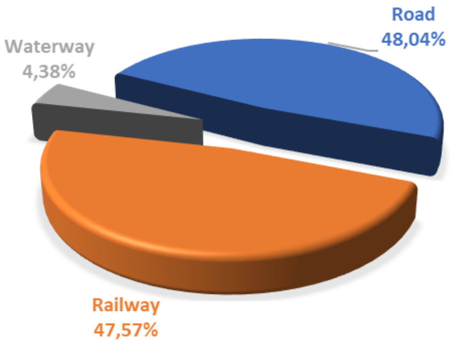
Outputs in container kilometers	
Road:	5 867 955
Railway:	6 174 467
Waterway:	495 572

+10%



Outputs in container kilometers	
Road:	5 660 180
Railway:	6 264 560
Waterway:	525 341

-10%



Outputs in container kilometers

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.

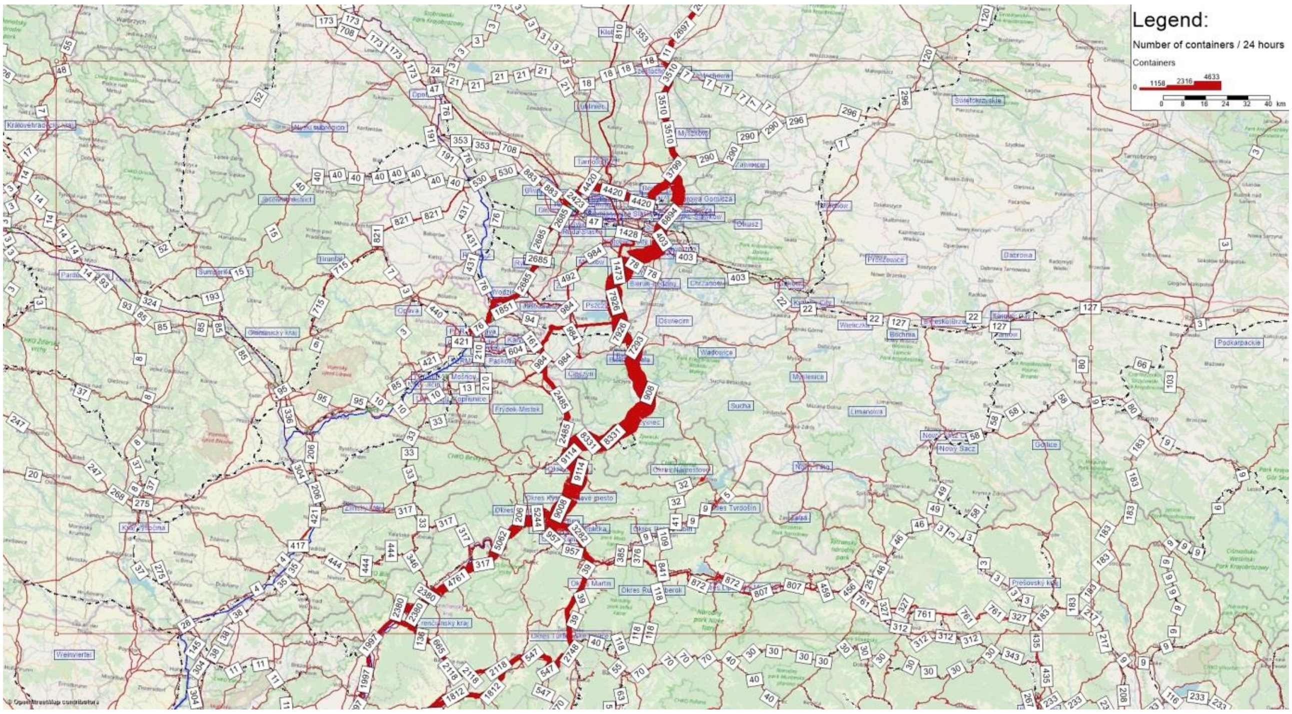


Figure 11 Pentlogram of potential shift between transport modes in TRITIA year 2030 Toll growth + 5% (Scenario S1)

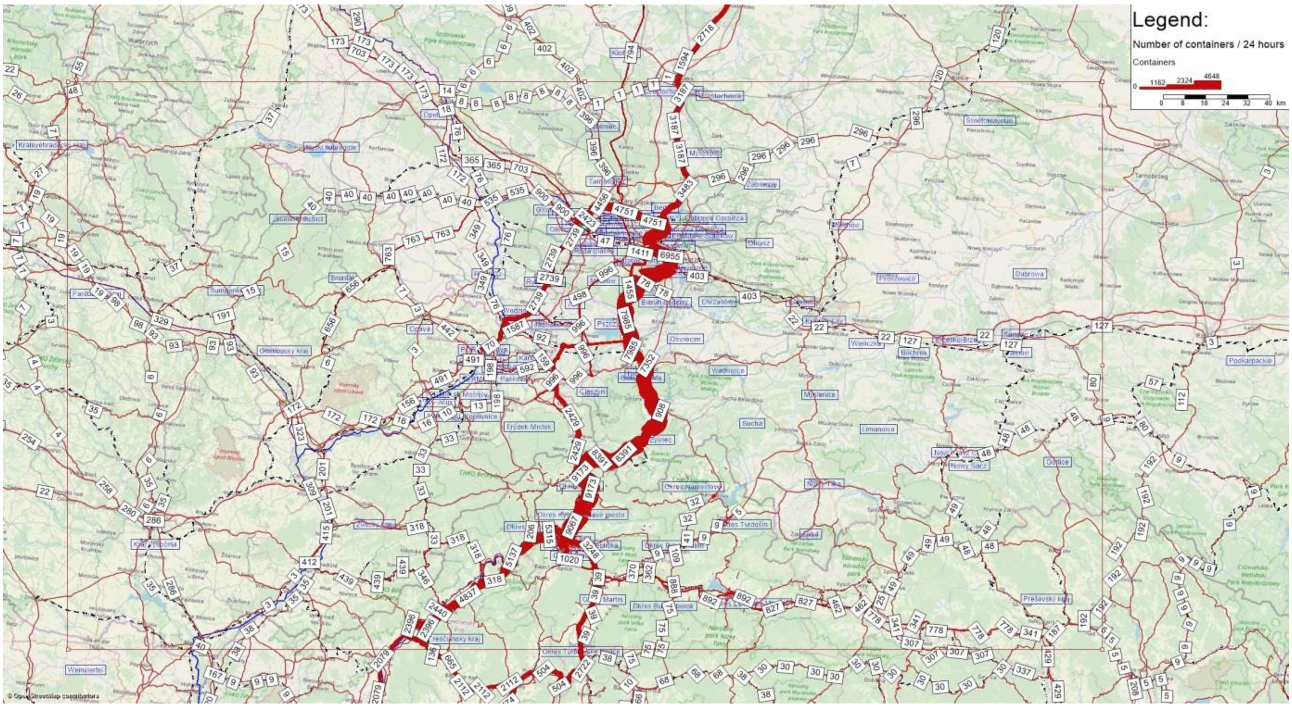


Figure 12 Pentlogram of potential shift between transport modes in TRITIA year 2030 Toll drop -5% (Scenario S1)

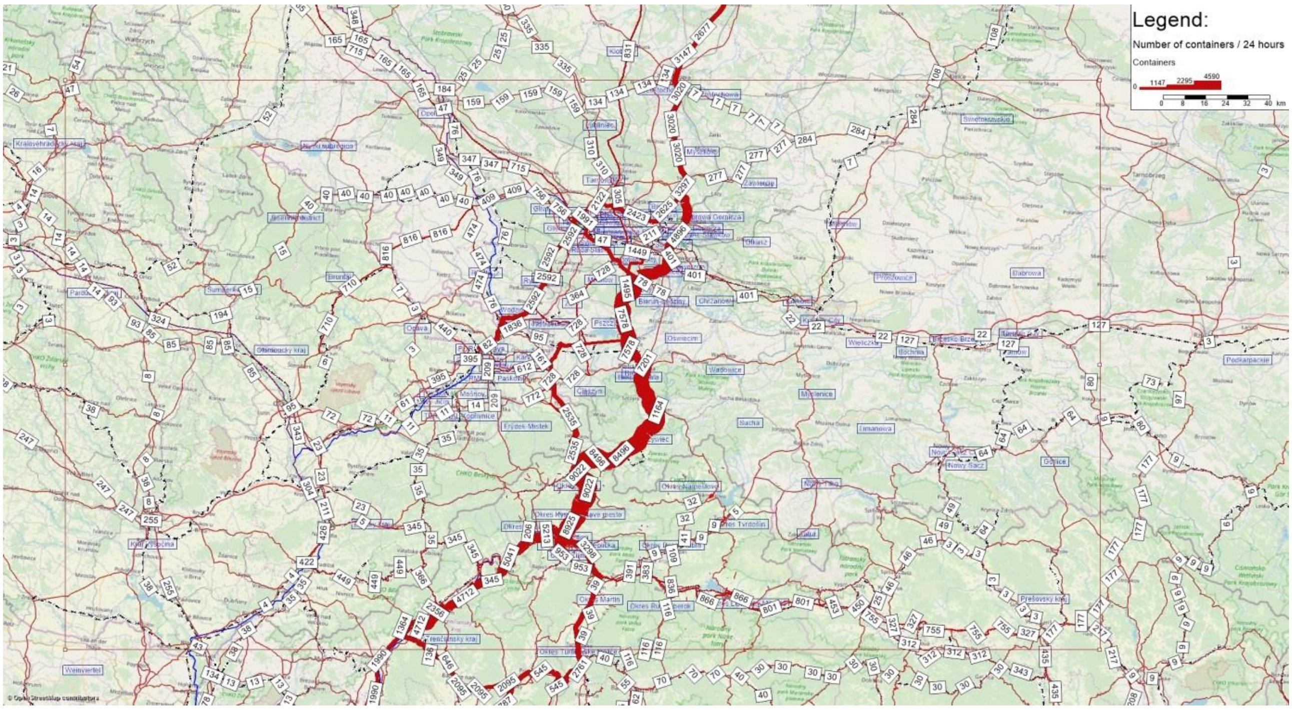


Figure 13 Pentlogram of potential shift between transport modes in TRITIA year 2030 Toll growth + 10% (Scenario S1)

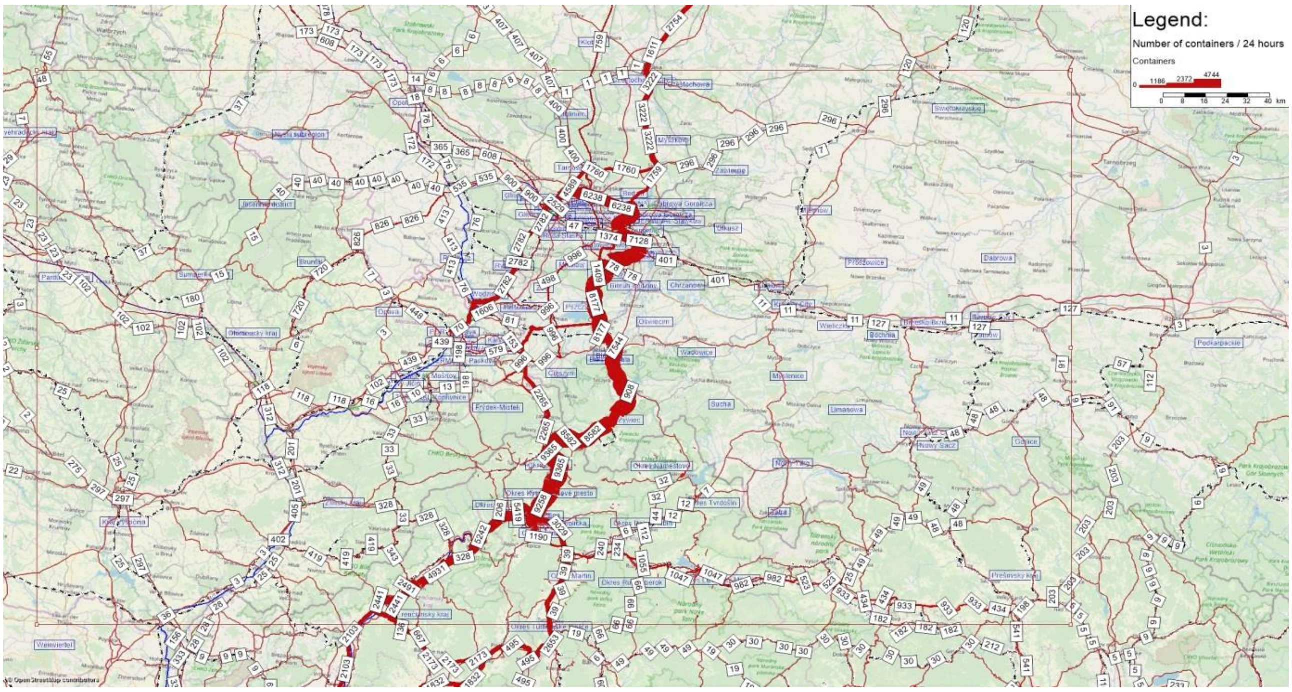
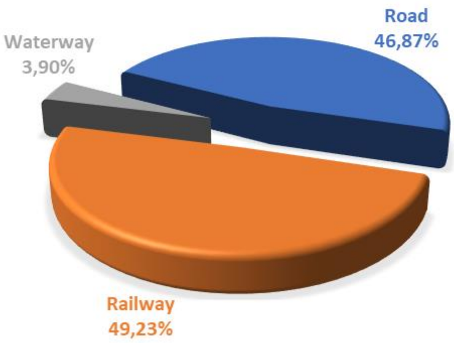


Figure 14 Pentlogram of potential shift between transport modes in TRITIA year 2030 Toll drop -10% (Scenario S1)

4.1.3. 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:

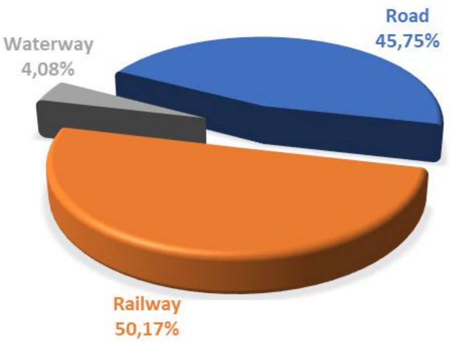
+ 5% network + 10% transhipment



Outputs in container kilometers

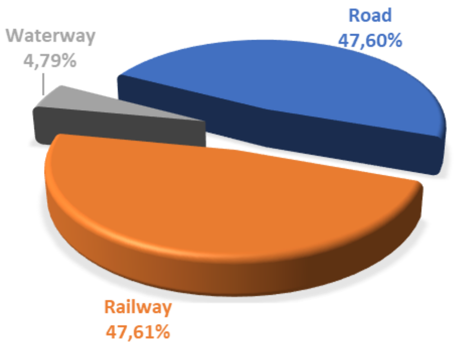
Road:	5 881 255
Railway:	6 176 592
Waterway:	489 738

-5% network -10% transhipment



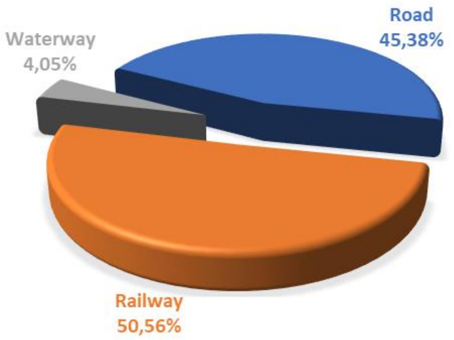
Outputs in container kilometers	
Road:	5 789 355
Railway:	6 348 530
Waterway:	516 100

+ 10% network + 20% transhipment



Outputs in container kilometers	
Road:	5 995 430
Railway:	5 996 294
Waterway:	603 024

-10% network -20% transhipment



Outputs in container kilometers	
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.

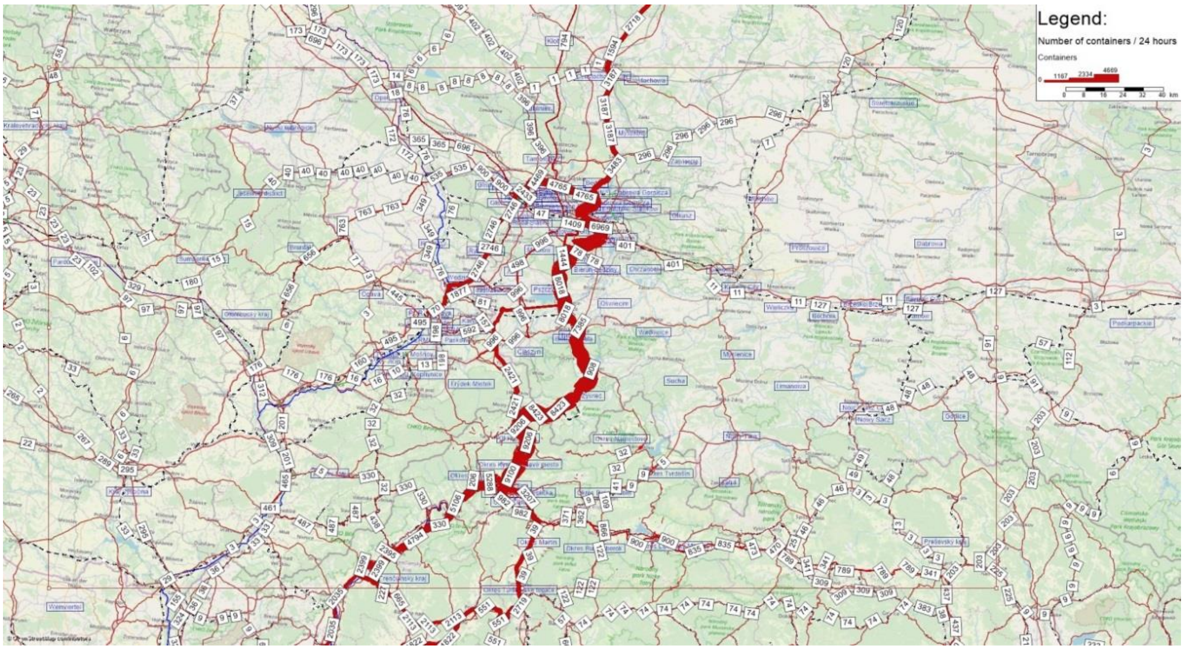


Figure 16 Pentlogram of potential shift between transport modes in the territory of TRITIA year 2030, increasing of railway charges + 5% and transhipment + 10% (Scenario S2a)

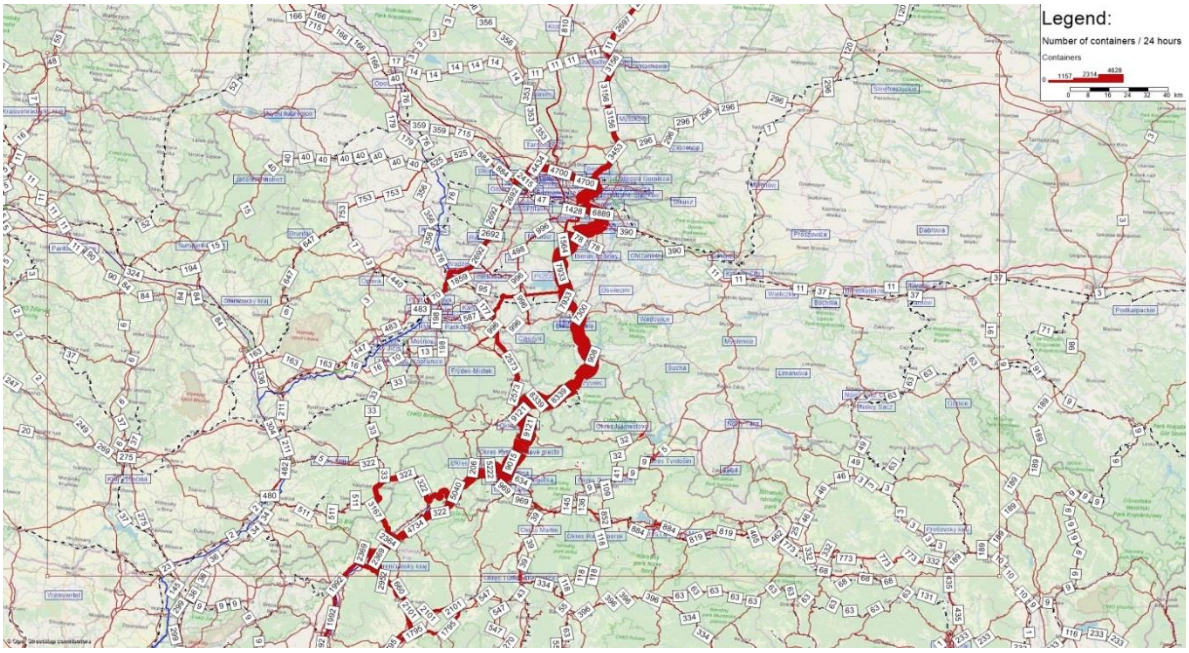


Figure 17 Pentlogram of potential shift between transport modes in the territory of TRITIA year 2030 decreasing of railway charges -5% and transhipment -10% (Scenario S2a)

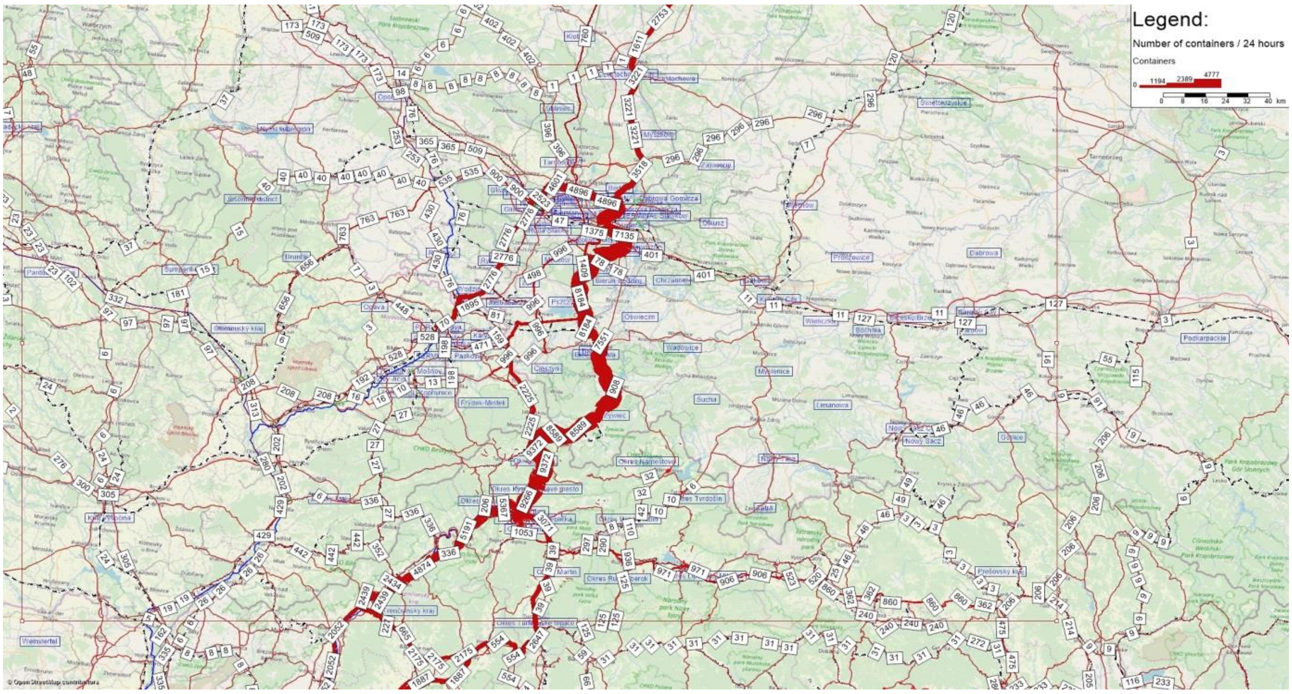


Figure 18 Pentlogram of potential shift between transport modes in the territory of TRITIA year 2030 Increase of railway charges + 10% and transhipment + 20% (Scenario S2a)

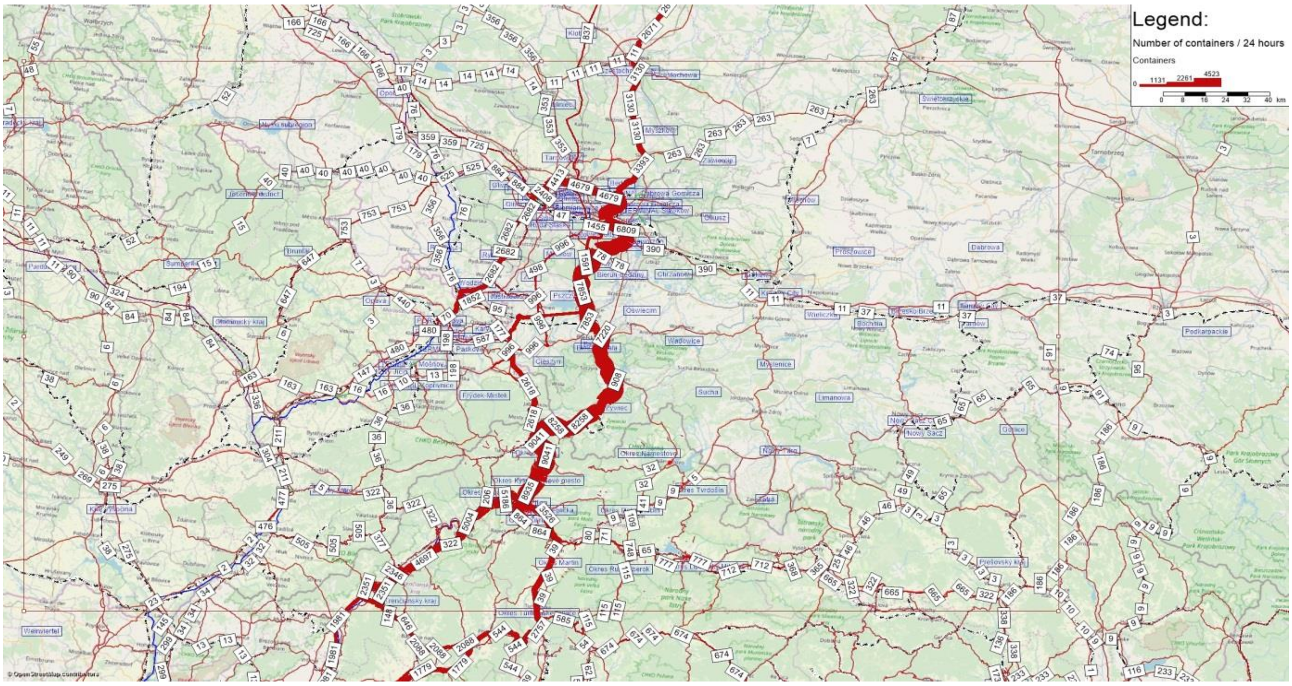
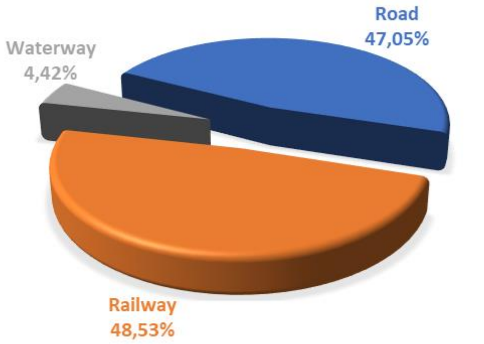


Figure 19 Pentlogram of potential shift between transport modes in the territory of TRITIA year 2030 decreasing of railway charges -10% and transhipment -20% (Scenario S2a)

4.1.4. Alternative Scenario S2b: Railway transport

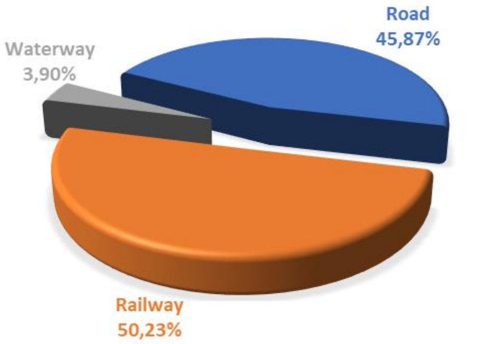
Under scenario S2b, only the change of +5% and +10% and a decrease of -5% and -10% of the railway infrastructure charge were envisaged. This change affects modal split as follows:

+5%



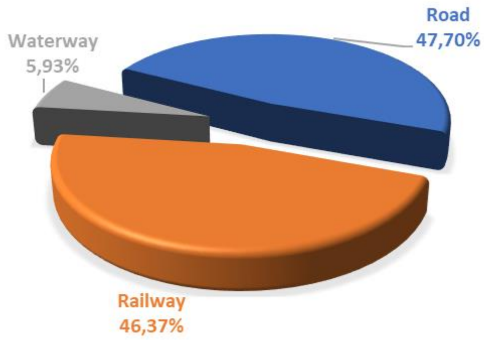
Outputs in container kilometres	
Road:	5 921 399
Railway:	6 107 148
Waterway:	555 722

-5%



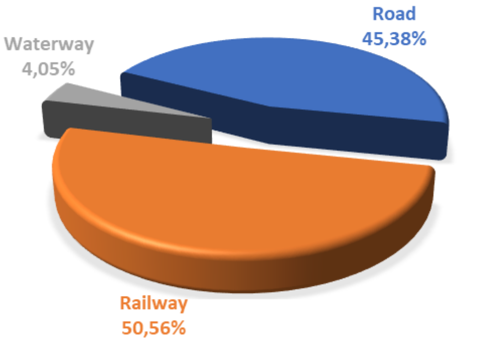
Outputs in container kilometres	
Road:	5 800 020
Railway:	6 351 362
Waterway:	492 877

+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.

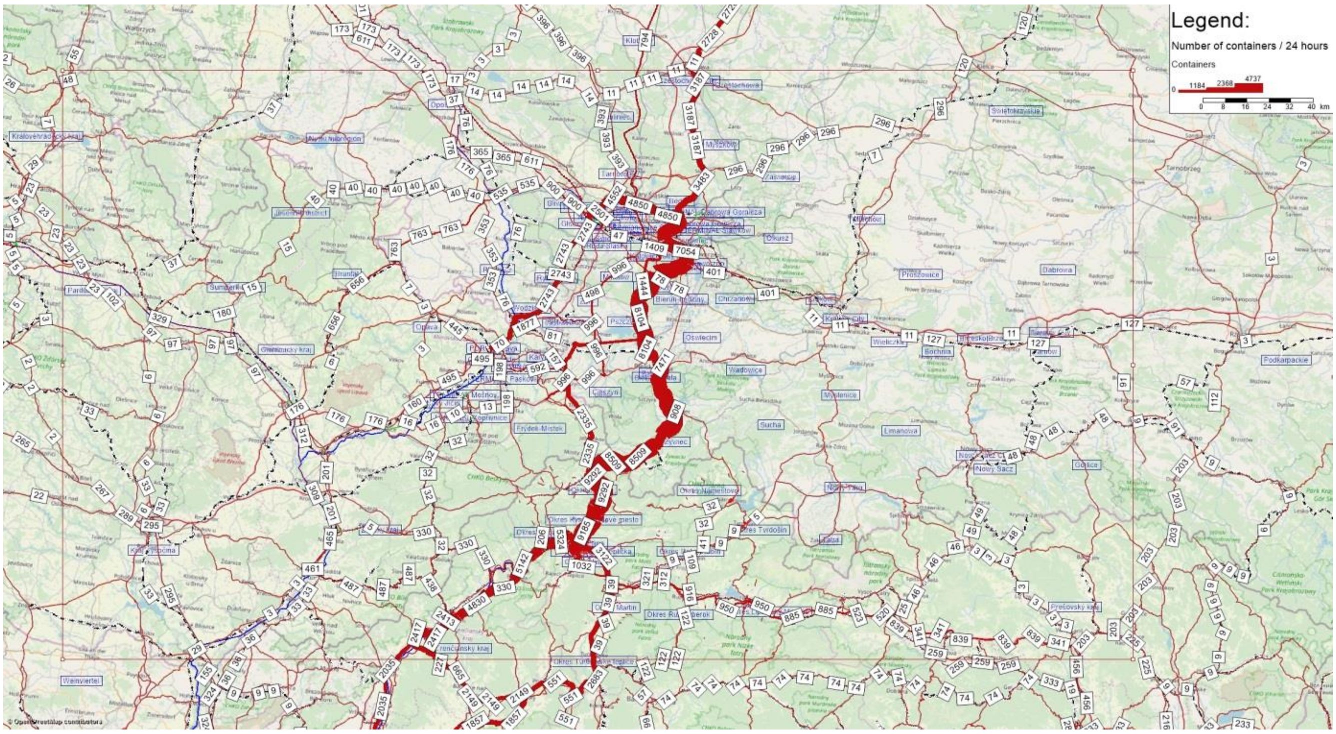


Figure 21 Pentlogram of potential shift between transport modes in the territory of TRITIA year 2030 increasing of railway charges + 5% (Scenario S2b)

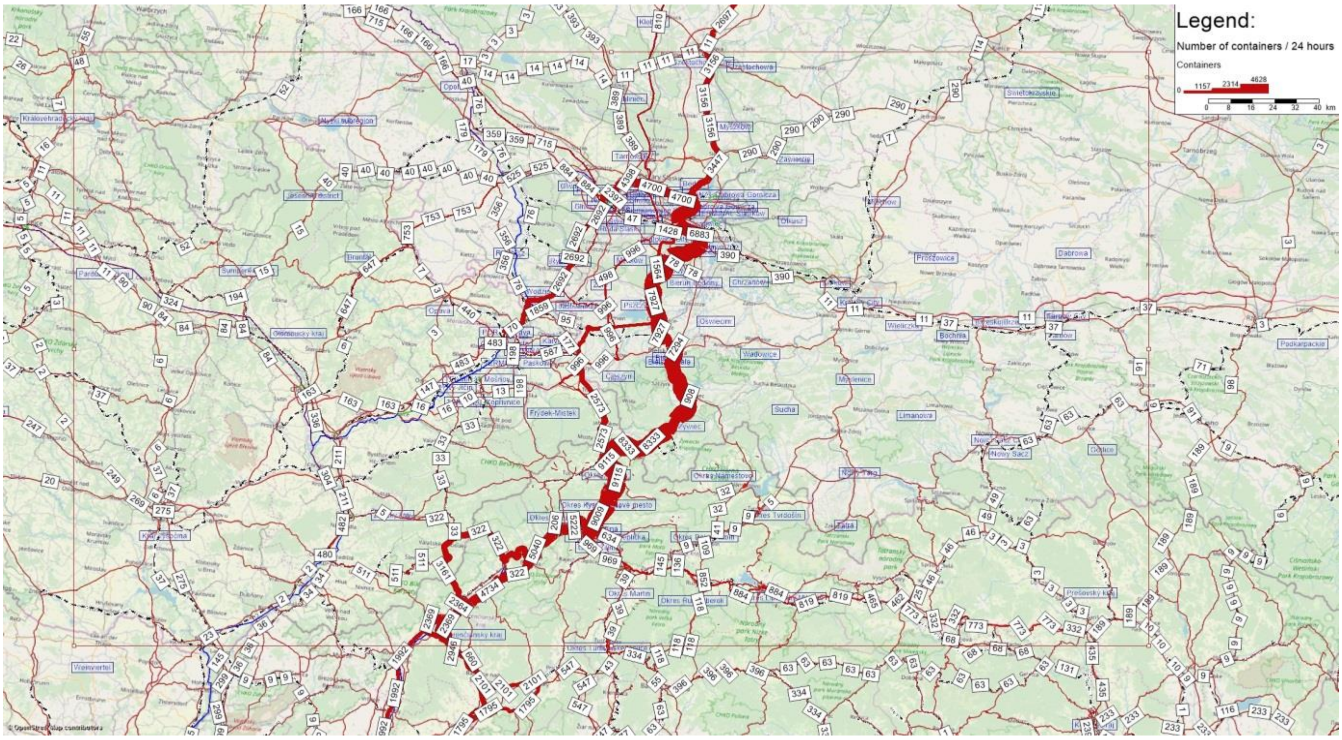


Figure 22 Pentlogram of potential shift between transport modes in the territory of TRITIA year 2030 decreasing of railway charges -5% (Scenario S2b)

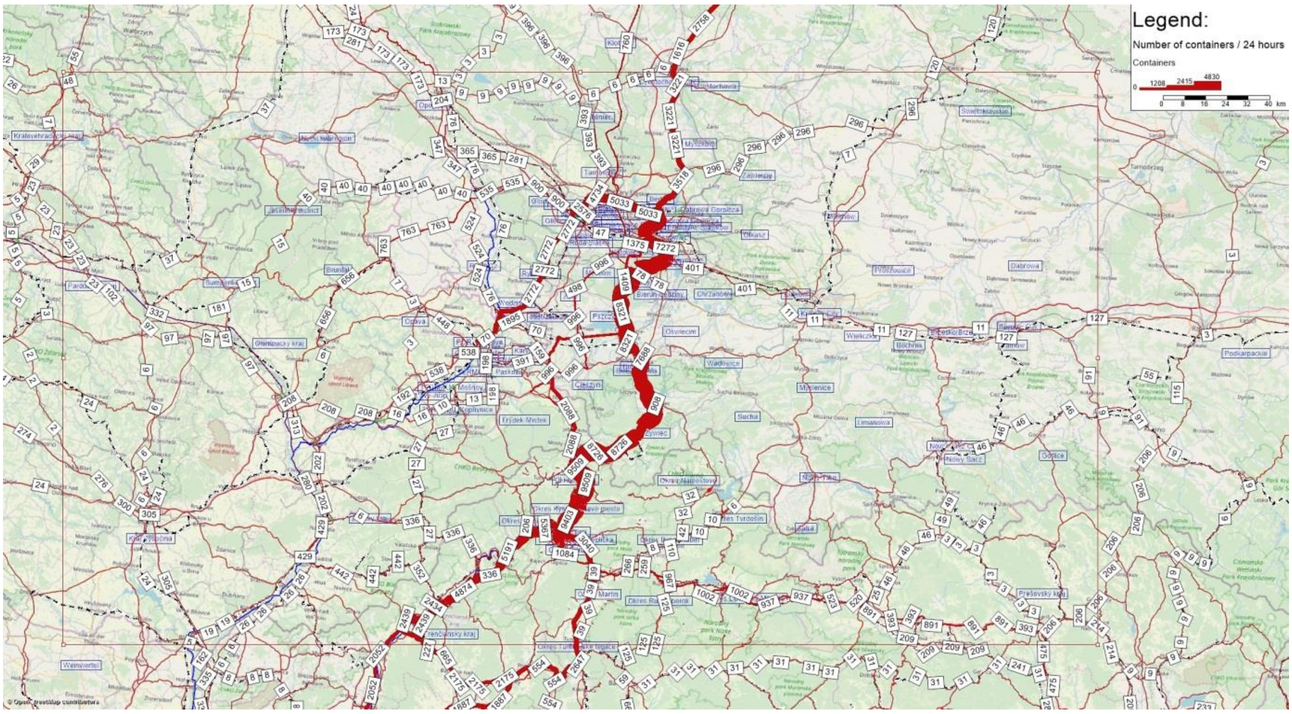


Figure 23 Pentlogram of potential shift between transport modes in the territory of TRITIA year 2030 increasing of railway charges + 10% (Scenario S2b)

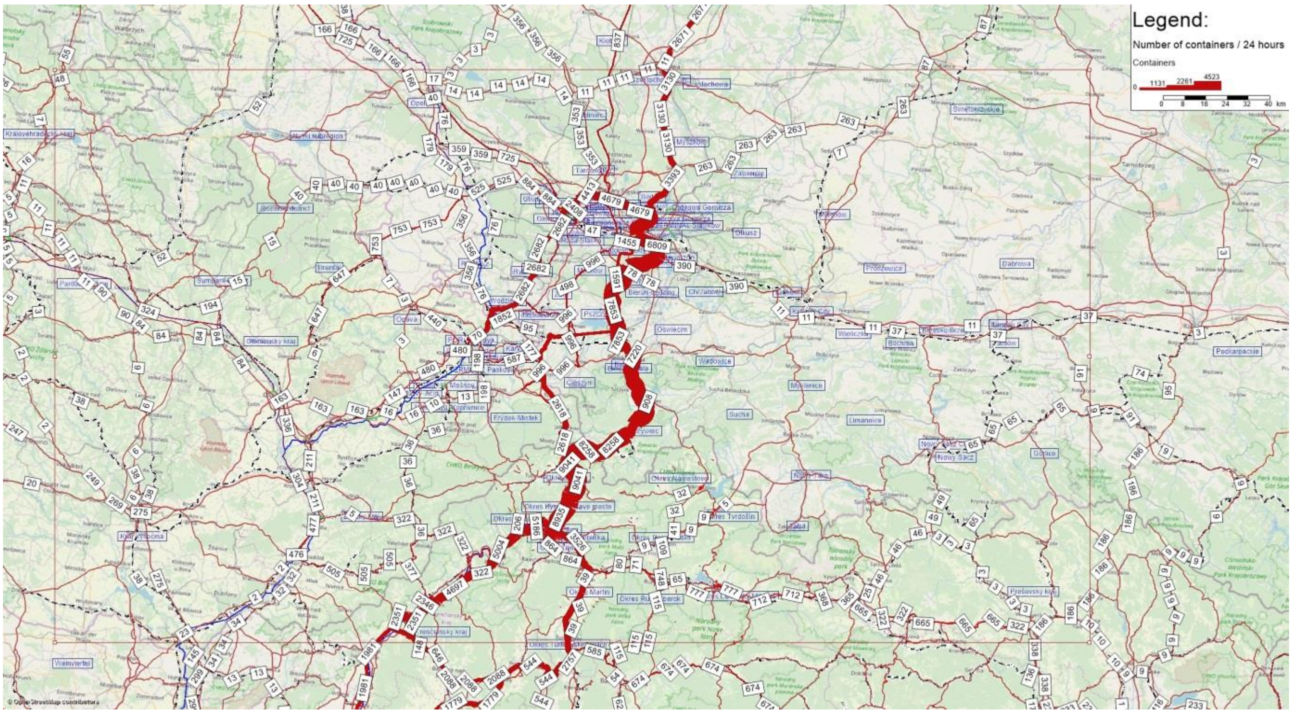
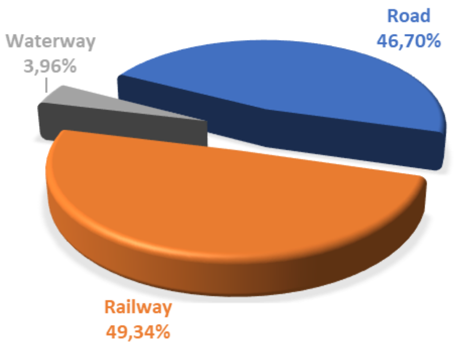


Figure 24 Pentlogram of potential shift between transport modes in the territory of TRITIA year 2030 decreasing of railway charges -10% (Scenario S2b)

4.1.5. 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:

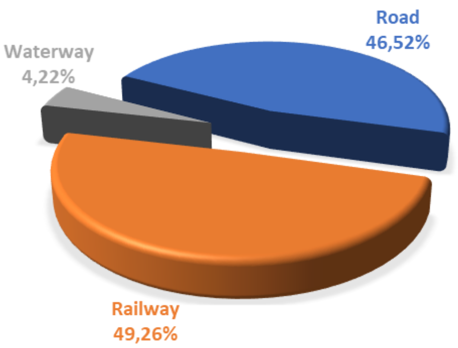
+10%



Outputs in container kilometres

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

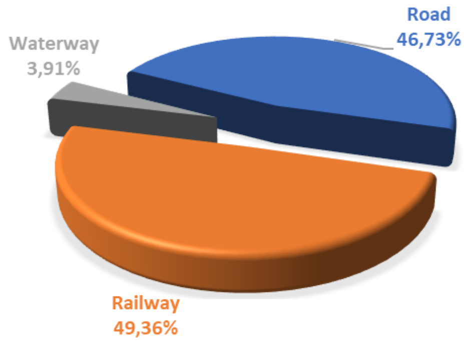
-10%



Outputs in container kilometres

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

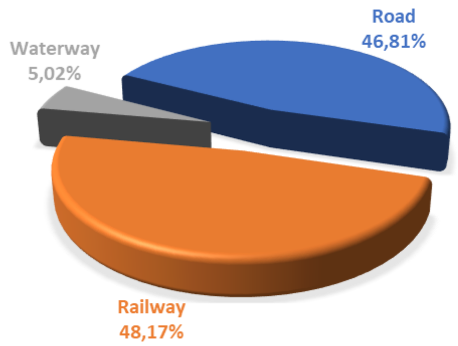
+20%



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.

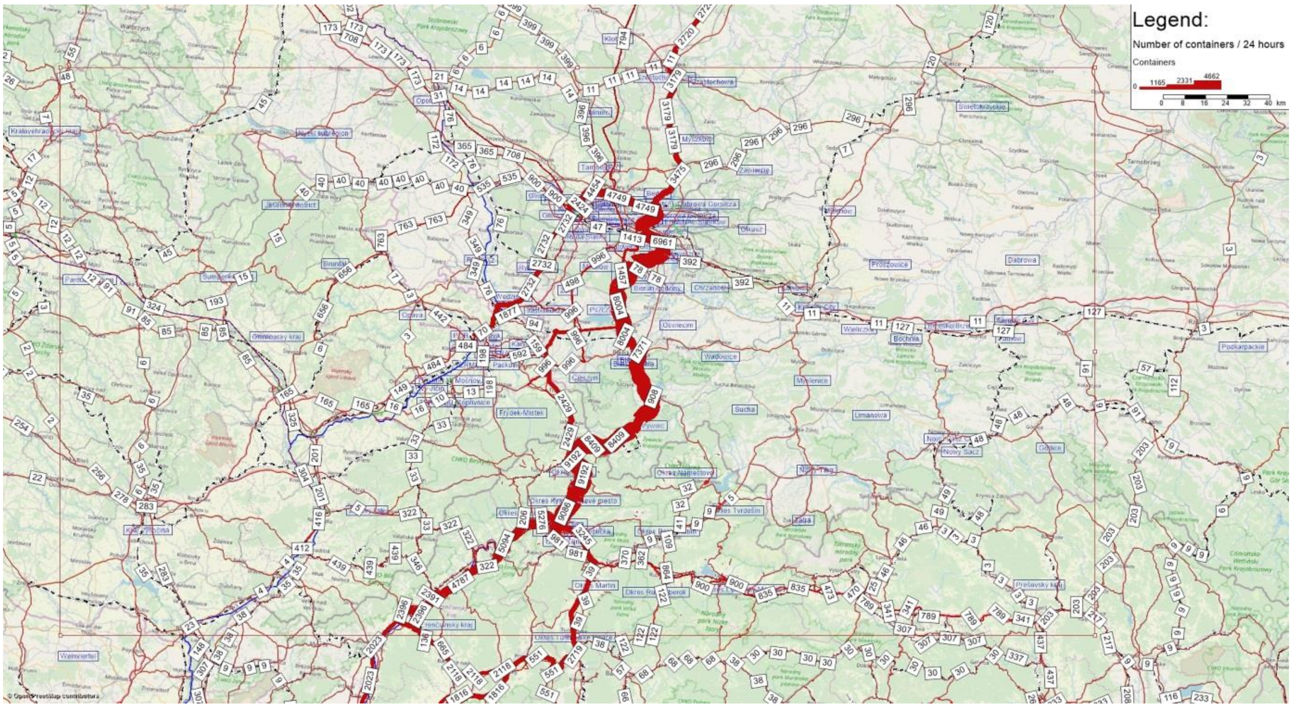


Figure 26 Pentlogram of potential shift between modes of transport in the territory of TRITIA year 2030 increase of the rates for transhipment of waterway transport (in combination with railway transport) + 10% (Scenario 3)

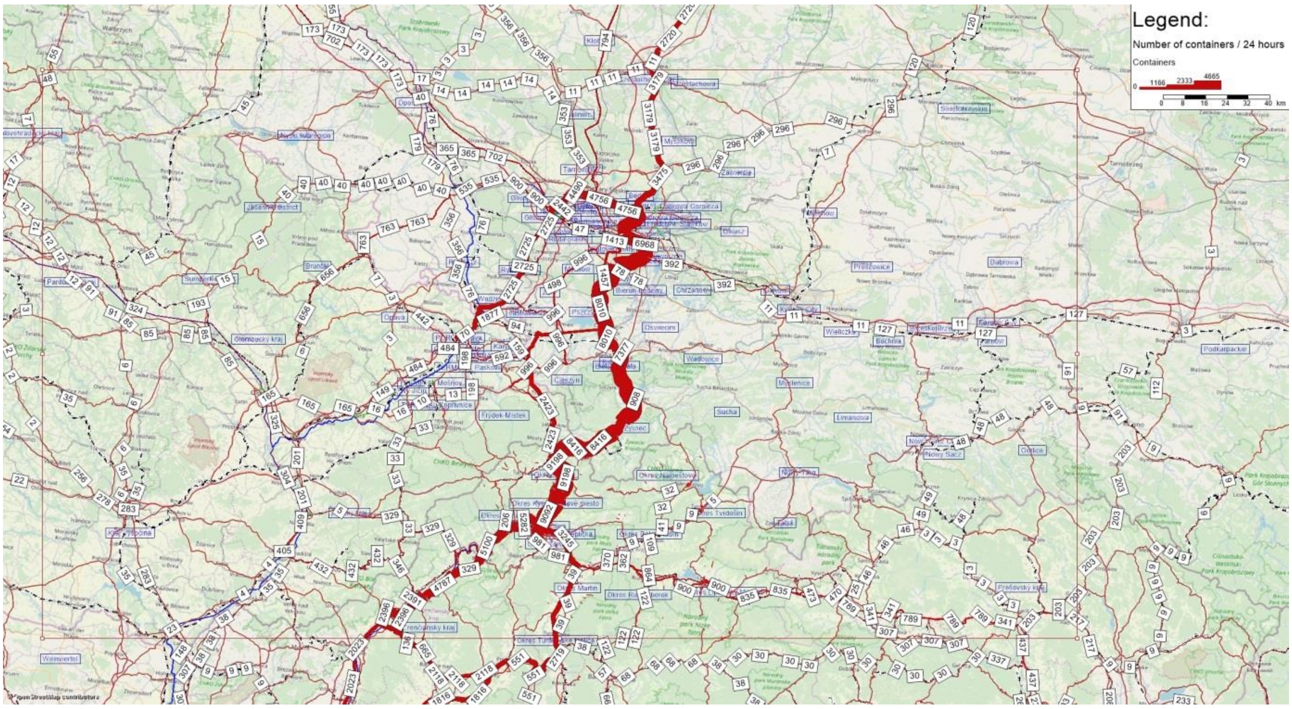


Figure 27 Pentlogram of potential shift between modes of transport in the territory of TRITIA year 2030 decrease of the rates for transhipment of waterway transport (in combination with railway transport) -10% (Scenario 3)

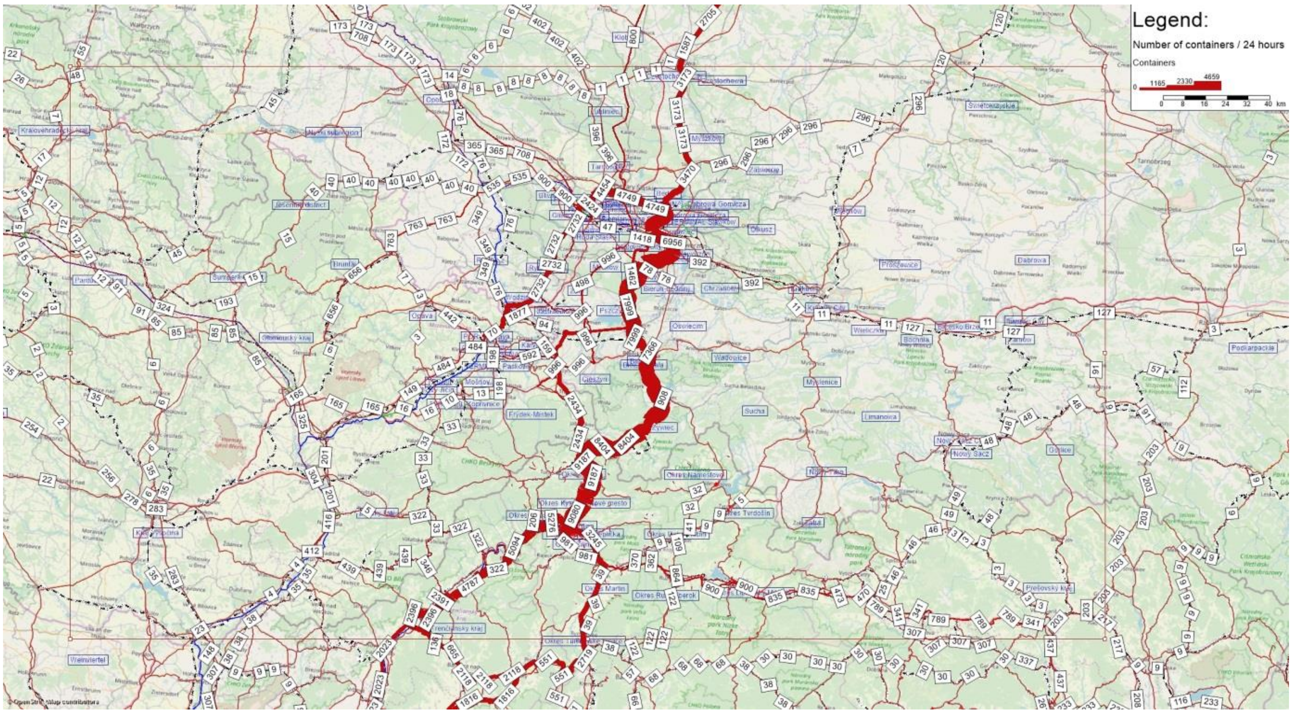


Figure 28 Pentlogram of potential shift between modes of transport in the territory of TRITIA year 2030 increase of the rates for transhipment of waterway transport (in combination with railway transport) + 20% (Scenario 3)

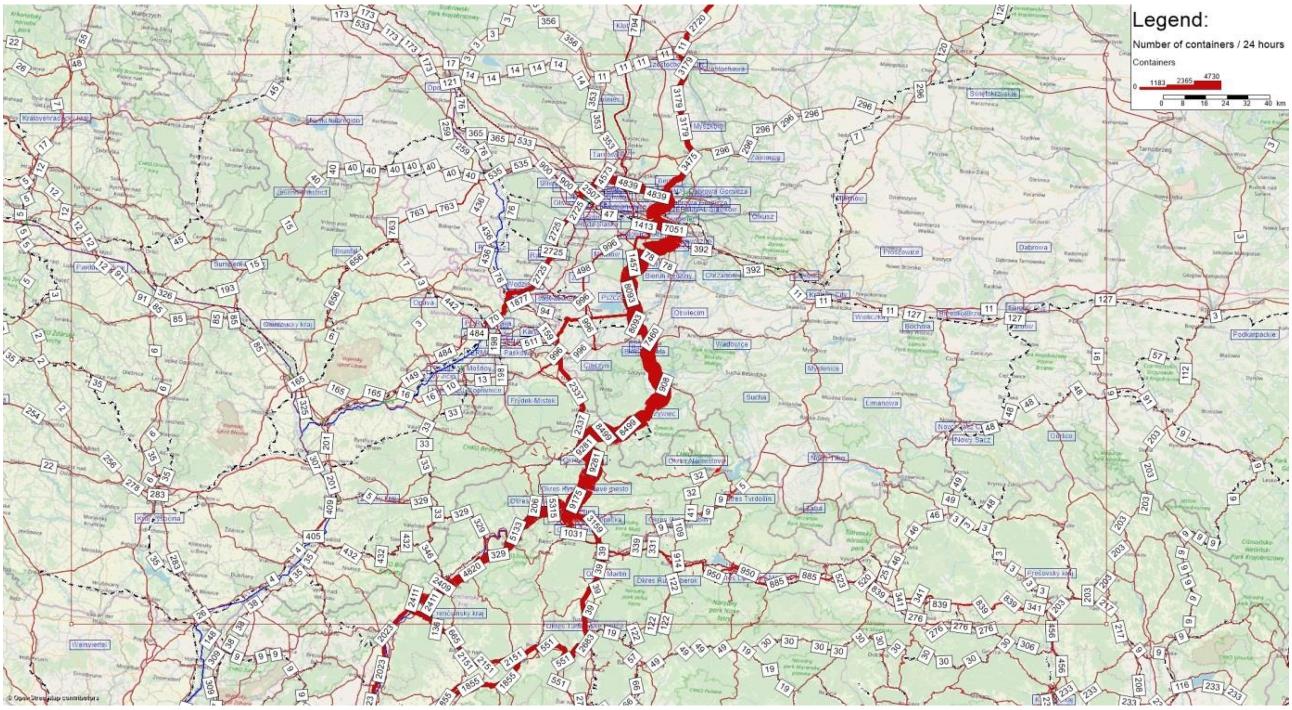
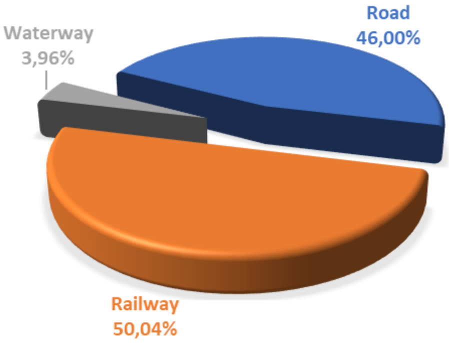


Figure 29 Pentlogram of potential shift between modes of transport in the territory of TRITIA year 2030 decrease of the rates for transhipment of waterway transport (in combination with railway transport) -20% (Scenario 3)

4.1.6. 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 kilometers

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.

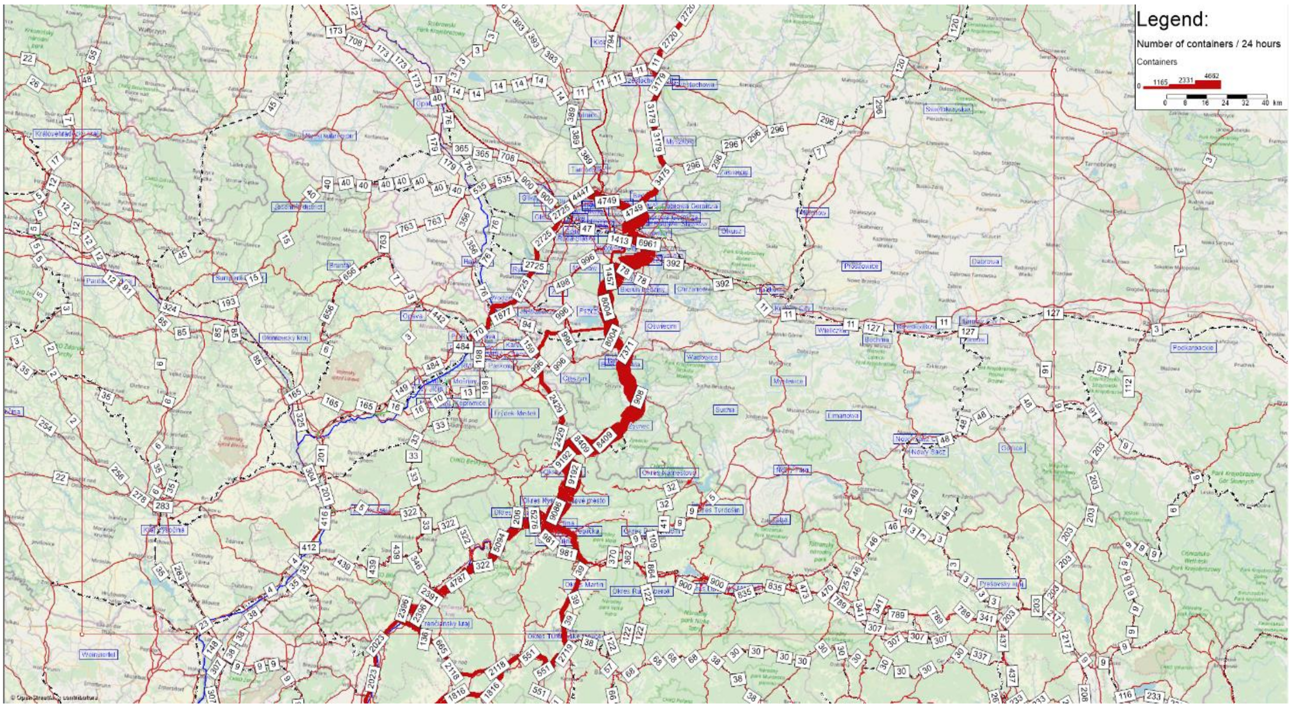


Figure 31 Pentlogram of potential shift between modes of transport in the territory of TRITIA year 2030 road toll + 10%, railway charges + 5%, transhipment + 20% (Scenario Combined)

4.2. Conclusions on alternative scenarios

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 in 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.

More details about alternative scenarios of TRITIA traffic model can be found in the report D.T3.2.3- Report on alternative scenarios of TRITIA traffic model.

5. Conclusions

The details of the TRITIA traffic model are described in the reports D.T3.2.2 - Report on the zero scenario of TRITIA traffic model and D.T3.2.3 - Report on alternative scenarios of TRITIA traffic model and there is an extract from these reports in the previous two chapters.

The purpose of the traffic model was to identify the potential transfer of long-distance road traffic over 300 km to alternative modes of transportation in the 2030 timeframe. The results of the scenario zero as well as alternative scenarios are that of the potential transfer identified in road transport is the possibility of transferring about 40% -50% to railway and 2% -4% to inland waterway transport. The reported values point to the possibility that by the year 2030 there is a possibility of shifting more than 30% of road transport over 300 km. It would mean that the objectives stated in the White Paper - Roadmap to a Single European Transport Area - Towards a competitive and resource-efficient transport system, could be met. If the objectives of the White Paper could be met, at the same time it is possible to support the EU low carbon economy (Roadmap for moving to a competitive low carbon economy in 2050).

When analysing and assessing the transport infrastructure within the TRITIA territory, the planned projects were taken into account. These are defined in the national resp. Regional Strategy Papers in the 2030 timeframe. The results of the traffic model have confirmed their relevance as they are located on infrastructure sections, because that are already problematic and administrators / owners are working to remove specific bottlenecks. Except planned measures, other sections (mainly on the railway infrastructure) have been identified. These, based on the assumptions stated in the traffic model, would be necessary to include among other required projects. The projects were prioritized in relation by severity of the capacity problem and also were reviewed at the pessimistic and optimistic development of the economy. Here it has been confirmed that even in the pessimistic developments scenarios bottlenecks were present on the transport infrastructure.

The EU seeks to support the development of alternative modes of transport (railway and inland waterways), thereby to reduce the share of road freight transport. Transferring of road freight to the railway can cause problems on the railway infrastructure, which is not yet sufficiently prepared and capacity restrictions needed to be taken into account in long term strategic planning. The TRITIA traffic model is an infrastructure model for identifying the potential of transferring from the road transport to the alternative modes of transportation. The results of the model are oriented to the analysis of infrastructure, respectively an assessment of the impact of the price for the use of infrastructure on changing of the shifts between transport modes. In any case, it has been confirmed that in the road transport there is sufficient potential to shift to other means of transportation. If this was not the case and there is a quality infrastructure available, then it would be necessary to address the system measures with respect to the organization in single-mode transport modes.

Based on the results of the TRITIA traffic model, an implementation plan was assembled of measures to be solved in the assessed area in the time horizon until the year 2030. The implementation plan takes into account already planned projects by the year 2030, but also the additional bottlenecks that the traffic model has demonstrated. The following tables show the implementation plan for individual TRITIA regions.

Table 5 Implementation plan – Moravian-Silesian region

Transport mode	Project Name		Project Type	Planned implementation
Projects from strategic documents				
Road	I/11	Opava - north bypass, west part	New 1st class bypass	2020-2023
Road	I/11	Opava - north bypass, east part	New 1st class bypass	2017-2019
Road	I/11	Ostrava – extended Rudná, bypass	New motorway	2012-2020
Road	I/11	Havířov - Třanovice	New motorway	2028-2032
Road	I/45	Bruntál - east bypass, 1st phase	New 1st class bypass	2022-2026
Road	I/45	Nové Heřminovy-Zátor - bypass, 1st phase	New 1st class bypass	2023-2026
Road	D48	Bělotín – Rybí, highway	Upgrade of existing motorway	2019-2023
Road	D48	Rybí - Rychaltice, highway	Upgrade of existing motorway	2017-2020
Road	D48	Frýdek - Místek, highway bypass	New highway bypass	2018-2022
Road	D56	Frýdek - Místek, connecting to D48	New highway bypass	2018-2022
Road	I/57	Krnov – north east bypass	New 1st class bypass	2017-2021
Road	I/58	Příbor - Skotnice	New 1st class road	2017-2020
Road	I/58	Mošnov - bypass	New 1st class bypass	2022-2024
Road	I/58	Frenštát pod Radhoštěm - Vlčovice	New 1st class bypass	2029-2031
Road	I/67	Karviná bypass	New 1st class bypass	2020-2022
Road	I/68	Třanovice - Nebory	New motorway	2019-2022
Railway	305B, 301G	Town Ostrava with surrounding area	Modernization and capacity utilization of the railway junction Ostrava hl.n. and adjacent track sections	2025-2033
Railway	305B	Section Polom – Suchdol n. O.	Reconstruction of 12,525 km of track, new railway turning Vražné	2022-2023
Railway	301A, 301B	Section Dětmarovice – Petrovice u K.	Reconstruction of 9,8 km of track and railway station Petrovice u. Karviné and Dětmarovice, Increase speed to 100 km/h	2020-2022
Railway	301B	Petrovice u Karviné	Track electrification, new safety device, displacement of Dětmarovice head , extension of track for freight trains, new platform	2020-2022
Railway	305B	Section Přerov – Ostrava	Diverting long-distance passenger traffic to a new line and thus creating new capacity for freight trains on an existing network	2025-2030

Transport mode	Project Name		Project Type	Planned implementation
Railway	301A	Section Český Těšín (outside) - Albrechtice u Českého Těšína (including)	Increase speed from 80 km/h to 100 - 145 km/h	2022-2023
Railway	305B, 301G, 301D	Section Ostrava-Kunčice – Ostrava-Svinov/Polanka n.O.	Track reconstruction in the section and station Ostrava-Vítkovice, increase speed to 120 km/h	up to 2030
Railway	302A	Section 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, increase speed to 120 km/h	2021-2023
Railway	301A, 305B, 305A, 305C	Station Bohumín-Vrbice, Section Bohumín Vrbice - Chałupki	Track reconstruction in the section Bohumín-Vrbice (outside) – border crossing PR, new railway turning Bohumín-Pudlov	2022
Railway	305B, 305A, 305C	Section Bohumín-Vrbice – Chałupki and Bohumín - Chałupki	Track line interconnection by switches, renewal of the Bohumín - Pudlov railway turning	up to 2030
Railway	305B, 306A	Studénka station, Sedlnice - Bartošovice station	New connecting line (clutch) between line 305B and 306A, Sedlnice-Bartošovice station – new track, Sedlnice station – new track	2020
Road/Railway	I/58, D48, 305H	Mošnov	New intermodal terminal	up to 2030
Water	Oder, section Ostrava – border crossing CZ/PL		No in use in Czech republic at present, waterway is in study phase, class will be Va. (13 km)	up to 2030
Projects from TRITIA traffic model				
Railway	301A	Třinec – Český Těšín freight railway station	Capacity increase	up to 2030
Railway	301A	border crossing(SK/CZ) - Mosty u Jablunkova	Capacity increase	up to 2030
Railway	301A	Bystřice n. Olší – Třinec	Capacity increase	up to 2030
Railway	301D	Chotěbuz turning – Albrechtice u Č.Těšína	Capacity increase	up to 2030
Railway	305B	Jistebník - Studénka	Capacity increase	up to 2030

Table 6 Implementation plan – Silesia and Opole Voivodeship

Transport mode	Project Name		Project Type	Planned implementation
Projects from strategic documents				
Road	GP40	Kedzierzyna Kozla - bypass	New 1st class road	2018-2022
Road	S11	Kepno - A1 - new road	New expressway	2020-2022
Road	GP46	Niemodlina - bypass	New 1st class road	2019-2021
Road	S1	Kosztowy - Bielsko-Biala - new road	New expressway	2019-2023
Road	A1	Czestochowa - Tuszyn - new road	New motorway	2017-2022
Road	S1	Przybedza - Milowka - new road	New expressway	2018-2023
Road	S1	Pyrzowice - Kosztowy - upgrade of existing road to higher class	New expressway	2018-2020
Road	S11	Kepna - bypass	New expressway	2017-2021
Road	GP78	Poreba, Zawiercia - bypass	New 1st class road	2019-2023
Road	S11	Tarnowske Góry - bypass	New expressway	2019-2024
Road	GP45	Praszka - bypass	New 1st class road	2018-2022

Transport mode	Project Name		Project Type	Planned implementation
Road	S11	Olesna - bypass	New expressway	2018-2022
Road	GP1	Pszczynia - intersection	Intersection on 1st class road	2017-2019
Road	S11	Opole voivodeship border - Tarnowske Góry bypass - new road	New expressway	2019-2024
Road	S1	Pyrzowice - Podwarpie - new road	New expressway	2018-20221
Road	GP39	Brzeg - bypass	New 1st class road	2021-2024
Road	A1	Rzasawa - Blachownia - new road	New motorway	up to 2019
Road	S1	Oswiecim - Dankowice - new road	New expressway	2019-2023
Road	S1	Dankowice - Suchy Potok - new road	New expressway	2019-2023
Road	GP44	Oswiecim - bypass	New 1st class road	2019-2021
Railway		Jastrzebie Zdroj - Wodzislaw Sl.	Modernization of infrastructure	2019 - 2023
Railway		Gogolin - Krapkowice - Prudnik	Modernization of infrastructure	2019 - 2023
Railway	171	Katowice Muchowiec - Ruda Kochlowice	Works on the south-eastern GOP beltway along with adjacent sections	2019 – 2021
Railway	C-E 65	Chorzow Batory - Tarnowskie Góry - Karsznice - Inowroclaw - Bydgoszcz - Maksymilianowo	Program Operacyjny Infrastruktura i Środowisko 2014-2020 (POIiŚ)	2018-2022
Railway	694, 157, 190, 191	Bronów - Bieniowiec - Skoczów - Goleszów - Cieszyn / Wisła Głębce	Modernization of infrastructure	2014-2020
Water	Poland	Oder Waterway	Support for the inland waterway development policy in the light of the new Water Law	2018-2021
Water	Poland	Oder Waterway	The research and technical concept for the modernization of the severed section of the Oder Waterway to the navigability class Va	2018-2019
Water	Poland	Oder Waterway	Research guidelines for the design of water degrees on the Odra flowing freely, planned in order to obtain a navigable waterway of Va	2018-2019
Water	Poland	Opole – Kedzierzyn Kozle	Modernisation Va	2020-2025
Water	Poland	Kedzierzyn-Kozle -Waterway Node (ODW-DOL)	Construction Va (km 117,000 – km 159,800) 42,8 km	2025-2030
Water	Poland	Waterway Node – Lock Bukow (incl. reservoir Raciborz Dolny)	Construction Va (km 103,000 – km 117,000) 14 km	2025-2030
Water	Poland	Lock Bukow – cross border PL/CZ	Construction Va (km 103,000 – km 98,300) 4,7 km	2025-2030
Water	Poland	Kedzierzyn Kozle - Gliwice	Modernization, Va	2020-2030
Water	Poland	Silesian canal	Construction	2020 - 2030
Projects from TRITIA traffic model				
Railway	**131**	**Chorzów Stary - Bytom Północny**	**Capacity increase**	**up to 2030**
Railway	**131**	**Radzionków - Tarnowskie Góry**	**Capacity increase**	**up to 2030**
Railway	**131**	**Tarnowskie Góry - Zwierzyniec**	**Capacity increase**	**up to 2030**
Railway	**131**	**Strzebiń - Kalina**	**Capacity increase**	**up to 2030**
Railway	**131**	**Herby Nowe - Kłobuck**	**Capacity increase**	**up to 2030**
Railway	**139**	**Katowice Ligota - Mąkołowiec**	**Capacity increase**	**up to 2030**
Railway	**139**	**Tychy - Pszczyna**	**Capacity increase**	**up to 2030**

Table 7 Implementation plan – Žilina region

Transport mode	Project Name		Project Type	Planned implementation
Projects from strategic documents				
Road	R1	Banská Bystrica – Sl. Ľupča	New expressway	up to 2023

Transport mode	Project Name		Project Type	Planned implementation
Road	R1	Sl. Ľupča - Korytnica	New expressway	up to 2027
Road	R1	Korytnica border of Žilina region - Litpvská Osada -Ružomberok south	New expressway	up to 2028
Road	R1	Ružomberok I/18 - D1 intersection	New expressway	up to 2026
Road	R3	Tvrdošín - Nižná nad Oravou	New expressway	up to 2021
Road	R3	Nižná nad Oravou - Dlhá nad Oravou	New expressway	up to 2026
Road	R3	Dlhá nad Oravou - Sedliacka Dubová	New expressway	up to 2026
Road	D1	Hubová - Ivachnová	New motorway	up to 2022
Road	D1	Ružomberok south - I/18 intersection	New motorway	up to 2025
Road	D1	Hričovské Podhradie - Lietavská Lúčka	New motorway	up to 2020
Road	D1	Lietavská Lúčka - Dubná Skala	New motorway	up to 2023
Road	D1	Feeder Lietavská Lúčka - Žilina II. phase	New motorway	up to 2020
Road	D1	Turany - Hubová	New motorway	up to 2030
Road	D3	Žilina, Brodno - Kysucké Nové Mesto	New motorway	up to 2030
Road	D3	Kysucké Nové Mesto - Oščadnica	New motorway	up to 2030
Road	D3	Oščadnica - Čadca, Bukov - full profile	New motorway	up to 2030
Railway	106A, 106D, 114A	Žilina node	Infrastructural, modernization with new line security (ETCS 2 with GSMR)) and transition to 25kV electrification	2019 - 2021
Railway	106D	Krásno nad Kysucou - Čadca (border), section Čadca - Krásno nad Kysucou	Modernization of infrastructure, line security and transition to 25kV electrification	2022 - 2025
Railway	105A	Poprad - Východná	Modernization of infrastructure, line security and transition to 25kV electrification	2025 - 2028
Railway	105A	Východná - Liptovský Hrádok	Modernization of infrastructure, line security and transition to 25kV electrification	2024 - 2026
Railway	105A	Liptovský Hrádok - Liptovský Mikuláš	Modernization of infrastructure, line security and transition to 25kV electrification	2020 - 2023
Railway	105A	Liptovský Mikuláš - Ružomberok	Modernization of infrastructure, line security and transition to 25kV electrification	2024 - 2025
Railway	105A, 106A	Ružomberok - Turany	Modernization of infrastructure, line security and transition to 25kV electrification	2026 - 2029
Railway	106A	Turany - Vrútky	Modernization of infrastructure, line security and transition to 25kV electrification	2024 - 2025
Railway	106A	Vrútky - Varín	Modernization of infrastructure, line security and transition to 25kV electrification	2026 - 2028
Projects from TRITIA traffic model				
Railway	**118A**	**Diviak - Vrútky**	**Capacity increase**	**Up to 2030**