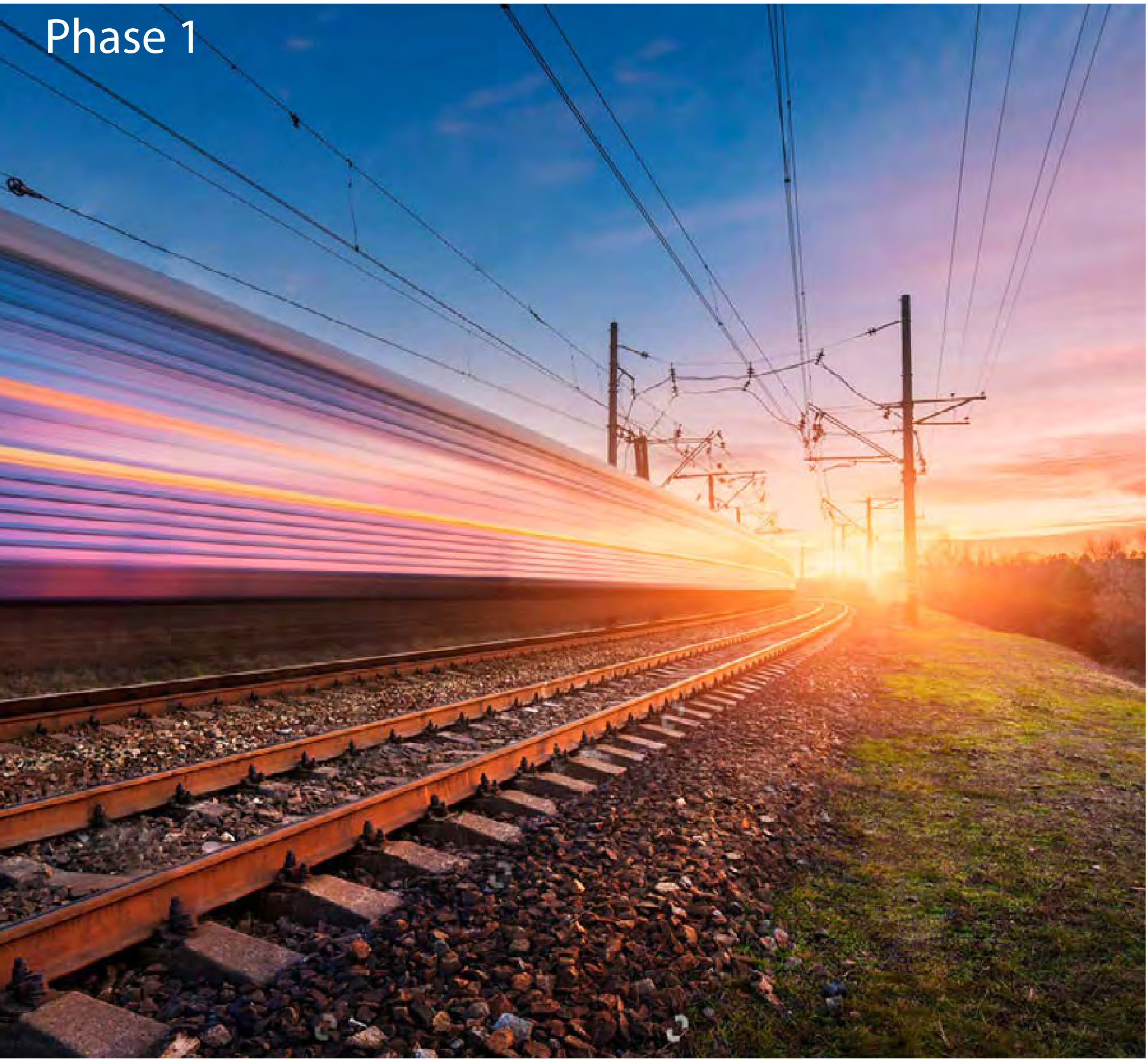
UNECE

# Trans-European Railway High-Speed
## Master Plan Study




UNITED NATIONS

UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE

# Trans-European Railway High-Speed
## Master Plan Study

Phase 1

UNITED NATIONS

## Note

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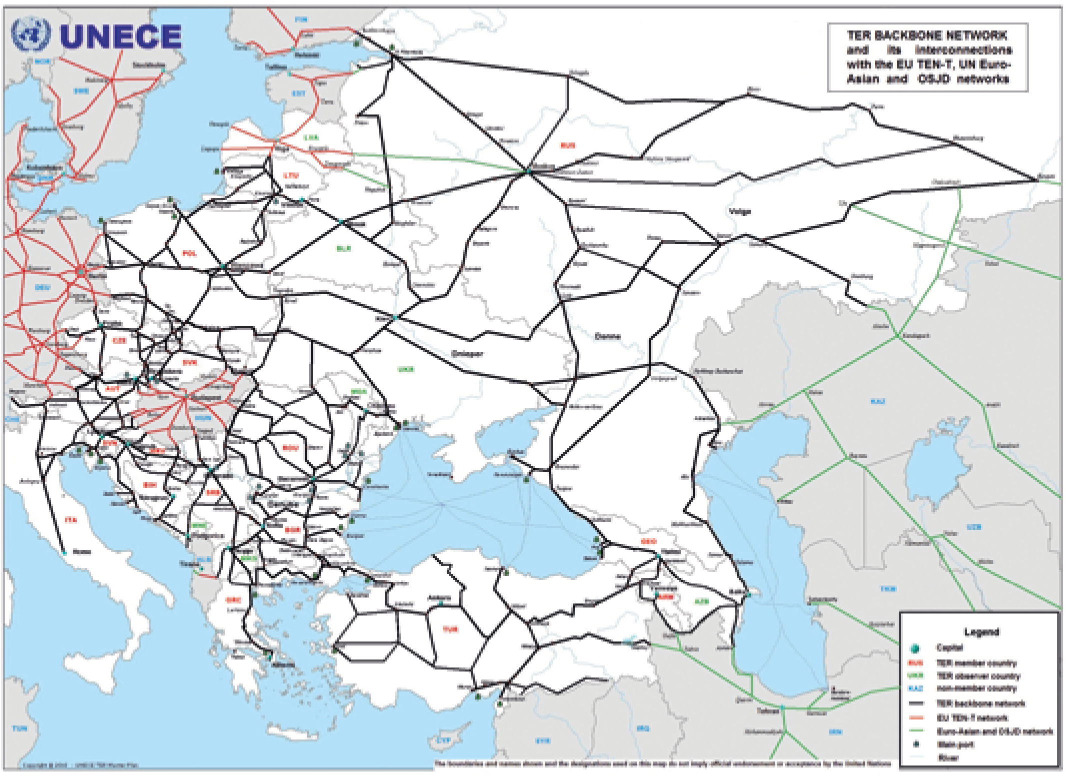


## Disclaimer:

# Contents

# Executive Summary

While the benefits of high-speed, i.e. considerable time savings are evident, there is also a strong impact on distances. Currently, shorter travel times essentially make distances shrink, which results in a higher attractiveness of affected regions as a location for economic activity. This makes high-speed rail investment attractive in addition to the local economic benefits that arise. These effects are illustrated by an Austrian example, the Koralm railway Graz-Klagenfurt, a new high-speed railway link closing the gap between these two cities.

At the European level, one can distinguish between monocentric countries such as e.g. France or Hungary and polycentric countries like the Czechia, Germany, Italy or Poland. Whereas in polycentric countries speeds on radial high-speed lines may be as high as technically, operationally and economically feasible, in polycentric countries network effects have to be taken into account, mostly by ensuring that integrated clock-face timetables are best integrated with speed needs.

Examples in France and other large countries show that time savings due to high-speed are high enough to cause a relevant shift from both road and air traffic to railways, sometimes even replacing air traffic completely. The reduction of emissions from fossil fuels has a very beneficial effect on climate and environment. Depending on selected speed levels, high-speed trains are competitive against road for distances above 100-200 km and against air up to 800 and 1,000 km. A project in the Russian Federation may extend this threshold to about 1,500 km.

The reduction of travel times may induce new commuting behaviour, with distances of 200 km and more in everyday commuting.

Furthermore, the gain of safety is not negligible, as in general, railways are safer than road by a factor of at least 10.

The only disadvantage of rail, including high-speed, is the emission of noise. This can be mitigated or avoided by noise protection measures such as walls or tunnels, which though expensive, are supported by the progress in technology for reducing noise emissions of vehicles.

All the advantages of high-speed rail are reasons for political decisions to implement concrete projects, mainly along the most important corridors and mainly linking the large urban agglomerations. But in many cases, even lower traffic demand is accepted, with the goal to foster regional development.

Running at speeds of at least 200 km/h has a number of effects that have to be taken into account for the layout and equipment of high-speed rolling stock: air resistance and dynamic air pressure, etc. The study gives an overview of high-speed rolling stock, comparing the basic design types as well as infrastructure parameters.

Examples are provided of existing high-speed lines in Austria, France, Germany, Italy and Spain are described as well as projects in the TER countries, including Rail Baltica, the "Centralna Magistrala Kolejowa" and the postponed "double Y" in Poland, the Czech projects, mainly along the Orient-EastMed and the Baltic-Adriatic Corridor, and projects in Croatia, Hungary, Greece, Serbia, Slovakia and Slovenia. There are also important projects, partly already implemented, in the Russian Federation, e.g. the existing Moscow-St.Petersburg high-speed line, with the project of a parallel new line, even faster, and the Moscow-Rostov na Donu-Adler and the Moscow-Nizhny Novgorod-Kazan-Yekaterinburg project. Finally, high-speed lines also exist in Turkey, such as the new Ankara-Polatli-Eskişehir-Istanbul line.

For high-speed lines in TER countries, the most important EU legislation consists of the TEN-T Regulation 1315/2013 with its counterpart for implementation, the CEF Regulation 1316/2013, as well as the set of Technical Standards for Interoperability (TSI).

A literature review was prepared with the aim of covering the whole field of high-speed rail, in particular the socioeconomic benefits and the political framework, the technical aspects of planning, construction, operation and maintenance, track geometry and practical experience, as well as costs of implementation and operation. This review has provided a basis for the detailed information on the key characteristics necessary for all components of high-speed infrastructure. This analysis is supplemented by a discussion on the challenges associated with track maintenance and renewal. Finally, the analysis explains operational requirements and the trade-off between speed and capacity on mixed use lines and highlights some key prefeasibility and feasibility studies as examples of potential projects.

Of particular importance for high-speed lines is the provision of the adequate technical parameters. For EU member States, the most relevant regulations are comprised in the "Technical Specifications for Interoperability" (TSI). These specifications have passed through a twenty years process of development and consolidation, during which the initially separated prescriptions for conventional and high-speed rail have been merged. TSIs cover all parts of the railway system, namely infrastructure, rolling stock, power supply and signalling. For non-EU countries a comparison has been provided of these standards with TSIs. Although not mandatory, non-EU TER countries are recommended to apply TSI to ensure full interoperability also across EU external borders and, for those seeking further integration with the EU, to be prepared for possible future EU accession. Alongside TSIs, the use of national standards may complement the design of high-speed railways.

This analysis also covers construction and maintenance costs, implementation schedules, funding and financing of high-speed projects. This shows that construction costs vary greatly, depending on the morphology and the actual land use as well as a result of the economic level of the corresponding country. In terms of financing, most of the TER countries that are also EU member States, are so called "Cohesion countries", as such they are entitled to receive up to 85 per cent co-funding for railway projects, including high-speed.

## Analysis, results, conclusions and recommendations

A significant component of the study focused on the calculation of traffic demand potentials are often the reason for implementing high-speed. The calculations have been undertaking using as a basis Lill's travelling law of 1891 where the traffic demand between two cities is directly proportional to the number of their inhabitants and reciprocally proportional to almost the square of their mutual distance. The advantage of this methodology is that it can produce results with limited data. This methodology is applied in two examples: the existing high-speed line Vienna-Linz and the high-speed line Linz-Salzburg with the forecast for the Vienna-Linz line being about twice as high as that of Linz-Salzburg.

In a first step, this methodology was used for a set of "reference links", i.e. existing high-speed lines, mainly in Western Europe and in the Russian Federation and Turkey. The results obtained can be used as the reference values, meaning that they may be understood as the minimum requirements necessary for high-speed investment.

Then, calculations were made for about 80 different sections that cover most of the TER area, but are focused on the international main corridors. The results are seen in five maps within the report showing present potential traffic demand, and two forecasts for each of the two scenarios which give an indication of where priorities could be in the future. The high-speed strategy of Turkey is underlined as an example of good practice. This is followed by examples of detailed assessments, including the extended cost-benefit analyses as had been developed by the Austrian Railways (ÖBB). Finally, an excel tool following the NIBA method has been included with the aim of facilitating the decision making processes of TER countries which includes an assessment of the Slovak Orient-East Med Corridor section as investigated in the above-mentioned feasibility study. The excel tool is also attached to the study.


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# 1. Introduction and historical background

## 1.1. Introduction into the present study

The Trans-European Railway (TER) is unique pan-European transport infrastructure projects bringing together countries of the European Union (EU), EU candidate countries as well as other United Nations Economic Commission for Europe (UNECE) member States in Central, Eastern and South-Eastern Europe and the Caucasus. It covers the following countries (TER member States): Armenia, Austria, Bosnia and Herzegovina, Bulgaria, Croatia, Czechia, Georgia, Greece, Lithuania, Poland, Romania, Russian Federation, Serbia, Slovakia, Slovenia and Turkey, of which Austria, Bulgaria, Croatia, Czechia, Greece, Lithuania, Poland, Romania, Slovakia and Slovenia are also EU member States. Belarus, Latvia (which is EU member State), Moldova, Montenegro and the former Yugoslav Republic of Macedonia have observer status.

In 2011, UNECE published the TEM and TER Revised Master Plan [1], which describes the "backbone networks" of roads and railways in the TER member States, as well as the priority projects within these networks. The present study is to be seen as a supplement to the railway part of that Master Plan with a focus on high-speed railway lines.

The definition of high-speed railway lines is based on corresponding specifications at EU level, e.g. "Council Directive 96/48/EC of 23 July 1996 on the interoperability of the trans-European high-speed rail system (modified by subsequent interoperability Directives) and, more specifically, TEN-T Regulation 1315/2013 [2], which foresee three categories of high-speed railway lines:

- **i.** Lines constructed explicitly for high-speed of 250 km/h as a minimum;
- **ii.** Conventional railway lines upgraded to 200 km/h as a minimum;
- **iii.** Conventional lines upgraded for high-speed trains, however below 200 km/h to allow for topographical particularities, such as in mountainous or urban areas.

Given the topographical environment in many parts of the TER region and the financial constraints on many of the TER countries, category (iii) may be of special importance. The study will later comment that, in some cases, upgrading to speeds in the order of 120-200 km/h may be sufficient, where considering network effects, integrated timetables with trains running at similar speeds, could be appropriate for some countries. This is a decision which depends on many parameters, such as spatial conditions and land morphology, the function of the link in the network, operational aspects, such as timetable needs or possible interference with freight traffic, and — last but not least — on the available financial resources of a country. All these parameters point to the necessity of decisions being made locally but with a view to the impact on the corridor as a whole.

This study seeks to look into this in more detail and propose which lines in TER member States high-speed may be taken into consideration and further investigated. For those TER countries which are EU members, the TEN-T Regulation [2] indicates, within the TEN-T core network, those lines which should be implemented for high-speed by 2030, as well as, within the comprehensive network, high-speed lines which should be considered beyond 2030. Given this legal background, for TER countries that are EU members, modifications may be proposed only for a future TEN-T core network, which will be in force from 2030.

## Structure of the Study

Following the requirements of the Terms of Reference, the work has been carried out in permanent cooperation with UNECE, the TER project management team and the TER member States, according to the following requirements:

### 1. Introduction and historical backgrounds

A general overview of what has been achieved so far in the sector with a focus on high-speed rail and European infrastructure policy. Some general, introductory, principles of high-speed railway systems are also provided here.

### 2. Benefits, political background, best practices and high-speed status

The political background and goals are provided in this chapter derived from spatial, economic and environmental effects. Some best practice examples from different counties illustrate the achievements of high-speed rail, and depict the status in the TER region. This section also provides an overview of high-speed rolling stock and European railway infrastructure policy.

### 3. Review of related work, studies and technical aspects of high-speed rail

Starting with a screening of selected studies and achievements made at global level, this part is focused on the technical challenges of and the technical parameters for high-speed infrastructure planning, construction, maintenance and operation. It also covers a review of costs and timings associated with building and running a high-speed railway.

### 4. Methodology and data

A fundamental input to the study was the data that was received from member countries in response to a questionnaire prepared at the start of the project. This data was then supplemented by additional, independent, data collection. The methodology is developed to forecast the traffic demand potentials for high speed and is applied to a set of reference sections (existing or under construction, mainly in Western Europe), as a base for appraising potential future projects.

### 5. Results, assessment

Chapter 5 provides the results of the forecasting model, providing forecasted traffic demand potential of relevant railway sections of the TER backbone network. The results are reproduced in maps. Finally, this part comprises considerations of project assessment, with a proposal for a cost-benefit analysis and a corresponding calculation tool, as well as final conclusions and recommendations.

### 6. Register of literature, figures and tables

These lists contain the literature references and the figures displayed in the study, with indication of the corresponding sources.

Furthermore, this final report includes 4 annexes with further details that supplement the information provided in the main chapters.

For the purpose of this study, a gravitation approach reflecting "Lill's travelling law" [3] has been used as a basis for the forecast demand flows. Commonly accepted, it is the core principle of more complicated models and as such provide a sufficiently robust estimate of sections of the networks where high-speed lines might be appropriate, in terms of affordability and efficiency. However, a full and detailed assessment including a detailed cost benefit analysis will need to be carried out on a case-by-case basis to ensure the economic and social viability of individual projects.

## 1.2. A brief history of conventional and high-speed railways

The industrial revolution at the beginning of the ninetieth century brought about the first steam-driven railways. Some key milestones are included in the table below.

**Table 1.1 - Key milestones in railway history**

| Year | Country | Line |
|---|---|---|
| **1825** | United Kingdom | Stockton — Darlington railway, with the steam locomotive by George Stephenson (41 km) |
| **1829** | United States of America | Baltimore — Ohio railroad: Baltimore — Ellicott's Mills (24 km) |
| **1835** | Belgium | Brussels — Mechelen/Malines (20 km) |
| **1835** | Germany | Nürnberg — Fürth (6 km) |
| **1837** | France | Paris — St. Germain (21 km) |
| **1837** | Austria | Kaiser Ferdinands-Nordbahn: Floridsdorf — Deutsch Wagram (13 km) |
| **1838** | Russia | St. Petersburg — Zarskoye Zelo (27 km) |
| **1854** | Austria | K. u. K. Südbahn: Semmering mountain section (41 km) closing the last gap between Vienna and Trieste |
| **1857** | Turkey | Izmir — Aydın (130 km) |

Most of these railway lines were built with a track gauge of 1,435 mm, which later became the standard for most of Western Europe and today is also used in China, the United States of America and many other countries. Most of the Japanese network has a track gauge of 1,067 mm since 1872 although high-speed lines are of Standard gauge (1,435mm). The Russian Federation originally used a broad gauge of 1,829 mm and later switched to 1,524 mm during the years of the Russian Empire, today still in use in Mongolia and Finland. This was modified to 1,520 mm in the Soviet Union and remains the standard in all succeeding countries, i.e. the Russian Federation, the Commonwealth of Independent States (CIS) and the Baltic States.

From the very beginning, there has been a drive to increase the speed of the railways. The need for shorter travel times, in particular from growing competition from road and air, as well as improved technologies, triggered a rapid development. The evolution of top speeds is set out in the table below.

### Table 1.2 - Evolution of top speeds in conventional rail transport

| Year | Country | Description | Maximum speed |
|---|---|---|---|
| **1830** | United Kingdom | Liverpool — Manchester | 48 km/h |
| **1848** | France | First locomotive faster than 100 km/h | 126 km/h |
| **1889** | United States of America | Baltimore: electric trainset | 185 km/h |
| **1903** | Germany | electric trainset (rotating current) | 210 km/h |
| **1931** | Germany | "Rail Zeppelin" in section Karstädt — Wittenberge | 230 km/h |
| **1955** | France | Electric locomotives CC7107, BB 9004 | 331 km/h |
| **1988** | Germany | ICE experimental | 406.9 km/h |
| **1990** | France | TGV Atlantique | 515.3 km/h |
| **2007** | France | Modified TGV train | 574.8 km/h |

In normal operation, however, speeds have always been considerably lower. This initial over-engineering of the railways meant that during the first few decades, before about 1850, were more suitable for higher speeds than those constructed in the second half of the ninetieth and early twentieth centuries. This was mainly due to the fact that, initially, locomotives were not able to pass tight curves. This changed by the middle of the century and, as a consequence, lines could be built at lower costs, following more closely the terrain. In modern times, this has had the reverse effect, making it more costly to upgrade lines to higher speeds.

The table below shows the evolution of the operating speeds on a subset of lines which have often been 30-40% below the maximum speeds recorded on the lines. It is of course important to note that the railway lines and rolling stock are designed to a higher maximum speed than the actual operating speed primarily for safety reasons but also to introduce some degree of future proofing.

### Table 1.3 - Historical evolution of maximum operating line speeds

| Year | Country | Description | Maximum speed |
|---|---|---|---|
| **1830** | United Kingdom | Liverpool — Manchester | 48 km/h |
| **1848** | France | First locomotive faster than 100 km/h | 126 km/h |
| **1889** | United States of America | Baltimore: electric trainset | 185 km/h |
| **1903** | Germany | electric trainset (rotating current) | 210 km/h |
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| **1955** | France | Electric locomotives CC7107, BB 9004 | 331 km/h |
| **1988** | Germany | ICE experimental | 406.9 km/h |
| **1990** | France | TGV Atlantique | 515.3 km/h |
| **2007** | France | Modified TGV train | 574.8 km/h |
| **2008** | China | Beijing — Tianjin | 350 km/h |

As indicated in table 1.3 above, the first high-speed lines in Europe (beginning in Italy) were built in the late 1970s and following the 1974 oil crisis, which had induced a renaissance of railways. Since then, a fairly dense network of high-speed lines has been developed across the continent as shown in figure 1.1, mainly in western and south-western parts of the continent, which have a spatial structure favouring high-speed rail traffic and have sufficient economic power (coupled with strong support from the EU) to finance construction of the needed infrastructure. This process is still ongoing, with, for the time being, only isolated cases in the north- and south-east (Russian Federation: Moscow — St. Petersburg: 250 km/h since 2009, Turkey: Ankara — Istanbul: 250 km/h since 2014).

Operational speeds of more recent high-speed lines have grown by one third when compared to the first services. In general, this process seems to have reached its maximum, as most of new projects foresee speeds between 200 and 300 km/h with only a small number of projects seeking greater than 300 km/h for example in Russian Federation where speeds of up to 400 km/h are envisaged to account for the long distances.

**Figure 1.1 - European existing and planned high-speed railway network**


High-speed lines are appropriate where there are densely populated centres between 100 and 1,000 km from each other, in particular between 200 and 600 km. At shorter distances, local access to high-speed railway stations puts rail at a competitive disadvantage to cars, while for longer distances, aircraft are more competitive.

The distances are longer on the Japanese high-speed corridors which connect cities of millions of inhabitants with intercity mobility needs. Given this high level of demand, they are operated at very short intervals with a punctuality which is measured in seconds. As no other region in the world has such a high potential for high-speed traffic demand (with the potential exception of north-eastern USA) as a result, this example cannot be copied in other regions, in particular not in Europe.

## 1.3. European railway infrastructure policy since 1990

EU transport policy has always been embedded in the general political framework. Since the upheavals of the start of the 1990s, tremendous geopolitical changes have taken place in Europe, initiating a step-by-step enlargement process of the EU, with the following countries acceding:

- **1995:** Austria, Finland, Sweden and Finland
- **2004:** Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia
- **2007:** Bulgaria and Romania
- **2013:** Croatia.

Over the same period, it became clear that the growing dominance of road transport would affect the environment and citizens to an intolerable extent. The European Commission published a series of White Papers to tackle this challenge and to define the intentions of the Union in the context with transport policy. The 2001 White Paper focused on modal shift, the 2006 White Paper on the importance of Co-Modality and the 2011 White Paper on Modal integration [4].

As can be seen, the initial intention was to shift transport from road to rail, inland waterways and short sea shipping. In practice, it became difficult and not feasible to enforce corresponding measures. This objective was subsequently watered down for the 2006 White Paper in the sense that at least each mode should become as environmentally friendly as possible. Currently, the core objective is to foster multimodality with efficient interfaces between the modes, in order to improve sustainability. This applies not only to freight but also to passengers, together with the goal to decarbonise transport by technical innovation and to attract passengers by cheaper and faster railways, including high-speed.

The Maastricht Treaty in 1992 introduced the requirement of the creation of a common market in the European Union. This implied the need for an interoperable transport system, without barriers at borders between EU member States, while the Schengen Treaty effectively removed internal borders in a large part of the EU. Based on this legal framework, the EU developed the concept of Trans-European Networks for Transport (TEN-T), for Energy (TEN-E) and Telecommunication (eTEN).

The first version of the TEN-T, based on a pure bottom-up approach, was published as Decision No. 1692/96/EC "Community guidelines for the development of the trans-European transport network" [5].

The then fifteen EU member States had notified the Commission their trunk networks of road, railways, inland waterways and combined transport, as well as their seaports, inland ports and airports which were, in turn, based on the European Agreements on Main International Traffic Arteries, on Main International Railway Lines and on Main Inland Waterways of International Importance administered by UNECE. In principle, the Commission developed an EU focused framework for these infrastructures and where cross-border discrepancies emerged, adapted them after consulting with the concerned member States.

As this became evident already before adopting the above decision, the European Council endorsed in 1994 in Essen, a list of 14 priority projects, which had been negotiated with the member States in a high-level group which included also some high-speed railway lines.

**Figure 1.2 - Pan-European Corridors I-X**


At the same time, preparations for a larger EU started. There was the intention to create a set of corridors from the outermost nodes within the EU territory into the neighbouring candidate countries (from north to south: Estonia, Latvia, Lithuania, Poland, Czech Republic, Slovakia, Hungary, Slovenia, Romania and Bulgaria) and beyond to Belarus, Russia, Ukraine and Moldova, to connect this wide area with the TEN-T of the EU. In the second pan-European conference of ministers of transport in Crete, 9 pan-European Corridors (I-IX) were adopted, in the third such conference 1997 in Helsinki, a tenth corridor (X) was added, as shown in figure 1.2, which formed the backbone for the Western Balkans region.

In 1997, the Transport Infrastructure Needs Assessment (TINA) process was launched to develop, together with the candidate countries, a network with a density comparable with the then TEN-T, and at the same time, to identify priorities for the implementation of this so called "TINA network". The TINA study published in 1999 [6] formed the basis for negotiating the accession of the individual candidate countries.

While within the EU, a series of Regulations (Nos. 2236/95, 1655/1999, 807/2004, 680/2007) each one amending the proceeding one, as well as the cohesion fund, became the legal basis for co-funding TEN-T projects, projects in candidate countries were supported with funds from PHARE and IPA programs.

**Figure 1.3 - The 30 TEN-T priority projects identified in 2004**

Whereas in the late 1990s, there were only minor amendments to the TEN-T Guideline, in 2004, the year of the first step of enlargement towards Central and Eastern Europe, was a year which saw a thorough revision of the TEN-T. Decision No. 884/2004 [7] comprised certain amendments of the basic network. Although implementation of the 14 projects had not been as successful as hoped, with a view to an enlarged EU, this list was extended, with a new focus on east-west connections, to a total of 30 projects. These priority projects, as shown in figure 1.3, comprised a number of high-speed projects. Some of the pan-European Corridors entered this priority list, such as pan-European Corridors I, IV, V, VI and VII.

In 2007, another high-level group added four axes into the neighbourhood of the enlarged EU [8], partly overlapping with pan-European corridors, but finally this exercise was less significant in the history of European transport infrastructure when compared to other, previous, initiatives.

In that period, several institutions and even the Commission itself had been creating different kinds of corridors apart from the priority projects. These included rail freight corridors, ERTMS corridors, the pan-European Corridors, RNE corridors, TRACECA corridors, the de Palacio axes, etc.

This was one of the starting conditions for a complete TEN-T policy review, which was prepared in 2008, began in 2009 and ended in 2013. From the very beginning, it was agreed that the result should be a dual layer multimodal network, linked across the modes, and consisting not only of nodes and links, but also of transport innovations (e.g. traffic information and management systems and alternative fuelling infrastructure) to achieve sustainable passenger and freight mobility.

It was the first time that a new approach was chosen, consisting of the following main steps:

- Revising the basic TEN-T network, now called "comprehensive network", in line with a corresponding guidance the Commission had given to EU member States
- Developing, with input from experts, a planning methodology to identify a core network with the highest strategic functionalities [9]
- Achieving general acceptance from member States for this methodology; and

- Applying this to select the core network elements from the comprehensive network in a uniform way throughout the EU. As an example, figure 1.4 shows the TEN-T comprehensive network for rail (passengers and freight) and the core network for passenger railways.

The objectives of the most recent Commission's White Paper on transport published in 2011 [4] focus on multimodality and the close interconnection of the networks across the modes, both for passengers and freight. In this context, the railway connections of sea and inland ports, as well as of rail-road terminals, play an important role, along with those of airports. However, only large airports, above the threshold of about 8 million passengers per year, must be linked to rail, to guarantee economic solutions for the interface between air and rail. The reason is that railway services at airports are attractive only with short intervals, as passengers would in general not accept long waiting times. This may be different where high-speed trains replace connecting flights or where an existing line with a dense commuter service would stop at the airport anyway, possibly because this stop would serve also a local population.

In order to provide the required long-term planning continuity, it was decided that the core network would be valid until 2030, although a revision is foreseen to start in 2023. At the level of the comprehensive network, only ports and airports may be added or removed if they pass certain thresholds, but without affecting the core network before 2030. Apart from these nodes, also the comprehensive network is stable until 2030.

**Figure 1.4 - TEN-T core network for railways for passengers (with high-speed links in purple)**

The results of this process were adopted and published in Regulation No. 1315/2013 (TEN-T Regulation [2]). With a view to a coordinated implementation of the core network, this regulation also foresees the possibility to connect certain parts of the core network, according to their functionalities, to so called "multimodal core network corridors".

These corridors should pass through at least three countries and comprise complex cross-border infrastructure projects, which may require strong coordination, which is ensured through a special governance structure (Corridor Fora, chaired by European Coordinators). When considering also the role of the EU Rail Freight Corridors as laid down in Regulation No. 913/2010 [10], they may be considered, from an operational view, to become the backbone of a sustainable integrated transport policy.

Regulation Nº. 1316/2013 [11] defines the "Connecting Europe Facility" (CEF), a tool for supporting the implementation of the core network. For the financial period 2014-2020, the budget available for the TEN-T has almost tripled, with the focus of the funds being on the core network. It includes for the first time a portion from the Cohesion Fund, earmarked for the TEN-T in cohesion countries.

Referring to the most frequent and important cases, the CEF Regulation foresees the co-funding rates as set out in the table below.

**Table 1.4 - CEF co-funding rates**

| Description | Maximum funding rates |
|---|---|
| Studies | 50% |
| "Normal" core network projects | 20% |
| Removing missing links and bottlenecks | 30% |
| Border crossing projects | 40% |
| Projects in cohesion countries | 85% |

Contrary to previous funding periods, the Commission now concentrates funds on fewer projects with high European added value, thus avoiding distribution of funds on too many projects with little impact for the Union.

Further to funding rules and project financing, the CEF-Regulation, being the tool for project implementation, defines in its annex I, on the base of the corresponding provisions in the TEN-T Regulation, the routing of nine core network corridors, as shown in figure 1.5.

**Figure 1.5 - TEN-T core network corridors**

As the CEF-Regulation is valid only for the 2014-2020 funding period, this allows a more flexible regime at corridor level. While the core network is unchanged until 2030, minor modifications or adaptations are possible for the corridors, for the period 2021-2027. Nevertheless, new links are possible only if they are part of the core network.

As with the entire core network, the planned high-speed lines within it must also be implemented by 2030. It is one of the main tasks of the European Coordinators to make sure that member States will respect this deadline. The comprehensive network officially implies a formal time horizon of 2050, but may be understood as "long-term".

Although core network corridors do not officially form a third level above the core network, they are in practice considered the most important part of the TEN-T, also given the special form of governance which attracts increased public awareness. It is therefore no surprise that high-speed railway lines are concentrated on the corridors.

As already mentioned, these nine core network corridors comprise also the nine rail freight corridors and replace all other previously defined "priority projects", corridors and axes. This has thus unified at EU level the multimodal transport corridors.

## 1.4. Some principle considerations of high-speed rail

Implementing a high-speed line, either by upgrading an existing conventional line or by constructing new infrastructure, requires considerable investment. In the case of new infrastructure, one has to consider the cost differences of building a high-speed compared to a conventional line. These differences mainly result from differing technical parameters and requirements. This difference may be very high in mountainous or in densely populated areas, for which however — as described in chapter 1.1. above — category (iii) according to UIC or TEN-T specifications may apply.

A prerequisite is appropriate infrastructure. The physical strains and technical requirements such as heavier superstructures with large radius bends, a more resistant catenary and a more advanced signalling system such as ETCS level 2, are described more in detail in chapter 3.2. below. Apart from purely functional demand, also safety issues need particular attention. In this sense, no level crossings are permitted at speeds above 200 km/h and passengers on platforms need to be protected against passing high-speed trains.

Typically, high-speed trains as presented more in detail in chapter 2.4., are built to minimise weight (in the order of 400 to 700 tons, depending on the length of the train) and motorised with 5,000 to 12,000 kW, many of them distributing driving forces to many axles, which improves acceleration of the trains and its ability to overcome greater gradients (up to 40‰) than conventional trains. This is an important factor to reduce construction costs of dedicated high-speed lines.

A key question is about cost effectiveness and economic viability. It is evident that the technical requirements, covering infrastructure, vehicles, etc., are a fundamental cost driver.

Assuming a sufficient traffic demand potential, high-speed services attract considerably more passengers and the resulting journey-time savings for passengers enhance their willingness to pay. Also, shorter times of circulation reduce costs of equipment and staff. An important benefit, which however does not affect the operator is the positive economic effect on the wider economy, in particular on the regional economy. This last point is one of the main justifications for public investments in high-speed rail.

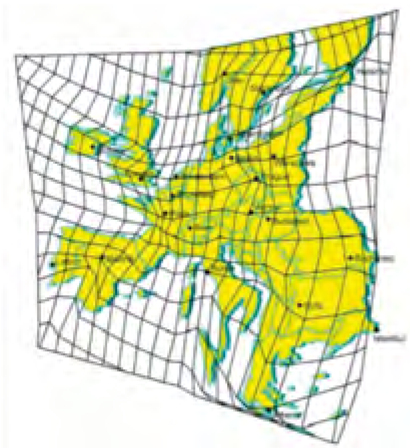
# 2. Benefits, political background, best practice and status of high-speed

## 2.1. Benefits of high-speed rail

As described in the previous chapter, high-speed railway lines have been in existence since the 1960s, with the first line opening in Japan, followed by many European countries including Russian Federation and Turkey, and more recently also in China and in the United States of America. Currently, there are many countries planning to build or extend high-speed lines or networks. The challenge for the future will be, step by step, to interconnect these lines and networks across borders, to obtain a high-speed railway system throughout Europe and even beyond. This challenge is also relevant for TER countries, albeit in the long run. In the short run, it is reasonable to foresee new high-speed lines in Russian Federation and Turkey and increased speeds in the eastern and south-eastern parts of Europe. A special situation may emerge in the context with new cargo flows along UNECE's EATL project or the "One Belt — One Road" initiative. Capacity needs from freight may induce the construction of new railway links, which could be designed for high-speed passenger services.

The construction of transport infrastructure, in general, has an impact on both space and environment, depending on its effects on travel times and traffic volumes. Although this spatial effect is not very well known, it is very often the background for political decisions on transport infrastructure, including high-speed lines. A number of studies have shown that high-speed lines strongly influence the structure and level of accessibility of a country or a region. Where these investments occur, distances seem to shrink, thus even remote places may become attractive as locations for economic activities and facilitating the movement of labour and goods. Figure 2.1 shows the impact of this spatial compression within Western Europe in 1993 and how South-Eastern Europe has not been able to capitalise on this. If this figure were to be reproduced today, the compression would be even more significant in western Europe with only small changes in South-Eastern Europe and many of the TER countries.

**Figure 2.1 - Europe shrunk by transport infrastructure shortening travel times (1993)**



High-speed rail has wider benefits beyond the direct user of the mode and the immediate construction jobs created, facilitating economic development of the areas around stations as well as those who are not direct users of the infrastructure by improving access to the market (while also causing some negative externalities such as noise). As expounded in D. Bökemann's and H. Kramar's study N0-E [12] for the Austrian Federal Transport Infrastructure Plan, this boosts productivity, strengthens competitiveness of local economy, enhances employment and increases social welfare.

Work package N0-S [13] elaborated by the same authors for the Austrian Federal Transport Infrastructure Plan, identifies in figure 2.2a (effects on accessibility due to (planning case A1) Koralm railway Graz — Klagenfurt)) the compensation of accessibility deficits in Southern Austria, due to the Koralm railway project and in figure 2.2b (effects on added value (due to planning case A1)) the corresponding potential increases in regional production. Summed up over all the regions concerned, the total potential for additional regional production, amounts to the range of M€170 per year, based on 1995 prices, which at current prices would be about M€250 per year.

**Figure 2.2a - Accessibility in southern Austria improved due to Koralm high-speed railway Graz — Klagenfurt**

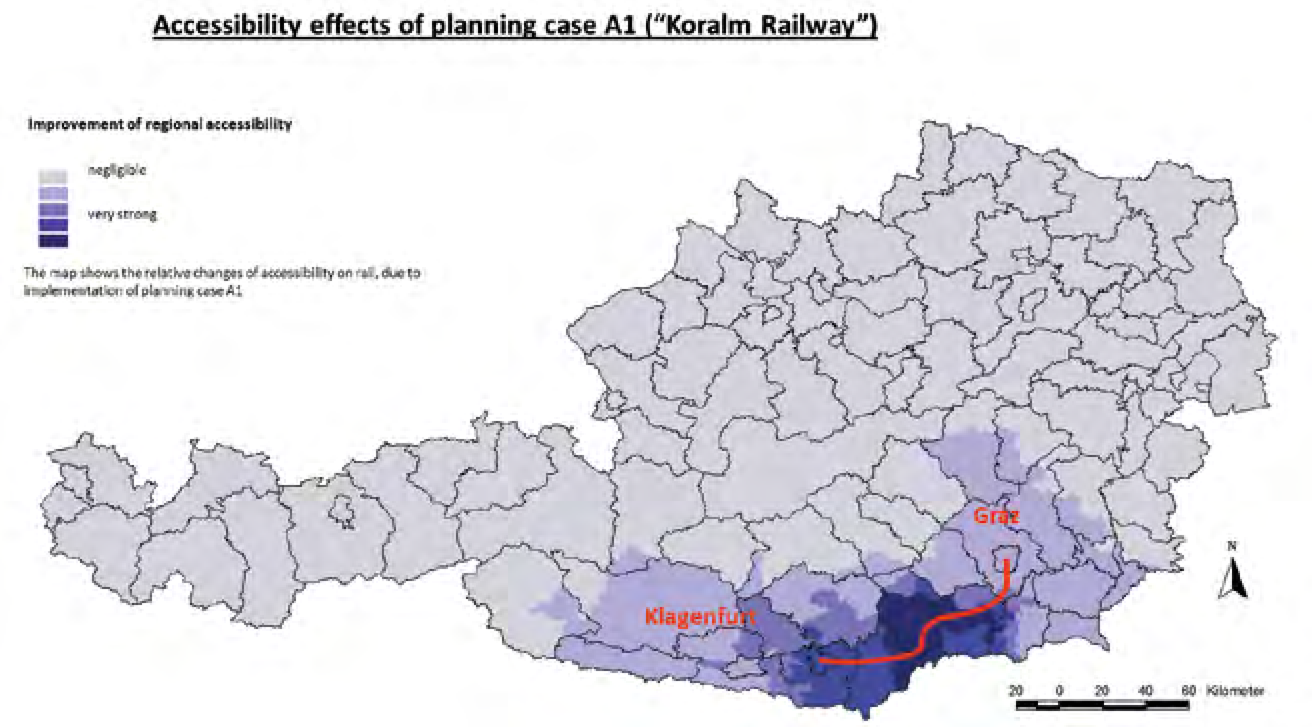
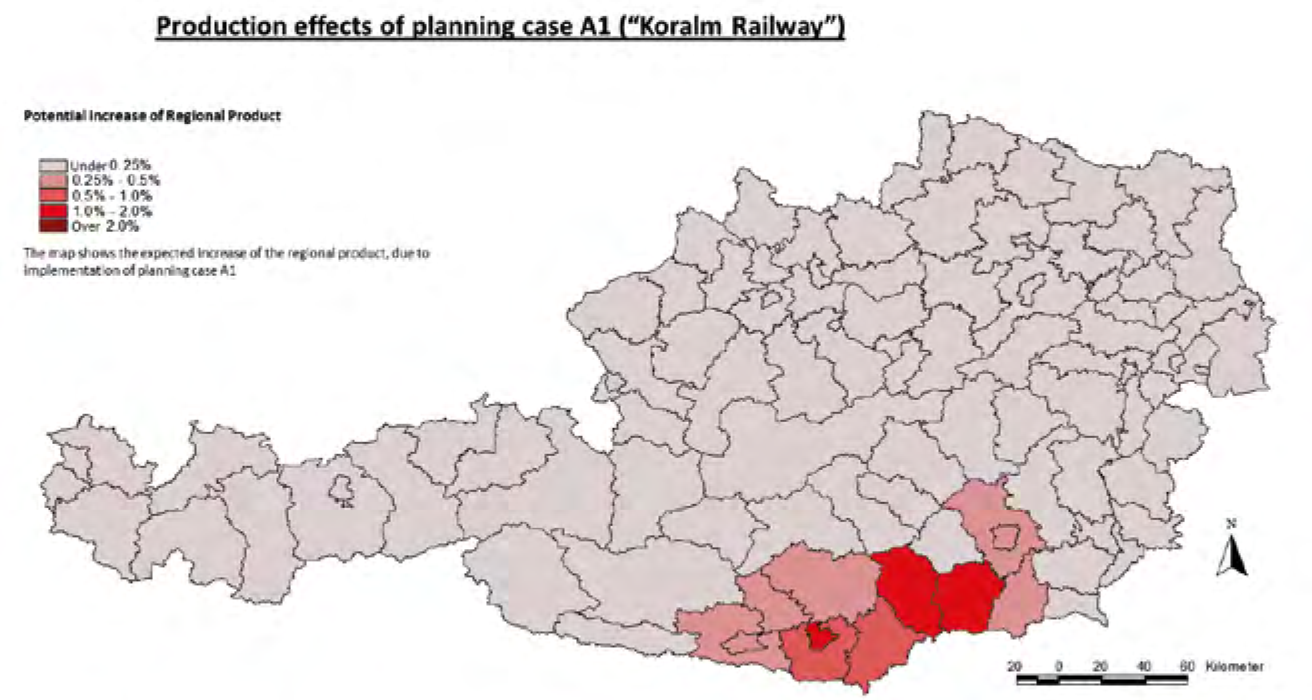



**Figure 2.2b - Potential added value in southern Austria induced by to Koralm high-speed railway Graz — Klagenfurt**



Despite these clear benefits, there are sometimes concerns that regions may lose their own economic power, as they may be more exposed to competitors and emigration. In general, this is not the case where larger areas are added to transport networks, but if peripheral regions also suffer from other economic deficits, it may happen that they even lose economic strength, while central regions gain. Against this background, it is recommended to consider these questions very carefully within the assessing and decision-making process.

When considering the benefits of high-speed rail, it is important to consider the unequal spatial structure that characterise individual countries, as shown in figures 2.3a and b. Some of them are oriented to a centre like France (Paris) or Hungary (Budapest), as in figure 2.3a. Emanating from these hubs, the main lines form the spokes, while tangential lines have minor importance. Consequently, there is no relevant interdependence between the radial lines, so it makes sense to take the highest possible speed on each individual radius.

Other countries with a more polycentric structure (as in figure 2.3b), such as Austria, Germany, Poland, Romania, etc. have a high grade of network integration, where passengers are more likely to have to change trains on their journey. In such cases, the solution cannot be to achieve maximum speeds, but rather ensure speeds that are adapted to network requirements, allowing for attractive transfer connections in selected nodes. This means that operating speeds need only be high enough to enable an integrated timetable and sufficient transfer times.

**Figure 2.3a and b - High-speed rail networks in France (centre-oriented, a, left) and Germany (networked, b, right)**


These differences reflect even in the location of railway stations: In France, where network integration is not so important, stations are mostly located on the outskirts of cities, which allows better integrating them into the high-speed lines. Contrary to this, in countries like Austria or Germany, where polycentric structures require distinct network integration, high-speed lines are linked directly into existing railway stations, accepting lower speed limits in the last mile sections.

High-speed services make railways more attractive to passengers and their introduction often induces significant shifts from road and even air to rail. This effect is the stronger, the more travel times are shortened. There are a number of examples where this has been the case in journeys between London and Paris and Brussels, between Paris and Brussels, between Milan and Rome, and between Madrid and Seville to name just a few.

If a new high-speed line parallel to existing conventional line creates additional capacity, additional freight trains and short-distance passengers or commuters also could be attracted to the railway. This would lead to an additional shift from road to rail.

Beyond speed, there are also other incentives for using rail, mainly punctuality and reliability, high service quality and comfort and, last but not least, low ticket prices when compared to air travel or the total cost of road travel.

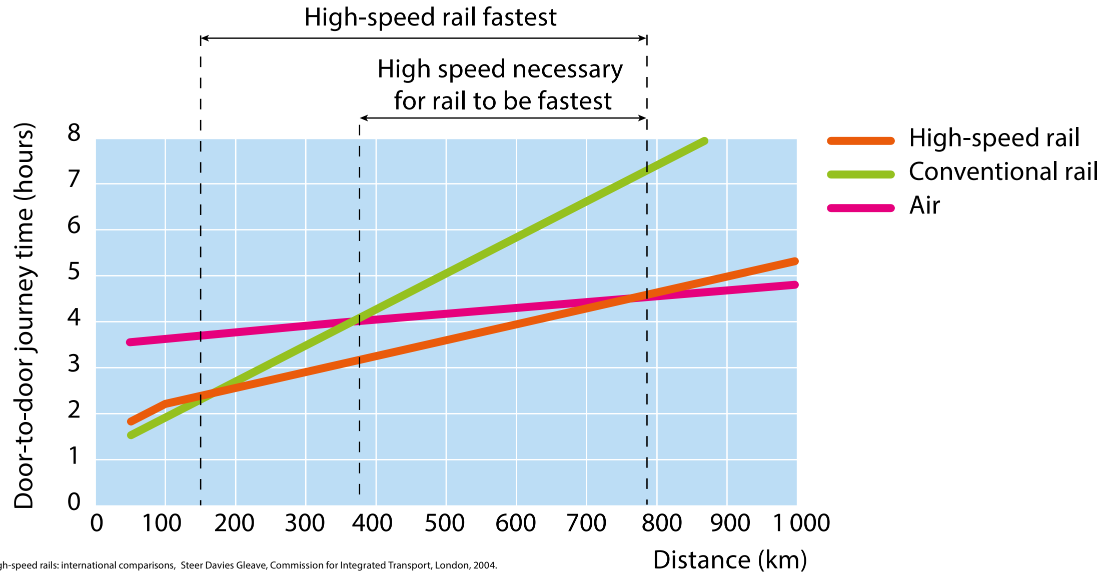
To be fully effective, high-speed rail must be integrated into the mobility system. This means, stations must be easily accessible within the cities, the lines themselves be well interconnected with other railway lines (conventional or high-speed), with road and air (where needed) and with regional and urban transport systems.

Any modal shift to rail, both in relation to freight and passengers, leads to relevant socio-economic benefit for example through fewer greenhouse gas emissions, with beneficial effects on the environment and climate.

From the point of view of operators, the main issue is how to extract the most commercial benefits from high-speed services. As set out in detail later in chapter 3.4., operation and maintenance costs are significant, and a sound business case needs to be developed before investments are undertaken. Faster trains allow more frequent services, which enhances the efficiency of rolling stock and staff. In turn, these faster and more frequent services attract additional passengers who also have a higher willingness to pay. This means that ticket prices may be increased, although within the limitations allowed by the wider transport market where railway fares often cannot compete with low fuel prices for cars and cheap tickets of low cost airlines. In many, mainly Central European countries motorway tolls are based on a vignette system. This system further subsidises road transport to the detriment of rail as the full cost of road transport is not being borne by the road user. As those routes that have the highest demand are those where high-speed is (or can be) implemented, the margins of operators may be further squeezed by new entrant operators who enter the market and reduce ticket fares further as has happened in Italy where following the entry of the new, private, high-speed rail operator average ticket fares have fallen by as much as 30%. If, moreover also conventional rail operators, or bus lines compete on these routes with lower fares, those that have a lower value of time would choose those modes over high-speed rail. It can be seen that the commercial benefits for operators are realised where a significant increase in passenger numbers outweigh the potential fall in fares as a result of inter- and intra-modal competition.

The competitive advantage of high-speed rail falls in the range between cars (80-140 km/h) and airplanes (800-900 km/h, compensated by long dwell times before take-off and after landing). High-speed trains are the "golden mean" — twice as fast as cars, half as fast as airplanes, and in many cases accessible not far from city centres. Figure 2.4 shows a comparison between conventional rail, high-speed rail and air.

**Figure 2.4 - Comparison between conventional rail, high-speed rail and air transport**




Source: High-speed rails: international comparisons, Steer Davies Gleave, Commission for Integrated Transport, London, 2004.

A useful summary of the benefits of high-speed rail is provided by the US High Speed Rail Association on their website. The following list provides this summary but in relation to those arguments that are relevant for Europe (and the TER area):

*"Faster, more efficient mobility, enormous energy savings, reduced environmental damage — a train system solves many problems:*

- *Offers a convenient, comfortable way to travel without hassles or delays*
- *Congestion Relief — delivers new mobility while relieving congestion on highways and runways*
- *Drastically reduces oil addiction and lowers our risk from the coming peak oil crisis*
- *Freedom from oil — Powered by clean electricity from renewable energy sources: wind, solar, geothermal, ocean/tidal*
- *Safe, affordable, green transportation for everyone*
- *Saves lives, due to fewer road accidents*
- *Provides efficient mobility that moves people and goods without delay and waste*
- *Creates millions of green jobs Europe-wide building the new rail infrastructure and manufacturing the rail cars".*

## 2.2. Social, environmental and safety aspects

Modern societies in great part of Europe, North America and Eastern Asia, are characterized by a high and still growing degree of division of labour, including international and global. This growth goes hand in hand with a growing economy, which is the main driver for growing volumes of cargo transport and increasing mobility. This mobility is both business and private reasons, including leisure and tourism, and affects all modes of passenger transport, mostly road and air, but also rail where it has a competitive advantage over road and air.

For the users, the intrinsic advantages of cars relating to flexibility, comfort and low costs (at least if full costs are not considered) in many cases prevail, while their disadvantages are often ignored.

At a socio-economic level, car use is questionable as it has:

- An excessive need for space (in particular in urban areas where space is scarce)
- A negative environmental emissions (including greenhouse and polluting gases as well as particle emissions); and
- Lower safety performance.

The advantage of air transport is mainly the fact that long distances can be accomplished in short time, even independently of transport infrastructure between the origin and destination, as infrastructure constraints are limited to airports and air traffic control systems. However, except in some especially important routes, the connections are limited, and in general door-to-door time is penalised by time and monetary costs associated with access to the airport, check-in (including security) and time after arrival. Including these time losses, even short flights take three hours. Moreover, polluting and greenhouse gas emissions from aircraft are more harmful on the environment because they are emitted in the upper layers of the atmosphere. Noise pollution is also a clear issue for commercial aviation, but is limited mainly during take-off and landing and around airports.

Given the fact that the costs of emissions are not paid by the polluter, railways are at a disadvantage when compared to its main competitors in the transport environment: road and air. With reference to both freight and passengers, as long as internalisation of external costs of road is not possible, externalisation of internal costs will be necessary. The status quo leads to double socio-economic inefficiency: While, for example, the environmental costs of road transport have to be borne by the public (or by future generations), railway infrastructure must be subsidised as allocating the full cost of rail infrastructure to users would oust railways from the transport market in most countries. This fact is a strong obstacle for more investments in railway infrastructure, including for high-speed.

Provided that the railway operates a certain route and that there are no other obstacles against the use of rail, in passengers transport, conventional rail has advantages in everyday commuting and over distances of between 100 and 600 km. For distances below 200 km the times to and from stations may be dominant. As illustrated in figure 2.4, the threshold between rail and air strongly depends on the speed of the railway service. It is in the order of 500 km for conventional rail, but may reach 1,000 km or even more if high-speed is available. For example, in the Russian Federation, where high-speed rail services of 400 km/h may shift this threshold to 1,500 km. In general, rail is preferred to air if travel times are below 3-5 hours, depending on ticket costs and other external conditions.

As railway traffic is safer than road traffic by a factor of about 10, attracting more passengers to rail would effectively contribute strongly to reducing the number of accidents and fatalities. Furthermore, this would also have a positive effect on the amount of emissions released into the atmosphere as set out in figure 2.5 below.

High-speed railways also have a significant role in strengthening domestic and cross-border cohesion of countries. With shorter travel times, distances between key centres essentially shrink. As explained in chapter 2.1. above, improving accessibility has a significant impact on economic performance of regions, making them more competitive and attractive for economic activities and boosting growth and jobs.

Noise, however, has become a great challenge for railways. Until recently, the main tool at the disposal of infrastructure owners in trying to mitigate noise emissions was by building walls or even tunnels, more recently reducing noise emissions has grown in importance. Freight wagons are equipped with better brakes, which also contribute to maintaining smoother surfaces of wheels and rails. Passenger trains, in particular high-speed trains, have a more aerodynamic profile which also helps in reducing noise emissions.

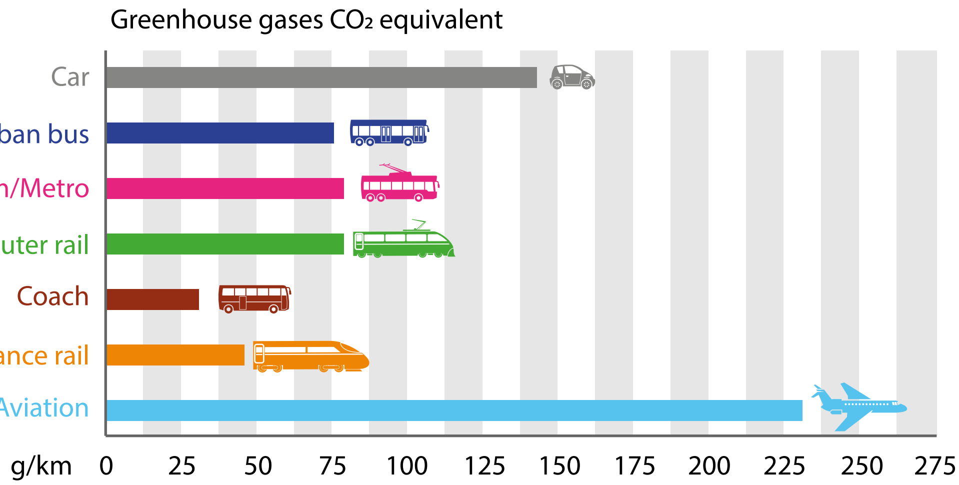
The high levels of safety seen on the railways is guaranteed by strict requirements in law, in particular in the EU's "Technical Specifications for Interoperability" (TSIs), discussed further below. Contrary to conventional rail, for high-speed lines, level crossings are not allowed, this further reduces the number of potential interferences on the network and increased safety. Within the European Union, the gradual replacement of the heterogeneous signalling systems with ERTMS will further improve traffic safety on rail.

## 2.3. Political background and goals of high-speed rail

Transport networks act as arteries and are therefore significant for territorial, economic and social cohesion. Building and improving infrastructure, and ensuring it meets the needs of the country is a key issue that needs to be addressed at regional, national and European level. Furthermore, the shorter the travel times are between a city and the rest of the country, the more attractive it is for economic activity. Therefore, high-speed rail can have a significant economic impact on a city (or region).

With view to the currently prevailing modal split, road seems to be the most effective mode of transport referred to accessibility. However, as road is almost omnipresent, it is accessibility on water and/or on rail which makes a decisive difference. This coincides with the fact that waterborne navigation is the most sustainable mode of transport, both inland and maritime, followed by rail, as can be seen in figure 2.5, according to a publication by the German Federal environmental Agency UBA [14], which indicates $CO_2$ equivalent greenhouse gas emissions (g km) per passenger. However, waterborne navigation is limited to the presence of navigable water infrastructure (i.e. sea and rivers) and to the speed of vessels, making navigation more appropriate for cargo, rather than passenger travel, with exception of tourist excursions and some local commuting.

**Figure 2.5 - Comparison of greenhouse gas emissions of transport modes**




Today's European transport policy aims to put railways as the backbone of inland transport networks, with road acting as an intra-regional feeding mode, although this is not possible across the entire ECE region. For an effective shift from other modes to rail, transport policy needs to seek an internalisation of external costs [15] as an effective measure as was proposed in the White Paper on Transport 2011 [4]. However, due to political resistances, it has not been accomplished so far.

Further to internalising external costs, in the field of passengers, short travel times and high travel comfort are key criteria for the acceptance of rail, of course at affordable and competitive prices. Reducing travel times by increasing speed has shown to be the most effective measure. High-speed rail has therefore come into the focus of transport policy in many countries, where large cities at appropriate distances from one another would benefit the economy. However, the high cost of building and maintaining high-speed infrastructure and acts as a check on the potential use of this type of railway. Generally, construction costs grow with the design speed of a line as well as with the type of terrain that the line needs to cross, in particular in mountainous or built-up areas, where more exigent track parameters require more bridges and tunnels. Noise mitigating measures, such as walls or even tunnels, contribute to increasing construction costs. Examples of high-speed railway construction costs are given in chapter 3.4.

In most cases, revenues from operation would not be sufficient to cover construction costs. In such cases, investments in high-speed rail may be justified by their wider socio-economic or macro-economic benefits. These include environmental, accessibility and economic benefits brought by the new infrastructure that go beyond the journey time savings of individuals. Therefore, an assessment of the suitability of building transport infrastructure would need to extract these benefits as well as the total costs associated with the new network through a cost-benefit analysis which will also need to assess the financial viability and affordability of the project.

As an example, it may be justified to prioritise railway sections for high-speed where corridors overlay or intersect, making the most of interconnection possibilities and potential capacity advantages. The superposition of traffic flows may cause bottlenecks in these sections, so that only adding a new line could result in sufficient capacity. This new line may be designed for high-speed and reduce utilisation of the existing line, which frees up significant capacity for freight and other passenger services.

All these aspects are described more in detail in later chapters of this study.

## 2.4. Rolling Stock

Appropriate rolling stock is needed to operate services on high-speed lines. To cope with the particular requirements resulting from high-speed, which is mainly due to great dynamic forces between vehicles and track and from aerodynamics, there are special design parameters that have to be obeyed:

- To keep forces between wheels and track within tolerable limits, to minimise maintenance costs, due to displacement of track and the abrasive wear of rails, axle loads should be between 16 and 20 tons. Bogies have to be designed to guarantee smooth running
- Pantographs must be designed to enable running at high speed, while maintaining sufficient pressure against the catenary for continuous power transmission (given the large amount of energy needed to accelerate and to keep high speeds, almost all high-speed trains are powered by electric traction).
- As air resistance grows with the square of speed, car bodies have to have an aerodynamic profile that cuts through the air in the most efficient way possible. Furthermore, windows and transitions between the coupled car bodies have to be airtight, to allow for shock pressure when crossing a train on the adjacent track or when entering or leaving tunnels
- For safety reasons, high-speed trains must be equipped with permanent in-cabin signalling

Within this framework, several kinds of solutions have been developed, which can be distinguished according to the traction type and according to the type or arrangement of bogies.[1]

### 2.4.1. Traction type

- Trains with locomotive-like powered cars at one or both ends of the train, for example the TGV, Thalys, Eurostar (produced by Alstom), ICE 1, RailJet (produced by Siemens), etc.
- Distributed power trains (with traction motors distributed along the entire train): ICE 3 (produced by Siemens), AGV (produced by Alstom), Frecciarossa 1000 (produced by Hitachi Rail/Bombardier), etc.

### 2.4.2. Bogie arrangement

- Trains with two bogies per each car, similar to a usual coupled train: all ICE trains (produced by Siemens), Frecciarossa 1000, etc.
- Trains with "Jacobs"-bogies that straddle two carriages: TGV, Thalys, Eurostar (produced by Alstom), etc.

[1] Throughout this report only conventional technology has been reviewed where there is a wheel and rail interface. Technology such as MAGLEV has been excluded from the analysis.

As an example, the table below sets out the main technical characteristics of the ICE fleet.

**Table 2.1 - Comparison of ICE train types**

| Train name | Characteristics |
|---|---|
| **ICE 1** | Two power cars and up to 14 intermediate cars; restaurant car with high roof; nose with DB logo that interrupts red stripe (unique to the ICE 1); maximum speed is 280 km/h. |
| **ICE 2** | One power car and one driving van trailer accessible to passengers; Bord-Restaurant/Bistro car has same height as other cars; contrary to ICE 1: nose is vertically divisible, parts of the coupler protruding to the outside; maximum speed is 280 km/h. |
| **ICE 3** | Distributed power: end cars with rounded windshield and passenger lounge, unpowered transformer car with pantograph; maximum speed of 320 km/h; red stripe is interrupted at the end cars by ICE logo, then runs downwards and across the nose lid; window band becomes narrow and ends near the windshield. |
| **ICE T/TD** | Similar to ICE 3, except: steeper front; pantograph; maximum speed of 230 km/h; no ICE logo on end coaches (ICE T)/ aerodynamic cover on end cars; maximum speed of 200 km/h; ICE logo on the left side of the end coaches (ICE TD); red stripe stays straight; red stripe ends near the lamps; windows narrows to a point instead of a flat end as on the ICE 3 |
| **ICE T2** | As ICE T series 1, except: painted sheet metal instead of glass between windows, front lamps with LEDs. |

As a further example, the table below indicates the main technical parameters of TGV trains.

**Table 2.2 - Comparison of TGV train types**

| Type | Max. speed (km/h) | No. of seats | Length (m) | Width (m) | Weight (tons) | Power (kW) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 25kV~ | 15 kV~ | 3kV= | 1500V= | 750 V= |
| **TGV Sud-Est** | 270 then 300 | 345 | 200.2 | 2.81 | 385 | 6,450 | | | 4,400 | |
| **TGV Atlantique** | 300 | 485 | 237.5 | 2.90 | 444 | 8,800 | | | 3,880 | |
| **TGV Réseau** | 300 then 320 | 377 | 200 | 2.90 | 383 | 8,800 | | | 3,680 | |
| **Eurostar** | 300 | 794 | 393.7 | 2.81 | 752 | 12,240 | | | 5,700 | 3,400 |
| **TGV Duplex** | 320 | 512 | 200 | 2.90 | 380 | 8,800 | | | 3,680 | |
| **Thalys PBKA** | 320 | 377 | 200 | 2.90 | 285 | 8,800 | 4,460 | 3,680 | 3,680 | |
| **TGV POS** | 320 | 377 | 200 | 2.90 | 383 | 9,280 | 6,280 | | | |
| **TGV 2N2** | 320 | 509 | 200.2 | 2.90 | 383 | 9,280 | 6,800 | | 3,680 | |

The advantage of trains with distributed power is that they have a better transmission of driving forces, so they can take on high gradients with ease, e.g. some LGV lines in France, high-speed line Cologne — Frankfurt in Germany. The driving force is n x μ x A, where n is the number of driven axles, μ is the friction coefficient and A is the axle load. The maximum for n is 4 or 8 where a train has power cars at each end of the train, whereas it would be 4 per traction car with distributed power. This can only be partly compensated by a higher axle forces of power heads or locomotives (where the "Taurus" locomotive with 22,5 tons is the absolute maximum, with, however, greater wear on the track).

Trains with Jacobs bogies have smoother running properties at high speeds, however they need shorter car-bodies, with respect to the clearance (gabarit) in curves. Furthermore, a crane is needed for the de-coupling of the various carriages which can only be done in an appropriately tooled depot.

In addition to these basic types there are also two special cases — the Spanish "Talgo" and the Italian "Pendolino" which introduce a further characteristic to high-speed trains. These trains are equipped with a tilting mechanism, which reduces centrifugal forces inside the cars. They allow for a more comfortable journey as well as allowing higher speeds on conventional lines, which can provide an alternative to investing in high-speed lines. Of course, this would cause additional maintenance costs for the track and the greater speed difference would reduce line capacity, if is used together with slower trains.

**Figure 2.6 - ICE-T train leaving a curve**

"Talgo" trains tilt passively, driven by the centrifugal force, by moving the lower parts of the wagons towards outside of curves, which needs a less complicated mechanism, however exerts higher forces on the outer rail of a curve, because the centre of gravity of a car body moves towards the outside of a curve, following the direction of the centrifugal force.

"Pendolino" trains (and some ICE-T trains) have active, electronically controlled hydraulic tilting mechanisms, which tilt the upper parts of the cars towards the inside. This method, as illustrated in figure 2.6, which shows the different tilting of cars with changing curvature, is more appropriate with respect to distributing dynamic forces and minimising the additional wear that this technology causes to the track. On the other hand, this system can have reliability limitations and, due to uneven tilting movements, passengers sometimes complain of nausea.

In general, the coaches of tilting trains have to be narrower to fit in the gabarit.

Given the fact that the conventional wheel-rail technology seems to have a technical limit between 500 and 600 km/h, high-speed railways may develop, at global level, in other directions, e.g. following the "MAGLEV" or the "Hyperloop" technologies, which would open a new range of speeds. However, such diversification does not seem likely in Europe, where morphological conditions, land availability and distances do not allow or not require speeds beyond 200-350 km/h and where the use of new technologies would interfere with the dense and highly developed existing railway network. Even in the Russian Federation, characterised by large distances, current planning is limited to 400 km/h.

Beyond the likely continuation of the previous development, aiming at improving existing high-speed technologies, there are other technological developments in rolling stock that could have significant effects both on operations and on costs in the medium term, in particular developments in batteries. Current battery technology can allow at most hybrid train operation where batteries reduce the overall energy consumption with a marginal knock on effect on cost reduction. The way this technology is developing however the near future could see a significant percentage of train services run through battery supplied power with recharging points only at station stops. This is unlikely to be feasible in the long-distance high-speed trunk network or where there are long distances between stations such as in the Russian Federation, but could allow high-speed trains leaving the electrified trunk network, to operate on non-electrified branch lines, though at conventional speed. Further benefits may result from removing both the visual impact of overhead lines across the countryside as well as well as the extensive infrastructure operating and maintenance costs associated with overhead lines. Using other alternative fuels is being developed for trains (e.g. natural gas or hydrogen) and these could also power high-speed rolling stock in future.

The developments with ERTMS and advanced signalling could, in future, also allow for autonomous trains on the networks of Europe. There are already a number of autonomous metro systems around the world (although these are closed systems) as well as some freight networks trialling autonomous trains, the step to conventional and high speed passenger trains is not far away.

For the future rolling stock, the following development may be expected:

**Table 2.3 - Targets and measures for future development of rolling stock**

| Target | Measures |
| --- | --- |
| Higher energy efficiency | • Optimised aerodynamic shape<br>• Alternative fuels<br>• Lighter materials |
| Safer and more reliable operation | • Improved signalling and communication (e.g. ERTMS in the whole HS network), autonomous trains<br>• Improved bogies |
| Less noise | • Optimised aerodynamic shape |
| Higher travel comfort | • Larger car bodies, higher seat clearance<br>• Improved on-board service (including information of passengers)<br>• Better services in railway stations (in particular for handicapped persons) |

With current developments in security and terrorism additional investments may also be necessary on rolling stock although the measures that need to be taken cannot be predicted in this report.

Overall, it is important to note that rolling stock life cycles are in the range of 30 years and more, so innovations would be difficult to introduce quickly (unless they could be introduced during a mid-life overhaul).

## 2.5. Country examples

As set out in previous chapters, high-speed services are already in operation in many countries. There is a variety of high-speed networks, tailored to the needs of the individual countries and their spatial structures. Although with different degrees of efficiency, significant shift from road and sometimes from air to rail can be observed. This is, in particular, the case where high passenger volumes allow combining high-speed with high frequency.

In some cases, high-speed lines serving also the airports of large cities feed into long-distance flights or even have fully replaced former flight connections, for example on the Frankfurt — Cologne — Düsseldorf route and the Paris — Brussels route.

**France** is an example for a country with a clearly monocentric structure. Paris with about 12.5 million inhabitants in the metropolitan area is the centre of this structure. Apart from the capital, there are a small number of cities with between 0.5 and 2 million inhabitants at distances of several hundred kilometres from Paris and from each other. The rest of the country is sparsely populated; most of the smaller cities are not larger than about 100,000 inhabitants.

Accordingly, the railway network is oriented towards Paris, which is the main hub of the whole country. Railway lines end at separate terminals in the capital, which means that passengers going from regions along one line to regions along another one, who are relatively few, have to change station in Paris. Therefore, the individual lines, including high-speed lines, and the corresponding timetables are mostly independent of each other, and there is no need to carry out extensive integration.

In order to achieve the shortest possible travelling times even between very distant cities, e.g. Paris and Marseille, commercial speeds are close to the maximum technical possible and special TGV railway stations have been built in the outskirts of intermediate cities to avoid having to slow down when entering agglomerations as well as interference from other traffic.

France has a long tradition as country of fast trains. The French high-speed network (LGV — “lignes à grande vitesse”) has a total length of about 2,500 km; in the long run, France intends to double this length.

In 1981, the first line, between Paris and Lyon, opened. Since then, high-speed operation between these two cities has led to a significant fall in car and even air traffic, including the cancellation of flight connections between the two cities. More recently, the line was extended to Marseille, LGV Sud-Est or Méditerranée now connects the three largest cities of France — Paris, Lyon and Marseille. It has turned out to be an important commercial success, being the most effective and efficient high-speed line of France. Already in 1987, after only six years operating, the market share between Paris and Lyon had reached a level of 60%. Based on this positive experience, with passengers’ demand still growing, SNCF is considering building a second, parallel line between these cities for even faster trains.

The rapid development that followed the entry into service of this line was so significant, that by mid nineteen-nineties, the LGV Atlantique was opened to Tours, now extended to Bordeaux (in 2017); the LGV Nord to Belgium and

Calais, connecting to the Channel Tunnel (Eurotunnel); the LGV Rhône-Alpes to Valence and the LGV Interconnexion Est bypassing Paris and connecting Charles de Gaulle airport and the amusement parks East of Paris.

More recently, the network has been extended to include the LGV Est Paris — Strasbourg, with links to Germany, as well as a first section of the LGV Rhin-Rhône. Further extensions are under construction or planned, in particular towards Spain, where the disconnect resulting from different gauges has already been removed between Perpignan (France) and Figueras (Spain).

Similar to LGV Sud-Est, the "PBKAL" line (Paris — Brussels — Cologne — Amsterdam — London) served by TGV and Thalys trains (to Brussels and beyond) and Eurostar trains (to London) is very effective and efficient. In the relation Paris — London, the share of railway passengers has reached 70%, already. LGV Atlantique, LGV Est and LGV Rhin-Rhone have less traffic demand, however are important for the internal cohesion of France.

The LGV networks are not uniform in terms of power supply and signalling. The Paris — Lyon line is powered by 1.5 kV DC, while 25 kV AC is used on the newer lines. Two versions of the in-cabin signalling system "Transmission Voie-Machine" (TVM) are used on these networks, currently they are not interoperable with the European ETCS system.

**Figure 2.7 - TGV Duplex train**

This growing network [16] is operated with the TGV ("Train à Grande Vitesse"), all built by Alstom, but to different specifications as set out in table 2.2 above. Contrary to the German high-speed trains, they all consist of powered end-cars, with up to 10 passenger carriages in between and are characterised by the use of the "Jakobs bogie" as described in chapter 2.4 above. Due to increasing demand, the national operator has, in recent years, procured also double-deck TGV trains to run on these higher use lines such as the Paris — Lyon line (figure 2.7).

Currently, depending on the LGV line, TGV trains operate at maximum speeds from 270 to 320 km/hour and have often replaced both car traffic and flights within France. TGV trains are operated also on the conventional network, in continuation of LGV lines, e.g. to Brest, Chambéry, the Côte d'Azur, etc. and into neighbouring countries such as Belgium, Germany, Switzerland and Italy. Chapter 2.4. gives more details as regards rolling stock.

Contrary to this, **Germany** has a purely polycentric structure. Although the capital Berlin with about 4 million inhabitants is the largest city, there are several other cities in the order of 1-2 million inhabitants, such as Hamburg, Munich, Düsseldorf, Cologne, Frankfurt, Leipzig, as well as a great number of cities between 200,000 and 1 million inhabitants. Further, there is the Ruhr agglomeration with about 10 million people living in a very dense cluster of medium sized cities. Overall, most of these cities are about 100 km apart, forming the nodes of a very dense transport network.

This structure means that, often, railway passengers have to change in one or more of these nodes to reach their final destination. For this system to work, high-speed trains have to be interlinked with each other and with conventional trains in existing railway stations close to city centres (different from the French system set out above. Consequently, achieving maximum speed is not only the primary goal on many routes, with speed being just one of the important factors needed to achieve optimal interconnections.

In Germany, the age of high-speed started ten years later than in France, in 1991. Due to the country's structure, as mentioned above, and the need for a dense interlinkage of lines, planning followed a more integrated approach. The first section of high-speed line to be completed was the Hannover — Würzburg section. With this, the distance between the northern and the southern parts of the former German Federal Republic (the so called "old Bundesländer") was shortened dramatically. This resulted in significant travel time savings between Hamburg, Bremen and Hannover in the north and Nuremberg, Munich and Stuttgart in the south. Total construction costs for this 327 km line were approximately €6.2 billion.

At the same time, the 99 km line between Mannheim and Stuttgart (built at a cost of about €2.3 billion) became operational, with comparable network effects between the west and the south of Germany. Both of these lines have been designed not only for high-speed passenger traffic, but also with gradients that would allow freight traffic to use the infrastructure. This dual potential has not been used as expected, during the day as a result of capacity problems linked to mixed traffic speeds and during the night because of maintenance needs.

In 2001, the 177 km Cologne — Frankfurt line (built at a cost of about €6.0 billion) was opened. This line was designed for a maximum commercial speed of 300 km/h, using a slab track superstructure. With gradients up to 40‰ it is not suitable for freight trains. It serves, and interconnects with, Frankfurt/Main and Köln/Bonn airports, replacing flights between them and extending their catchment areas. This line has a key role as a connector between the Ruhr area and Benelux countries, Southern Germany, Switzerland and the Mediterranean.

In 2005, the partly new, partly upgraded, high-speed line Nuremberg — Munich became operational, also designed for up to 300 km/h in the newly-built section. This line serves both the connections Munich — North-eastern Germany and Munich — Frankfurt.

One of the most important high-speed links in recent history, not least with view to strengthening the cohesion in the re-united country, is the new line Berlin — Leipzig/Halle — Erfurt — Nuremberg. Opened in late 2015, the section Berlin — Leipzig/Halle is an upgraded conventional line (mainly in a flat terrain with large curve radii already from the past) the section from Leipzig/Halle to Erfurt is completely new build (built at a cost of about €3.0 billion). The Unstrut valley bridge along this line is shown in figure 2.8.

The 190 km section between Erfurt and Nuremberg (expected to cost about €5.3 billion — new build line between Erfurt and Ebensfeld, upgraded line between Ebensfeld and Nuremberg) will open in late 2017. These lines have been designed with maximum gradients of 12.5‰, allowing the mixed operation pf passengers and freight if required. This high-speed line continues southbound on the Nuremberg — Munich high-speed line as well as towards Stuttgart on an existing conventional line.

An important project currently under construction is the Stuttgart 21 railway station (expected to cost about €6.5 billion), as well as the Stuttgart — Ulm high-speed line (with a new line on the Wendlingen — Ulm section), which will interconnect with Stuttgart airport. The opening of this line is planned for 2021. This line will have gradients of 25‰, but with short subsections of 31 and 35‰.

All electrified lines on the German rail network are powered with 15 kV AC, 162/3 Hz current, this includes all high-speed lines. Whereas the older high-speed lines are equipped with the continuous automatic train running system ("lineare Zugbeeinflussung" LZB), recently built lines have the interoperable European ETCS level 2 signalling system.

**Figure 2.8 - Slab tracks on Unstrut valley bridge**

**Spain** has developed an extensive high-speed network, the longest in Europe, deviating from the previous railways on the Iberian Peninsula, by using UIC standard gauge rather than the normal Iberian gauge. This high-speed network is interlinked with the Iberian conventional gauge network by special gauge changing devices in many places, thus enabling dual gauge high-speed trains to reach destinations located on broad gauge branch lines. With the intention of a long-term migration strategy from broad to standard gauge, some of the existing and new lines are provided with special sleepers which permit a gauge change at a later time.

The line between Madrid and Seville was opened in 1992 in the context of Expo. Ten years later, the Madrid — Zaragoza — Barcelona line became operational. Many other sections followed, some of which have low passenger demand. These lines have been constructed to improve accessibility of remote regions of the country. However, some of these investments have proven uneconomic, because improved accessibility is effective only when considered with other essential factors of location quality, such as industrial endowment.

Another particularity of the Spanish system, detrimental to profitability of the Spanish system, is the large variety of train types in operation.

**Italy** is the country which first initiated the concept of high-speed, with precursors already in the late nineteenth century (for example the "Succursale dei Giovi" between Milan and Genova) and in the 1930s. The first high-speed line to be completed was the "Direttissima" between Florence and Rome in 1978. Meanwhile, the implementation of a "T-shaped" high-speed network for speeds of up to 300 km/h, consisting of the lines Milan — Bologna — Florence — Rome — Naples (Florence — Rome designed for and operated at 250 km/h, Bologna — Florence for 300 km/h, but operated at 250-275 km/h) is complete and the Torino — Milan — Verona — Venice line is well advanced.

The north-south line Milan — Roma — Naples is in operation mainly with 25 kV, 50 Hz, however between Florence and Rome traction still remains at 3 kV DC: The east-west connection Torino — Milano is operative as well, while implementation towards Venice is proceeding from the extremities to the centre.

As regards the border between Italy and France, the planned new line between Lyon and Turin, part of the "Mediterranean Corridor" and agreed by a state treaty between Italy and France, with a 57 km long base tunnel from Susa Valley in Italy to Maurienne in France, will interlink the high-speed networks of Italy and France at an estimated cost of €25 billion. With a maximum speed of 220 km/h the project will be below the threshold of 250 km/h, however with gradients which will allow freight trains (and especially rolling motorways) running at 100 km/h to circulate.

The high-speed network is to be extended further with new lines or lines to be upgraded to high-speed including the southern access to the Brenner base tunnel as well as the Naples — Bari link, with the option of a continuation towards Calabria and Sicily. The project of constructing a new high-speed line also between Venice and Trieste was abandoned and replaced with a project to upgrade the existing infrastructure to 200 km/h. Table 2.2 shows the main parameters and opening dates of the existing Italian high-speed network.

**Table 2.4 - Main parameters of high-speed lines in Italy**

| Line | Length km | Opening | Travel time hh:mm | Top speed km/h | Voltage |
|---|---|---|---|---|---|
| **Florence — Rome "Direttissima"** | 254 | 24 February 1978/ 26 May 1992 | 01:18 | 250 | 3 kV DC |
| **Rome — Naples** | 205 | 19 December 2005/ 13 December 2009 | 01:08 | 300 | 25 kV 50 Hz |
| **Turin — Milan** | 125 | 10 February 2006 (Turin-Novara) 13 December 2009 (Novara-Milan) | 00:44 | 300 | 25 kV 50 Hz |
| **Padua — Venice (Mestre) [6]** | 25 | 1 March 2007 | 00:14 | 250 | 3 kV DC |
| **Milan — Brescia [6]** | 67[1] | 11 December 2016 | 00:36 | 300 | 25 kV 50 Hz |
| **Naples — Salerno** | 29 | June 2008 | 00:30 | 250 | 3 kV DC |
| **Milan — Bologna** | 215 | 13 December 2008 [7] | 00:53 | 300 | 25 kV 50 Hz |
| **Bologna — Florence** | 79 | 5 December 2009 | 00:35 | 300 | 25 kV 50 Hz |
| **Total** | 926 | | | | |

A further example of how to integrate high-speed rail into an already busy network can be seen in the **Swiss** example. The overall concept is a fully integrated timetable, which includes even regional bus lines. Investments take place just as needed to fulfil the conditions of that integrated timetable. This means that in the nodes trains arrive more or less simultaneously, which allows for simple connections. To facilitate this integration, a new section was built, between Mattstetten and Rothrist on the Bern — Olten (— Basel/Zürich) line, with a short branch to Solothurn. This section is not a high-speed line per se, but is a good example of: "… not as fast as possible, but as fast as needed". The new sections of the Gotthard and Lötschberg lines allow for high-speed as the great radii needed do not cause excessive additional costs, in particular not in tunnels. In general, higher costs are more likely to be due to the more expensive equipment on the lines, such as heavier track, catenary and in-cabin, ETCS, signalling.

A similar approach is also followed in **Austria**. As shown in figure 2.9 below, new and upgraded sections of the western railway Vienna — Linz — Salzburg and in the lower Inn valley, between Wörgl and Innsbruck, are designed for 250 km/h and operated at up to 230 km/h. Traffic demand has more or less doubled between Vienna and Linz, with knock-on positive effects beyond this line since it has been operating at high-speed. This positive effect has also been supplemented by the use of "RailJet" high-speed trains.

The 64 km Brenner base tunnel (including the Innsbruck bypass), a €10 billion, which was agreed between Austria and Italy by a state treaty, will link the German and Italian high-speed networks. In its northern access, capacity needs were the main reason for constructing a new line between Wörgl and Innsbruck. This tunnel line was designed for high-speed; with only marginal additional costs, covering the high-speed equipment of the line.

The new sections of the southern railway Vienna — Graz — Villach — Tarvisio: the Semmering base tunnel and Koralm railway, which are key sections of this Core Network Corridor, replace existing mountain sections by flat alignments, in particular needed for freight transport.

In line with the explanation set out in chapter 2.1., the main reasons for closing the gap between Graz and Klagenfurt with this €6 billion high-speed rail project are:

- A basic improvement of space structure and accessibility in the Southern parts of Austria, which are handicapped by poor accessibility, in particular on rail
- Bypassing Neumarkter Sattel mountain line via Graz (to achieve a flat railway connection for heavy freight in the Baltic-Adriatic Corridor ("from Poland to Po-Land")
- Improvements for regional public transport.

As such, the project is a good example of high-speed investments based on functional and socio-economic criteria. The Brenner and Semmering base tunnels are scheduled to open in 2026, while the Koralm railway is expected to open in 2023. The layout of the Austrian network is set out in the figure below.

**Figure 2.9 - Austrian trunk network (TERSTAT map)**


In addition to these projects, a high-speed line is also planned from Vienna, via Vienna Airport, to the Austrian-Hungarian border, with the possibility of continuing to Budapest and linking with Bratislava. A flyover is already in operation, across Kledering marshalling yard, to connect Vienna Airport to Vienna main railway station.

Beyond this selection of examples from Western European countries, there are further best practice examples also in TER countries, in particular in the Russian Federation and in Turkey. These examples are considered in the next chapter 2.6. "High-speed rail status in TER countries".

## 2.6. High-speed rail status in TER countries

In many TER countries, high-speed rail, where it has been initiated, is at a rather early stage of development with a few exceptions. Apart from Austria, explained above, the Russian Federation and Turkey both have well-developed high-speed networks and, beyond this, ambitious plans for the future.

However, there are also TER countries that currently have no realistic plans for high-speed services, such as Bosnia and Herzegovina, Bulgaria and the Caucasian countries. Only Romania has a long term vision to build a high-speed line from Curtici (HU border) — Arad — Timisoara — Sibiu — Bucharest. Countries that currently have no plans for high-speed lines are not explicitly mentioned below.

On the other hand, there are some significant projects in the area between Western Europe, the Russian Federation and Turkey. Most of them are located within the TEN-T Core Network Corridors, which means that projects can be co-financed from the cohesion portion of Connecting Europe Facility, with EU co-financing up to 50% for planning phases of a project and up to 85% for the construction.

**Figure 2.10 - Rail Baltica**


One project, which is of the highest importance for the cohesion of north-eastern Europe, is **"Rail Baltica"**, as illustrated in figure 2.11. This north-south UIC standard gauge high-speed link will connect the Baltic countries of Estonia, Latvia and Lithuania with Poland and other parts of central Europe. The section Białystok — Kaunas is already in operation. The rest of the Baltic railway network, traditionally east-west oriented will remain in Russian broad gauge. These links mainly serve as freight links from Russian Federation to its former Baltic Sea ports and to Kalinin¬grad. The challenge is how to integrate Rail Baltica in the existing railway stations in Tallinn, Riga, Kaunas and other cities, later also in Vilnius, because of the coexistence of two gauges. Furthermore, there are plans to extend, in the long run, Rail Baltica to Helsinki through a submerged tunnel connection under the Finnish Bay.

In **Poland**, works to upgrade the "Centralna Magistrala Kolejowa" (CMK) Grodzisk Mazowiecki — Zawierce to 200 km/h commercial speed are in their final phase and, in some sections, already completed. Originally built mainly as a freight line, but nevertheless following an alignment laid out for 250 km/h., this line was opened in 1977. Since then, as a part of the Baltic-Adriatic Corridor it has become the main link between Warsaw and the industrial agglomeration around Katowice, as well as with Krakow, also for passengers. A similar approach is also being followed in sections of the Warsaw — Gdansk link. Figure 2.11 shows the Polish high-speed plans.

**Figure. 2.11 - Polish TER network and high-speed projects**
**Short term: CMK and Warsaw — Gdansk: bold dotted red lines**
**Long term: "double Y" dotted red lines**


The Polish government has postponed construction of the planned "double Y" Warsaw — Łódź — Kalisz — Poznan/ Wrocław line. This high-speed project will not only become a key section of the North Sea-Baltic Corridor, but also enable a shorter rail connection between Warsaw and Wrocław, thus adapting the configuration of the national rail network to the geographical structure of today's Poland. In the long run, high-speed extensions are considered westbound from Poznan to Berlin and southwest-bound from Wrocław to Prague. Polish infrastructure plans do not currently forsee a continuation of the Rail Baltica high-speed line on Polish territory.

The existing **Czech** railway network with its 9,566 kilometres is among the densest in Europe. In addition to this conventional network, the Czech Republic has prepared ambitious high-speed projects as shown in figure 2.12. The upgrading of the Brno — Břeclav section to 200 km/h is ongoing and a new line from Prague towards Ústí nad Labem is planned. In a second phase, this line — part of the Orient-EastMed Corridor — may be extended through an "Erzgebirge base tunnel" to Dresden in Germany. In the same corridor, there are plans to construct a new high-speed line Prague — Brno, which will link the two biggest cities of the country in less than 1 hour.

The table below sets out the high-speed lines (operational speed 250 km/h unless lower specified below) planned in the Czech Republic:

**Table. 2.5 - Planned Czech high-speed infrastructure, completion years**

| Line | Year |
|---|---|
| Brno — Přerov (upgrade 200 km/h) | 2026 |
| Brno — Břeclav (Brno — Vranovice new line, Vranovice — Břeclav upgrade 200 km/h) | 2030 |
| Praha — Lovosice (new line) | 2030 |
| Lovosice — border CZ/DE (Ústí nad Lavem — Dresden — 200-230 km/h) | 2050 |
| Praha — Brno (new line) | 2050 |
| Přerov — Ostrava (new line) | 2050 |
| Praha — Beroun (new line) | 2050 |

**Figure 2.12 - Czech TER network and high-speed projects:**
**Short term: Prague — Lovosice, Brno — Břeclav, Brno — Přerov: bold dotted red lines**
**Long term: Prague — Brno, Lovosice — border CZ-DE, Přerov — Ostrava: dotted red lines**


Within the Orient-East Med Corridor in **Slovakia**, it is foreseen to upgrade significant parts of the sections Kuty — Devinska Nova Ves and Bratislava- Vajnory — Šturovo to 200 km/h. Furthermore, Bratislava may be included in, or linked to, the high-speed project Vienna — Budapest, which is part of the Rhine-Danube Corridor.

**Hungary** has the intention to implement, after 2030, high-speed links from Budapest to the Austrian-Hungarian border (Hegyeshalom) towards Bratislava and Vienna and to Szeged and the Hungarian-Romanian border towards Arad along the Orient-EastMed Corridor, with a link across the Hungarian-Serbian border towards Belgrade and from Budapest to the Hungarian-Croatian border (Gyekenyes) in the Mediterranean Corridor.

According to TEN-T Regulation, **Slovenia** is planning to build a high-speed line from Ljubljana to the Slovenian-Italian border (Sezana) on the Mediterranean and Adriatic-Baltic Corridor. However, given current investment priorities in Slovenia, it seems unlikely that this project will be implemented before 2030.

In **Croatia**, the construction of a new high-speed link Zagreb — Rijeka is likely to be delayed, due to insufficient financing and other priorities for the country with the provision of a lower gradient connection being a more urgent need, mainly on the ascent up from Rijeka to the Karst mountains.

The only Serbian high-speed project relates to the upgrading of the existing Belgrade — Novi Sad — Subotica connection of the Belgrade — Budapest line, to a commercial speed of 200 km/h.

In **Greece**, projects of note include the Athens-Thessaloniki and the Athens — Patras high-speed links, which are both operational on most of their lengths. Completion of the remaining sections may be delayed due to the current unfavourable economic situation in the country.

Located between Western Europe and the Far East, the **Russian Federation** is by far the largest TER country, with the longest railway network and 1,520 mm broad gauge. The distances between the major cities of the country are in the order of up to several hundred kilometres. This means that inland transport can only cover these large distances, in a comparatively (to other forms of land transport) short amount of time with high speed railways.

In 1984, the Moscow — St. Petersburg link was upgraded to 200 km/h. This line was extended to the Russian-Finnish border in 2010, with a 1,524 mm gauge high-speed extension to Helsinki (200 km/h). In addition, and since 2010, parts of the Moscow — Nizhny Novgorod link have also been operating at 200 km/h.

Plans to construct by 2018 a new 400 km/h line between Moscow and St. Petersburg were postponed in order to advance the Moscow — Rostov na Donu — Adler high-speed line with view to the 2014 winter Olympics in Sotchi. The Russian Federation is also implementing the high-speed connection Moscow — Nizhny Novgorod — Kazan, with the option for a later extension to Perm, Jekaterinburg, Chelyabinsk, Ufa and Samara.

**Turkey** is characterised by large cities a few hundred kilometres apart, whereas the existing railway network does quite often deviate from direct, short alignments. Some cities, though neighbouring, are not connected by rail. This situation, connected with a very high potential in passenger traffic and the location of the country between the "One belt — One road" and the TEN-T, is the reason that Turkey is planning to revise and complete its entire railway network. This ambitious approach means accepting, within a reasonable order, additional costs and designing new links, which in any case need to be built, according to high-speed parameters. Once completed, Turkey will have a railway network tailored to its needs. Figure 2.13 shows the Turkish network with the high-speed lines in blue.

**Figure 2.13 - Turkish railway network, indicating high-speed lines in blue**


The first completed investment was the high-speed link Ankara — Polatlı — Eskişehir — Istanbul, which opened for full operation in 2014. Connected to this line with a triangle in the Polatlı area, which allows direct traffic both to Ankara and Istanbul, is the link to Konya, which is intended to extend to Antalya. The high-speed connection Ankara — Izmir is scheduled to open in 2019.

Furthermore, the links Bandırma — Bursa — Yenişehir — Osmaneli and Ankara — Sivas — Erzincan are either in the planning or tendering stage, or partly under construction [17].

## 2.7. The EU railway infrastructure package and its impacts on TER region

The EU infrastructure package comprises the TEN-T Regulation (No. 1315/2013) [2] and the "Connecting Europe Facility" (CEF) Regulation (No. 1316/2013) [11].

The TEN-T Regulation indicates the current state and (in the Core Network) the targets for upgraded and new infrastructure for 2030 and shows possible developments (in the Comprehensive Network) for the time after.

Changes are possible only at the next TEN-T revision, which is due to start in 2023 and will be effective only in 2030, the year when the current Core Network projects need to have been implemented. The Regulation comprises maps showing the Comprehensive and Core Networks for railways, inland waterways, roads, sea and inland ports, road-rail-terminals and airports. Figure 2.14 shows an example of part of the network highlighting passenger railways (with a focus on high-speed railways) as an example.

**Figure 2.14 - Existing and planned TEN-T high-speed lines (pink) in TER member States**

The CEF Regulation determines the conditions for the implementation of the TEN-T, including both the Core Network Corridors and the funding and financing rules for the period 2014-2020. Both these Regulations are inter-linked, as CEF-funding is possible only for projects which lie on the TEN-T Core Network.

In those TER countries that are EU member States, all EU legislation is mandatory, including the TEN-T Regulation and the TSIs, meaning that modifications of the Core Network are not permitted. This applies for Austria, Czech Republic, Greece, Italy, Lithuania, Poland, Romania and Slovenia, the only countries that are both TER and EU member States and have high-speed projects in the TEN-T Core Network to be implemented by 2030.

EU member States may choose to add high-speed lines to the Comprehensive Network but their implementation horizons would be after 2030. This may apply to possible links to extend high-speed lines within the EU towards neighbouring non-EU, TER, member States. The table below sets out the existing and planned high-speed lines in the TEN-T Core Network (projects planned or under construction are shown in *italics*).

**Table 2.6 - Existing and planned high-speed lines in TEN-T Core Network, with relevance for TER**

| Country | High-speed line |
|---|---|
| **Austria** | • Vienna — Linz — Wels, Semmering base tunnel, Graz — Klagenfurt<br>• Rosenheim — Kustein — *Brenner* (incl. Austrian section of *Brenner base tunnel*) |
| **Czech Republic** | • *Praha — Usti nad Labem* |
| **Greece** | • *Thessaloniki — Texote*, Thessaloniki — Athens (≈ 80% completed)<br>• *Athens — Patras* |
| **Italy** | • (Lyon —) Torino — Milano — *Verona — Venezia*<br>• Milano — Bologna — Florence — Rome — Naples — *Bari*<br>• *Milano — Genova — Ventimiglia (— Nice)*<br>• *Brennero (incl. Italian section of Brenner base tunnel) — Verona — Bologna*<br>• *Cervignano* — Udine (— Villach) (180 km/h) |
| **Lithuania** | • *Rail Baltica* |
| **Poland** | • *Poznan/Wroclaw — Lodz — Grodzisk Mazowieski — Warszawa/Opozno (This project has been postponed to a later time of implemention)*<br>• Grodzisk Mazowieski — Katowice (160 km/h, upgrading to 200 km/h ongoing) |
| **Romania** | • *Bucureşti — Constanţa (currently 160 km/h)* |
| **Slovenia** | • *(Trieste —) Divaca — Ljubljana* |

Except parts of the sections in Austria, Greece and Italy, none of the listed sections, (those in "new" EU member States) have been implemented, nor are they in progress. For example, there is little probability for further upgrading of the Romanian link Bucureşti — Constanţa, beyond the speed level already reached.

The non-EU TER countries are not bound by EU law, but those that are candidate countries are obliged to bring their acquis into line with EU requirements. In principle, they are free to develop high-speed networks outside the constraints of the TEN-T. However, where there are connections to the EU, it is reasonable to assume that the TEN-T will be a significant input into their planning framework. The goal of investment should be to provide a continuous system, even beyond EU borders, seeking to avoid the development of a patchwork of not interlinked high-speed lines. This may imply modifications to the TEN-T Comprehensive Network, aiming at connecting the networks across the EU external borders in a fully interoperable manner.

The same discussion is true in relation to the Technical Standards for Interoperability (TSIs). Their application outside the EU will guarantee not only increased interoperability, but also the same high level of safety across the entire TER area. For those TER countries outside the EU, it is important to distinguish between those which have standard gauge (1,435 mm) and those which have broad gauge (1,520 mm). The TSIs cover these and other gauges so interoperability is facilitated within these gauges for some aspects and across gauges for common aspects. For example, safety must be guaranteed at all times.

Other aspects of interoperability may be subject to further considerations individually, if no continuous gauge changing conventional (passengers or freight) or high-speed service or is foreseen.

Further to the TEN-T and CEF Regulations, four legislative packages were adopted between 2001 and 2016 with the aim of gradually opening up rail transport service markets to competition, making national railway systems interoperable and defining appropriate framework conditions for the development of a single European railway area. These include charging and capacity allocation rules, common provisions on the licensing of railway undertakings and train driver certification, safety requirements, the creation of the European Agency for Railways and rail regulatory bodies in each member State as well as issues related to rail passenger rights.[2] The main provisions of the rail packages are set out below:

**First Railway Package (2001)**

- Access for railway operators to the TEN-T on a non-discriminatory basis
- Creation of a one-stop-shop to market train paths
- Establishing a tariff structure according to relevant costs
- Reduction of delays at borders
- Introduction of quality standards.

*Key Legislative provisions:*

Directives 2001/12/EU, 2001/13/EU, 2001/14/EU of 26 February 2001, of which: 2001/14/EU focuses on the allocation of infrastructure capacity, and the levying charges for infrastructure use. This first Railway Package was recast through Directive 2012/34/EU.

**Second Railway Package (2004)**

- Revitalisation of railways through the creation of a European railway area
- Improve interoperability and safety
- Opening up the freight market across Europe
- Establishing the "European Railway Agency" (ERA) in Valenciennes, France.

*Key Legislative provisions:*

Directive 2004/49/EU: allocation of infrastructure capacity, levying charges for infrastructure use; Directive 2004/50/EU: amending Directives 96/48/EC (interoperability of high-speed railway system) and Directive 2001/16/EC (interoperability of conventional railway system).

Regulation (EC) 881/2004 establishing ERA.

**Third Railway Package (2007)**

- Liberalisation of international railway passenger transport
- European driving licence for train drivers
- Strengthening of passengers' rights.

*Key Legislative provisions:*

Directive 2007/58/EU, on the allocation of infrastructure capacity, levying charges for infrastructure use and Directive 2007/59/EU on the certification of train drivers; Regulations (EU) 1370/2007 on passenger transport

[2] https://ec.europa.eu/transport/modes/rail/packages_en.

services on rail and on road, Regulation (EU) 1371/2007 on passengers' rights and obligations, Regulation (EU) 1972/2007 on a labour force sample survey in the EU.

**Fourth Railway Package (2016)**

*Technical pillar:*

- Regulation 2016/796/EU on the European Union Agency for Railways (previously European Agency for Railways) and repealing Regulation (EC) No 881/2004 (establishing ERA),
- Regulation 2016/797/EU on railway interoperability (In principle, this regulation refers to the TSIs, however also indicates exceptions from the obligation of application, which may be of importance for non-EU TER countries, in particular in those that have broad gauge railways.)
- Regulation 2016/798/EU on railway safety.

*Market pillar:*

There are 2 Regulations and one Directive, of which Directive 2016/2370/EU is relevant in the context of this study: It refers to the opening of domestic markets for passenger transport services by rail and the governance of railway infrastructure ("Governance Directive").

The market pillar completes the process of gradual market opening started with the first Railway Package. It establishes the general right for railway undertakings established in one member State to operate all types of passenger services everywhere in the EU. It also lays down rules aimed at improving impartiality in the governance of railway infrastructure, preventing discrimination and introduces the principle of mandatory tendering for public service contracts in rail. Competition in rail passenger service markets will encourage railway operators to become more responsive to customer needs, improve the quality of their services and their cost-effectiveness. The competitive tendering of public service contracts should lead to savings in public subsidies. According to the European Commission, the market pillar is expected to deliver more choice and better quality of rail services for European citizens.

While these Railway Packages apply only to EU member States, their impact on interoperability and governance of infrastructure make them relevant also for non-EU TER countries (especially, so-called, candidate countries).

As explained in chapter 3.3, the TSIs should be applied in the TER area in order to provide trans-European interoperability, whilst allowing for exceptions as laid down in Article 7 of the above referenced Regulation 2016/797/EU.

Beyond TEN-T, TSI and the Railway Packages, there is another important piece of EU legislation which is to be considered part of the EU infrastructure package, namely the ERTMS Deployment Plan [18]. ERTMS is the new "European Railway Traffic Management System", which consists of the two components ETCS, the "European Train Control System" and GSM-R, "the "Global System for Mobile Communications — Rail". ERTMS shall replace the national signalling systems, which are not interoperable with each other and therefore are an obstacle to border crossing rail traffic.

Article 12 (2) a of the TEN-T Regulation stipulates that all TEN-T railway sections be equipped with ERTMS by 2050 and identifies this as a priority in Article 13 a. This applies, in particular, to the TEN-T Core Network, where the time horizon is 2030 and to the nine TEN-T Core Network Corridors, for which a special deployment plan has been elaborated, the compliance with which is monitored by a European Coordinator.

While the entire set of TEN-T Core Network Corridors has to be equipped with ERTMS by 2030, the following table, which is an excerpt from annex A of the ERTMS Deployment Plan, indicating in which (border crossing) sections in TER member countries this has to be done by 2023.

**Table 2.7 - Excerpt from ERTMS Deployment Plan (implementation by 2023 in TER countries)**

| Corridor | Country 1 | Country 2 | Cross border | Date country 1 | Date country 2 |
|---|---|---|---|---|---|
| **BAC-OEM** | Austria | Czech Republic | Wien — Břeclav | in operation | 2018 |
| **BAC** | Austria | Slovenia | Werndorf — Maribor | 2023 | 2023 |
| **MED** | Slovenia | Hungary | Hodos — Zalalövö | 2017 | 2018 |
| **NSB** | Germany | Poland | Frankfurt/Od. — Poznan | 2020 | 2023 |
| **OEM** | Czech Republic | Slovakia | Břeclav — Dev. Nová Vés | 2018 | 2023 |
| **OEM-RDN** | Austria | Hungary | Parndorf — Hegyeshalom | 2022 | 2022 |
| **OEM-RDN** | Hungary | Romania | Budapest — Cutici | 2018 | 2018 |
| **OEM** | Romania | Bulgaria | Calafat — Vidin | 2018 | in operation |
| **RDN** | Germany | Czech Republic | Schirnding — Cheb | 2023 | 2023 |

Notes: BAC: Baltic-Adriatic Corridor; OEM: Orient-EastMed Corridor; MED: Mediterranean Corridor; NSB: North-Sea-Baltic Corridor; RDN: Rhine-Danube Corridor.

# 3. Review of Related Work, Initiatives, Policies and Studies

## 3.1. Collection of relevant studies and achievements made by other institutions

There is a significant library of studies worldwide, covering the entire field of high-speed railways: political objectives and impact on mobility, technical principles, engineering and planning issues, implementation and construction experience, operation and maintenance. It is not possible to cover all these documents within the scope of this study.

Therefore, a selection has been made to cover the whole area of high-speed rail with its effects on socio-economic issues, technical challenges, environmental impacts, implementation and operation, but with the focus on studies that are relevant for decision-making, or are exemplary for strategic planning, technical design or operation of high-speed lines. Beyond the core studies identified in this chapter, a number of other references used for this study are listed in chapter 6.1.

### 3.1.1. "High-speed Europe", a brochure of the European Commission [19]

This paper was published by the Directorate General for Mobility and Transport (DG MOVE) in 2010 and based on the TEN-T according to the 2004 revision with its 30 priority projects. It presents high-speed rail "offering European citizens a safe, fast, comfortable and ecological mode of transport". In line with the later White Paper "Roadmap to a Single European Transport Area - Towards a competitive and resource efficient transport system" (a policy paper of the European Commission [4] published in 2011), it describes the status of implementation and further plans and the role of high-speed in European transport policy. It sums up the benefits of high-speed railways for cohesion and environment, as well as for citizens and the climate, showing a number of good practice examples from mainly western European EU member States. Last, but not least, with view to the European railway industry, reference is made to the impact on technological and commercial success.

Given the date of the publication before the recent TEN-T Policy Review, the maps shown in this brochure, are outdated. Currently and for the coming years, the maps attached to the TEN-T Regulation 1315/2013 [2] apply.

As regards the TEN-T Core Network Corridors, reference is made to the figure 1.5 in chapter 1.3. above.

### 3.1.2. High-speed rail: CER's perspective [20]

This article by Libor Lochman and Pauline Bastidon from the Community of European Railway and Infrastructure Companies (CER), mainly focused on the political background, in particular the effects of high-speed on modal balance and environmental and socio-economic issues, was published in the European Railway Review in December 2014. Figures 3.1, 3.2 and 3.3, which underpin the message of the authors in a very demonstrative way, are taken from this publication.

The article states that high-speed could cope with many of the challenges of today's society: enhancing economic growth, saving energy and mitigating environmental problems. Where high-speed has already been implemented, it has shown its clear advantages. For example, travel times between Brussels and Frankfurt have been reduced by about 45%, while between Madrid and Barcelona by 60%. Consequently, demand has grown by factors up to 2 or 3, on many routes.

With this in mind, high-speed railways contribute strongly to sustainability. As figure 3.1 shows, in terms of passenger-kilometres per 1 kWh, they have the highest energy efficiency of all motorised modes. This reflects also the significant shift that has occurred from other modes, due to high-speed. According to the article, the Eurostar connection between Paris and London now has a market share of about 80%. Beyond this, it could be shown that high-speed also has the potential to attract additional, new, passengers, to up to 33%.

While within railway transport, building dedicated high-speed lines would provide additional capacity for commuter trains and freight trains on the existing infrastructure; in air transport, this shift allows the number of flights outside the high-speed rail network to increase, in particular over long distances. By means of air-rail partnerships, the catchment areas of airports could increase and attractive multimodal transport chains for passengers emerge. However, this would make sense only for main airport hubs.

Figure 3.2 displays a comparison of land-use of motorways and high-speeds lines, showing that high-speed railway infrastructure saves much more space than comparable motorways (provided that all potential passengers can be shifted to rail).

Taking into account all these benefits, the external costs of high-speed, on average, are half of those of coaches, less than half of those of airplanes and even less than a third of those of cars.

**Figure 3.1 - Comparison of energy efficiency**

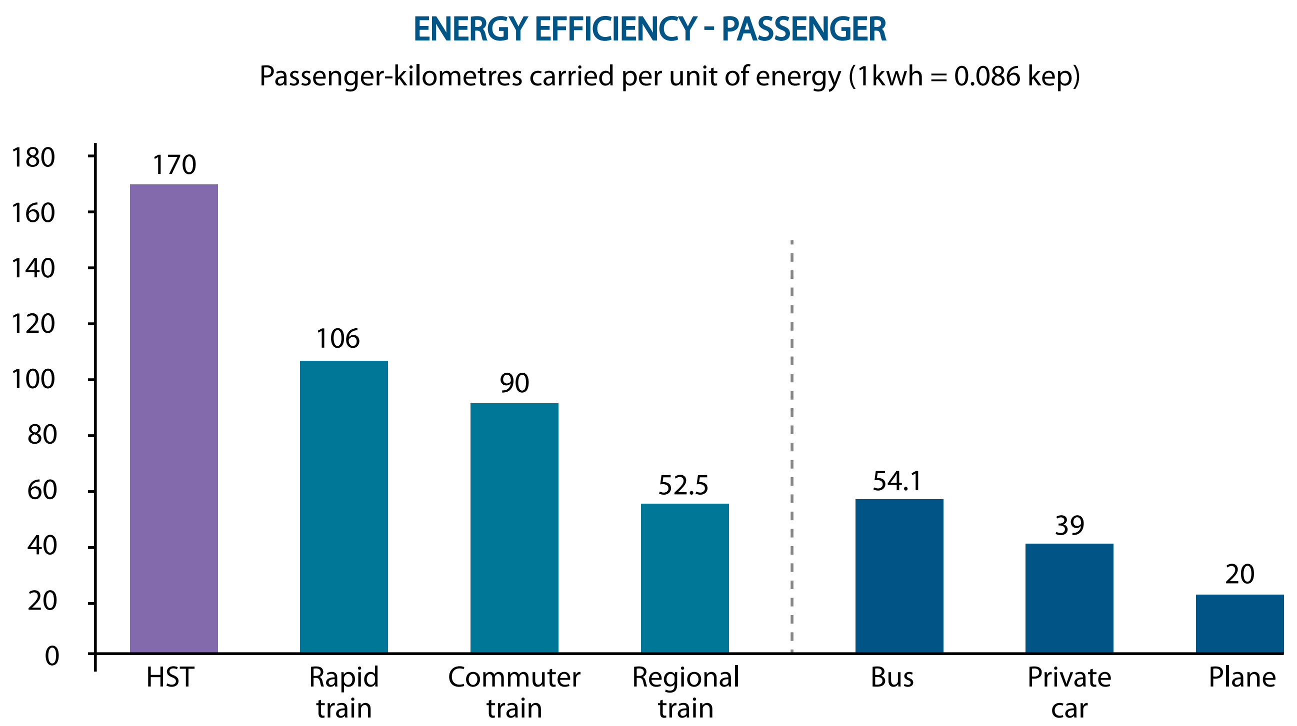
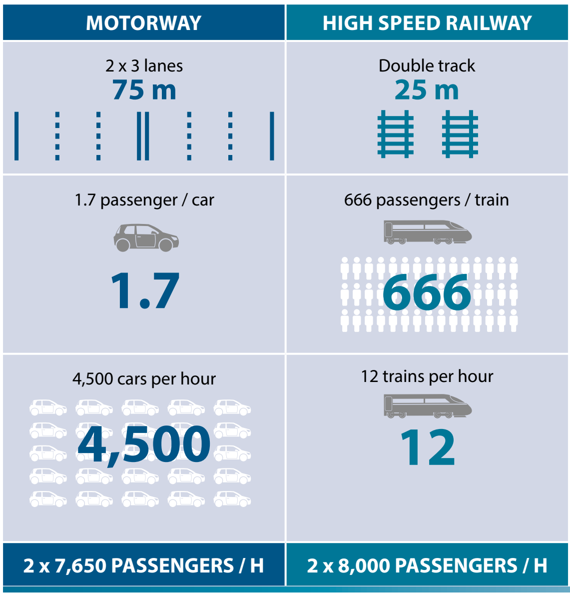
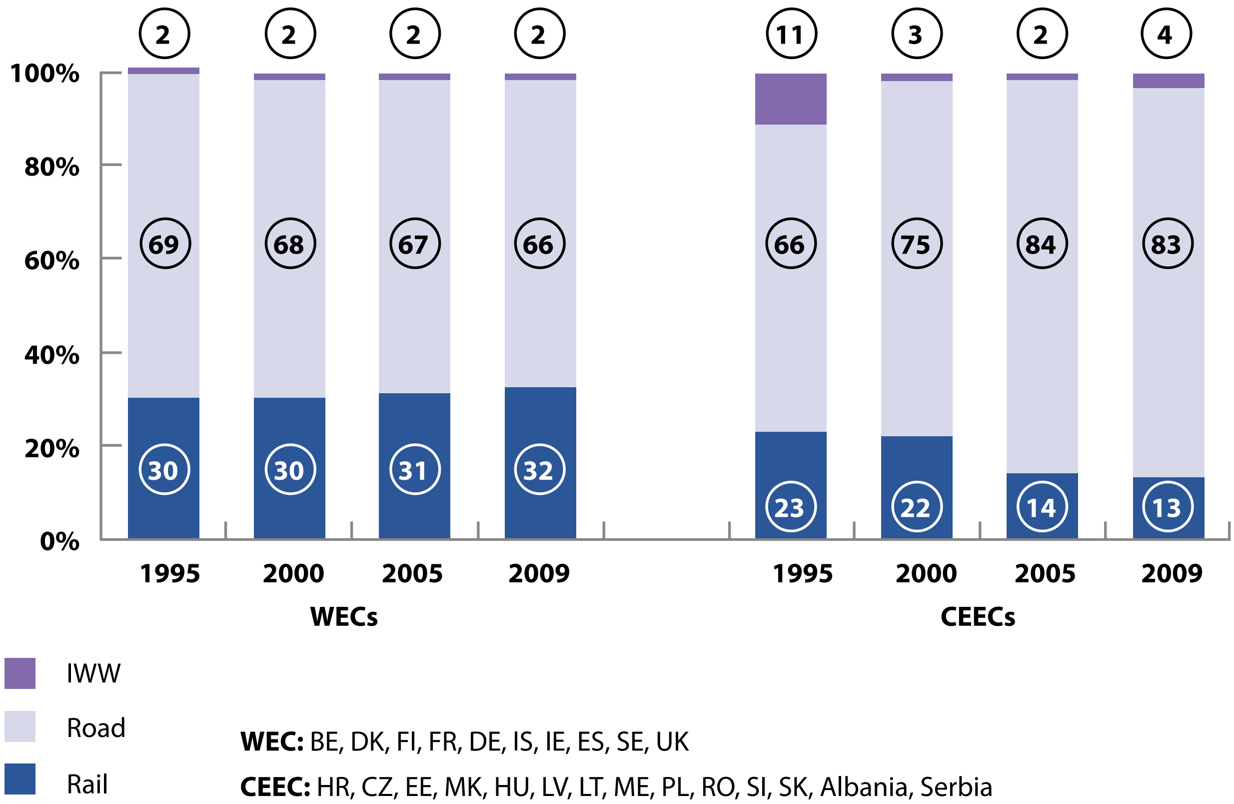


**Figure 3.2 - Comparison of infrastructure capacity and efficiency**




Nevertheless, it is important to note that less than one third of investments in infrastructure in Western Europe goes into rail (including high-speed) whereas about two thirds are used for road. Alongside this, the share for inland waterways is almost negligible. In Central and Eastern Europe, the share of road has grown from 66% to 84% from 1995 to 2009, whereas a decreasing share from 23% to 13% in the same period go to railway projects. This is shown in figure 3.3 below.

**Figure 3.3 - Share of infrastructure investments per mode of transport in Europe**



Given the cost of building and maintaining high-speed lines, as set out in the UIC brochure described below, the authors caution readers on whether high-speed investment should be undertaken at the expense of investments in conventional lines, in particular for regional transport. Given the steady reduction of investment means for rail in Central and Eastern European countries, it might be difficult to implement high-speed railway projects in these parts of Europe, which also would concern most of the TER countries.

In order to make high-speed even more attractive, it would be necessary to offer low, affordable, fares, easy, flexible ticketing and accurate real time passenger information, including online.

Given the fact that a significant portion of revenues go to infrastructure charges, this issue would have to be tackled at a political level. Certain subsidies corresponding to the socio-economic benefits, targeted at infrastructure, could improve the position of rail in general and of high-speed in particular. Full internalisation of external costs would slightly increase train ticket prices, but would increase the cost of road traffic much more, so that there would be a net positive effect in favour of rail, with the consequence that high-speed rail could, indeed, become the "transport mode of the future".

### 3.1.3. UIC brochure "High-speed rail — fast track to sustainable mobility) [21]

UIC published this brochure for the UIC high-speed world congress in Philadelphia in 2012. It defines high-speed as a railway system operating at a minimum of 250 km/h, requiring specific trains, in general aerodynamically shaped train sets, instead of locomotive with carriages, appropriate infrastructure and a specific traffic management system. According to this brochure, it is generally not make high-speed lines that are suitable for speeds higher than 200-220 km/h, just by upgrading conventional lines.

The focus of the brochure, addressing policy makers and citizens, lies on the advantages of high-speed in relation to external (environmental and social) costs, compared with other modes of transport. In this context, it also covers issues like land use and energy efficiency.

It also gives information on the technical requirements of all components, such as railway infrastructure, including railway stations and their strategic value, vehicles, operations, signalling, safety and security.

The focus of the brochure is on commercial aspects, such as infrastructure and operating costs, financing and revenues, areas of particular importance for infrastructure managers, railway undertakings as well as the public administration and financing bodies.

As always, sustainability has to be understood in its full range, covering economy, society and environment. Whereas economic costs, at least in principle, are covered by corresponding money flows (fares, infrastructure fees, and subsidies), this is generally not the case for social and environmental costs, such as from noise, air pollution, $CO_2$ emissions, the impact on nature and landscape as well as of accidents and their long-term social costs.

The results and the success of high-speed are illustrated through some key figures:

- 1,400 million passengers carried by TGV trains since 1981
- 400,000 passengers per day on the Tokaido Shinkansen (Tokyo — Osaka, 515 km)
- 1964 (1 October) world's first high-speed train service Tokyo — Osaka
- 80% modal split obtained by high-speed trains in relation to air transport when travel time by train is less than 2.5 hours
- 574.8 km/h world speed record (France 2007).

The brochure indicates the services or advantages passenger enjoy in high-speed trains: speed — leading to short travel times, the frequency of trains (unfortunately not everywhere), comfort, reliability, price, safety and freedom, which means freedom to move during the journey, e.g. going to have meals or coffee, during the journey.

As regards costs, the brochure indicates the following information about average values across Europe:

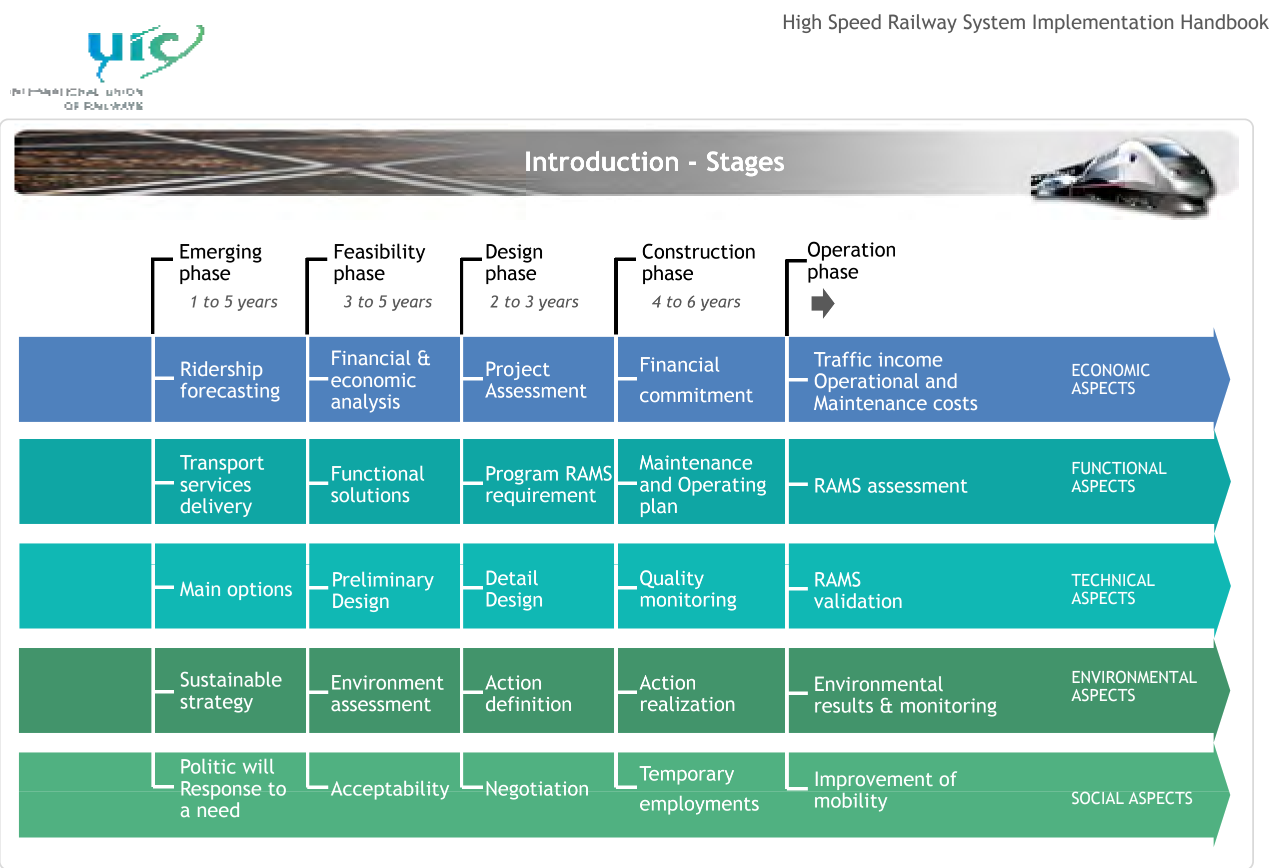
| | |
|---|---|
| Construction per 1 km new high-speed line | €12-30 million |
| Maintenance of 1 km of high-speed line per year | €70,000 per year |
| Cost of a high-speed train for 350 passengers seated | €20-25 million |
| Maintenance of a high-speed train (2 €/km-500 000 km/year) | €1 million per year |

The last pages of the brochure provide maps of the high-speed networks in Europe, North and South America and Asia (Japan, China, India Middle East), as well as information about the UIC high-speed department, research and development and technological aspects.

### 3.1.4. UIC handbook "High-Speed Railway System Implementation Handbook" [22]

This UIC handbook elaborated by SENER (Spain) and INGÉROP (France) was published in 2012. Whereas the previously presented publications and brochures mainly concentrate on issues of transport policy, such as the effects of high-speed on modal balance, this handbook is directed to engineers and planners.

**Figure 3.4 - Project implementation phases and activities**




SENER-INGÉROP

This handbook describes in a matrix form, as shown in figure 3.4, in principle, the individual implementation phases and the corresponding main stages of a project, from project initiation to operation and a recommended ex-post evaluation. Given its comprehensiveness and practical importance, more space is dedicated to this publication, within this study. Following this matrix, the handbook explains in a comprehensive manner, by means of concise texts, graphic examples and illustrations, the corresponding activities, indicating and describing in which phase of implementation which particular step is necessary, what these steps — or project stages — should comprise and what decision makers should consider. Of course, this should be considered as a rough general guideline. As regards the approval of a concrete project, it is mandatory to obey EU and/or national laws.

The following description of project phases is a short summary out of this UIC handbook, following the subdivision of the implementation process from project emergence to ex-post evaluations. The subsequent reflections on the individual phases and stages according to this UIC-handbook are followed by some additional deliberations and recommendations.

### 3.1.4.1. Emerging phase

#### Stage 0: Emergence

The birth of a project may stem from a correspondingly high demand potential and capacity needs as well as from a political will to improve regional accessibility in a country or to shift traffic to rail. At this stage, all basic information needed to back up a project idea must be collected and compiled. With the focus on sustainability, the basic decision to implement a high-speed line has to be made within general (national or even supra-national) spatial, economic and mobility concepts.

#### Stage 1: Ridership forecasting and transport services delivery

On the margins of a pre-feasibility study, a strategic concept to show the plausibility of a project must be developed. At this early conceptual phase, there must be a clear idea about the main objectives and target travel times. Potential passenger flows and costs must be estimated for the variants of the project. Integration into and interrelation with the existing conventional network has to be ensured, including public transport in urban areas. Also, there must be at least a rough idea about target timetables, capacity effects and operational aspects, as well as about the effects on modal split. If studies already exist, they should be a basis for the investigations.

### 3.1.4.2. Feasibility phase

#### Stage 2: Feasibility studies

A feasibility study shall investigate along potential corridors geotechnical conditions, technical feasibility, traffic effectiveness and economic viability of different variants, to identify the most effective solutions. These investigations have to describe and quantify (as far as possible) spatial integration and cohesion effects, modal shift, time savings for passengers, operational savings, environmental benefits etc., versus all costs such as for planning, land acquisition and infrastructure construction, purchase of vehicles, maintenance, but also social costs as local environmental impacts and noise. They must be thorough enough to underpin the political decision for implementation of a high-speed project.

**Stages 3: Environmental assessment**

Environmental effects are key impacts of a project and have to be considered in the design process, including possible mitigating measures. They have also been discussed with the public, along with issues of urban development and local planning. An environmental management plan should also be established.

**Stage 4: Financial and economic analysis**

It is necessary to determine the profitability of a project to estimate both the financial requirements to implement the project and if the economic benefits for the society would justify the investment.

**Stage 5: Multicriteria analysis**

The results of the environmental assessment, the financial and a socio-economic analysis, should be consolidated in a multicriteria analysis, as the basis for the selection of the optimal alternative on hand. The tool of a multicriteria analysis is appropriate because not all of the indicators resulting from the previous analyses can be monetised. (This may be supplemented with a kind of "multimodal analysis" as requested by the European Commission, to underpin compliance with EU policy goals and to support the TER Master Plan).

**Stage 6: Preliminary design**

A preliminary design shall determine the exact horizontal and vertical alignment, with its land acquisition requirements and the impacts on affected property owners. It has, among other things, to include the identification of interfaces and dependencies, the preliminary design of power supply and substations, signalling, sidings and maintenance facilities and a preliminary construction schedule.

**Stage 7: Empowerment**

In this phase, the political decision to go on with the project shall be made and the procurement phase prepared.

### 3.1.4.3. Design phase

**Stage 8: Operation and maintenance planning**

Depending on whether the infrastructure will be used exclusively for high-speed or for mixed passenger — freight services, appropriate operation and maintenance plans must be developed, for both the track and the rolling stock, taking into account that maintenance phases affect operation, with a view to life cycle costs of the equipment. Special attention is needed for bridges and tunnels.

**Stage 9: Detailed design**

The detailed design must determine the complete solution covering technical, architectural and landscaping issues, the definitive land acquisition needs and a fully-fledged cost calculation, based on precise material and labour requirements. This is also the basis for the subdivision of a project into lots, including their interfaces, and for the tendering procedure.

### 3.1.4.4. Construction phase

**Stage 10: Construction planning**

A first step in the construction phase is the preparation of a detailed time-schedule for the construction works, taking into account the times realistically needed for the individual steps including earthworks, civils engineering, bridges, tunnels, track-laying, electrification and signalling, etc. This also needs to include the planned time for testing and commissioning. The time-schedule must ensure the timely inauguration of the project.

**Stage 11: Construction**

The construction phase has to start with a final checking and fine-tuning of all previous planning steps and the tendering process, until the awarding of the corresponding contracts, of course following the overall time-schedule of the works. The construction management and supervision of works are of crucial importance, to make sure that deviations from the plans can be minimised and, if they occur, compensated for as much as possible. This covers the technical concept in all details, the time-schedule and the costs. Safety on site is of key importance and has to be strictly supervised. Further, it is important to avoid or reduce environmental and other negative impacts during construction. All steps of the works have to be documented carefully.

**Stage 12: Testing and commissioning**

Having finalised the construction activities, it must be proved and documented in the testing and commissioning phase that all requirements, as foreseen in the previous phase of planning as well as all legal requirements, for example as regards safety, have been met. Also in this final phase, prior to commercial operation, the technical reliability and the fulfilment of the operational parameters must be tested and certified.

#### 3.1.4.5. Operation phase

**Stage 13: Operation and maintenance**

The objective once commercial services start is to ensure adequate reliability, maintenance and safety throughout operation. This includes monitoring, inspection and testing, all while minimising interferences with commercial traffic.

**Stage 14: Ex-post evaluation**

With a view to future projects, it is advisable to analyse and review the project to assess whether project targets have been met or otherwise.

#### 3.1.4.6. Additional deliberations and recommendations

Deviating from the process recommended in the handbook, it may make sense to combine stages 3, 4 and 5 and to carry out, at the strategic level, a strategic assessment comprising all aspects of sustainability including economy, society and environment. The part of this strategic assessment referring to environmental issues may be understood as a "Strategic Environmental Assessment" (SEA), as is foreseen in EU legislation.

At a project level, an environmental impact assessment (EIA) has to accompany the planning process, to provide mitigating measures such as biotopes and green bridges as well as noise protecting structures, to ensure adherence to all relevant laws but also to ensure public acceptance of the new infrastructure.

As regards project design and planning, high-speed projects have to ensure travel times as foreseen in the overall concept. In mountainous regions or in built-up areas, this is a difficult challenge, as finding the optimal alignment is a trade-off between speed requirements, standards which have to be fulfilled, minimising the impact on the local population and costs. With view to costs, it is recommended in these cases to apply category (iii) high-speed railway lines according to Regulation (EU) No. 1315/2013, Art. 11.2(a).

Whereas there is no principle difference between high-speed and conventional railway infrastructure, given the dynamic forces growing with the square of speed, heavier rails and sleepers must be laid within tighter tolerances, in order to achieve higher track stability and lower shocks and vibrations of trains, when running at high-speeds. High horizontal and vertical accelerations, perpendicular to the rail axis, are not only a comfort problem. They also cause excessive wear and tear and deform the track, leading to even stronger dynamic forces. High resistance of track, combined with precise initial alignment will reduce maintenance intervals and efforts, and is therefore an important factor for cost reduction.

### 3.1.5. "Track geometry for high-speed railways" by Martin Lindahl [23]

This publication comprises a literature survey, with reference to European and Japanese standards (CEN and TSIs), and a simulation of vehicle response.

The abstract point to the following results:

- A cant up to 200 mm is possible if the track is built for high-speed traffic, only, in freight train operations it is some 20-50 mm lower
- A cant deficiency of 225-250 mm could be allowed when using car-body tilt and suitable bogie technology. Tilt is a basic requirement when using such high levels of cant deficiency
- Transition curves should be long, to ensure the transition enduring 4-5 seconds, if car body tilt is anticipated
- It could be concluded that hunting stability is achieved
- Track quality would have to be improved relative to current standards for 200 km/h, in order to meet requirements on lateral track shift forces
- Safety criteria for side-wind exposure can be met, if the trains have favourable — although realistic — aerodynamic performance
- The maximum gradient shall be chosen according to the type of freight traffic foreseen.

### 3.1.6. "25 Jahre Hochleistungsbahnen in Österreich" by Norbert Ostermann [24]

The title of this publication is "25 years of high performance railways in Austria". This book is a good example how to interpret "high-speed" in a flexible way, in line with the spatial needs and the financial possibilities in most of the TER countries. In a set of more than 50 different professional articles, it describes the historical, legal, technical and operational backgrounds of the particular Austrian planning philosophy. This planning approach aims at achieving a compromise between high-speed and high capacity, with appropriate parameters, to cope with the requirements of passenger transport at elevated speeds, mostly high-speed, and the needs of freight transport, in particular accompanied combined transport ("Rollende Landstrasse").

With a view to many TER countries, it is of particular importance to read this article against the background of the mainly mountainous or hilly morphology and the polycentric spatial structure of Austria. Under these conditions, which are prominent also in other TER countries, non-fully-fledged high-speed lines, that is not providing the highest possible speed, may be the key factor, but the overall swiftness of travelling, including changing trains.

This operational concept, which is often referred to as the "integrated timetable", was developed in Switzerland as discussed earlier in the study. It is based on a network of nodes ("Taktknoten"), preferably regional capitals or medium sized towns located at important intersections on the network. These nodes are served according to a timetable providing regular intervals (a multiple of 30 or 60 minutes). Within this network, speeds are chosen, so that travel times between the nodes are multiples of 30 minutes. This may result in different speeds between about 100 km/h and 200-250 km/h, depending on the respective distance of the corresponding nodes. Due to the repetition of departure minutes every hour, it is easy to memorise the timetable ("clock-face departures").

Design speeds that are on average below high-speed level, result in lower construction costs, in particular in mountainous areas. Corresponding time losses that may occur along direct connections are at least partly compensated by time gains in indirect connections, which is common in countries with polycentric structure.

This principle allows more flexibility in operation, because high-speed and conventional trains can be used on the same infrastructure as well as mixed operation of passenger and freight trains. Nevertheless, a high level of punctuality is possible, which is especially essential for travellers who have to change trains.

### 3.1.7. "Cost-effectiveness of speed upgrades in the Austrian railway system" by Peter Veit [25]

Although published in 1991 and focused on the Austrian network, the thesis of Peter Veit is very basic and gives information on both technical and economic aspects.

As explained later in chapter 4.4, this thesis is based on "Lill's travelling law" [3], which gives a suitable reference for potential traffic demand and the economic and financial viability of high-speed projects. This principle dates back to 1891 and is described in detail in chapter 4.4. It is the basis for traffic generation within most traffic models. The following paragraph is a short abstract of this thesis:

It aims at demonstrating the relation between costs of transport, referred to train-kilometre, and maximum speed. The calculation considers the specific legal situation in Austria. After scrutinizing technical, operational and legal effects of speed increases, the author establishes the functional context between the individual cost components and speed, which he combines to the total speed-dependant costs. This calculation is based on an average passenger train in Austria, but can be applied to any type of trainsets. The result is that for Austria the maximum speed of 160 km/h would be adequate; further speed increasing would lead to a sudden increase of costs, which would not be economic.

It is important to note that the Austrian railway infrastructure policy followed a different approach, building a set of new sections, which were designed for 250 km/h from the very beginning. This was due to the need for higher capacity on the western railway axis Vienna — Linz — Wels, where the overlaying of high-speed on dense freight traffic would lead to pronounced bottlenecks, so that additional tracks were necessary to cope with the capacity needs. Finally, in a forward-looking manner, it was decided to choose more generous parameters, for the new lines.

The gravitation approach yields overall total traffic demand potentials between two nodes, covering all modes of transport available in a certain relation, but not assigning them to a particular one. On the other hand, it does not require more input data than just the sizes of the nodes (numbers of inhabitants) and the distance between them. Therefore, it is used as the basis of the methodology described in detail in chapter 3.1, which will be applied to determine demand potentials as a criterion to find out where high-speed could possibly be an option, at all.

### 3.1.8. High-speed rail in Europe [26]

This article is taken from Wikipedia. It gives a very comprehensive overview on the development and the status quo of high-speed railways in Europe, including the historical background, important infrastructure and operational data, maps and concise descriptions of the individual sections. As this link is easily accessible on the web, this study does not explicitly describe it, but only gives a rough overview, as set out in its contents:

1. Early national high-speed rail networks: Britain, France, Germany, Italy, Spain
2. Integration of European high-speed rail network (cross-border infrastructure and services): Belgium, Netherlands, Paris — Frankfurt, Channel Tunnel (London — Paris/Brussels, London — Amsterdam/Germany), Spanish-French border, Crossing the Alps
3. Future projects adjacent to existing high-speed services: "Magistrale für Europa", Austria, Switzerland, United Kingdom of Great Britain and Northern Ireland
4. Nordic Countries: Denmark, Finland, Norway, Sweden
5. South-east: Turkey, Hungary and Romania, Hungary and Serbia
6. Other high-speed projects: the Baltics, Croatia, Czech Republic, Ireland, Poland, Portugal, Russian Federation
7. In development: cross-border, country specific

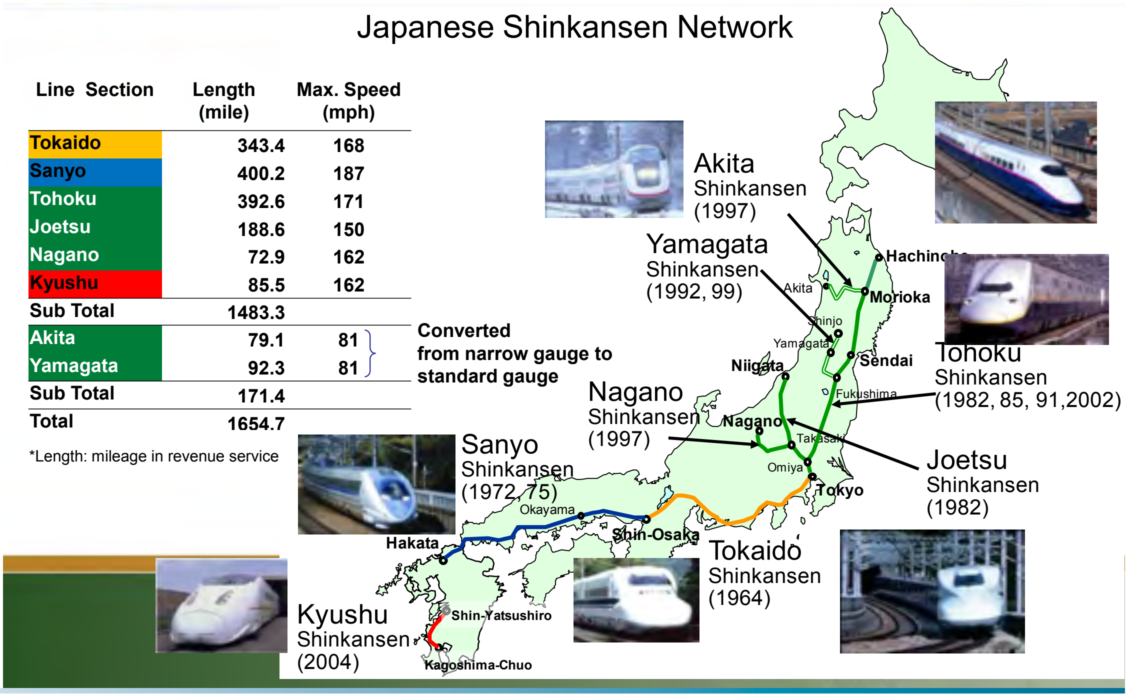
8-10. Not relevant.

### 3.1.9. Infrastructure of high-speed lines in Japan by Atsushi Yokoyama [27]

The author is director of Japan Railways Group Paris Office. He gives an overview of the Japanese Shinkansen system: network and rolling stock, its development over more than 50 years — as shown in figure 3.5 — and its most relevant characteristics including:

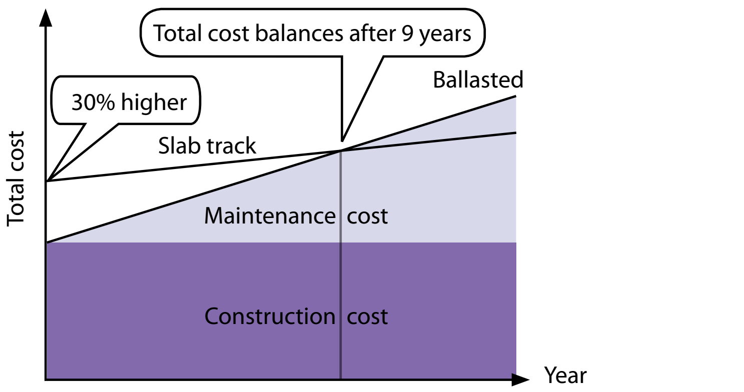
- Operating at up to 200 km/h
- Up to 15 trains per hour
- Average delay time per train is 36 seconds
- Less energy consumption
- Low noise
- No fatal accidents (excluding suicides).

**Figure 3.5 - Japanese Shinkansen system: network and history**




Whereas in the first high-speed line only or mostly ballasted track was used, in more recent times, slab tracks have become almost the standard. There is a particular focus describing the slab track in many design details, the tolerances of its alignment and its maintenance. Very interesting in this context is the comparison of construction costs versus maintenance costs, which shows according to figure 3.6, a cost balance after about nine years, with lower cost of the slab track in the longer run.

**Figure 3.6 - Construction and maintenance costs of ballasted and slab track**




The author also describes in detail, the works of inspection and maintenance of the track, distinguishing short (≈ 10 m) and long (≈ 40 m) wavelengths of the deviations from the target track alignment. For instance, there is a regular inspection every 10 days by a maintenance train running at commercial speed.

A Japanese particularity, which is also mentioned, is the delicate earthquake situation. The "Niigata Chuetsu earthquake on 23 October 2004 caused the derailment of a train at almost 200 km/h, however with no fatalities.

Concrete structures had to be repaired and reinforced to achieve better resilience against earthquakes. Meanwhile an earthquake observation system and an early earthquake detection network have been installed.

Other important safety measures concern weather impacts on infrastructure and operation, such as those of storm or snow.

Operational safety is secured by means of an in-cabin signalling system comparable in its functionality to the European ERTMS.

Finally, some attention is dedicated to the power supply system, as to avoid vibration of the catenary, together with the pantographs. The cross section and consequently the weight of the catenary is selected in accordance with the traffic load, as this affects the intensity of the current. Anyway, a higher mechanical tension of the catenary would increase its eigenfrequency, so to avoid resonance effects with the pantographs.

## 3.2. The technical challenges of high-speed rail traffic

High-speed lines are characterised by large curvature radii and long transition curves, heavy superstructures (ballast, sleepers and rails), the absence of level crossings with other transport infrastructure, in particular roads, as well as walking and cycling paths. They are further equipped with reinforced, stiff catenaries and with modern in-cabin signalling systems, which are needed at high-speeds (> 160 km/h) for safety reasons.

Dynamic forces, in particular the centrifugal force, which is a lateral inert force resulting in bends, as visualised in figure 3.7, grow with the square of speed, causing corresponding impacts on tracks and catenary. These forces have to be taken into account not only for the design of tracks and trains, but also for track stability, abrasive wear and, consequently, also for maintenance.

**Figure 3.7 - Centrifugal force, in theory and practice — cant of railway track**


A corresponding cant of the track can partly compensate for these forces, so that passengers would only feel a residual centrifugal force, which has to be within admitted thresholds. Slower or halting trains, in particular freight trains (which circulate at most at 100-120 km/h), are a limiting factor for the cant or superelevation of the track. The corresponding design rules allow maximum cants in the order of 150-180 mm, sometimes, exceptionally, 200 mm.

With tilting trains, it is possible to reduce residual the centrifugal forces that passengers feel in the carriages. Active tilting (e.g. Italian "Pendolino") or passive tilting (e.g. Spanish "Talgo") reduce the free centrifugal force inside the carriages, so as to maintain travelling comfort, whereas forces on tracks correspond to real speed and the radius as for conventional trains. There have been sporadic reports about passengers becoming sick on tilting trains, this could be considered as a disadvantage of using this technology.

As a consequence of the necessary limitation of the cant, higher speeds require larger curve radii, in the order of 3,000-6,000 m and even more, which in general makes finding an appropriate alignment difficult — and expensive. The key limiting factors are safety, availability of land, in particular in mountainous and built-up areas, and costs for construction, operation and maintenance.

For smooth changes between sections of different curvature, including straight parts, sufficient transition curves like clothoids have to be fitted into the alignment. Clothoids, according to figure 3.8, have the characteristic that curvature increases in a linear manner with the length. (In the past, cubic parabolas were used in railway engineering.) Where tilting trains are in operation, transition lengths, in particular between curves in the opposite direction, have to be sufficient to avoid disrupting the tilting devices and causing nausea to passengers.

**Figure 3.8 - Clothoid (Euler's spiral) and its use as transition curve**

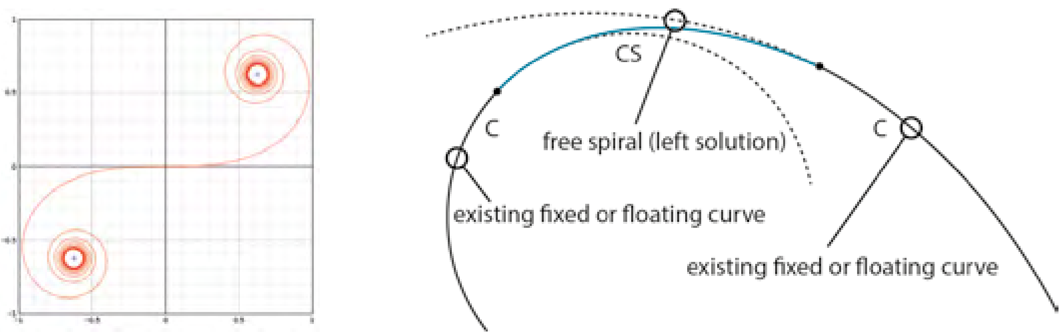



**Figure 3.9 - Cologne — Frankfurt high-speed line; Hallerbach Valley bridge**

While heavy freight trains require a rather strict limitation of gradient of, for example 12,5‰ or even less, and inclinations up to 25‰ are tolerated on existing lines with mixed passenger and freight traffic, this is not a significant problem for high-speed trains, which, in general, are light and possess many powered axes. Dedicated high-speed lines may be designed with gradients up to up to 35‰, in some cases even as much as 40‰ as in the Cologne — Frankfurt section in Germany, shown in figure 3.9. In such cases, however, one would have to accept minor speed losses in longer uphill parts, which however has no relevant impact on travel times.

For shock-free motion, it is also necessary to round out transitions between differing cants and gradients, using radii up to 10,000 m or more.

Given the large dynamic forces of high-speed lines, a reinforced superstructure is essential. At high-speeds, additional horizontal and vertical forces result from inevitable imperfections of track alignment. To safeguard the accuracy of track alignment and its stability against dynamic forces, it is necessary to use heavy rail profiles (≥ UIC 60 profile) fastened elastically on heavy monoblock or equivalent sleepers / e.g. frame-shaped twin sleepers) laid on heavy ballast. Elastic under sleeper pads improve stress distribution between sleepers and ballast, reduce abrasion and extend maintenance intervals considerably. Furthermore, noise emissions are reduced using this technique. Figure 3.10 shows the track of a high-speed line.

For speeds greater than 250 km/h, one has to face the problem of flying ballast, due to aerodynamic suction. Slab tracks are mainly, but not exclusively, used on bridges and in tunnels. On the one hand, the rail position is fixed by slab tracks, on the other hand it does not allow for the absorption effects (both to changes in the underlying terrain and to the moment of track) of ballast.

A particular problem relates to changes in the stiffness of track at changing types of superstructure. It is evident that all these dynamic effects have to be taken into account when planning the frequency of tamping and other maintenance activities.

**Figure 3.10 - High-speed track**

On level track, at speeds above the range of 160-200 km/h, air exceeds rolling resistance, depending of the shape of the train. This is even more important in tunnels, which in some cases have to be designed with a lesser gradient than open-air sections of the same line. Furthermore, in tunnels pressure shocks occur in the interior of carriages as such passenger carriages have to be designed to be airtight, to protect passengers from such surges as those experienced in at tunnel entrances. In a similar manner, freight could be pushed from its place on open wagons where freight trains use the same line. To avoid such incidents, distances between parallel tracks have to be greater the higher operational speed. Therefore, track distances along high-speed lines are usually between 4.20 and 4.70 m, depending on the actual design speed.

Due to the large radii needed for high-speed also on the deflecting track, turnout design and construction is very demanding. Special turnout geometries, including clothoidal transition curves, have been developed to minimise dynamic forces and sudden surges. Overall turnout length up to 200 m are not an exception. Common characteristics of high-speed turnouts, in particular for high-speed also deflecting, include long tongue rails with up to 10 or 12 drives and locks, usually hydraulic, and movable frog crossings (or swing-nose crossings) as shown in figure 3.11.

Modern detection systems allow permanent monitoring of the correct position of the movable parts and surveying the state of wear of all expendable parts of the turnout. Nowadays, these detection systems are integrated into the signalling system, to make sure that the running track is set free only if all components of the turnouts are in their correct position.

**Figure 3.11 - Movable point or swing-nose crossing frog in turnout (source: VAE)**

The technology of catenaries has also been further developed to meet the needs of high-speed, as shown in figure 3.12. Catenary and pantograph, the latter connected with the vehicle, form a complex system of coupled masses that are connected with each other through damped elastic springs. This system is susceptible to oscillations. With growing speed, these oscillations may endanger the continuity of the current transmitted between catenary and pantograph, if equal frequencies of catenary and pantograph cause increasing oscillation amplitudes. In the worst cases, the pantograph may tear down the catenary. To avoid interferences between the catenaries of neighbouring tracks, single mast suspension should be used, in particular in railway stations.

Energy consumption is growing more than with the square of speed, in particular inside tunnels. For high-speed lines, calculations and experience have shown that, to ensure sufficient electrical continuity, a higher stiffness of the catenary-pantograph system is needed. This means increasing the pressure that the pantograph applies to the catenary from usual 70 N to between 100 and 120 N, to pre-stress the catenary with 25-30 kN and to reduce the distance between the supporting pylons to less than 50 m. Furthermore, to avoid interference from oscillations or resonance between trains on different tracks, it is necessary to reduce the distances between pylons and to foresee single pylon suspension of the catenary instead of transversal yokes (suspension ropes), also within railway stations.

Nowadays, installing and tightening as well as inspection, maintenance and repair of catenaries can be done easily and within short time, through the use of specialised equipment that is available on the market.

**Figure 3.12 - High-speed catenary (ICE)**

Sometimes, mainly in tunnels, contact rails, which are fixed elastically, are used instead of catenaries. The lesser vertical dimension of contact rails reduces the clearance that is needed. Reducing the height of a circular tunnel results in an equal reduction of width, so that the cross section diminishes by a square function. This saves construction costs by a great amount, however increases air resistance at high speeds. Figure 3.13 shows an example of contact rail.

**Figure 3.13 - Pantograph on an overhead conductor rail at the Berlin main station**
**S. Terfloth (User: Sese Ingolstadt - Eigenes Werk, Deckenstromschiene mit Stromabnehmer in Berlin Hauptbahnhof)**

Different kinds of current (AC and DC) as well as the use of different voltages and AC frequencies have developed historically. While DC is not an option for high-speed operation, the optimal kind of current has proven to be AC 25 kV with 50 Hz, however 15 kV with 162/3 Hz frequency is also permitted in those countries which have been using them to date, for example in Sweden, Norway, Germany, Switzerland and Austria. It is possible to achieve interoperability at acceptable costs, by using modern multi-current locomotives. This does, at least, apply for locomotives of different AC systems.

For high-speed lines, track-side signalling is insufficient, because the time to perceive signals would be insufficient for the drivers to act or the signals may not be visible in unfavourable weather conditions. Therefore, at speeds above 160 km/h, in-cabin signalling is necessary for example such as the German LZB system or the European Train Control System (ETCS), which the EU is requiring within the European Rail Traffic Management System ERTMS, for full interoperability of signalling. All three levels of ETCS are permitted for high-speed, as long as in-cabin signalling is foreseen, however level 1 is used for this purpose only in a limited number of countries.

Further, for safety reasons, level crossings are generally not allowed for speeds above 160 km/h.

**Figure 3.14 - Track tamping machine**

Maintenance is key for railways in general, and is especially important for high-speed lines, concerning all components of a railway, in particular infrastructure and rolling stock. Alignment and technical parameters of the track must be kept within small tolerances, which are more stringent, the higher the operating speed of the line, as stipulated in the corresponding standards. This requires regular inspection of all components. At sufficient frequency, depending on traffic load, type of track, etc., the track must be positioned correctly within the tolerances, the ballast tamped and the track stabilised in the correct position, to secure long durability of the measures. Considering the life cycle of the track, extending maintenance intervals may result in undue high costs, as deviations from the target alignment grow almost exponentially. In general, using tamping machines as shown in figure 3.14, is the fastest, most efficient and economical solution.

Nowadays, there are also universal machines on the market that allow ballast swapping and cleaning, adjusting, tamping and stabilising the track, even including turnouts.

Special attention has to be given to turnouts and to the catenary. With turnouts equipped with modern diagnostic systems and with innovative maintenance equipment, maintenance has become more targeted, easier, faster and less expensive than in the past, when it was done by hand. Catenaries have to be checked for intactness of suspension, abrasive wear and local damage due to electric arcs.

For the rolling stock, prescribed inspection intervals must be observed, for regular testing of wheels, springs, brakes, etc., to detect possible damage or cracks before they would threaten the safety of passengers and staff.

A special approach is needed when there is high-speed passenger and heavy freight transport on the same infrastructure. First of all, an appropriate alignment and technical parameters which fulfil the needs of both kinds of transport, that is large curve radii for passengers and low gradients for freight trains make the design of the optimal routeing even more difficult and construction even more complex and expensive. This includes also enhanced noise protection and other mitigating measures.

Moreover, great speed differences lead to a serious reduction in line capacity. After every freight train, a sufficient gap is needed to avoid the following fast train catching up to it. Intervals between subsequent trains must be longer where the section is longer and does not have passing loops and there are speed differences between the trains. In general, shortening block distances may not make a significant difference.

Capacity loss due to mixed traffic depends on the sequence of fast and slow trains on the same track, but optimisation is limited, in particular during day times, because of fixed intervals that are usually required for high-speed trains, which have priority in operation. This means that mixed operation is possible only if train frequency is relatively low, speed differences not too high (which would mean that fast trains could not reach their top speed) or if distances between sidings or passing loops are short enough (in such cases, however, the line might not be economically viable).

When planning and constructing a high-speed railway network or high-speed lines, from the emerging until the operation phase, it is important to consider all these aspects and their contexts.

Strategic deliberations should stand at the very beginning: What are the objectives and to what extent is it possible to meet them? Depending on the design speed, real travel times as well as operational aspects, the inputs to this deliberation should be:

- Passenger flows, impacts on freight transport
- Territorial accessibility and cohesion

- Cross-border effects (in particular if located in transnational corridors)
- Interactivity within a mobility system and modal shift effects
- Environment and climate
- Safety and security
- Costs of design, implementation, operation and maintenance (life cycle costs) and financing.

Railway stations are a complex system of different functionalities, being the entrance point to the railway for passengers, where they enter, leave or change trains, as well as the main bases for services and for the operation of tracks and trains.

Platforms are the critical places where passengers are close to trains. It is therefore important that trains do not pass at high-speed at platforms. As a general rule, trains passing at speeds above 160 km/h, which cause dangerous aerodynamic forces, must pass only on tracks off the platforms.

Turnouts or switches are important components of the track systems in railway stations. For safe operation, the design rules for turnouts as described above in this chapter have to be followed. This is of particular importance if turnouts are used in the deflection.

Whereas in general, in railway stations the catenaries are suspended by cross trusses or transversal joists, this must be avoided for high-speed tracks, with view to the danger of oscillation. For high-speed tracks, single mast suspension must be foreseen also in railway stations.

With view to the safety of passengers and railway staff, in EU member States, as a minimum the requirements as set out in the TSI (in particular INF TSI, ENE TSI and PRM TSI), described in chapter 3.3. or in other countries, equivalent national laws must be applied.

Accessibility remains a key parameter for all high-speed rail services. To ensure that these services capture the maximum possible passengers from other forms of transport stations need to be equipped with the necessary facilities for such a level of service. For example, platform heights need to be such to allow step free access to passengers and information within the stations needs to be clear and sufficient to ensure smooth and efficient boarding and alighting in order not to slow train operations. There are a number of examples of good station operation which facilitate the passage of passengers through stations in a safe and effective manner. A separate benchmarking study could be undertaken to highlight best practices on station operations in a high-speed environment.

## 3.3. Specifications of technical, operational and maintenance parameters

As a general recommendation, implementing high-speed rail projects should, at least in principle, follow the UIC brochure "High-speed rail — fast track to sustainable mobility [19], however in line with the legal prescriptions and technical rules as described below, in this chapter.

As explained earlier, high-speed railways have been built in many parts of the world since the 1970s. Countries developed their individual standards, of course obeying physical laws, but covering also important aspects including safety, protection of travellers, staff, adjacent citizens and the environment, as well as economic and financial needs. It is evident that different requirements resulted in different directives, not in principle, but concerning side issues and details. Anyway, as a result there is a lack of interoperability, complicating international transport because of waiting times and additional operation costs.

Further to that, differing technical solutions have led to a rather segmented market for railway equipment, which therefore has become more expensive. (This is of course not only a problem for high-speed, but of the entire field of railway components.)

Since the Maastricht Treaty, it has been a general principle of the EU, to unify standards, in order to create favourable conditions for the common market. As already explained above in chapter 1.3., cross-border interoperability of railways enables trains to circulate without barriers at borders, but it also creates a common market for railway equipment, to achieve lower price levels. Both effects, though sometimes in contradiction to national interests, contribute to a higher competitiveness of rail against other modes of transport. Not least, this is also important with a view to competition from the road sector.

EU standards for railways are laid down in a set of "Technical Specifications for Interoperability" (TSI) [28], which have been amended and developed over several years and through many different versions. The executive body responsible for application of the TSIs on behalf of the European Commission is ERA, the EU Agency for Railways (the former European Railway Agency) in Valenciennes. In recent years, several TSIs were merged, in order to obtain a clearer structure. Relevant for high-speed infrastructure is the fact that the former separate TSI for conventional and for high-speed railways were replaced by the current INF TSI (Regulation No. 1299/2014). Furthermore, the ENE TSI (Regulation No. 1301/ 2014) covers energy supply, including catenary and pantographs. Other TSI refer to vehicles, operational and maintenance aspects, but also to the needs of persons with reduced mobility.

In EU member States, application of the TSIs is mandatory for all railway lines of the Trans-European Network for Transport (TEN-T) with gauges of 1,435, 1,520, 1,524, 1,600 and 1,668 mm, but not to narrow gauge lines. This means, in particular, that railway projects are eligible for funding from the CEF only if they follow the standards defined in these TSI. Depending on national legislation, these standards may be even higher in individual EU member States, with a view to national particularities, for example in relation to better protection against noise for those parts of the population living close to railway lines or related to the environment.

The International Union of Railways (UIC) has attended to basic questions of high-speed railways from a supra-national approach, in a comprehensive and systematic way. Prior, and in addition, to the EU, UIC has been aiming at promoting scientific research and technological development in the entire railway sector and at unifying standards, also outside the EU, on the basis of the most up-to-date practices. The result of UIC's efforts is a wide range of studies, leaflets and other publications, covering the optimisation of speed, technical issues, in particular the interaction between pantographs and catenaries, as well as safety and maintenance. The High-Speed Railway System Implementation Handbook, which is very comprehensive, has already been presented in the previous chapter 3.1. UIC cannot decree legally binding rules, but these papers, available on their website,[1] are indeed valuable and helpful recommendations, complementary to the TSIs, to support the design, construction, operation and maintenance of high-speed lines.

Furthermore, technical requirements are specified also in Annex II of the AGC agreement [29]. This legal instrument makes a distinction between existing and new lines. While it is virtually impossible to change existing lines, except by building new sections or renewing existing infrastructure, the specifications mainly apply to new infrastructure. These specifications cover many aspects, of which only a few may be relevant for high speed, e.g. track distances recommended to be 4,2 m as a minimum for speeds up to 300 km/h, or 17 tons per axle for high-speed rail cars or rail motor sets. Also, it states that new international railway lines should be built without any level crossings.

[1] www.shop-etf.com/en/leaflets-irs/7-way-and-works.html.

Other organisations, such as CER or EIM, which are important railway organisations, or RNE (RailNet Europe) have not published technical standards of relevance for high-speed.

Within EU member States, national standards or technical recommendations may be applied, but only if complementary to the TSIs, but not contradicting them. This may be helpful to cover national particularities that are not regulated at EU level.

Anyway, it is one of the declared principles and main objectives of UNECE-TER, to extend relevant EU policies also beyond EU territory, in order to achieve interoperability of railways also in eastern and south-eastern parts of Europe. The benefits of a single market on rail should not stop at the borders of the EU and operation of trains should continue without obstacles at borders. Besides applying EU legislation in non-EU countries might be advantageous easing their possible accession at a later date.

Therefore, one may consider applying the TSIs also in non-EU TER countries, in principle both for UIC standard (1,435 mm) and broad gauge (1,520 or 1,524 mm).

Given the great potential of high-speed railways in Russia, the largest of the TER countries, it is important to also identify the corresponding Russian standards, and compare the main design and operational rules with the corresponding TSIs, considering the specifications for the planned Moscow — Kazan high-speed line as an example. Russia, due to its extension, even of the European part, is a country in which high-speed rail has already great importance. This is likely to grow further in future.

In this context, it is necessary to take into account the different gauges within the TER region, which are certainly a strong obstacle to full railway interoperability in the east of Europe. To a certain degree, the border between the UIC standard gauge and the Russian broad gauge separates the European railway system into two parts (in this context, the Iberian and the Irish broad gauges are ignored as they are not relevant for TER).

However, changing the train gauge at the border is technically feasible. There are several solutions (technical and operational) to overcome the situation of different gauges:

- Changing bogies as this is currently done at most borders between GUS countries and UIC standard gauge
- Using displaceable axles, which can be adapted to both gauges by passing through a particular track device
- Changing trains by passengers (or transhipment of containers in freight transport).

Changing bogies is a lengthy process, in which the bodies of the wagons or carriages have to be lifted by cranes and bogies shifted along the track. This process can be applied only to wagons/carriages designed for this purpose, certainly not to fixed coupled train-sets. Nevertheless, it is technically not very sophisticated, so additional costs are not significant. However, it causes waiting times at the border in the order of 1-2 hours, which would not be compatible with high-speed.

Using displaceable axes enable gauge changes within a few minutes, but it needs special vehicles which must have complicated, special bogies. This procedure is used mainly in Spain, where trains — even high-speed trains — on one trip, use both standard and 1,668 mm broad gauge network sections. This system is technically fairly challenging and pays off economically only if it is used several times a day. It is not an option if trains would have to change the gauge only occasionally.

In general, requiring passengers to change trains might be the most appropriate solution. If passenger trains are parked alongside each other, using the same platform, this could be done within about 10 minutes, however less comfortably. This time loss might be acceptable, even more as the long distances towards the east from the borders to Ukraine or Belarus, would require many hours of travel time, even at high-speed.

Furthermore, these changing times could be combined with border crossing procedures, of course taking more time (for freight, in particular if unitised, this is the preferred way to avoid gauge changing, by lifting containers from one train to another one on the neighbouring track).

These deliberations show that there is a certain independence between the European standard gauge and the Russian broad-gauge areas. While in the EU member States Estonia, Finland, Latvia and Lithuania, the TSIs apply, this may, at least, be questioned for the large area of Russian broad gauge, at least beyond the main connections between the EU and Kiev/Moscow.

Against this background, in this chapter the most relevant prescriptions of Russian standards are compared with those in the corresponding TSIs, in order to derive and highlight key differences.

Currently, applying the following different TSIs (of which those for high-speed are highlighted in bold letters) is mandatory throughout the EU, including TER members. They cover the relevant subsystems of railways:

- **INF TSI** — infrastructure
- **ENE TSI** — energy supply
- **CCS TSI** — control, command, signalling
- **SRT TSI** — safety in railway tunnels
- **RST TSI** — rolling stock — locomotives and passenger rolling stock
- **WAG TSI** — rolling stock — freight wagons (not relevant for high-speed)
- **NOI TSI** — rolling stock — noise
- **PRM TSI** — persons with reduces mobility
- **OPE TSI** — operation and traffic management. Before 2012 separate for conventional (CR) and high-speed (**HS**) railways)
- **TA TSI** — telematics applications for freight (TAF TSI) and passengers (**TAP TSI**) (The abbreviation TA TSI is not in general use; mostly reference is made to both TAF and TAP TSIs).

A summary of the TSIs is provided below, followed by tables 3.1a-c, which explain the development, in particular the merging process, of the TSIs:

First merged **INF TSI**, Regulation 1299/2014, in force since 1 January 2015 (infrastructure):

- Track alignment and track centres' distance
- Track parameters (incl. turnouts and crossings)
- Specifications of track components (ballast, sleepers, rail fastening systems, rails)
- Platforms
- Stability of track and immediate action limits on track geometry defects

(Many of these specifications are dependent on the design speed of a line)

First merged **ENE TSI**, Regulation 1301/2014, in force since 1 January 2015 (energy):

- Power supply
- Contact wire material
- Geometry of the overhead contact line, quality of current collection
- Voltage and frequency, dynamic effects
- Pantograph gauge and contact force

(There is a high relevance of speed in all aspects regarding catenary and pantographs)

**CCS TSI,** Regulation 2016/919, in force since 05/07/2016 (control, command and signalling):

ERTMS = European Rail Traffic Management System = ETCS + GSM-R:

- Track-side and on-board control, command and signalling, (train protection; voice radio communication; data radio communication; train detection)
- GSM-R (Global System for Mobile Communications — Railway)
- ETCS (European Train Control System), levels 0, 1, 2 and 3:
    - Level 0 Safety back-up level, enabling operation in case ETCS would fail
    - Level 1 Similar to conventional intermittent signalling, usually not applied for speeds greater than 160 km/h
    - Level 2 Linear, continual signalling without trackside signals, appropriate for high-speed
    - Level 3 Continual signalling not bound to blocks

Second **SRT TSI**, Regulation No. 1303/2014, in force since 1 January 2015 (safety in railway tunnels):

- Risk scenarios: "hot" incidents: fire, explosion followed by fire, emission of toxic smoke or gases, "cold" incidents: collision, derailment
- Infrastructure (crossways, etc.)
- Tunnel emergency plan
- Self rescue
- Exercises

First merged **RST TSI**, Regulation No. 1302/2014, in force since 1 January 2015 (locomotives and passenger rolling stock):

- Self-propelling thermal or electric trains or electric traction units, passenger carriages
- Maximum speed
- Traction
- Braking
- Buffers and couplings
- Lamps, horns, toilets, etc.
- Aerodynamic effects (relevant for high-speed)

Third **NOI TSI**, Regulation No. 1304/2014, in force since 1 January 2015 (rolling stock — noise):

- New and upgraded rolling stock
- Stationary, starting and passing-by noise, inside noise.

Second **PRM TSI**, Regulation No. 1300/2014, in force since 1 January 2015 (accessibility of the rail system for persons with disabilities and persons with reduced mobility):

- Infrastructure (access to platforms, etc.)
- Rolling stock (entry into rolling stock, clearances, etc.)

**OPE TSI**, Commission Regulation 2015/995, in force since 1 July 2015 (operation and traffic management):

- Trains and staff, drivers
- Linguistic knowledge and communication
- Driver vigilance
- Train visibility and audibility
- Timetables
- Operational quality

**TAP TSI**, Commission Regulation No. 454/2011, amended by Regulations No. 665/2012 and 1273/2013, the latter in force since 8 December 2013 (telematics applications for passengers):

- Systems providing passengers with information before and during the journey
- Reservation and payment systems
- Luggage management
- Issuing of tickets via ticket offices or ticket selling machines or telephone or Internet; or any other widely available information technology, and on board trains
- Management of connections between trains and with other modes of transport.

Most of these TSIs, apart from the general EU level, also allow, in certain aspects, for specific national particularities and possible adaptation to national conventions. Beyond the TSIs, national as well as UIC standards supplement the TSI, in particular with respect to issues which the TSIs do not regulate.

The following chronological charts (tables 3.1a-c), issued and updated by the EU Agency for Railways and available on their website,[2] show the complex, interrelated development of the TSIs. Through the link that is indicated in the footnote, individual TSIs can be downloaded in all EU languages. After merging TSIs for high-speed and TSIs for conventional railways, the complete set of TSI applies both to conventional and high-speed infrastructure and rolling stock, as for example in INF TSI section 4.2.9 on platforms or in PRM TSI, however with specific provisions that depend on operational speed, wherever this would have an influence on design and operation.

[2] www.era.europa.eu/Document-Register/Documents/TSIs-chronology.pdf.

## Table 3.1a - Development of INF, ENE, SRT and PRM TSIs

| Year | INF | | ENE | | TSI SRT | TSI PRM |
|---|---|---|---|---|---|---|
| | HS TSI INF | CR TSI INF | HS TSI ENE | CR TSE ENE | | |
| 1999 | | | | | | |
| 2000 | | | | | | |
| 2001 | | | | | | |
| 2002 | Decision 2002/732<br>(1st HS INF TS)<br>EiF: 30/11/2002 | | Decision 2002/733<br>(1st HS ENE TSI)<br>EiF: 30/11/2002 | | | |
| 2003 | | | | | | |
| 2004 | | | | | | |
| 2005 | | | | | | |
| 2006 | | | | | | |
| 2007 | | | | | | |
| 2008 | Decision 2008/217<br>(2nd HS INF TS)<br>EiF: 21/12/2007<br>DoA: 1/7/2008 | | Decision 2008/284<br>(2nd HS ENE TSI)<br>EiF: 6/3/2008<br>DoA: 1/10/2008 | | Decision 2008/163<br>(1st SRT TSI)<br>EiF: 21/12/2007<br>DoA: 1/7/2008 | Decision 2008/164<br>(1st PRM TSI)<br>EiF: 27/12/2007<br>DoA: 1/7/2008 |
| 2009 | | | | | | |
| 2010 | | | | | | |
| 2011 | | Decision 2011/275<br>(1st CR INF TSI)<br>DoA: 1/6/2011 | | Decision 2011/274<br>SRT and PRM TSIs | Decision 2011/291<br>(amendment)<br>DoA: 1/6/2011 | |
| 2012 | Decision 2012/462<br>(Amendment of Decision 2002/732 etc.)<br>DoA: 24/1/2013 | | Decision 2012/462<br>(Amendment of Decision 2002/733 etc.)<br>DoA: 24/1/2013 | | | |
| | Decision 2012/464/EU:*<br>DoA: 24/1/2013 | | | | | |
| 2013 | | | | | | |
| 2014 | Regulation 1299/2014<br>(1st merged INF TSI)<br>EiF/DoA: 1/1/2015 | | Regulation 1301/2014<br>(1st merged ENE TSI)<br>EiF/DoA: 1/1/2015 | | Regulation 1303/2014<br>(2nd SRT TSI)<br>EiF/DoA: 1/1/2015 | Regulation 1300/2014<br>(2nd PRM TSI)<br>EiF/DoA: 1/1/2015 |
| 2015 | | | | | | |
| 2016 | | | | | | |

amending Decisions 2006/861/EC, 2008/163/EC, 2008/164/EC, 2008/217/EC, 2008/232/EC, 2008/284/EC, 2011/229/EU, 2011/274/EU, 2011/275/EU, 2011/291/EU etc. (EiF: entry in force, DoA: date of application)

**Table 3.1b - Development of RST and CCS TSIs (EiF: entry in force, DoA: date of application)**

| Year | RST | | | | CCS | |
|---|---|---|---|---|---|---|
| | **HS TSI RST** | **CR TSI RST** | **HS TSI ENE** | **CR TSE ENE** | **HS TSI CCS** | **CR TSI CCS** |
| **1999**<br>**2000** | | | | | Decision 1999/569 on basic parameters EiF: 29/07/1999 | |
| **2001** | | | | | Decision 2001/260 on basic parameters | |
| **2002**<br>**2003** | Decision 2002/735 (1st HS RST TSI) EiF: 30/11/2002 | | | | Decision 2002/731 (1st HS CCS TSI) | |
| **2004**<br>**2005** | | | Decision 2004/446 (on basic parameters) | Decision 2004/446 (on basic parameters) (CR only) | Decision 2004/447 (amendment annex A) | Decision 2004/447 (on basic parameters) |
| **2006** | | | | Decision 2006/66 | Decision 2006/860 (2nd HS CCS TSI) DoA: 7/11/2006 | Decision 2006/679 (1st CR CCS TSI) |
| **2007** | | | | | Decision 2007/153 (amendment annex A) DoA: 6/3/2007 | |
| **2008** | Decision 2008/232 (2nd HS RST TSI) EiF: 21/2/200 DoA: 1/9/20088 | | Decision 2006/861 (1st CR WAG TSI) DoA 31/01/2008 | | Decision 2008/386 (amendment annex A) | |
| **2009** | | | Decision 2009/107 (amendment) DoA: 1/7/2009 | | | Decision 2009/561 (amendment ch.7) DoA: 1/9/2009 |
| **2010** | | | | | Decision 2010/79 (amendment annex A) DoA: 1/4/2010 | |
| **2011** | | Decision 2011/291 (1st CR LOC&PAS TSI) DoA: 1/6/2011 | | Decision 2011/229 (2nd NOI TSI ) | | |
| **2012** | Decision 2012/464: DoA: 24/1/2013 | | | | Decision 2012/696 (amendment annexes A and G) DoA: 23/7/2012 | |
| | Decision 2012/462 (Amendment of Decision 2002/73 etc.) DoA: 24/1/2013 | Decisions 2012/462 and 2012/463 (amendment) DoA: 24/1/2013 | | Decision 2012/462 (Amendment of Decision 2006/66 etc.) DoA: 24/1/2013 | Decisions 2012/462 and 2012/463 (amendment) DoA: 24/1/2013 | Decision 2012/463 amendment DoA: 24/1/2013 |
| **2013** | | | Regulation 321/2013 (2nd WAG TSI) EiF: 13/4/2013 DoA: 1/1/2014<br>Regulation 1236/2013 Amendment EiF: 4/12/2013 DoA: 1/1/2014 | | Decision 2012/88 (1st merged CCS TSI) DoA: 1/1/2013 | |
| **2014** | Regulation 1302/2014 (2nd LOC&PAS TSI) EiF/DoA: 1/1/2015 | | Regulation 2015/924 amendment DoA: 01/07/2015 | Regulation 1304/2014 (3rd NOI TSI) EiF/DoA: 1/1/2015 | | |
| **2015** | | | | | Decision (EU) 2015/14 (amendment) DoA: 1/7/2015 | |
| **2016** | | | | | Commission Regulation 2016/919 (recast) EiF: 05/07/2016 | |

**Table 3.1c - Development of OPE and TA (TAF and TAP) TSIs (EiF: entry in force, DoA: date of application)**

| Year | TSI OPE | | TA | |
|---|---|---|---|---|
| | **HS TSI OPE** | **CR TSI OPE** | **CR TSI TAF** | **TSI TAP** |
| **2002** | Decision 2002/734<br>(1st HS OPE TSI)<br>DoA: 12/3/2003 | | | |
| **2003** | | | | |
| **2004** | | | Decision 2004/446<br>on basic parameters | |
| **2005** | | | | |
| **2006** | | Decision 2006/920<br>(1st CR OPE TSI)<br>DoA: 18/05/2007 | Regulation 62/2006<br>(1st TAF TSI)<br>EiF: 19/1/2006 | |
| **2007** | | | | |
| **2008** | Decision 2008/231<br>(2nd HS OPE TSI)<br>DoA: 1/9/2008 | | | |
| **2009** | | Decision 2009/107<br>(amendment)<br>DoA: 1/7/2009 | | |
| **2010** | Decision 2010/640<br>(amendment)<br>DoA: 25/10/2010 and<br>01/01/2014 | Decision 2010/640<br>(amendment)<br>DoA: 25/10/2010 and<br>01/01/2014 | | |
| **2011** | | Decision 2011/314<br>(2nd CR OPE TSI)<br>DoA: 01.01.2012 | | Regulation 454/2011<br>(1st TAP TSI)<br>EiF: 13/5/2011 |
| **2012** | Decision 2012/464<br>amending Decisions 2008/231/EC<br>and 2011/314/EU etc. | | Regulation 328/2012<br>(amendment)<br>EiF: 08/5/2012 | Regulation 665/2012<br>(amendment)<br>EiF: 22/7/2012 |
| **2013** | | | Regulation 280/2013<br>(amendment)<br>EiF: 24/3/2013 | Regulation 1273/2013<br>(amendment)<br>EiF: 8/12/2013 |
| **2014** | Decision 2012/757 OPE:2012<br>(1st merged OPE TSI)<br>DoA: 1/1/2014 | | | |
| **2015** | Commission Regulation 2015/995<br>amending Decision 2012/757/EU<br>EIF/DoA: 20/07/2015 | | Regulation 1305/2014<br>(2nd TAF TSI)<br>EiF/DoA: 1/1/2015 | |

### Comparison of TSI and corresponding Russian standards

The Russian "project specifications for the high-speed line Moscow — Kazan" (PSS-MK), which were received from the Russian Federation are of special interest, due to an approach that differs from the TSIs. Therefore, some parts of it are compared with corresponding paragraphs of the TSIs and a complete copy of this document can be found in annex II.

The following comparison has been provided for information purposes only and is not intended to provide a full engineering comparison of the specifications but to illustrate the similarities and differences between the two systems. Only a selection should show some main criteria of track geometry and catenary structure according to INF TSI and ENE TSI, compared with the project-specific technical specification for the design of the Moscow —

Kazan high-speed line. For full comparability, the following figures refer to the prescription for 1,520 mm broad gauge in the TSI, while the Russian standards apply by default to this gauge.

Of course, physical laws apply generally, dynamic forces are the same. Certain differences result from a different approach on other aspects including economy, environment, safety and security, a different basic "philosophy", other general technical standards or with a view to particular climate situations.

The following table 3.2 shows similarities and differences between these design standards, regarding important technical parameters, i.e. track distances, cants and cant deficiency. It is evident that the Russian standard gives predominantly functional prescriptions, represented by formulas, while the TSI prescribe absolute thresholds or limits, depending on design speed.

**Table 3.2 - Track distance, cant and cant deficiency; comparison INF-TSI — Russian "PSS-MK"**

<table>
<tr><td colspan="4">Minimal nominal horizontal distances between track centres</td></tr>
<tr><th>Speed</th><th>INF TSI 1,435 mm</th><th>INF TSI 1,520 mm</th><th>PSS-MK 1,520 mm [i]</th></tr>
<tr><td>≤ 160</td><td></td><td>4.10 m</td><td>4.10 m</td></tr>
<tr><td>160 < v ≤ 200</td><td>3.80 m</td><td>4.30 m</td><td>4.10 m</td></tr>
<tr><td>200 < v ≤ 250</td><td>4.00 m</td><td>4.50 m</td><td>4.10 m</td></tr>
<tr><td>250 < v ≤ 300</td><td>4.20 m</td><td>4.70 m</td><td>4.50 m</td></tr>
<tr><td>300 < v ≤ 350</td><td>4.50 m</td><td>4.70 m</td><td>4.80 m</td></tr>
<tr><td>350 < v ≤ 400</td><td>4.50 m</td><td>4.70 m</td><td>5.00 m</td></tr>
<tr><td colspan="4">Maximum design cant</td></tr>
<tr><th>Track type</th><th>INF TSI freight and mixed traffic</th><th>INF TSI passenger traffic</th><th>PSS-MK 1,520 mm [i] general maximum</th></tr>
<tr><td>Ballast track</td><td>160 mm</td><td>180 mm</td><td rowspan="2">150 mm</td></tr>
<tr><td>Non-ballast track</td><td>170 mm</td><td>180 mm</td></tr>
<tr><td colspan="4">Maximum cant deficiency</td></tr>
<tr><th colspan="2">Category</th><th>INF TSI</th><th>PSS-MK 1,520 mm [i]</th></tr>
<tr><td>Freight trains</td><td></td><td>130 mm</td><td>-0.3 $m/s^2$ [ii]</td></tr>
<tr><td rowspan="6">Passenger trains</td><td>≤ 160</td><td>153 mm</td><td>0.7 $m/s^2$</td></tr>
<tr><td>160 < v ≤ 200</td><td>153 mm</td><td>0.7 $m/s^2$</td></tr>
<tr><td>200 < v ≤ 250</td><td>153 mm</td><td>0.7 $m/s^2$</td></tr>
<tr><td>250 < v ≤ 300</td><td>153 mm</td><td>0.6-0.7 $m/s^2$ [iii]</td></tr>
<tr><td>300 < v ≤ 350</td><td>100 mm</td><td>0.5-0.6 $m/s^2$</td></tr>
<tr><td>350 < v ≤ 400</td><td>100 mm</td><td>0.4-0.5 $m/s^2$</td></tr>
</table>

Notes: [i] PSS-MK relate to project specific parameters for the Moscow-Kazan high-speed line.
[ii] The PSS-MK specify the maximum non-quenched transversal acceleration: 0.3 $m/s^2$ (under difficult conditions — 0.4 $m/s^2$ towards inside curve.
[iii] The admissible non-quenched transversal acceleration decreases continually with speed: The lower value applies to the higher speed, the higher value for the lower speed, with linear interpolation between.

Similarly, INF-TSI indicates absolute figures for vertical curves, i.e. curvatures at crests or in hollows, while the Russian "PSS-MK" prescribes limits of acceleration to calculate curvatures, as set out in the box below.

### Box 1 - Vertical curves

**INF TSI (4.2.3.5.):**

Minimum radius of vertical curve:

1. The radius of vertical curves (except for humps in marshalling yards) shall be at least 500 m on a crest or 900 m in a hollow.
2. For humps in marshalling yards the radius of vertical curves shall be at least 250 m on a crest or 300 m in a hollow.
3. Instead of point (1), for the 1,520 mm track gauge system the radius of vertical curves (except the marshalling yards) shall be at least 5,000 m both on a crest and in a hollow.
4. Instead of point (2), for the 1,520 mm track gauge system and for humps in marshalling yards the radius of vertical curves shall be at least 350 m on a crest and 250 m in a hollow.

**PSS-MK (6.1):**

Vertical curves:

- The maximum inclination of the profile elevation of the main tracks must not exceed 24‰.
- Straight-line elements of the profile elevation must be mated with the vertical curve.

The radius of the vertical curve is determined with consideration of the restriction of the maximum vertical acceleration at passage of trains on the curve (to ensure comfortable travel for passengers and ride quality), which is as follows:

- For passenger trains on summits — no more than 0.3 $m/s^2$
- For passenger trains on sags — no more than 0.4 $m/s^2$.

The box below provides a comparison for catenaries between ENE-TSI (4.2.9): Contact wire height and PSS-MK (14.4): Railway electric power supply. Despite some minor differences regarding the grading, the maximum height of the contact wire of the catenary above the level of rail tops is 6.80 m in both cases (TSI for 1520 mm gauge and PSS-MK).

## Box 2 - Catenary

**ENE TSI (4.2.9):**

### 4.2.9.1. Contact wire height

(1) The permissible data for contact wire height is given in table 4.2.9.1.

**Table 4.2.9.1 - Contact wire height**

| Description | V ≥ 250 km/h | V < 250 km/h |
|---|---|---|
| **Nominal contact wire height [mm]** | Between 5,080 and 5,300 | Between 5,000 and 5,750 |
| **Minimum design contact wire height [mm]** | 5,080 | In accordance with EN 50119:2009, clause 5.10.5 depending on the chosen gauge |
| **Maximum design contact wire height [mm]** | 5,300 | 6,200[1] |

[1] Taking into account tolerances and uplift in accordance with EN 50119:2009 figure 1, the maximum contact wire height shall not be greater than 6,500 mm. 12 December 2014 EN Official Journal

(2) For the relation between the contact wire heights and pantograph working heights see EN 50119:2009 figure 1.

(3) At level crossings the contact wire height shall be specified by national rules or in the absence of national rules, according to EN 50122-1:2011, clauses 5.2.4 and 5.2.5.

(4) For the track gauge system 1,520 and 1,524 mm the values for contact wire height are as follows:

a. Nominal contact wire height: between 6,000 mm and 6,300 mm

b. Minimum design contact wire height: 5,550 mm

c. Maximum design contact wire height: 6,800 mm.

PSS-MK (14.4): Railway electric power supply:

14.4. To ensure high quality current collection at speeds of up to 400 km/h, when designing the HSR, the overhead catenary and power collectors must be considered to be a single electromechanical system with dynamic characteristics and quality of the sliding electrical contact conditional upon the parameters of the current collector and the overhead catenary.

14.4.1. The minimum allowable vertical clearance for an overhead line is 5,620 mm from the top of rails.

14.4.2. The maximum length of catenary spans must be limited based upon reliable current collection criteria, but must not exceed 70 m.

14.4.3. Overhead system wire tension must ensure the spread velocity of transversal waves in the overhead catenary exceeding the maximum speed of electric stock by at least 43%.

14.4.4. The working height of the current collector slide for electric stock moving on HSR sections with speeds between 200 km/h and 400 km/h must be within the range of 5,570 mm and 6,200 mm from the top of rails, and when entering the overhead system section at speeds below 250 km/h, the current collector must ensure current collection at the maximum height of the overhead line of 6,800 mm from the top of rails.

14.4.5. AC static current collector pressure must be equal to 70 (+20/-10) N.

14.4.6. The HSR overhead system must be designed for operation with one or two simultaneously raised current collectors. The distance between two operational current collectors must be at least 150 m, but not more than 400 m.

Overall, the parameters are quite similar, however, as already mentioned, show a different approach in some cases where the TSI mainly sets out specific figures, the Russian standard sets out conditions which describe the parameters functionally. In general, the Russian paper is more specific and detailed, which should be seen in the context of its purpose, namely the design and construction of the Moscow — Kazan high-speed line, which will be operated at 400 km/h.

Contrary to this, the TSIs are general rules applicable in all parts of the EU railway network. They are more complex in their structure, whereas the Russian specification is concentrated in one document. As set out earlier, it is recommended to apply the TSIs also beyond EU borders in the TER area, to ensure full interoperability across Europe. This is even more important as many of the currently non-EU TER countries may become EU members.

It is not possible within the margins of this study to compare all existing standards, in particular the national ones, however, in substance, there seem to be no significant differences between the considered standards. The partial juxtaposition of INF and ENE TSI with extracts from the Russian project-specific technical specifications for the design of the Moscow — Kazan high-speed line should only give some examples. In specific cases, it is necessary to obey all relevant laws and specifications, both national and supra-national.

For comparison, it would also be appropriate to consider also an example from Japan. Table 3.3 reproduces a table from the paper "Infrastructure for high-speed lines in Japan" by Atsushi Yokoyama, the director of the Paris office of Japan Railways Group [27].

**Table 3.3 - Shinkansen infrastructure parameters**

| Line name | Tokaido | Sanyo | Tohoku | Hokuriku |
|---|---|---|---|---|
| **Section of line** | Tokyo-Shin-Osaka | Okaynawa-Hakata | Omiya-Morioka | Takasaki-Nagano |
| **Year opened** | 1964 | 1975 | 1982 | 1997 |
| **Max. speed (mph) initial/ present** | 130/168 | 130/186 | 130/171 | 162/162 |
| **Track gauge (mm)** | | | | 1 435 |
| **Permissible axle weight (t)** | 16 | 16 | 17 | 16 |
| **Dominant track type** | Ballast | Slab | Slab | Slab |
| **Distance between centres of main tracks (m)** | 4.2 | 4.3 | 4.3 | 4.3 |
| **Minimum curve dadius (m)** | 2 500 | 4 000 | 4 000 | 4 000 |
| **Maximum design cant (mm)** | 200 | 200 | 180 | 200 |
| **Cross section of tunnel (m²)** | 60.5 | 63.4 | 63.4 | 63.4 |
| **Maximum gradient (if needed)** | 1.5% (2%) | 1.5% (2%) | 1.2% (1.5%) | 1.5% (3.5%) |
| **Electrical power supply (AC)** | 25KV 60Hz | 25KV 60Hz | 25KV 50Hz | 25KV 50/ 60Hz |
| **Signal type** | Digital ATC | ATC | Digital ATC | ATC |

Comparing these Japanese parameters with INF TSI or the Russian PSS-MK, the maximum cant of 200 mm attracts attention. This is because the entire Shinkansen Network is exclusively for passenger traffic, while freight is transported on a separate narrow gauge network. Against this background, the relatively low gradients, mostly in the range of a maximum 2‰, are remarkable. It is also important to note that the use of 60 Hz AC frequency differs from European standards.

## 3.4. Prefeasibility, feasibility and alignment studies

### 3.4.1. Feasibility study for "Süd-Ost-Spange" (south-east link) in Austria, 1991 [28]

This multi-functional high-speed project had been developed to cope with the situation that in 1920, due to the Treaty of St. Germain, Austria had lost a significant part of its territory and gained the Burgenland in the east from Hungary. As a consequence, the railway network in this region had been disjoined, some lines had even dismantled and services interrupted, especially along the eastern and south-eastern borders. With the "Süd-Ost-Spange", the Austrian Federal Government, the ÖBB (Austrian Federal Railways) and the regions of Burgenland, Styria and Carinthia intended to close these network gaps to interconnect the large centres of Vienna, Graz and Klagenfurt and the mostly remote peripheral regions and to improve their accessibility.

Geographically, this feasibility study considered two sections, i.e. the "eastern section" Vienna — Vienna airport — Eisenstadt — Oberwart — Graz and the "western section" Graz — Klagenfurt — Villach — Austrian/Italian border close to Tarvisio. It was elaborated in several steps, by a team under the leadership of Peter Faller (Vienna University of Economics and Business), with contributions from Austria's leading experts in the field of spatial planning, economics and railway infrastructure and operation.

**Figure 3.15a - "Austrian "Süd-Ost-Spange" as shown in Decision 1692/96-EC ("TEN-T Guidelines")**

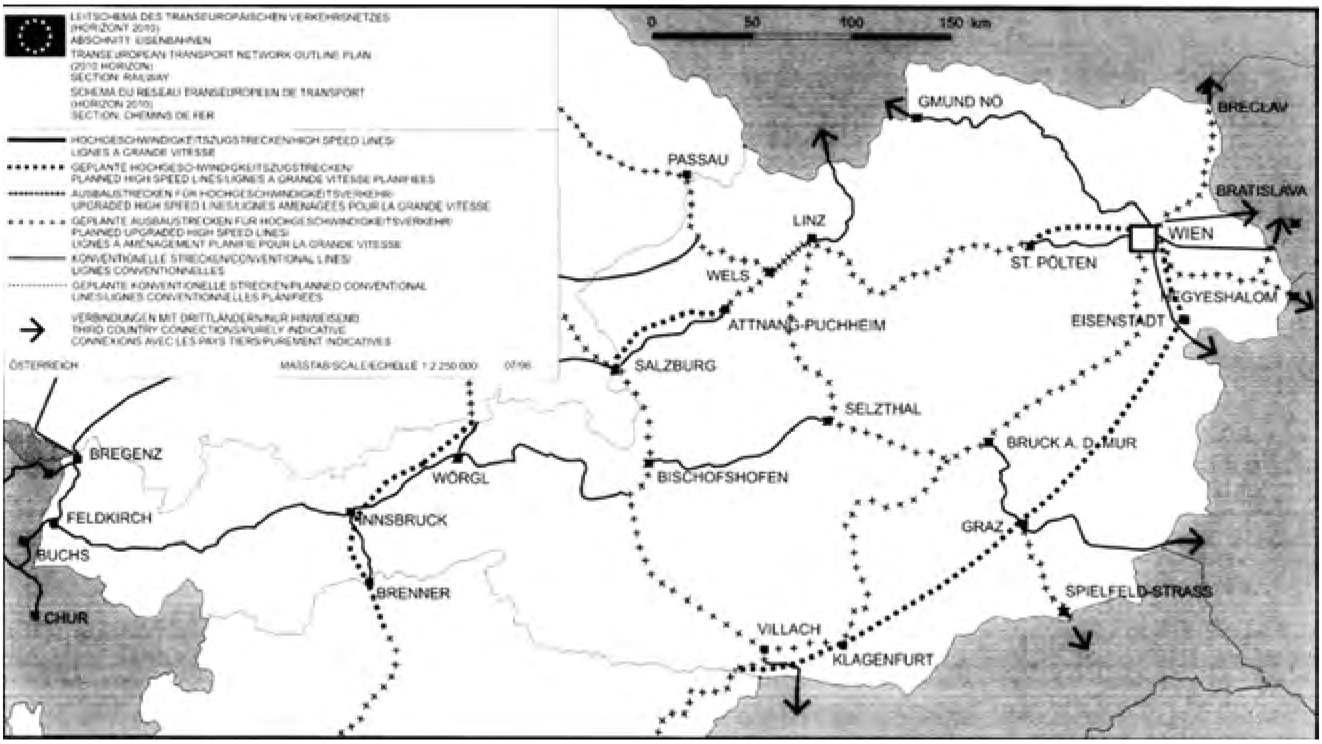
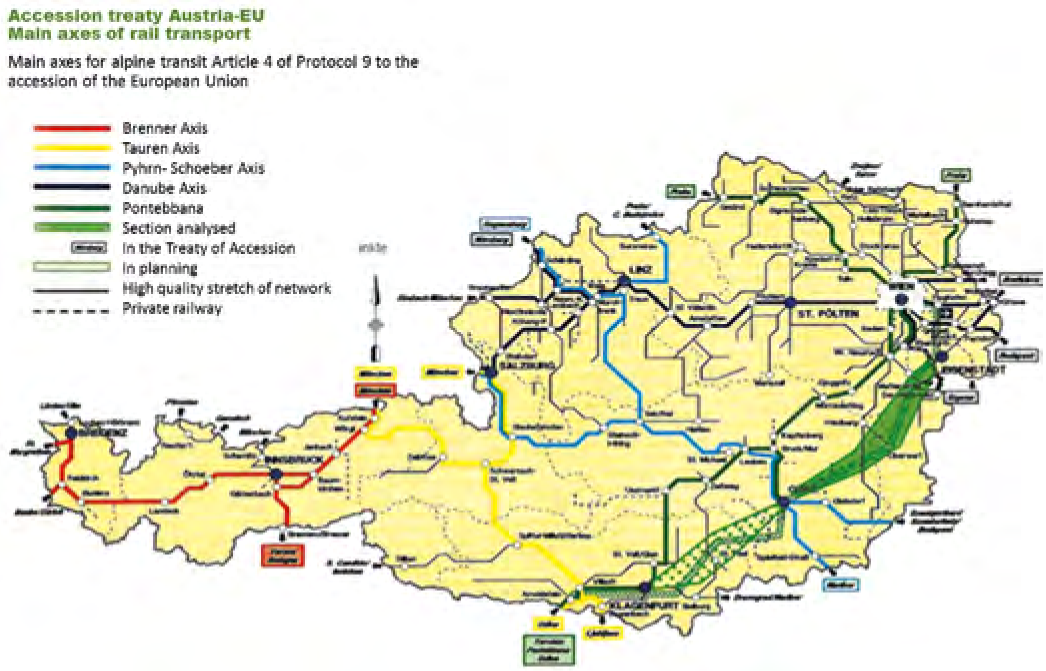


**Figure 3.15b - Investigation corridors of "Süd-Ost-Spange" according to HL-AG 1996**

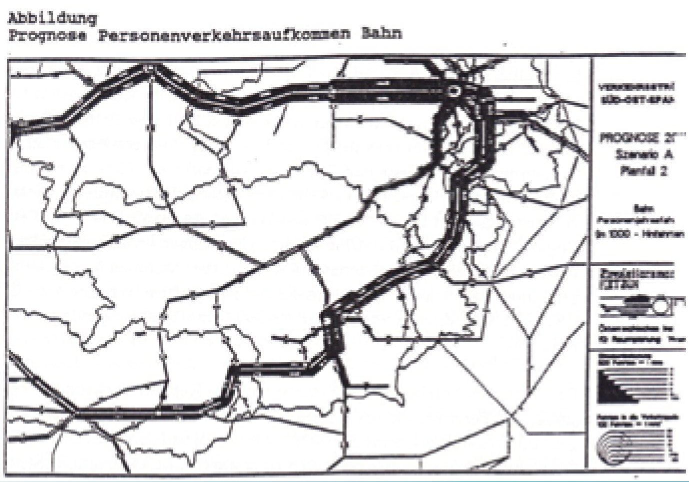



While the first and the second intermediate reports have the character of a pre-feasibility study, the further works ending in the final report are more focused and detailed, corresponding to a feasibility study.

### 3.4.2. First intermediate report

In the first step, the authors explained general aspects, project purpose and planning principles (e.g. infrastructural and operational integration with other, including regional lines, protection of landscape and environment) and made reference to the operational programme of this new line. Special attention was given to regional economy and spatial structures. Functional criteria like mixed operation for passengers and freight, tight interconnections with regional railway lines and, in particular, the possibility to establish an optimal timetable, based on so-called "clock-face departures", had been determined as pre-conditions for the selection of possible solutions.

**Figure 3.16 - "Süd-Ost-Spange", Forecast of railway passenger traffic 2020 by ÖIR**



The corresponding multimodal traffic analysis and forecasts considered the European and border crossing perspective, mainly towards eastern and southern neighbours (after the fall of the Iron Curtain), national passenger and freight flows and the linkage with airports. The calculations were carried out by means of the "NETSIM" model.

### 3.4.3. Second intermediate report

Separated for the "eastern section" and the "western section", the functionalities of the "Süd-Ost-Spange" was investigated as part of the Austrian and European trunk network — at that time the TEN-T did not yet exist. For the "eastern section", the parallel "Semmering base tunnel" was assumed to exist already, whereas the "western section" was considered as an alternative to upgrading the existing Bruck/Mur — Klagenfurt line, with a 28 km long tunnel through "Neumarkter Sattel". The focus was set on the development of variants, a rough identification of possible alignments, a description and appraisal of their main effects, based on traffic volumes, estimated construction and operation costs, spatial and environmental impacts and likely political acceptance. Variants that would not fulfil the requirements were eliminated early on. The investigation of the remaining variants continued in depth in what may be considered as a feasibility study in the narrower sense of the term.

Also, it has become evident that the "western section" Graz — Klagenfurt would have priority over the "eastern section", which could be constructed in a later phase, complementary to the existing line, which would be upgraded through the "Semmering base tunnel". Time savings between Vienna and Graz due to the "Süd-Ost-Spange" and inclusion of few smaller towns would not justify the investment and the impact on landscape and environment, as long as the capacity would not be needed.

### 3.4.4. Final report

Volume A summarises all the basic information set out in intermediate reports 1 and 2. Volume B is an alignment study of the "eastern section" Vienna — Eisenstadt — Oberwart — Graz, although it was already clear at that time, that construction of this section would be postponed, if not cancelled. Alignment optimisation was carried out through an investigation of travel times and its compatibility with a "clock-face" timetable, minimising spatial and environmental impacts.

Volume C sets out the same process for the "western section" Graz — Klagenfurt — Austrian/Italian border. In this context, also the possible later interlinkage with the "eastern section" in Graz and the inclusion of the planned rail-roads terminal south of Graz were studied. Possible alignments were selected step-by-step and subsection by subsection. The main criteria applied were effectiveness and compatibility with space, nature and environment.

Volume D contains construction and operation cost estimates, based on maps with a scale of 1:25.000, with unit costs obtained from comparison with similar projects. An implementation plan was developed, in order to show the most effective and efficient way for a step-by-step implementation, both of the "eastern section" and the "western section", so as to achieve partial benefits at the earliest possible time.

Total construction costs, including a supplement of 20% for environmental protection and contingencies, amounted to 36.9 billion (Austrian Schilling) ATS for the "eastern section", including a freight bypass of Graz, and 24.3 billion ATS for the "western section". For comparison, construction of "Koralm railway" Graz — Klagenfurt, corresponding to about 80% of the "western section" and currently under construction, costs about €6 billion.

Given that €1 equates to 13.76 ATS, this means that construction has grown by a factor of about 3, which is due only partially to inflation, but primarily to stricter environmental legislation, more noise barriers and higher safety requirements.

Further steps were establishing an operational concept and determining operation costs.

An economic assessment was carried out for both sections at three levels:

- Microeconomic (ÖBB)
- Regional economic (the affected regions between Vienna, Graz and the Austrian/Italian border)
- Macroeconomic, taking into account time savings and benefits from modal shift.

As these calculations were carried out by means of a cost-benefit-analysis, non-monetisable effects were taken into account in a verbal appraisal (Unfortunately, these assessments are not accessible). The consequence of these results was the political decision to drop the "eastern section" Vienna — Graz, but to further pursue the "Koralm Railway" project Graz — Klagenfurt, which is the main part of the "western section". Further investigations, that are mentioned in chapter 2.1, underlined the great spatial and socio-economic effectiveness of the "Koralm Railway" and finally lead to the political decision to actually implement this project.

### 3.4.5. Koralm Railway alignment study 1998 [30]

Picking up the results of the feasibility study for the "Süd-Ost-Spange" project of 1991, the next step was an in-depth investigation of "Koralm Railway", with the goal of selecting a definitive alignment and creating the basis for a future detail design.[3]

The following technical parameters were fixed by the contracting entity:

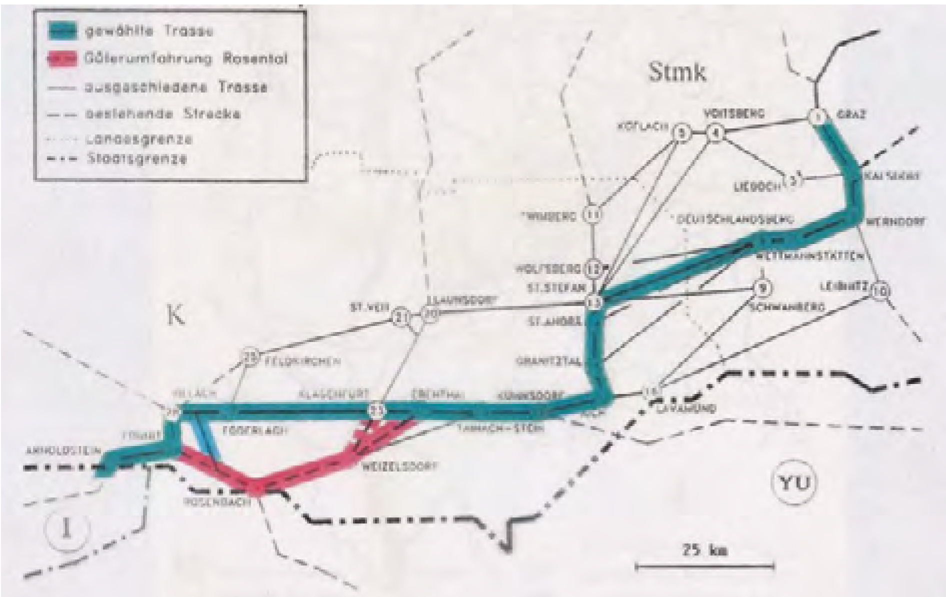
- A design speed of 200 km/h (later this was increased to 250 km/h
- Maximum radius of 3,000 m
- Maximum gradient of 12.5‰, in tunnels 5‰.

Starting with 10 alignment corridors, the recommended corridor was determined in two steps:

- Pre-selection on base of criteria for exclusion (e.g. of variants that would not permit travelling times below 60 minutes)
- Final selection according to travelling times, regional effects, political feasibility, suitability for freight transport, operational aspects, tunnel lengths, accompanied by a micro-economic comparison of the remaining corridors.

[3] The authors of this study was a consortium consisting of Klaus Riessberger, Helmut Stickler and Peter Cerwenka.

**Figure 3.17 - Koralm Railway; alignment variants and selected variant, continued to the border AT-IT (shown in turquoise)**




Finally the recommended corridor was further investigated and, in comparison with the former pan-European Corridor V, namely with the section Budapest —Zalalövö — Hodos — Pragersko — Ljubljana — Trieste — Venice and upgrading projects in Western Hungary, it was shown that there was no direct competition between these lines.

With updated construction costs for the section Graz — Klagenfurt amounting to about 28 billion ATS, the conclusion was that, in principle, "Koralm Railway" would be technically and politically feasible and beneficial for the Austrian and European railway network, and that no alternative would exist.

### 3.4.6. Feasibility Study on Rail Baltica Rail Baltica Railways [31]

Rail Baltica is a project that has its origins in the independence of the Baltic States 1991. With the goal to connect Estonia, Latvia and Lithuania with the centre of Europe, it was already part of the former pan-European Corridor 1 and later, after the accession of these countries to the EU in 2004, it became Priority Project No. 27 of the TEN-T Guidelines 2004 (Decision No. 884/2004/EC) [7], annex I.

On behalf of the European Commission, DG Regional Policy, in 2007, a Consortium led by COWI, with TRANSPORTO IR KELIŲ TYRIMO INSTITUTAS, NEA, University of Karlsruhe, ETC, OBET and Konsorts as partners, elaborated a feasibility study on "Rail Baltica Railways". In this study a set of three variants (called "Packages") — plus 2 sub-variants of package 3 — were investigated:

Package 1: design speed of minimum 120 km/h, Russian broad gauge

Package 2: design speed of minimum 120 km/h, Russian broad gauge

Package 3: design speed 160-200 km/h, European standard gauge

Package 3.1 different alignment Riga — Tallinn

Package 3.2 no electrification.

**Figure 3.18a**
**Rail Baltica; package 1**


**Figure 3.18b**
**Rail Baltica; package 2**


**Figure 3.18c**
**Rail Baltica; package 3**


For the three packages, passenger and freight traffic analyses were carried out, with the following results:

- Low passenger traffic in Estonia and Latvia
- International traffic flows along Rail Baltica corridor is dominated by road
- Relevant passenger flows exist between Warsaw and Białystok.

While packages 1 and 2 show freight volumes of about 1.5 million tons per year, this may increase to more than 4 million tons per year with package 3. This is also due to the possibility to tap the potential of cargo transport between Finland and central Europe.

The following table 3.4 shows the investment costs of the packages, as described above, in € million, at 2007 prices (excluding VAT).

**Table 3.4 - Rail Baltica; construction costs**

| € million (2007 prices) | Package 1 | Package 2 | Package 3 | Package 3 without electrification |
|---|---|---|---|---|
| Investment costs | 979 | 1,546 | 2,369 | 1,830 |

A financial analysis focusing on the costs and revenues from the perspective of the infrastructure manager, the operator of passenger trains and the operator of freight trains, shows a financial gap of more than 60% for all three packages. This might be compensated by grants by the EU (In the meantime, 85% can be granted from the CEF budget).

Beyond the financial returns, the economic analysis encompasses also users' benefits and externalities (air pollution, $CO_2$ emissions and accidents). It shows the following economic net present values (NPV), internal rates of return (IRR) and benefit-cost ratios (B/C ratios) as set out in the table below.

**Table 3.5 - Rail Baltica, results of economic analyses**

| | Investment Package 1 | Investment Package 2 | Investment Package 3 |
|---|---|---|---|
| **Rail manager** | | | |
| Financial NPV (FNPV) | -10 | -109 | -274 |
| FIRR on own capital (FRR/K) | 4.7% | 3.4% | 2.6% |
| **Rail operator, passengers** | | | |
| Financial NPV (FNPV) | -26 | -105 | -96 |
| **Rail operator, freight** | | | |
| Financial NPV (FNPV) | 33 | 39 | 70 |

The largest benefit of the investment is time savings for passengers, mainly due to packages 2 and 3, but also time savings for freight and increased revenues from freight are substantial.

Regarding the environment, package 3 is the most effective in terms of reduced emissions and accidents, but due to the construction of new sections, the local impact is the strongest one.

The recommended development and investment strategy is unclear. On the one hand, the cheaper solutions (packages 1 and 2) are financially more viable and, with the Russian broad gauge, have the advantage of full interoperability with the national networks. On the other hand, the European standard gauge solution would open the region to the core regions of the EU, both for passengers and freight.

The authors do not recommend a dual gauge solution, mainly because of operational problems and negative experiences from elsewhere. If a European standard gauge option is chosen, implementation should proceed from south to north, extending the existing standard gauge section from the Polish/Lithuanian border to Kaunas.

### 3.4.7. Feasibility Study for pan-European Railway Corridor IV of the Czech Republic/ Slovakian Border — Kúty — Bratislava — Nove Zamky — Štúrovo/Komarno — Slovakian Hungarian Border [32]

**Figure 3.19 - Location of Orient-EastMed Corridor in Slovakia**

This feasibility study was elaborated by Výskumný Ústav Dopravný (VUD; Transport Research Institute Bratislava, Žilina) for the Slovak Ministry of Transport, Construction and Regional Development in 2015. The main line extends from the Czech border near Kuty to the Hungarian border near Šturovo, with a branch from Nové Zámky to Komárno on the Danube. The corridor under review is subdivided into three sections:

- Kúty state border — Kúty — Devínska Nová Ves
- Bratislava Vajnory — Nové Zámky — Štúrovo — Štúrovo state border
- Nové Zámky — Komárno — Komárno state border.

After general considerations of the assumptions for the study and an analysis of the status quo of substructure, superstructure, overhead lines and the existing signalling system of the line, the first focus of the study has been dedicated to the demographic situation, traffic demand, traffic forecast and operational concepts. Within this feasibility study, much consideration is given to geological, hydrological and soil conditions, bio-diversity, climate protection, air quality, noise, as well as the natural and cultural heritage.

Four different alternative solutions have been investigated, considering railway sub- and superstructure, overhead line, electrical equipment and power supply and signalling and communication system.

The considered alternatives were called "no project" or "zero", "basic" or "blue", "medium" or "green" and "high" or "red".

- The "zero" alternative does not foresee investments beyond keeping the current operating conditions, which entails higher operational and maintenance costs
- The "basic" alternative means improving the infrastructure standards to the minimum level under TSI requirements, with an operating speed of 140 km/h on the main line and 120 km/h on the Nové Zámky — Komárno branch
- The "medium" alternative foresees improving the infrastructure standards at the minimum level under TSI requirements, for an operational speed of 160 km/h on the main line and 120 km/h on the Nové Zámky — Komárno branch
- The "high" alternative considers modification of routing the main line sections for speeds up to 200 km/h, namely for the passenger transport, in line with the national regulations and TSI standards, and 120 km/h in the Nové Zámky — Komárno branch.

From these alternatives, the following "variants" have been derived:

"A": Mainly corresponding to the "blue" alternative, with 140 km/h operational speed on the open line sections and 120 km/h to Komárno

"B": Mainly corresponding to the "green" alternative, with 160 km/h operational speed on the open line sections and 120 km/h to Komárno

"C": Mainly corresponding to the "red" alternative, with 200 km/h operational speed on the open line sections and 120 km/h to Komárno.

At the end of this review, there are comprehensive financial and socio-economic cost-benefit analyses for each variant. The investment costs, which comprise planning, land acquisition and construction including supervision and contingencies, have been determined for the variants as follows (price basis 2016, excluding VAT):

"A": €1.835 billion

"B": €2.188 billion

"C": €2.384 billion.

For all variants, investment costs resulted not to be covered by commercial revenues, resulting in the need for a substantial financial contribution from the EU (85%).

The socio-economic assessment, based on the assumption of unit prices for time, environmental and other socio-economic impacts, according to Slovak conventions, e.g. for time: €4.81/h (private) — €9.64/h (business), has led to the following benefit-cost ratios:

"A": 1.08

"B": 1.06

"C": 1.18.

(This example is used in chapter 5.4 to show the function of the CBA tool developed there)

Based on these clear results, the Slovak government has decided to pursue variant "C", i.e. upgrading to up to 200 km/h operational speed, for implementation.

## 3.5. Construction costs and times of high-speed infrastructure, maintenance costs; funding and financing

### 3.5.1. Construction costs

Basically and in accordance with the definition in chapter 1.1., one can distinguish between three categories of high-speed lines, i.e. new lines, constructed for high-speed (category i), upgraded conventional lines (category ii) and lines which are considered high-speed lines, although they are operated at lower speed, due to their alignment through difficult mountainous or built-up urban areas (category (iii)).

The main reason for implementing high-speed is a correspondingly high passenger traffic demand potential. But there may be also other reasons, such as modal shift or improving regional accessibility or simply capacity needs of freight transport (e.g. along corridors with growing cargo flows). If a new line is needed anyway, to remove a bottleneck situation, it may be useful to accept additional costs to design it for high-speed. Of course, any mixture of all these reasons is possible, as well.

Only in a few cases, a completely new railway network, exclusively dedicated for high-speed operation is implemented in a country. The Japanese Shinkansen high-speed system is an example: In Japan, previously there was a narrow-gauge network, mainly for freight, so the decision was made to construct a completely new UIC standard gauge network, only for high-speed passenger transport.

In general, high-speed lines are linked into an existing railway network, so that high-speed trains may operate also on conventional lines, to reach the main destinations in a country and abroad. Such high-speed lines may be designed either for mixed traffic or for high-speed trains, exclusively. This means that interoperability between new high-speed and existing conventional line must be foreseen, to facilitate the operation as foreseen. This applies also on the vehicles.

Generally, wherever feasible with view to the existent land morphology, completely new lines are designed with large radii and other parameters to allow a high level of speed. Along new railway lines, hardly level crossings would be foreseen. Therefore, in many cases, providing high-speed affects construction costs only marginally, in particular in green field in flat areas. In such cases, construction costs may range in the order of 10 million € per km, depending also on land acquisition costs. For Rail Baltica, total construction costs of only 5 million Euro are expected.

Of course, this is quite different where a line would follow a winded valley or through a densely-populated area. A higher share of bridges and tunnels, and expropriation may increase the unit costs per km considerably. In such cases, also provisions for environmental protection, in built-up areas also noise, may become a decisive cost factor: An average noise protecting wall is more expensive per meter than the track! Unit costs may reach orders up to €60 million per km and beyond. Based on 2017 prices, the average costs of constructing new double track high-speed lines in Austria is in the order between €20 and 36 million per km, with an average mixed value of €29 million per km. This average reflects the morphology of Austria outside the Alps. Included in these values is the share of the equipment for high-speed operability, which may vary between 10 and 15% (€3-5 million per km), however may reach 20-30% (€6-10 million per km), if the layout of railway stations must be changed. Under extreme conditions, variations may even be higher. Surprisingly low are the construction cost of only €5 billion budgeted for the 1,390 km long Rail Baltica project, which would correspond to only €3.6 million per km. This may be due to an extremely flat morphology and to a large extent sparsely populated area, with no need for tunnels and only few bridges and road crossings.

If a level crossing must be replaced by an underpass of a two lanes road, one may assume construction costs of €8-12 million each, flyovers would cost only €3-5 million each.

The most expensive parts of new railway lines are tunnels. For safety reasons, at least longer tunnels (> 5 km) are realised with two tubes, interconnected by transversal galleries every 500 metres. If foreseen for high-speed operation, tunnel cross sections must allow for air pressure compensation and therefore feature 80 to 100 $m^2$, which entails additional costs with respect to tunnels for conventional lines. Austrian examples, all three being two-tube tunnels, show a broad variance of implementation costs (including design, construction, equipment):

**Table 3.6 - Construction cost of tunnels in Austria**

| Base Tunnel | Total cost (€ billion) | Length (km) | Cost per km (€ million) |
|---|---|---|---|
| **Semmering** | 3.3 | 28 | 118 |
| **Koralm** | 2.4 | 33 | 73 |
| **Brenner*** | 5.0 | 31 | 161 |

* Brenner refers only to Austrian part.

(These differences are due to different geological qualities of the rock and different concepts: Brenner base tunnel consists of two operational tube plus a service tube in between, which also can be used for rescue in case of accidents or fire).

In hilly or mountainous regions, high-speed lines which are also to be used also for freight transport have to have low gradients, at the best below 10 or 12‰. This means a significant impact on the routing, with construction costs sometimes exploding, compared with pure high-speed lines with gradients up to 30 or even 40‰, as chosen for the Frankfurt — Cologne high-speed line.

Even upgrading existing conventional lines may be expensive, because apart from curvature, also other parameters have to be adapted. This comprises for instance, widening the track distance on double track lines, the abolition of level crossings, changing the configuration of railway stations (to avoid high-speed trains passing by platforms), providing a stiffer, single mast suspended catenary and an appropriate in-cabin signalling system, preferably ETCS level 2. While there are huge differences in construction costs of the substructure of high-speed lines, depending on many external conditions from flat country to tunnels, as described, this is not so much the case for the additional costs of superstructure, electrification and signalling. The following figures refer to the additional expenditures and equipment needed for high-speed lines, with respect to conventional lines in the same routing:

- The share of high-speed equipment is about €3-6 million per km for double track lines, but can reach about twice this value, if configurations of railway stations must be modified
- For a double track line, installation of ETCS level 1 costs about €100,000 per km, whereas level 2 costs between €175,000 and 260,000 per km, without signal-boxes.

An example from Slovakia is the upgrading project of sections Kúty — Devínska Nová Ves (51 km) and Bratislava Vajnory — Nové Zámky — Štúrovo (93 km) of the Orient-EastMed Corridor [32]. Although the existing alignment corresponds to high-speed requirements, to a large extent, an investment of €2,384 billion (excluding VAT) is foreseen to increase the operational speed from the current 120-140 km/h to 200 km/h. This corresponds to an average of €16.7 million per km.

Examples from the Russian Federation and Turkey show quite different unit construction costs:

- Moscow — Kazan: 772 km €15 billion €19.43 million per km
- Ankara — Istanbul: 533 km €3.5 billion €6.57 million.

These numbers mean that construction costs per kilometre are three times higher in the Russian Federation than in Turkey. Although it is reasonable to assume that morphological conditions are more difficult in Turkey than in Russia, even considering the different time horizons (Ankara — Istanbul completed in 2014 whereas Moscow — Kazan planned) the fact that the Moscow — Kazan link has been designed for 400 km/h, against the Turkish section for only 250 km/h will have an impact on the total cost.

As one can see from these values, the influence of surrounding conditions, morphology and geology, legal requirements, foreseen operation etc. is so great, that giving an unambiguous specification of unit costs is not possible. Most indications are therefore intervals on minima and maxima costs (based on 2015-2017 price levels), which furthermore change over time.

### 3.5.2. Construction times

Whereas the implementation process includes the design, approval and construction phases, in the following only the construction phase is highlighted, because sometimes approvals may be unpredictably lengthy, depending on the public acceptance of a project and the legal situation in a country.

The following examples indicate the periods from starting construction to opening of the line, for projects in several parts of Europe:

| | |
|---|---|
| Paris — Lyon | 1976-1981 |
| Cologne — Frankfurt | 1995-2002 |
| Milan — Rome | 1970 (?)-2009 (*) |
| Vienna — Linz | 1989 (?)-2014 (*) excl. St.Pölten freight bypass |
| Moscow — St. Petersburg | 1998 (?)-2009 |
| Ankara — Istanbul | 2003-2014. |

Some of these projects (those marked with *) were implemented in phases, with longer breaks.

### 3.5.3. Maintenance

For maintenance, the difference of costs mainly derives from the narrow tolerances of high-speed line. With view to dynamic forces growing with the square of speed, these tolerances are in the order of +/- 1 mm as regards the undulation, while they may reach 10 or even 20 mm as regards deviations from the target value, if occurring on a long stretch. Whereas this is partly compensated by generally lower axle loads on pure high-speed lines, the situation is even worse, if freight is operated on the same track.

According to a technical expert, Professor DI. Dr. Peter Veit, Institute for Railways and Transport Economy of the Technical University in Graz (Austria), typical average maintenance costs (value base 2017, in Central Europe) can be quantified under certain circumstances: ballasted track, straight line (as values increase considerably if radius is less than 600 m), sufficient bearing capacity and drainage of substructure, granite ballast, heavy superstructure (rails uic60 or 60E1, concrete sleepers), no turnouts, mechanised maintenance in time.

| | |
|---|---|
| Conventional track (50,000 tons per day) | 10,000-25,000 €/km |
| High-speed track (350 km/h; 50,000 tons per day): | 35,000-45,000 €/km |

If tracks are used both by high-speed trains and heavy haulage freight trains, costs may be much higher, because tolerances for high-speed must be kept despite high strains from freight. A general quantification is not possible, not least if abrasive wear of inner rails in curves is relevant, due to super elevation designed for high-speed.

Also, maintenance costs are significantly higher in curves with radii below 600 m, but this an exception which only would apply for category (iii) high-speed lines (as described in chapter 1.1.).

Maintaining turnouts causes considerable costs, each equivalent to 500 m track. Total life cycle costs of a turnout Investment and maintenance amount to 10-12 times of the life cycle costs of a normal track.

### 3.5.4. Funding and financing

For funding and financing railway infrastructure, there are several possibilities at EU level and outside the EU, however not accessible to all TER countries:

EU:

- CEF ("Connecting Europe Facility", restricted to TEN-T core network, supporting also innovative "financial instruments" like project bonds, etc.)
- EFSI ("European Fund for Structural Investments", "Juncker fund, not really a fund, but "financial instrument" to leverage private money)
- Structural Fund, incl. ERDF ("European Regional Development" Fund)
- Cohesion Fund ("only for EU "cohesion countries", large fund, but dedicated also for other transport projects (e.g. road) and environment)
- IPA ("Instrument for Pre-accession" to prepare "candidate countries" for EU accession)
- Other funds (e.g. for EU "Eastern Partnership").

It has to be stated that, in principle, EU does not fund maintenance works.

International Financing Institutions (no grants, only loans)

- EIB (mainly EU and candidate countries)
- EBRD (with a focus on south-eastern Europe)
- World Bank.

Furthermore, there is strong interest from the Chinese government to develop and finance railway projects along corridors linking Europe and China. This applies in particular to sections that may become parts of a future railway link between China and Europe ("EATL", "New Silk Road" or "One Belt — One Road"), including the northbound hinterland connection of Piraeus including the Belgrade — Budapest link.


TCDD

# 4. Methodology and Data

## 4.1. Methodology to identify future traffic demand potentials

Infrastructure planning and constructing is a complex undertaking that takes, including the award of the necessary approvals, ten years or more on average and should be embedded in long-term strategies, with horizons at least 30 years ahead. Once built, transport infrastructure will remain for decades or even for centuries, forming the arteries of countries and economic spaces. As a matter of fact, strategic infrastructure planning does not only consist in (passively) coping with traffic demand, but also in (actively) shaping the structure of space. Planners should understand projects have a strong impact on space and environment, by changing space structure, accessibility and modal shares. This knowledge should serve to maximise positive effects while minimising detrimental impacts.

Forecasts are important tools to support decision-making. While getting reliable forecasts has always been a great challenge, this is even more difficult today, characterised by unsteady, volatile development, due to economic crises and political instabilities. The forecast as developed in chapter 4.2. is an attempt to obtain, in a justified way, plausible expectations how economy and mobility might develop in coming decades.

The methodology as described in this chapter, using simplifications to compensate uneven levels of information and data availability, consists of two main components:

- Component 1

  A simplified "gravitation approach" as described in the following chapter 4.2., to determine the "absolute traffic demand potential" ("ATDP"), which only reflects the geographic and demographic conditions in the area of TER countries; and

- Component 2

  An economic forecast for each TER country as explained in chapter 4.3., to include also the influence of a growing traffic demand and to obtain for each link the "weighted traffic demand potentials" ("WTDP") for the presence and the forecast horizons, which are selected to be 2030 and 2050.

Chapter 4.4. gives two examples to illustrate the way to apply this methodology on individual links, i.e. the Austrian railway sections Vienna — Linz (existing link with two conventional and two high-speed tracks) and Linz — Salzburg (two-track link, currently mostly conventional, but foreseen for selective the future).

After these examples, in part 5 of this study, this methodology is applied first to a set of reference links, existing or in implementation, mainly in EU countries, but also in Turkey and in the Russian Federation. Most of these links are in operation, but some of them are only planned or implementation is under way. Also, these links are different in the sense of their WTDP value and, consequently, of capacity utilisation and commercial success. This selection had been made by intention, to show that different reasons may be relevant for the decision on high-speed projects, in some cases even despite low WTDP values.

After this, the same methodology is applied to those links in TER countries, for which due to their functionalities, e.g. as sections of a corridor, high-speed operation may be an option.

The focal point of this methodology is the comparison of selected and investigated TER links with the reference links, based on their WTDP values. Out of the selected TER links, those with a WTDP value greater than average WTDP values of reference links, may be considered as candidates for high-speed. This may be the case already in the presence or at a later time horizon, when its WTDP value has reached such dimension.

This procedure allows a rough, but plausible estimation, which of the investigated links would at which time horizon reach a level of traffic demand, so that high-speed implementation could be appropriate. Further, with the economic growth in the background, it is also possible to identify priorities.

Given the inevitable inaccuracies of the data and the simplifications within the methodology, this study cannot replace much more in-depth investigations at national and at project level. Given current economic volatility, such planning steps should be done, as far as possible, as close to actual investment as possible.

## 4.2. Gravitation approach

Within the scope of this study, it is not possible to establish a fully-fledged traffic model for the TER area. However, with respect to the purpose of this study, this is not necessary, either.

The methodology of this study is based on the assumption of "Lill's travelling law", established already in 1891 [3], according to which the potential number of travellers between two cities can be described by a function, quite similar to Newton's gravitation formula. This empirically developed formula is the core of most of the usual traffic models, leading to a first approach or a matrix of traffic flows between the individual nodes, which in a traffic model are distributed to the different modes of transport and which are improved by a systematic calibration. Also Peter Veit applied this principle in his thesis on "cost effects of increasing speed in the Austrian railway system", as described in chapter 3.1. [25].

A classical traffic model consists of four steps (traffic generation, traffic distribution, modal choice and assignment to concrete routes). The more realistic database and functional approach (algorithm) of a model are chosen, the less is the need for calibration. (While any traffic model, if sufficiently calibrated, can quite well depict the status quo, this is not the case for modelling impacts of policy or infrastructure changes, neither for forecasts.)

As explained, the following main simplifications are necessary:

- Instead of applying a traffic model, an individual section approach is followed, which can, at least, be used to compare potential high-speed lines with reference lines already existing or under construction. In this case, the gravitation approach does not lead to real traffic flows, but to figures that represent an abstract potential traffic demand.
- Except of a few (further below) justified cases, the size of urban nodes is indicated as the number of inhabitants within their political borders only, not taking into account the entire agglomeration for which in most cases no data are available.
- To depict the resistance to travelling from node to node, up-to-date traffic models use "generalised costs" (combining time and distance costs). In this study, the beeline distances (or accumulated beeline distances) between the nodes are used.

These simplifications do not affect the results substantially: Neglecting the population around the nodes leads to an underestimation of traffic generation, while using beeline distances, without taking into account real distances and travelling times, leads to an overestimation. This compensates the errors partially, but with the uncertainty of the direction (plus or minus) of the remaining error. Moreover, as already stated, the potentials refer to overall traffic demand between nodes, and do not differentiate between modes of transport.

However, as these values only serve to compare potential high-speed lines with existing reference links and with each other, this error does not cause a basic nor severe distortion of the results.

This is the "gravitation formula", named this way with a view to its principle structure, which is similar to Newton's formula. With simplified data as input, as described above, it is used to calculate the "traffic potential indicators":

$P_{i-k} = a \cdot U_i \cdot U_k / D_{i-k}^{f}$.

The variables in the formula have the following meanings:

$P_{i-k}$ number of travellers (e.g. per day)

a a coefficient depending on several parameters, in particular GDP per capita (To compare links, as foreseen in the context of this study, this factor may be set a = 1, to obtain relative results Pi-k, not absolute figures.)

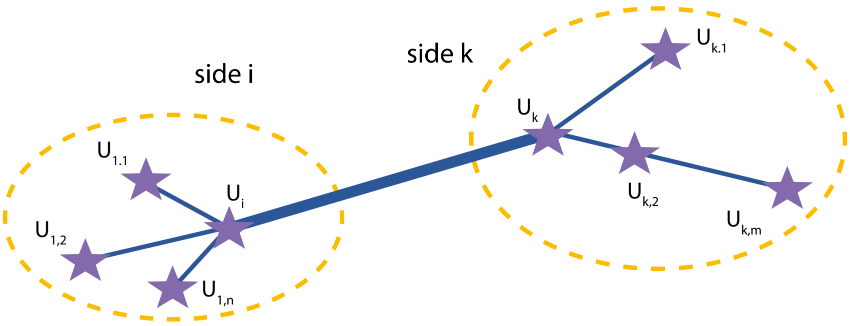
$U_i$ number of inhabitants of city i

$U_k$ number of inhabitants of city k (better inhabitants of entire agglomerations, but these data are not generally available)

$D_{i-k}$ distance of the urban agglomerations Ui and Uk (or better: generalised costs, which result from both travelling time and costs)

f exponent describing the abating of the mutual attractiveness of the agglomerations in dependence of distance (while this exponent is 2 in Newton's law, it has empirically resulted in the order of 1.7 in many traffic demand surveys. Consequently f = 1.7 is used in all calculations).

**Figure. 4.1 - Overlaying links between two nodes I and k**




As set out in figure 4.1, for each considered link $U_{i,0}$ — $U_{k,0}$, a sum $P_{i-k}$ must be calculated, following the formula below. This sum comprises all connections between the nodes $U_{i-v}$ ($U_{i-0}$ … $U_{i-n}$)and nodes $U_{k-\mu}$, ($U_{k-0}$ … $U_{k-m}$), with $D_{i,v-k,\mu}$ being the corresponding distance, i.e. the sum of beeline section lengths as depicted by the blue polygons above. This means that every link includes all those relations between the "i-side" and the "k-side" which overlay bundled along the considered link, as far as they contribute to the result to a relevant extent:

$P_{i-k} = \Sigma (U_{i,v} \cdot U_{k,\mu} / D_{i,v-k,\mu}^{1.7})$, where $U_i$ and $U_k$ are elements of the sets $U_{i,v}$ and $U_{k,\mu}$.

Applying the methodology, the first step is to draw a schematic map of all nodes $U_{i-v}$ and $U_{k-\mu}$ between which the connections are relevant, as passing through the considered section, as indicated in principle in figure 4.1.

As shown in figure 4.4, these nodes are attributed with their individual numbers of inhabitants (in million inhabitants) and the individual links between these nodes by their beeline lengths (in 100 km units). Only for practical reasons, the dimensions of the numbers (=> inhabitants in millions, distances in 100 km) are chosen to obtain results in a reasonable range between 0.1 and 20.

The second step is creating a "distance matrix" of the nodes $U_{i-v}$ and the nodes $U_{k-\mu}$ (dimension: m x n nodes) with their numbers of inhabitants, with the mutual distances filling up the matrix.

The distances between not immediately neighbouring nodes are not indicated as direct beeline distances, but as the sums of the individual beelines along their corresponding polygonal connection, derived from the graphic (e.g. figure 4.4). This is a pragmatic way to avoid extreme overestimations of traffic demand between more distant cities. Given the strong decremental effects of the exponent 1.7 in the denominator, it is evident that with growing distance, only large nodes have to enter the calculation.

Where shorter alternative connections exist between two nodes, bypassing the considered link, they might be only partly relevant for the considered link. In such cases, in the matrix, the mutual distance referring to such relation is arbitrarily set as 20 (which means 2,000 km), to suppress its influence on the "absolute traffic potential indicator". This might in many cases not fully reflect the real situation, but the small amounts would rather compensate for other nodes not taken into account, than distort the result. Anyway, one has to keep in mind the numeric limits of the algorithm, in order not to be deceived by a pretended accuracy.

Applying the "gravitation formula" for all relations $U_{i-v}$ — $U_{k-\mu}$ as indicated in the distance matrix generates a new congruent matrix of the partial results, representing the contribution of the corresponding relation $U_{i-v}$ — $U_{k-\mu}$ to the total "absolute traffic demand potential", which finally results from adding (horizontally and vertically) all partial results in the matrix.

The "absolute traffic demand potential" indicates the total potential of passenger traffic between two links, covering all modes of transport in the considered connection. This is not a criterion that would affect the applicability of this procedure, because both in the case of investigated TER links and in reference links, railway and road or motorways exist in all relevant relations.

However, the "absolute traffic demand potential" does not allow for the influence of the economic situation and the corresponding mobility level of the country. It is "static" in the sense that it does not change for a certain relation, except if cities grow or shrink.

Also, the "absolute traffic demand potential" does not take into account language barriers across borders, which actually has great influence on real traffic demand between cities. However, it is quite difficult to quantify these effects. In a model calculation, this problem can be solved by calibration.

## 4.3. Economic and traffic forecasts

This step is needed to introduce the influence of different and changing economic levels on mobility and traffic demand. Assuming that in general, mobility parameters grow roughly proportionally to the economy of a country, which is reflected in its GDP per capita value, the real traffic demand of a link also grows with the same proportionality. The higher the GDP per capita value and consequently the standard of life is in a country, the more intense business and private interactivities between cities persist. The faster economy grows in a country, the sooner it may happen that it will catch up with levels as observed in "Western" countries, including mobility.

The forecast for the TER area is developed by extrapolating in a plausible way the data from a recently published forecast covering almost the entire TER area.

Forecasting has become extremely difficult in recent years, in particular since the global financial crisis in 2008. While the European economy and even the world economy had experienced a stable and constant growth throughout about six decades after World War II, with only minor setbacks, the current period and probably the coming years as well, with all political and economic instabilities, are characterised by an unpredictable volatility. Moreover, this may affect individual countries differently, but also refers to the global economy. Phases of recession may change quite suddenly with phases of growth, however at different times in the different countries. Provided that there will not be disruptions by war or other incidents, one may expect, at least in the long run, an overall moderate growth, which tends to slow down over time.

Not surprisingly and as explained in chapter 4.4. below, only a few TER countries have delivered, and only to some extent, information about their economic expectations for the coming few years or indicated references on the internet for this information, namely Austria, the Czech Republic, Lithuania, Slovakia, Slovenia and the Russian Federation. In most cases information was made available for the near future only. Even despite special efforts (e.g. with OECD), systematic up-to-date long-term forecasts for 2030 or 2050 do not seem available. Older ones, such as the study "Scenarios, Traffic Forecasts and Analysis of Traffic Flows Including Countries Neighbouring the European Union" elaborated in 2005 by COWI, IVT, IWW, NEA, Nestear, PWC and TINA Vienna [34] are outdated.

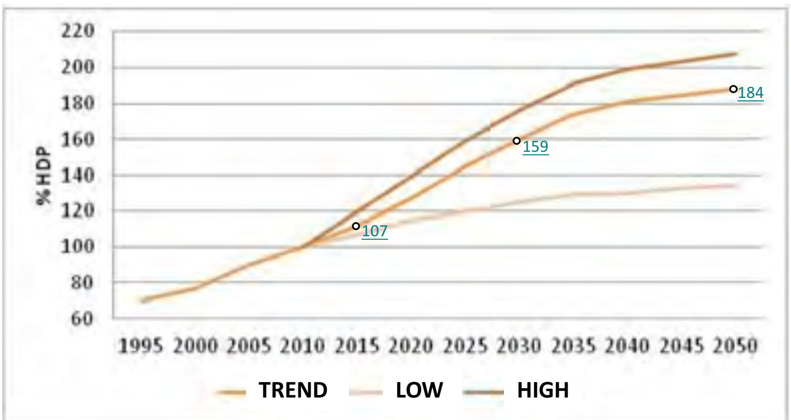
Actually, replying to the questionnaires, the following TER countries have delivered GDP and growth data (rounded) as shown in table 4.1, but not long-term forecasts, whereas the Russian Federation has attached to its reply, a deliberation of macro-economic development, including GDP, however without indicating absolute numbers in this context.

**Table 4.1 - Economic data according to replies from TER counties to questionnaires**

| | | |
|---|---|---|
| **Austria** | $GDP_{2015}$ per capita = €44,000 | |
| **Bosnia and Herzegovina** | $GDP_{2015}$ per capita = €14,300 | growth rate = 2.5% |
| **Czech Republic** | $GDP_{2015}$ per capita = €16,000 | growth rate = 2.5% |
| **Lithuania** | $GDP_{2015}$ per capita = €12,900 | growth rate = 3.2% |
| **Slovakia** | $GDP_{2015}$ per capita = €13,500 | growth rate = 1.7% |
| **Slovenia** | $GDP_{2015}$ per capita = €18,700 | growth rate = 3.3% |
| **Poland** has submitted one map but no economic data | | |

Only the information package delivered by the Czech Republic gives outlooks as far as to 2050 and thus is an exception. The paper contains a graphic which is in line with the general expectation of growth, but at decreasing rates after 2030. This graphic is shown in figure 4.2.

**Figure 4.2 - Economic forecast scenarios according to Czech Ministry of Finance until 2050**



Although the "trend" curve in figure 4.2 is considered the most likely one of the three, it seems still optimistic: Starting in 2010 as reference year (100%), the curve reaches 107% in 2015, 159% in 2030 and 184% in 2050. With the GDP per capita value (PPP), according to table 4.2 below, which was €25,100 in 2016, the trend" curve in figure 4.2 would increase to €37,300 in 2030, respectively to €43,200 in 2050, which seems rather high. This is the basic assumption for the main scenario ("medium scenario") of this study.

Nevertheless, additional scenarios show the effects of unbroken growth ("upper scenario") and for stagnation as from 2030 ("lower scenario"). For 2030, no distinction is made for these scenarios.

In the margins of this study, the GDP per capita values based on purchase power parities (PPP) are used, because PPP-based values reflect, better than nominal values, the levels of welfare in different countries and, therefore, better describe mobility behaviour.

In March 2017, the "Vienna Institute for International Economic Studies" ("Wiener Institut für internationale Wirtschaftsvergleiche" — WIIW) published a new economic forecast, based on 2016 statistic data, for Central, Eastern and South-eastern Europe and the Western Balkans, Belarus, Kazakhstan, the Russian Federation, Turkey and Ukraine , however only for the next three years: 2017, 2018 and 2019 [35]. Not included in this study are Moldova and the Caucasian countries. The following table 4.2 comprises the GDP per capita values and table 4.3 the corresponding growth rates.

**Table 4.2 - GDP per capita values at purchasing power parities (forecast until 2019)**

| | 1991 | 1995 | 2000 | 2005 | 2010 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Forecast | |
| **Bulgaria** | 4,300 | 5,000 | 5,600 | 8,700 | 11,400 | 12,200 | 12,800 | 13,600 | 14,200 | 14,600 | 15,000 | 15,500 |
| **Croatia** | 6,600 | 6,900 | 9,400 | 13,000 | 15,100 | 15,900 | 16,100 | 16,700 | 17,400 | 17,900 | 18,400 | 19,000 |
| **Czech Republic** | 8,800 | 11,500 | 14,100 | 18,600 | 21,000 | 22,400 | 23,800 | 25,200 | 25,800 | 26,400 | 27,100 | 27,700 |
| **Estonia** | 5,400 | 5,300 | 8,200 | 14,000 | 16,500 | 20,100 | 20,900 | 21,600 | 22,000 | 22,500 | 23,000 | 23,600 |
| **Hungary** | 6,800 | 7,700 | 10,400 | 14,500 | 16,400 | 17,900 | 18,700 | 19,700 | 20,300 | 21,000 | 21,700 | 22,400 |
| **Latvia** | 6,000 | 4,600 | 7,000 | 11,800 | 13,400 | 16,600 | 17,500 | 18,600 | 19,200 | 19,700 | 20,200 | 20,800 |
| **Lithuania** | 6,900 | 5,000 | 7,400 | 12,300 | 15,400 | 19,600 | 20,700 | 21,600 | 22,300 | 22,900 | 24,700 | 25,500 |
| **Poland** | 4,600 | 6,500 | 9,300 | 11,800 | 15,900 | 17,900 | 18,600 | 19,800 | 20,400 | 21,000 | 21,600 | 22,300 |
| **Romania** | 3,900 | 4,600 | 5,200 | 8,300 | 13,100 | 14,600 | 15,300 | 16,500 | 17,300 | 18,000 | 18,700 | 19,400 |
| **Slovakia** | 6,000 | 7,300 | 9,900 | 14,100 | 19,000 | 20,500 | 21,300 | 22,300 | 23,100 | 23,800 | 24,600 | 25,500 |
| **Slovenia** | 8,800 | 11,400 | 15,800 | 20,300 | 21,200 | 21,700 | 22,800 | 23,900 | 24,600 | 25,300 | 26,000 | 26,800 |
| **EU-CEE** | 5,400 | 6,600 | 8,700 | 12,100 | 15,800 | 17,500 | 18,300 | 19,400 | 20,100 | 20,700 | 21,300 | 22,000 |
| **Albania** | 1,400 | 1,900 | 3,300 | 5,000 | 7,400 | 7,800 | 8,300 | 8,600 | 8,900 | 9,200 | 9,600 | 10,000 |
| **Bosnia & Herzeg.** | . | . | 3,900 | 5,400 | 6,900 | 7,500 | 7,700 | 8,100 | 8,300 | 8,500 | 8,800 | 9,100 |
| **Kosovo** | . | . | . | 5,300 | 6,000 | 6,500 | 6,700 | 7,400 | 7,800 | 8,100 | 8,400 | 8,700 |
| **Macedonia** | 4,300 | 4,000 | 5,400 | 6,700 | 8,700 | 9,300 | 10,000 | 10,500 | 10,700 | 11,000 | 11,400 | 11,700 |
| **Montenegro** | . | . | 5,700 | 7,100 | 10,400 | 10,900 | 11,300 | 12,100 | 12,400 | 12,800 | 13,200 | 13,600 |
| **Serbia** | . | 3,100 | 5,000 | 7,400 | 9,200 | 10,100 | 10,100 | 10,500 | 11,000 | 11,300 | 11,600 | 12,000 |
| **Turkey** | 5,200 | 6,000 | 8,100 | 10,000 | 13,200 | 16,300 | 16,900 | 18,000 | 18,200 | 18,600 | 19,100 | 19,700 |
| **Belarus** | 3,800 | 3,200 | 5,100 | 8,200 | 12,200 | 13,400 | 13,900 | 13,700 | 13,500 | 13,600 | 13,800 | 14,100 |
| **Kazakhstan** | 5,000 | 3,800 | 3,700 | 7,400 | 13,600 | 17,400 | 18,200 | 18,700 | 18,600 | 19,000 | 19,600 | 20,200 |
| **Russia** | 6,800 | 4,700 | 6,000 | 10,000 | 15,700 | 18,700 | 18,700 | 17,700 | 17,200 | 17,400 | 17,700 | 18,100 |
| **Ukraine** | 3,500 | 2,500 | 3,100 | 4,900 | 5,700 | 6,600 | 6,400 | 5,900 | 6,100 | 6,200 | 6,300 | 6,500 |
| **Austria** | 18,900 | 19,900 | 25,700 | 29,600 | 32,000 | 35,100 | 35,700 | 36,900 | 37,500 | 38,100 | 38,700 | 39,500 |
| **Germany** | 18,800 | 20,000 | 24,100 | 27,500 | 30,500 | 33,200 | 34,600 | 35,800 | 36,500 | 37,100 | 37,800 | 38,600 |
| **Greece** | 12,800 | 13,000 | 17,100 | 21,700 | 21,500 | 19,200 | 19,400 | 19,600 | 19,700 | 20,200 | 20,800 | 21,200 |
| **Ireland** | 12,800 | 16,000 | 26,400 | 34,400 | 33,000 | 35,500 | 37,700 | 51,100 | 53,300 | 55,100 | 56,900 | 58,000 |
| **Italy** | 17,500 | 18,800 | 23,700 | 25,400 | 26,500 | 26,400 | 26,600 | 27,800 | 28,100 | 28,400 | 28,700 | 29,300 |
| **Portugal** | 10,800 | 12,100 | 16,500 | 19,300 | 20,900 | 20,500 | 21,100 | 22,200 | 22,500 | 22,900 | 23,200 | 23,700 |
| **Spain** | 13,200 | 13,700 | 18,900 | 23,500 | 24,400 | 24,000 | 24,700 | 25,900 | 26,700 | 27,300 | 27,900 | 28,500 |
| **United States** | 20,800 | 24,300 | 31,900 | 37,600 | 36,900 | 38,700 | 40,000 | 41,800 | 42,500 | 43,500 | 44,500 | 45,400 |
| **EU-28 average** | 14,200 | 15,200 | 19,800 | 23,400 | 25,500 | 26,700 | 27,600 | 28,900 | 29,000 | 29,500 | 30,000 | 30,600 |

Comparing these figures with the values delivered by some TER countries as listed in table 4.1 above, it becomes evident that the GDP values received from the latter are nominal values, not based on PPP. Furthermore, they seem to stem from different reference years. In order to have a common base for the entire area as far as this is possible, they are not used as part of this study, and data taken from the present WIIW forecast, instead.

### Table 4.3 - Economic growth rates (forecast until 2019)

| | | Forecast, % | | | | Revisions, pp | | |
|---|---|---|---|---|---|---|---|---|
| | | 2016 | 2017 | 2018 | 2019 | 2016 | 2017 | 2018 |
| EU-CEE | BG | 3.4 | 2.9 | 3.1 | 3.3 | ↑ 0.4 | ↓ -0.1 | → 0.0 |
| | HR | 2.8 | 2.8 | 2.9 | 3.0 | ↑ 0.3 | ↑ 0.1 | ↑ 0.1 |
| | CZ | 2.3 | 2.4 | 2.6 | 2.3 | ↑ 0.1 | → 0.0 | → 0.0 |
| | EE | 1.3 | 2.2 | 2.3 | 2.4 | ↓ -0.3 | → 0.0 | → 0.0 |
| | HU | 2.0 | 3.3 | 3.4 | 3.1 | ↑ 0.0 | ↑ 0.7 | ↑ 0.5 |
| | LV | 1.8 | 2.5 | 2.7 | 2.8 | ↓ -0.6 | ↓ -0.1 | ↓ -0.2 |
| | LT | 2.2 | 2.7 | 2.8 | 3.1 | ↓ -0.1 | ↑ 0.1 | ↓ -0.2 |
| | PL | 2.8 | 2.9 | 3.0 | 3.1 | ↓ -0.4 | ↓ -0.6 | ↓ -0.3 |
| | RO | 4.8 | 4.0 | 4.0 | 4.0 | ↑ 0.1 | ↑ 0.5 | ↑ 0.2 |
| | SK | 3.3 | 3.1 | 3.6 | 3.9 | ↑ 0.1 | → 0.0 | ↑ 0.2 |
| | SI | 2.6 | 2.9 | 2.9 | 3.0 | ↑ 0.2 | ↑ 0.3 | → 0.0 |
| WB | AL | 3.2 | 3.5 | 3.9 | 4.0 | ↑ 0.2 | ↑ 0.2 | ↑ 0.3 |
| | BA | 2.3 | 2.8 | 3.0 | 3.1 | ↓ -0.8 | ↓ -0.5 | ↓ -0.5 |
| | XK | 3.6 | 3.9 | 3.8 | 3.7 | ↑ 1.0 | ↑ 0.9 | ↑ 0.6 |
| | MK | 2.5 | 3.1 | 3.3 | 3.0 | → 0.0 | → 0.0 | → 0.0 |
| | ME | 2.7 | 3.1 | 2.9 | 3.3 | ↑ 0.0 | → 0.0 | → 0.0 |
| | RS | 2.7 | 2.8 | 3.0 | 3.3 | ↑ 0.5 | ↑ 0.3 | ↑ 0.5 |
| Turkey | TR | 1.9 | 2.1 | 2.6 | 3.1 | ↓ -1.4 | ↓ -0.9 | ↓ -0.1 |
| CIS +UA | BY | -2.6 | 0.5 | 1.6 | 2.2 | ↑ 0.2 | ↑ 1.4 | → 0.0 |
| | KZ | 1.0 | 2.0 | 3.0 | 3.0 | ↑ 0.6 | → 0.0 | → 0.0 |
| | RU | -0.2 | 1.7 | 1.7 | 2.0 | ↑ 0.6 | ↑ 0.9 | ↓ -0.1 |
| | UA | 2.0 | 2.5 | 3.0 | 3.0 | ↑ 1.2 | ↑ 0.6 | ↑ 0.6 |

Note: Current forecast and revisions relative to the wiiw autumn forecast 2016. Colour scale reflects variation from the minimum (red) to the maximum (green) values.
Source: wiiw forecast.

For the Republic of Moldova, it was possible to get GDP per capita (= €4,000) and economic growth rate (= 4.1%) for 2016 directly from the WIIW, from a special inquiry.

While data for France were obtained from a recent internet publication [36], the GDP per capita values (PPP) and growth rates for the Caucasian countries have been taken from country leaflets of the Austrian Chamber of Economy (WKO) [37]. To compensate untypically high or low growth rates, which may reflect casual, transient fluctuations, and to avoid erroneous forecasts, growth rates of less than +1.0% (or even negative), which are considered not to represent a permanent status, are set 1.0% arbitrarily, for the period 2015-2030 (in 2016, this was the case for Azerbaijan, where the current growth rate is indicated as -2.4%).

### Table 4.4 - Economic data of Caucasian countries

| Caucasian countries | Growth rate | $GDP_{2015}$ (PPP) per capita [€] |
|---|---|---|
| **Armenia** | 3.2% | 7,770 |
| **Azerbaijan** | -2.4% | 16,430 |
| **Georgia** | 3.4% | 8,960 |

Given the fact that no reliable long-term forecasts are available, the forecast in this study follows a generally shared expectation that growth might slow down in future years, assuming growth rates that decrease from 2030, to only 50% of the initial values. As mentioned already, an additional scenario is considered to show the effect of unbroken growth.

This means that for the forecast, the data are processed in the following way:

- The basis are the GDP per capita values for 2016 from the mentioned forecast and other sources (for the Caucasian countries: Armenia, Azerbaijan and Georgia);
- The "initial annual growth rates" (= R in the formulas below) are taken from the mentioned study and adapted according to the 2017-2019 growth, to determine biased arithmetic means, closer to 2019 than to 2017 in order to better reflect variations in the coming years. Further, growth rates of less than 1.0% are set 1.0%, to avoid unfavourable influence from atypical situations. This leads to the "basic annual growth rates". (In table 4.5, these growth rates are indicated in the first two columns, following the names of the countries.)
- From this input, 2030 values are extrapolated linearly, with the growth rates as determined above, acc. to the formula $GDP_{2030} = GDP_{2016} \times (1 + 0.14 \times R)$.
- The 2050 forecasts are obtained in the following way:
  - Low scenario: no further growth assumed so that $GDP_{2050} = GDP_{2030}$ (This corresponds to an effective growth rate of 70% of the "basic annual growth rate)
  - Medium scenario: allowing for a likely reduction of economic growth in the further future, the development from 2030 to 2050 is assumed to be linear, as well, but with only half the previous growth rate, based on the originals GDP: $GDP_{2050} = GDP_{2016} \times (1 + (0.14 + 0.20/2) \times R) = GDP_{2016} \times (1 + 0.24 \times R)$
  - High scenario: for the time after 2030, unbroken growth is assumed: $GDP_{2050} = GDP_{2016} \times (1 + 0.34 \times R)$.

The results of these calculations, i.e. the GDP values for 2030 and 2050, as well as their ratios against the EU average for 2016 (= quotients of GDP per capita of a country at a certain time horizon and the EU average GDP per capita for 2016 (= €29,000)) are summarised in the following table 4.5.

These quotients are needed, because within component 2 of the present methodology, the "ATDP" of each link is multiplied by them, to obtain the WTDP value of the considered link at the considered time horizon (for comparability of results, any reference base may be chosen, as long as it is the same in all cases, including for the reference links).

For better visibility in this table, the lines corresponding to Armenia, Azerbaijan France and Georgia, for which the input data stem from other sources than the WIIW forecast, are marked by red values and GDP per capita values are highlighted in yellow if above €20,000, light orange if above €30,000 and dark orange if above €40,000.

## Table 4.5 - GDP per capita forecast for reference and TER countries

**Linear Growth GDP per capita Forecast 2030 and 2050 (base 2016)**

| | Country | => Economic forecast data / => Scenario | initial annual growth rate in 2016 [%] | basic annual growth rate*) [%] | $GDP_{2016}$ per capita [1000 €] | $GDP_{2030}$ per capita [1000 €] | $GDP_{2050}$ per capita [1000 €] LOW | $GDP_{2050}$ per capita [1000 €] MEDIUM | $GDP_{2050}$ per capita [1000 €] HIGH | GDP growth factor 2016 - 2030 | GDP growth factor 2016 - 2050 LOW | GDP growth factor 2016 - 2050 MEDIUM | GDP growth factor 2016 - 2050 HIGH | $GDP_{2015}$ per capita vs. EU 2016 | $GDP_{2030}$ per capita vs. EU 2016 | $GDP_{2050}$ per capita vs. EU 2016 LOW | $GDP_{2050}$ per capita vs. EU 2016 MEDIUM | $GDP_{2050}$ per capita vs. EU 2016 HIGH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| non-TER countries | EU average | | 1.90 | 1.80 | 29.00 | 36.31 | 36.31 | 41.53 | 46.75 | 1.25 | 1.25 | 1.43 | 1.61 | 1.00 | 1.25 | 1.25 | 1.43 | 1.61 |
| | Estonia | | 1.30 | 2.30 | 22.00 | 29.08 | 29.08 | 34.14 | 39.20 | 1.32 | 1.32 | 1.55 | 1.78 | 0.76 | 1.00 | 1.00 | 1.18 | 1.35 |
| | France | | 1.20 | 1.20 | 34.40 | 40.18 | 40.18 | 44.31 | 48.44 | 1.17 | 1.17 | 1.29 | 1.41 | 1.19 | 1.39 | 1.39 | 1.53 | 1.67 |
| | Germany | | 1.60 | 1.60 | 36.50 | 44.68 | 44.68 | 50.52 | 56.36 | 1.22 | 1.22 | 1.38 | 1.54 | 1.26 | 1.54 | 1.54 | 1.74 | 1.94 |
| | Latvia | | 1.80 | 2.70 | 19.20 | 26.46 | 26.46 | 31.64 | 36.83 | 1.38 | 1.38 | 1.65 | 1.92 | 0.66 | 0.91 | 0.91 | 1.09 | 1.27 |
| TER countries | Albania | | 3.20 | 3.80 | 8.90 | 13.63 | 13.63 | 17.02 | 20.40 | 1.53 | 1.53 | 1.91 | 2.29 | 0.31 | 0.47 | 0.47 | 0.59 | 0.70 |
| | Armenia | | 3.20 | 3.20 | 7.77 | 11.26 | 11.26 | 13.74 | 16.23 | 1.45 | 1.45 | 1.77 | 2.09 | 0.27 | 0.39 | 0.39 | 0.47 | 0.56 |
| | Austria | | 1.60 | 1.60 | 37.50 | 45.90 | 45.90 | 51.90 | 57.90 | 1.22 | 1.22 | 1.38 | 1.54 | 1.29 | 1.58 | 1.58 | 1.79 | 2.00 |
| | Azerbaijan | | -2.40 | 1.00 | 16.43 | 18.73 | 18.73 | 20.37 | 22.01 | 1.14 | 1.14 | 1.24 | 1.34 | 0.57 | 0.65 | 0.65 | 0.70 | 0.76 |
| | Belarus | | -2.60 | 1.50 | 13.50 | 16.34 | 16.34 | 18.36 | 20.39 | 1.21 | 1.21 | 1.36 | 1.51 | 0.47 | 0.56 | 0.56 | 0.63 | 0.70 |
| | Bosnia and Herzegovina | | 2.30 | 3.00 | 8.30 | 11.79 | 11.79 | 14.28 | 16.77 | 1.42 | 1.42 | 1.72 | 2.02 | 0.29 | 0.41 | 0.41 | 0.49 | 0.58 |
| | Bulgaria | | 3.40 | 3.10 | 14.20 | 20.36 | 20.36 | 24.76 | 29.17 | 1.43 | 1.43 | 1.74 | 2.05 | 0.49 | 0.70 | 0.70 | 0.85 | 1.01 |
| | Croatia | | 2.80 | 2.90 | 17.40 | 24.46 | 24.46 | 29.51 | 34.56 | 1.41 | 1.41 | 1.70 | 1.99 | 0.60 | 0.84 | 0.84 | 1.02 | 1.19 |
| | Czech Republic | | 2.30 | 2.40 | 25.10 | 33.53 | 33.53 | 39.56 | 45.58 | 1.34 | 1.34 | 1.58 | 1.82 | 0.87 | 1.16 | 1.16 | 1.36 | 1.57 |
| | Georgia | | 3.40 | 3.40 | 8.96 | 13.23 | 13.23 | 16.27 | 19.32 | 1.48 | 1.48 | 1.82 | 2.16 | 0.31 | 0.46 | 0.46 | 0.56 | 0.67 |
| | Greece | | 2.50 | 2.50 | 19.70 | 26.60 | 26.60 | 31.52 | 36.45 | 1.35 | 1.35 | 1.60 | 1.85 | 0.68 | 0.92 | 0.92 | 1.09 | 1.26 |
| | Hungary | | 2.00 | 3.20 | 20.30 | 29.39 | 29.39 | 35.89 | 42.39 | 1.45 | 1.45 | 1.77 | 2.09 | 0.70 | 1.01 | 1.01 | 1.24 | 1.46 |
| | Italy | | 1.10 | 1.10 | 28.10 | 32.43 | 32.43 | 35.52 | 38.61 | 1.15 | 1.15 | 1.26 | 1.37 | 0.97 | 1.12 | 1.12 | 1.22 | 1.33 |
| | Lithuania | | 2.20 | 2.90 | 22.30 | 31.35 | 31.35 | 37.82 | 44.29 | 1.41 | 1.41 | 1.70 | 1.99 | 0.77 | 1.08 | 1.08 | 1.30 | 1.53 |
| | Montenegro | | 2.70 | 3.10 | 12.40 | 17.78 | 17.78 | 21.63 | 25.47 | 1.43 | 1.43 | 1.74 | 2.05 | 0.43 | 0.61 | 0.61 | 0.75 | 0.88 |
| | Poland | | 2.80 | 3.00 | 20.40 | 28.97 | 28.97 | 35.09 | 41.21 | 1.42 | 1.42 | 1.72 | 2.02 | 0.70 | 1.00 | 1.00 | 1.21 | 1.42 |
| | Republic of Moldova | | 4.10 | 4.10 | 4.00 | 6.30 | 6.30 | 7.94 | 9.58 | 1.57 | 1.57 | 1.98 | 2.39 | 0.14 | 0.22 | 0.22 | 0.27 | 0.33 |
| | Romania | | 4.80 | 4.00 | 17.30 | 26.99 | 26.99 | 33.91 | 40.83 | 1.56 | 1.56 | 1.96 | 2.36 | 0.60 | 0.93 | 0.93 | 1.17 | 1.41 |
| | Russian Federation | | -0.20 | 1.80 | 17.20 | 21.53 | 21.53 | 24.63 | 27.73 | 1.25 | 1.25 | 1.43 | 1.61 | 0.59 | 0.74 | 0.74 | 0.85 | 0.96 |
| | Serbia | | 2.70 | 3.20 | 11.00 | 15.93 | 15.93 | 19.45 | 22.97 | 1.45 | 1.45 | 1.77 | 2.09 | 0.38 | 0.55 | 0.55 | 0.67 | 0.79 |
| | Slovakia | | 3.30 | 3.50 | 23.10 | 34.42 | 34.42 | 42.50 | 50.59 | 1.49 | 1.49 | 1.84 | 2.19 | 0.80 | 1.19 | 1.19 | 1.47 | 1.74 |
| | Slovenia | | 2.60 | 2.80 | 24.60 | 34.24 | 34.24 | 41.13 | 48.02 | 1.39 | 1.39 | 1.67 | 1.95 | 0.85 | 1.18 | 1.18 | 1.42 | 1.66 |
| | The former Yugoslav Republic of Macedonia | | 2.50 | 3.10 | 10.70 | 15.34 | 15.34 | 18.66 | 21.98 | 1.43 | 1.43 | 1.74 | 2.05 | 0.37 | 0.53 | 0.53 | 0.64 | 0.76 |
| | Turkey | | 1.90 | 2.70 | 18.20 | 25.08 | 25.08 | 29.99 | 34.91 | 1.38 | 1.38 | 1.65 | 1.92 | 0.63 | 0.86 | 0.86 | 1.03 | 1.20 |
| | Ukraine | | 2.00 | 2.80 | 6.10 | 8.49 | 8.49 | 10.20 | 11.91 | 1.39 | 1.39 | 1.67 | 1.95 | 0.21 | 0.29 | 0.29 | 0.35 | 0.41 |

*) 2016 - 2030, after 2030 only 50 % thereof

GDP per capita > € 20000 GDP per capita > € 30000 GDP per capita > € 40000

## 4.4. Questionnaires and responses

One of the first steps of this study was the preparation and distribution of a questionnaire to all TER members. The questionnaire was sent out to all TER National Coordinators on 23 May 2016, consisting of questions on:

1. Geographic, demographic and socio-economic data of the country
2. Technical parameters and traffic flows on existing railway sections of the TER backbone network (including questions on road and air traffic, etc.)
3. Information on possible or planned high-speed lines
4. Information and data on environment, climate and traffic safety.

It had been foreseen to determine transport flows on potential high-speed lines resulting from shortened travelling times, by estimating also the likely shifts from road and air to rail. Further the intention was to identify possible bottlenecks, due to the superposition of high-speed traffic with existing short distance passenger and freight trains, in order to recommend where to foresee separate new lines for high-speed.

As only a few TER member States returned this questionnaire completed; a reminder was sent out on 21 July 2016, however with little success. Only very few countries, e.g. Turkey, communicated current traffic flows, while no country at all delivered economic and/or traffic forecasts. Furthermore, the responding countries do not form a coherent area, which would make it impossible to conceive a border crossing high-speed network.

Finally, on 1 September 2016, a simplified version of the questionnaire was sent out to all countries. Given that most of the geographic, demographic and socio-economic data would be available from internet research, the new focus was restricted mainly to existing infrastructure and planned upgrades of the national networks. Copies of the questionnaires and corresponding mail to TER member States are collected in annex I:

The following countries have, to differing extents, replied to the questionnaires:

- **Austria** has delivered a fairly complete questionnaire, with some references to websites and, as regards the railway network, to the updated TER Master Plan, however with no reference to economic developments and forecasts.
- **Bosnia and Herzegovina** has responded with a thorough and detailed compilation of demographic data for the individual cantons, some economic data, however no forecasts, and a summary of the technical parameters of its UIC standard gauge railway lines.
- The **Czech Republic** has sent a summary of economic analyses and short-term forecasts (horizon 2020), however with a chart and a graph that reach until 2050. Further, information on the existing railway network and planned high-speed lines was given.
- **Lithuania** has supplied a brief overview on GDP development over the past four years and growth expectations for the coming three years, as well as a forecast of railway passengers in 2020 and 2030. Lithuania has further submitted a brochure on the Rail Baltica project between Warsaw and Tallinn.
- **Poland** has only sent a railway network map with information of number of tracks and electrification.
- **Slovakia** has submitted the final report on "Multimodal Transport Relations … in the form of a transport model of the Slovak Republic". This paper is quite comprehensive and includes alongside many aspects of mobility and transport, also economic data.

- **Slovenia** has sent a concise paper on geographic, demographic and transport data, GDP and economic growth values, maps and technical data describing the Slovenian TER network.
- The **Russian Federation** has delivered the most comprehensive documentation, consisting of the partly filled-in questionnaire and many annexes, covering traffic volumes and transhipment quantities in seaports, agricultural and industrial production data, economic data such as GDP and growth rates (but without an absolute GDP figure), a general high-speed operation manual, track parameters and train numbers in the Russian railway network and the project-specific technical specification for the high-speed line Moscow — Kazan.
- **Turkey** has responded to the questionnaire, with a partly filled-in copy and some attachments, indicating demography, economy and greenhouse gas emissions, but mainly with a focus on technical data and the capacity use of the Turkish railway network, and some maps showing the ambitious high-speed programme of the country.

At this point, it is important to thank the representatives of all countries who actively contributed to this information and data collection.

Although these pieces of information and data are extremely valuable, at least with view to a more in-depth investigation of the high-speed topic, there is nevertheless the problem of incompleteness, incoherence and inconsistence, as already stated in this context.

Geographically, countries that have delivered data are separated by countries in between that have not, and the data received refer to different issues and have differing quality and accuracy, so they lack comparability and compatibility. On this data base, it is impossible to create data sets coherent for the entire TER area and coherent for all relevant aspects of planning.

To cope with this unfavourable situation, nevertheless achieving plausible results, which may differ from exact values by not more than +/- 20 or 25%, it was necessary to collect corresponding data from the internet and from maps and benchmark them against data actually received from some countries.

## 4.5. Input data of nodes and links of TER backbone network

Apart from economic effects, which are considered in chapter 4.3., for the determination of traffic demand, the population of the entire urban areas or agglomerations, reaching beyond the corresponding political borders and the mutual distance between the corresponding cities are relevant.

However, it is difficult to define border lines of build-up areas against open field to quantify the numbers of inhabitants of an agglomeration that are relevant for traffic generation, so such data are available only exceptionally. Equally, determining distances along certain routes e.g. from maps, is not possible.

Regarding their population, the cities have been selected because of their size (≥ 100,000 inhabitants) or their position in the network. The following table 4.6 contains the official data (indicated in units of 1 million) that represent the population living within the corresponding political borders, as extracted from Wikipedia.

Only in a few exceptions where it is evident that the effective size of a city is much larger than the official number — and therefore neglecting this would lead to an unrealistic and unacceptable underestimation of their traffic potentials — agglomerations are taken into account, instead, or groups of neighbouring cities clustered. The names of these cities (e.g. Brussels, London, Moscow, Paris, etc.) are marked with asterisks in the table.

For example, when looking at Paris, within the Boulevard Périphérique the population is only 2.24 million inhabitants whereas the whole agglomeration has 12.4 million. The same is true to a lesser extent in the city of London which has a population of 8.67 million people, while there are 13.61 million in greater London. In addition, in all these cases, one also would have to take into account implicitly, their high potential as origin or destination of business trips, due to their economic and political importance.

As regards the links, it was necessary in a uniform way, to replace real distances between neighbouring nodes, which were not generally available, by beeline distances. With a view to the structure of table 4.6, it is not possible to display also the distances between the cities. These beeline distances, extracted from maps, are indicated, later in this chapter, in figures 4.3a-h, which are schematic maps covering all parts of Europe from north-western Europe to the Russian Federation (western parts) and from south-western Europe to Turkey.

These distances are used instead of distances on rail, which have not been received. This is acceptable because even scientifically, there is a certain tolerance where distance between nodes (along road, along rail, the shortest along any infrastructure or just the beeline) is relevant in the "gravitation formula" — in traffic models, the so-called "generalised costs" reflecting the resistance (consisting of time and money) to get from one node to the other, are used.

**Table 4.6 - Demographic data of TER countries and adjacent countries and their main agglomerations**

| | Capital, cities ≥ 100,000 inhabitants | Area ($km^2$) | Inhabitants | Inhabitants of city (million inhabitants) |
|---|---|---|---|---|
| **Albania** | | 28,748 | 2,894,000 | |
| | Tirana | | | 0.42 |
| | Durres | | | 0.18 |
| **Armenia** | | 29,743 | 2,984,000 | |
| | Yerevan | | | 1.06 |
| **Austria** | | 83,879 | 8,534,000 | |
| | Vienna | | | 1.84 |
| | Linz | | | 0.20 |
| | Salzburg | | | 0.15 |
| | Innsbruck | | | 0.13 |
| | Graz | | | 0.28 |
| | Klagenfurt* | | | 0.16 |
| **Azerbaijan** | | 86,600 | 9,538,000 | |
| | Baku | | | 2.14 |
| | Gence | | | 0.32 |
| | Sumqayit | | | 0.32 |
| **Belarus** | | 207,595 | 9,470,000 | |
| | Minsk | | | 1.89 |
| | Brest | | | 0.31 |
| | Orsha | | | 0.12 |
| | Homyel | | | 0.48 |
| **Bosnia and Herzegovina** | | 51,129 | 3,825,000 | |
| | Sarajevo | | | 0.53 |
| | Mostar | | | 0.13 |
| **Bulgaria** | | 119,994 | 7,226,000 | |
| | Sofia | | | 1.21 |
| | Plovdiv * | | | 0.57 |
| | Burgas | | | 0.20 |
| | Varna | | | 0.33 |
| | Russe | | | 0.15 |
| | Pleven | | | 0.11 |
| **Croatia** | | 56,542 | 4,236,000 | |
| | Zagreb | | | 0.79 |
| | Rijeka | | | 0.13 |
| | Zadar | | | 0.08 |
| | Split | | | 0.18 |
| | Vinkovci* | | | 0.17 |

| | Capital,<br>cities ≥ 100,000 inhabitants | Area ($km^2$) | Inhabitants | Inhabitants of city<br>(million inhabitants) |
|---|---|---|---|---|
| **Czechia** | | 78,866 | 10,511,000 | |
| | Prague | | | 1.27 |
| | C. Budejovice | | | 0.09 |
| | Brno | | | 0.39 |
| | Ostrava | | | 0.30 |
| **Georgia** | | 69,700 | 4,504,000 | |
| | Tbilisi | | | 1.17 |
| | Kutaisi | | | 0.20 |
| | Batumi | | | 0.13 |
| | Rustavi | | | 0.12 |
| **Greece** | | 131,957 | 10,958,000 | |
| | Athens* | | | 3.75 |
| | Thessaloniki | | | 0.33 |
| | Patras | | | 0.17 |
| **Hungary** | | 93,030 | 9,862,000 | |
| | Budapest | | | 1.74 |
| | Györ | | | 0.13 |
| | Pecs | | | 0.15 |
| | Miskolc | | | 0.17 |
| | Nyiregyhaza | | | 0.12 |
| | Debrecen | | | 0.21 |
| | Szeged | | | 0.17 |
| | Szombathely | | | 0.08 |
| **Latvia** | | 64,583 | 1,990,000 | |
| | Riga | | | 0.64 |
| **Lithuania** | | 65,301 | 2,929,000 | |
| | Vilnius | | | 0.54 |
| | Kaunas | | | 0.31 |
| **Montenegro** | | 13,812 | 622,000 | |
| | Podgorica | | | 0.20 |
| **Poland** | | 312,685 | 37,996,000 | |
| | Warsaw | | | 1.71 |
| | Gdansk * | | | 0.71 |
| | Szecin | | | 0.41 |
| | Torun | | | 0.20 |
| | Poznan | | | 0.55 |
| | Lodz | | | 0.72 |
| | Wroclav | | | 0.63 |
| | Katowice* | | | 1.28 |
| | Krakow | | | 0.76 |
| | Tarnow | | | 0.11 |
| | Rzeszow | | | 0.18 |

| | Capital, cities ≥ 100,000 inhabitants | Area (km²) | Inhabitants | Inhabitants of city (million inhabitants) |
|---|---|---|---|---|
| | Lublin | | | 0.35 |
| | Białystok | | | 0.29 |
| **Republic of Moldova** | | 33,800 | 3,556,000 | |
| | Chisinov | | | 0.67 |
| | Tiraspol | | | 0.14 |
| **Romania** | | 238,391 | 19,911,000 | |
| | Bucharest | | | 1.88 |
| | Oradea | | | 0.20 |
| | Arad | | | 0.16 |
| | Timisoara | | | 0.32 |
| | Cluj | | | 0.30 |
| | Sibiu | | | 0.43 |
| | Craiova | | | 0.29 |
| | Constanta | | | 0.30 |
| | Ploiesti | | | 0.22 |
| | Buzau | | | 0.13 |
| | Braila* | | | 0.50 |
| | Focsani | | | 0.10 |
| | Bacau | | | 0.17 |
| | Suceava* | | | 0.22 |
| | Iasi | | | 0.32 |
| | Baia Mare | | | 0.12 |
| | Satu Mare | | | 0.11 |
| **Russian Federation** | | 17,075,400 | 143,820,000 | |
| | Moscow * | | | 12.86 |
| | St. Petersburg | | | 4.99 |
| | Pskov | | | 0.21 |
| | Smolensk | | | 0.33 |
| | Bryansk | | | 0.41 |
| | Orël | | | 0.32 |
| | Tula | | | 0.50 |
| | Voronesh | | | 1.00 |
| | Yaroslavl | | | 0.60 |
| | Vologda | | | 0.31 |
| | Ryazan | | | 0.53 |
| | Saransk | | | 0.30 |
| | Nizhnij Novgrorod | | | 1.26 |
| | Kirov | | | 0.47 |
| | Perm | | | 1.00 |
| | Kasan | | | 1.17 |
| | Ishevsk | | | 0.63 |
| | Yekaterinburg | | | 1.39 |

| | Capital, cities ≥ 100,000 inhabitants | Area ($km^2$) | Inhabitants | Inhabitants of city (million inhabitants) |
|---|---|---|---|---|
| | Chelyabinsk | | | 1.15 |
| | Omsk | | | 1.16 |
| | Novosibirsk | | | 1.51 |
| | Samara | | | 1.17 |
| | Saratov | | | 0.84 |
| | Volgograd | | | 1.02 |
| | Rostov na Donu* | | | 1.09 |
| | Krasnodar | | | 0.75 |
| | Sotchi | | | 0.36 |
| | Kaliningrad | | | 0.44 |
| **Serbia** | | 77,474 | 7,129,000 | |
| | Belgrade | | | 1.23 |
| | Novi Sad | | | 0.25 |
| | Nis | | | 0.26 |
| **Slovakia** | | 49,034 | 5,419,000 | |
| | Bratislava | | | 0.42 |
| | Trnava | | | 0.07 |
| | Žilina* | | | 0.14 |
| | Kosice | | | 0.24 |
| **Slovenia** | | 20,253 | 2,062,000 | |
| | Ljubljana | | | 0.29 |
| | Maribor | | | 0.09 |
| **The former Yougoslav Republic of Macedonia** | | 25,713 | 2,108,000 | |
| | Skopje | | | 0.54 |
| | Tetovo | | | 0.09 |
| **Turkey** | | 779,452 | 75,837,000 | |
| | Ankara* | | | 4.59 |
| | Edirne | | | 0.15 |
| | Istanbul* | | | 14.66 |
| | Adapazari | | | 0.27 |
| | Eskisehir | | | 0.69 |
| | Kütahya | | | 0.20 |
| | Balikesir | | | 1.19 |
| | Manisa | | | 0.28 |
| | Izmir | | | 4.11 |
| | Denizli | | | 1.00 |
| | Aydin | | | 0.19 |
| | Konya | | | 1.22 |
| | Antalya | | | 2.22 |
| | Alanya | | | 0.29 |
| | Kirikkale | | | 0.19 |
| | Kayseri | | | 1.06 |

| | Capital, cities ≥ 100,000 inhabitants | Area (km²) | Inhabitants | Inhabitants of city (million inhabitants) |
|---|---|---|---|---|
| | Sivas | | | 0.35 |
| | Samsun | | | 0.61 |
| | Trabzon | | | 0.19 |
| | Erzurum | | | 0.37 |
| | Adana | | | 1.72 |
| | Mersin | | | 0.96 |
| | Iskenderun | | | 0.24 |
| | Gaziantep | | | 1.56 |
| | Diyarbakir | | | 0.93 |
| **Ukraine** | | 603,700 | 45,363,000 | |
| | Kyiv | | | 2.80 |
| | Lviv | | | 0.72 |
| | Vinnytsya | | | 0.37 |
| | Charkiv | | | 1.43 |
| | Kirovohrad | | | 0.23 |
| | Krivy Rih | | | 0.65 |
| | Zaporozhye | | | 0.76 |
| | Dnipropetrovsk | | | 0.99 |
| | Donetsk* | | | 2.19 |
| | Luhansk | | | 0.45 |
| | Odessa | | | 1.00 |
| | Ushhorod* | | | 0.11 |

* Refers to a group or conurbation of several cities, which are merged under the name of the most important one.

Considering the simplification of input data (reduced population of cities, due to neglecting their peripheries, versus reduced distances, due to beelines), the corresponding errors, at least partly, compensate each other. This is because in the "gravitation formula" which, according to the methodology developed in chapters 4.1.-4.3., is used for the determination of traffic demand potentials, the population stands in the numerator, whereas the distance in the denominator.

In the following schematic maps (figures 4.3a-h), indicating nodes with numbers of inhabitants (in millions) and mutual distances (in 100 km units), commas are used instead of decimal points to indicate decimals.

## Figure 4.3a - North-Western Europe

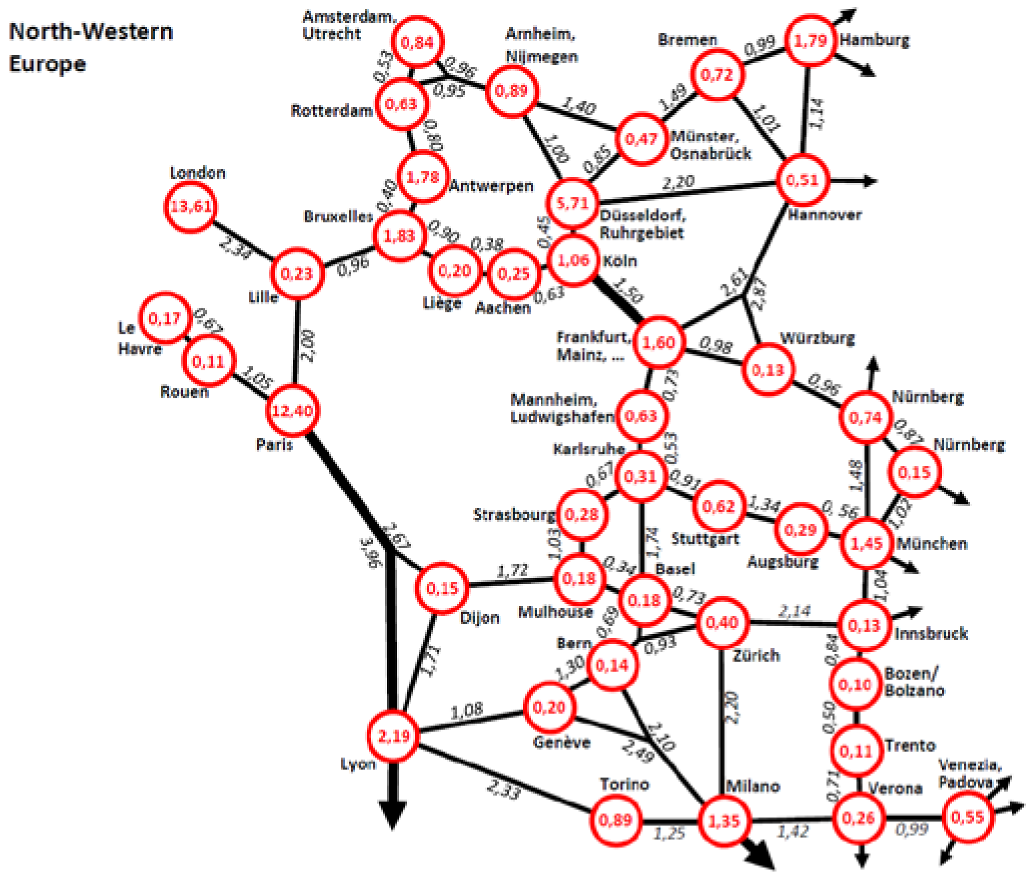


**Figure 4.3b - North-Central Europe**

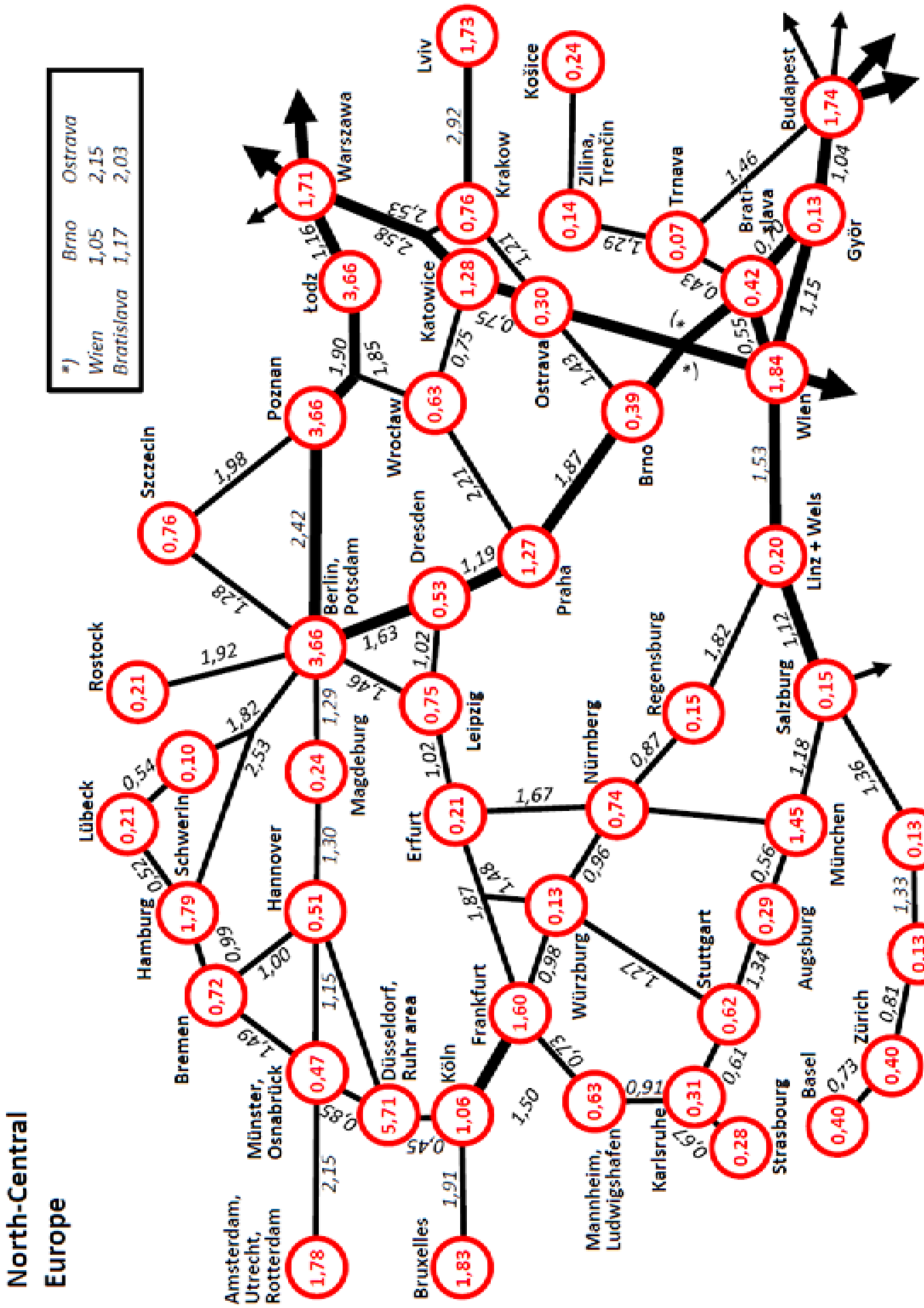


**Figure 4.3c - North-Eastern Europe**

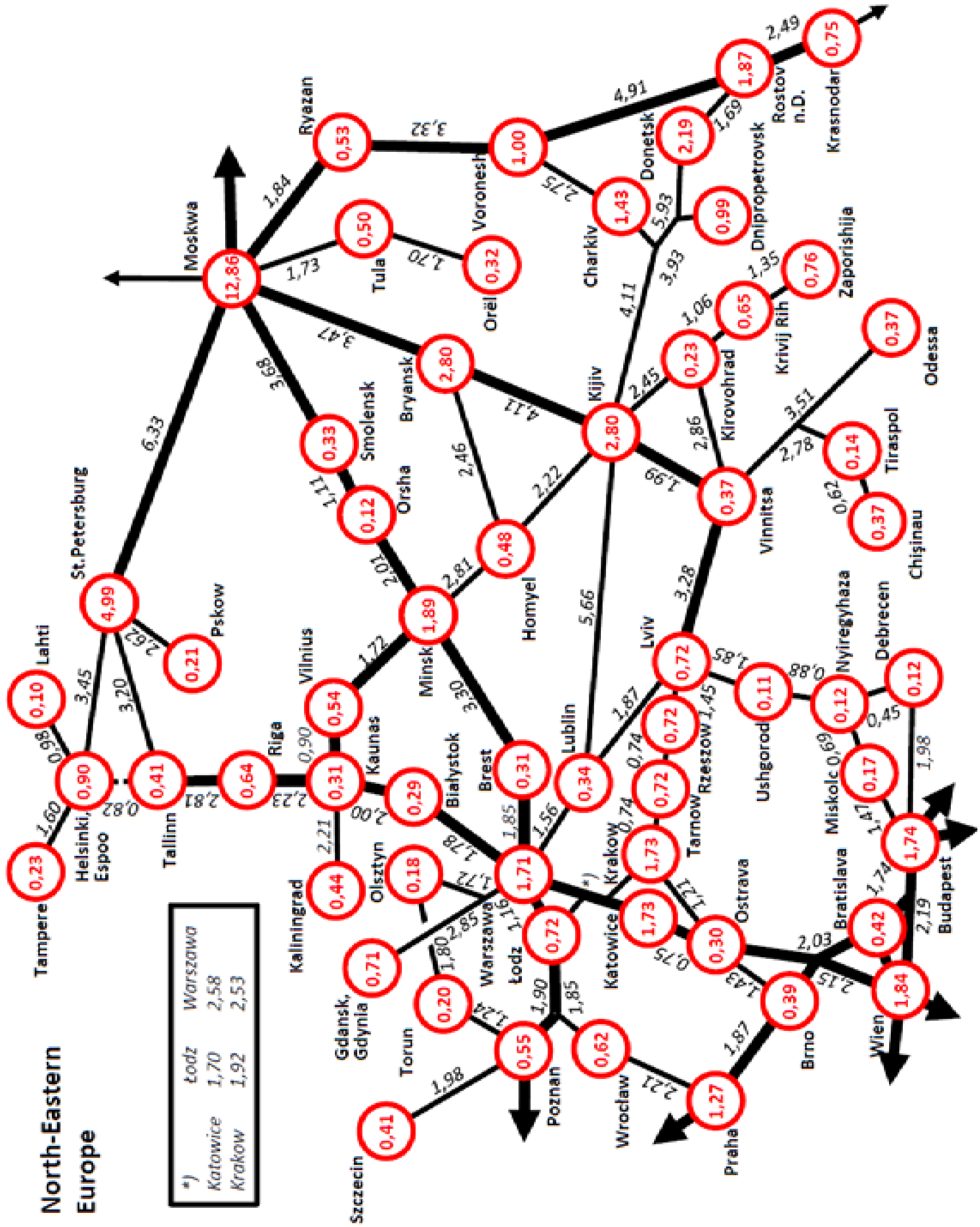
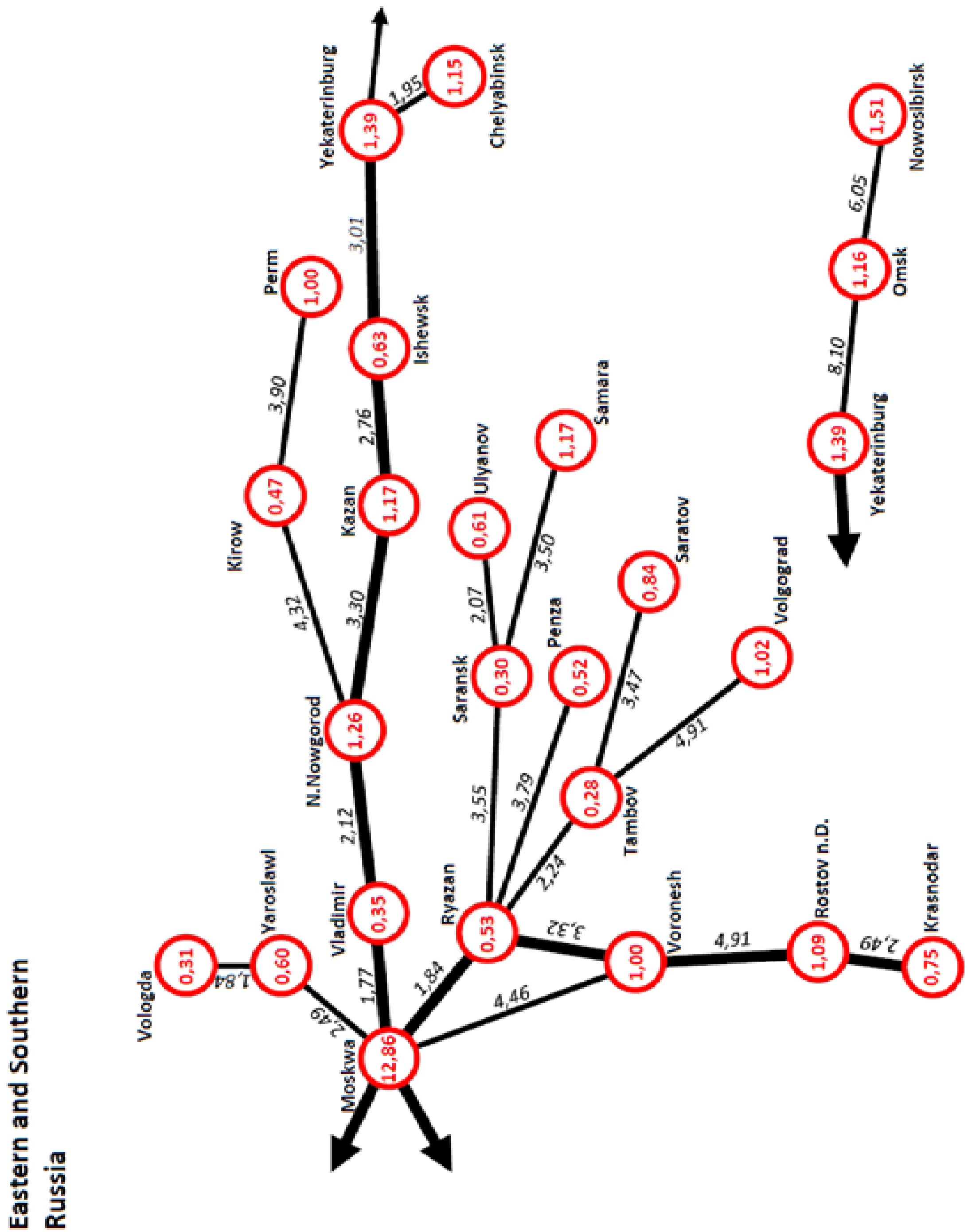


**Figure 4.3d - Eastern and Southern Russia**



## Figure 4.3e - South-Western Europe

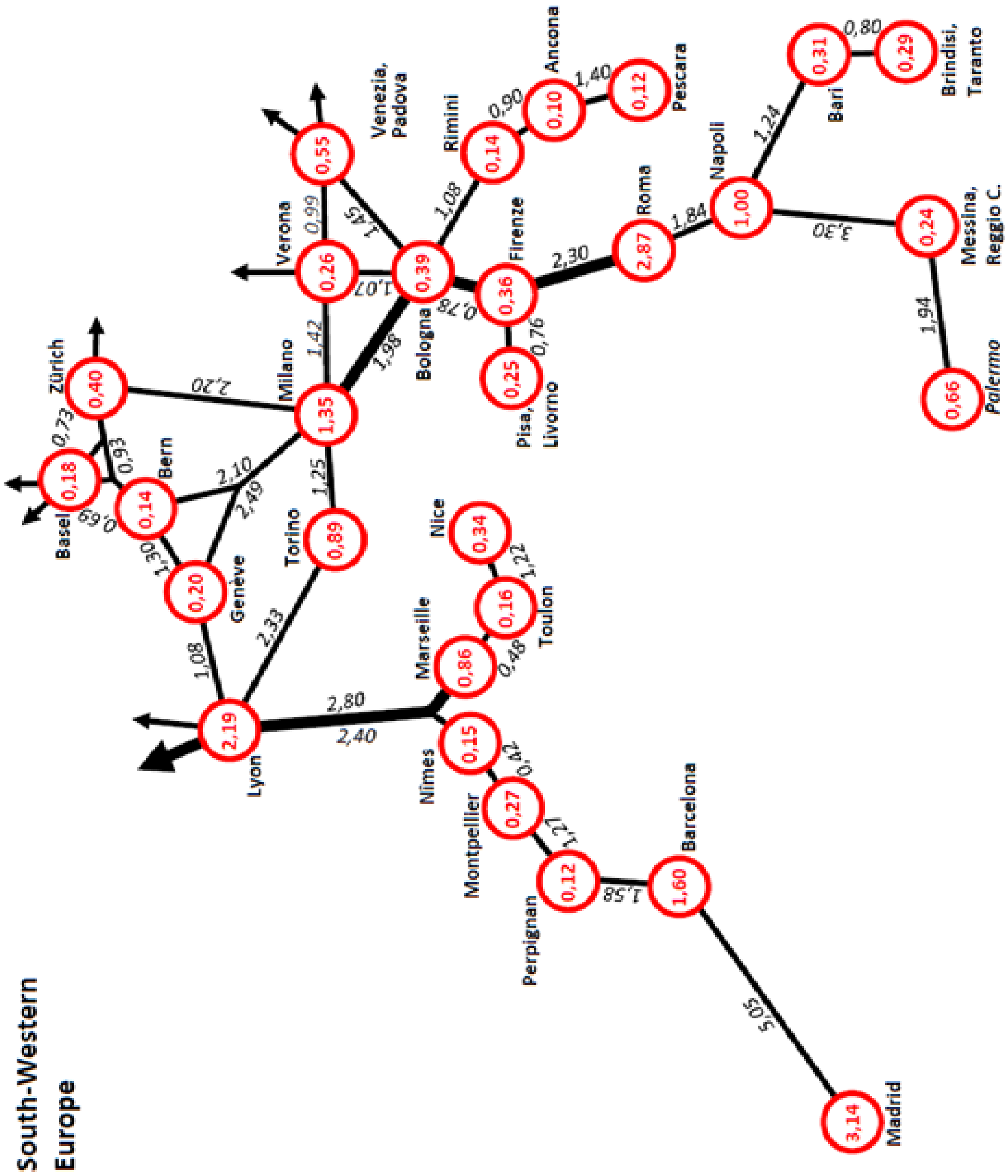


**Figure 4.3f - South-Central Europe**

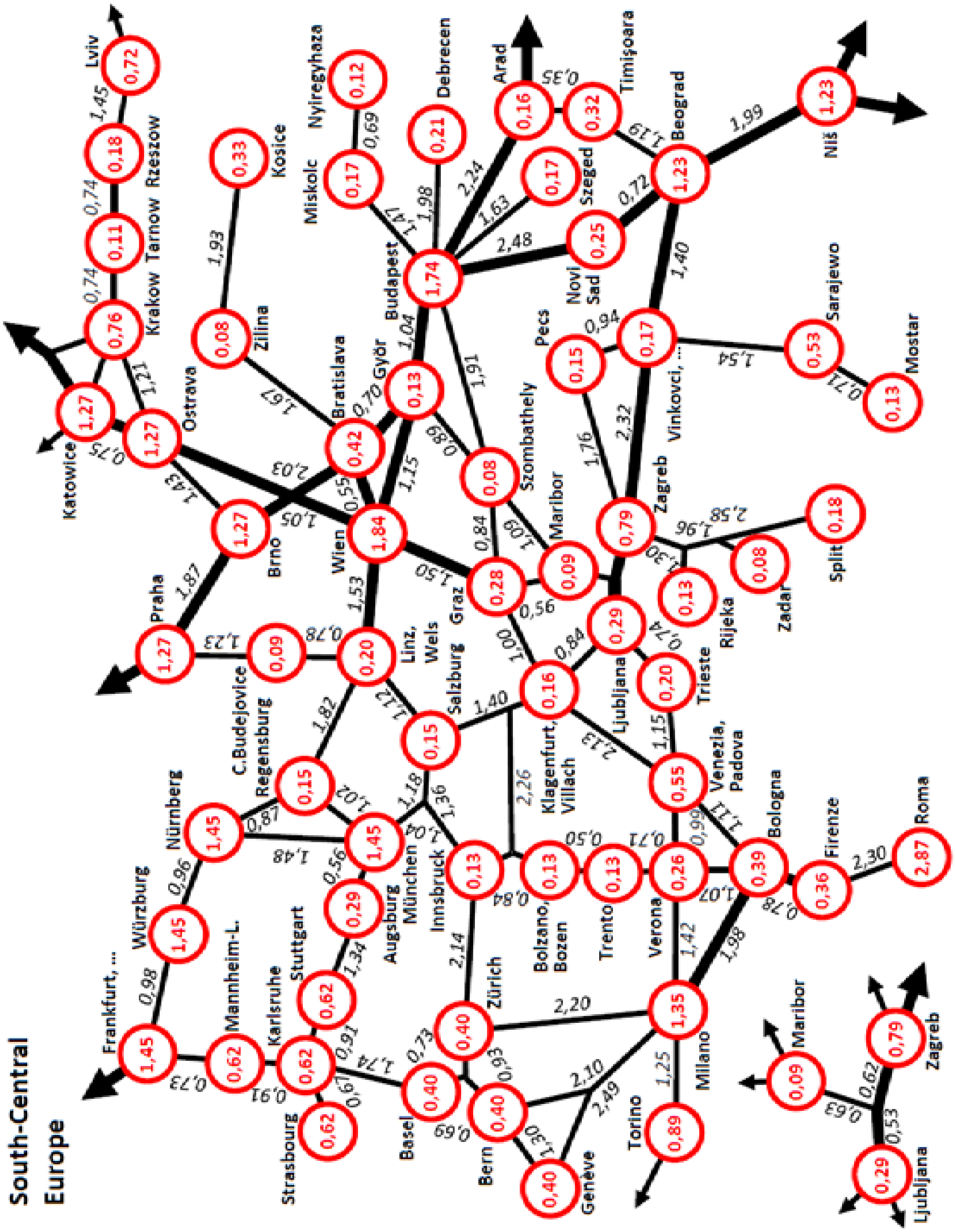


**Figure 4.3g - South-Eastern Europe**

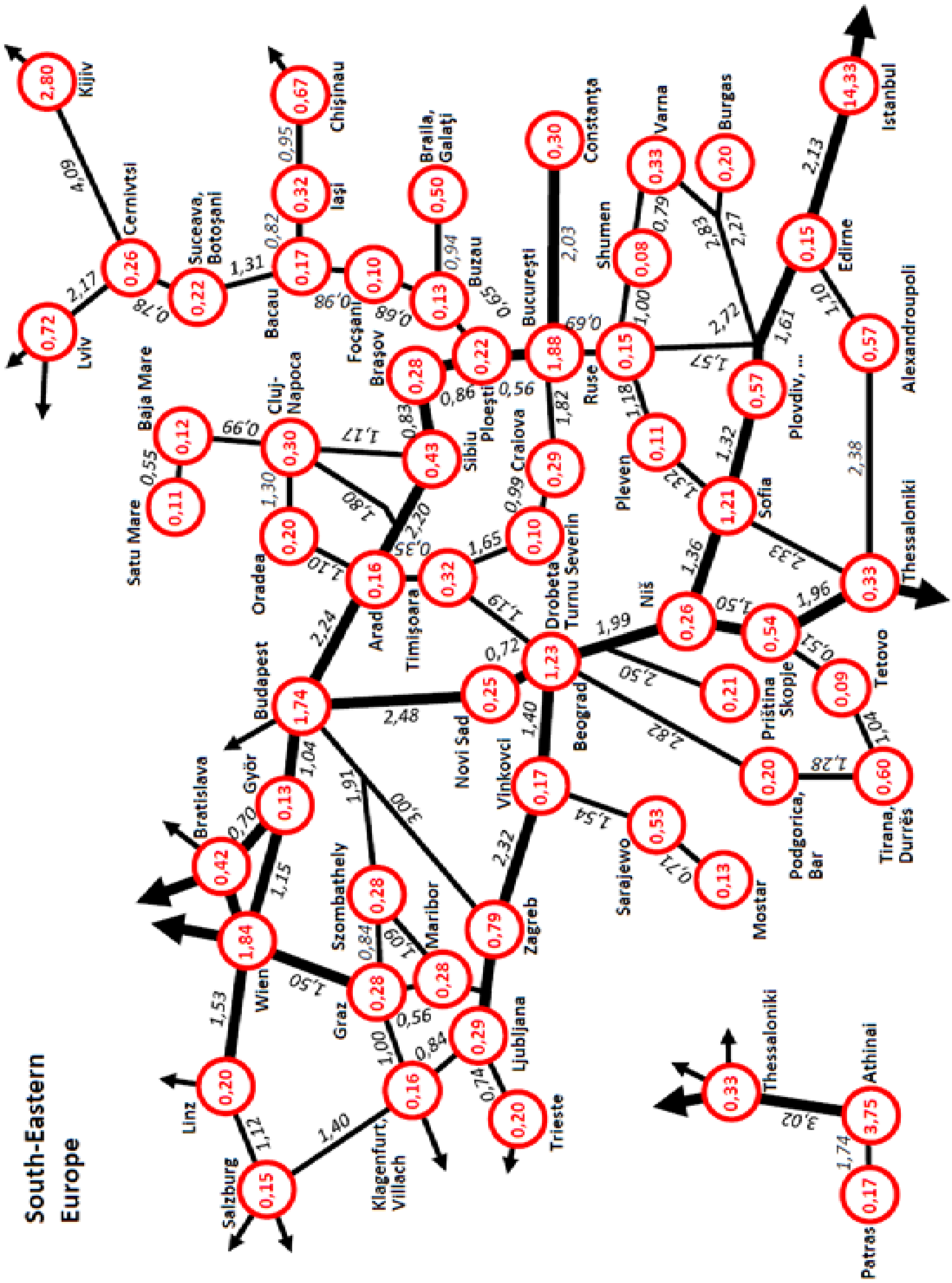
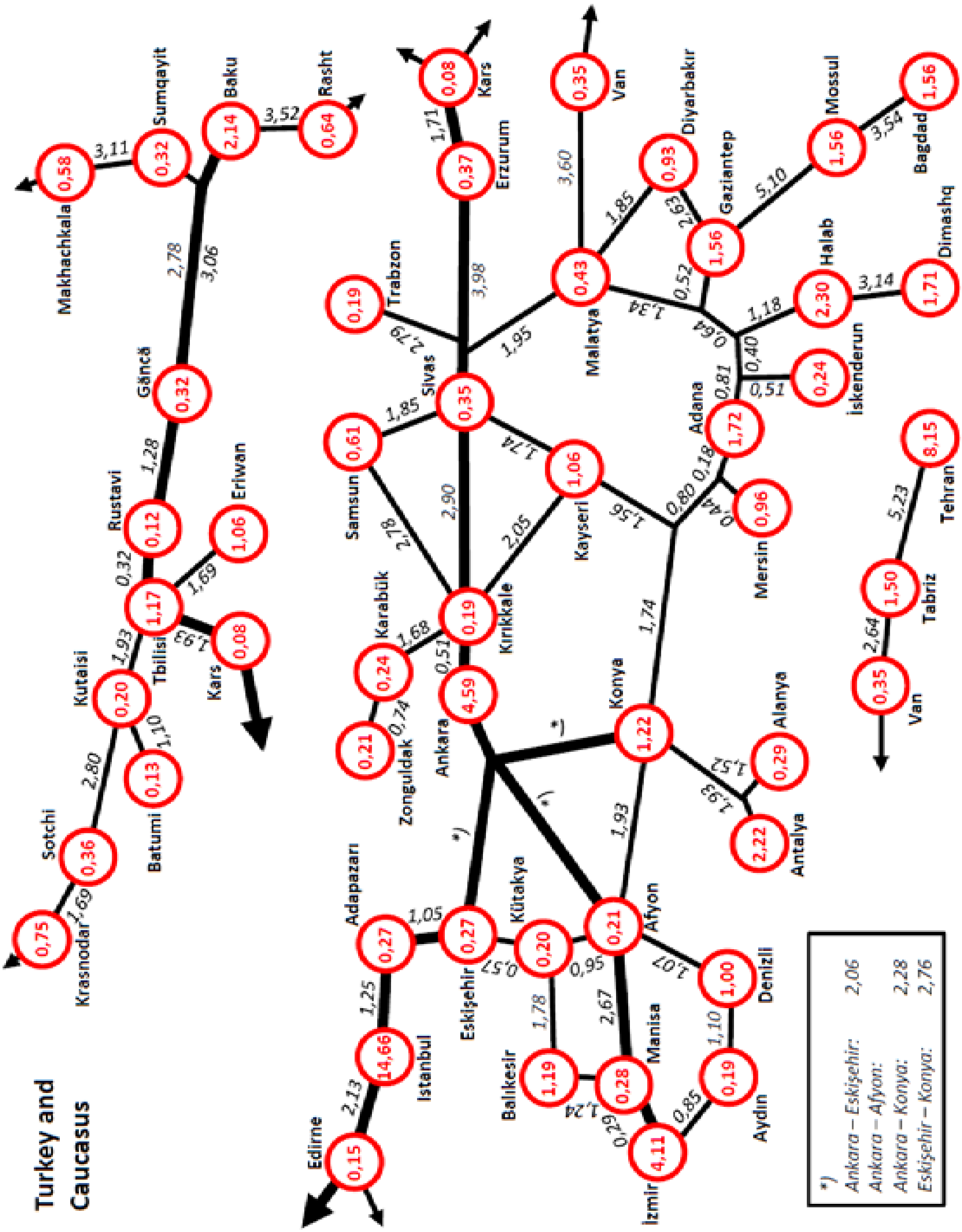


**Figure 4.3h - Turkey and Caucasus**

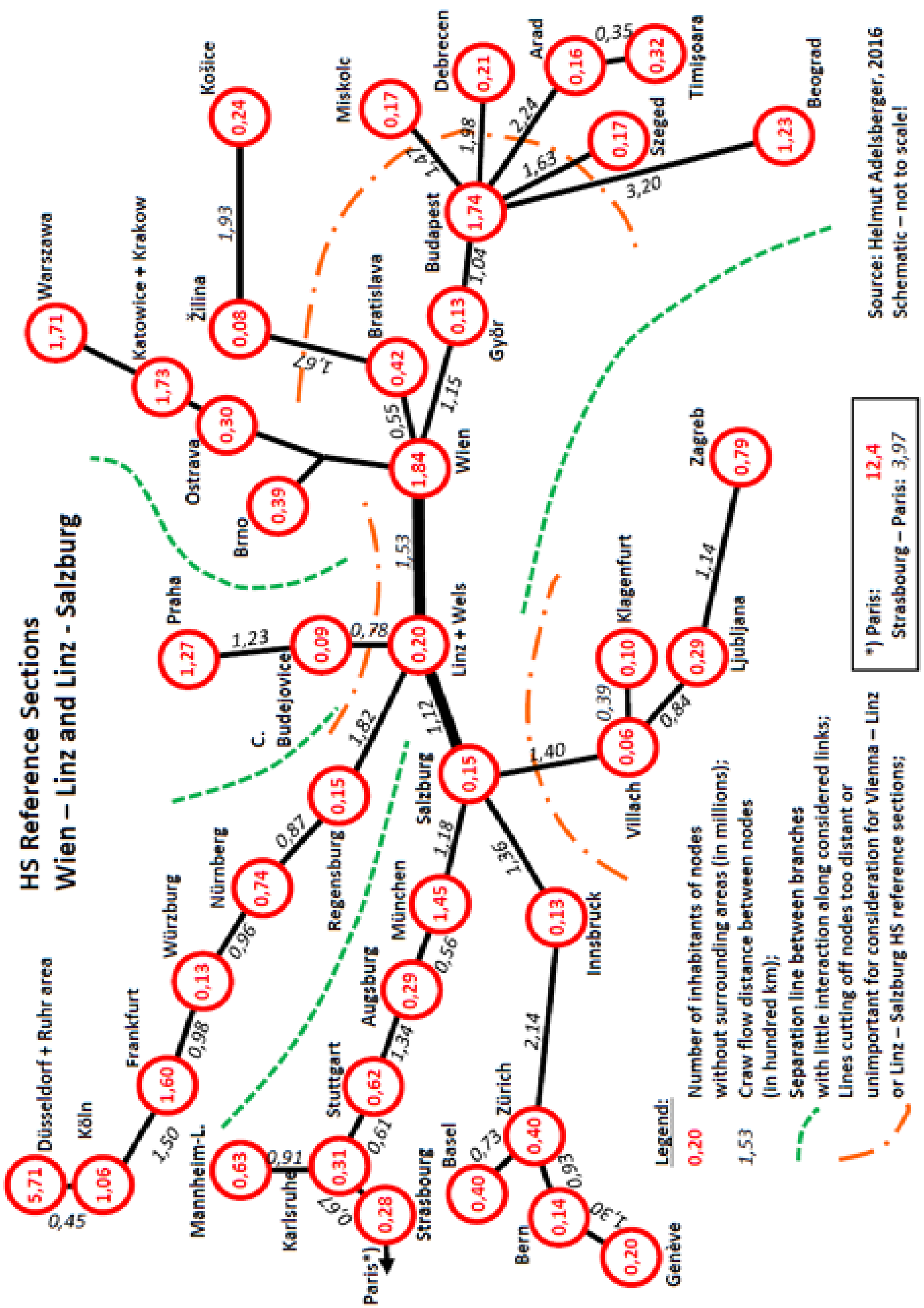


## 4.6. Examples of the application of the methodology

To give examples to demonstrate how to apply this methodology, the planned high-speed link Salzburg — Linz and the existing high-speed link Linz — Vienna are used.

Figure 4.3 shows the schematic map of cities that have been considered relevant for the "absolute traffic demand potentials" of these sections. The cities are attributed with their numbers of inhabitants (in millions, e.g. Vienna 1,84 means 1.84 million inhabitants), the links with their beeline lengths (in hundred kilometres, e.g. Linz — Vienna 1,53 means 153 km). This schematic map may be extended west and east. However, the influence on the results would be negligible. (In this map, the catchment areas which are relevant for one of the considered links are marked with dotted green lines.)

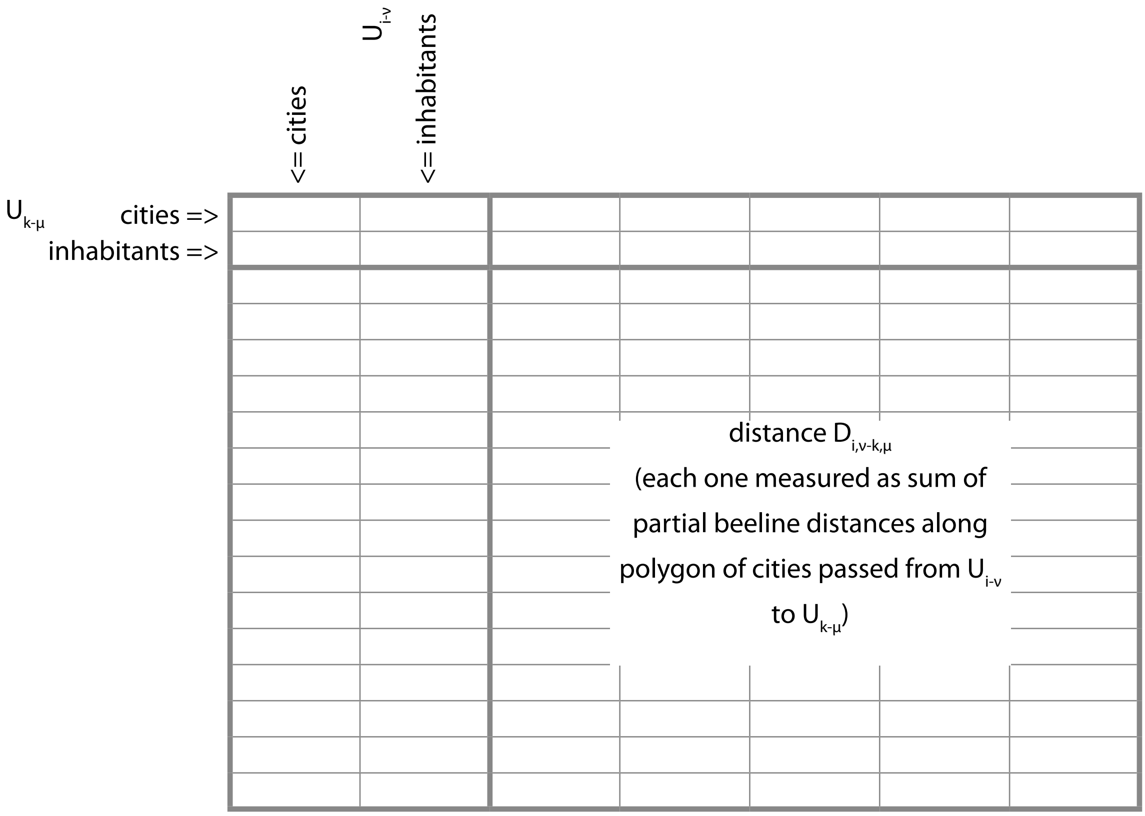
**Figure 4.4 - Reference links Vienna — Linz and Linz — Salzburg (Austria)**



According to this schematic maps and in line with the example of the model matrix in figure 4.5, the fields of the upper matrices in tables 4.1 and 4.2 are completed:

- In the first column and in the first line, the names of the cities $U_{i-\nu}$, respectively $U_{k-\mu}$
- In the field where the second line and the second column cross, the beeline distance between $U_i$ and $U_k$
- And in the other fields summed up the beeline distances between the cities $U_{i-\nu}$ and $U_{k-\mu}$, along the polygonal accesses "behind" $U_i$ and $U_k$.

**Figure 4.5 - Model matrix to demonstrate the principle of calculation**




Then, the matrices as shown in tables 4.7 for Vienna — Linz and 4.8 for Linz — Salzburg are completed with the individual results of applying the "gravitation formula", i.e. by multiplying together the numbers of inhabitants of the relative cities $U_{i-\nu}$ and $U_{k-\mu}$ (see left columns and upper lines of the matrices) and dividing each of the products by their mutual distance (sum along the polygon from $U_{i-\nu}$ to $U_{k-\mu}$, (see second columns from the left and second lines from above in the matrices 4.7 and 4.8), to the power of 1.7. This means that the result of each such calculation with the data corresponding to the nodes μ and ν and their mutual distance indicated in the field in column μ, line ν enter into the corresponding field (μ, ν) of the lower matrix.

The sum of all "inner" fields of the matrices (horizontal and vertical) is the "absolute traffic demand potential" of the considered links. This value only represents sizes and distances of cities, but not mobility rates, which are a function of economy and welfare.

In order to obtain the real grade of exploitation of a particular link for a certain time horizon, represented by its "weighted traffic demand potential", it is necessary to multiply its "absolute traffic demand potential" by the relevant GDP per capita quotient (GDP of the considered country at a certain time horizon/EU average GDP per capita in 2015).

**Table 4.7 - Railway section Vienna — Linz; calculation of "absolute traffic demand potential"**

(Red values indicate relations for which the link Linz — Vienna has only little relevance)

## Linz - Wien

| | | Wien | Brno | Ostrava | Katowice + Krakow | Warszawa | Bratislava | Zilina | Kosice | Györ | Budapest | Miskolc | Debrecen | Szeged | Arad | Timisoara | Belgrade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1,84 | 0,39 | 0,30 | 2,04 | 1,71 | 0,42 | 0,08 | 0,33 | 0,13 | 1,74 | 0,17 | 0,21 | 0,17 | 0,16 | 0,32 | 1,23 |
| Linz + Wels | 0,26 | 1,53 | 2,58 | 3,68 | 4,43 | 7,01 | 2,08 | 3,75 | 5,58 | 2,68 | 3,72 | 5,19 | 5,70 | 5,35 | 5,96 | 6,41 | 6,92 |
| Passau | 0,06 | 2,25 | 3,30 | 4,40 | 5,15 | 7,73 | 2,80 | 4,47 | 6,30 | 3,40 | 4,44 | 5,91 | 6,42 | 6,07 | 6,68 | 7,13 | 7,64 |
| Regensburg | 0,15 | 3,35 | 4,40 | 5,50 | 6,25 | 8,83 | 3,90 | 5,57 | 7,40 | 4,50 | 5,54 | 7,01 | 7,52 | 7,17 | 7,78 | 8,23 | 8,74 |
| Nürnberg | 0,74 | 4,22 | 20,00 | 20,00 | 20,00 | 20,00 | 4,77 | 20,00 | 20,00 | 5,37 | 6,41 | 7,88 | 8,39 | 8,04 | 8,65 | 9,10 | 9,61 |
| Würzburg | 0,13 | 5,18 | 20,00 | 20,00 | 20,00 | 20,00 | 5,73 | 20,00 | 20,00 | 6,33 | 7,37 | 8,84 | 9,35 | 9,00 | 9,61 | 10,06 | 10,57 |
| Frankfurt | 1,60 | 6,16 | 20,00 | 20,00 | 20,00 | 20,00 | 6,71 | 20,00 | 20,00 | 7,31 | 8,35 | 9,82 | 10,33 | 9,98 | 10,59 | 11,04 | 11,55 |
| Köln | 1,06 | 7,66 | 20,00 | 20,00 | 20,00 | 20,00 | 8,21 | 20,00 | 20,00 | 8,81 | 9,85 | 11,32 | 11,83 | 11,39 | 12,09 | 12,54 | 13,05 |
| Ddf. + Ruhrg. | 5,71 | 8,11 | 20,00 | 20,00 | 20,00 | 20,00 | 8,66 | 20,00 | 20,00 | 9,26 | 10,30 | 11,77 | 12,28 | 11,84 | 12,54 | 12,99 | 13,50 |
| Salzburg | 0,15 | 2,65 | 3,70 | 4,80 | 5,55 | 8,13 | 3,20 | 4,87 | 6,70 | 3,80 | 4,84 | 6,31 | 6,82 | 6,47 | 7,08 | 7,53 | 20,00 |
| München | 1,45 | 3,83 | 4,88 | 5,98 | 6,73 | 9,31 | 4,38 | 6,05 | 7,88 | 4,98 | 6,02 | 7,49 | 8,00 | 7,65 | 8,26 | 8,71 | 20,00 |
| Ausburg | 0,29 | 4,39 | 5,44 | 6,54 | 7,29 | 9,87 | 4,94 | 6,61 | 8,44 | 5,54 | 6,58 | 8,05 | 8,56 | 8,21 | 8,82 | 9,27 | 20,00 |
| Stuttgart | 0,62 | 5,73 | 6,78 | 7,88 | 8,63 | 11,21 | 6,28 | 7,95 | 9,78 | 6,88 | 7,92 | 9,39 | 9,90 | 9,55 | 10,16 | 10,61 | 20,00 |
| Mannheim-L. | 0,63 | 6,64 | 20,00 | 20,00 | 20,00 | 20,00 | 7,19 | 8,86 | 10,69 | 7,79 | 8,83 | 10,30 | 10,81 | 10,46 | 11,07 | 11,52 | 20,00 |
| Karlsruhe | 0,31 | 6,34 | 20,00 | 20,00 | 20,00 | 20,00 | 6,89 | 8,56 | 10,39 | 7,49 | 8,53 | 10,00 | 10,51 | 10,16 | 10,77 | 11,22 | 20,00 |
| Strasbourg | 0,28 | 7,01 | 20,00 | 20,00 | 20,00 | 20,00 | 7,56 | 9,23 | 11,06 | 8,16 | 9,20 | 10,67 | 11,18 | 10,83 | 11,44 | 11,89 | 20,00 |
| Paris | 12,4 | 10,98 | 20,00 | 20,00 | 20,00 | 20,00 | 11,53 | 13,20 | 15,03 | 12,13 | 13,17 | 14,64 | 15,15 | 14,80 | 15,41 | 15,86 | 20,00 |
| Innsbruck | 0,13 | 4,01 | 5,06 | 6,16 | 6,91 | 9,49 | 4,56 | 6,23 | 8,06 | 5,16 | 6,20 | 7,67 | 8,18 | 7,83 | 8,44 | 8,89 | 20,00 |
| Vorarlberg | 0,11 | 5,34 | 6,39 | 7,49 | 8,24 | 10,82 | 5,89 | 7,56 | 9,39 | 6,49 | 7,53 | 9,00 | 9,51 | 9,16 | 9,77 | 10,22 | 20,00 |
| Zürich | 0,40 | 6,15 | 7,20 | 8,30 | 9,05 | 11,63 | 6,70 | 8,37 | 10,20 | 7,30 | 8,34 | 9,81 | 10,32 | 9,97 | 10,58 | 11,03 | 20,00 |
| Basel | 0,18 | 6,88 | 7,93 | 9,03 | 9,78 | 12,36 | 7,43 | 9,10 | 10,93 | 8,03 | 9,07 | 10,54 | 11,05 | 10,70 | 11,31 | 11,76 | 20,00 |
| Bern | 0,14 | 7,08 | 8,13 | 9,23 | 9,98 | 12,56 | 7,63 | 9,30 | 11,13 | 8,23 | 9,27 | 10,74 | 11,25 | 10,90 | 11,51 | 11,96 | 20,00 |
| Genève | 0,20 | 8,38 | 9,43 | 10,53 | 11,28 | 13,86 | 8,93 | 10,60 | 12,43 | 9,53 | 10,57 | 12,04 | 12,55 | 12,20 | 12,81 | 13,26 | 20,00 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Linz + Wels | 0,232 | 0,020 | 0,009 | 0,042 | 0,016 | 0,031 | 0,002 | 0,005 | 0,006 | 0,048 | 0,003 | 0,003 | 0,003 | 0,002 | 0,004 | 0,012 |
| Passau | 0,028 | 0,003 | 0,001 | 0,008 | 0,003 | 0,004 | 0,000 | 0,001 | 0,001 | 0,008 | 0,000 | 0,001 | 0,000 | 0,000 | 0,001 | 0,002 |
| Regensburg | 0,035 | 0,005 | 0,002 | 0,014 | 0,006 | 0,006 | 0,001 | 0,002 | 0,002 | 0,014 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,005 |
| Nürnberg | 0,118 | 0,002 | 0,001 | 0,009 | 0,008 | 0,022 | 0,000 | 0,001 | 0,006 | 0,055 | 0,004 | 0,004 | 0,004 | 0,003 | 0,006 | 0,019 |
| Würzburg | 0,015 | 0,000 | 0,000 | 0,002 | 0,001 | 0,003 | 0,000 | 0,000 | 0,001 | 0,008 | 0,001 | 0,001 | 0,001 | 0,000 | 0,001 | 0,003 |
| Frankfurt | 0,134 | 0,004 | 0,003 | 0,020 | 0,017 | 0,026 | 0,001 | 0,003 | 0,007 | 0,075 | 0,006 | 0,006 | 0,005 | 0,005 | 0,009 | 0,031 |
| Köln | 0,061 | 0,003 | 0,002 | 0,013 | 0,011 | 0,012 | 0,001 | 0,002 | 0,003 | 0,038 | 0,003 | 0,003 | 0,003 | 0,002 | 0,005 | 0,017 |
| Ddf. + Ruhrg. | 0,299 | 0,014 | 0,011 | 0,072 | 0,060 | 0,061 | 0,003 | 0,012 | 0,017 | 0,189 | 0,015 | 0,017 | 0,015 | 0,012 | 0,023 | 0,084 |
| Salzburg | 0,053 | 0,006 | 0,003 | 0,017 | 0,007 | 0,009 | 0,001 | 0,002 | 0,002 | 0,018 | 0,001 | 0,001 | 0,001 | 0,001 | 0,002 | 0,001 |
| München | 0,272 | 0,038 | 0,021 | 0,116 | 0,056 | 0,049 | 0,005 | 0,014 | 0,012 | 0,119 | 0,008 | 0,009 | 0,008 | 0,006 | 0,012 | 0,011 |
| Ausburg | 0,043 | 0,006 | 0,004 | 0,020 | 0,010 | 0,008 | 0,001 | 0,003 | 0,002 | 0,021 | 0,001 | 0,002 | 0,001 | 0,001 | 0,002 | 0,002 |
| Stuttgart | 0,059 | 0,009 | 0,006 | 0,032 | 0,017 | 0,011 | 0,001 | 0,004 | 0,003 | 0,032 | 0,002 | 0,003 | 0,002 | 0,002 | 0,004 | 0,005 |
| Mannheim-L. | 0,046 | 0,002 | 0,001 | 0,008 | 0,007 | 0,009 | 0,001 | 0,004 | 0,002 | 0,027 | 0,002 | 0,002 | 0,002 | 0,002 | 0,003 | 0,005 |
| Karlsruhe | 0,025 | 0,001 | 0,001 | 0,004 | 0,003 | 0,005 | 0,001 | 0,002 | 0,001 | 0,014 | 0,001 | 0,001 | 0,001 | 0,001 | 0,002 | 0,002 |
| Strasbourg | 0,019 | 0,001 | 0,001 | 0,004 | 0,003 | 0,004 | 0,001 | 0,002 | 0,001 | 0,011 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,002 |
| Paris | 0,388 | 0,030 | 0,023 | 0,155 | 0,130 | 0,082 | 0,012 | 0,041 | 0,023 | 0,270 | 0,022 | 0,026 | 0,022 | 0,019 | 0,036 | 0,094 |
| Innsbruck | 0,023 | 0,003 | 0,002 | 0,010 | 0,005 | 0,004 | 0,000 | 0,001 | 0,001 | 0,010 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 |
| Vorarlberg | 0,012 | 0,002 | 0,001 | 0,006 | 0,003 | 0,002 | 0,000 | 0,001 | 0,001 | 0,006 | 0,000 | 0,001 | 0,000 | 0,000 | 0,001 | 0,001 |
| Zürich | 0,034 | 0,005 | 0,003 | 0,019 | 0,011 | 0,007 | 0,001 | 0,003 | 0,002 | 0,019 | 0,001 | 0,002 | 0,001 | 0,001 | 0,002 | 0,003 |
| Basel | 0,012 | 0,002 | 0,001 | 0,008 | 0,004 | 0,002 | 0,000 | 0,001 | 0,001 | 0,007 | 0,001 | 0,001 | 0,001 | 0,000 | 0,001 | 0,001 |
| Bern | 0,009 | 0,002 | 0,001 | 0,006 | 0,003 | 0,002 | 0,000 | 0,001 | 0,001 | 0,006 | 0,000 | 0,000 | 0,000 | 0,000 | 0,001 | 0,001 |
| Genève | 0,010 | 0,002 | 0,001 | 0,007 | 0,004 | 0,002 | 0,000 | 0,001 | 0,001 | 0,006 | 0,000 | 0,001 | 0,000 | 0,000 | 0,001 | 0,002 |

| |
|---|
| 5,469 |

**Table 4.8 - Railway section Linz — Salzburg; calculation of "absolute traffic demand potential"**

(red values indicate relations for which the link Salzburg — Linz has only little relevance)

## Linz - Salzburg

| | | Linz + Wels | C.Budejovice | Praha | Wien | Brno | Ostrava | Katowice + Krakow | Warszawa | Bratislava | Zilina | Kosice | Györ | Budapest |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0,26 | 0,09 | 1,27 | 1,84 | 0,39 | 0,30 | 2,04 | 1,71 | 0,42 | 0,08 | 0,33 | 0,13 | 1,74 |
| Salzburg | 0,15 | 1,12 | 1,90 | 3,13 | 2,65 | 3,70 | 4,15 | 4,90 | 7,48 | 3,20 | 4,87 | 6,80 | 3,80 | 4,84 |
| München | 1,45 | 2,30 | 3,08 | 20,00 | 3,83 | 4,88 | 5,33 | 6,08 | 8,66 | 4,38 | 6,05 | 7,98 | 4,98 | 6,02 |
| Augsburg | 0,29 | 2,86 | 3,64 | 20,00 | 4,39 | 5,44 | 5,89 | 6,64 | 9,22 | 4,94 | 6,61 | 8,54 | 5,54 | 6,58 |
| Stuttgart | 0,62 | 4,20 | 4,98 | 20,00 | 5,73 | 6,78 | 7,23 | 7,98 | 10,56 | 6,28 | 7,95 | 9,88 | 6,88 | 7,87 |
| Mannheim-L. | 0,63 | 5,11 | 5,89 | 20,00 | 6,64 | 7,69 | 8,14 | 8,89 | 11,47 | 7,19 | 8,86 | 10,79 | 7,79 | 8,78 |
| Karlsruhe | 0,31 | 4,81 | 5,59 | 20,00 | 6,34 | 7,39 | 7,84 | 8,59 | 11,17 | 6,89 | 8,56 | 10,49 | 7,49 | 8,48 |
| Strasbourg | 0,28 | 5,48 | 6,26 | 20,00 | 7,01 | 8,06 | 8,51 | 9,26 | 11,84 | 7,56 | 9,23 | 11,16 | 8,16 | 9,15 |
| Paris | 12,40 | 9,45 | 10,23 | 20,00 | 10,98 | 12,03 | 12,48 | 13,23 | 15,81 | 11,53 | 13,20 | 15,13 | 12,13 | 13,12 |
| Innsbruck | 0,13 | 2,98 | 3,76 | 4,99 | 4,01 | 5,06 | 5,06 | 5,06 | 5,06 | 5,06 | 5,06 | 8,16 | 5,16 | 6,20 |
| Vorarlberg | 0,11 | 4,31 | 5,09 | 6,32 | 5,34 | 6,39 | 6,39 | 6,39 | 6,39 | 6,39 | 6,39 | 9,49 | 6,49 | 7,53 |
| Zürich | 0,40 | 5,12 | 5,90 | 7,13 | 6,15 | 7,20 | 7,20 | 7,20 | 7,20 | 7,20 | 7,20 | 10,30 | 7,30 | 8,34 |
| Basel | 0,18 | 5,85 | 6,63 | 7,86 | 6,88 | 7,93 | 7,93 | 7,93 | 7,93 | 7,93 | 7,93 | 11,03 | 8,03 | 9,07 |
| Bern | 0,14 | 6,05 | 6,83 | 8,06 | 7,08 | 8,13 | 8,13 | 8,13 | 8,13 | 8,13 | 8,13 | 11,23 | 8,23 | 9,27 |
| Genève | 0,20 | 7,35 | 8,13 | 9,36 | 8,38 | 9,43 | 9,43 | 9,43 | 9,43 | 9,43 | 9,43 | 12,53 | 9,53 | 10,57 |
| Villach | 0,06 | 2,52 | 3,30 | 4,53 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Klagenfurt | 0,10 | 2,91 | 3,69 | 4,92 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Ljubljana | 0,29 | 3,36 | 4,14 | 5,37 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Zagreb | 0,79 | 4,50 | 5,28 | 6,51 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Salzburg | | 0,032 | 0,005 | 0,027 | 0,053 | 0,006 | 0,004 | 0,021 | 0,008 | 0,009 | 0,001 | 0,002 | 0,002 | 0,018 |
| München | | 0,091 | 0,019 | 0,011 | 0,272 | 0,038 | 0,025 | 0,138 | 0,063 | 0,049 | 0,005 | 0,014 | 0,012 | 0,119 |
| Augsburg | | 0,013 | 0,003 | 0,002 | 0,043 | 0,006 | 0,004 | 0,024 | 0,011 | 0,008 | 0,001 | 0,002 | 0,002 | 0,021 |
| Stuttgart | | 0,014 | 0,004 | 0,005 | 0,059 | 0,009 | 0,006 | 0,037 | 0,019 | 0,011 | 0,001 | 0,004 | 0,003 | 0,032 |
| Mannheim-L. | | 0,010 | 0,003 | 0,005 | 0,046 | 0,008 | 0,005 | 0,031 | 0,017 | 0,009 | 0,001 | 0,004 | 0,002 | 0,027 |
| Karlsruhe | | 0,006 | 0,001 | 0,002 | 0,025 | 0,004 | 0,003 | 0,016 | 0,009 | 0,005 | 0,001 | 0,002 | 0,001 | 0,014 |
| Strasbourg | | 0,004 | 0,001 | 0,002 | 0,019 | 0,003 | 0,002 | 0,013 | 0,007 | 0,004 | 0,001 | 0,002 | 0,001 | 0,011 |
| Paris | | 0,071 | 0,021 | 0,097 | 0,388 | 0,070 | 0,051 | 0,314 | 0,194 | 0,082 | 0,012 | 0,040 | 0,023 | 0,271 |
| Innsbruck | | 0,005 | 0,001 | 0,011 | 0,023 | 0,003 | 0,002 | 0,017 | 0,014 | 0,003 | 0,001 | 0,001 | 0,001 | 0,010 |
| Vorarlberg | | 0,002 | 0,001 | 0,006 | 0,012 | 0,002 | 0,001 | 0,010 | 0,008 | 0,002 | 0,000 | 0,001 | 0,001 | 0,006 |
| Zürich | | 0,006 | 0,002 | 0,018 | 0,034 | 0,005 | 0,004 | 0,028 | 0,024 | 0,006 | 0,001 | 0,003 | 0,002 | 0,019 |
| Basel | | 0,002 | 0,001 | 0,007 | 0,012 | 0,002 | 0,002 | 0,011 | 0,009 | 0,002 | 0,000 | 0,001 | 0,001 | 0,007 |
| Bern | | 0,002 | 0,000 | 0,005 | 0,009 | 0,002 | 0,001 | 0,008 | 0,007 | 0,002 | 0,000 | 0,001 | 0,001 | 0,006 |
| Genève | | 0,002 | 0,001 | 0,006 | 0,010 | 0,002 | 0,001 | 0,009 | 0,008 | 0,002 | 0,000 | 0,001 | 0,001 | 0,006 |
| Villach | | 0,003 | 0,001 | 0,006 | 0,001 | 0,000 | 0,000 | 0,001 | 0,001 | 0,000 | 0,000 | 0,000 | 0,000 | 0,001 |
| Klagenfurt | | 0,004 | 0,001 | 0,008 | 0,001 | 0,000 | 0,000 | 0,001 | 0,001 | 0,000 | 0,000 | 0,000 | 0,000 | 0,001 |
| Ljubljana | | 0,010 | 0,002 | 0,021 | 0,003 | 0,001 | 0,001 | 0,004 | 0,003 | 0,001 | 0,000 | 0,001 | 0,000 | 0,003 |
| Zagreb | | 0,016 | 0,004 | 0,042 | 0,009 | 0,002 | 0,001 | 0,010 | 0,008 | 0,002 | 0,000 | 0,002 | 0,001 | 0,008 |

3,988

The results of these calculation, the values 5.469 for Linz — Vienna and 3.988 for Salzburg — Linz represent the "absolute traffic demand potentials" of these links, only depending on the geographic and demographic conditions, however without considering their economic environment, i.e. the GDP per capita value for the country and the time horizon in consideration.s

From these ATDP values (rounded to 2 decimal places), the corresponding WTDP values can be obtained by multiplying them by the corresponding GDP per capita value, divided by the 2015 EU average GDP per capita, which can be found in table 4.5:

**2016:**

| | |
|---|---|
| Linz — Vienna: | WTDP2016 = 5.47 x 37,500/29,000 = 5.469 x 1.29 = 7.07 |
| Salzburg — Linz: | WTDP2016 = 3.99 x 37,500/29,000 = 3.988 x 1.29 = 5.16 |

**2030:**

| | |
|---|---|
| Linz — Vienna: | WTDP2030 = 5.47 x 45,900/29,000 = 5.469 x 1.58 = 8.64 |
| Salzburg — Linz: | WTDP2030 = 3.99 x 45,900/29,000 = 3.988 x 1.58 = 6.31 |

**2050 — lower scenario:**

| | |
|---|---|
| Linz — Vienna: | WTDP2050L = 5.47 x 45,900/29,000 = 5.469 x 1.58 = 8.65 |
| Salzburg — Linz: | WTDP2050L = 3.99 x 45,900/29,000 = 3.988 x 1.58 = 6.31 |

**2050 — medium scenario:**

| | |
|---|---|
| Linz — Vienna: | WTDP2015M = 5.47 x 51,900/29,000 = 5.469 x 1.79 = 9.79 |
| Salzburg — Linz: | WTDP2015M = 3.99 x 51,900/29,000 = 3.988 x 1.79 = 7.14 |

**2050 — higher scenario:**

| | |
|---|---|
| Linz — Vienna: | WTDP2015U = 5.47 x 57,900/29,000 = 5.469 x 2.00 = 10.92 |
| Salzburg — Linz: | WTDP2015U = 3.99 x 57,900/29,000 = 3.988 x 2.00 = 7.97 |

These values show the great influence of the economic background, represented by the corresponding GDP per capita value on the "weighted traffic demand potential", which is a proxy for the number of passengers to be expected on a certain link at a certain time (of course provided an economic development in line with the corresponding assumption).

However, these values cannot replace a more in-depth investigation of traffic demand, prior to decision-making. They only indicate the traffic demand in a certain link, covering all modes of transport, due to geographical conditions and population. The real exhaustion of this potential for rail depend on its competitiveness against road and air, which reflects travel times and prices, as well as soft factors like the general acceptance of rail, comfort etc.

There may be even more passengers on a certain link, if it connects touristically important cities or if there is special business mobility. This is, for instance, the case for the Vienna — Linz — Salzburg railway line in Austria.

Finally, there may be further aspects on decision-making, such as capacity needs for freight transport or improving regional accessibility, to enhance regional economy and employment.

Альфа-Банк
ФЕСТИВАЛЬ
ЭЛЕКТРОННОЙ МУЗЫКИ
И ТЕХНОЛОГИЙ
ALFA FUTURE PEOPLE
AFP
13+
САПСАН

# 5. Results, Assessment, Conclusions and Recommendations

## 5.1. Reference high-speed links

In chapter 4.4., the application of the methodology was demonstrated by means of two examples in Austria: the existing high-speed line Vienna — Linz and the continuing section Linz — Salzburg, for which a step-by-step upgrading to higher speeds is foreseen.

Applying the same methodology on a number of other European high-speed sections, most of which are presented as best practice examples in chapter 2.5., the corresponding WTDP value is calculated. As it is the same algorithm as applied in all cases, the following description contains only the list of sections and the corresponding results (the matrices comprising the sizes of the nodes (in million inhabitants) and their relevant mutual distances (in 100 km units) as well as the contributions of the individual relations can be found in annex III).

The following investigated sections show the following ATDP values ("absolute traffic demand potentials"):

**Table 5.1 - Absolute traffic demand potentials of reference links (absolute = without reference to forecast)**

| Reference links | Countries | ATDP 2016 |
|---|---|---:|
| Paris — Lyon | France | 11.256 |
| Lyon — Marseille | France | 5.250 |
| Milano — Bologna | Italy | 7.652 |
| Bologna — Firenze | Italy | 4.324 |
| Firenze — Roma | Italy | 3.700 |
| Koeln — Frankfurt | Germany | 12.247 |
| Wien — Linz | Austria | 5.469 |
| Linz — Salzburg | Austria | 3.988 |
| Wien — Graz | Austria | 4.379 |
| Moskwa — St. Petersburg | Russia | 4.810 |
| Ankara — Polatli | Turkey | 17.598 |
| Polatli — Eskisehr | Turkey | 17.701 |
| Eskisehir — Istanbul | Turkey | 19.336 |

Applying to these ATDP values the corresponding GDP per capita ratios for 2015, 2030 and 2050, according to the forecast as developed in chapter 4.3., leads to the corresponding WTDP values ("weighted traffic demand potentials"), which are appropriate proxies for real traffic demand in the considered links for the quoted time horizons.

**Table 5.2 - Weighted traffic demand potentials of reference links**

| | | ATDP | GDP-Ratio: GDP per capita (year)/ EU average 2016 | | | | | WTDP = ATDP * GDP-Ratio | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Year | 2016 | 2016 | 2030 | 2050 | 2050 | 2050 | 2016 | 2030 | 2050 | 2050 | 2050 |
| Reference Links | Countries | | | | L | M | H | | | L | M | H |
| Paris - Lyon | FR | 11.256 | 1.19 | 1.39 | 1.39 | 1.53 | 1.67 | 13.39 | 15.65 | 15.65 | 17.22 | 18.80 |
| Lyon - Marseille | FR | 5.250 | 1.19 | 1.39 | 1.39 | 1.53 | 1.67 | 6.25 | 7.30 | 7.30 | 8.03 | 8.77 |
| Milano - Bologna | IT | 7.652 | 0.97 | 1.12 | 1.12 | 1.22 | 1.33 | 7.42 | 8.57 | 8.57 | 9.34 | 10.18 |
| Bologna - Firenze | IT | 4.324 | 0.97 | 1.12 | 1.12 | 1.22 | 1.33 | 4.19 | 4.84 | 4.84 | 5.28 | 5.75 |
| Firenze - Roma | IT | 3.700 | 0.97 | 1.12 | 1.12 | 1.22 | 1.33 | 3.59 | 4.14 | 4.14 | 4.51 | 4.92 |
| Koeln - Frankfurt | DE | 12.247 | 1.26 | 1.54 | 1.54 | 1.74 | 1.94 | 15.43 | 18.86 | 18.86 | 21.31 | 23.76 |
| Wien - Linz | AT | 5.469 | 1.29 | 1.58 | 1.58 | 1.79 | 2.00 | 7.06 | 8.64 | 8.64 | 9.79 | 10.94 |
| Linz - Salzburg | AT | 3.988 | 1.29 | 1.58 | 1.58 | 1.79 | 2.00 | 5.14 | 6.30 | 6.30 | 7.14 | 7.98 |
| Wien - Graz | AT | 4.379 | 1.29 | 1.58 | 1.58 | 1.79 | 2.00 | 5.65 | 6.92 | 6.92 | 7.84 | 8.76 |
| Moskwa - St. Petersburg | RU | 4.810 | 0.59 | 0.74 | 0.74 | 0.85 | 0.96 | 2.84 | 3.56 | 3.56 | 4.09 | 4.62 |
| Ankara - Polatli | TR | 17.598 | 0.63 | 0.86 | 0.86 | 1.03 | 1.20 | 11.09 | 15.13 | 15.13 | 18.13 | 21.12 |
| Polatli - Eskisehir | TR | 17.701 | 0.63 | 0.86 | 0.86 | 1.03 | 1.20 | 11.15 | 15.22 | 15.22 | 18.23 | 21.24 |
| Eskisehir - Istanbul | TR | 19.336 | 0.63 | 0.86 | 0.86 | 1.03 | 1.20 | 12.18 | 16.63 | 16.63 | 19.92 | 23.20 |

≥ 6.00

≥ 12.00

≥ 18.00

In Western Europe, Paris — Lyon and Cologne — Frankfurt do not only have the highest potential, they have indeed very high levels of traffic demand.

Within the monocentric space structure of France, there is the metropolitan area of Paris with more than 12 million inhabitants, which generates the lion share of traffic. The corridor with the highest traffic demand is Paris — Lyon, which moreover continues to Marseille, thus connecting the three largest cities of France. Correspondingly, Paris — Lyon has one of the highest, still growing WTDP values in Europe. In this relation France is already considering the construction of a second high-speed line, following a more western alignment, which would include and connect other regions in the Paris — Lyon corridor and the TGV network.

Germany is characterised by a typically polycentric space structure. There are several cities between 1 and 4 million inhabitants, a wide range of cities between 100,000 and 1 million inhabitants, and even a very large and important agglomeration, consisting of Cologne, Düsseldorf and the Ruhr area, all of them at relatively short distances from each other. In the corridor between the agglomerations of Cologne and Frankfurt, there is an especially high concentration of overlaying relations. As already mentioned in chapter 2.5., there are three double-track railway lines linking these nodes: two conventional double track lines along the Rhine river, on its left (western) banks, the main passenger line; on its right (eastern) banks the freight line, as well as the high-speed line opened in 2002, which is operated at 300 km/h, with gradients up to 40‰, mostly along the existing six-lane motorway.

The Italian lines are embedded in a space structure that are in principle similar to the German situation. However, due to the location on the peninsula, the capture area of the individual links is smaller the more to the south, which results in lower "absolute" and "weighted traffic demand potentials", in particular south of Bologna. Nevertheless, not least to improve its internal cohesion, Italy has constructed the high-speed connection Turin — Milan — Bologna — Florence — Rome — Naples — Salerno, with extensions being implemented from Turin to Lyon in France, thus creating a continuous high-speed connection Paris — Rome, and from Naples to Bari. Extensions south towards Calabria and Sicily are planned as well, but their implementation does not seem likely.

In relation to other sections in Western Europe, in Austria, Vienna — Linz, Linz —Salzburg and Vienna — Graz have medium traffic demand potentials. However, with attractive fares, a dense, mostly integrated timetable, convenient trains and a not negligible tourist demand, mainly between Vienna and Salzburg, a high grade of real demand can be observed today.

Further to passengers, the Rhine-Danube Core Network Corridor, in particular the section Vienna — Linz — Wels has a very high freight load; therefore, between Vienna and Linz, the high-speed line has been constructed alongside the existing conventional line, which is used for regional passenger and freight trains. However, the lines are interlinked so that one may consider them rather a four track than two double track lines.

Equally, adding two tracks to the existing section Linz — Wels of the link Linz — Salzburg is foreseen, where the majority of freight traffic branches off towards Passau, Nuremberg, the Ruhr Region and the North Sea ports. The remaining part of this link, i.e. Wels — Salzburg, has already been upgraded to high-speed, for further short sections this is foreseen step-by-step, for the future.

On the Vienna — Graz section, the 28 km long Semmering base tunnel is under construction and will open in 2026. It will shorten the link by about 20 km, it will replace the existing historical mountain railway with radii below 180 m, gradients of 25‰ and 160 years old tunnels with clearance restrictions. This will save 30 minutes in travel time. At its northern access, upgrading to high-speed is foreseen to upgrade the section Vienna — Wiener Neustadt simultaneously. For the southern access to the Semmering base tunnel, upgrading is foreseen in the TEN-T Comprehensive network, which means after 2030. This is continued by the Koralm railway Graz — Klagenfurt as described above in chapter 2.1. As from 2026, the entire line Vienna — Graz — Klagenfurt — Villach will be partly high-speed, and continuously flat high-performance section of the Baltic-Adriatic Corridor.

At first sight, the high level of "potential traffic demand" indicators in Turkey seems surprising. However, there is a significant number of large cities, Istanbul in particular, which in relation to their sizes are located at not too long distances.

This must also be seen against the background that the existing Turkish railway network is characterised by several missing links, diversions and other weaknesses inherited from the past as, for example, described in the context with Austrian Koralm railway above. Furthermore — and this may be an important aspect for the future — Turkey has a key location along one of the EATL corridors between Europe and China, which may result in a fast-growing freight transport in the future, resulting in the need of new capacities. This may mean that projects become viable even if WTDP values are low.

Although, according to the GDP per capita level, WTDP values are reduced for the time being, they are still very high, due to the size of cities. Reflecting the growing strength of the Turkish economy, the figures clearly show, that a steep upward development of this potential may be expected. The Turkish high-speed lines are excellent examples of how high-speed is an option also for TER countries, where traffic demand is high enough to justify the investment.

A very special case is the Russian Federation. There are a large number of agglomerations, at least in the European part of the country, but distances are considerably greater than in the rest of Europe. As a consequence, average travel distances are longer in Russian Federation than in EU countries. This is the background that for some relations, speeds up to 400 km/h are foreseen in the Russian Federation. With respect to uniformity, it has not been done in this study (Phase 1), but it might make sense and be justified, as well, to consider in the "gravitation formula" setting 1.5 or 1.6 instead of 1.7 as the exponent. This would result in a slower decrease of the impact of distance on the "absolute traffic potential indicator" or, more figuratively, "expand" space, also in correspondence with the higher speeds. (As an example, for the Moscow — St. Petersburg relation, the ATDP value would increase from 4.81 to 5.93 with 1.6 or even to 7.29 with 1.5.)

Resuming the results of the calculations for the reference links in this chapter is the insight that in general, existing or planned reference high-speed links have WTDP values greater than 6.0. This does not exclude special cases, where high-speed may be implemented despite lower WTDP values, but for other reasons than (only) passenger potential. The really profitable high-speed links show a WTDP value clearly above 12.0, in a range of 18.0 and higher.

## 5.2. Identification of potential high-speed links

This chapter is the very core of this study, as it comprises the calculation of the WTDP values for a variety of links, applying the same methodology as for the reference links. For this reason, the WTDP values obtained are fully comparable with those of the reference links.

The links investigated in this chapter have been selected with a view to their functionalities. For example, connecting large, important cities or forming continuous corridors, mainly following TEN-T Core Network Corridors or former pan-European Corridors and their possible extensions towards the east and southeast, to cover a large part of the TER area. As far as available, information from TER countries has been used, as well.

The following functional corridors, which are partly "official" TEN-T Core Network Corridors, former pan-European Transport Corridors (PETC) or other sections continuing or supplementing the network of these corridors, are the base for selecting links for investigation within this study:

- North Sea-Baltic Corridor (former PETC II): Berlin — Warsaw — Minsk — Moscow
- Ukraine — Russian Federation (former PETC IX): Lviv — Kiev — Moscow
- Russian Federation: Moscow — Nishnij Nowgorod — Kazan — Yekaterinburg and Moscow — Voronesh — Rostow n. D. — Krasnodar
- Orient-EastMed Corridor (former PETC IV): Berlin — Prague — Vienna/Bratislava — Budapest — Bucharest — Constanta
- Baltic-Adriatic Corridor (former PETC VI) + Rail Baltica (former PETC I): Vienna — Ostrava — Katowice — Warsaw — Kaunas — Riga — Tallinn and Kaunas — Vilnius — Minsk
- Alpine-Balkans Corridor (former PETC X): Ljubljana — Zagreb — Belgrade — Niš — Sofia — Istanbul, Budapest — Belgrade and Niš — Skopje — Thessaloniki — Athens
- Turkey and Caucasian countries: Ankara — Konya and Ankara — Sivas — Erzurum — Tbilisi — Baku.

Among the pan-European Corridors, there were a few for which sufficient potential cannot be expected, due to relatively small cities at relatively long distances, in particular pan-European Corridors III (Dresden — Katowice — Lviv), V (Ljubljana — Budapest — Lviv) and VIII (Durres — Skopje — Sofia — Varna/Burgos). The latter is, moreover, not effective so far, as there are still missing links across the borders Albania — The former Yugoslav Republic of Macedonia — Bulgaria. Pan-European Corridor VII is the (mono-modal) Danube inland waterway, for which high-speed rail does not apply.

Based on the forecast according to chapter 4.3., the calculations are carried out for the time horizons 2016, 2030 and — for three scenarios (L = low, M = medium, H = high) for 2050, which are the same as chosen for the reference links.

The following tables 5.3a and 5.3b are structured according to the above listed corridors and areas. They show the WTDP values as they result from the calculations, while pdf copies of the corresponding excel sheets are attached to this study in annex III. The resulting WTDP values are assigned to four categories (see box 3 below), marked by corresponding colours, as defined in the legends of tables 5.3a and 5.3b and figures 5.1-5.5.:

**Box 3 - WTDP ranges**

| | | | | | | |
|---|---|---|---|---|---|---|
| | | WTDP | ≤ | 6.0 | => | high-speed might not be justified by passenger traffic alone |
| 6.0 | ≤ | WTDP | ≤ | 12.0 | => | high-speed may be justified under certain conditions |
| 12.0 | ≤ | WTDP | ≤ | 18.0 | => | high-speed may be justified by traffic demand |
| 18.0 | ≤ | WTDP | | | | high-speed should be seriously considered. |

Each line of tables 5.3a and 5.3b represents one investigated link, as indicated in the first column, in the TER country or countries, as referred to in the second column. The third column shows the ADTP value of each link, as it results from the "gravitation approach". The following five columns display the quotients of the present (2016) and forecasted (2030 and 3 scenarios for 2050) GDP per capita values for the individual countries against the 2016 EU average GDP per capita and reflect the GDP per capita growth over time. By multiplying the ADTP values with the GDP ratio for the corresponding time horizon, the WDTP values of the individual links are obtained. These values, which are arranged in the last five columns, are the final results of the calculation: On this base, the individual links can be appraised if and at which time horizon, they may be appropriate for high-speed.

While for the individual countries, the GDP per capita ratios are calculated directly from the corresponding input data, for border crossing links, the geometric means of the countries involved are used (*the geometric mean of A and B is obtained as* $\sqrt{(A \times B)}$ *, in the case of three numbers it is the cubic root of their product*).

**Table 5.3a - Determination of WTDP ("weighted traffic demand potentials") values**

| | | ATDP | GDP-Ratio: GDP per capita (year)/ EU average 2016 | | | | | WTDP = ATDP * GDP-Ratio | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Year | 2016 | 2016 | 2030 | 2050 | 2050 | 2050 | 2016 | 2030 | 2050 | 2050 | 2050 |
| Investigated Links (a) | Countries | | | | L | M | H | | | L | M | H |
| **North Sea - Baltic Corridor (II)** | | | | | | | | | | | | |
| Poznan - Berlin | DE, PL | 8.265 | 0.94 | 1.24 | 1.24 | 1.40 | 1.66 | 7.77 | 10.25 | 10.25 | 11.57 | 13.72 |
| Lodz - Poznan/Wroclaw | PL | 8.113 | 0.70 | 1.00 | 1.00 | 1.21 | 1.42 | 5.68 | 8.11 | 8.11 | 9.82 | 11.52 |
| Warszawa - Brest | BY, PL | 3.601 | 0.57 | 0.75 | 0.75 | 0.87 | 1.00 | 2.05 | 2.70 | 2.70 | 3.13 | 3.60 |
| Brest - Minsk | BY | 3.903 | 0.47 | 0.56 | 0.56 | 0.63 | 0.70 | 1.83 | 2.19 | 2.19 | 2.46 | 2.73 |
| Minsk - Orsha | BY | 5.222 | 0.47 | 0.56 | 0.56 | 0.63 | 0.70 | 2.45 | 2.92 | 2.92 | 3.29 | 3.66 |
| Orsha - Smolensk | BY, RU | 2.830 | 0.53 | 0.64 | 0.64 | 0.73 | 0.82 | 1.50 | 1.81 | 1.81 | 2.07 | 2.32 |
| Moskwa - Smolensk | RU | 5.499 | 0.59 | 0.74 | 0.74 | 0.85 | 0.96 | 3.24 | 4.07 | 4.07 | 4.67 | 5.28 |
| **Ukraine - Russia** | | | | | | | | | | | | |
| Lviv - Vinnitsa | UA | 5.713 | 0.21 | 0.29 | 0.29 | 0.35 | 0.41 | 1.20 | 1.66 | 1.66 | 2.00 | 2.34 |
| Vinnitsa - Kijiv | UA | 6.393 | 0.21 | 0.29 | 0.29 | 0.35 | 0.41 | 1.34 | 1.85 | 1.85 | 2.24 | 2.62 |
| Kijiv - Bryansk | RU, UA | 3.691 | 0.36 | 0.46 | 0.46 | 0.54 | 0.63 | 1.33 | 1.70 | 1.70 | 1.99 | 2.33 |
| Bryansk - Moskwa | RU | 4.238 | 0.59 | 0.74 | 0.74 | 0.85 | 0.96 | 2.50 | 3.14 | 3.14 | 3.60 | 4.07 |
| **Russia** | | | | | | | | | | | | |
| Moskwa - Vladimir | RU | 6.293 | 0.59 | 0.74 | 0.74 | 0.85 | 0.96 | 3.71 | 4.66 | 4.66 | 5.35 | 6.04 |
| Vladimir - Nishnij Nowgorod | RU | 4.572 | 0.59 | 0.74 | 0.74 | 0.85 | 0.96 | 2.70 | 3.38 | 3.38 | 3.89 | 4.39 |
| Nishnij Nowgorod - Kazan | RU | 2.207 | 0.59 | 0.74 | 0.74 | 0.85 | 0.96 | 1.30 | 1.63 | 1.63 | 1.88 | 2.12 |
| Kazan - Ishevsk | RU | 1.537 | 0.59 | 0.74 | 0.74 | 0.85 | 0.96 | 0.91 | 1.14 | 1.14 | 1.31 | 1.48 |
| Ishevsk - Yekaterinburg | RU | 1.123 | 0.59 | 0.74 | 0.74 | 0.85 | 0.96 | 0.66 | 0.83 | 0.83 | 0.95 | 1.08 |
| Krasnodar - Rostow n.D. | RU | 0.667 | 0.59 | 0.74 | 0.74 | 0.85 | 0.96 | 0.39 | 0.49 | 0.49 | 0.57 | 0.64 |
| Rostow n.D. - Voronesh | RU | 1.560 | 0.59 | 0.74 | 0.74 | 0.85 | 0.96 | 0.92 | 1.15 | 1.15 | 1.33 | 1.50 |
| Voronesh - Ryazan | RU | 5.514 | 0.59 | 0.74 | 0.74 | 0.85 | 0.96 | 3.25 | 4.08 | 4.08 | 4.69 | 5.29 |
| Ryazan - Moskwa | RU | 9.084 | 0.59 | 0.74 | 0.74 | 0.85 | 0.96 | 5.36 | 6.72 | 6.72 | 7.72 | 8.72 |

| Investigated Links (a) | Countries | ATDP | GDP-Ratio: GDP per capita (year)/ EU average 2016 | | | | | WTDP = ATDP * GDP-Ratio | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Year | 2016 | 2016 | 2030 | 2050 L | 2050 M | 2050 H | 2016 | 2030 | 2050 L | 2050 M | 2050 H |
| **Orient - East Med Corridor (IV)** | | | | | | | | | | | | |
| Dresden - Berlin | DE | 4.901 | 1.26 | 1.54 | 1.54 | 1.74 | 1.94 | 6.18 | 7.55 | 7.55 | 8.53 | 9.51 |
| Praha - Dresden | CZ, DE | 4.439 | 1.05 | 1.34 | 1.34 | 1.54 | 1.75 | 4.66 | 5.95 | 5.95 | 6.84 | 7.77 |
| Brno - Praha | CZ | 5.453 | 0.87 | 1.16 | 1.16 | 1.36 | 1.57 | 4.74 | 6.33 | 6.33 | 7.42 | 8.56 |
| Wien/Bratislava - Brno | AT, CZ, SK | 4.478 | 0.96 | 1.30 | 1.30 | 1.53 | 1.76 | 4.30 | 5.82 | 5.82 | 6.85 | 7.88 |
| Wien - Bratislava | AT, SK | 3.892 | 1.02 | 1.37 | 1.37 | 1.62 | 1.87 | 3.97 | 5.33 | 5.33 | 6.31 | 7.28 |
| Bratislava/Wien - Györ | AT, HU, SK | 6.942 | 0.90 | 1.24 | 1.24 | 1.48 | 1.72 | 6.25 | 8.61 | 8.61 | 10.27 | 12.01 |
| Györ - Budapest | HU | 4.820 | 0.70 | 1.01 | 1.01 | 1.24 | 1.46 | 3.37 | 4.87 | 4.87 | 5.98 | 7.04 |
| Budapest - Arad | HU, RO | 4.396 | 0.65 | 0.97 | 0.97 | 1.20 | 1.43 | 2.86 | 4.26 | 4.26 | 5.28 | 6.29 |
| Arad - Sibiu/Craiova | RO | 4.469 | 0.60 | 0.93 | 0.93 | 1.17 | 1.41 | 2.68 | 4.16 | 4.16 | 5.23 | 6.30 |
| Sibiu - Brasov | RO | 4.399 | 0.60 | 0.93 | 0.93 | 1.17 | 1.41 | 2.64 | 4.09 | 4.09 | 5.15 | 6.20 |
| Brasov - Ploesti | RO | 4.854 | 0.60 | 0.93 | 0.93 | 1.17 | 1.41 | 2.91 | 4.51 | 4.51 | 5.68 | 6.84 |
| Ploesti - Bucuresti | RO | 8.565 | 0.60 | 0.93 | 0.93 | 1.17 | 1.41 | 5.14 | 7.97 | 7.97 | 10.02 | 12.08 |
| Bucuresti - Constanta | RO | 0.566 | 0.60 | 0.93 | 0.93 | 1.17 | 1.41 | 0.34 | 0.53 | 0.53 | 0.66 | 0.80 |
| **Baltic - Adriatic Corridor (VI) + Rail Baltica** | | | | | | | | | | | | |
| Wien/Bratislava - Ostrava | AT, CZ, SK | 4.515 | 0.96 | 1.30 | 1.30 | 1.53 | 1.76 | 4.33 | 5.87 | 5.87 | 6.91 | 7.95 |
| Ostrava - Katowice/Krakow | CZ, PL | 5.553 | 0.78 | 1.08 | 1.08 | 1.28 | 1.49 | 4.33 | 6.00 | 6.00 | 7.11 | 8.27 |
| Katowice/Krakow - Warszawa/Lodz | PL | 5.082 | 0.70 | 1.00 | 1.00 | 1.21 | 1.42 | 3.56 | 5.08 | 5.08 | 6.15 | 7.22 |
| Warszawa - Bialystok | PL | 2.604 | 0.70 | 1.00 | 1.00 | 1.21 | 1.42 | 1.82 | 2.60 | 2.60 | 3.15 | 3.70 |
| Bialystok - Kaunas | PL, LT | 2.287 | 0.73 | 1.04 | 1.04 | 1.25 | 1.47 | 1.67 | 2.38 | 2.38 | 2.86 | 3.36 |
| Kaunas - Riga | LT, LV | 1.084 | 0.71 | 0.99 | 0.99 | 1.19 | 1.39 | 0.77 | 1.07 | 1.07 | 1.29 | 1.51 |
| Riga - Tallinn | ET, LV | 2.133 | 0.71 | 0.95 | 0.95 | 1.24 | 1.31 | 1.51 | 2.03 | 2.03 | 2.64 | 2.79 |
| Kaunas - Vilnius | LT | 5.566 | 0.77 | 1.08 | 1.08 | 1.30 | 1.53 | 4.29 | 6.01 | 6.01 | 7.24 | 8.52 |
| Vilnius - Minsk | BY, LT | 2.454 | 0.60 | 0.78 | 0.78 | 0.90 | 1.03 | 1.47 | 1.91 | 1.91 | 2.21 | 2.53 |

| | |
|---|---|
| yellow | ≥ 6.00 |
| orange | ≥ 12.00 |
| dark orange | ≥ 18.00 |

**Table 5.3b - Determination of WTDP ("weighted traffic demand potentials") values**

| Investigated Links (c) | Year / Countries | ATDP 2016 | GDP-Ratio: GDP per capita (year)/ EU average 2016: 2016 | 2030 | 2050 L | 2050 M | 2050 H | WTDP = ATDP * GDP-Ratio: 2016 | 2030 | 2050 L | 2050 M | 2050 H |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Alpine - WB Corridor (X)** | | | | | | | | | | | | |
| Ljubljana - Zidani Most | SI | 5.200 | 0.85 | 1.18 | 1.18 | 1.42 | 1.66 | 4.42 | 6.14 | 6.14 | 7.38 | 8.63 |
| Zidani Most - Zagreb | HR, SI | 5.517 | 0.71 | 1.00 | 1.00 | 1.20 | 1.41 | 3.92 | 5.52 | 5.52 | 6.62 | 7.78 |
| Zagreb - Vinkovci/Osijek/ Vukovar | HR | 3.850 | 0.60 | 0.84 | 0.84 | 1.02 | 1.19 | 2.31 | 3.23 | 3.23 | 3.93 | 4.58 |
| Vinkovci/Osijek/Vukovar - Beograd | HR, RS | 4.287 | 0.48 | 0.68 | 0.68 | 0.83 | 0.97 | 2.06 | 2.92 | 2.92 | 3.56 | 4.16 |
| Budapest - Novi Sad | HU, RS | 4.542 | 0.52 | 0.75 | 0.75 | 0.91 | 1.07 | 2.36 | 3.41 | 3.41 | 4.13 | 4.86 |
| Novi Sad - Beograd | RS | 5.062 | 0.38 | 0.55 | 0.55 | 0.67 | 0.79 | 1.92 | 2.78 | 2.78 | 3.39 | 4.00 |
| Beograd - Nis | RS | 6.688 | 0.38 | 0.55 | 0.55 | 0.67 | 0.79 | 2.54 | 3.68 | 3.68 | 4.48 | 5.28 |
| Nis - Skopje | MK, RS | 1.859 | 0.37 | 0.54 | 0.54 | 0.65 | 0.77 | 0.69 | 1.00 | 1.00 | 1.21 | 1.43 |
| Skopje - Thessaloniki | GR, MK | 3.476 | 0.50 | 0.70 | 0.70 | 0.84 | 0.98 | 1.74 | 2.43 | 2.43 | 2.92 | 3.41 |
| Thessaloniki - Athenai | GR | 3.724 | 0.68 | 0.92 | 0.92 | 1.09 | 1.26 | 2.53 | 3.43 | 3.43 | 4.06 | 4.69 |
| Nis - Sofia | BG, RS | 5.373 | 0.50 | 0.69 | 0.69 | 0.75 | 0.89 | 2.69 | 3.71 | 3.71 | 4.03 | 4.78 |
| Sofia - Plovdiv/Stara Zagora/Sliven | BG | 5.483 | 0.49 | 0.70 | 0.70 | 0.85 | 1.01 | 2.69 | 3.84 | 3.84 | 4.66 | 5.54 |
| Plovdiv/Stara Zagora/ Sliven - Edirne | BG, TR | 9.001 | 0.56 | 0.78 | 0.78 | 0.94 | 1.10 | 5.04 | 7.02 | 7.02 | 8.46 | 9.90 |
| Edirne - Istanbul | TR | 10.105 | 0.63 | 0.86 | 0.86 | 1.03 | 1.20 | 6.37 | 8.69 | 8.69 | 10.41 | 12.13 |
| **Turkey + Caucasian Region** | | | | | | | | | | | | |
| Polatli - Afyon | TR | 3.057 | 0.63 | 0.86 | 0.86 | 1.03 | 1.20 | 1.93 | 2.63 | 2.63 | 3.15 | 3.67 |
| Afyon - Izmir | TR | 6.742 | 0.63 | 0.86 | 0.86 | 1.03 | 1.20 | 4.25 | 5.80 | 5.80 | 6.94 | 8.09 |
| Polatli - Konya | TR | 10.447 | 0.63 | 0.86 | 0.86 | 1.03 | 1.20 | 6.58 | 8.98 | 8.98 | 10.76 | 12.54 |
| Ankara - Kirikkale | TR | 11.941 | 0.63 | 0.86 | 0.86 | 1.03 | 1.20 | 7.52 | 10.27 | 10.27 | 12.30 | 14.33 |
| Kirikkale - Sivas | TR | 4.900 | 0.63 | 0.86 | 0.86 | 1.03 | 1.20 | 3.09 | 4.21 | 4.21 | 5.05 | 5.88 |
| Sivas - Erzurum | TR | 4.550 | 0.63 | 0.86 | 0.86 | 1.03 | 1.20 | 2.87 | 3.91 | 3.91 | 4.69 | 5.46 |
| Erzurum - Tbilisi | TR, GE | 1.603 | 0.43 | 0.60 | 0.60 | 0.72 | 0.90 | 0.69 | 0.96 | 0.96 | 1.15 | 1.44 |
| Tbilisi - Gence | AZ, GE | 1.604 | 0.39 | 0.49 | 0.49 | 0.56 | 0.71 | 0.63 | 0.79 | 0.79 | 0.90 | 1.14 |
| Gence - Baku | AZ | 1.433 | 0.52 | 0.58 | 0.58 | 0.62 | 0.76 | 0.75 | 0.83 | 0.83 | 0.89 | 1.09 |

≥ 6.00 ≥ 12.00 ≥ 18.00

It is evident that the resulting WTDP values for the lower scenario ("L") for 2050 and those for 2030 are equal. This corresponds to the assumption that, in this case, from 2030 to 2050, no further growth would take place.

Already a first survey of the results shows that in the present and even in 2030, in general, they are lower than most of the WTDP values of the reference links. The large majority of links might not reach present WTDP levels of the reference links by 2050. Exceptions to this are links located in Poland, the Czech Republic, Hungary, Slovakia and Slovenia and, in particular, in the western parts of Turkey, where there is a very high traffic demand already today between Istanbul, Ankara and Konya, even compared with most reference links. Also, the links Edirne — Istanbul and Ankara — Izmir show a relatively high WTDP value.

In order to allow a better overview of the individual links in their spatial context as sections of corridors, these results are visualised in maps of the TER backbone network, separately for each time horizon (and scenario). Comparing these maps shows the growth of traffic demand over time, in line with the forecast horizons.

**Figure 5.1 - Weighted traffic demand potentials in selected links of TER backbone network — 2016**

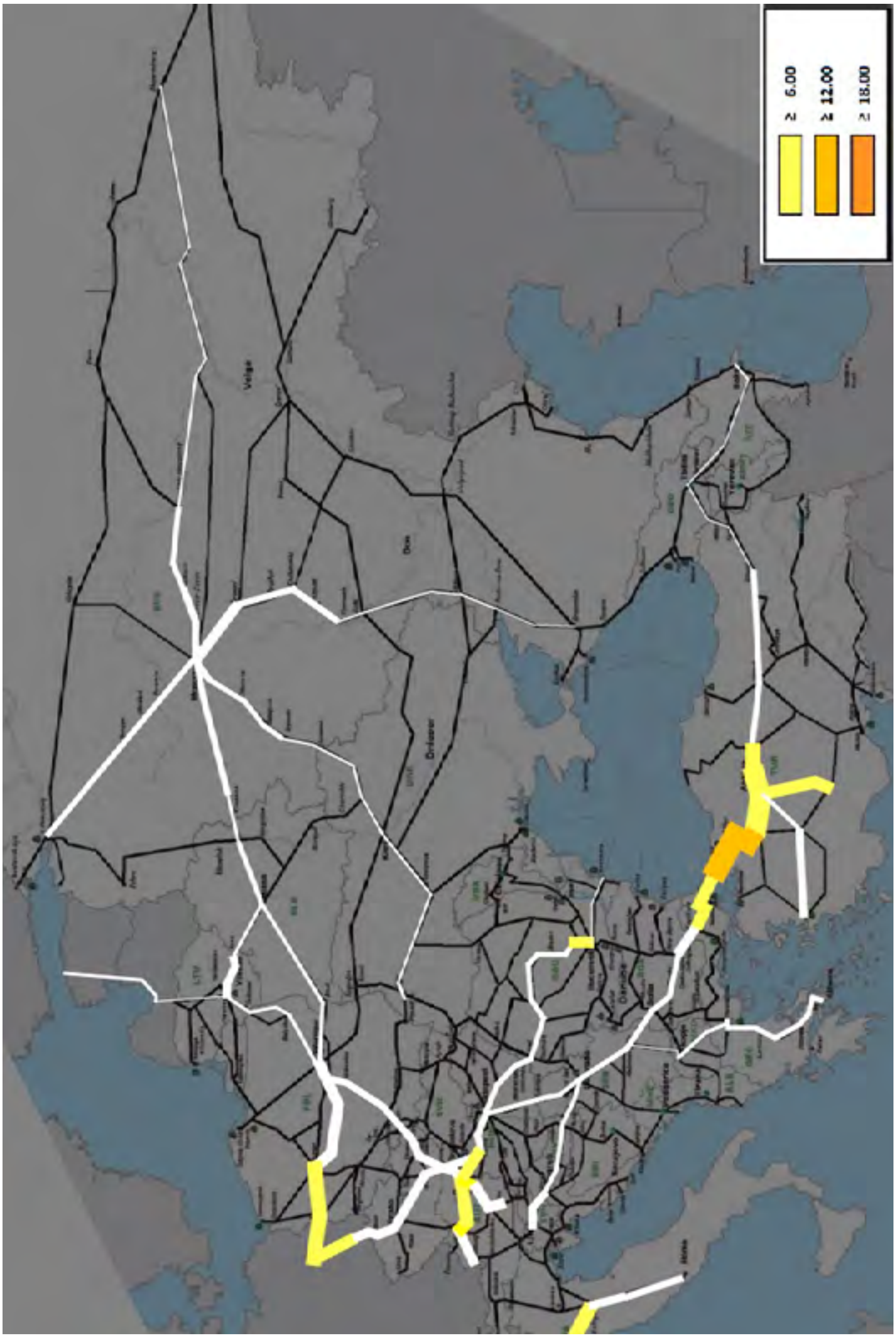


**Figure 5.2 - Weighted traffic demand potentials in selected links of TER backbone network — 2030**

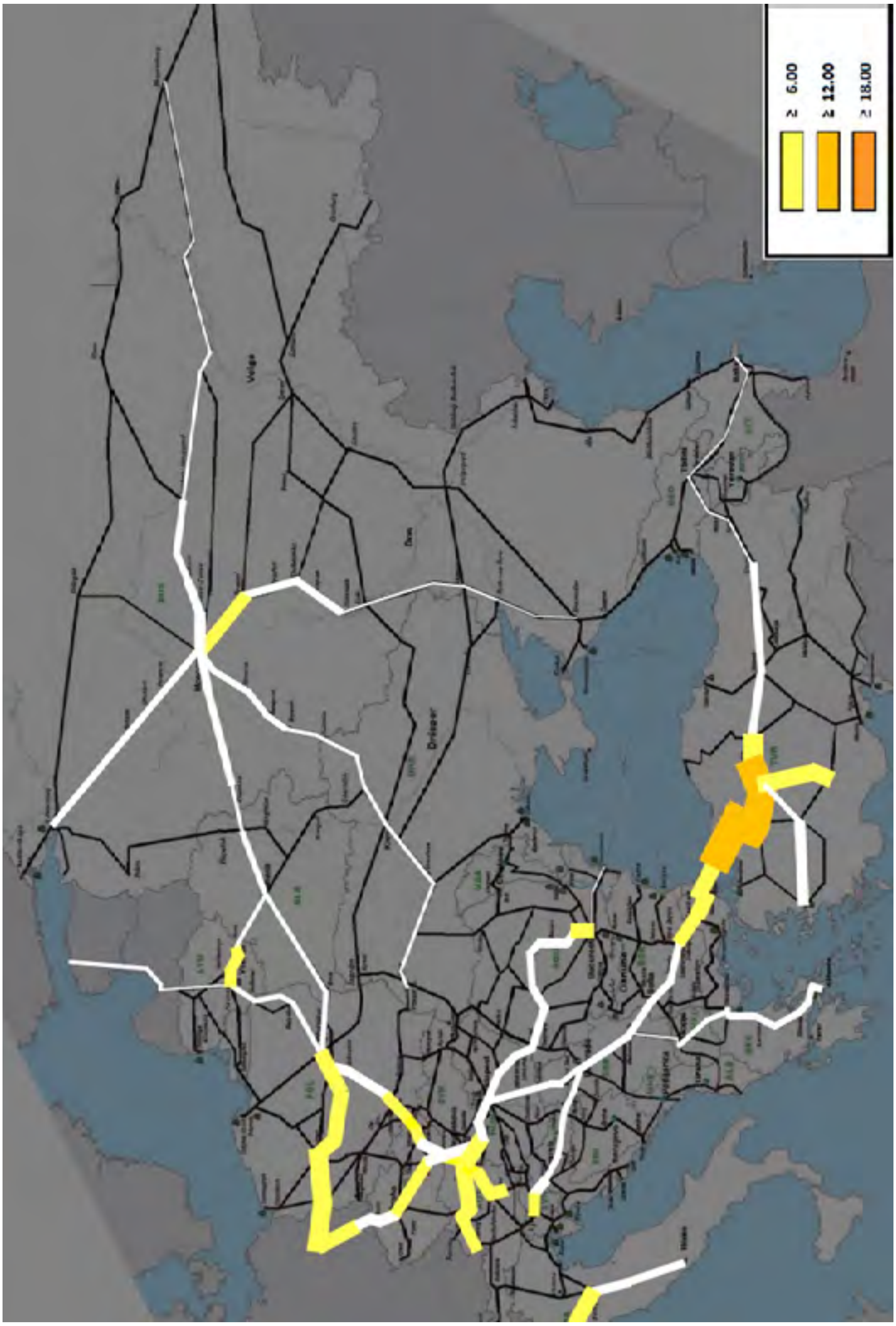


**Figure 5.3 - Weighted traffic demand potentials in selected links of TER backbone network — 2050 (Low scenario)**

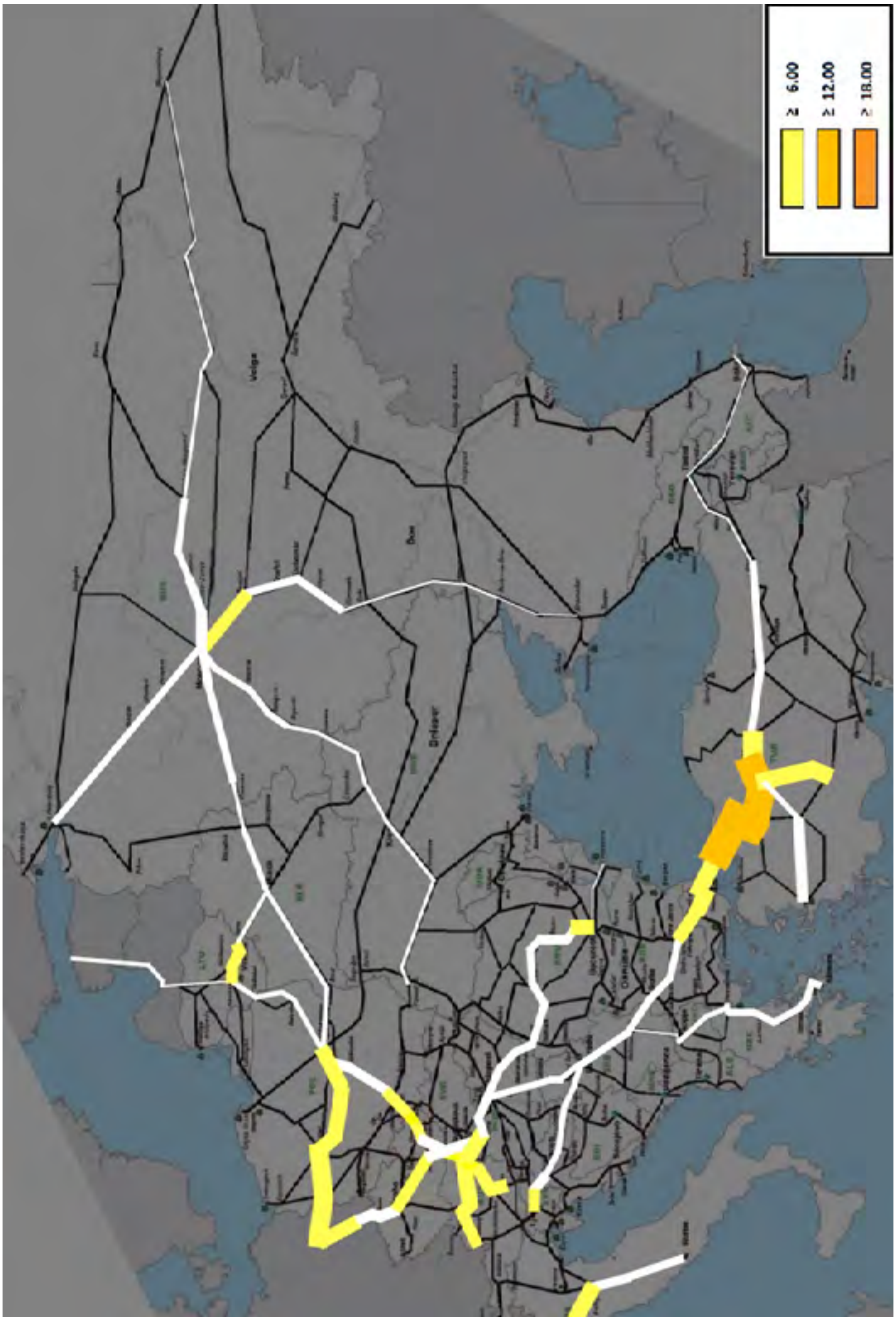


**Figure 5.4 - Weighted traffic demand potentials in selected links of TER backbone network — 2050 (Medium scenario)**

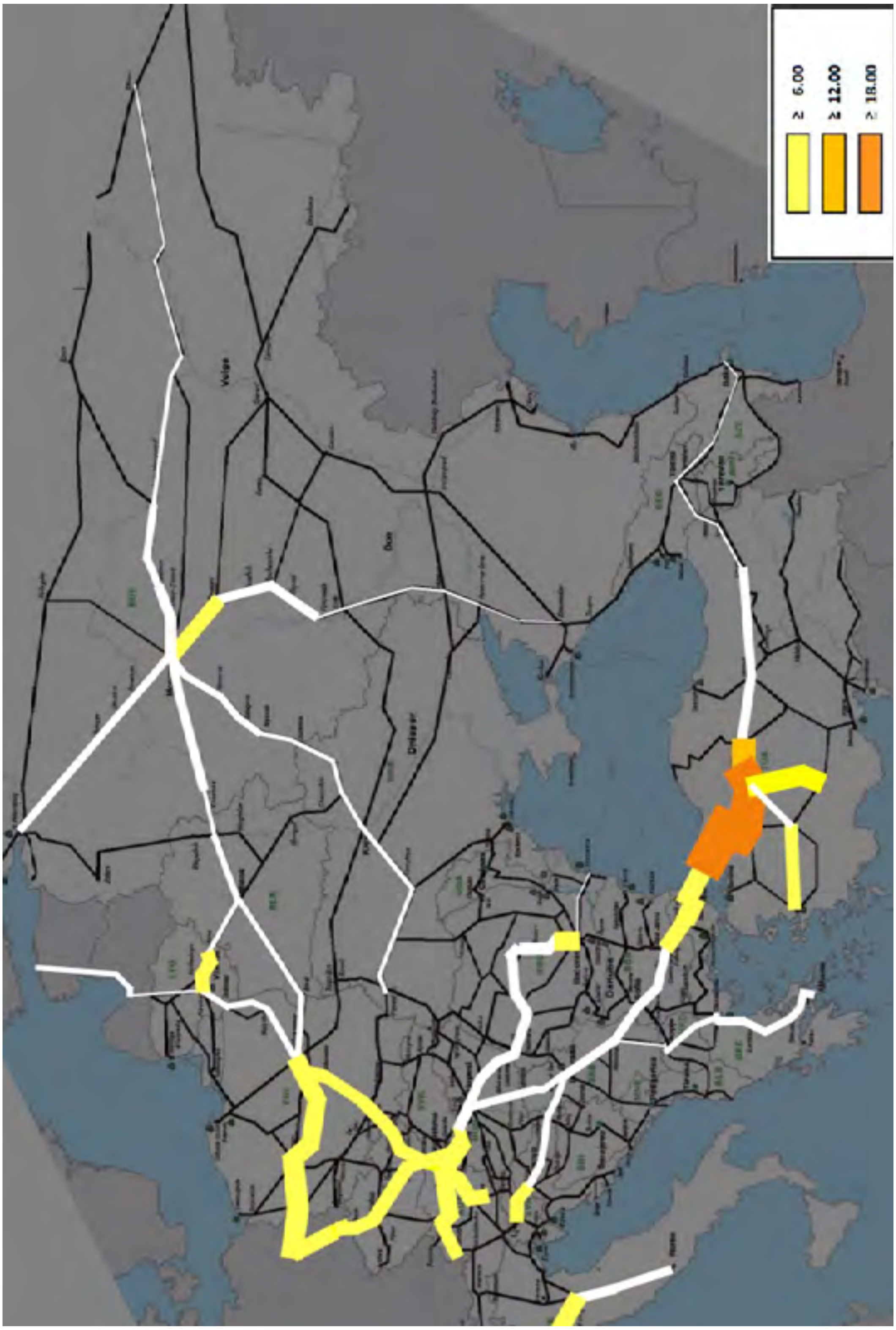
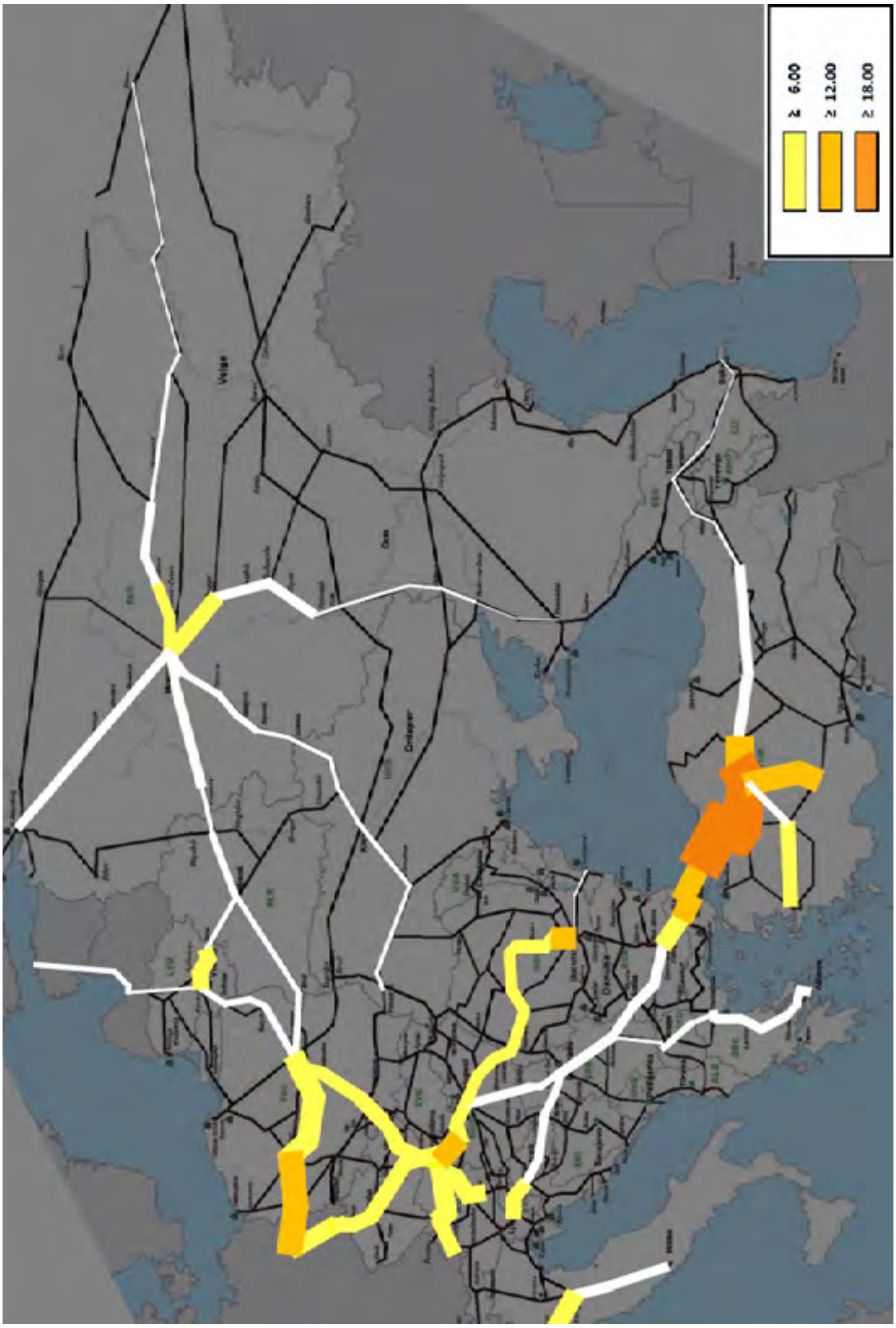


**Figure 5.5 - Weighted traffic demand potentials in selected links of TER backbone network — 2050 (High scenario)**



As set out above, the resulting WTDP values are appraised in comparison with the values obtained for the reference links investigated. In the maps included in figures 5.1 to 5.5, the WTDP values are displayed in corresponding widths and in colours according to the categories (WTDP ≤ 6.0; 6.0 ≤ WTDP ≤ 12.0; 12.0 ≤ WTDP ≤ 18.0; 0 ≤ WTDP) as defined above (see box 3).

Figures 5.1-5.5 show the individual links in the context of corridors, with their WTDP growths of traffic demand over time. (This growth is visualised both by increasing widths of the lines and by the colours turning from white to yellow, orange and brown.)

The higher the WTDP value of a certain link, the higher is the likeliness that it could be a candidate for high-speed. This does not a priori exclude links with low WTDP values, as there may be other reasons decisive for implementing high-speed, nevertheless, e.g. the continuity of a corridor or the fact that a gap must be closed anyway, so the decision would be only about additional costs for high-speed, against those of a conventional link. On the other hand, there may be situations, e.g. financial restrictions, which would not allow high-speed investments, even if the corresponding WTDP value is very high. Besides, one has to remind, that with respect to the current situation, in many cases moderate, but affordable upgrading of railway lines to 120 to 160 km/h would also be a very great success, at the benefit of regions, passengers and railway undertakings. Anyway, these results can give only some hints that a link could be, with a certain likeliness, appropriate for high-speed implementation. For a final decision, much deeper investigations have to be carried out carefully, taking into account all its functionalities, including freight — and the financing possibilities.

These results show that there is a concentration of high WTDP values in the western parts of the TER area, in particular in Poland, the Czech Republic, Slovakia, Austria, Hungary and Slovenia, as well as in Turkey, in particular west of Ankara. The links with the highest WTDP values are located in a triangle Berlin — Warsaw — Vienna — (Prague) — Berlin, with west and southbound extensions from Vienna, along Rhine-Danube and Baltic-Adriatic Core Network Corridors. Also, a concentration of traffic demand can be observed in and around the large agglomeration in the area, such as Moscow, Warsaw, Prague, the "twin cities" Vienna and Bratislava, Budapest, Belgrade, Istanbul and Ankara.

Among the corridors, it is the Orient-EastMed Core Network Corridor (former pan-European Corridor IV), which has the highest WTDP values close to 6.0 over its entire length Berlin — Vienna/Bratislava — Budapest — Bucharest, in the high 2050 scenario even greater than 6.0, with values over 12.0 between Ploeşti and Bucharest. The Alpine-Balkans Corridor (former pan-European Corridor X) has its highest WTDP values between Ljubljana and Zagreb as well as between Plovdiv, Edirne and Istanbul. Its branch to Greece has lower WTDP values. The corridor Berlin — Warsaw — Minsk — Moscow (former pan-European Corridor II, now partly covered by the North Sea-Baltic Core Network Corridor has relatively low WTDP values east of Warsaw.

Most of the links in the Russian Federation show WTDP values clearly below 6.0, despite the large size of many cities. This is due to the significant distances in the country, although speeds up to 400 km/h will be in operation. Given this very special situation, it might make sense to replace 1.7 as exponent in the "gravitation formula" by 1.6 or even 1.5, because of the large distances in the country, as already considered in chapter 5.1.

The Russian corridor Moscow — Nishnij Nowgorod — Kazan — Yekaterinburg, the Orient-EastMed Corridor, the Alpine-Balkans Corridor and the Turkish links from Kapikkule (border BG-TR) — Edirne — Istanbul — Eskişehir — Polatlı — Ankara — Kirikkale — Sivas — Erzurum — Kars — borders (TR-GE) and/or (TR-IR) are potentially parts of connections between Europe and China. This means that growing freight traffic demand along these lines could anticipate the construction of parallel lines that could be designed for high-speed.

As regards the time horizons, it is important to keep in mind all the uncertainties in the context with forecasts. The time horizons used above "2015", "2030" and "2050" are rather proxies for a more flexible definition like present, medium term and long term. This means that the traffic potential will be reached hand in hand with the real economic development.

## 5.3. Assessment, cost-benefit analysis

In principle, there are (at least) two levels of planning:

- The strategic level, represented e.g. by macro-regional or national planning, covers macro-economic questions, such as accessibility, network shaping and cohesion, as well as modal preferences and climate protection, etc.
- The project level is based on decisions made at a strategic level, e.g. the TEN-T Regulation or national transport infrastructure schemes, but focuses on project related benefits, e.g. time savings or local relieve from traffic, as well as local impacts such as pollution, noise, accidents etc.

Whereas at the strategic level, alternatives — including the "do nothing" alternative — are compared and the need of projects derived from strategic decisions, the project level focuses on identifying the optimal variant of a project, without any more questioning the justification of the project itself. Optimising investments means comparing in a comprehensive and objective manner the benefits and costs of various variants with a predefined system of objectives and targets. This applies for the strategic level as well as for individual projects.

Generally, targets derive from sustainability objectives, which comprise three pillars, i.e. society, economy and environment. To carry out a representative, correct and valid assessment, it is mandatory to obey certain basic rules: Target systems must cover all relevant effects of the envisaged measures, without overlapping, to avoid double counting. Equally, it is mandatory to apply the same target system in all individual cases, consider effects at the same or equivalent spatial extension, and during the same assessing period, for example 30 years.

- At the strategic level, as for national programmes or investment plans, a "strategic assessment", which is a tool to optimise and to assess economic, social and environmental sustainability of planning at the strategic level, comparing different development alternatives with respect to the target system is necessary. Limiting this assessment to environmental issues, the "Strategic Environmental Assessment" (SEA) as stipulated by EU Directive 42/2001/EC [38] is state of the art.

  It is evident that in this case, only global or general effects can be taken into account, however local effects, e.g. intolerable impacts on a certain biotope, exclude certain areas a priori. Whereas the classical SEA refers only to environmental effects, a complete strategic assessment has to result in a reasonable trade-off between economic, social and environmental effects. Actually, at a strategic level, the assessment is used to decide on different alternatives, like upgrading railways against new roads, or even the "do nothing option".
- At a project level, it is necessary to focus mainly on local effects such as exposure to noise of particular objects. This exercise may either serve for a ranking of projects, based on benefit to cost relations, or to select the optimal solution out of a set of variants. In general, it is not the purpose of a project assessment to question the planned measure in principle. As regards assessing environmental impacts at project level, the state-of-the-art instrument is the "Environmental Impact Assessment" (EIA).

Assessments can be carried out according to different principles and approaches, which accordingly have different significance for decision-making: From a simple appraisal in the sense of establishing a list of effects, with partial or no quantification at all, to well-founded assessment methods such as a multi-criteria analysis (MCA) or a cost-benefit analysis (CBA). The latter ones need corresponding data input, which has a direct impact on the quality of the outcome.

Nevertheless, they have one problem in common, i.e. the need to include in the calculation effects which are of different quality than money. Whereas multi-criteria analyses cope with this challenge by weighting the criteria, the cost-benefit analysis foresees monetising all effects by different approaches: either by determining the costs to avoid or to compensate a damage caused by a project, or by finding out the willingness to pay for avoidance or compensation. There are broadly accepted values of time and unit costs for pollution, noise and even the value of human life. Using these unit costs is easy, however they disguise the fact that behind them, as well, there are individual appreciations, as it is the case in a MCA. This means that any accuracy achieved is only pretended.

The special problem of a CBA emerges from the need of monetising, i.e. how to assign money value to macro-economic benefits, e.g. to time gains, ecological impacts, enhanced economic power of a region with improved accessibility. The classical CBA simply neglects these effects. To include such benefits in a CBA, complicated macroeconomic calculations would be a solution. Carried out in a few cases, the results show a very high effectiveness of infrastructure investments, sometimes prevailing over all other benefits, e.g. in the case of Koralm railway as explained in chapters 2.1. and 2.5. However, this is not feasible nor affordable for every small project.

Nevertheless, the cost-benefit analysis is state of the art. Despite its weaknesses, it is generally considered the most reliable and even the most objective tool for project assessment. Therefore, it is commonly accepted to demonstrate the viability and bankability of a project. Based on a monetary approach, with all benefits monetised, they can be added. Detrimental economic, social and ecological effects are considered as negative benefits.

A CBA can be applied in the following two ways:

- By dividing the sum of benefits including the negative ones (in monetary units) by the investment costs (in money units). Projects of which the ratio is greater than 1 should be implemented, the greater the ratio is, the higher priority should be given to the project. In this case, every effect except the cost for implementing the project is considered as a “benefit”, although it can be negative if detrimental. Only the implementation cost of a project stands in the denominator. It is evident that errors of implementation costs would strongly affect the results.
- An alternative approach involves calculating the difference between all (positive) benefits on one side and all costs (which include all negative benefits) on the other. This calculation can be done for one year (based on annuities) or for a whole life cycle. If the result is greater than zero (positive), the project is worth implementation. Costs of implementation and other costs and benefits, all in monetary units, must be added or subtracted, according to their sign.

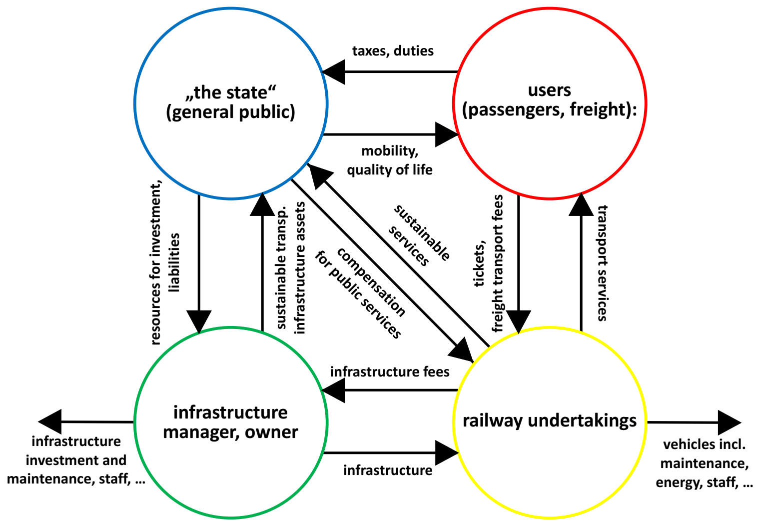
The multi-criteria analysis is more comprehensive and transparent, because it is more evident, where project specific considerations (which would have to be justified, e.g. by a broad consent of independent stakeholders) enter the algorithm: The effects of a project are assigned to grades of fulfilment of the corresponding target, which is converted into a corresponding percentage of compliance (complete = 100%), or a number of points attributed.

The targets must be weighted before carrying out the analysis, mostly in groups of experts from different disciplines or even in public. The sum of all weights must be 1 (or 100%). For every project or every variant, the percentages or points achieved with respect to each target are then multiplied by the corresponding weight and then summed up to an overall fulfilment value. The result may vary between 0 and 1 (or between 0 and 100%), and the project or the variant with the highest value (closest to 100%) is the winner. As an alternative, in the so-called cost-effectiveness analysis, one may add only the weighted points assigned to benefit targets and then divide this sum by the implementation costs.

Which assessment tool to apply, consequently also depends on the level of assessment that is required. While at strategic level, a multi-criteria analysis might be the appropriate means, even more as at this early and general stage, there might be only rough cost estimates. It will rather be a cost-benefit analysis at project level, in particular, if micro-economic assessment at the level of railway undertakings are required.

To illustrate this, figure 5.6 gives some impression of the role of the different players in the context with rail transport and the corresponding effects of high-speed on the different players in the rail transport business.

**Figure 5.6 - Circle of services and payment flows in rail transport (without "external costs")**




The following information provides further explanation on the figure above:

- Passengers and freight forwarders for transport pay for transport services. High-speed reduces travelling times of passengers, who may pay a somewhat higher fare. Freight forwarders may benefit indirectly, due to better operational conditions on conventional lines parallel to high-speed lines. Due to the shift from road and air to rail, overall external costs are reduced.
- Railway undertakings have revenues from tickets (and freight transport), while they have costs for train operation and maintenance and for infrastructure use. In the case of high-speed, the number of passengers increase and revenues from tickets grow. Further revenues may come from the state side, as compensation for public services (for example subsidies for commuters' fares and/or for combined transport). At the same time, operational costs including for vehicles and energy increase. High-speed may increase external cost, for example for noise.
- Infrastructure managers have infrastructure charges as revenues, which grow with modal shift to rail. Assuming that the infrastructure manager is also the infrastructure owner, the costs comprise both implementation and maintenance of infrastructure. In this case, the state (= the tax payer) may compensate the infrastructure manager and owner for the expenses of infrastructure construction. External costs may occur due to impacts on space (land separation, groundwater, landscape, etc.) but also external benefits (such as improved accessibility) and the costs for infrastructure maintenance.
- The state representing the general public, i.e. also all tax payers, is the anonymous entity where all external costs (except climate costs, which are global) accumulate, some of them immediately, affecting particular groups, others with decades of delay. However, the "state" is also beneficiary of

effects like improved accessibility, which may be advantageous also for neighbouring countries. Taxpayers, of course including railway passengers and freight forwarders who pay taxes and other duties, for which in exchange, among many other benefits, the "state" should offer its citizens high quality of life and good conditions for economy, including an attractive sustainable mobility system.

With this knowledge in mind, one will understand that, depending on the level for which an assessment is foreseen, different method may be appropriate and different criteria relevant. At the level of railway undertakings operating high-speed lines, it is important to assess the additional revenues from passengers against additional expenses for operation. In addition, a balance between a reduction of environmental and climate impacts due to modal shift in passenger transport and additional impacts, e.g. due to more noise, may be needed. The corresponding indicators are either in money units or can be monetised easily. In this case, it is recommended to apply a cost-benefit analysis (CBA).

Under current economic conditions, which are characterised by significant distortions of the transport market in favour of non-sustainable modes of transport, rail is not in the position to finance greater investments in infrastructure and, in particular, to earn on the market, the money spent. In many cases, this also applies to high-speed.

Therefore, large size railway infrastructure investments must, in general, be funded with public money — sometimes with the support from supranational institutions (for example EU funds as indicated earlier in the study).

There is also the possibility to finance such projects with loans from EIB, ERBD or World Bank (as identified earlier), however this money must be paid back with interest. For this reason, it is of particular importance to prove the profitability of a project, including also indirect returns. The decision to invest in high-speed needs to be based on a sound project assessment, as required by the international financing institutions (IFIs). However, in this context, cash flows and internal and external effects are more complex, and not all of them can be depicted with easily monetisable indicators. Although it is the state of the art to apply a CBA in such cases, non-monetisable effects should not be neglected, to present the full range of benefits of a project. For this reason, it is recommended under such conditions, to apply a cost-benefit analysis, but to extend it by additional non-monetary features, to assign to a project not only one number (the benefit-cost quotient), but also some additional non-monetisable information. This can give decision-makers a more complete and more realistic picture of a project, including its full range of functionalities and benefits.

Since 2005, Austria has been implementing the "Strategic Environmental Assessment" as stipulated in Directive 42/2001/EC [38] in the field of transport, in the extended form of a law on "Strategic Assessment" which, apart from the environment, covers all three pillars of sustainability, i.e. including society and economy.

In line with this law, a methodology has been developed, based on a cost-benefit analysis, but extended to include non-monetisable criteria as well, in a systematic way. This methodology [39] is very detailed, even including the macro-economic calculations, to monetise the effects of accessibility. As data requirements are rather high (which means that a traffic model would be needed), it is recommended to apply it only for very large projects if relevant non-monetisable effects may be expected, that justify the efforts. Tables 5.4a and b give a complete overview of which targets and indicators may be used for this analysis and which input data would be needed. It further indicates which of the criteria would be processed within a cost-benefit analysis (orange background in the table) and which of them in a complementary non-monetised effectiveness (green background in the table) analysis.

### Table 5.4a - Targets, indicators and data requirement for extended CBA (economic dimension)

ECONOMIC DIMENSION

| Main Target | Partial Target | Indicator | Dimension | Input Data |
|---|---|---|---|---|
| **Micro-economic part** | | | | |
| Improvement of economic results | Improvement of economic results of infrastructure, due to investment | not necessary re-investments | € per year | re-investment in existing infrastructure |
| | | costs of infrastructure investment | € per year | investments split up into components |
| | | residual value value after 30 years | € per year | life time of components |
| | | additional re-investments | € per year | life time of components |
| | | revenues from utilisation of facilities | € per year | |
| | Improvement of economic results of infrastructure, due to operation | variation of maintenance costs | € per year | additional maintenance costs |
| | | variation of revenues from infrastructure fees | € per year | variation of train-km (average unit costs) |
| | | variation of energy consumption | € per year | variation of train-km (energy consumption) |
| | Improvement of economic results on client's (RU) side | variation of contribution margin (long-dist. pass.) | € per year | variation of train-km (average unit costs) |
| | | variation of contribution margin (commuters) | € per year | variation of train-km (average unit costs) |
| | | variation of contribution margin (freight) | € per year | variation of train-km (average unit costs) |
| Enhancement of liqidity | more favourable charging of investment buget | availment of of investment budget | % of infrastructure budget | |
| | higher share of in-house contribution | in-house contribution | % of project sum | |
| Reduction of risks | Reduction of interest risks | internal interest rate | % | annuity |
| | Reduction of pay-off risks | pay-off period | years | annuity |
| | Reduction of revenues risks | minimum payment per train-km | €/train-km | annuity |
| | Reduction of performance risks | minimum performance in train-km per year | train-km | annuity |
| Improvement of quality | Improvent of operation quality | variation of service life | years | residual usage time |
| | | avoided re-investments | € (difference to reference case) | annuity |
| | Improvent of logistics quality | variation of logistics performance (client = RU) | isochrone | |
| Improvement of potential | Increase of capacity | variation of capacity | trains per day / per year | |
| | Improvement of capacity utilisation | variation of capacity utilisation | quotient | |
| | Increase of investment rate | variation of investment rate | quotient | annuity |
| | Improvement of maintenance rate | variation of maintenance rate | quotient | annuity |
| Strengthening of rail in competition against road | Improvement of benchmark rail to road costs | benchmark road costs | € per km per TEU | annuity |
| **Macro-economic part - construction phase** | | | | |
| Increase of national and regional added value | Increase of national and regional added value | variation of gross added value | € during duration of construction per investment sum | investments according to NACE groups |
| Increase of national and regional employment | Increase of national and regional employment | variation of employment (withous railway) | full time equivalents | |
| **Macro-economic part - operation phase** | | | | |
| Increase of national and regional added value | Increase of national and regional added value | variation of gross added value | € per year | variation of accessibility and of international division of labour |
| Increase of national and regional employment | Increase of national and regional employment | variation of employment (withous railway) | full time equivalents per year | variation of accessibility and of international division of labour |

**Table 5.4b - Targets, indicators and data requirement for extended CBA (ecological, social and European dimension)**

| | Main Target | Partial Target | Indicator | Dimension | Input Data |
|---|---|---|---|---|---|
| ECOLOGICAL DIMENSION | Protection of natural resources | Reduction of air pollution and climate deterioration | variation of immissions due to modal shift | € per year | variation of tons CO2 equivalent due to modal shift |
| | | | variation of immissions due to induced traffic | € per year | variation of tons CO2 equivalent on rail |
| | | Reduction of impairment of soil | variation of land consumption by construction measures | ha per type of land (CORINE) | sealed areas [ha] acc. To CORINE Landcover |
| | | Reduction of impairment of water | km | length of passage [km] | passage through protected areas |
| | Retention of landscape quality | Retention of particularity, variety and beauty of landscape | disturbing effects regarding prospect etc. | description | according to land protection regulations |
| | | Retention of leisure and recreation value | disturbing effects regarding accessibility, etc. | description | according to land protection regulations, including touristic aspects |
| | Retention of bio-variety | protection of valuable biotopes | variation of impairment biotopes | length of passage [km], separation effects (type of protection), description | passage through protected areas |
| | | Retention of subnatural cultural landscape | variation of extensively used agricultural ares | ha per type of cultural landscape (SINUS) | land use [ha] in SINUS cultural landscapes |
| | | Protection of genetic corridors | variation of separarting effects | description | migration corridors |
| SOCIAL DIMENSION | Increase of human health | Increase of traffic safety | variation of accident costs due to modal shift | € per year | variation of numbers of accidents, fatalities |
| | | | variation of accident costs due to induced traffic on rail | € per year | variation of numbers of accidents, fatalities |
| | | Reduction of noise impacts | variation of noise-affected settlement areas | number of affected inhabitants | data from CORINE landcover, raster cells |
| | Promotion of homogenous conditions of life | Improvement of accessibility in public transport | variation of accessibility or regional centres | number of inhabitants within 60 min / 120 min accessible by public transport | |
| | Retention of cultural heritage | Protection of cultural or archeological goods, architectonically valuable buildings | variation of impairments of such objects | description | national registers of monuments, etc. |
| | | Protection of culturally valueble towscapes | visual or aesthetic change of such places | description | UNESCO |
| EFFECTS ON EUROPEAN LEVEL | complience with pan-European and general transport-political objectives at European level | Strengthening of competitiveness of rail | border crossing induced rail transport/traffic | description | |
| | | total European added value in planning and construction phase | variation of gross added value | € during duration of construction per investment sum | investments according to NACE groups |
| | | total European increase of employment in planning and construction phase | variation in employment | full time equivalents per year | |
| | | total European added value in operation phase | variation of gross added value | € per year | variation of accessibility and of international division of labour |
| | | total European increase of employment in operation phase | variation in employment | full time equivalents per year | variation of accessibility and of international division of labour |

The Austrian national Railway company, ÖBB, applies this assessment method primarily at a strategic level, that is on a whole set of projects, to upgrade an entire corridor or corridor section, as, for example, the Austrian section of the Baltic-Adriatic Corridor. For individual projects, ÖBB normally uses simpler methods, comparable to the NIBA method as described below. It is important to note that, to compare small-scale variants of the same project, effects that would be the same for all variants, may be neglected.

As a reasonable trade-off between accuracy needs and practicability, applying the Swiss "NIBA" [40] ("Nachhaltigkeitsindikatoren für Bahninfrastrukturprojekte" = "sustainability indicators for railway infrastructure projects") may be recommended. It can serve both for micro- and macro-economic assessments, depending on whether they are applied at the level of the operator or the investor. Of course, this method, based on a cost-benefit tool only, does not foresee the inclusion of non-monetisable effects. It is, therefore, recommended to add a set of non-monetisable criteria to this assessment, to cover also important effects like the economic benefits of improved accessibility or soft effects like travelling comfort.

**Table 5.5a - CBA indicators according to NIBA, micro-economic part**

**Micro-economic Project Assessment**

| **Micro-economic indicators** | **costs and benefits [€], caused by the project** |
|---|---|
| Long-distance passenger traffic | |
| Revenues from long-distance passenger traffic | |
| Operational costs of long-distance passenger traffic | |
| Infrastructure fees for long-distance passenger traffic | |
| Result for long-distance passenger traffic | |
| Regional passenger traffic | |
| Revenues from regional passenger traffic | |
| Operational costs of regional passenger traffic | |
| Infrastructure fees for regional passenger traffic | |
| Result for regional passenger traffic | |
| Freight Traffic | |
| Revenues from freight traffic | |
| Operational costs of freight traffic | |
| Infrastructure fees for freight traffic | |
| Result for freight traffic | |
| Infrastructure | |
| Revenues from infrastructure fees | |
| Operational costs of infrastructure | |
| Energy costs | |
| Maintenance costs | |
| Result for Infrastructure | |
| Total result of micro-economic cost-benefit analysis | |

**Table 5.5b - CBA indicators according to NIBA, macro-economic part**

**Macro-economic Project Assessment**

| **Macro-economic indicators** | **costs and benefits [€], caused by the project** |
|---|---|
| **Environment and climate** | |
| Polluting emissions | |
| Noise immissions | |
| Soil sealing and land separation | |
| Greenhouse gas emissions | |
| External costs of traction energy | |
| **Environmental and climate benefits** | |
| **Economy** | |
| Operational costs of passenger traffic | |
| Operational costs of freight traffic | |
| Operational costs of infrastructure | |
| Energy costs | |
| Maintenance costs | |
| Travelling time reduction for passengers (monetised) | |
| Transport time reduction for freight (monetised) | |
| Benefits of induced passenger traffic on rail | |
| Benefits of induced freight traffic on rail | |
| **Economic benefits** | |
| **Society** | |
| Reduction of accidents | |
| **Societal benefits** | |
| **Total result of macro-economic cost-benefit analysis** | |

The above tables 5.5a and b, taken from the corresponding NIBA publication and translated into English, show the micro-economic (table 5a) and macro-economic (table 5.5b) criteria used according to the NIBA approach.

Whereas the chart illustrating the extended cost-benefit analysis (tables 5.4a and b) is structured in a very detailed way, this is not the case for the NIBA assessments. In particular, in the macro-economic part, there are some aggregated criteria, e.g. the polluting emissions, which cover different toxic gases, as well as dust. In the real calculation, it would be necessary to subdivide the criteria and indicators accordingly.

For practical applications it may be appropriate to start from a NIBA type approach and check for completeness with the criteria list according to the extended cost-benefit analysis. Tables 5.5a and b indicate the indicators for the micro-economic and the macro-economic assessments.

As regards induced traffic, which is additional traffic resulting from shorter travel times and improved accessibility, it is necessary to take into account its detrimental impacts within the environmental and climate assessment within the CBA. For a balanced project assessment, it suits to consider also its benefits, which evidently exist to an extent corresponding to time and costs for additional journeys. Such benefits could comprise those of additional economic activities, that may result from additional movements, using the time saved due to faster trains.

For the input data to be used in this tool according to NIBA, the following explanations may be taken into account:

### 5.3.1. Micro-economic project assessment

- For all kinds of transport, the revenues result from tickets sold, transport fees for freight and, if applicable, subsidies for the operation, e.g. as compensation for socio-economic benefits

- Operational costs of passenger and freight traffic comprise depreciation, maintenance and repair costs of rolling stock, traction energy costs and the cost of the operational staff
- Infrastructure costs are the infrastructure fees to be paid to the infrastructure manager (this value is a cost factor for the operation side, but a revenue for the infrastructure side)
- Operational costs of infrastructure comprise all services provided by the infrastructure manager to allow safe and timely operation of trains
- Energy costs apply only if train operators pay energy needed for train operation from the infrastructure manager
- Maintenance costs include infrastructure repair
- In this context, it is assumed that the infrastructure manager only operates and maintains the infrastructure, whereas investment and/or depreciation costs of infrastructure (incl. financing costs) are borne by the public. In order to carry out such micro-economic assessment, operators and infrastructure manager must deliver the corresponding data
- Taking into account that, as indicated in figure 5.6, part of operation costs are revenues for infrastructure, it is evident from table 5.5a, that a project assessment can be made for the train operator and infrastructure manager individually as well as for their combination.

### 5.3.2. Macro-economic project assessment

- Polluting emissions consist of $NO_x$, $SO_2$, $CH_n$ and particles ($PM_{2,5}$ and $PM_{10}$), which have mainly local impacts on nature and human health
- Noise emissions depend on noise emissions and the local situation, including the number of persons affected by noise
- Soil sealing can be described by a devaluation of land, land separation by the costs of diversions caused by new infrastructure
- Greenhouse gas emissions mainly mean $CO_2$ emissions, which are globally effective. For electric traction, also the kind of power generation (hydro-electric, thermic, nuclear) is relevant. This is reflected in the external costs of traction energy
- For a macro-economic assessment, the full operating costs for passengers and freight transport, infrastructure, energy and maintenance is relevant, regardless if it is covered by operational revenues or public subsidies
- However, time gains for passengers and freight are a socio-economic benefit and have to enter the macro-economic assessment
- While the economic, ecological and social costs of induced traffic, i.e. traffic caused by reduced "generalised costs" (time + money), is included in the calculation of costs (emissions, etc.), the benefits as described above must be taken into account separately
- Last, but not least, also a reduction of accidents, due to a project, has to be assessed.

As railway projects, especially high-speed, have a strong impact on the entire transport system in a certain area, for a complete project assessment it is necessary to consider also the effects of the project on other modes of transport. Apart from induced traffic, which normally is in the range of a few percent, additional passengers on rail correspond to a reduction of cars and air passengers and an increase in environmental impacts of rail is generally more than compensated by reduced impacts of road and air transport.

The following chart as shown in table 5.6 gives a summary of an example for an excel tool to calculate a macro-economic cost-benefit analysis, following the NIBA methodology as described above. The original excel version with its intrinsic algorithms is attached in annex IV of this study. This tool is flexible for adaptation to individual needs, including a micro-economic assessment, as it is covered by NIBA, as well.

**Table 5.6 -Summary of excel tool for macro-economic CBA according to NIBA**

**Macro-economic Assessment**

| Macro-economic indicators | without project | with project | quantities *) | unit benefits**) | benefits**) |
|---|---|---|---|---|---|
| **Environment and climate** | | | | | |
| Polluting emissions | | | 0 | | - |
| Noise immissions | | | 0 | | - |
| Greenhouse gas emissions | | | 0 | | - |
| External costs of traction energy | | | 0 | | - |
| **Environmental and climate benefits** | | | | | - |
| **Economy** | | | | | |
| Operational costs of long-distance passenger traffic | | | 0 | | - |
| Operational costs of regional passenger traffic | | | 0 | | - |
| Operational costs of freight traffic | | | 0 | | - |
| Operational costs of infrastructure | | | 0 | | - |
| Annuities for infrastructure investment | | | 0 | | - |
| Energy costs | | | 0 | | - |
| Maintenance costs | | | 0 | | - |
| Travelling time reduction for passengers (monetised) | | | 0 | | - |
| Transport time reduction for freight (monetised) | | | 0 | | - |
| Benefits of induced long-distance passenger traffic on rail (monetised) | | | 0 | | - |
| Benefits of induced regional passenger traffic on rail (monetised) | | | 0 | | - |
| Benefits of induced freight on rail (monetised) | | | 0 | | - |
| **Economic benefits** | | | | | - |
| **Society** | | | | | |
| Reduction of accidents | | | 0 | | - |
| **Societal benefits** | | | | | - |
| **Total result of macro-economic cost-benefit analysis** | **Difference Benefits - Costs (p.a.)** | | | | - |
| | **Quotient Benefits/Costs** | | | | |

*) Variations due to project: quantities of emissions, immissions, unit values of time, etc. (differences with - without project)
**) Numbers indicated in 1000 €; costs are negative (-) benefits.

The following example is based on the high-speed project along the Orient-EastMed Core Network Corridor (former pan-European Corridor IV) in Slovakia, for which the feasibility study [32] is quoted and described in chapter 3.4. The corridor section extends from the CZ-SK border via Kúty — Devínska Nová Ves — Bratislava — Nové Zámky — Štúrovo — SK/HU border with a branch from Nové Zámky to Komárno — border SK/HU. Variant "C" of this feasibility study, foresees a thorough refurbishment of this existing line, including upgrading to 200 km/h between Kúty and Devínska Nová Ves, as well as between Bratislava Vajnory and Štúrovo.

The corresponding data have been taken from the mentioned feasibility study and its annex 9, which comprises a complete CBA, however based on data, for example the number of passengers, that had been calculated in other parts of the study and already aggregated before. As the reference CBA covers both sections of the project, i.e. Kúty — Devínska Nová Ves and Bratislava — Nové Zámky — Štúrovo in one single CBA, a splitting according to these two sections is not feasible.

Against this background, it was in the most cases not possible, to indicate basic input data as passenger volumes of emissions, and resulting costs or savings have been inserted in the right column of the chart.

Furthermore, the study assumes that after implementation the traffic volumes would only consist of those traffic flows that would exist without the project, plus a certain modal shift, due to the higher speed of trains, but no induced traffic. According to general experience, induced traffic can generally be considered to be in the range of between 2 and 5% of the original traffic flows, depending on the existing demand potential and on the volume of the improvement. Despite the high demand potential as shown above in chapter 5.2., a conservative assumption for induced traffic performance being only 2% of the existing traffic performance has been made. This addition also serves to show in detail, the function of the attached CBA excel tool (table 5.6).

To obtain a CBA for an average year, the annuity of investment is calculated with an interest rate of 4% per annum (as in the feasibility study in reference) and average annual benefit rates from data indicated in annex 9 for the 45 year period between 2016 and 2060:

Total investment volume (construction costs) (without contingencies and VAT, according to the study):

| | | | |
|---|---|---|---|
| | €1,907,389,462 | => => | annually: €92,108,000 |
| Transport performances (without project): | | | |
| Long-distance: | 37,013,296,000 pass-km | => | 822,518,000 pass-km/a |
| Regional: | 5,786,296,000 pass-km | => | 128,584,000 pass-km/a |
| Sum long-distance + regional: | 42,799,592,000 pass-km | => | 951,102,000 pass-km/a |

As a unit value, it is assumed that, as a minimum, an average ticket price of €0.05/pass-km may cover the socio-economic benefits of induced traffic. As it would be passenger traffic in existing trains, no additional detrimental environmental impact may be expected.

Based on the unit time values according to table 5.7 and environmental, climate and accident costs according to table 5.8, annex 9 of the study in reference indicates the following benefits, due to traffic shifted from road to rail:

| | | | |
|---|---|---|---|
| Time savings of passengers: | €1,041,570,470 | => | 23,146,000 €/a |
| Time savings of fright: | €485,340 | => | 11,000 €/a |
| Noise: | €159,698,678 | => | 3,549,000 €/a |
| Pollution: | €465,445,734 | => | 10,343,000 €/a |
| Climate: | €257,367,632 | => | 5,719,000 €/a |
| Accidents: | €1,271,257,019 | => | 28,250,000 €/a |

Annex 9 also indicates operation and maintenance cost savings, due to the project:

| | | | |
|---|---|---|---|
| Passenger cars: | €478,959,866 | => | 10,643,000 €/a |
| Trucks: | €596,984,087 | => | 13,267,000 €/a |
| Road maintenance: | €94,809,139 | => | 2,107,000 €/a |
| Train operation: | €-54,400,449 | => | -1,209,000 €/a (negative benefit) |
| Rail operation and maintenance: | €441,698,618 | => | 9,818,000 €/a |

**Table 5.7 - CBA Kúty — Devínska Nová Ves and Bratislava — Nové Zámky — Štúrovo: Value of time unit values**

| **Per person/hour** | **€, 2016** |
|---|---|
| Travelling to work (short distance) | 6.75 |
| Travelling to work (long distance) | 6.75 |
| Other (short distance) | 4.81 |
| Other (long distance) | 4.81 |
| Business trips | 9.64 |
| **Per ton/hour** | **€, 2016** |
| Freight transport | 1.15 |

### Table 5.8 - CBA Kúty — Devínska Nová Ves and Bratislava — Nové Zámky — Štúrovo: Unit external costs

**Unit societal costs of accidents (EUR, 2012):**
*per 1000 pass.km or 1000 ton.km*

| | | 2016 |
|---|---|---|
| Cars | 37,02 | 37,76 |
| Buses | 14,10 | 14,38 |
| Lorries 3.5 - 12 tonnes | 64,42 | 65,71 |
| Lorries > 12 tonnes | 11,69 | 11,92 |
| Lorries - average | 38,06 | 38,82 |
| Rail transport - passenger | 0,69 | 0,70 |
| Rail transport - freight | 0,23 | 0,23 |

Source: Handbook CBA, tab. 28

**Unit external costs: Pollution of environment**
*per vehkm and train km (EUR, 2010):*

| | | 2016 |
|---|---|---|
| Cars | 0,02 | 0,02 |
| Buses | 0,19 | 0,21 |
| Lorries 3.5 - 12 tonnes | 0,02 | 0,02 |
| Lorries > 12 tonnes | 0,16 | 0,18 |
| Lorries - average | 0,09 | 0,10 |
| Rail transport - passenger | 1,86 | 2,04 |
| Rail transport - freight | 0,81 | 0,89 |

Source: Handbook CBA, tab. 37 - 39

**Unit external costs of noise (EUR, 2010):**
*per 1000 vehkm or 1000 train km*

| | | 2016 |
|---|---|---|
| Cars | 5,56 | 6,10 |
| Buses | 27,87 | 30,60 |
| Lorries 3.5 - 12 tonnes | 27,87 | 30,60 |
| Lorries > 12 tonnes | 51,24 | 56,26 |
| Lorries - average | 39,55 | 43,43 |
| Rail transport - passenger | 153,68 | 168,74 |
| Rail transport - freight | 323,27 | 354,95 |

Source: Handbook CBA, tab. 40 - 41

**Unit external costs: Climate impacts (greenhouse gases)**
*per vehkm and train km (EUR, 2010):*

| | | 2016 |
|---|---|---|
| Cars | 0,02 | 0,02 |
| Buses | 0,06 | 0,07 |
| Lorries 3.5 - 12 tonnes | 0,02 | 0,03 |
| Lorries > 12 tonnes | 0,06 | 0,07 |
| Lorries - average | 0,04 | 0,05 |
| Rail transport - passenger | 0,71 | 0,77 |
| Rail transport - freight | 1,26 | 1,39 |

Source: Handbook CBA, tab. 37 - 39

Table 5.9 shows, as example, a CBA calculation by means of the excel chart according to table 5.6, with the data as available from the feasibility study in reference and its annex 9. Despite some simplifications (the development of costs and benefits over time has not been taken into account in this example), the resulting CBA values (the difference of benefits minus construction costs and the quotient of benefits and construction costs, the latter being 1,157) reflects quite well the results in the referenced study (CBA = 1.18). With the extremely conservative assumptions taken, the influence of the benefits of induced traffic is negligible.

### Table 5.9 - Summary results for macro-economic CBA according to NIBA; example HS section Kúty — Devínska Nová Ves and Bratislava — Nové Zámky — Štúrovo

**Macro-economic Assessment**

| Macro-economic indicators | without project | with project | quantities *) | unit benefits**) | benefits**) |
|---|---|---|---|---|---|
| **Environment and climate** | | | | | |
| Polluting emissions | | | 0 | | 10 343 |
| Noise immissions | | | 0 | | 3 549 |
| Greenhouse gas emissions | | | 0 | | 5 719 |
| External costs of traction energy | | | 0 | | - |
| **Environmental and climate benefits** | | | | | 19 611 |
| **Economy** | | | | | |
| Operational costs of long-distance passenger traffic | | | 0 | | 10 643 |
| Operational costs of regional passenger traffic | | | 0 | | 13 267 |
| Operational costs of freight traffic | | | 0 | | - 1,209 |
| Operational costs of infrastructure | | | 0 | | - |
| Annuities for infrastructure investment | | | 0 | | - 92,108 |
| Energy costs | | | 0 | | - |
| Maintenance costs | | | 0 | | 11 922 |
| Travelling time reduction for passengers (monetised) | | | 0 | 6.39 | 23 146 |
| Transport time reduction for freight (monetised) | | | 0 | 1.18 | 11 |
| Benefits of induced long-distance passenger traffic on rail (monetised) | 0 | 16 450 | 16,450 | 0.05 | 823 |
| Benefits of induced regional passenger traffic on rail (monetised) | 0 | 2 571 | 2 571 | 0.05 | 129 |
| Benefits of induced freight on rail (monetised) | | | 0 | | - |
| **Economic benefits** | | | | | - 33,377 |
| **Society** | | | | | |
| Reduction of accidents | | | 0 | | 28,250 |
| **Societal benefits** | | | | | 28,250 |
| **Total result of macro-economic cost-benefit analysis** | **Difference Benefits - Costs (p.a.)** | | | | **14 484** |
| | **Quotient Benefits/Costs** | | | | **1.157** |

*) Variations due to project: quantities of emissions, immissions, unit values of time, etc. (differences with - without project)
**) Numbers indicated in 1000 €; costs are negative (-) benefits.

## 5.4. Conclusions and recommendations

The purpose of this study (Phase 1) is to give a broad overview of the state of the art of high-speed rail, covering historical, legal and political backgrounds, technical challenges, benefits and costs and best-practice examples. Furthermore, a methodology has been developed, based on a gravitation approach and including forecast scenarios for 2030 and 2050, to determine traffic demand potentials for a selected number of links in TER countries. Finally, with the goal to identify links where high-speed may be a realistic option, these potentials have been compared with a set of high-speed lines already existing or under implementation.

Given the fact that it has not been possible to investigate details at this stage, one should be aware that final decisions on high-speed implementation in individual cases can be made only on the basis of much deeper investigations, taking duly into account the individual particularities, as costs and benefits.

High-speed rail is an expensive but effective means to reduce travelling times for passengers and to make spaces shrink. Travellers have the advantage to enjoy shorter travelling times, which moreover they can use productively, compared with driving times in cars. The socio-economic or macro-economic benefits are mainly due to improved accessibility, while the modal shift due to shorter travelling times lead to rail higher traffic safety and lower greenhouse gas and polluting emissions.

The overall magnitude of benefits depends on the potential of passengers. This can be exhausted most effectively at distances between 200 and 1,000 km, respectively if travelling times are between 1 and 4 hours. Although high-speed is efficient only if connecting large cities at reasonable distances, also smaller cities (which by themselves would not justify high-speed investments) would benefit, if they are located between larger cities and, therefore, served by high-speed trains.

Apart from socio-economic benefits, the investments in high-speed rail may pay off for railway undertakings and infrastructure owners, if sufficient additional passengers can be attracted. This depends on the traffic demand potential of a link and the general long-distance mobility in a country, which is a function of economic prosperity. The WTDP values as calculated in chapter 5.2. are based on these main determinants.

Modal shift results in additional passengers, consequently in additional revenues. Of course, this effect is relevant only, if there is a sufficient potential of passengers. Secondly, shorter travel times increase their willingness to pay. Thirdly, high-speed permits more frequent train cycles, which boost the efficiency of the services through reduced costs of rolling stock and train staff per cycle. This all contributes to reducing operation costs, enhanced efficiency and higher revenues.

On the other hand, there are considerable infrastructure costs for investment and operation, including maintenance. However, there are limitations on how much fares can be increased, due to inter- and intra-modal competition on the transport market, which are subject to EU and national transport policy, covering fuel taxes, tolls, subsidies, etc. Therefore, in most cases, revenues might not be sufficient to cover all costs, so that public budgets would be challenged.

Consequently, an optimal performance and financial circle should obey the following principles, taking into account the context between socio-economic benefits and profitability of high-speed rail for operators:

- High-speed operation shall at least cover operating costs of railway undertaking operating high-speed trains (maintenance of vehicles, energy, staff, etc. plus infrastructure charges

- Infrastructure charges should at least cover operation costs of high-speed infrastructure (maintenance of infrastructure, staff), in the case of mixed operation, the share attributed to high-speed operation
- The remaining costs (in most cases the greater part) which are mainly infrastructure investment costs, should be borne by the public budget, provided that there are macro-economic benefits (accessibility and regional and national economic benefits, due to the high-speed rail, climate and environmental benefits, improved traffic safety).

For taking decisions on high-speed, as a minimum, the following aspects regarding the context of a high-speed link in the network or in a corridor have to be taken into account, as well as effects on timetables and capacities, which would have to be considered in detail on the basis of accurate data:

- The functionalities of the link in the network: Should it be a new or an upgraded link? (which also depends on potential capacity needs), the expected operational condition (only high-speed or mixed traffic), the design and operational speeds
- The impact on space and environment
- The forecasted passenger volumes and corresponding commercial rates of return
- The benefits for traffic safety, environment and climate, due to modal shift from road and air to rail
- The technical requirements and costs for high-speed implementation and operation, including the necessary signalling system
- Interoperability with the existing rail network
- Funding and financing.

Complementary to this and maybe even as an alternative, other measures to shorten travel times should be considered before implementing high-speed, for example accelerated border crossing procedures, as it has been proposed in the ACROSSEE project [41] for South-Eastern Europe. Time lost at borders sum up to hours, which even with the highest investments in infrastructure cannot be cancelled. Excessive waiting times at borders are one of the main reasons for low exploitation of transport capacities. Improving border crossing would attract high traffic and transport volumes, which would substantially ease funding and financing of infrastructure projects, including for high-speed.

With a view to the concrete results, which refer to about 85 links throughout the TER area, the present study shows that the quantity and spatial distribution of population in most TER countries is comparable with Western Europe. However, the economic level is generally lower than in most western EU member States, so that mobility parameters and, in particular, current WTDP values are lower. With growing economies, a certain convergence may be expected, which means that high-speed lines may be justified in certain cases, mainly in the western parts of the TER area, in Turkey anyway and also in the Russian Federation, which would deserve special consideration, taking into account the extremely long distances between cities there.

As far as high-speed already exists, it is mostly confirmed by the results of this study. This is, for instance, the case for high-speed links in Turkey.

As set out in chapter 2.5., Turkey does not only have the existing high-speed lines Ankara — Istanbul and Ankara — Konya, but also an ambitious and advanced high-speed programme, with several links under construction. Equally, the Russian Federation already operates high-speed lines, for example Moscow — St. Petersburg and has ambitious plans, including for a new link Moscow — St. Petersburg and Moscow — Nishnij Novgorod — Kazan (with possible later extension to Yekaterinburg) designed for 400 km/h.

The overall picture shows that most links that may be candidates for high-speed, at least in the long run, are located on former pan-European Corridors or present TEN-T Core Network Corridors or other evident corridors (e.g. in Turkey or the Russian Federation), with the highest priorities around the large, densely populated agglomerations. These could be the starting points for a future TER high-speed network which, one day, may grow together with planned or already existing Western-European high-speed lines.

A particular situation may emerge with links along one of the EATL-corridors between Europe and China ("One belt — One road"). Along these inter-continental corridors passing the Russian Federation and Eastern Europe or Turkey and south-eastern Europe, significant cargo volumes may be expected over the coming decades, probably far beyond the economic growth of the transited TER countries. In these cases, capacity may be exhausted by freight, so that new parallel links for passengers may be needed. It is recommended to consider, in the design phase, high-speed an option, even if the WTDP value of the link is not very high. As shown in chapter 3.4., this may, at least in some cases, cause relatively low additional expenses.

Another reason may be the objective to improve accessibility of certain remote regions, which has been done in some parts of Spain. This however can cause significant economic losses for infrastructure managers and operators. However, given the extremely low commercial revenues of lines with low passenger numbers, this cannot be a general recommendation for TER countries.

In an overall consideration of this phase of the study, quite some important insights could be gleaned. However, this should only be seen as a starting point for more in-depth investigations in the future. In this sense, it is recommended to carry out the following activities in the second phase of this study:

- Intensify knowledge of the existing infrastructure, with focus on the corridors that predominantly consist of links with high WTDP values
- Improve forecasting for the entire TER area
- Intensify knowledge on existing and forecasted traffic flows (passengers and freight) in these corridors, including particular observation of EATL links
- Intensify knowledge on national plans, with a focus on high-speed
- Complete corridor network with additional links, where this seems useful.

These steps should be done in close cooperation with TER member states, to achieve a common understanding on the development of high-speed in the area.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| 2 | UBA | Umweltbundesamt (Federal Environment Agency) |
| 3 | ELSEVIER Ltd. | UK branch of ELSEVIER BV (Scientific publisher in NL) |
| 4 | J G PALMERS LLP | UK based publisher |
| 5 | KTH | Kungliga Tekniska Högskolan (Royal Institute of Technology) |
| 6 | TU | Technische Universität (Technical University) |
| 7 | APTA | American Public Transport Association |
| 8 | WUD | Výskumný Ústav Dopravný (= Transport Research Institute) Bratislava, Žilina, SK |
| 9 | WIIW | Wiener Institut für Internationale Wirtschaftsvergleiche (Vienna Institute for international economic studies) |
| 10 | WKO | Wirtschaftskammer Österreich (Austrian Chamber of Economy) |
| 11 | IHS | Institut für Höhere Studien (Institute for Advanced Studies) Vienna |
| 12 | CEI | Central European Initiative Trieste |

## 6.2. Figures

## 6.3. Tables


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# Annex I: Questionnaires

## First questionnaire, 18 May 2016: Questionnaire for Collection of Information and Data on TER Member States and their Railway Network

All TER Member States are kindly requested to supply the following data, which will be needed as a database for the new UNECE TER High-Speed Masterplan. With view to the tight schedule of this project, each TER Member State is asked to complete the questionnaire and submit it electronically to InfraConceptA, Mr. Helmut Adelsberger (helmut.adelsberger@infraconcepta.at), not later than by June 30th, 2016. Data recently delivered in an updated version to your consultant Mr. Petr Pospisil for monitoring the TER Masterplan are not needed in this context.

Basically, forecasts should refer to 2030 and 2050. If not available for these particular years, actual time horizons shall be indicated, instead.

### 1. Geographic, demographic and socio-economic data of the country:

For clear assignment of data and to prevent confusion, maps showing the topography (relevant mountains and large rivers), the cities as indicated below and the trunk transport network (incl. rail backbone) are needed from each TER Member State, as well as the following information and data:

- Area ($km^2$), split up into regions or provinces and population (number of inhabitants, male/female, clustered according to ages, clustered according to education) incl. forecasts;
- Cities with more than 100.000 inhabitants and/or important crossing points of the railway network, indicating their sizes (number of inhabitants) incl. forecasts;
- Relevant sea and/or inland ports, with their current transhipment volumes per year (bulk, non-bulk, passengers, in and out) incl. forecasts (landlocked countries: Please indicate most important foreign seaport(s) for import and export!);
- Relevant airports incl. their current passenger volumes per year (arriving, departing), incl. forecasts;
- GDP (B€) and forecasts;
- Agriculture and rural population (assigned to regions or provinces) and expectations for future development;
- Relevant industries (mining and production), number of industrial employees (assigned to regions or provinces) and expectations for future development,

- Relevant services, number of self-employed persons and employees (assigned to regions or provinces) and expectations for future development;
- Import volume (B€), main raw materials and/or products imported, from which origins and expectations for future development;
- Export volume (B€), main raw materials and/or products imported, to which destinations and expectations for future development;
- Particularities which may be relevant, such as: conflicts with neighbours, closed borders, relevant number of refugees from other countries, etc.;

## 2. Technical parameters and traffic flows on existing railway sections of TER backbone network:

Sections should be defined as links between relevant nodes such as important cities, crossing points and junctions of the network, border crossing points and places where track parameter or traffic flows change considerably. These nodes should be clearly shown on the map(s) stipulated above.

For each of these sections, the following technical parameters and traffic flow data are required:

- Gauge (mm);
- Length of section (km);
- Number of tracks;
- Axle load (tons);
- Loading gauge (in particular if there are relevant restrictions);
- Electrification (if so, please indicate voltage and AC/DC!);
- Minimum radius (m): relevant average minimum, absolute minimum, maximum admissible latera acceleration in curves;
- Maximum gradient (‰): relevant maximum gradient, absolute maximum;
- Minimum/maximum travelling times for the section;
- Maximum daily numbers of passenger and freight trains, if available also number of travellers and freight quantities (tons),
- Minimum/maximum Travelling time for passengers and freight (h:min),
- Only for sections reaching a border, number of border crossing passenger and freight trains, if available also number of travellers and freight quantities (tons).
- For corresponding road sections, number of vehicles (cars and trucks) as well as number of persons and freight volumes per day should be indicated.
- Please indicate also number of air travellers and freight volumes per day by maritime transport and/or on inland waterways!

These data are essential to estimate potentials for rail, in particular in the context with possible high-speed connections.

## 3. Information on possible or planned high speed lines:

TER countries are requested to inform also about relevant projects and their parameters: new lines, upgrading of existing lines to higher speed and/or capacity, electrification, etc., rehabilitation (if technical parameters are substantially improved) and deliver studies. As far as existing, also studies, political agreements and cost estimates should be delivered!)

- Are there plans to upgrade existing lines or construct new lines for high speed? What is concretely foreseen? (Please indicate intended speed level, travelling times, if it is an upgrade or a new line parallel to an existing line or in a new relation, what will be the tariffs – in relation to current fares, how many travellers are expected, etc.!)
- Are there studies on high speed in your country available?
- Are there agreements with neighbouring countries on border crossing high-speed links?
- Do cost estimates exist for upgrading and construction (at which price basis)?

## 4. Information and data on environment, climate and traffic safety:

- Location, kind and extension of protected areas;
- Emissions of polluting gases, particles and $CO_2$ (for the whole country);
- Data on road accidents.

For TER High-Speed Masterplan, thanking you in advance for your kind cooperation, in particular for timely delivery of this information (by end of June 2016), with best regards,

**InfraConceptA**
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# Second questionnaire, 1 September 2016: UNECE TER High-Speed Masterplan Questionnaire for Collection of Information and Data on TER Member States and their Railway Network

Despite a kind reminder issued on July 21, there was very poor return of completed questionnaires so far. In order to get work started, the methodology to determine sections for which high-speed may be considered was modified, without substantially reducing the accuracy of the results. Based on a demand potential, which results from inhabitants of nodes (urban areas) and their mutual distances, according to proven experience (Lill's travelling law; gravitation approach), it is possible to identify railway sections for which high-speed may be an option. Actual exhaustion of the potential depends on the GDP per capita of the individual country. Assuming that earlier or later each country will reach the GDP per capita of Western Europe countries, priorities for implementation may be derived from the forecasted GDP per capita growth rate.

With view to the revised methodology for the concept of high-speed railway lines in the TER countries, the questionnaire as prepared and distributed in May this year, has been simplified and the number of data drastically reduced.

Now, all TER Member States are kindly requested to supply those of the following data, which they have not delivered already.

With view to the time already lost and the time schedule of this project now even tighter, each TER Member State is asked to complete this questionnaire and submit it electronically to InfraConceptA, Mr. Helmut Adelsberger (helmut.adelsberger@infraconcepta.at), not later than by 12 September 2016.

Basically, forecasts should refer to 2030 and 2050. If not available for these particular years, actual time horizons shall be indicated, instead.

## 1. Geographic, demographic and socio-economic data of the country:

For clear assignment of data and to prevent confusion, maps showing the topography (relevant mountains and large rivers), the cities as indicated below and the trunk railway network are needed from each TER Member State, as well as the following information and data:

- Urban areas (agglomerations) with more than 100,000 inhabitants;
- Relevant airports incl. their current passenger volumes per year (arriving, departing), incl. forecasts;
- GDP per capita 2015 (B€) and current growth rate;
- Particularities which may be relevant, such as: conflicts with neighbours, closed borders, relevant number of refugees from other countries, etc.;

## 2. Technical parameters and traffic flows on existing railway sections of TER backbone network:

Network sections should be defined as links between relevant nodes such as important cities (or urban areas), crossing points and junctions of the network and border crossing points. These nodes should be clearly shown on the map(s) stipulated above.

For each and every of these sections, the following technical parameters and traffic flow data are required (list to be repeated according to number of sections:

- Length of section (km);
- Relevant track parameters (number of tracks, axle load, min/max speed);
- Electrification (if so, please indicate voltage and AC/DC!);
- Minimum/maximum travelling times for the section;
- Maximum daily numbers of passenger and freight trains, if available also number of travellers;
- Minimum/maximum Travelling time for passengers and freight (h:min);
- Only for sections reaching a border, number of border crossing passenger trains per day, if available also number of travellers per day;
- Number of passengers per day on corresponding road sections;
- Number of air travellers per day in corresponding air connection.

These data are essential to estimate potentials for rail, in particular in the context with possible high-speed connections.

## 3. Information on possible or planned high-speed lines:

TER countries are requested to inform also about relevant projects and their parameters: new lines, upgrading of existing lines to higher speed and/or capacity, electrification, etc., rehabilitation (if technical parameters are substantially improved) and deliver studies. As far as existing, also studies, political agreements and cost estimates should be delivered!)

- Are there plans to upgrade existing lines or construct new lines for high-speed? What is concretely foreseen? (Please indicate intended speed level, travelling times, if it is an upgrade or a new line parallel to an existing line or in a new relation, what will be the tariffs – in relation to current fares, how many travellers are expected, etc.!)
- Are there studies on high-speed available in your country?
- Are there agreements with neighbouring countries on border crossing high-speed links?
- Do cost estimates exist for upgrading and construction (at which price basis)?

For TER High-Speed Masterplan, thanking you in advance for your kind cooperation, in particular for timely delivery of this information (by end of June 2016).


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# Annex II:
# Extracts from the Project-Specific Technical Specification Design of the Moscow — Kazan section of the Moscow — Kazan — Yekaterinburg High-Speed Railway

[Logo:] St. Petersburg State Transport University

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DEPUTY MINISTER FOR
CONSTRUCTION, HOUSING
AND UTILITIES OF THE
RUSSIAN FEDERATION

[signature] Y.O. SIERRA

**PROJECT-SPECIFIC TECHNICAL SPECIFICATIONS**
Design of the Moscow-Kazan section
of the Moscow-Kazan-Yekaterinburg High-Speed Railway
with speeds of up to 400 km/h

DRAFTED BY

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[Seal:] Federal Agency for Railway Transport Federal State Government-funded Educational Institution of Higher Professional Education Emperor Alexander I St. Petersburg State Transport University (FSGEI HPE SPSTU), OGRN 1027810241502

St. Petersburg 2014

[…]

## 1.7. Need to draft PSTS

**1.7.1.** The need to draft the Project-Specific Technical Specifications (hereinafter PSTS) is due to the absence of documents in the Russian Federation governing the requirements for the design, construction and operation of specialised railway lines for high-speed passenger trains with maximum speeds of up to 400 km/h;

**1.7.2.** The Project-Specific Technical Specifications for the design, construction and operation of the Moscow-Kazan-Yekaterinburg High-Speed Railway, which were endorsed by Gosstroy of Russia on 27 November 2013, were drafted during the investment feasibility study stage of the project 'Moscow-Kazan-Yekaterinburg High-Speed Railway (HSR-2). Moscow-Kazan Section. Construction Phase' and require clarification.

## 1.8. Scope

These PSTS contain the standards and requirements for the design of the Moscow-Kazan section of the new Moscow-Kazan-Yekaterinburg High-Speed Railway (hereinafter HSR), which is designed for high-speed passenger trains with speeds of up to 200 km/h and special container trains with speeds of up to 160 km/h.

## 1.9. Brief description of object

**1.9.1.** The HSR is designed as a process system that includes railway infrastructure and rolling stock subsystems.

**1.9.2.** The route of the Moscow-Kazan section of the Moscow-Kazan-Yekaterinburg High-Speed Railway passes through the territories of seven constituent entities of the Russian Federation: the City of Moscow, the Moscow, Vladimir and Nizhny Novgorod Regions, and the Republics of Chuvashia, Mari El and Tatarstan.

The route unites the major cities: Moscow, Nizhny Novgorod, Cheboksary and Kazan.

**1.9.3.** The construction area is located in the Eastern European (Russian) platform and geologically consists of anunexposed crystalline basement and a sedimentary cover. The crystalline basement is comprised of Archaean and Proterozoic granite and gneisses, while the sedimentary cover consists of deposits from the Paleozoic, Mesozoic and Cenozoic eras. The glaciers left behind moraine loams with pebbles and boulders from different types of rocks (granite, gneiss, quartzite, dolomite, limestone, sandstone); traces from the Dnieper glaciation are particularly noticeable in the region (with moraine thickness of as much as 15 m). In the Nizhny Novgorod Region, the area through which the HSR passes consists of karst topography (caves, pits, etc.).

**1.9.4.** The construction area has a temperate continental climate with well-defined seasons: a warm summer and a moderately cold winter. The coldest month is January and the warmest month is July.

The main rivers in the construction area are the Volga, Oka, Klyazma, Sura, Tyosha and Ilet. Most of the rivers are part of the Volga basin.

**1.9.5.** The HSR is designed as a two-track line with track gauge of 1,520 mm that can handle traffic speed for high-speed passenger trains of up to 400 km/h with a maximum static axle load not exceeding 170 kN along with the ability to handle passenger trains with speeds of up to 200 km/h and special container trains with speeds of up to 160 km/h.

The maximum static axle load of the electric locomotives for rapid passenger and special container trains is accepted as 226 kN, while the flat cars for container trains and passenger trains is accepted as 210 kN.

**1.9.6.** The HSR is designed with electric traction.

**1.9.7.** All railway infrastructure and rolling stock subsystems must be compatible with one another.

**1.9.8.** When designing the HSR infrastructure facilities for the sections on which train speeds are less than 200 km/h, the existing regulatory framework is used. When designing station tracks (except main tracks and receiving and departure tracks), the existing regulatory framework is used regardless of the speeds to be reached on the sections. Exceptions are facilities and their components for which innovative design solutions specific to the HSR are used.

**1.9.9.** The main data of the investment feasibility study include:

- The length of the Moscow-Kazan section is 770 km;
- Maximum gradient of 24%.

[…]

## Abbreviations used:

| | |
|---|---|
| **DMR** | Digital Mobile Radio; |
| **GPS** | Global Positioning System; |
| **GSM-R** | Global System for Mobile communications – Railways; |
| **LTE** | Long Term Evolution; |
| **Wi-Fi** | Wireless Fidelity; |
| **AB** | automatic blocking; |
| **AMU** | subscriber protection device; |
| **ALAS** | automatic locomotive alarm system; |
| **AUI** | act of unlawful interference; |
| **AWS** | automated work station; |
| **WDTS** | wireless data transmission system; |
| **IPDN** | input-protector device network; |
| **FOL** | fibre-optic line; |
| **HSR** | high-speed railway (line); |
| **GLONASS** | Global Navigation Satellite System; |
| **UMAS** | unified monitoring and administration system; |
| **RAT** | railway automation and telemechanics; |
| **TSCS** | train separation control system; |
| **TSES** | transport safety engineering structures; |
| **TSESU** | transport safety engineering systems and utilities; |
| **IMS** | information management system; |
| **LNS** | local notification system; |
| **LP** | line path; |
| **LS** | logistic support; |
| **BCN** | basic communication network; |
| **LBCN** | local basic communication network; |
| **OC** | optic cable; |
| **TIF** | transport infrastructure facility; |
| **OCSN** | operational communication system network; |
| **OA** | optical amplifier; |
| **SW** | software; |
| **TRS** | train radio communication; |
| **RORC** | repair and operational radio communication; |
| **RCC** | regional communication centre; |
| **REE** | radio-electronic equipment; |
| **CE** | computer equipment; |
| **PAS** | passenger alert system; |
| **SCS** | structured cabling system; |
| **MAS** | monitoring and administration system; |
| **ISS** | information security system; |
| **HSSOF** | hardware system for search operation functions; |
| **DTN** | data transmission network; |
| **OTDTN** | operational and technological data transmission network; |
| **TDMS** | technical diagnostics and monitoring system; |
| **SCB** | signalling, centralization and blocking; |
| **TDM** | technical diagnostics and monitoring; |
| **TD** | technical diagnostics; |
| **TN** | telecommunications network; |
| **TM** | technical maintenance; |
| **TS** | traction substation; |
| **TV** | transport vehicle; |
| **TSHS** | transport safety hardware system; |
| **CNSS** | clock network synchronisation system; |
| **PRCDS** | process radio communication digital system; |
| **TMC** | technical maintenance centre; |
| **TCS** | transport control centre; |
| **EMC** | electromagnetic compatibility; |
| **PI** | power interlocking. |

[…]

# 4. Obstruction clearance

**4.1.** All facilities and structures comprising the infrastructure of the high-speed railway must provide for safe handling of trains with size T in accordance with GOST 9238-83.

**4.2.** The obstruction clearance at the sections designed for high-speed train handling at the speed of 200 km/h must be in conformity with clearance C400 and with the one shown on Figure 4.1.

**4.3.** The obstruction clearance at the railway tracks not designed for high-speed train handling must be in conformity with clearance C in accordance with GOST 9238-83.

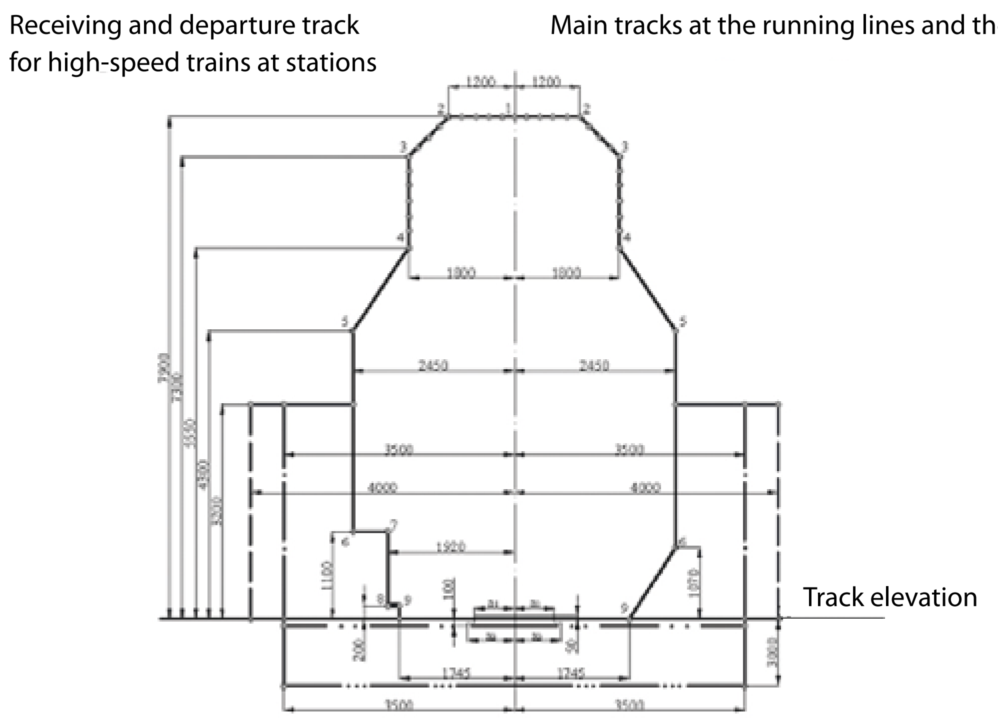
**4.4.** Obstruction clearance C400T specified below (figure 4.2) must be arranged in railway tunnels in case of high-speed railway train traffic.

**4.5.** The inter track spacing between the main track centres in the straight sections of the running lines and the stations must be:

- Up to 250 km/h inclusively – no less than 4,100 mm;
- More than 250 to 300 km/h – no less than 4,500 mm;
- More than 300 to 350 km/h – no less than 4,800 mm;
- More than 350 to 400 km/h – no less than 5,000 mm.

**4.6.** There must be widening of the inter track spacing and the clearance to the rail-side facilities in the curved tracks sections. The values of the widening and of the clearances must be established based on the geometric calculation for the particular rolling stock.

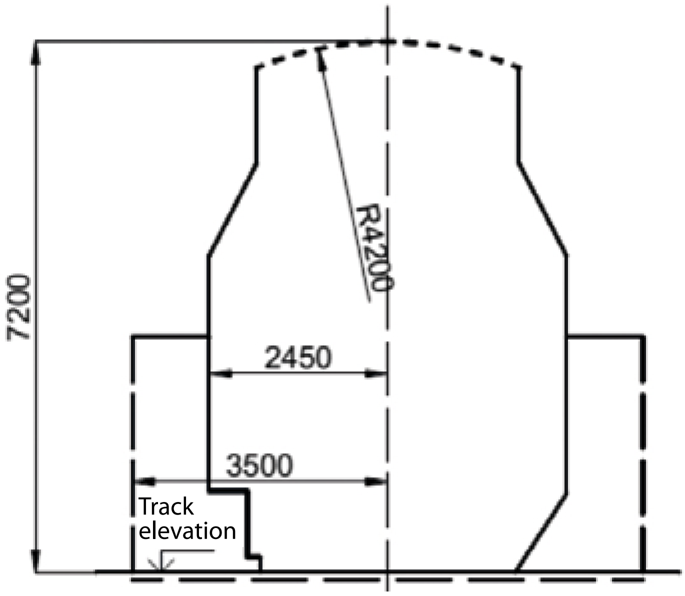
**Figure 4.1 – Obstruction clearance C400**



| | |
|---|---|
| ——————— | The line of clearance of bridge spans, platforms, flooring of the crossings, mechanisms of track switches and SCB devices located therewith, as well as of devices located within the inter track spacing. |
| —— · —— | Distance 3,500 mm is the line of clearance of traffic light masts, supporting structures, as well as of buildings, structures and constructions (not including bridge spans, and platforms) located on the outside of the outer tracks of running lines and isolated tracks at stations. |
| -o-o-o-o-o- | The line limiting the space for supporting structures and bow current collector. |
| — — — | The line of clearance of flyover supports, railings on bridges, and noise screens. |
| —— · · —— | The line limiting the elevation for all devices at running lines and within the effective length of the line at stations, except flooring of crossings, inducers of cab signalling, as well as mechanisms of track switches and SCB devices located therewith. |
| —— · · · —— | The line of clearance of foundations of buildings and supports, cables, pipelines and other structures not related to the track located at running lines and stations, except engineering structures and SCB devices in the area of signalling and broadcasting points. |

**Figure 4.2 – Obstruction clearance C400T**

The legend is the same as the legend for figure 4.1




**4.7.** The minimum spacing between the centres of the HSR main track, the connecting main tracks, as well as the HSR tracks and the main tracks of the railways of public use for speeds ranging from 251 to 400 km/h must be accepted equal to 10 meters. For speeds of 250 km/h and less – 7,650 mm in accordance with the applicable standard.

# 5. Track plan

Safety and comfort, and reliable communication between the track and the rolling stock are ensured at designing of the plan by compliance with the requirements of SNiP 32-01-95, and with respect to the matters described below – with the requirements of this section.

## 5.1. Track plan at running lines

**5.1.1.** The track plan at running lines is designed with consideration of topographic, site and other conditions with respect to the train speed at the section, provided that the below requirements are strictly complied with:

- Non-quenched transverse acceleration at the box at the maximum speed pursuant to the terms of comfortable travel of passengers, ride quality and allowable dynamic impact on the track must not exceed:

  For high-speed passenger trains:

  ~ plus 0.4 $m/s^2$ – at the speed of 400 km/h;

  ~ plus 0.5 $m/s^2$ – at the speed of 350 km/h;

  ~ plus 0.6 $m/s^2$ – at the speed of 300 km/h;

  ~ plus 0.7 $m/s^2$ – at the speed of 250 km/h and less (the rated values of non-quenched transverse acceleration for intermediate speed levels are determined by interpolation);

  For speed passenger trains:

  ~ plus 0.7 $m/s^2$;

  For freight container trains:

  ~ minus 0.3 $m/s^2$ (minus 0.4 $m/s^2$ under difficult conditions).

- Elevation of outer rail must not exceed 150 mm. The rated value is determined in conjunction with the train speed level and the radius value of the constant-radius curve with consideration of compliance with the requirements specified in clause 5.1.1.

The train speed level is determined with consideration of possible restrictions based on the results of grade computations and is checked for compliance with these requirements. When needed, compliance with these requirements is ensured by adjustment of elevation of outer rail, the radius of the constant-radius curve or the maximum train speed level at the given section of the railway.

**5.1.2.** The constant-radius curves must have constant radius at the entire length. The minimum length of the curve must be at least 200 m at passenger train speeds of up to 350 km/h and at least 250 m at speeds of 351–400 km/h.

**5.1.3.** The length of the ease curve is determined considering strict compliance with the following requirements:

a. The allowable value of the vertical velocity of the wheel rise by the elevation of outer rail must not exceed 28 mm/s;

b. The allowable values of the exit steepness of the elevation of outer rail must not exceed the values matching the allowable value of the vertical velocity of the wheel rise within the exit of the elevation of outer rail and the actual maximum train speed at the given section;

c. The speed of rise of non-quenched transverse acceleration allowed within the ease curve must not exceed 0.4 $m/s^3$.

The biggest length of the ease curve out of the values of the length of the ease curve determined in accordance with the specified requirements is selected as the final value.

**5.1.4.** The length of the straight between the start points of the neighbouring ease curves must be at least 400 m; the length of the straight between the curves may be decreased to 300 m under difficult conditions, when technically and economically justified.

## 5.2. Track plan at intersections

**5.2.1.** The plan of the main track at intersections must be designed in accordance with the terms specified in clause 5.1 of this section.

The main and the receiving and departure tracks of passenger platforms must be located on the tangent track in plan. Should there be justifications, passenger platforms may be located on curves meeting the requirements of clause 5.1 of these PSTS.

**5.2.2.** Other station tracks must be designed with consideration of the existing regulatory documents.

**5.3.** Location of tunnels in plan must comply with the requirements applicable to the open sections of the HSR.

# 6. Profile elevation of the track

Safety and comfort, and reliable communication between the track and the rolling stock are ensured at designing of the profile elevation of the track by compliance with the requirements of SNiP 32-01-95, SNiP 2.06.04-82*, SP 122.13330.2012, SP 33-101-03, and with respect to the matters described below – with the requirements of this section.

## 6.1. Profile elevation of the track at running lines

**6.1.1.** The maximum inclination of the profile elevation of the main tracks must not exceed 24‰.

**6.1.2.** Straight-line elements of the profile elevation must be mated with the vertical curve.

The radius of the vertical curve is determined with consideration of the restriction of the maximum vertical acceleration at passage of trains on the curve (to ensure comfortable travel for passengers and ride quality), which is as follows:

- For passenger trains on summits – no more than 0.3 $m/s^2$
- For passenger trains on sags – no more than 0.4 $m/s^2$.

**6.1.3.** The space between the end and the start points of the neighbouring vertical curves, i.e. the length of the section of the track with constant inclination of the profile elevation must be at least 300 m.

The length of the section with the constant inclination of the profile elevation located between two neighbouring vertical curves may be shortened to 200 m under difficult conditions, provided that trains run in a traction mode or idle on the given section.

**6.1.4.** Vertical curves must be located:

- Outside of ease curves in plan
- Outside of bridge span structures with the length of over 50 m
- Outside of track switches.

**6.1.5.** The profile elevation of the track in cuts with the length of over 400 m may be designed by one or several elements of the profile, the inclination of directions of which must ensure free drainage of surface waters towards beginning and end of the cuts. The values of inclinations of profile elevation in cuts must be at least 3‰.

At approaches to bridges and pipes, as well as in areas, where the HSR goes along river banks and water bodies, the shoulder of the main area of the subgrade must rise above the highest high water level with the probability of exceeding the level of 0.33% with consideration of affluent, wind surge, action of the wave on the bank slope and of ice phenomena by at least 0.9 m. The top elevation of flood-free regulation structures and bermes must exceed the specified highest high water level by at least 0.25 m.

**6.1.6.** The shoulder of the main area of the subgrade on the areas, which may be covered with snow, must exceed the rated snow cover level with the probability of exceeding the level of one time in 50 years by at least 1.0 m.

**6.1.7.** The profile elevation in the cuts should be avoided in areas of development of active karst.

## 6.2. Profile elevation at intersections

**6.2.1.** The elevation profile of the main tracks at intersections must comply with the standards established for the main tracks at intersections.

The main and the receiving and departure tracks of passenger platforms must be positioned on the platform in the profile elevation. Should there be proper justification, sections of passenger platforms may be positioned on vertical curves meeting the requirements of clause 6.1.2 of these PSTS.

The profile of station tracks, where special container and service trains may stay and where locomotives may be disconnected, is designed in accordance with the existing regulatory documents.

**6.2.2.** The radius of the vertical curve of at least 900 m is allowed for station tracks, except main, receiving and departure, and connecting tracks, to be used for passage of high-speed rolling stock.

## 6.3. Inclination of the profile elevation in tunnels

The inclination of the profile elevation for rise in tunnels must comply with the requirements of clause 6.1.1 of these PSTS and must not exceed the value allowing for the speed of 350 km/h at the entire length of the tunnel.

# 7. Subgrade

## General provisions

**7.1.** The subgrade of the HSR must be designed for the maximum allowable vertical dynamic load of the wheel on the rail of 160 kN (16.3 t), as well as with consideration of the load of the type of the track superstructure.

**7.2.** The subgrade must be designed in conjunction with the track superstructures, engineering structures and amenities.

**7.3.** The subgrade must be designed based on the results of the engineering and geological exploration, the engineering and geodetic survey, the engineering and hydrometeorological examination and the hydrologic studies. The hydrogeological, engineering and seismic and other surveys, as well as full-scale determination of stress-related characteristics of the foundation soil may be additionally performed when needed under difficult conditions.

**7.4.** The required level of reliability with respect to safety against failure, stability and deformability of the subgrade with consideration of the vibrodynamic impact from trains at the minimum expense, as well as at the maximum preservation of valuable soils, the minimum natural environment damage must be ensured at designing and construction.

**7.5.** Soils used for the subgrade are classified in accordance with GOST 25100-2011 Soils. Classification.

**7.6.** The project of the HSR structure must mandatory have provisions for arrangement of the multilayer consolidation of soils of the subgrade. The thickness of the filled-in layers, the number of runs of tamping machines on one track, the duration of the impact of working bodies on the soil and other technological parameters assuring the designed soil density must be determined empirically.

**7.7.** The standard (group) solutions must be used at designing of the subgrade. These solutions are developed by the design company for the most common building conditions. No individual justifications are required for the subgrade erected pursuant to the standard (group) solution.

The subgrade is designed individually for:

- Embankments with the height of over 12 m consisting of broken rocky soil, coarse soil, sands, hard and stiff soil;
- Embankments on floodplains, in the area of crossing with water bodies and water channels, as well as in the area of temporary flooding, at the sections of the subgrade located along water channels, water bodies and reservoirs;
- Embankments on slopes steeper than 1:5 consisting of rocky soil, on slopes steeper than 1:3 consisting of non-rocky soil, as well as on slopes with the steepness ranging from 1:5 to 1:3 at downstream elevations exceeding 12 m;
- Embankments on week bases, except sections, where soft soils are on the surface and are 4 m in capacity;

- Embankments on weak bases at the sections of laying of ballastless track;
- Embankments in the area of mating with engineering structures;
- Subgrade, in the construction on which hydromechanization and explosion works are used;
- Subgrade at the sections of output of keys within the foundation;
- Cuts with the slope elevation of over 12 m in any soils;
- Cuts in rocky soils under difficult engineering and geological conditions, including in case of rock deposits with the inclination steeper than 1:3 towards the line;
- Cuts in loam soils with the consistency ratio of over 0.5 or confined-water cuts;
- Cuts with the depth of over 6 m in loam and silt soils in the area of overmoisturizing;
- Cuts in soils with dramatically reducing structural and stress-related characteristics exposed to climatic factors and dynamic loads (loam soils with the moisture at the liquid limit of over 0.4);
- Cuts at the sections of occurrence of ground waters above the base of the second protective layer;
- Subgrade in the area of active sloping processes;
- Subgrade at the sections, where karst processes develop;
- Subgrade in the area of crossing with pipelines.

**7.8.** Options of switching from the subgrade to overpasses and tunnels must be considered at designing of the subgrade. The solution for switching to overpasses and tunnels must be accepted based on the engineering and economical comparison of the options of constructive solutions.

## Subgrade design

**7.9.** The subgrade of the HSR, except intersections, is designed for two tracks.

**7.10.** The design of junction of bridge crossings with embankments must ensure smooth exit and entry of the train from and to the bridge and must eliminate formation of above-level local pockets.

**7.11.** The design of the subgrade of main tracks of the stations and control rooms must comply with all standards applicable to the main tracks of the running lines.

**7.12.** Measures of protection of the subgrade and drainage structures from projected possible unfavourable natural and industrial processes and events must be developed at designing of the HSR to ensure train safety.

**7.13.** Structures for removal of surface waters and, when needed, of ground waters from the subgrade must be designed at running lines and intersections.

**7.14.** The subgrade arranged in the area of karst processes must be designed preferably as embankments with anti-deformation protection, including, protection eliminating activation of karst processes.

**7.15.** The process guidelines for the subgrade must be developed and must cover monitoring during construction and further exploitation.

# 8. Track superstructure

## 8.1. General requirements

**8.1.1.** Subrail base structure design should be selected depending on the speed limit on respective track section. A ballastless design should be arranged at main HSR tracks with a speed limit for high-speed trains of more than 200 km/h. If appropriate justification is provided, it is allowed to use a ballasted design. Transitional sections should be arranged between the sections with ballasted and ballastless track design.

**8.1.2.** Track superstructure design should be determined based on the specific geological conditions of construction, economic and technical calculations. Different track design options can be used throughout the entire length of HSR lines. The length of sections for each track design option should be determined by the project. Track design options should be selected taking into account the minimization of lifecycle costs while ensuring absolute reliability of operation with given load and train speed in accordance with paragraph 1.9.5 of these PSTS.

**8.1.3.** Any materials used in the construction of HSR track superstructure should be subject to certification or declaration of conformity on the basis of own evidence and evidence obtained with the participation of an authorized certification body and (or) accredited testing laboratory (centre) in accordance with Annexes 3 and 4 of the Technical Regulations of the Customs Union "On the Security of High-Speed Rail Transport" [87] or substituting documents.

**8.1.4.** Track superstructure design should take into account the requirements for the minimization of vibration and noise.

**8.1.5.** Track superstructure design should meet the requirements for high accuracy of its arrangement and subsequent operation.

## 8.2. Requirements to track superstructure design elements

**8.2.1.** Continuous welded rail tracks should be arranged throughout the entire length of HSR lines (including artificial structures).

Rail strings of continuous welded rail tracks should be fastened at an optimum temperature of 35±5°C. Optimal fastening temperature should be tested with due regard to strength and stability characteristics.

Any structures and elements of track superstructure (track switches, feathered joints, equalizing gears, etc.) on the main tracks of HSR lines and other tracks, where high-speed trains with speeds over 200 km/h are operated, should be welded into rail strings of continuous welded rail tracks. The length of rail strings, the position of welded joints, feathered joints, equalizing gears, etc. should be determined by a separate project.

Temperature variation of the length of rail strings adjoining track switches should not cause the displacement of their elements. Feathered joints should be welded at the junctions of rail strings of continuous welded rail tracks and track switches in order to compensate the effects of temperature variation. The quantity and the location of feathered joints designed to ensure the protection of rail bottlenecks, groups of track switches and individual switches should be determined with due regard to the actual location of switches within the stations.

**8.2.2.** Rail strings welded from new rail bars with the length of 100 m without bolt holes and weighing not less than 60 kg per linear meter should be laid on the main tracks of HSR lines.

Rail bars must meet the following requirements of GOST R 51685-2013:

- Intended purpose – VS grade
- Thermal hardening – DT or OT grade
- Surface quality – E grade
- Straightness – Class A.

Rail bars and rail strings laid in the main tracks of HSR lines should meet the weldability requirements.

The system for monitoring the integrity of rail strings should transmit inspection results to the train traffic control system panel. An integrity control system with signalling, centralization and blocking systems shall be arranged in order to ensure proper operation of rail strings.

**8.2.3.** The design of ballastless track superstructure (BTSP) should generally include rail strings, elastic intermediate rail fastenings, under-rail supports, bearing structure made of plates or monolithic concrete and a hydraulically bound carrier layer.

The decision to use a particular BTSP design should be taken on the basis of a feasibility study taking into account the optimization of lifecycle costs.

All BTSP elements must retain their operating parameters in a temperature range from minus 48°C to plus 67°C.

Elastic BTSP elements should have calculated hardness.

It is recommended to apply elastic elements having a reversible hardness increase at low temperatures of not more than two times.

In order to ensure the durability of BTSP elements, track elasticity modulus should not exceed the respective values of the structure located above the ballast.

The design of BTSP at artificial structures (bridges, tunnels, etc.) should provide for the installation of protective devices.

BTSP manufacturer should develop and duly endorse technical specifications for the design, construction and operation of ballastless railway tracks.

**8.2.4.** Intermediate BTSP fasteners should ensure: stability of track position, pressing of rail to the base with a force of not less than 20 kN and longitudinal shear resistance in rail fastener assembly of not less than 14 kN.

For ballastless tracks, elastic fasteners allowing for vertical adjustment of up to 10 mm and lateral adjustment of up to ±4 mm.

Special fasteners should be used on the approaches to artificial structures to allow for vertical rail adjustment on a larger scale in the range from minus 4 mm to plus 56 mm.

Intermediate rail fasteners should have elastic terminals. The required rigidity of rail fastener assembly should be achieved through the use of elastic elements. Elastic properties of these elements should be stable. Their dynamic stiffness should not vary by more than 50%, static stiffness – by more than 20% within the temperature range from plus 20°C to minus 48°C.

Additional elastic elements between the under-rail support and its base can be used on artificial structures and in areas requiring vibration damping.

At track switches it is necessary to ensure a uniform deflection of rails and structural elements of track switches under the load transmitted by a train.

The distribution diagram of BTSP sleepers (or other under-rail supports) regardless of their design should be not less than 1,660 pieces per kilometre of railway track.

Electrical resistance of rail fastener assembly should be not less than 10 kOhm.

**8.2.5.** The BTSP bearing structure can be made of plates or reinforced concrete. The cross section and the material of bearing structure should be determined by calculation.

The bearing structure should be made of concrete with the grade of not lower than B 40. The reinforcement content in the cross-section of bearing structure must be greater than 0.9%

When laying the track, the track width deviation should not exceed ±0.5 mm. The height deviation at rail fastener assembly should not exceed 0.5 mm.

**8.2.6.** Cement-and-sand, concrete or asphalt mix should be used as the material of hydraulically bound carrier layer. The thickness and the material of this layer should be determined by calculation.

The degree of compaction of hydraulically bound carrier layer should be not less than 98% (as per Proctor density method)

This layer should be arranged only after the end of subgrade compacting process throughout its entire cross-section. Any sedimentation of subgrade is not allowed.

**8.2.7.** A special jointing structure with a smooth change of rigidity (variable stiffness section, hereinafter – VSS) should be arranged at the junction of tracks with ballastless and ballasted superstructures.

Transitional sections should be arranged independently, they should not be included in the general track construction workflow.

**8.2.8.** The design of ballasted track superstructure consists of rail strings, elastic intermediate rail fasteners, sleepers and a ballast layer.

The scope of application of ballasted track superstructure should be defined by the project, taking into account the necessity to ensure reliable operation of railway track with given speed and axial loads transmitted by rolling stock in the area of design with due consideration to optimization of lifecycle costs.

Ballasted track superstructure is usually applied at sections with the maximum speed of not greater than 200 km/h or on bridges at all speeds.

**8.2.9.** Intermediate rail fasteners of ballasted track superstructure should ensure stable position of the track.

Intermediate rail fasteners should provide resistance to longitudinal shear of rail at the fastener assembly of not less than 14 kN, except for fasteners, which must ensure free sliding of rails with respect to bearing structure (in beacon-type sleepers, equalizing gears and artificial structures in areas where this condition is provided).

Intermediate rail fasteners should provide resistance to lateral forces of not less than 50 kN.

Intermediate rail fasteners should have elastic elements ensuring the required rigidity of the railway track. The elastic properties of these elements should remain stable in a range of calculated temperature changes from minus 48°C to plus 67°C within their entire service life.

The design of fasteners should reduce resonance vibrations in reinforced concrete foundations of sleepers.

These elastic intermediate fasteners should ensure stable position of the track and the ability to adjust rail height within the range of ±10 mm and rail width of up to ±4 mm per each fastener.

**8.2.10.** Ballasted track sections of HSR lines should be constructed with the use of reinforced concrete sleepers.

The number of sleepers per 1 km of track (distribution diagram of the sleepers) on main HSR lines should be 1,840 pieces per kilometre of straight and curved track sections.

**8.2.11.** Material used for the arrangement of ballast layer on main HSR lines should comply with category I requirements as per GOST R 54748-2011.

Category II crushed stone as per GOST R 54748-2011 can be used as material for the arrangement of ballast layer at the HSR sections where the train speed does not exceed 200 km/h.

The deformation modulus of ballast prism at the sleepers sole level, determined in accordance with GOST 20276 2012, should be not less than 180 MPa.

The thickness of ballast layer on main tracks under sleeper sole in under-rail section at straight sections and at the ends of sleepers from the side of the inner rail at curved sections should be not less than 30 cm. From the side of exterior rail the thickness of ballast layer should be calculated taking into account the magnitude of the rise.

The surface of ballast prism should be located at least 30 mm below the rail bottom.

Ballast prism shoulder width, regardless of the plan line, should not be less than 50 cm. The slopes of ballast prism shall not be steeper than 1:1.75.

Intertrack spaces, with the distance between the axes of adjacent tracks of up to 6,500 mm, should be filled with ballast with the same characteristics as the material used for the arrangement of track ballasting layer.

Crushed stone on the shoulders of ballast prism from the field side and at the intertrack space, as well as in the space between sleepers, should be compacted.

**8.2.12.** The surface of the ballast layer must be secured, e.g. with polymeric binder, in order to prevent aerodynamic uplift of crushed stone during the passage of high-speed trains with a speed of over 200 km/h.

## 8.3. Requirements to the design of track switches

**8.3.1.** Specifications and designs of the types of track switching equipment (track switches, crossovers, feathered joints, equalizing gears) should ensure safe and uninterrupted movement of trains in accordance with the established train speeds.

**8.3.2.** Any track switching equipment and its individual elements (products) used in the construction of HSR lines shall be subject to certification or declaration of conformity on the basis of own evidence and evidence obtained with the participation of an authorized certification body and (or) accredited testing laboratory (centre) in accordance with Annexes 3 and 4 of the Technical Regulations of the Customs Union "On the Security of High-Speed Rail Transport" [87] or substituting documents.

**8.3.3.** Track switches operated at main lines:

- Crossovers (both within stations, overtaking points and at dispatching centres) – monolithic structures made of special track switches ensuring forward direction speed of 400 km/h and side direction speed of not less than 220 km/h
- When HSR trains move in forward direction without being diverted to side tracks – special track switches ensuring forward direction speed of 400 km/h
- When HSR trains are diverted from main tracks to receiving and departure tracks to passenger platforms for embarkation/disembarkation of passengers and switching to crossover tracks leading To existing railway lines – special track switches ensuring forward direction speed of 400 km/h and side track speed of not less than 120 km/h
- At sections with HSR trains speed of up to 200 km/h (terminal stations when HSR trains enter major cities) – not steeper than 1/11.

**8.3.4.** Track switches at receiving and departure tracks:

- When HSR trains are diverted to adjacent receiving and departure tracks leading to a passenger platform for embarkation/disembarkation of passengers – not steeper than 1/18
- When HSR trains move only in the forward direction – not steeper than 1/11
- Leading to adjacent receiving and departure tracks of other yard tracks – not steeper than 1/11
- At other tracks – not steeper than 1/9.

**8.3.5.** Main HSR tracks shall be equipped with track switches with crossing pieces with continuous rolling surface (hereinafter – CRS).

**8.3.6.** The assemblies of switch devices of points and crossing pieces with CRS of track switches should be equipped with external contactors and tongue position control systems.

**8.3.7.** The design of points and crossing pieces with CRS should provide trouble-free operation of track switches without lubrication of working surfaces contacting with movable elements of turnouts and frogs with CRS.

**8.3.8.** The design of switching mechanisms and devices ensuring the operation of track switches, as well as the devices that control safe passage of trains at the switches, should enable the conduct of straightening operations at the turnouts using mechanized facilities.

**8.3.9.** Track switches, arranged at the main tracks and crossovers from main roads, as well as points and crossing pieces with CRS of track switches at receiving and departure tracks along the passage route of high-speed trains shall be equipped with heating systems, including the assemblies of electrical actuators and external contactors. The heating system should be capable of ensuring proper operation of points and crossing pieces over the entire temperature range in winter period.

**8.3.10.** The design of high-speed track switches should enable the installation of insulating joints on the side track behind the root portion of switch point rail.

**8.3.11.** The slope of rolling surfaces of rail heads of track switches should match the slope of roll surface (canting) of adjacent tracks.

**8.3.12.** Lead curves located behind the crossing pieces should have a radius not less than the minimum radius of track switch turnout curves.

**8.3.13.** The arrangement of track switches and crossovers within vertical and horizontal circular and transition curves is not allowed.

# 9. Engineering structures

## 9.1. Bridge crossings

### 9.1.1. Clearances

HSR construction clearances should be equal to C400 construction clearances. Unless otherwise specified, field road and cattle driving (wild animal migration) construction clearances should be as follows (in meters):

a. Field road clearances: height – 4.5 and over, width – 6.0 and over, but not less than the maximum width of farm machinery that may be driven by road increased by 1.0 m

b. Cattle driving clearances: height – 3.0 and over, width – 8.0 and over.
Navigation span underclearances on inland waterways should be established according to GOST 26775-97.

At overpasses that cross over general-purpose highways the distance from construction bottom up to the roadway should be 5.50 m and over. Rigid clearance gates should be installed on both sides of the construction.

### 9.1.2. Bridge track structure

Continuously welded track (CWT) is used exclusively on all HSR bridges. The choice of bridge schemes and constructions should rely on the minimum secondary stress experienced by rail due to the impact of temperatures and forces. The deck of engineered structures should match the construction of the track structure on approaches along the distance of 500 m on either side and may use mushroom floor or ballast.

It is noted that places where chamfered joints should be installed along a 55 m long bridge should be located by means of calculating the longitudinal interaction between the bridge/CWT system elements taking into account the impact of temperatures and forces. Forces resulting from the collaboration of bridge structures and rail should be taken into account when designing the spans, fixed bearings, support bearings, and calculating the CWT effort.

### 9.1.3. Joining bridges to approaches

In areas, where the approach fill is adjacent to bridges and pipes, it is important to focus on the organization of transitional sections to ensure that the stiffness of approaches is gradually increasing.

#### 9.1.4. Operational arrangements

In order to ensure the safe operation of structures, all bridges and overpasses should have at least 1 m wide operating passages on either side which should be located outside the construction clearances. For the purposes of construction monitoring and repairs, bridges should be equipped with devices ensuring the safe maintenance of structures and rail, such as specialized manholes and gear, bridge floor, ladders, ramps with handrail, signalling alarms, power supply units for maintenance equipment, power tools, stationary air supply lines, electric light units, foul-to-gauge detectors, navigational watch alarm systems, etc.

### 9.2. Subaqueous crossings

**9.2.1.** The safety requirements to the design of HSR tunnels are set out in SP 122.13330.2012, SP 119.13330.2012, SP 120.13330.2012, SP 32-106-2004.

**9.2.2.** KS-3 grade shall be applicable to tunnels and tunnel portals. According to Table 2, Amendments No. 1 to GOST R 54257-2010 of 1 July 2014, an increased level of responsibility shall be established.

**9.2.3.** The structure of tunnel casings and portals constructed in seismic areas (zones) where intensities reach 7 and over should meet the requirements of SP 14.13330.2014.

**9.2.4.** The requirements of SP 119.13330.2012 and SP 51.13330.2011 shall apply when conservation measures are projected.

**9.2.5.** The geotechnical investigation which is required for the development of the project and tunnel specification documents should be performed in accordance with SP 47.13330.2010, SP 22.13330.2011, SP 122.13330.2012.

**9.2.6.** The design documents should contain data from ecological monitoring of mountains performed during construction and operation.

# 10. Interstations

**10.1.** The location and technological infrastructure of interstations on the designed Moscow-Kazan HSR should ensure:

- The specified speed and safety of train operation and shunting, as well as personal safety of HSR staff, passengers and population. This requirement can be observed by meeting the proper parameters of the plan and track profile, specified dimensions; equipping interstations with interlocking systems for interlocking points and signals, arranging crossings with passages for people, motorways and other tracks at different levels only; adequately locating and sizing the railway platforms for passengers, fencing the territory, equipping the interstations with audio-visual train warning systems;
- The specified crossing and train-handling capacity which can be met by means of laying the required number of tracks, constructing railroad complexes, railway platforms for passengers and

passages of required size; constructing devices in proper amount and of proper capacity to perform the maintenance and repairs of rolling stock and railway infrastructure, servicing and after-sales maintenance of trains;

- The comprehensive character of the project with allowance made for the location of communities, ensuring good connection with the existing intermodal infrastructure, meeting environmental requirements and ensuring vital activity security;
- The economic efficiency of the project ensured through the feasibility study of community servicing options, connections with the existing railways, location of infrastructure devices and rolling stock without maintenance and repairs;
- Prospective development considerations through reserved dimensions of the station platform to be able to extend the tracks or increase their number in future, by upgrading track switches in necks, or by ensuring the possibility of joining new approaches and extra station facilities;
- The technological efficiency of the project which suggests the smooth performance of all technological operations, including the reception, dispatch and handling of trains; loading, unloading and servicing of passengers; maintenance, servicing and repairs of the rolling stock; maintenance and repairs of infrastructure facilities; ensuring connection with the existing railways, passengers' transfer to other modes.

**10.2.** The specified set of technological operations on the Moscow-Kazan section of the projected HSR requires the arrangement of the following types of interstations:

- Passenger terminals;
- Coach yards for comprehensive maintenance and repairs of high-speed rolling stock at terminals (with a base or servicing depot);
- Intermediate stations where high-speed passenger trains make a stop to perform passenger operations and then follow the specified route.
- Furthermore, intermediate stations may have junction tracks connected to the existing railways or junction tracks for high-speed passenger trains' entering the town centre, namely specially built railroad complexes (junction centres); facilities for handling parts of high-speed trains (zone stations), as well as junction tracks with depots used for repairs, maintenance and staging of rolling stock; machines and devices for the diagnostics, running maintenance and repairs of HSR structures and facilities (base stations);
- Passing stations where high-speed trains can overtake other categories of trains or where passengers from unserviceable train may change for a backup train. The passing station may, where necessary, have a depot for the repairs, maintenance and staging of rolling stock; machines and devices for the diagnostics, running maintenance and repairs of HSR structures and facilities;
- Control rooms consisting of a pair of crossovers switchable to different sides and allowing trains to change from one main track to another when the diagnostics, maintenance and repairs of HSR devices are underway or in emergency situations. If it is necessary to arrange a diverging line from the HSR main track, where it is unadvisable to arrange an interstation with tracks, the junctions of connecting tracks may be integrated with control rooms.

**10.3.** Based on international experience, depending on planned traffic intensity, the recommended average distance between interstations generally makes 20–40 km, for interstations with tracks – 50–70 km, for base stations – 200–250 km.

The number and location of interstations, their functions, composition of designed devices and junctions should be determined and justified by the project.

**10.4.** Passenger terminals and coach yards should be designed as part of transportation hubs located in Moscow, Kazan and Nizhny Novgorod in accordance with effective regulatory instruments.

The functionality of intermediate stations located on the projected Moscow-Kazan section of the Moscow-Kazan-Yekaterinburg High-Speed Railway requires that they be equipped with devices that ensure:

- The passing of trains on the main tracks at speeds not lower than those set on the adjacent sections;
- The overtaking of passenger and container trains;
- The reception of high-speed trains to specialized receiving and departure tracks to load/unload passengers on railway platforms for passengers;
- The turnover (where necessary) of some part of high-speed trains;
- The possibility for high-speed trains to run nonstop with reduced speed on another main track;
- The shunting on high-speed and special trains (emergency situations, repairs);
- The staging of track machines to service the tracks, overhead system, other structures and devices.

The functionality of the passing stations located on the designed HSR stretch requires that they be equipped with devices that ensure:

- The passing of trains on the main tracks at speeds not lower than those than those set on the adjacent sections;
- The possibility for high-speed trains to run nonstop with reduced speed on another main track;
- The overtaking of passenger and container trains;
- Passengers' changing an unserviceable high-speed train for an operable one;
- The staging of track machines and other maintenance vehicles (where necessary) used for servicing HSR.

Every station should be equipped with sound and light systems to warn rail staff and passengers of an approaching high-speed train.

In order to prevent rolling stock from entering the HSR main and receiving and departure tracks without authorization, every station should have safety barriers.

Places where connecting tracks adjoin the HSR stations and JSC Russian Railways should be equipped with safety barriers.

**10.5.** In the plan of the line, the main tracks should be located on straight sections at intermediate passenger stations and passing stations, while in profile, within railway platforms for passengers, they should be located on level grounds.

In the plan of the line, the main and receiving and departure tracks may be located on curved sections at intermediate passenger stations and passing stations, provided there is an adequate feasibility study and the requirements to the parameters of the plan of the line accepted for the main tracks on the runs and the receiving and departure tracks at stations are observed.

Switches should be located outside vertical curves.

The radiuses of turnout curves should not be shorter than the radiuses of transmission curves of the adjoining switches.

**10.6.** The track plans of interstations should generally be projected in a similar way throughout the railway; any deviation from this principle should be proven in the project.

Intermediate passenger stations and passing stations should have the main tracks laid in parallel, with a pair of dispatcher access tracks laid on approaches in each direction.

Intermediate passenger stations should have two receiving and departure tracks in each direction in order to be able to receive and dispatch high-speed, conventional passenger and container trains, with high central platforms located between the tracks. Tracks for the staging of track machines and other maintenance vehicles should be laid, where necessary.

The running maintenance and repair depots for the HSR facilities at base stations should be equipped with special receiving and departure tracks for equipment, track machines, firefighting and emergency trains. The track plans of the depots should be developed within the project.

The track layout of junction centres should ensure the simultaneous reception and dispatch of trains on the main and connecting approaches.

The passing stations should have two receiving and departure tracks on one side of the main track with a high platform between them to allow passengers change an unserviceable train for a backup train, as well as one receiving and departure track on the other side. Even sides on which the tracks and platform are located should generally alternate with odd sides throughout the HSR line. Tracks for the staging of track machines and other maintenance vehicles should be laid, where necessary.

If the number of connecting tracks or receiving and departure tracks at the first stage of project implementation is lower than in the standard design solution, it is necessary to proceed from the complete layout of the interstation when allocating the station platforms.

**10.7.** The effective length standard for the receiving and departure tracks located at intermediate passenger stations and passing stations should be 650 m and over, allowing for the arrangement of passenger railway platforms at least 400 m long. The final parameter should be approved for the project, taking into account the length of every type of train to circulate on the HSR.

The effective length of the special receiving and departure tracks located at base stations should be proven in the project based on the adopted HSR operation system.

**10.8.** Given that it is inadmissible for people to stay in the intertrack space during the organized circulation of high-speed trains at predetermined speed, the distance between the centres of adjacent tracks at HSR intermediate and passing stations should be based on the outline of C400 construction clearance, taking into account the arrangement of required devices in the intertrack space:

- Between the main tracks – equal to the space between the centres of tracks on adjoining runs;
- Between the main track and the adjoining receiving and departure track – 7,650 mm. In complex conditions, if there is no necessity to arrange catenary supports, foot bridges, overpasses and other constructions in these places, there may be a substantiation in the project allowing to reduce the distance to 5,300 mm;
- Between the receiving and departure tracks for the circulation of trains – according to estimation, taking into account the width and dimensions of high passenger platforms, in absence thereof – 5,300 mm.

The width of central passenger platforms should be determined in the project based on the necessity to arrange exits from the pedestrian underpass (ladder, escalator or lift-type), as well as the construction of the platform roof and estimated passenger flow, and in all circumstances should not be lower than 8,500 mm. The width of the side platform, where necessary, should be at least 6,000 mm.

The project should provide for the distance between the centres of tracks at the running maintenance and repair depots for the HSR facilities based on the location of equipment and SP clearance outline.

**10.9.** Switches arranged at intermediate passenger stations, passing stations and control rooms of the Moscow-Kazan section of the Moscow-Kazan-Yekaterinburg High-Speed Railway should meet the requirements set out in clause 8.3 Requirements to the design of track switches of these PSTS.

If switches which do not ensure the above speed values are arranged at the first stage of project implementation on a temporary basis (this situation may be observed when switches of required design are temporarily unavailable), the station platforms should be allocated in such a way as to allow the arrangement of required switches in future.

Straights between switches laid in sequence (between the front extensions of stock rails or between the front extensions of stock rails and the end butt of the frogs of adjacent switches) should be equal to:

- On the HSR main tracks – 50 m and over;
- On the receiving and departure tracks for the circulation of high-speed trains – 25 m and over.

The straight between the front extension of stock rails (or the end butt of the frog) and the beginning of the closure rail (in absence thereof – circular curve) on the HSR main tracks should make 50 m and over."

Requirements to switches arranged at passenger terminals, coach yards, stretches with maximum speed limit less than 200 km/h are determined in accordance with current standards.

**10.10.** A train schedule should be developed within the project to harmonize the major parameters of the projected infrastructure and rolling stock, check the observance of the target parameters of the high-speed line set by the customer (time of delivery of passengers, volume of passenger and cargo shipments, train-handling and processing capacity), given the unconditional observance of safety requirements.

As the projected Moscow-Kazan section is primarily a high-speed passenger railway, the amount of traffic and the order of clearing for cargo trains should be determined based on real possibility after all types of passenger trains (high-speed and local speed trains) have been included into the train schedule. The laying of routes in the schedule of cargo trains should not require the reinforcement of such infrastructure elements as the number of main tracks on runs and stations, the number of receiving and departure tracks, the number of railway substations, etc.

In order to determine the station-to-station travel time and the energy costs of train circulation in the design documentation, train performance calculations should be made based on the traction and braking performance of rolling stock.

The amount of traffic for passenger trains should be determined in the project based on the target passenger flows approved by the customer for the target period taking into account seasonal irregularity. The substantiation of running and station intervals to be used for the train schedule should be made in the project based on the traction estimates, taking into account the features and limitations of traffic regulating and control systems, traction power supply, etc.

Justified requirements and limitations relating to the organization of the safe circulation of trains of different categories on adjacent tracks (either in opposite or in cocurrent direction) should be set out and the order of provision and the duration of time intervals required for the running maintenance and repairs of infrastructure facilities should be established in the project, when developing the train schedule.

The project train schedule as a consolidated document covering the major construction and operation parameters of the railway should be approved by the developers of all sections of design documentation and endorsed by the customer following all the required corrections. Performance against the approved parameters of the project train schedule should be used as a criterion when checking the quality of all project solutions.

# 11. Protection of the track and structures

## 11.1. Protection of the track and structures from unfavourable natural and artificial processes and phenomena

**11.1.1.** In order to ensure the protection of train service in compliance with Technical Regulations of the Customs Union 002/2011 “On the Security of the Operation of High-Speed Rail Transport,” measures and/or structures must be envisaged to protect the HSR from unfavourable natural and artificial processes and phenomena.

**11.1.2.** Protection of the track and structures from snowdrifts must be designed in compliance with Federal Law of the Russian Federation No. 384-FZ [12].

**11.1.3.** Sections affected by snowdrifts include: terminal areas, hollows of any depth, zero levels, elevated approaches to new tracks with heights above the estimated depth of snow cover of not more than 0.7 m for single-track lines and 1.0 m for double-track lines, as well as open areas of traction and electric substations.

**11.1.4.** The system for the protection of railway tracks and structures from snowdrifts must be designed depending upon: snow deposits resulting from snowfall of various intensity, and wind speed during snowstorms.

**11.1.5.** The railway track must have protection against snowdrifts along all of the sections that can be affected separately for each side of the track, as well as around terminals and, where necessary, within terminals.

**11.1.6.** Protection of the track and structures from erosion by surface and underground waters must be designed in compliance with Construction Regulation SP 32-104-98.

**11.1.7.** Water diversion, erosion protection, and stabilization requirements must comply with Construction Regulation SP 32-104-98.

**11.1.8.** Protective measures and structures must be designed within sections that can be affected by hazardous geological processes (landslides, rock falls, sinkholes, heaving, ice build-up, flooding and impoundment, marginal erosion of ponds, lakes, and rivers). Such measures must be designed in compliance with Construction Regulation SP 116.13330.2012 as for the protection of high risk buildings and structures under Federal Law of the Russian Federation No. 384-FZ [12] subject to compliance with the tightest standards.

**11.1.9.** The right-of-way width for the HSR must be established in compliance with the applicable Federal Law of the Russian Federation "On Land Use" (No. 112-FZ) and depending on the area required to ensure safe train traffic given the location of structures protecting the track from natural and artificial impacts.

In addition to the right-of-way, special buffer areas are established within the sections that may be affected by hazardous natural and artificial phenomena in accordance with the applicable Federal Law "On Railway Transport" (No. 17-FZ), within which the influence of those processes may produce a negative impact on the safety of the HSR, and restrictions on the use of such areas must be imposed.

**11.1.10.** During the design of the HSR, locations must be identified along the track that may be affected by strong winds (storms, hurricanes, tornadoes, and vertical whirls) with wind speed in excess of 15 m/s. For such locations, the design documentation must envisage measures, structures, and design solutions for the horizontal alignments and grades to prevent the overtopping and derailment of rolling stock.

**11.1.11.** Along the entire length of the HSR close fencing of the track must be provided to prevent the intrusion of unauthorized persons and animals.

**11.1.12.** In seismically active areas, the HSR must be designed in compliance with Construction Regulation SP 14.13330.2014.

## 11.2. List of threats associated with acts of unlawful interference

**11.2.1.** Threats associated with acts of unlawful interference (AUI) into transport infrastructure facilities (TIF) of the HSR and critical elements thereof include:

- Threat of a capture – possibility of capturing HSR TIF, establishing control of HSR TIF with the use of force of threat of the use of force, or through any other form of intimidation;
- Threat of an explosion – possibility of the destruction of HSR TIF or infliction of damages on HSR TIF and/or passengers, staff, or any other persons, as well as freight carried by the HSR, as a result of an explosion;
- Threat of placing or attempts to place explosive devices (explosive agents) on HSR TIF – possibility of placing or performing actions with the express purpose of placing, by any means, of explosive devices (explosive agents) on HSR TIF, which may destroy HSR TIF or damage HSR TIF or inflict damages on HSR TIF and/or passengers, staff, or any other persons, as well as freight carried by the HSR;
- Threat of damage by hazardous substances – possibility of contaminating HSR TIF or critical elements

thereof of hazardous chemical, radioactive, or biological agents that threaten the life or health of the staff, passengers, and other persons;

- Threat of a capture of a critical element of HSR TIF – possibility of a capture of a critical element of HSR TIF, establishing control of a critical element of HSR TIF with the use of force of threat of the use of force, or through any other form of intimidation;
- Threat of an explosion of a critical element of HSR TIF – possibility of the destruction of a critical element of HSR TIF or infliction of damages on a critical element of HSR TIF by an explosion that threaten the operation of HSR TIF, life and health of the staff, passengers, or other persons;
- Threat of placing or attempts to place explosive devices (explosive agents) on a critical element of HSR TIF – possibility of placing or performing actions with the express purpose of placing, by any means, of explosive devices (explosive agents) on a critical element of HSR TIF, which may destroy a critical element of HSR TIF or inflict damages on a critical element of HSR TIF that threaten the operation of HSR TIF, life and health of the staff, passengers, or other persons;
- Threat of blocking – possibility of creating an obstacle that makes it impossible to operate HSR TIF, threatens life and health of the staff, passengers, or other persons;
- Threat of theft – possibility of a theft of elements of HSR TIF that may render it inoperable and threaten life and health of the staff, passengers, or other persons.

## 11.3. List of protective structures and devices to prevent acts of unlawful interference

**11.3.1.** The totality of protective structures and devices to prevent acts of unlawful interference into HSR TIF is an aggregate of transport safety engineering systems and utilities (TSESU) incorporating the transport safety hardware system (TSHS) and transport safety engineering structures (TSES). TSESU also incorporate automated work stations (AWS) under GOST R 50923-96 [29] of transport security forces.

**11.3.2.** List of protective structures and devices incorporated in the TSHS:

- Perimeter barrier system;
- Security alarm system;
- Closed-circuit television system;
- Access control and management system;
- Screening system;
- Information collection and display system;
- Post communication and alarm and ringing alarm system.

**11.3.3.** List of protective structures and devices incorporated in the TSESU:

- Door systems;
- Window systems;
- Air channels, hatches, and other technological channels;
- Locking devices;
- Gates and portals;

- Passages for guards;
- Explosive device containment systems.

**11.3.4.** TSESU hardware and software must be manufactured in Russia and comply with the technical and engineering requirements of the project.

### 11.4. Organization and management of the system of protection against acts of unlawful interference

**11.4.1.** Two contours must be established to respond to threats in order to effectively prevent AUIs at HSR TIF:

- The timely response contour – blocking of a trespasser seeking to perform an AUI at HSR TIF, with minimum harm done by the trespasser;
- The emergency response contour – fastest possible blocking of a trespasser that has performed an AUI at HSR TIF, with possibly quite significant harm done by the trespasser.

# 12. Right-of-way

**12.1.** A railway right-of-way is required to meet the applicable safety requirements for the construction and operation of all infrastructure facilities.

The borderlines of the rights-of-way and buffer zones designated for the HSR must be established by the project in compliance with Resolution of the Government of the Russian Federation dated 12 October 2006 No. 611 and "Regulations for rights-of-way required to form a right-of-way for railways, as well as regulations for the calculation of buffer zones of railways."

The size of land plots for the rights-of-way and buffer zones must be identified in accordance with the applicable land utilization legislation.

**12.2.** The right-of-way along hauls must ensure the placement and safe operation of a double-track roadbed with a catch water drain system, traction power supply facilities, SCB and communication lines and devices.

**12.3.** At stations, rights-of-way must include lands under the tracks and adjacent structures, facilities, buildings, stations with station tracks, passenger stations, artificial structures, signalling and communication buildings and structures, energy, locomotive, car, track, freight, and passenger facilities, water supply and sewerage facilities, annexes, utility roads, and other constructions ensuring the operation of the HSR.

**12.4.** A right-of-way must include areas for placing structures required to ensure the integrity and stability of infrastructure facilities as well as to ensure protection against the negative impact of the HSR:

- Facilities to protect against snowdrifts in hollows, zero levels, and elevated approaches with heights below 1 m;
- Close fencing along the entire railway area to prevent the intrusion of unauthorized persons and animals;

- Sound absorbing devices in settlements along the HSR tracks;
- HSR protective facilities against hazardous natural and artificial phenomena;
- Facilities ensuring the safety of the HSR during emergencies, such as patrol roads, guard posts, area surveillance stations, etc.

The size of rights-of-way for buffer zones are identified as a result of calculations based upon the applicable legislation.

**12.5.** HSR rights-of-way and buffer zones under design must not be located within rights-of-way of existing linear facilities, buildings, and structures.

# 13. Connections and crossings

**13.1.** The HSR must have its own developed infrastructure; however, in some cases, possibilities for connection to the existing common use railway infrastructure must be provided for in order to:

- Implement possibilities for directing high-speed container trains to alternative routes;
- Transfer of high-speed passenger trains, high-speed container trains, and special trains for technical operations that cannot be performed with the use of the HSR infrastructure to alternative routes;
- Deliver new and introduce/remove to/from the HSR infrastructure rolling stock, as well as special vehicles (cars, motor coaches) performing infrastructure status monitoring;
- Deliver, introduce/remove to/from the infrastructure rolling stock performing track/roadbed/bridge status monitoring (testing trains);
- Where necessary, deliver, introduce/remove to/from the infrastructure fire and emergency trains running on common use railways.

**13.2.** Common use railways must be adjacent to HSR lines with the use of connecting tracks in yard necks. Connecting tracks must not be connected to main line tracks.

Non-common use tracks must not be connected to HSR tracks.

**13.3.** All of the HSR crossings with railways must be built on various levels. When crossing cannot be ensured at right angle, skew crossing is possible subject to a relevant feasibility study.

**13.4.** The crossing of the HSR with motor roads must be built on various levels. When crossing cannot be ensured at right angle, skew crossing is possible subject to a relevant feasibility study.

**13.5.** All of the organized pedestrian crossings must be placed either in tunnels or through pedestrian overpasses. No single-level crossing is allowed.

**13.6.** In case of the use of an overpass to provide HSR crossing (an overpass bridge or pedestrian bridge) the track, overhead system components and rolling stock must be protected from inappropriate items.

**13.7.** The crossing of the HSR by engineering networks must be ensured in accordance with the applicable regulatory documents that set forth conditions for crossing common use railways, as well as those provided in Special Technical Regulations for design.

**13.8.** In order to reduce the number of HSR crossings by various networks, underground utility networks must be placed in the same chamber wherever possible.

**13.9.** Where the HSR crosses any railways of any designation, motor roads, and utility networks, technical requirements and approvals must be received from their respective owners.

**13.10.** In accordance with the Federal Law of the Russian Federation "On the Animal World", special crossings must be provided in places where the HSR crosses migration routes of wild animals.

# 14. Railway electric power supply

Railway management infrastructure is part of the railway transport infrastructure that provides power supply for high-speed train traffic. As part of the high-speed railway transport infrastructure, the electric power supply system must have its parameters comply with the other infrastructure facilities and rolling stock. The power supply system must provide power for first category consumers.

**14.1.** Railway power supply as a component of the HSR infrastructure incorporates the traction power supply system and the power supply system for non-traction consumers.

**14.1.1.** The 2x25 kV, 50 hz AC system must be used for the traction power supply system with the upper voltage level for traction substations of at least 220 kV and three-phase short circuit capacity at the input of the traction power supply system of at least 2,000 MVA. The traction power supply system must provide power transmission to traction electric stock while ensuring the minimum voltage level at the power collector of at least 21 kV.

**14.1.2.** The power supply system for non-traction consumers must provide power supply for only non-traction railway consumers from separate double-winding transformers with secondary (low) voltage of up to 20 kV installed at traction substations, and tree-phase cables laid in cable trays along the tracks.

**14.2.** The main parameters of traction power supply must be identified during the design of the HSR infrastructure: the distance between the traction substations, capacity and number of power transformers, design current of switching units, brand, section, and number of overhead system wires, as well as cables and wires of feeder and return circuits, capacity and number of autotransformer points, types and capacities of devices ensuring the improvement in the quality of electric power in the traction network.

**14.2.1.** The specific capacity of power consumption in the traction network must be determined based upon the results of traction and electric computations.

**14.2.2.** Permissible voltage on traction substation busbars must meet specified values: nominal voltage – 27,500 V, maximum voltage – 29,000 V.

**14.2.3.** AC traction substations must have 100% backup of stepdown power transformers.

**14.2.4.** As a rule, traction substations must be built within stations. When selecting sites for the construction of traction substations, the following requirements must be met:

- A site must be located next to the centre of electric load;
- Possibilities must be provided for the construction of an approach motor road or railway to the traction substation site;
- The site must be located outside of natural or artificial contamination areas, sinkholes, outside industrial developments, areas affected by radioactive contamination, or areas with groundwater levels below the foundation and utility networks.

**14.3.** To develop a substantiated design for the location of traction substations the entire HSR line must be divided into a certain number of inter-station traction network feed zones.

**14.3.1.** The traction network of an inter-station area must provide double-way feed of the overhead system from adjacent traction substations.

**14.3.2.** The overhead system must have longitudinal and lateral electric sectionalisation.

**14.3.3.** The overhead catenary must be connected to the busbars of a traction substation with the use of a neutral section with its length determined on the basis of the parameters of running electric stock depending upon the location of end power collectors.

**14.3.4.** The overhead system as a non-backup infrastructure facility must be divided into tension sections with the use of isolating and non-isolating interlinkages to ensure safety, reliability and serviceability.

**14.3.5.** Sectioning points, autotransformer points, and parallel connection points must be provided within inter-station areas. As a rule, autotransformer points must coincide with sectioning points and parallel connection points.

**14.3.6.** The overhead system must incorporate an overhead catenary consisting of high strength abrasion-resisting wires and lines, wire anchorage points supporting and fixing structures, supporting framework (separate metal pillars and foundations), portal structures, polymer insulators with high insulating strength, as well as switching and safety devices.

**14.3.7.** The clearance between the supports of the overhead system in the direction of traffic must be at least 3,500 mm.

**14.3.8.** The overhead system must envisage a return traction network based upon the parallel switching on of traction tracks having longitudinal electric connection with the use of rail bonds and impedance bond transformer, and lateral connection with the use of intertrack rail bonds, as well as return line laid to the support of the overhead system from the field side.

**14.4.** To ensure high quality current collection at speeds of up to 400 km/h, when designing the HSR, the overhead catenary and power collectors must be considered to be a single electromechanical system with dynamic characteristics and quality of the sliding electrical contact conditional upon the parameters of the current collector and the overhead catenary.

**14.4.1.** The minimum allowable vertical clearance for an overhead line is 5,620 mm from the top of rails.

**14.4.2.** The maximum length of catenary spans must be limited based upon reliable current collection criteria, but must not exceed 70 m.

**14.4.3.** Overhead system wire tension must ensure the spread velocity of transversal waves in the overhead catenary exceeding the maximum speed of electric stock by at least 43%.

**14.4.4.** The working height of the current collector slide for electric stock moving on HSR sections with speeds between 200 km/h and 400 km/h must be within the range of 5,570 mm and 6,200 mm from the top of rails, and when entering the overhead system section at speeds below 250 km/h, the current collector must ensure current collection at the maximum height of the overhead line of 6,800 mm from the top of rails.

**14.4.5.** AC static current collector pressure must be equal to 70+20-10 N.

**14.4.6.** The HSR overhead system must be designed for operation with one or two simultaneously raised current collectors. The distance between two operational current collectors must be at least 150 m, but not more than 400 m.

# 15. Signalling and automatic control system

**15.1.** The railway automation and telemechanics (RAT) of the high-speed railway must be established on the basis of the Russian signalling, centralization and blocking systems (SCB) and advanced models of foreign technologies adapted to the requirements of Russian railways.

**15.2.** The train control system of the high-speed railway (TCS HSR) consists of three levels:

- *Upper level* – the traffic control level, including:
  the centralized traffic control system (CTCS);
  the technical diagnostics and monitoring system (TDaMS) of the RAT;
  the linkage with other infrastructure devices control systems (power supply, monitoring of facilities);
- *Medium level* – the stationary level. It includes:
  the automatic identification tools;
  the train separation control system (TSCS);
  the power interlocking (PI);
  the interfaces with auxiliary systems (electric heating of switches, pneumatic cleaning);
  the linkage with the upper level devices, as well as with other devices and sub-systems (barriers, warning systems for the personnel working on railway lines, passenger alerting systems, etc.);
- *Lower level* – It includes:
  on-board devices of the vehicles;
  the trackside assets (switches, traffic lights, track circuits devices, etc.).

**15.3.** The information from the stations must be transmitted to the traffic control centre (TCC) of the high-speed railway through the remote control-remote signalling redundant channels of the TCC sections. It must contain the information necessary for making management decisions, the location data of vehicles, the state of the objects of electric centralization subsystems, the data on the interval control and other devices.

**15.4.** The TCS subsystems are combined into a single set via the data transmission networks based on the FOTL in accordance with the requirements for information protection and cyber threats prevention.

In order to provide communication with on-board devices of high-speed vehicles, it is required to use redundant digital radio channels, as well as inductive railway channels transmitting information from the traditional RAT subsystems.

**15.5.** The TCS architecture must provide 100% redundancy of all the system nodes, including monitoring and control interface modules or redundancy of functions using independent technical tools. The secure structure of the RAT microprocessor security systems must be implemented using the 2^2v2^2 architecture.

**15.6.** The hardware and software of the RAT systems must provide possibilities of servicing, repair and modernization of the system, as well as the modification of processes without termination of the TCS.

**15.7.** The TCS must ensure a secure communication between the HSR and the common network railway connection lines on the basis of the prioritized provision of high-speed traffic.

**15.8.** The traffic control conducted from the Traffic Control Centre (TCC) must be used as the main mode of train traffic control.

**15.9.** If common elements of gridiron with the main transport are used, at the city entrance end stations the provision is made for the design of only the infrastructure telemonitoring mode with the data transmission to the TCC HSR.

**15.10.** The CTCS remote control and remote signalling transmission channels must be reserved in order to ensure uninterrupted centralized monitoring and control of train traffic on the HSR.

**15.11.** The CTCS devices must exchange data with the traffic control information systems of the TCC HSR (the design of train movement graphics, the formation of speed limits, etc.).

**15.12.** The CTCS devices must provide other operational train traffic control systems of the infrastructure (power supply, passenger alerting, and others.) with initial information about the location and status of vehicles and railway facilities.

**15.13.** Responsible teams must be created within the CTCS.

**15.14.** The site must be equipped with a control system consisting of two levels operating continuously:

- Traffic control via a digital radio channel based on the information supplied to the RBC from the power centralization system on the basis of the microprocessor centralization (MPC) and the train separation systems based on tonal rail circuits without intermediate colour light signals;
- Traffic control via wayside light signals of stations and the continuous automatic locomotive alarm system (CALAS and multi-valued ALAS) of the train separation control system.

Selection of the TSCS management system level (as well as in the event of faults) is carried out with the locomotive safety systems installed on locomotives, specialized for the relevant category of trains.

**15.15.** The TSCS system must be implemented at the station level. The RAT station level developed on the basis of the security structure must be supplemented with the TSCS functions.

**15.16.** Multi-functionality of operation and coding of rail circuits must be provided with the digital-electronic and microprocessor hardware via software control.

**15.17.** As part of the traditional functions, the TSCS must provide interaction with on-board devices by coding rail circuits via the signals of the automatic locomotive alarm system (ALAS) and multi-valued automatic locomotive alarm system MVALAS.

**15.18.** Coordinate regulation radioblocking must use digital communication networks, satellite radio navigation means and other systems with the hardware and software locating the coordinates of the vehicle, as well as determining movement parameters under the principle "distance to target".

**15.19.** The TSCS is designed without intermediate colour light signals and supplemented with the functions of the multi-valued locomotive signalling based on the MVALAS code and coding of the ALAS numeric code.

**15.20.** The TSCS must ensure a two-way movement of trains on each of the open-line railways without compromising the functionality.

**15.21.** Tonal rail circuits on the microprocessor basis must be used in order to control the integrity of the rail line.

**15.22.** The electrical centralized control subsystem is integrated at the stations as part of the station level technical equipment.

**15.23.** Colour light signalling is implemented at the stations for train and shunting movements. High-speed traffic at the stations is organized via the RBC. When switching to the backup system, station traffic control is carried out with the help of the colour light signalling.

**15.24.** The microprocessor type PI (MPC) with the distributed architecture must be used at all the newly built interstations of the HSR. In this case, the computer controlled information complex (CCIC) is designed at the base station, and the site controllers (SC) can be located at the adjacent stations (checkpoints).

**15.25.** A reserved and secure CCIC and SC architecture, including the management and control modules, must be used. The CCIC and SC communication channels must be reserved.

**15.26.** The MPC subsystem must be designed in conjunction with the means of diagnostics and monitoring of the RAT technical condition and logic control of the technical equipment operation and actions of the operating personnel.

**15.27.** Turnout switches on high-speed trains crossing routes must be equipped with electric switch mechanisms (ESM) and the switch garnitures with external contactors. External contactors must be equipped with monitoring devices. It is not allowed to use open contact controller system in the ESM.

**15.28.** Light-optical LED signal lights (mast and dwarf signal lights) must be used at railway stations.

**15.29.** Switches and other devices being in the safety position for passing high-speed trains must automatically return to the safety position after use.

**15.30.** The provision must be made for power supply of stationary devices (station and concentration points) as electricity consumers of I reliability category – the special group. The feeders powering the RAT devices must meet the requirements set out in the operational regulations (OR).

**15.31.** The electrofeeding unit (EU) of the RAT must provide input and switching of at least two independent external AC power sources, and a back-up stand-alone power plant (BUSAPP) must be used as an additional AC power source. The provision must be made for the possibility to use mobile power plants at the tower EUs of the intermediate stations.

**15.32.** A power supply and grounding system for the RAT equipment must be selected depending on the type, technical capabilities and economic feasibility of the power supply equipment.

**15.33.** To avoid the interruption of the RAT devices power supply, operation of which depends on the feeders switching time and the start time of the BUSAPP. In addition, uninterruptible power supply systems (UPSS) with a capacity of batteries must be used to ensure proper quality of electricity, as well as operation of the TCS devices for at least 2 hours.

**15.34.** The UPSS converters must be reserved in the event of failure with the aim to backup the CCIC power supply sources and devices ensuring the recovery of actions of these systems without additional human intervention after switching the feeders and starting the BUSAPP.

**15.35.** Power supply of the subsystems must be organized via various secondary sources with reservation.

**15.36.** Power cable lead-in and laying in buildings of the PI and CTCS towers for the automation and telemechanics, communication and power supply cables must be separated.

**15.37.** The RAT equipment must meet the requirements of the electromagnetic resistance (EMRS) to atmospheric and switching overvoltage and electromagnetic compatibility (EMC) to interference from electric vehicles, electrical equipment, and the residual voltage at the output of the atmospheric and switching overvoltage protection systems.

**15.38.** The measures aimed to ensure EMRS must reduce the power and voltage of atmospheric and switching surges to levels of interferences that are safe for the insulation and inputs the RAT devices.

**15.39.** The measures on the EMC provision must ensure the ability of the RAT devices to function with a given quality in a given electromagnetic environment and not to cause harmful electromagnetic interferences to other technical means, which include data transmission and communication systems.

**15.40.** The RAT service-technical buildings must be protected from the effects of lightning. Depending on relative locations of lightning strikes in relation to the structure, it is required to take into consideration: lightning strikes hitting the service-technical building (STB); lightning strikes near the STB; lightning strikes hitting the communications connected to the STB; lightning strikes near the communications connected to the STB.

**15.41.** Protection against electromagnetic effects of lightning current must be adequate in terms of the electromagnetic environment in which a technical tool is operated.

The selection of protection schemes and the development of overvoltage protection systems for the RAT devices are based on the zone concept with due consideration of the RAT systems structure. It is an electrical system having the protection against external atmospheric and switching overvoltage with several levels of operating voltages and currents entering the hardware most commonly through the inputs: from the power supply lines of the RAT devices; from the floor automation devices (rail circuits, switch machines, signals); from the signal-blocking communication lines and the lines interfacing with other devices.

**15.42.** Location of the RAT elements in the zones with the electromagnetic environment of a varying severity predetermines the use of the cascade protection principle, in which each cascade must provide voltage drop to a level acceptable for the next protection cascade and the RAT elements.

**15.43.** The TDaMS must automate the control, diagnostics and monitoring of the RAT devices technical condition, as well as maintenance works on the RAT devices and train traffic tracking functions and actions of the operational personnel.

**15.44.** The TDaMS distributed stationary structure of the RAT devices must be built on the basis of a hierarchical architecture with the function of transferring discrete and analogue diagnostic information to the automated work places of:

- The electrician of the SCB at the station;
- The traffic controller (monitoring engineers) of the SCB distance;
- The monitoring engineers of the diagnostics and monitoring centre.

**15.45.** The controlled analogue values must allow to detect disruptions of the SCB devices, as well as to predict prefault states with the aim to timely adjust and predict possible delays of trains.

# 16. Railway Telecommunication

## 16.1. Wired Networks and Railway Telecommunication Systems

**16.1.1.** Wired networks and railway telecommunication systems at HSR section should include:

Networks: transport network; operational communication system network; basic communication network; operational and technological data transmission network;

Systems: engineering audio conferencing system; engineering video-conferencing system; service negotiations documented recording system;

Functional subsystems: clock network synchronisation system; time standard system; information security system; monitoring and administration system; railway communication unit power supply system.

**16.1.2.** Communication Transport Network

The technological basis of the communication transport system (for the first – physical level of 081 model) should be multiplexing technology with a wavelength-division multiplexing (WDM).

The transport network core equipment should provide multiservice and multifunctionality based on IP, MPLS-TP, Ethernet state-of-the-art digital technologies of the carrier class, NGN, SDH and DWDM.

**16.1.3.** Integrated Network of Operational Communication System (OCS) and Basic Communication (BC) with Packet Switching

The integrated network of OCS and BC should be a multiservice network providing services for OCS and BC subscribers based on packet switching technology. Transport network common resources and single switching control means (call handling, connection establishment) should be used in the integrated network of OCS and BC.

In order to meet the requirements regarding rendering of services for OCS and BC subscribers, connection process logical separation should be provided by the integrated network.

There should be the priorities excluding call losses for the subscribers of the most important communication modes or exceeding of the time limit for connection establishment in the integrated network for OCS subscribers when handling calls.

OCS system of the high-speed railway should be correlated to the existing operational communication system of JSC Russian Railways and the transport control centre and the backup control centre determined by the design documentation.

**16.1.4.** Engineering Audio Conferencing System

The engineering audio conferencing system (EACS) should provide holding of meetings on the principle "One of the meeting participants speaks – other participants hear" with a meeting chairman's right to interrupt any participant. EACS should be connected to EACS of JSC Russian Railways. The engineering audio conferencing system should be included into IP-OCS.

**16.1.5.** Engineering Video-Conferencing System

The engineering video-conferencing system (EVCS) is intended to transmit video and audio information between participants being in studios and service spaces when performing teleconferences or holding negotiations. The engineering video-conferencing system should be included into IP-OCS.

**16.1.6.** Service Negotiations Documented Recording System

The service negotiations documented recording system is intended to ensure automated documented recording of service negotiations held through communication networks and transmission of the data by the transportation process participants, record automatic archivation and saved record playback in order to control (listen) negotiations procedure fulfilment, compliance with the technology and the traffic safety regulations. The service negotiations documented recording system should be included into IP-OCS.

**16.1.7.** Technological Segment Data Transmission Network (DTN)

Operational and technological DTN should provide data transmission through dedicated channels for each information management system imposing strict requirements for efficiency, accuracy and reliability indices.

Basic communication DTN should provide transmission of the data which are not associated with safety and timeliness of rail transportation directly in order to arrange interaction of information systems of different departments and services of JSC Russian Railways.

**16.1.8.** Clock Network Synchronisation System

CNSS should provide establishment and maintenance of a digital signal clock frequency definite value in digital communication networks which are designed for digital switching, transit and information digital stream synchronous integration.

The time standard system is established for synchronization of all processes. It should receive, store, distribute and supply time signals to consumers with an accuracy complying with UTC (SU) coordinated time scale of the state primary standard of unit.

**16.1.9.** Requirements for System Ensuring Information Security

Protection of communication network information resources included into HSR control subsystem during information accumulation, processing and storage should comply with the requirements of the existing normative documents of RF in the information security area.

ISS should consist of two subsystems: information security system; physical security system.

**16.1.10.** Requirements for Monitoring and Control Automated System Equipment

The requirements for monitoring and control automated system equipment are specified regarding failure monitoring and control, configuration monitoring and control, operating parameter monitoring and control, next digital transport systems.

All networks, systems and functional subsystems of railway telecommunication should have a monitoring and administration integrated system which should be included into the unified communication monitoring and administration system of JSC Russian Railways.

**16.1.11.** Wired Telecommunication Unit Power Supply

Wired railway telecommunication units should be powered from two independent feeders as collectors of the first category of the special group.

Accumulator batteries ensuring communication device autonomous operation time of at least 8 h in case of loss of power supply from external feeders should be provided as an additional independent power supply source. It is necessary to ensure a possibility of use of a mobile diesel-engine power plant, which can be supplied and brought into operation during not more than eight hours.

## 16.2. Railway Radio Communication

**16.2.1.** The railway radio communication of Moscow-Kazan-Yekaterinburg HSR project should include the following radio communication systems:

- Process radio communication digital systems (PRCDS) (main – GSM-R standard, standby – DMR standard);
- Process repair and operational radio communication system (RORC) based on mobile networks of commercial operators (the information not associated with the train traffic safety can be transmitted through these radio networks only);
- Digital wireless data transmission system (WDTS) for information management systems (IMS).

**16.2.2.** In order to provide passengers with communication services during travel by HSR wireless data transmission networks of commercial operators should be used.

**16.2.3.** The rolling stock of any type used at HSR line should be equipped with the following radio communication means:

- Three-band voice communication radio stations with transceivers within the bands of 900 MHz (GSM-R standard), 160 MHz (DMR standard and analogue radio communication) and 2 MHz (analogue radio communication). Besides, analogue radio communication is required to provide radio communication with a mobile unit when it drives outside HSR to railway sections equipped with appropriate process radio communication analogue systems;
- Radio stations for RORC arrangement based on mobile networks of commercial operators;
- Data transmission radio stations for IMS operation.

In order to provide operation of train traffic control systems and also other systems requiring determination of a mobile unit position the rolling stock should be equipped with GLONASS/GPS modules.

The work stations of the passenger train masters should be equipped with two-band voice communication radio stations within the band of 900 MHz (GSM-R) and 160 MHz (DMR standard and analogue communication).

The passenger rolling stock should be equipped with wide-band repeaters of GSM standard in order to provide functioning of subscriber devices of train passengers and also satellite communication radio stations.

**16.2.4.** Radio communication means at mobile units should be powered from the sources with a voltage of 48 V with admissible deviations from the rated voltage not more than by ±20%.

**16.2.5.** Stationary radio communication means should be powered as collectors of the first category of the special group. Power supply should be provided from two independent feeders. Besides, installation of an accumulator battery ensuring continuous operation during not less than 8 h in case of loss of power supply from external feeders should be provided.

**16.2.6.** The technical requirements for hardware system for search operation functions in mobile telephone communication networks should be met in process radio communication digital networks at HSR section.

**16.2.7.** The requirements for provision of information security according to the existing normative documents in the information security area should be met in PRCDS. The functional requirements for information protection should be implemented by the information security system (ISS) which is developed additionally.

## 16.3. Check of Operation and Parameters of Train Radio Communication and Wireless Data Transmission Systems

**16.3.1.** The check of TRC and WDTS operation and parameters is aimed at train traffic safety improvement by means of provision of a periodic monitoring system for the stationary REE main parameters and also the infrastructure condition ensuring distribution of radio signals from REE used for transportation process control along railway sections.

**16.3.2** All main TRC and WDTS functions regarding voice communication and data transmission implemented in radio communication networks at HSR section should be checked and controlled.

**16.3.3.** All radio-electronic equipment (stationary, mobile, portable) and also radio communication channels between mobile and stationary radio stations, adjacent stationary radio stations and between channels of portable radio stations, if applicable, are subject to periodic inspection and control.

**16.3.4.** The main types of TRC and WDTS inspections and monitoring are:

1) Operation monitoring (by means of UMAS);
2) Periodic (scheduled) inspections (a test car – according to the schedule);
3) Verification inspections (a track test car – inspections of elimination of faults revealed earlier);
4) Unscheduled inspections.

**16.3.5.** Train radio communication with an appropriate capability should be included into the monitoring and administration system (MAS) of train radio communication intended for monitoring and administration of the infrastructure owner radio communication system parameters.

**16.3.6.** Train radio communication MAS should be included into the infrastructure owner process communication network.

**16.3.7.** Depending on capabilities and decisions on the procedure of execution of measurements with a mobile unit for the benefit of other railroad facilities (power supply, SCB etc.) the radio measuring equipment can be placed in an individual track test car or in a track test car together with other facilities, in a special measuring train or a standard rolling stock used at HSR section. A definite option of the measuring equipment placement should be determined taking into account a definite train type for HSR and also needs of other facilities to execute rolling stock measurements.

## 16.4. Requirements for the design of cable communication lines

**16.4.1.** In terms of their purpose, cable communication lines should be divided into: main cable communication lines; zonal cable communication lines; local and on-site cable communication lines.

**16.4.2.** Communication via cable communication lines must be organised using two fibre-optic cables spaced on opposite sides of the path and in justified cases using a third cable routed via a separate track.

**16.4.3.** Cable lines must be laid using one of the following methods: in cable trays that meet the relevant requirements of GOST R 52868-2007; directly in the ground; in cable ducts; via (or in) artificial structures (bridges, tunnels, overpasses). Based on the construction results in the executive documentation, the cable lines must have both horizontal and vertical positioning in the same coordinates system as the HSR tracks.

**16.4.4.** In order to ensure the sustainable operation of the communications network, the design must provide for the ability to utilise fibre-optic transmission lines (FOTL) from among those existing on the communications networks of JSC Russian Railways with a linear path that is geographically spaced apart from the route of the projected HSR main communication line.

**16.4.5.** Operational and process-related types of communication on the running line – AVS and PGS – as well as the connection of representatives of state control bodies in emergency situations (Federal Protective Service, Ministry of Emergency Situations) must be organised based on a fibre-optic cable with the installation of terminal equipment on the running lines in order to ensure the ability for communication with the nearest stations restricting the running line.

**16.4.6.** For the new construction of a railway transport facility, the local cable network must be installed as a structured cable system of subscriber groups at a station in buildings using an optical cable between buildings. The size of the locally covered facility must not exceed the area by a diameter of up to 3,000 m, with a usable service area of up to 1,000,000 m2 and up to 50,000 users.

**16.4.7.** The FOTL monitoring system must ensure the detection, identification and localisation of failures or changes to the transmission characteristics of optical fibres with a particular accuracy and speed.

**16.4.8.** The FOTL monitoring system must be capable of integrating with the existing unified monitoring and administration system (UMAS) of the JSC Russian Railways communications network.

## 16.5. Main requirements for organising the alert system for passengers and workers on railway tracks

**16.5.1.** The automated alert systems that warn of approaching rolling stock must include:

- Devices to collect and process information from sources about approaching rolling stock;
- Alarms designed to warn workers performing work on tracks about approaching rolling stock.

**16.5.2.** On double-track (multi-track) railway sections, information about approaching rolling stock must come from all the tracks of this section.

**16.5.3.** All stations and HSR running lines must be equipped with alert systems for workers performing work on tracks (hereinafter alert systems).

**16.5.4.** Crews working on tracks must have collective and/or individual alarms that warn of an approaching train.

**16.5.5.** The alert signals for collective and individual alarms must be transmitted via a radio channel.

**16.5.6.** Passenger alert systems are installed at platforms which high-speed, rapid-transit trains and special container trains pass without stopping.

**16.5.7.** If high-speed, rapid-transit trains and special container trains pass on two sides of a platform, an independent passenger alert system must be designed for each side of the platform.

**16.5.8.** Use of local alert systems (LAS)

Local alert system equipment must be installed: in the control room, at HSR communication facilities, passenger platforms as well as buildings at high-speed railway facilities and exchange points (connection points to the civil defence and emergency situations network or the LAS of potentially hazardous facilities).

# 17. Integrated safety control system

## 17.1. General provisions

**17.1.1.** The processes involving the design and construction of HSR infrastructure facilities must take into account the safety control requirements of the following subsystems:

- Railway tracks;
- Railway power supply;
- Railway automation and telemechanics;
- Railway telecommunications;
- Station facilities and devices.

These requirements are divided into general requirements pertaining to all infrastructure and special requirements pertaining to a particular subsystem of the infrastructure or components of this subsystem.

### 17.1.2. General safety requirements

**17.1.2.1.** The design, construction, installation, technical maintenance and monitoring of systems (subsystems, components) associated with safety and the systems involved in ensuring train safety must provide guaranteed safety during the operation stage.

**17.1.2.2.** The structure of the infrastructure buildings and facilities, rolling stock and materials used must be resistant to fire, earthquakes, wind and other factors in accordance with the Urban Planning Code of the Russian Federation.

The design of maintenance and engineering buildings, their siting on the HSR, dimensions and other technical parameters are governed by existing regulatory technical documents.

**17.1.2.3.** Any devices used must be designed so that their safety does not diminish in the event of any standard or potentially extraordinary handling.

**17.1.2.4.** Diagnostic and monitoring equipment for infrastructure facilities and rolling stock must ensure control over any pre-failure conditions.

**17.1.2.5.** Maintenance and repair equipment for infrastructure facilities and rolling stock must be sufficient to ensure the safety conditions of the facilities following scheduled (unscheduled) maintenance and required repairs.

**17.1.2.6.** The design process must utilise devices and systems that are built based on Russian or foreign systems (devices) that are certified or have been declared for compliance on the basis of their own evidence and evidence obtained involving a certification body and/or an accredited testing laboratory (centre).

**17.1.2.7.** In order to ensure train safety, the design must provide for the establishment of an integrated safety control system that consists of safety measures and actions to be taken in the event of a critical situation, a traffic control system with an intelligent support system for management decisions, testing, measurement and diagnostic equipment, compliance with the technical standards and requirements presented in these PSTS, and a diagnostic and monitoring centre.

**17.1.2.8.** All the microprocessor systems used in the traffic safety control system, diagnostics, monitoring and data transmission must be protected against cyberattacks (cyber threats). Protection must be established using both software and hardware.

# 18. Engineering and geodetic support

**18.1.** In order to meet safety requirements, geodetic support must be provided based on the establishment of a high-precision coordinate system (hereinafter HPCS) to effectively obtain and utilise reliable, relevant and accurate data for the design, construction and operation of HSR facilities and devices, to perform systematic high-precision control of geometric track parameters and also for comprehensive track diagnostics and the monitoring of the condition of railway infrastructure facilities in the same coordinate space.

**18.2.** In the design, construction and operation of the HSR, the use of the HPCS shall ensure:

- The performance of engineering surveys and the issuance of design and working documentation during the first stage (design);
- The performance of geodetic and demarcation work, monitoring the construction of facilities, functions involving the geometric basis for securing the projected plan and profile track positions, matching the actual track position to the projected position and performing as-built surveys during the second stage (construction);
- Monitoring of the condition of HSR infrastructure facilities, including geodetic monitoring during the third stage (operation);
- The coordinate and metric basis for the HSR geo-information system;
- The performance of work using track measuring equipment, the line-tamper-surfacer system as well as automation, telemechanic and communication track test cars.

**18.3.** The HPCS must include:

- A differentiated sub-system of geodetic satellite navigation systems (base station network, network centre).
- A geodetic control network (base stations, main and intermediate points). Base stations must be located close to a railway line at a distance of 50 km apart. The main points, which are equipped with forced centring devices, are positioned every 3–4 km. The intermediate points are laid in pairs every 250–750 m with visibility between the pairing points.

The mean square error of the geodetic control network's related points must not exceed 8 mm laterally and 5 mm in height (using the Baltic height system).

Each point of the geodetic control network is tied to the main height basis reference points of the Russian Federation via individual class 3 geometric levelling rates.

- Communications segment (spatial data system of JSC Russian Railways, mobile radio communications channel).
- User segment (dual-frequency GLONASS/GPS/GALILEO receivers, modems for obtaining differential corrections and controllers).

## 18.4. The stages and types of work specified in clause 18.2 must be taken into account when establishing the HPCS.

Prior to the start of engineering surveys, a design for the HPCS must be drafted as part of the preparation of design documentation. The design must ensure the performance of work during the HSR design, construction and operation stages and provide for:

- The construction of a network that fully ensures the preparation of the engineering survey materials that are required to issue design and working documentation.
- The installation of additional geodetic points and their inclusion in the network when modifying the alignment position during design or to replace lost points for the performance of geodetic and demarcation work, monitoring the construction of facilities, functions involving the geometric basis for securing the projected plan and profile track positions, matching the actual track position to the projected position and performing as-built surveys.
- The full construction of the HPCS. The installation of additional points to replace lost ones, the installation of points on structures built based on the requirements of regulatory documents and their inclusion in the network to ensure the monitoring of their condition, including the geodetic monitoring of HSR infrastructure facilities; ensuring the coordinate and metric basis for the HSR geo-information system; the performance of work using track measuring equipment, the line-tamper-surfacer system as well as automation, telemechanic and communication track test cars.

The established network must meet the requirements of clause 18.2 of these PSTS.

**18.5.** Coordinate system and projection – V.A. Kougiya. Projection consists of oblique equidistant projection that allows for identifying the plane coordinates for an extended, arbitrarily designed route and depicting the route on a plane with a high degree of accuracy. The height system is the Baltic system of 1977. Design solutions and documentation must be established in these coordinate and height systems on the basis of the HPCS.

**18.6.** As part of the engineering and geodetic surveys, the ground swaths along the projected route must be plotted with the preparation of a digital elevation model, topographical plans with a 1:1000 scale and a vertical interval of 0.5 m on this basis.

A survey scaled at 1:1500 with a vertical interval of 0.5 m must be additionally performed in the boundaries of cities, populated areas and on sections where small and medium bridges and pipes are to be built and where the HSR intersects with railways and roads.

The methods used to obtain materials are identified in the work programme. Requirements for measurement precision, the scope and list of survey materials as well as reports on engineering and geodetic surveys are to be employed based on the existing regulatory documents and terms of reference.

**18.7.** The HPCS points constitute the geodetic basis for geodetic and demarcation work. The accuracy of the offsetting of the alignment must be no less than 10 mm. The accuracy of the offsetting of infrastructure components is determined by the relevant regulatory documents.

**18.8.** Geodetic and demarcation work as well as step-by-step geodetic control during the construction of bridges and overpasses with length of more than 300 m, cable-stayed bridges, bridges and overpasses on curves, bridges and overpasses with supports higher than 15 m and the railway track and in other cases specified by regulatory documents and the legislation of the Russian Federation must be performed according to a design for geodetic work developed by a general design organisation as part of working documentation for the construction of facilities.

**18.9.** After a design has been prepared for HSR infrastructure facilities (bridges, tunnels, overpasses, high embankments, deep cuts) as well as sections of the route characterised by complex geological conditions such as extensive landforms featuring landslides and secondary erosion, high tectonic dynamic activity and exogenous features (creep, debris, erosion, flooding, karsts, avalanches, mudflows), geodetic monitoring must be carried out during the construction and operation stages by creating an automated monitoring system based on HPCS points.

# 19. Fire safety requirements

Measures to ensure fire safety of the projected infrastructure facilities of the Moscow-Kazan section of the Moscow-Kazan-Yekaterinburg High-Speed Railway must be prepared in accordance with the existing regulatory legal and technical documents pertaining to fire safety.

# 20. Environmental protection

## 20.1. Ecology and environmental protection

Environmental protection measures for the design of the Moscow-Kazan section of the Moscow-Kazan-Yekaterinburg High-Speed Railway must be prepared in accordance with the existing regulatory legal documents pertaining to environmental protection.

**20.2.** Noise protection. Short list of main provisions

**20.2.1.** The noise characteristics of railway transport traffic are determined in order to obtain initial data to calculate the noise level generated by high-speed railway transportation on areas near mainlines.

In addition to the noise generated from power units (engines) and the wheels rolling along the rails, one specific feature of the noise generated from trains travelling at speeds in excess of 250 km/h is a sharp increase in aerodynamic noise that is primarily generated by the flow of air masses around the locomotives, cars and collectors. The aerodynamic noise intensifies as speed increases, and prevails over the noise of power units and the wheels rolling along the rails at speeds exceeding 300 km/h.

The general train noise level includes the following sub-sources:

- The engine;
- The 'wheel-rail' system – the noise of rolling;
- Aerodynamic sources.

The sources of aerodynamic noise are:

- The nose of the train;
- The undercar space;
- Pantograph.

The PSTS "Noise protection measures for the Moscow-Kazan section of the Moscow-Kazan-Yekaterinburg High-Speed Railway. Technical standards and requirements for design and construction" provides an analysis of the effect of all the aforementioned sources and offers noise protection measures.

The noise characteristics of railway transport traffic are the equivalent of LAeq25 , equivalent over the assessment period of LAeq25,k , maximum LAmax25 , and maximum over the assessment period LAmax25,k of the A sound level, equivalent over the assessment period of Leq25,k of the sound pressure level in octave bands with centre frequencies ranging from 63 Hz to 8,000 Hz as determined in accordance with GOST 20444-85 at a distance of 25 m from the axis near the main railway track at a height of 1.5 m from the ground.

The noise characteristic of high-speed trains is the SEL noise exposure level.

**20.2.2.** The noise characteristics of individual trains are determined depending on the train's length, speed and traffic intensity.

Audible signals emitted by trains on the track section in question are also taken into account when determining the maximum values of noise characteristics.

**20.2.3.** Noise in areas near mainlines is calculated for the purpose of assessing the noise levels in residential areas in accordance with the sanitary standards approved by the Russian State Committee on Sanitary and Epidemiology Surveillance, SN 2.2.4/2,1,8,562-96. Noise in workplaces, rooms of residential and public buildings, and the territory of residential areas, the definitions of clear zones for railway mainlines in accordance with sanitary rules and standards SanPiN 2.2.1/2.1.1.1200-03 (amended) "Sanitary protection zones and sanitary classification of enterprises, structures and other facilities" approved by a resolution of the Chief Sanitary Doctor of the Russian Federation, the compilation of operational noise maps according to GOST R 53187-2008 and the development of noise protection measures.

Noise is calculated taking into account the decrease in noise over the propagation path, including due to geometrical divergence, the atmospheric absorption of sound, the ground surface, restricted visibility, sound attenuation in residential areas, the effect of screening structures and green areas as well as sound reflection from buildings.

**20.2.4.** A number of measures (both individually and in conjunction) are carried out to reduce noise from high-speed railways such as the installation of acoustic screens, the construction of artificial ditch cuts and embankments, the use of sound-proof glass in protected buildings and the use of the principle of noise reduction at the source, among other things.

**20.2.5.** Acoustic screens are used to reduce noise generated from high-speed train traffic in a protected area. Acoustic screens installed along HSR must comply with the requirements of GOST R 54931-2012 "Acoustic screens for railway transport. Technical requirements" except for the requirements described in these PSTS.

**20.2.6.** Acoustic screens for HSR consist of the following key components:

- Load-bearing structural components: metal posts manufactured in accordance with GOST 21.502-2007 and a foundation if the screen is placed on subsoil;
- Sound-proof filling – acoustic panels;
- Structural grounding components.

The foundation is the part of the acoustic screen that bears the main load on the screen and distributes it among the base (subgrade). The screen foundation may have different structural and technological features depending on its installation site and the geological structure of the subsoil. When an acoustic screen is installed on artificial structures (bridges, retaining walls, etc.), the components of the structure on which the screen is installed serve as the foundation; the load transmitted from the screen must be taken into account during design.

The frame of the screen may be of any form depending on the architectural design and the structural capabilities of the screen components utilised and may be in a vertical or slanting position depending on the longitudinal slope and cross fall.

The acoustic panels come in different colours depending on the architectural design and are generally installed between posts using additional components.

The acoustic screens must be grounded.

**20.2.7.** The second feature of high-speed train traffic is the significant increase in the alternating aerodynamic effect on facilities and structures located close to a rapid-transit railway line compared with train traffic at lower speeds.

Screen components must be calculated taking into account their operation conditions, i.e. not only the constant load – wind pressure and the weight load, but also the significant aerodynamic load generated when trains travel close to the screen at high speeds. Thus, the total horizontal load must be accepted as the sum of the force and moments from the impact of wind and aerodynamic loads.

The minimum clear distance from the track centre to the acoustic screen is 4.5 m, while the maximum distance from the track centre to the acoustic screen is determined by the design and depends on: the need for acoustic efficiency of the screen at its lowest possible height and train traffic safety at the design speed; the railway infrastructure components (contact line supports, cable trays, trackside assets, etc.) located within the main area of the subgrade.

**20.2.8.** The screen foundation is calculated based on engineering and geological exploration of the construction site as well as the design solutions for the track bed embankment. Depending on the type of foundation structure selected, it is calculated in accordance with the requirements of SP 22.13330.2011 "SNiP 2.02.01-83* Foundations of buildings and structures" and SP 24.13330.2011 "SNiP 2.02.03-85 Pile foundations".

**20.2.9.** The siting of acoustic screens requires taking into account the location of drainage facilities – ditches, gutters, drains – in the area where acoustic screens are to be installed. Acoustic screens and their foundations should not disrupt the system for the drainage of surface water and groundwater from the railway tracks.

Acoustic screens must be installed so that the contact line supports as well as the signalling and communication equipment (relay cabinets, automation and telemechanics system, etc.) are located between the railroad tracks and acoustic screen. The visibility of signal components must be taken into account when installing the acoustic screen.

**20.2.10.** The compliance of acoustic screens with technical requirements must be monitored for certain components of acoustic screens and when commissioning an installed acoustic screen according to the regulatory documents of the operating organisation.

**20.2.11.** In order to reduce the noise level in tunnels and structures around tunnels, sound-proof and sound-absorbing enclosures must be used. Noise suppression devices must be installed in the ventilation systems of tunnels. Sound-absorbing lining or other equipment (Helmholtz resonators, etc.) must be used at tunnels exits to reduce the noise generated by the HSR.

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[Extract of:] (69 pages) sixty-nine pages

Pro-rector for Research of

FSGEI HPE SPSTU [signature] T.S. Titova

[Seal:] Federal Agency for Railway Transport Federal State Government-funded Educational Institution of Higher Professional Education Emperor Alexander I St. Petersburg State Transport University (FSGEI HPE SPSTU), OGRN 1027810241502


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# Annex III:
# Traffic demand potentials: calculation tables

## Afyon - Izmir

| | | Izmir (+ Manisa) |
|---|---|---|
| | | 4,39 |
| Afyon | 0,21 | 2,96 |
| Kütakya | 0,20 | 3,91 |
| Eskişehir | 0,69 | 4,48 |
| Adapazarı | 0,27 | 5,53 |
| Istanbul | 14,66 | 6,78 |
| Edirne | 0,15 | 8,91 |
| Ankara | 4,59 | 5,39 |
| Kırıkkale | 0,19 | 5,90 |
| Kayserı | 1,06 | 7,95 |
| Sivas | 0,35 | 8,80 |
| Samsun | 0,61 | 8,68 |
| Malatya | 0,43 | 10,75 |
| Diyarbakır | 0,93 | 12,60 |
| Van | 0,35 | 14,35 |
| Tabriz | 1,50 | 16,99 |
| Teheran | 8,15 | 22,22 |
| Erzurum | 0,37 | 12,78 |
| Tbilisi | 1,17 | 16,42 |
| Baku | 2,14 | 21,08 |
| Konya | 1,22 | 4,89 |
| Antalya | 2,22 | 6,82 |
| Alanya | 0,29 | 6,41 |
| Mersin | 0,96 | 7,87 |
| Adana | 1,72 | 7,61 |
| Iskenderun | 0,24 | 8,93 |
| Aleppo | 2,30 | 10,00 |
| Damascus | 1,71 | 13,14 |
| Gaziantep | 1,56 | 9,98 |
| Mosul | 0,66 | 15,08 |
| Baghdad | 3,84 | 18,62 |
| Diyarbakir | 0,93 | 12,61 |

| | |
|---|---|
| Afyon | 0,146 |
| Kütakya | 0,086 |
| Eskişehir | 0,237 |
| Adapazarı | 0,065 |
| Istanbul | 2,486 |
| Edirne | 0,016 |
| Ankara | 1,150 |
| Kırıkkale | 0,041 |
| Kayserı | 0,137 |
| Sivas | 0,038 |
| Samsun | 0,068 |
| Malatya | 0,033 |
| Diyarbakır | 0,055 |
| Van | 0,017 |
| Tabriz | 0,053 |
| Teheran | 0,184 |
| Erzurum | 0,021 |
| Tbilisi | 0,044 |
| Baku | 0,053 |
| Konya | 0,361 |
| Antalya | 0,373 |
| Alanya | 0,054 |
| Mersin | 0,126 |
| Adana | 0,240 |
| Iskenderun | 0,025 |
| Aleppo | 0,201 |
| Damascus | 0,094 |
| Gaziantep | 0,137 |
| Mosul | 0,029 |
| Baghdad | 0,117 |
| Diyarbakir | 0,055 |
| | 6,742 |

# Ankara - Kirikkale

| | | Kirikkale | Karabük | Zomguldak | Samsun | Kayserı | Sivas | Maltya | Diyarbakir | Van | Tabriz | Teheran | Erzurum | Kars | Tbilisi | Baku |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0,19 | 0,24 | 0,21 | 0,61 | 1,06 | 0,35 | 0,35 | 0,93 | 0,35 | 1,50 | 8,15 | 0,37 | 0,08 | 1,17 | 2,14 |
| Ankara | 4,59 | 0,51 | 2,19 | 2,93 | 3,29 | 2,56 | 3,41 | 5,36 | 7,21 | 8,96 | 11,50 | 16,73 | 7,39 | 9,10 | 11,03 | 15,45 |
| Eskişehir | 0,69 | 2,57 | 4,25 | 4,99 | 5,35 | 4,62 | 5,47 | 7,42 | 9,27 | 11,02 | 13,56 | 18,79 | 9,45 | 11,16 | 13,09 | 17,51 |
| Adopazani | 0,27 | 3,62 | 5,30 | 6,04 | 6,40 | 5,67 | 6,52 | 8,47 | 10,32 | 12,07 | 14,61 | 19,84 | 10,50 | 12,21 | 14,14 | 18,56 |
| Istanbul | 14,66 | 4,87 | 6,55 | 7,29 | 7,65 | 6,92 | 7,77 | 9,72 | 11,57 | 13,32 | 15,86 | 21,09 | 11,75 | 13,46 | 15,39 | 19,81 |
| Edirne | 0,15 | 7,00 | 8,68 | 9,42 | 9,78 | 9,05 | 9,90 | 11,85 | 13,70 | 15,45 | 17,99 | 23,22 | 13,88 | 15,59 | 17,52 | 21,94 |
| Bucureşţi | 1,88 | 10,41 | 12,09 | 12,83 | 13,19 | 12,46 | 13,31 | 15,26 | 17,11 | 18,86 | 21,40 | 26,63 | 17,29 | 19,00 | 20,93 | 25,35 |
| Sofia | 1,21 | 9,93 | 11,61 | 12,35 | 12,71 | 11,98 | 12,83 | 14,78 | 16,63 | 18,38 | 20,92 | 26,15 | 16,81 | 18,52 | 20,45 | 24,87 |
| Beograd | 1,35 | 13,28 | 14,96 | 15,70 | 16,06 | 15,33 | 16,18 | 18,13 | 19,98 | 21,73 | 24,27 | 29,50 | 20,16 | 21,87 | 23,80 | 28,22 |
| Kütakya | 0,20 | 3,14 | 4,82 | 5,56 | 5,92 | 5,19 | 6,04 | 7,99 | 9,84 | 11,59 | 14,13 | 19,36 | 10,02 | 11,73 | 13,66 | 18,08 |
| Balikeşir | 1,19 | 4,92 | 6,60 | 7,34 | 7,70 | 6,97 | 7,82 | 9,77 | 11,62 | 13,37 | 15,91 | 21,14 | 11,80 | 13,51 | 15,44 | 19,86 |
| Manisa | 0,28 | 6,16 | 7,84 | 8,58 | 8,94 | 8,21 | 9,06 | 11,01 | 12,86 | 14,61 | 17,15 | 22,38 | 13,04 | 14,75 | 16,68 | 21,10 |
| Izmir | 4,11 | 6,45 | 8,13 | 8,87 | 9,23 | 8,50 | 9,35 | 11,30 | 13,15 | 14,90 | 17,44 | 22,67 | 13,33 | 15,04 | 16,97 | 21,39 |
| Afyon | 0,21 | 4,09 | 5,77 | 6,51 | 6,87 | 6,14 | 6,99 | 8,94 | 10,79 | 12,54 | 15,08 | 20,31 | 10,97 | 12,68 | 14,61 | 19,03 |
| Denizli | 1,00 | 5,16 | 6,84 | 7,58 | 7,94 | 7,21 | 8,06 | 10,01 | 11,86 | 13,61 | 16,15 | 21,38 | 12,04 | 13,75 | 15,68 | 20,10 |
| Konya | 1,22 | 2,79 | 4,47 | 5,21 | 5,57 | 4,84 | 5,69 | 7,64 | 9,49 | 11,24 | 13,78 | 19,01 | 9,67 | 11,38 | 13,31 | 17,73 |
| Antalya | 2,22 | 4,72 | 6,40 | 7,14 | 7,50 | 6,77 | 7,62 | 9,57 | 11,42 | 13,17 | 15,71 | 20,94 | 11,60 | 13,31 | 15,24 | 19,66 |
| Alanya | 0,29 | 4,31 | 5,99 | 6,73 | 7,09 | 6,36 | 7,21 | 9,16 | 11,01 | 12,76 | 15,30 | 20,53 | 11,19 | 12,90 | 14,83 | 19,25 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ankara | | 2,740 | 0,291 | 0,155 | 0,370 | 0,984 | 0,200 | 0,093 | 0,149 | 0,039 | 0,108 | 0,311 | 0,057 | 0,009 | 0,091 | 0,094 |
| Eskişehir | | 0,026 | 0,014 | 0,009 | 0,024 | 0,054 | 0,013 | 0,008 | 0,015 | 0,004 | 0,012 | 0,038 | 0,006 | 0,001 | 0,010 | 0,011 |
| Adopazani | | 0,006 | 0,004 | 0,003 | 0,007 | 0,015 | 0,004 | 0,003 | 0,005 | 0,001 | 0,004 | 0,014 | 0,002 | 0,000 | 0,003 | 0,004 |
| Istanbul | | 0,189 | 0,144 | 0,105 | 0,281 | 0,580 | 0,157 | 0,107 | 0,212 | 0,063 | 0,200 | 0,670 | 0,082 | 0,014 | 0,164 | 0,196 |
| Edirne | | 0,001 | 0,001 | 0,001 | 0,002 | 0,004 | 0,001 | 0,001 | 0,002 | 0,001 | 0,002 | 0,006 | 0,001 | 0,000 | 0,001 | 0,002 |
| Bucureşţi | | 0,007 | 0,007 | 0,005 | 0,014 | 0,027 | 0,008 | 0,006 | 0,014 | 0,004 | 0,015 | 0,058 | 0,005 | 0,001 | 0,013 | 0,017 |
| Sofia | | 0,005 | 0,004 | 0,004 | 0,010 | 0,019 | 0,006 | 0,004 | 0,009 | 0,003 | 0,010 | 0,038 | 0,004 | 0,001 | 0,008 | 0,011 |
| Beograd | | 0,003 | 0,003 | 0,003 | 0,007 | 0,014 | 0,004 | 0,003 | 0,008 | 0,003 | 0,009 | 0,035 | 0,003 | 0,001 | 0,007 | 0,010 |
| Kütakya | | 0,005 | 0,003 | 0,002 | 0,006 | 0,013 | 0,003 | 0,002 | 0,004 | 0,001 | 0,003 | 0,011 | 0,001 | 0,000 | 0,003 | 0,003 |
| Balikeşir | | 0,015 | 0,012 | 0,008 | 0,023 | 0,046 | 0,013 | 0,009 | 0,017 | 0,005 | 0,016 | 0,054 | 0,007 | 0,001 | 0,013 | 0,016 |
| Manisa | | 0,002 | 0,002 | 0,002 | 0,004 | 0,008 | 0,002 | 0,002 | 0,003 | 0,001 | 0,003 | 0,012 | 0,001 | 0,000 | 0,003 | 0,003 |
| Izmir | | 0,033 | 0,028 | 0,021 | 0,057 | 0,115 | 0,032 | 0,023 | 0,048 | 0,015 | 0,048 | 0,166 | 0,019 | 0,003 | 0,039 | 0,048 |
| Afyon | | 0,004 | 0,003 | 0,002 | 0,005 | 0,010 | 0,003 | 0,002 | 0,003 | 0,001 | 0,003 | 0,010 | 0,001 | 0,000 | 0,003 | 0,003 |
| Denizli | | 0,012 | 0,009 | 0,007 | 0,018 | 0,037 | 0,010 | 0,007 | 0,014 | 0,004 | 0,013 | 0,045 | 0,005 | 0,001 | 0,011 | 0,013 |
| Konya | | 0,041 | 0,023 | 0,015 | 0,040 | 0,089 | 0,022 | 0,013 | 0,025 | 0,007 | 0,021 | 0,067 | 0,010 | 0,002 | 0,018 | 0,020 |
| Antalya | | 0,030 | 0,023 | 0,016 | 0,044 | 0,091 | 0,025 | 0,017 | 0,033 | 0,010 | 0,031 | 0,103 | 0,013 | 0,002 | 0,025 | 0,030 |
| Alanya | | 0,005 | 0,003 | 0,002 | 0,006 | 0,013 | 0,004 | 0,002 | 0,005 | 0,001 | 0,004 | 0,014 | 0,002 | 0,000 | 0,003 | 0,004 |

11,941

# Ankara - Polatlı

| | | Konya | Mersin | Adana | Aleppo | Damascus | Gaziantep | Mosul | Baghdad | Eskişehir | Afyon | Manisa | Izmir | Istanbul | Edirne | Alexandroupolis | Thessaloniki | Plovdiv | Sofia | Niš | Beograd | Budapest | Stara Zagora | Ruse | Bucureşti |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1,22 | 0,96 | 1,72 | 2,30 | 1,71 | 1,56 | 0,66 | 3,84 | 0,69 | 0,21 | 0,28 | 4,11 | 14,66 | 0,15 | 0,07 | 0,33 | 0,37 | 1,21 | 0,26 | 1,35 | 1,74 | 0,14 | 0,15 | 1,88 |
| Ankara | 4,59 | 2,28 | 5,26 | 5,00 | 7,39 | 10,53 | 7,37 | 12,47 | 16,01 | 2,06 | 3,17 | 5,84 | 6,13 | 4,36 | 6,49 | 7,59 | 9,97 | 8,10 | 9,42 | 10,78 | 12,77 | 15,97 | 7,64 | 9,21 | 9,90 |
| Kırıkkale | 0,19 | 2,79 | 5,77 | 5,51 | 7,90 | 11,04 | 7,88 | 12,98 | 16,52 | 2,57 | 3,68 | 6,35 | 6,64 | 4,87 | 7,00 | 8,10 | 10,48 | 8,61 | 9,93 | 11,29 | 13,28 | 16,48 | 8,15 | 9,72 | 10,41 |
| Samsun | 0,61 | 5,57 | 8,55 | 8,29 | 10,68 | 13,82 | 10,66 | 15,76 | 19,30 | 5,35 | 6,46 | 9,13 | 9,42 | 7,65 | 9,78 | 10,88 | 13,26 | 11,39 | 12,71 | 14,07 | 16,06 | 19,26 | 10,93 | 12,50 | 13,19 |
| Kayserı | 1,06 | 4,84 | 7,82 | 7,56 | 9,95 | 13,09 | 9,93 | 15,03 | 18,57 | 4,62 | 5,73 | 8,40 | 8,69 | 6,92 | 9,05 | 10,15 | 12,53 | 10,66 | 11,98 | 13,34 | 15,33 | 18,53 | 10,20 | 11,77 | 12,46 |
| Sivas | 0,35 | 5,69 | 8,67 | 8,41 | 10,80 | 13,94 | 10,78 | 15,88 | 19,42 | 5,47 | 6,58 | 9,25 | 9,54 | 7,77 | 9,90 | 11,00 | 13,38 | 11,51 | 12,83 | 14,19 | 16,18 | 19,38 | 11,05 | 12,62 | 13,31 |
| Malatya | 0,43 | 7,64 | 10,62 | 10,36 | 12,75 | 15,89 | 12,73 | 17,83 | 21,37 | 7,42 | 8,53 | 11,20 | 11,49 | 9,72 | 11,85 | 12,95 | 15,33 | 13,46 | 14,78 | 16,14 | 18,13 | 21,33 | 13,00 | 14,57 | 15,26 |
| Diyarbakır | 0,93 | 9,49 | 12,47 | 12,21 | 14,60 | 17,74 | 14,58 | 19,68 | 23,22 | 9,27 | 10,38 | 13,05 | 13,34 | 11,57 | 13,70 | 14,80 | 17,18 | 15,31 | 16,63 | 17,99 | 19,98 | 23,18 | 14,85 | 16,42 | 17,11 |
| Van | 0,35 | 11,24 | 14,22 | 13,96 | 16,35 | 19,49 | 16,33 | 21,43 | 24,97 | 11,02 | 12,13 | 14,80 | 15,09 | 13,32 | 15,45 | 16,55 | 18,93 | 17,06 | 18,38 | 19,74 | 21,73 | 24,93 | 16,60 | 18,17 | 18,86 |
| Tabriz | 1,50 | 13,88 | 16,86 | 16,60 | 18,99 | 22,13 | 18,97 | 24,07 | 27,61 | 13,66 | 14,77 | 17,44 | 17,73 | 15,96 | 18,09 | 19,19 | 21,57 | 19,70 | 21,02 | 22,38 | 24,37 | 27,57 | 19,24 | 20,81 | 21,50 |
| Teheran | 8,15 | 19,11 | 22,09 | 21,83 | 24,22 | 27,36 | 24,20 | 29,30 | 32,84 | 18,89 | 20,00 | 22,67 | 22,96 | 21,19 | 23,32 | 24,42 | 26,80 | 24,93 | 26,25 | 27,61 | 29,60 | 32,80 | 24,47 | 26,04 | 26,73 |
| Erzurum | 0,37 | 9,67 | 12,65 | 12,39 | 14,78 | 17,92 | 14,76 | 19,86 | 23,40 | 9,45 | 10,56 | 13,23 | 13,52 | 11,75 | 13,88 | 14,98 | 17,36 | 15,49 | 16,81 | 18,17 | 20,16 | 23,36 | 15,03 | 16,60 | 17,29 |
| Tbilisi | 1,17 | 13,28 | 16,26 | 16,00 | 18,39 | 21,53 | 18,37 | 23,47 | 27,01 | 13,06 | 14,17 | 16,84 | 17,13 | 15,36 | 17,49 | 18,59 | 20,97 | 19,10 | 20,42 | 21,78 | 23,77 | 26,97 | 18,64 | 20,21 | 20,90 |
| Baku | 2,14 | 17,70 | 20,68 | 20,42 | 22,81 | 25,95 | 22,79 | 27,89 | 31,43 | 17,48 | 18,59 | 21,26 | 21,55 | 19,78 | 21,91 | 23,01 | 25,39 | 23,52 | 24,84 | 26,20 | 28,19 | 31,39 | 23,06 | 24,63 | 25,32 |

| | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ankara | 1,379 | 0,262 | 0,512 | 0,352 | 0,143 | 0,240 | 0,042 | 0,158 | 0,927 | 0,136 | 0,064 | 0,865 | 5,506 | 0,029 | 0,010 | 0,030 | 0,048 | 0,123 | 0,021 | 0,082 | 0,072 | 0,020 | 0,016 | 0,175 |
| Kırıkkale | 0,041 | 0,009 | 0,018 | 0,013 | 0,005 | 0,009 | 0,002 | 0,006 | 0,026 | 0,004 | 0,002 | 0,031 | 0,189 | 0,001 | 0,000 | 0,001 | 0,002 | 0,005 | 0,001 | 0,003 | 0,003 | 0,001 | 0,001 | 0,007 |
| Samsun | 0,040 | 0,015 | 0,029 | 0,025 | 0,012 | 0,017 | 0,004 | 0,015 | 0,024 | 0,005 | 0,004 | 0,055 | 0,281 | 0,002 | 0,001 | 0,002 | 0,004 | 0,010 | 0,002 | 0,007 | 0,007 | 0,001 | 0,001 | 0,014 |
| Kayserı | 0,089 | 0,031 | 0,059 | 0,049 | 0,023 | 0,033 | 0,007 | 0,028 | 0,054 | 0,011 | 0,008 | 0,110 | 0,580 | 0,004 | 0,001 | 0,005 | 0,007 | 0,019 | 0,003 | 0,014 | 0,013 | 0,003 | 0,002 | 0,027 |
| Sivas | 0,022 | 0,009 | 0,016 | 0,014 | 0,007 | 0,010 | 0,002 | 0,009 | 0,013 | 0,003 | 0,002 | 0,031 | 0,157 | 0,001 | 0,000 | 0,001 | 0,002 | 0,006 | 0,001 | 0,004 | 0,004 | 0,001 | 0,001 | 0,008 |
| Malatya | 0,017 | 0,007 | 0,014 | 0,013 | 0,007 | 0,009 | 0,002 | 0,009 | 0,010 | 0,002 | 0,002 | 0,028 | 0,132 | 0,001 | 0,000 | 0,001 | 0,002 | 0,005 | 0,001 | 0,004 | 0,004 | 0,001 | 0,001 | 0,008 |
| Diyarbakır | 0,025 | 0,012 | 0,023 | 0,022 | 0,012 | 0,015 | 0,004 | 0,017 | 0,015 | 0,004 | 0,003 | 0,047 | 0,212 | 0,002 | 0,001 | 0,002 | 0,003 | 0,009 | 0,002 | 0,008 | 0,008 | 0,001 | 0,001 | 0,014 |
| Van | 0,007 | 0,004 | 0,007 | 0,007 | 0,004 | 0,005 | 0,001 | 0,006 | 0,004 | 0,001 | 0,001 | 0,014 | 0,063 | 0,001 | 0,000 | 0,001 | 0,001 | 0,003 | 0,001 | 0,003 | 0,003 | 0,000 | 0,000 | 0,004 |
| Tabriz | 0,021 | 0,012 | 0,022 | 0,023 | 0,013 | 0,016 | 0,004 | 0,020 | 0,012 | 0,003 | 0,003 | 0,046 | 0,198 | 0,002 | 0,001 | 0,003 | 0,003 | 0,010 | 0,002 | 0,009 | 0,009 | 0,001 | 0,001 | 0,015 |
| Teheran | 0,066 | 0,041 | 0,074 | 0,083 | 0,050 | 0,056 | 0,017 | 0,083 | 0,038 | 0,011 | 0,011 | 0,163 | 0,665 | 0,006 | 0,002 | 0,010 | 0,013 | 0,038 | 0,008 | 0,035 | 0,038 | 0,005 | 0,005 | 0,057 |
| Erzurum | 0,010 | 0,005 | 0,009 | 0,009 | 0,005 | 0,006 | 0,002 | 0,007 | 0,006 | 0,001 | 0,001 | 0,018 | 0,082 | 0,001 | 0,000 | 0,001 | 0,001 | 0,004 | 0,001 | 0,003 | 0,003 | 0,001 | 0,000 | 0,005 |
| Tbilisi | 0,018 | 0,010 | 0,018 | 0,019 | 0,011 | 0,013 | 0,004 | 0,017 | 0,010 | 0,003 | 0,003 | 0,038 | 0,165 | 0,001 | 0,001 | 0,002 | 0,003 | 0,008 | 0,002 | 0,007 | 0,008 | 0,001 | 0,001 | 0,013 |
| Baku | 0,020 | 0,012 | 0,022 | 0,024 | 0,014 | 0,016 | 0,005 | 0,023 | 0,011 | 0,003 | 0,003 | 0,048 | 0,196 | 0,002 | 0,001 | 0,003 | 0,004 | 0,011 | 0,002 | 0,010 | 0,011 | 0,001 | 0,001 | 0,017 |

17,598

# Arad - Sibiu/Craiova

| | | Sibiu | Cluj | Brasov | Ploeşti | Buzau | Braila + Galaţi | Bucureşti | Constanţa | Ruse | Plovdiv + ... | Istanbul | Craiova |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0,43 | 0,30 | 0,28 | 0,22 | 0,12 | 0,50 | 1,88 | 0,30 | 0,15 | 0,57 | 14,33 | 0,29 |
| Arad | 0,16 | 2,20 | 1,80 | 3,03 | 3,89 | 4,54 | 5,48 | 4,45 | 6,48 | 5,14 | 6,71 | 9,99 | 2,99 |
| Budapest | 1,74 | 4,44 | 4,04 | 5,27 | 6,13 | 6,78 | 7,72 | 6,69 | 8,72 | 9,41 | 10,98 | 14,26 | 5,23 |
| Trnava | 0,07 | 5,90 | 5,50 | 6,73 | 7,59 | 8,24 | 9,18 | 8,15 | 10,18 | 10,87 | 12,44 | 15,72 | 6,69 |
| Zilina + Trencin | 0,14 | 7,19 | 6,79 | 8,02 | 8,88 | 9,53 | 10,47 | 9,44 | 11,47 | 12,16 | 13,73 | 17,01 | 7,98 |
| Györ | 0,13 | 5,48 | 5,08 | 6,31 | 7,17 | 7,82 | 8,76 | 7,73 | 9,76 | 10,45 | 12,02 | 15,30 | 6,27 |
| Bratislava | 0,42 | 6,18 | 5,78 | 7,01 | 7,87 | 8,52 | 9,46 | 8,43 | 10,46 | 11,15 | 12,72 | 16,00 | 6,97 |
| Ostrava | 0,30 | 8,21 | 7,81 | 9,04 | 9,90 | 10,55 | 11,49 | 10,46 | 12,49 | 13,18 | 14,75 | 18,03 | 9,00 |
| Katowice + ... | 1,28 | 8,96 | 8,56 | 9,79 | 10,65 | 11,30 | 12,24 | 11,21 | 13,24 | 13,93 | 15,50 | 18,78 | 9,75 |
| Krakow | 0,76 | 9,42 | 9,02 | 10,25 | 11,11 | 11,76 | 12,70 | 11,67 | 13,70 | 14,39 | 15,96 | 19,24 | 10,21 |
| Warszawa | 1,71 | 11,54 | 11,14 | 12,37 | 13,23 | 13,88 | 14,82 | 13,79 | 15,82 | 16,51 | 18,08 | 21,36 | 12,33 |
| Brno | 0,39 | 7,35 | 6,95 | 8,18 | 9,04 | 9,69 | 10,63 | 9,60 | 11,63 | 12,32 | 13,89 | 17,17 | 8,14 |
| Praha | 1,27 | 9,22 | 8,82 | 10,05 | 10,91 | 11,56 | 12,50 | 11,47 | 13,50 | 14,19 | 15,76 | 19,04 | 10,01 |
| Wien | 1,84 | 6,63 | 6,23 | 7,46 | 8,32 | 8,97 | 9,91 | 8,88 | 10,91 | 11,60 | 13,17 | 16,45 | 7,42 |
| Linz + Wels | 0,26 | 8,16 | 7,76 | 8,99 | 9,85 | 10,50 | 11,44 | 10,41 | 12,44 | 13,13 | 14,70 | 17,98 | 8,95 |
| Regensburg | 0,15 | 9,98 | 9,58 | 10,81 | 11,67 | 12,32 | 13,26 | 12,23 | 14,26 | 14,95 | 16,52 | 19,80 | 10,77 |
| Nürnberg | 0,74 | 10,85 | 10,45 | 11,68 | 12,54 | 13,19 | 14,13 | 13,10 | 15,13 | 15,82 | 17,39 | 20,67 | 11,64 |
| Würzburg | 0,13 | 11,81 | 11,41 | 12,64 | 13,50 | 14,15 | 15,09 | 14,06 | 16,09 | 16,78 | 18,35 | 21,63 | 12,60 |
| Frankfurt | 1,60 | 12,79 | 12,39 | 13,62 | 14,48 | 15,13 | 16,07 | 15,04 | 17,07 | 17,76 | 19,33 | 22,61 | 13,58 |
| Salzburg | 0,15 | 9,28 | 8,88 | 10,11 | 10,97 | 11,62 | 12,56 | 11,53 | 13,56 | 14,25 | 15,82 | 19,10 | 10,07 |
| München | 1,45 | 10,46 | 10,06 | 11,29 | 12,15 | 12,80 | 13,74 | 12,71 | 14,74 | 15,43 | 17,00 | 20,28 | 11,25 |
| Ausburg | 0,29 | 11,02 | 10,62 | 11,85 | 12,71 | 13,36 | 14,30 | 13,27 | 15,30 | 15,99 | 17,56 | 20,84 | 11,81 |
| Stuttgart | 0,62 | 12,36 | 11,96 | 13,19 | 14,05 | 14,70 | 15,64 | 14,61 | 16,64 | 17,33 | 18,90 | 22,18 | 13,15 |
| Karlsruhe | 0,31 | 12,97 | 12,57 | 13,80 | 14,66 | 15,31 | 16,25 | 15,22 | 17,25 | 17,94 | 19,51 | 22,79 | 13,76 |
| Innsbruck | 0,13 | 10,64 | 10,24 | 11,47 | 12,33 | 12,98 | 13,92 | 12,89 | 14,92 | 15,61 | 17,18 | 20,46 | 11,43 |
| Zürich | 0,40 | 12,78 | 12,38 | 13,61 | 14,47 | 15,12 | 16,06 | 15,03 | 17,06 | 17,75 | 19,32 | 22,60 | 13,57 |
| Szekesfehervar | 0,10 | 5,02 | 4,62 | 5,85 | 6,71 | 7,36 | 8,30 | 7,27 | 9,30 | 9,99 | 11,56 | 14,84 | 5,81 |
| Szombathely | 0,08 | 6,35 | 5,95 | 7,18 | 8,04 | 8,69 | 9,63 | 8,60 | 10,63 | 11,32 | 12,89 | 16,17 | 7,14 |
| Graz | 0,28 | 7,29 | 6,89 | 8,12 | 8,98 | 9,63 | 10,57 | 9,54 | 11,57 | 12,26 | 13,83 | 17,11 | 8,08 |
| Klagenfurt + Vill. | 0,16 | 8,29 | 7,89 | 9,12 | 9,98 | 10,63 | 11,57 | 10,54 | 12,57 | 13,26 | 14,83 | 18,11 | 9,08 |
| Venezia + Pad. | 0,55 | 10,03 | 9,63 | 10,86 | 11,72 | 12,37 | 13,31 | 12,28 | 14,31 | 15,00 | 16,57 | 19,85 | 10,82 |
| Timioşara | 0,32 | 2,55 | 2,15 | 3,38 | 4,24 | 4,89 | 5,83 | 4,80 | 6,83 | 5,49 | 7,06 | 10,34 | 3,34 |
| Beograd | 1,35 | 3,74 | 3,34 | 4,57 | 5,43 | 6,08 | 7,02 | 5,99 | 8,02 | 6,68 | 8,25 | 11,53 | 4,53 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Arad | 0,018 | 0,018 | 0,007 | 0,003 | 0,001 | 0,004 | 0,024 | 0,002 | 0,001 | 0,004 | 0,046 | 0,007 |
| Budapest | 0,059 | 0,049 | 0,029 | 0,018 | 0,008 | 0,027 | 0,129 | 0,013 | 0,006 | 0,017 | 0,272 | 0,030 |
| Trnava | 0,001 | 0,001 | 0,001 | 0,000 | 0,000 | 0,001 | 0,004 | 0,000 | 0,000 | 0,001 | 0,009 | 0,001 |
| Zilina + Trencin | 0,002 | 0,002 | 0,001 | 0,001 | 0,000 | 0,001 | 0,006 | 0,001 | 0,000 | 0,001 | 0,016 | 0,001 |
| Györ | 0,003 | 0,002 | 0,002 | 0,001 | 0,000 | 0,002 | 0,008 | 0,001 | 0,000 | 0,001 | 0,018 | 0,002 |
| Bratislava | 0,008 | 0,006 | 0,004 | 0,003 | 0,001 | 0,005 | 0,021 | 0,002 | 0,001 | 0,003 | 0,054 | 0,004 |
| Ostrava | 0,004 | 0,003 | 0,002 | 0,001 | 0,001 | 0,002 | 0,010 | 0,001 | 0,001 | 0,002 | 0,031 | 0,002 |
| Katowice | 0,013 | 0,010 | 0,007 | 0,005 | 0,002 | 0,009 | 0,040 | 0,005 | 0,002 | 0,007 | 0,125 | 0,008 |
| Krakow | 0,007 | 0,005 | 0,004 | 0,003 | 0,001 | 0,005 | 0,022 | 0,003 | 0,001 | 0,004 | 0,071 | 0,004 |
| Warszawa | 0,012 | 0,009 | 0,007 | 0,005 | 0,002 | 0,009 | 0,037 | 0,005 | 0,002 | 0,007 | 0,135 | 0,007 |
| Brno | 0,006 | 0,004 | 0,003 | 0,002 | 0,001 | 0,004 | 0,016 | 0,002 | 0,001 | 0,003 | 0,044 | 0,003 |
| Praha | 0,013 | 0,009 | 0,007 | 0,005 | 0,002 | 0,009 | 0,038 | 0,005 | 0,002 | 0,007 | 0,122 | 0,007 |
| Wien | 0,032 | 0,025 | 0,017 | 0,011 | 0,005 | 0,019 | 0,084 | 0,009 | 0,004 | 0,013 | 0,226 | 0,018 |
| Linz + Wels | 0,003 | 0,002 | 0,002 | 0,001 | 0,001 | 0,002 | 0,009 | 0,001 | 0,000 | 0,002 | 0,027 | 0,002 |
| Regensburg | 0,001 | 0,001 | 0,001 | 0,001 | 0,000 | 0,001 | 0,004 | 0,000 | 0,000 | 0,001 | 0,013 | 0,001 |
| Nürnberg | 0,006 | 0,004 | 0,003 | 0,002 | 0,001 | 0,004 | 0,018 | 0,002 | 0,001 | 0,003 | 0,062 | 0,003 |
| Würzburg | 0,001 | 0,001 | 0,000 | 0,000 | 0,000 | 0,001 | 0,003 | 0,000 | 0,000 | 0,001 | 0,010 | 0,001 |
| Frankfurt | 0,009 | 0,007 | 0,005 | 0,004 | 0,002 | 0,007 | 0,030 | 0,004 | 0,002 | 0,006 | 0,114 | 0,006 |
| Salzburg | 0,001 | 0,001 | 0,001 | 0,001 | 0,000 | 0,001 | 0,004 | 0,001 | 0,000 | 0,001 | 0,014 | 0,001 |
| München | 0,012 | 0,009 | 0,007 | 0,005 | 0,002 | 0,008 | 0,036 | 0,004 | 0,002 | 0,007 | 0,125 | 0,007 |
| Ausburg | 0,002 | 0,002 | 0,001 | 0,001 | 0,000 | 0,002 | 0,007 | 0,001 | 0,000 | 0,001 | 0,024 | 0,001 |
| Stuttgart | 0,004 | 0,003 | 0,002 | 0,002 | 0,001 | 0,003 | 0,012 | 0,002 | 0,001 | 0,002 | 0,046 | 0,002 |
| Karlsruhe | 0,002 | 0,001 | 0,001 | 0,001 | 0,000 | 0,001 | 0,006 | 0,001 | 0,000 | 0,001 | 0,022 | 0,001 |
| Innsbruck | 0,001 | 0,001 | 0,001 | 0,000 | 0,000 | 0,001 | 0,003 | 0,000 | 0,000 | 0,001 | 0,011 | 0,001 |
| Zürich | 0,002 | 0,002 | 0,001 | 0,001 | 0,000 | 0,002 | 0,008 | 0,001 | 0,000 | 0,001 | 0,029 | 0,001 |
| Szekesfehervar | 0,003 | 0,002 | 0,001 | 0,001 | 0,000 | 0,001 | 0,006 | 0,001 | 0,000 | 0,001 | 0,015 | 0,001 |
| Szombathely | 0,001 | 0,001 | 0,001 | 0,001 | 0,000 | 0,001 | 0,004 | 0,000 | 0,000 | 0,001 | 0,010 | 0,001 |
| Graz | 0,004 | 0,003 | 0,002 | 0,001 | 0,001 | 0,003 | 0,011 | 0,001 | 0,001 | 0,002 | 0,032 | 0,002 |
| Klagenfurt + Vill. | 0,002 | 0,001 | 0,001 | 0,001 | 0,000 | 0,001 | 0,005 | 0,001 | 0,000 | 0,001 | 0,017 | 0,001 |
| Venezia + Pad. | 0,005 | 0,004 | 0,003 | 0,002 | 0,001 | 0,003 | 0,015 | 0,002 | 0,001 | 0,003 | 0,049 | 0,003 |
| Timioşara | 0,028 | 0,026 | 0,011 | 0,006 | 0,003 | 0,008 | 0,042 | 0,004 | 0,003 | 0,007 | 0,086 | 0,012 |
| Beograd | 0,062 | 0,052 | 0,029 | 0,017 | 0,008 | 0,025 | 0,121 | 0,012 | 0,008 | 0,021 | 0,303 | 0,030 |

4,469

## Beograd - Niš

| | | Niš | Sofia | Plovdiv + ... | Varna | Burgas | Edirne | Istanbul | Skopje | Thessaloniki | Athenai |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0,26 | 1,21 | 0,57 | 0,33 | 0,20 | 0,15 | 14,66 | 0,54 | 0,33 | 3,75 |
| Beograd | 1,23 | 1,99 | 3,35 | 4,67 | 7,50 | 6,94 | 6,20 | 8,41 | 3,49 | 5,45 | 8,47 |
| Timişoara | 0,32 | 3,18 | 4,54 | 5,86 | 8,69 | 8,13 | 7,39 | 9,60 | 4,68 | 6,64 | 9,66 |
| Arad | 0,16 | 3,53 | 4,89 | 6,21 | 9,04 | 8,48 | 7,74 | 9,95 | 5,03 | 6,99 | 10,01 |
| Oradea | 0,20 | 4,63 | 5,99 | 7,31 | 10,14 | 9,58 | 8,84 | 11,05 | 6,13 | 8,09 | 11,11 |
| Novi Sad | 0,25 | 2,71 | 4,07 | 5,39 | 8,22 | 7,66 | 6,92 | 9,13 | 4,21 | 6,17 | 9,19 |
| Subotica | 0,10 | 3,60 | 4,96 | 6,28 | 9,11 | 8,55 | 7,81 | 10,02 | 5,10 | 7,06 | 10,08 |
| Budapest | 1,74 | 5,27 | 6,63 | 7,95 | 10,78 | 10,22 | 9,48 | 11,69 | 6,77 | 8,73 | 11,75 |
| Miskolc | 0,17 | 6,74 | 8,10 | 9,42 | 12,25 | 11,69 | 10,95 | 13,16 | 8,24 | 10,20 | 13,22 |
| Trnava | 0,07 | 6,73 | 8,09 | 9,41 | 12,24 | 11,68 | 10,94 | 13,15 | 8,23 | 10,19 | 13,21 |
| Žilina + Trenčin | 0,14 | 8,02 | 9,38 | 10,70 | 13,53 | 12,97 | 12,23 | 14,44 | 9,52 | 11,48 | 14,50 |
| Györ | 0,13 | 6,31 | 7,67 | 8,99 | 11,82 | 11,26 | 10,52 | 12,73 | 7,81 | 9,77 | 12,79 |
| Bratislava | 0,42 | 7,01 | 8,37 | 9,69 | 12,52 | 11,96 | 11,22 | 13,43 | 8,51 | 10,47 | 13,49 |
| Ostrava | 0,30 | 9,04 | 10,40 | 11,72 | 14,55 | 13,99 | 13,25 | 15,46 | 10,54 | 12,50 | 15,52 |
| Katowice, ... | 2,04 | 9,79 | 11,15 | 12,47 | 15,30 | 14,74 | 14,00 | 16,21 | 11,29 | 13,25 | 16,27 |
| Brno | 0,39 | 8,18 | 9,54 | 10,86 | 13,69 | 13,13 | 12,39 | 14,60 | 9,68 | 11,64 | 14,66 |
| Praha | 1,27 | 10,05 | 11,41 | 12,73 | 15,56 | 15,00 | 14,26 | 16,47 | 11,55 | 13,51 | 16,53 |
| Wien | 1,84 | 7,46 | 8,82 | 10,14 | 12,97 | 12,41 | 11,67 | 13,88 | 8,96 | 10,92 | 13,94 |
| Linz + Wels | 0,20 | 8,99 | 10,35 | 11,67 | 14,50 | 13,94 | 13,20 | 15,41 | 10,49 | 12,45 | 15,47 |
| Regensburg | 0,15 | 10,81 | 12,17 | 13,49 | 16,32 | 15,76 | 15,02 | 17,23 | 12,31 | 14,27 | 17,29 |
| Nürnberg, Fürth, ... | 0,74 | 11,68 | 13,04 | 14,36 | 17,19 | 16,63 | 15,89 | 18,10 | 13,18 | 15,14 | 18,16 |
| Frankfurt, ... | 1,60 | 13,62 | 14,98 | 16,30 | 19,13 | 18,57 | 17,83 | 20,04 | 15,12 | 17,08 | 20,10 |
| Vinkovci, Osijek, ... | 0,17 | 3,39 | 4,75 | 6,07 | 8,90 | 8,34 | 7,60 | 9,81 | 4,89 | 6,85 | 9,87 |
| Pecs | 0,15 | 4,33 | 5,69 | 7,01 | 9,84 | 9,28 | 8,54 | 10,75 | 5,83 | 7,79 | 10,81 |
| Sarajewo | 0,53 | 4,93 | 6,29 | 7,61 | 10,44 | 9,88 | 9,14 | 11,35 | 6,43 | 8,39 | 11,41 |
| Mostar | 0,13 | 5,64 | 7,00 | 8,32 | 11,15 | 10,59 | 9,85 | 12,06 | 7,14 | 9,10 | 12,12 |
| Zagreb | 0,79 | 5,71 | 7,07 | 8,39 | 11,22 | 10,66 | 9,92 | 12,13 | 7,21 | 9,17 | 12,19 |
| Maribor | 0,09 | 6,57 | 7,93 | 9,25 | 12,08 | 11,52 | 10,78 | 12,99 | 8,07 | 10,03 | 13,05 |
| Graz | 0,28 | 7,13 | 8,49 | 9,81 | 12,64 | 12,08 | 11,34 | 13,55 | 8,63 | 10,59 | 13,61 |
| Rijeka | 0,13 | 7,01 | 8,37 | 9,69 | 12,52 | 11,96 | 11,22 | 13,43 | 8,51 | 10,47 | 13,49 |
| Zadar | 0,08 | 7,67 | 9,03 | 10,35 | 13,18 | 12,62 | 11,88 | 14,09 | 9,17 | 11,13 | 14,15 |
| Split | 0,18 | 8,29 | 9,65 | 10,97 | 13,80 | 13,24 | 12,50 | 14,71 | 9,79 | 11,75 | 14,77 |
| Ljubljana | 0,29 | 6,85 | 8,21 | 9,53 | 12,36 | 11,80 | 11,06 | 13,27 | 8,35 | 10,31 | 13,33 |
| Trieste | 0,20 | 7,59 | 8,95 | 10,27 | 13,10 | 12,54 | 11,80 | 14,01 | 9,09 | 11,05 | 14,07 |
| Venezia + Treviso | 0,34 | 8,74 | 10,10 | 11,42 | 14,25 | 13,69 | 12,95 | 15,16 | 10,24 | 12,20 | 15,22 |
| Padova | 0,21 | 9,08 | 10,44 | 11,76 | 14,59 | 14,03 | 13,29 | 15,50 | 10,58 | 12,54 | 15,56 |
| Bologna | 0,39 | 10,19 | 11,55 | 12,87 | 15,70 | 15,14 | 14,40 | 16,61 | 11,69 | 13,65 | 16,67 |
| Verona | 0,26 | 9,73 | 11,09 | 12,41 | 15,24 | 14,68 | 13,94 | 16,15 | 11,23 | 13,19 | 16,21 |
| Milano | 1,35 | 11,15 | 12,51 | 13,83 | 16,66 | 16,10 | 15,36 | 17,57 | 12,65 | 14,61 | 17,63 |
| Klagenfurt + Villach | 0,16 | 7,69 | 9,05 | 10,37 | 13,20 | 12,64 | 11,90 | 14,11 | 9,19 | 11,15 | 14,17 |
| Salzburg | 0,15 | 9,09 | 10,45 | 11,77 | 14,60 | 14,04 | 13,30 | 15,51 | 10,59 | 12,55 | 15,57 |
| München | 1,45 | 10,27 | 11,63 | 12,95 | 15,78 | 15,22 | 14,48 | 16,69 | 11,77 | 13,73 | 16,75 |
| Augsburg | 0,29 | 10,83 | 12,19 | 13,51 | 16,34 | 15,78 | 15,04 | 17,25 | 12,33 | 14,29 | 17,31 |
| Stuttgart | 0,62 | 12,17 | 13,53 | 14,85 | 17,68 | 17,12 | 16,38 | 18,59 | 13,67 | 15,63 | 18,65 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Beograd | 0,099 | 0,191 | 0,051 | 0,013 | 0,009 | 0,008 | 0,483 | 0,079 | 0,023 | 0,122 |
| Timişoara | 0,012 | 0,030 | 0,009 | 0,003 | 0,002 | 0,002 | 0,100 | 0,013 | 0,004 | 0,025 |
| Arad | 0,005 | 0,013 | 0,004 | 0,001 | 0,001 | 0,001 | 0,047 | 0,006 | 0,002 | 0,012 |
| Oradea | 0,004 | 0,012 | 0,004 | 0,001 | 0,001 | 0,001 | 0,049 | 0,005 | 0,002 | 0,013 |
| Novi Sad | 0,012 | 0,028 | 0,008 | 0,002 | 0,002 | 0,001 | 0,085 | 0,012 | 0,004 | 0,022 |
| Subotica | 0,003 | 0,008 | 0,003 | 0,001 | 0,001 | 0,000 | 0,029 | 0,003 | 0,001 | 0,007 |
| Budapest | 0,027 | 0,084 | 0,029 | 0,010 | 0,007 | 0,006 | 0,390 | 0,036 | 0,014 | 0,099 |
| Miskolc | 0,002 | 0,006 | 0,002 | 0,001 | 0,001 | 0,000 | 0,031 | 0,003 | 0,001 | 0,008 |
| Trnava | 0,001 | 0,002 | 0,001 | 0,000 | 0,000 | 0,000 | 0,013 | 0,001 | 0,000 | 0,003 |
| Žilina + Trenčin | 0,001 | 0,004 | 0,001 | 0,001 | 0,000 | 0,000 | 0,022 | 0,002 | 0,001 | 0,006 |
| Györ | 0,001 | 0,005 | 0,002 | 0,001 | 0,000 | 0,000 | 0,025 | 0,002 | 0,001 | 0,006 |
| Bratislava | 0,004 | 0,014 | 0,005 | 0,002 | 0,001 | 0,001 | 0,074 | 0,006 | 0,003 | 0,019 |
| Ostrava | 0,002 | 0,007 | 0,003 | 0,001 | 0,001 | 0,001 | 0,042 | 0,003 | 0,001 | 0,011 |
| Katowice + Krakow | 0,011 | 0,041 | 0,016 | 0,007 | 0,004 | 0,003 | 0,263 | 0,018 | 0,008 | 0,067 |
| Brno | 0,003 | 0,010 | 0,004 | 0,002 | 0,001 | 0,001 | 0,060 | 0,004 | 0,002 | 0,015 |
| Praha | 0,007 | 0,025 | 0,010 | 0,004 | 0,003 | 0,002 | 0,159 | 0,011 | 0,005 | 0,040 |
| Wien | 0,016 | 0,055 | 0,020 | 0,008 | 0,005 | 0,004 | 0,308 | 0,024 | 0,010 | 0,078 |
| Linz + Wels | 0,001 | 0,005 | 0,002 | 0,001 | 0,000 | 0,000 | 0,028 | 0,002 | 0,001 | 0,007 |
| Regensburg | 0,001 | 0,003 | 0,001 | 0,000 | 0,000 | 0,000 | 0,017 | 0,001 | 0,001 | 0,004 |
| Nürnberg, Fürth, ... | 0,003 | 0,011 | 0,005 | 0,002 | 0,001 | 0,001 | 0,079 | 0,005 | 0,002 | 0,020 |
| Frankfurt, ... | 0,005 | 0,019 | 0,008 | 0,003 | 0,002 | 0,002 | 0,144 | 0,009 | 0,004 | 0,037 |
| Vinkovci, Osijek, ... | 0,006 | 0,015 | 0,005 | 0,001 | 0,001 | 0,001 | 0,051 | 0,006 | 0,002 | 0,013 |
| Pecs | 0,003 | 0,009 | 0,003 | 0,001 | 0,001 | 0,001 | 0,039 | 0,004 | 0,002 | 0,010 |
| Sarajewo | 0,009 | 0,028 | 0,010 | 0,003 | 0,002 | 0,002 | 0,125 | 0,012 | 0,005 | 0,032 |
| Mostar | 0,002 | 0,006 | 0,002 | 0,001 | 0,000 | 0,000 | 0,028 | 0,002 | 0,001 | 0,007 |
| Zagreb | 0,011 | 0,034 | 0,012 | 0,004 | 0,003 | 0,002 | 0,166 | 0,015 | 0,006 | 0,042 |
| Maribor | 0,001 | 0,003 | 0,001 | 0,000 | 0,000 | 0,000 | 0,017 | 0,001 | 0,001 | 0,004 |
| Graz | 0,003 | 0,009 | 0,003 | 0,001 | 0,001 | 0,001 | 0,049 | 0,004 | 0,002 | 0,012 |
| Rijeka | 0,001 | 0,004 | 0,002 | 0,001 | 0,000 | 0,000 | 0,023 | 0,002 | 0,001 | 0,006 |
| Zadar | 0,001 | 0,002 | 0,001 | 0,000 | 0,000 | 0,000 | 0,013 | 0,001 | 0,000 | 0,003 |
| Split | 0,001 | 0,005 | 0,002 | 0,001 | 0,000 | 0,000 | 0,027 | 0,002 | 0,001 | 0,007 |
| Ljubljana | 0,003 | 0,010 | 0,004 | 0,001 | 0,001 | 0,001 | 0,052 | 0,004 | 0,002 | 0,013 |
| Trieste | 0,002 | 0,006 | 0,002 | 0,001 | 0,001 | 0,000 | 0,033 | 0,003 | 0,001 | 0,008 |
| Venezia + Treviso | 0,002 | 0,008 | 0,003 | 0,001 | 0,001 | 0,001 | 0,049 | 0,004 | 0,002 | 0,012 |
| Padova | 0,001 | 0,005 | 0,002 | 0,001 | 0,000 | 0,000 | 0,029 | 0,002 | 0,001 | 0,007 |
| Bologna | 0,002 | 0,007 | 0,003 | 0,001 | 0,001 | 0,001 | 0,048 | 0,003 | 0,002 | 0,012 |
| Verona | 0,001 | 0,005 | 0,002 | 0,001 | 0,001 | 0,000 | 0,034 | 0,002 | 0,001 | 0,009 |
| Milano | 0,006 | 0,022 | 0,009 | 0,004 | 0,002 | 0,002 | 0,151 | 0,010 | 0,005 | 0,039 |
| Klagenfurt + Villach | 0,001 | 0,005 | 0,002 | 0,001 | 0,000 | 0,000 | 0,026 | 0,002 | 0,001 | 0,007 |
| Salzburg | 0,001 | 0,003 | 0,001 | 0,001 | 0,000 | 0,000 | 0,021 | 0,001 | 0,001 | 0,005 |
| München | 0,007 | 0,027 | 0,011 | 0,004 | 0,003 | 0,002 | 0,178 | 0,012 | 0,006 | 0,045 |
| Augsburg | 0,001 | 0,005 | 0,002 | 0,001 | 0,001 | 0,000 | 0,034 | 0,002 | 0,001 | 0,009 |
| Stuttgart | 0,002 | 0,009 | 0,004 | 0,002 | 0,001 | 0,001 | 0,063 | 0,004 | 0,002 | 0,016 |

6,688

# Białystok - Kaunas

| | | Kaunas | Vilnius | Daugavpils | Pskow | St. Petersburg | Riga | Tallinn | Helsinki + Espoo | Lahti | Tampere |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0,31 | 0,54 | 0,09 | 0,21 | 4,99 | 0,64 | 0,41 | 0,90 | 0,10 | 0,23 |
| Białystok | 0,29 | 2,00 | 2,90 | 4,46 | 6,88 | 9,50 | 4,23 | 7,04 | 7,86 | 8,84 | 9,46 |
| Warszawa | 1,71 | 3,78 | 4,68 | 6,24 | 8,66 | 11,28 | 6,01 | 8,82 | 9,64 | 10,62 | 11,24 |
| Lublin | 0,35 | 5,34 | 6,24 | 7,80 | 10,22 | 12,84 | 7,57 | 10,38 | 11,20 | 12,18 | 12,80 |
| Lviv | 0,72 | 7,21 | 8,11 | 9,67 | 12,09 | 14,71 | 9,44 | 12,25 | 13,07 | 14,05 | 14,67 |
| Krakow | 0,76 | 6,31 | 7,21 | 8,77 | 11,19 | 13,81 | 8,54 | 11,35 | 12,17 | 13,15 | 13,77 |
| Tarnov | 0,11 | 7,05 | 7,95 | 9,51 | 11,93 | 14,55 | 9,28 | 12,09 | 12,91 | 13,89 | 14,51 |
| Kosice | 0,24 | 8,82 | 9,72 | 11,28 | 13,70 | 16,32 | 11,05 | 13,86 | 14,68 | 15,66 | 16,28 |
| Katowice | 1,28 | 6,36 | 7,26 | 8,82 | 11,24 | 13,86 | 8,59 | 11,40 | 12,22 | 13,20 | 13,82 |
| Ostrava | 0,30 | 7,11 | 8,01 | 9,57 | 11,99 | 14,61 | 9,34 | 12,15 | 12,97 | 13,95 | 14,57 |
| Brno | 0,39 | 8,54 | 9,44 | 11,00 | 13,42 | 16,04 | 10,77 | 13,58 | 14,40 | 15,38 | 16,00 |
| Wien | 1,84 | 9,26 | 10,16 | 11,72 | 14,14 | 16,76 | 11,49 | 14,30 | 15,12 | 16,10 | 16,72 |
| Bratislava | 0,42 | 9,14 | 10,04 | 11,60 | 14,02 | 16,64 | 11,37 | 14,18 | 15,00 | 15,98 | 16,60 |
| Budapest | 1,74 | 10,88 | 11,78 | 13,34 | 15,76 | 18,38 | 13,11 | 15,92 | 16,74 | 17,72 | 18,34 |
| Łodz | 0,72 | 4,94 | 5,84 | 7,40 | 9,82 | 12,44 | 7,17 | 9,98 | 10,80 | 11,78 | 12,40 |
| Wrocław | 0,63 | 6,79 | 7,69 | 9,25 | 11,67 | 14,29 | 9,02 | 11,83 | 12,65 | 13,63 | 14,25 |
| Praha | 1,27 | 9,03 | 9,93 | 11,49 | 13,91 | 16,53 | 11,26 | 14,07 | 14,89 | 15,87 | 16,49 |
| Poznań | 0,55 | 6,84 | 7,74 | 9,30 | 11,72 | 14,34 | 9,07 | 11,88 | 12,70 | 13,68 | 14,30 |
| Berlin | 3,66 | 9,26 | 10,16 | 11,72 | 14,14 | 16,76 | 11,49 | 14,30 | 15,12 | 16,10 | 16,72 |
| Leipzig + Halle | 0,75 | 10,72 | 11,62 | 13,18 | 15,60 | 18,22 | 12,95 | 15,76 | 16,58 | 17,56 | 18,18 |
| Hannover | 0,51 | 11,85 | 12,75 | 14,31 | 16,73 | 19,35 | 14,08 | 16,89 | 17,71 | 18,69 | 19,31 |
| Hamburg | 1,79 | 11,79 | 12,69 | 14,25 | 16,67 | 19,29 | 14,02 | 16,83 | 17,65 | 18,63 | 19,25 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Białystok | 0,028 | 0,026 | 0,002 | 0,002 | 0,032 | 0,016 | 0,004 | 0,008 | 0,001 | 0,001 |
| Warszawa | 0,055 | 0,067 | 0,007 | 0,009 | 0,139 | 0,052 | 0,017 | 0,033 | 0,003 | 0,006 |
| Lublin | 0,006 | 0,008 | 0,001 | 0,001 | 0,023 | 0,007 | 0,003 | 0,005 | 0,000 | 0,001 |
| Lviv | 0,008 | 0,011 | 0,001 | 0,002 | 0,037 | 0,010 | 0,004 | 0,008 | 0,001 | 0,002 |
| Krakow | 0,010 | 0,014 | 0,002 | 0,003 | 0,044 | 0,013 | 0,005 | 0,010 | 0,001 | 0,002 |
| Tarnov | 0,001 | 0,002 | 0,000 | 0,000 | 0,006 | 0,002 | 0,001 | 0,001 | 0,000 | 0,000 |
| Kosice | 0,002 | 0,003 | 0,000 | 0,001 | 0,010 | 0,003 | 0,001 | 0,002 | 0,000 | 0,000 |
| Katowice | 0,017 | 0,024 | 0,003 | 0,004 | 0,073 | 0,021 | 0,008 | 0,016 | 0,002 | 0,003 |
| Ostrava | 0,003 | 0,005 | 0,001 | 0,001 | 0,016 | 0,004 | 0,002 | 0,003 | 0,000 | 0,001 |
| Brno | 0,003 | 0,005 | 0,001 | 0,001 | 0,017 | 0,004 | 0,002 | 0,004 | 0,000 | 0,001 |
| Wien | 0,013 | 0,019 | 0,003 | 0,004 | 0,076 | 0,019 | 0,008 | 0,016 | 0,002 | 0,004 |
| Bratislava | 0,003 | 0,004 | 0,001 | 0,001 | 0,018 | 0,004 | 0,002 | 0,004 | 0,000 | 0,001 |
| Budapest | 0,009 | 0,014 | 0,002 | 0,003 | 0,062 | 0,014 | 0,006 | 0,013 | 0,001 | 0,003 |
| Łodz | 0,015 | 0,019 | 0,002 | 0,003 | 0,049 | 0,016 | 0,006 | 0,011 | 0,001 | 0,002 |
| Wrocław | 0,008 | 0,011 | 0,001 | 0,002 | 0,034 | 0,010 | 0,004 | 0,008 | 0,001 | 0,002 |
| Praha | 0,009 | 0,014 | 0,002 | 0,003 | 0,054 | 0,013 | 0,006 | 0,012 | 0,001 | 0,002 |
| Poznań | 0,006 | 0,009 | 0,001 | 0,002 | 0,030 | 0,008 | 0,003 | 0,007 | 0,001 | 0,001 |
| Berlin | 0,026 | 0,038 | 0,005 | 0,009 | 0,151 | 0,037 | 0,016 | 0,033 | 0,003 | 0,007 |
| Leipzig + Halle | 0,004 | 0,006 | 0,001 | 0,001 | 0,027 | 0,006 | 0,003 | 0,006 | 0,001 | 0,001 |
| Hannover | 0,002 | 0,004 | 0,000 | 0,001 | 0,017 | 0,004 | 0,002 | 0,003 | 0,000 | 0,001 |
| Hamburg | 0,008 | 0,013 | 0,002 | 0,003 | 0,058 | 0,013 | 0,006 | 0,012 | 0,001 | 0,003 |

2,287

## Bologna - Firenze

| | | Firenze | Livorno + Pisa | Roma | Napoli | Bari | Taranto + Brindisi | Reggio C. + Messina | Palermo |
|---|---|---|---|---|---|---|---|---|---|
| | | 0,36 | 0,25 | 2,87 | 1,00 | 0,31 | 0,29 | 0,24 | 0,66 |
| Bologna | 0,39 | 0,78 | 1,54 | 3,08 | 4,92 | 6,16 | 6,96 | 8,22 | 10,19 |
| Milano | 1,35 | 2,76 | 3,52 | 5,06 | 6,90 | 8,14 | 8,94 | 10,20 | 12,17 |
| Torino | 0,89 | 4,01 | 4,77 | 6,31 | 8,15 | 9,39 | 10,19 | 11,45 | 13,42 |
| Lyon | 2,19 | 6,34 | 7,10 | 8,64 | 10,48 | 11,72 | 12,52 | 13,78 | 15,75 |
| Paris | 12,40 | 10,30 | 11,06 | 12,60 | 14,44 | 15,68 | 16,48 | 17,74 | 19,71 |
| Genève | 0,20 | 5,25 | 6,01 | 7,55 | 9,39 | 10,63 | 11,43 | 12,69 | 14,66 |
| Bern | 0,14 | 4,86 | 5,62 | 7,16 | 9,00 | 10,24 | 11,04 | 12,30 | 14,27 |
| Zürich | 0,40 | 4,96 | 5,72 | 7,26 | 9,10 | 10,34 | 11,14 | 12,40 | 14,37 |
| Basel | 0,18 | 5,69 | 6,45 | 7,99 | 9,83 | 11,07 | 11,87 | 13,13 | 15,10 |
| Mannheim-L. | 0,63 | 8,09 | 8,85 | 10,39 | 12,23 | 13,47 | 14,27 | 15,53 | 17,50 |
| Frankfurt | 1,60 | 8,82 | 9,58 | 11,12 | 12,96 | 14,20 | 15,00 | 16,26 | 18,23 |
| Verona | 0,26 | 1,85 | 2,61 | 4,15 | 5,99 | 7,23 | 8,03 | 9,29 | 11,26 |
| Trento | 0,11 | 2,56 | 3,32 | 4,86 | 6,70 | 7,94 | 8,74 | 10,00 | 11,97 |
| Bozen/Bolzano | 0,10 | 3,06 | 3,82 | 5,36 | 7,20 | 8,44 | 9,24 | 10,50 | 12,47 |
| Innsbruck | 0,13 | 3,90 | 4,66 | 6,20 | 8,04 | 9,28 | 10,08 | 11,34 | 13,31 |
| München | 1,45 | 4,94 | 5,70 | 7,24 | 9,08 | 10,32 | 11,12 | 12,38 | 14,35 |
| Augsburg | 0,29 | 5,50 | 6,26 | 7,80 | 9,64 | 10,88 | 11,68 | 12,94 | 14,91 |
| Stuttgart | 0,62 | 6,84 | 7,60 | 9,14 | 10,98 | 12,22 | 13,02 | 14,28 | 16,25 |
| Nürnberg | 0,74 | 6,42 | 7,18 | 8,72 | 10,56 | 11,80 | 12,60 | 13,86 | 15,83 |
| Padova | 0,21 | 1,89 | 2,65 | 4,19 | 6,03 | 7,27 | 8,07 | 9,33 | 11,30 |
| Venezia | 0,34 | 2,23 | 2,99 | 4,53 | 6,37 | 7,61 | 8,41 | 9,67 | 11,64 |
| Klagenft.+Vill. | 0,16 | 4,28 | 5,04 | 6,58 | 8,42 | 9,66 | 10,46 | 11,72 | 13,69 |
| Graz | 0,28 | 5,28 | 6,04 | 7,58 | 9,42 | 10,66 | 11,46 | 12,72 | 14,69 |
| Wien | 1,84 | 6,78 | 7,54 | 9,08 | 10,92 | 12,16 | 12,96 | 14,22 | 16,19 |
| Brno | 0,39 | 7,83 | 8,59 | 10,13 | 11,97 | 13,21 | 14,01 | 15,27 | 17,24 |
| Ostrava | 0,30 | 8,93 | 9,69 | 11,23 | 13,07 | 14,31 | 15,11 | 16,37 | 18,34 |
| Katowice+...*) | 1,73 | 9,68 | 10,44 | 11,98 | 13,82 | 15,06 | 15,86 | 17,12 | 19,09 |
| Bratislava | 0,42 | 7,33 | 8,09 | 9,63 | 11,47 | 12,71 | 13,51 | 14,77 | 16,74 |
| Trieste | 0,20 | 3,38 | 4,14 | 5,68 | 7,52 | 8,76 | 9,56 | 10,82 | 12,79 |
| Ljubljana | 0,29 | 4,13 | 4,89 | 6,43 | 8,27 | 9,51 | 10,31 | 11,57 | 13,54 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Bologna | 0,214 | 0,047 | 0,165 | 0,026 | 0,005 | 0,004 | 0,003 | 0,005 |
| Milano | 0,087 | 0,040 | 0,246 | 0,051 | 0,012 | 0,009 | 0,006 | 0,013 |
| Torino | 0,030 | 0,016 | 0,111 | 0,025 | 0,006 | 0,005 | 0,003 | 0,007 |
| Lyon | 0,034 | 0,020 | 0,161 | 0,040 | 0,010 | 0,009 | 0,006 | 0,013 |
| Paris | 0,085 | 0,052 | 0,479 | 0,132 | 0,036 | 0,031 | 0,022 | 0,052 |
| Genève | 0,004 | 0,002 | 0,018 | 0,004 | 0,001 | 0,001 | 0,001 | 0,001 |
| Bern | 0,003 | 0,002 | 0,014 | 0,003 | 0,001 | 0,001 | 0,000 | 0,001 |
| Zürich | 0,009 | 0,005 | 0,039 | 0,009 | 0,002 | 0,002 | 0,001 | 0,003 |
| Basel | 0,003 | 0,002 | 0,015 | 0,004 | 0,001 | 0,001 | 0,001 | 0,001 |
| Mannheim-L. | 0,006 | 0,004 | 0,034 | 0,009 | 0,002 | 0,002 | 0,001 | 0,003 |
| Frankfurt | 0,014 | 0,009 | 0,076 | 0,021 | 0,005 | 0,005 | 0,003 | 0,008 |
| Verona | 0,033 | 0,013 | 0,066 | 0,012 | 0,003 | 0,002 | 0,001 | 0,003 |
| Trento | 0,008 | 0,004 | 0,021 | 0,004 | 0,001 | 0,001 | 0,001 | 0,001 |
| Bozen/Bolzano | 0,005 | 0,003 | 0,017 | 0,003 | 0,001 | 0,001 | 0,000 | 0,001 |
| Innsbruck | 0,005 | 0,002 | 0,017 | 0,004 | 0,001 | 0,001 | 0,001 | 0,001 |
| München | 0,035 | 0,019 | 0,144 | 0,034 | 0,009 | 0,007 | 0,005 | 0,010 |
| Augsburg | 0,006 | 0,003 | 0,025 | 0,006 | 0,002 | 0,001 | 0,001 | 0,002 |
| Stuttgart | 0,008 | 0,005 | 0,041 | 0,011 | 0,003 | 0,002 | 0,002 | 0,004 |
| Nürnberg | 0,011 | 0,006 | 0,053 | 0,013 | 0,003 | 0,003 | 0,002 | 0,004 |
| Padova | 0,026 | 0,010 | 0,053 | 0,010 | 0,002 | 0,002 | 0,001 | 0,002 |
| Venezia | 0,031 | 0,013 | 0,075 | 0,015 | 0,003 | 0,003 | 0,002 | 0,003 |
| Klagenft.+Vill. | 0,005 | 0,003 | 0,019 | 0,004 | 0,001 | 0,001 | 0,001 | 0,001 |
| Graz | 0,006 | 0,003 | 0,026 | 0,006 | 0,002 | 0,001 | 0,001 | 0,002 |
| Wien | 0,026 | 0,015 | 0,124 | 0,032 | 0,008 | 0,007 | 0,005 | 0,011 |
| Brno | 0,004 | 0,003 | 0,022 | 0,006 | 0,002 | 0,001 | 0,001 | 0,002 |
| Ostrava | 0,003 | 0,002 | 0,014 | 0,004 | 0,001 | 0,001 | 0,001 | 0,001 |
| Katowice+...*) | 0,013 | 0,008 | 0,073 | 0,020 | 0,005 | 0,005 | 0,003 | 0,008 |
| Bratislava | 0,005 | 0,003 | 0,026 | 0,007 | 0,002 | 0,001 | 0,001 | 0,002 |
| Trieste | 0,009 | 0,004 | 0,030 | 0,006 | 0,002 | 0,001 | 0,001 | 0,002 |
| Ljubljana | 0,009 | 0,005 | 0,035 | 0,008 | 0,002 | 0,002 | 0,001 | 0,002 |

4,324

# Brasov - Ploesti

| | | Ploeşti | Buzau | Braila + Galaţi | Bucureşti | Constanţa | Ruse | Shumen | Varna | Stara Zagora, Plovdiv, Sliven | Istanbul | Pleven | Sofia | Craiova | Drobeta Turnu Severin |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0,22 | 0,12 | 0,50 | 1,88 | 0,30 | 0,15 | 0,08 | 0,33 | 0,57 | 14,66 | 0,11 | 1,21 | 0,29 | 0,10 |
| Brasov | 0,28 | 0,86 | 1,51 | 2,45 | 1,42 | 3,45 | 2,11 | 3,11 | 3,90 | 3,68 | 6,96 | 3,29 | 4,61 | 3,24 | 4,23 |
| Sibiu | 0,43 | 1,69 | 2,34 | 3,28 | 2,25 | 4,28 | 2,94 | 3,94 | 4,73 | 4,51 | 7,79 | 4,12 | 5,44 | 4,07 | 5,06 |
| Cluj | 0,30 | 2,86 | 3,51 | 4,45 | 3,42 | 5,45 | 4,11 | 5,11 | 5,90 | 5,68 | 8,96 | 5,29 | 6,61 | 5,24 | 6,23 |
| Baia Mare | 0,12 | 3,85 | 4,50 | 5,44 | 4,41 | 6,44 | 5,10 | 6,10 | 6,89 | 6,67 | 9,95 | 6,28 | 7,60 | 6,23 | 7,22 |
| Satu Mare | 0,11 | 4,40 | 5,05 | 5,99 | 4,96 | 6,99 | 5,65 | 6,65 | 7,44 | 7,22 | 10,50 | 6,83 | 8,15 | 6,78 | 7,77 |
| Arad | 0,16 | 3,89 | 4,54 | 5,48 | 4,45 | 6,48 | 5,14 | 6,14 | 6,93 | 6,71 | 9,99 | 6,32 | 7,64 | 6,27 | 7,26 |
| Oradea | 0,20 | 4,99 | 5,64 | 6,58 | 5,55 | 7,58 | 6,24 | 7,24 | 8,03 | 7,81 | 11,09 | 7,42 | 8,74 | 7,37 | 8,36 |
| Budapest | 1,74 | 6,13 | 6,78 | 7,72 | 6,69 | 8,72 | 7,38 | 8,38 | 9,17 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Trnava | 0,07 | 7,59 | 8,24 | 9,18 | 8,15 | 10,18 | 8,84 | 9,84 | 10,63 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Zilina + Trencin | 0,14 | 8,88 | 9,53 | 10,47 | 9,44 | 11,47 | 10,13 | 11,13 | 11,92 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Györ | 0,13 | 7,17 | 7,82 | 8,76 | 7,73 | 9,76 | 8,42 | 9,42 | 10,21 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Bratislava | 0,42 | 7,87 | 8,52 | 9,46 | 8,43 | 10,46 | 9,12 | 10,12 | 10,91 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Ostrava | 0,30 | 9,90 | 10,55 | 11,49 | 10,46 | 12,49 | 11,15 | 12,15 | 12,94 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Katowice | 1,28 | 10,65 | 11,30 | 12,24 | 11,21 | 13,24 | 11,90 | 12,90 | 13,69 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Krakow | 0,76 | 11,11 | 11,76 | 12,70 | 11,67 | 13,70 | 12,36 | 13,36 | 14,15 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Warszawa | 1,71 | 13,23 | 13,88 | 14,82 | 13,79 | 15,82 | 14,48 | 15,48 | 16,27 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Brno | 0,39 | 9,04 | 9,69 | 10,63 | 9,60 | 11,63 | 10,29 | 11,29 | 12,08 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Praha | 1,27 | 10,91 | 11,56 | 12,50 | 11,47 | 13,50 | 12,16 | 13,16 | 13,95 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Wien | 1,84 | 8,32 | 8,97 | 9,91 | 8,88 | 10,91 | 9,57 | 10,57 | 11,36 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Linz + Wels | 0,26 | 9,85 | 10,50 | 11,44 | 10,41 | 12,44 | 11,10 | 12,10 | 12,89 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Regensburg | 0,15 | 11,67 | 12,32 | 13,26 | 12,23 | 14,26 | 12,92 | 13,92 | 14,71 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Nürnberg | 0,74 | 12,54 | 13,19 | 14,13 | 13,10 | 15,13 | 13,79 | 14,79 | 15,58 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Frankfurt | 1,60 | 14,48 | 15,13 | 16,07 | 15,04 | 17,07 | 15,73 | 16,73 | 17,52 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Salzburg | 0,15 | 10,97 | 11,62 | 12,56 | 11,53 | 13,56 | 12,22 | 13,22 | 14,01 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| München | 1,45 | 12,15 | 12,80 | 13,74 | 12,71 | 14,74 | 13,40 | 14,40 | 15,19 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Ausburg | 0,29 | 12,71 | 13,36 | 14,30 | 13,27 | 15,30 | 13,96 | 14,96 | 15,75 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Stuttgart | 0,62 | 14,05 | 14,70 | 15,64 | 14,61 | 16,64 | 15,30 | 16,30 | 17,09 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Zürich | 0,40 | 14,47 | 15,12 | 16,06 | 15,03 | 17,06 | 15,72 | 16,72 | 17,51 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Timioşara | 0,32 | 4,24 | 4,89 | 5,83 | 4,80 | 6,83 | 5,49 | 6,49 | 7,28 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Beograd | 1,35 | 5,43 | 6,08 | 7,02 | 5,99 | 8,02 | 6,68 | 7,68 | 8,47 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Brasov | 0,080 | 0,017 | 0,031 | 0,290 | 0,010 | 0,012 | 0,003 | 0,009 | 0,017 | 0,152 | 0,004 | 0,025 | 0,011 | 0,002 |
| Sibiu | 0,039 | 0,012 | 0,029 | 0,204 | 0,011 | 0,010 | 0,003 | 0,010 | 0,019 | 0,192 | 0,004 | 0,029 | 0,011 | 0,003 |
| Cluj | 0,011 | 0,004 | 0,012 | 0,070 | 0,005 | 0,004 | 0,001 | 0,005 | 0,009 | 0,106 | 0,002 | 0,015 | 0,005 | 0,001 |
| Baia Mare | 0,003 | 0,001 | 0,003 | 0,018 | 0,002 | 0,001 | 0,000 | 0,001 | 0,003 | 0,035 | 0,001 | 0,005 | 0,002 | 0,000 |
| Satu Mare | 0,002 | 0,001 | 0,003 | 0,014 | 0,001 | 0,001 | 0,000 | 0,001 | 0,002 | 0,030 | 0,000 | 0,004 | 0,001 | 0,000 |
| Arad | 0,003 | 0,001 | 0,004 | 0,024 | 0,002 | 0,001 | 0,001 | 0,002 | 0,004 | 0,047 | 0,001 | 0,006 | 0,002 | 0,001 |
| Oradea | 0,003 | 0,001 | 0,004 | 0,020 | 0,002 | 0,001 | 0,001 | 0,002 | 0,003 | 0,049 | 0,001 | 0,006 | 0,002 | 0,001 |
| Budapest | 0,018 | 0,008 | 0,027 | 0,129 | 0,013 | 0,009 | 0,004 | 0,013 | 0,006 | 0,157 | 0,001 | 0,013 | 0,003 | 0,001 |
| Trnava | 0,000 | 0,000 | 0,001 | 0,004 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 | 0,006 | 0,000 | 0,001 | 0,000 | 0,000 |
| Zilina + Trencin | 0,001 | 0,000 | 0,001 | 0,006 | 0,001 | 0,000 | 0,000 | 0,001 | 0,000 | 0,013 | 0,000 | 0,001 | 0,000 | 0,000 |
| Györ | 0,001 | 0,000 | 0,002 | 0,008 | 0,001 | 0,001 | 0,000 | 0,001 | 0,000 | 0,012 | 0,000 | 0,001 | 0,000 | 0,000 |
| Bratislava | 0,003 | 0,001 | 0,005 | 0,021 | 0,002 | 0,001 | 0,001 | 0,002 | 0,001 | 0,038 | 0,000 | 0,003 | 0,001 | 0,000 |
| Ostrava | 0,001 | 0,001 | 0,002 | 0,010 | 0,001 | 0,001 | 0,000 | 0,001 | 0,001 | 0,027 | 0,000 | 0,002 | 0,001 | 0,000 |
| Katowice | 0,005 | 0,002 | 0,009 | 0,040 | 0,005 | 0,003 | 0,001 | 0,005 | 0,004 | 0,115 | 0,001 | 0,010 | 0,002 | 0,001 |
| Krakow | 0,003 | 0,001 | 0,005 | 0,022 | 0,003 | 0,002 | 0,001 | 0,003 | 0,003 | 0,068 | 0,001 | 0,006 | 0,001 | 0,000 |
| Warszawa | 0,005 | 0,002 | 0,009 | 0,037 | 0,005 | 0,003 | 0,001 | 0,005 | 0,006 | 0,154 | 0,001 | 0,013 | 0,003 | 0,001 |
| Brno | 0,002 | 0,001 | 0,004 | 0,016 | 0,002 | 0,001 | 0,001 | 0,002 | 0,001 | 0,035 | 0,000 | 0,003 | 0,001 | 0,000 |
| Praha | 0,005 | 0,002 | 0,009 | 0,038 | 0,005 | 0,003 | 0,001 | 0,005 | 0,004 | 0,114 | 0,001 | 0,009 | 0,002 | 0,001 |
| Wien | 0,011 | 0,005 | 0,019 | 0,084 | 0,009 | 0,006 | 0,003 | 0,010 | 0,006 | 0,166 | 0,001 | 0,014 | 0,003 | 0,001 |
| Linz + Wels | 0,001 | 0,001 | 0,002 | 0,009 | 0,001 | 0,001 | 0,000 | 0,001 | 0,001 | 0,023 | 0,000 | 0,002 | 0,000 | 0,000 |
| Regensburg | 0,001 | 0,000 | 0,001 | 0,004 | 0,000 | 0,000 | 0,000 | 0,001 | 0,001 | 0,014 | 0,000 | 0,001 | 0,000 | 0,000 |
| Nürnberg | 0,002 | 0,001 | 0,004 | 0,018 | 0,002 | 0,001 | 0,001 | 0,002 | 0,003 | 0,067 | 0,000 | 0,005 | 0,001 | 0,000 |
| Frankfurt | 0,004 | 0,002 | 0,007 | 0,030 | 0,004 | 0,002 | 0,001 | 0,004 | 0,006 | 0,144 | 0,001 | 0,012 | 0,003 | 0,001 |
| Salzburg | 0,001 | 0,000 | 0,001 | 0,004 | 0,001 | 0,000 | 0,000 | 0,001 | 0,001 | 0,014 | 0,000 | 0,001 | 0,000 | 0,000 |
| München | 0,005 | 0,002 | 0,008 | 0,036 | 0,004 | 0,003 | 0,001 | 0,005 | 0,005 | 0,131 | 0,001 | 0,011 | 0,003 | 0,001 |
| Ausburg | 0,001 | 0,000 | 0,002 | 0,007 | 0,001 | 0,000 | 0,000 | 0,001 | 0,001 | 0,026 | 0,000 | 0,002 | 0,001 | 0,000 |
| Stuttgart | 0,002 | 0,001 | 0,003 | 0,012 | 0,002 | 0,001 | 0,000 | 0,002 | 0,002 | 0,056 | 0,000 | 0,005 | 0,001 | 0,000 |
| Zürich | 0,001 | 0,000 | 0,002 | 0,008 | 0,001 | 0,001 | 0,000 | 0,001 | 0,001 | 0,036 | 0,000 | 0,003 | 0,001 | 0,000 |
| Timioşara | 0,006 | 0,003 | 0,008 | 0,042 | 0,004 | 0,003 | 0,001 | 0,004 | 0,001 | 0,029 | 0,000 | 0,002 | 0,001 | 0,000 |
| Beograd | 0,017 | 0,008 | 0,025 | 0,121 | 0,012 | 0,008 | 0,003 | 0,012 | 0,005 | 0,122 | 0,001 | 0,010 | 0,002 | 0,001 |

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|---|
| 4,854 |

# (Bratislava/Wien -) Hegyeshalom - Györ

| | | Györ | Budapest | Miskolc | Nyiregyhaza | Ushgorod | Debrecen | Oradea | Cluj | Arad | Sibiu | Brasov | Bucureşti | Timioşara | Szeged | Belgrade | Niš | Sofia | Plovdiv + ... | Istanbul |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0,13 | 1,74 | 0,17 | 0,12 | 0,20 | 0,21 | 0,20 | 0,30 | 0,16 | 0,43 | 0,28 | 1,88 | 0,32 | 0,17 | 1,23 | 0,26 | 1,21 | 0,57 | 14,66 |
| Bratislava | 0,42 | 0,70 | 1,74 | 3,21 | 3,90 | 4,78 | 3,72 | 3,98 | 5,28 | 3,98 | 6,18 | 7,01 | 8,43 | 4,33 | 3,37 | 4,94 | 6,93 | 8,29 | 9,61 | 13,35 |
| Ostrava | 0,30 | 2,73 | 3,77 | 5,24 | 5,93 | 6,81 | 5,75 | 6,01 | 7,31 | 6,01 | 8,21 | 9,04 | 10,46 | 6,36 | 5,40 | 6,97 | 8,96 | 10,32 | 11,64 | 15,38 |
| Katowice | 1,28 | 3,48 | 4,52 | 5,99 | 6,68 | 7,56 | 6,50 | 6,76 | 8,06 | 6,76 | 8,96 | 9,79 | 11,21 | 7,11 | 6,15 | 7,72 | 9,71 | 11,07 | 12,39 | 16,13 |
| Krakow | 0,76 | 3,74 | 4,78 | 6,25 | 6,94 | 7,82 | 6,76 | 7,02 | 8,32 | 7,02 | 9,22 | 10,05 | 11,47 | 7,37 | 6,41 | 7,98 | 9,97 | 11,33 | 12,65 | 16,39 |
| Warszawa | 1,71 | 6,06 | 7,10 | 8,57 | 9,26 | 10,14 | 9,08 | 9,34 | 10,64 | 9,34 | 11,54 | 12,37 | 13,79 | 9,69 | 8,73 | 10,30 | 12,29 | 13,65 | 14,97 | 18,71 |
| Brno | 0,39 | 1,87 | 2,91 | 4,38 | 5,07 | 5,95 | 4,89 | 5,15 | 6,45 | 5,15 | 7,35 | 8,18 | 9,60 | 5,50 | 4,54 | 6,11 | 8,10 | 9,46 | 10,78 | 14,52 |
| Praha | 1,27 | 3,74 | 4,78 | 6,25 | 6,94 | 7,82 | 6,76 | 7,02 | 8,32 | 7,02 | 9,22 | 10,05 | 11,47 | 7,37 | 6,41 | 7,98 | 9,97 | 11,33 | 12,65 | 16,39 |
| Wien | 1,84 | 1,15 | 2,19 | 3,66 | 4,35 | 5,23 | 4,17 | 4,43 | 5,73 | 4,43 | 6,63 | 7,46 | 8,88 | 4,78 | 3,82 | 5,39 | 7,38 | 8,74 | 10,06 | 13,80 |
| Linz + Wels | 0,26 | 2,68 | 3,72 | 5,19 | 5,88 | 6,76 | 5,70 | 5,96 | 7,26 | 5,96 | 8,16 | 8,99 | 10,41 | 6,31 | 5,35 | 6,92 | 8,91 | 10,27 | 11,59 | 15,33 |
| Passau | 0,06 | 3,41 | 4,45 | 5,92 | 6,61 | 7,49 | 6,43 | 6,69 | 7,99 | 6,69 | 8,89 | 9,72 | 11,14 | 7,04 | 6,08 | 7,65 | 9,64 | 11,00 | 12,32 | 16,06 |
| Regensburg | 0,15 | 4,50 | 5,54 | 7,01 | 7,70 | 8,58 | 7,52 | 7,78 | 9,08 | 7,78 | 9,98 | 10,81 | 12,23 | 8,13 | 7,17 | 8,74 | 10,73 | 12,09 | 13,41 | 17,15 |
| Nürnberg | 0,74 | 5,37 | 6,41 | 7,88 | 8,57 | 9,45 | 8,39 | 8,65 | 9,95 | 8,65 | 10,85 | 11,68 | 13,10 | 9,00 | 8,04 | 9,61 | 11,60 | 12,96 | 14,28 | 18,02 |
| Würzburg | 0,13 | 6,33 | 7,37 | 8,84 | 9,53 | 10,41 | 9,35 | 9,61 | 10,91 | 9,61 | 11,81 | 12,64 | 14,06 | 9,96 | 9,00 | 10,57 | 12,56 | 13,92 | 15,24 | 18,98 |
| Frankfurt | 1,60 | 7,31 | 8,35 | 9,82 | 10,51 | 11,39 | 10,33 | 10,59 | 11,89 | 10,59 | 12,79 | 13,62 | 15,04 | 10,94 | 9,98 | 11,55 | 13,54 | 14,90 | 16,22 | 19,96 |
| Salzburg | 0,15 | 3,80 | 4,84 | 6,31 | 7,00 | 7,88 | 6,82 | 7,08 | 8,38 | 7,08 | 9,28 | 10,11 | 11,53 | 7,43 | 6,47 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| München | 1,45 | 4,98 | 6,02 | 7,49 | 8,18 | 9,06 | 8,00 | 8,26 | 9,56 | 8,26 | 10,46 | 11,29 | 12,71 | 8,61 | 7,65 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Ausburg | 0,29 | 5,54 | 6,58 | 8,05 | 8,74 | 9,62 | 8,56 | 8,82 | 10,12 | 8,82 | 11,02 | 11,85 | 13,27 | 9,17 | 8,21 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Stuttgart | 0,62 | 6,88 | 7,92 | 9,39 | 10,08 | 10,96 | 9,90 | 10,16 | 11,46 | 10,16 | 12,36 | 13,19 | 14,61 | 10,51 | 9,55 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Karlsruhe | 0,31 | 7,49 | 8,53 | 10,00 | 10,69 | 11,57 | 10,51 | 10,77 | 12,07 | 10,77 | 12,97 | 13,80 | 15,22 | 11,12 | 10,16 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Strasbourg | 0,28 | 8,16 | 9,20 | 10,67 | 11,36 | 12,24 | 11,18 | 11,44 | 12,74 | 11,44 | 13,64 | 14,47 | 15,89 | 11,79 | 10,83 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Innsbruck | 0,13 | 5,16 | 6,20 | 7,67 | 8,36 | 9,24 | 8,18 | 8,44 | 9,74 | 8,44 | 10,64 | 11,47 | 12,89 | 8,79 | 7,83 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Vorarlberg | 0,11 | 6,49 | 7,53 | 9,00 | 9,69 | 10,57 | 9,51 | 9,77 | 11,07 | 9,77 | 11,97 | 12,80 | 14,22 | 10,12 | 9,16 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Zürich | 0,40 | 7,30 | 8,34 | 9,81 | 10,50 | 11,38 | 10,32 | 10,58 | 11,88 | 10,58 | 12,78 | 13,61 | 15,03 | 10,93 | 9,97 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Basel | 0,18 | 8,03 | 9,07 | 10,54 | 11,23 | 12,11 | 11,05 | 11,31 | 12,61 | 11,31 | 13,51 | 14,34 | 15,76 | 11,66 | 10,70 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bratislava | 0,100 | 0,285 | 0,010 | 0,005 | 0,006 | 0,009 | 0,008 | 0,007 | 0,006 | 0,008 | 0,004 | 0,021 | 0,011 | 0,009 | 0,034 | 0,004 | 0,014 | 0,005 | 0,075 |
| Ostrava | 0,007 | 0,055 | 0,003 | 0,002 | 0,002 | 0,003 | 0,003 | 0,003 | 0,002 | 0,004 | 0,002 | 0,010 | 0,004 | 0,003 | 0,014 | 0,002 | 0,007 | 0,003 | 0,042 |
| Katowice | 0,020 | 0,171 | 0,010 | 0,006 | 0,008 | 0,011 | 0,010 | 0,011 | 0,008 | 0,013 | 0,007 | 0,040 | 0,015 | 0,010 | 0,049 | 0,007 | 0,026 | 0,010 | 0,166 |
| Krakow | 0,010 | 0,093 | 0,006 | 0,003 | 0,005 | 0,006 | 0,006 | 0,006 | 0,004 | 0,007 | 0,004 | 0,023 | 0,008 | 0,005 | 0,027 | 0,004 | 0,015 | 0,006 | 0,096 |
| Warszawa | 0,010 | 0,106 | 0,008 | 0,005 | 0,007 | 0,008 | 0,008 | 0,009 | 0,006 | 0,012 | 0,007 | 0,037 | 0,012 | 0,007 | 0,040 | 0,006 | 0,024 | 0,010 | 0,172 |
| Brno | 0,017 | 0,110 | 0,005 | 0,003 | 0,004 | 0,006 | 0,005 | 0,005 | 0,004 | 0,006 | 0,003 | 0,016 | 0,007 | 0,005 | 0,022 | 0,003 | 0,010 | 0,004 | 0,061 |
| Praha | 0,018 | 0,155 | 0,010 | 0,006 | 0,008 | 0,010 | 0,009 | 0,010 | 0,007 | 0,013 | 0,007 | 0,038 | 0,014 | 0,009 | 0,046 | 0,007 | 0,025 | 0,010 | 0,160 |
| Wien | 0,189 | 0,845 | 0,034 | 0,018 | 0,022 | 0,034 | 0,029 | 0,028 | 0,023 | 0,032 | 0,017 | 0,084 | 0,041 | 0,032 | 0,129 | 0,016 | 0,056 | 0,021 | 0,311 |
| Linz + Wels | 0,006 | 0,048 | 0,003 | 0,002 | 0,002 | 0,003 | 0,003 | 0,003 | 0,002 | 0,003 | 0,002 | 0,009 | 0,004 | 0,003 | 0,012 | 0,002 | 0,006 | 0,002 | 0,037 |
| Passau | 0,001 | 0,008 | 0,000 | 0,000 | 0,000 | 0,001 | 0,000 | 0,001 | 0,000 | 0,001 | 0,000 | 0,002 | 0,001 | 0,000 | 0,002 | 0,000 | 0,001 | 0,000 | 0,008 |
| Regensburg | 0,002 | 0,014 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,004 | 0,001 | 0,001 | 0,005 | 0,001 | 0,003 | 0,001 | 0,018 |
| Nürnberg | 0,006 | 0,055 | 0,004 | 0,002 | 0,003 | 0,004 | 0,004 | 0,004 | 0,003 | 0,006 | 0,003 | 0,018 | 0,006 | 0,004 | 0,019 | 0,003 | 0,011 | 0,005 | 0,080 |
| Würzburg | 0,001 | 0,008 | 0,001 | 0,000 | 0,000 | 0,001 | 0,001 | 0,001 | 0,000 | 0,001 | 0,000 | 0,003 | 0,001 | 0,001 | 0,003 | 0,000 | 0,002 | 0,001 | 0,013 |
| Frankfurt | 0,007 | 0,075 | 0,006 | 0,004 | 0,005 | 0,006 | 0,006 | 0,007 | 0,005 | 0,009 | 0,005 | 0,030 | 0,009 | 0,005 | 0,031 | 0,005 | 0,020 | 0,008 | 0,145 |
| Salzburg | 0,002 | 0,018 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,004 | 0,002 | 0,001 | 0,001 | 0,000 | 0,001 | 0,001 | 0,014 |
| München | 0,012 | 0,119 | 0,008 | 0,005 | 0,007 | 0,009 | 0,008 | 0,009 | 0,006 | 0,012 | 0,007 | 0,036 | 0,012 | 0,008 | 0,011 | 0,002 | 0,011 | 0,005 | 0,131 |
| Ausburg | 0,002 | 0,021 | 0,001 | 0,001 | 0,001 | 0,002 | 0,001 | 0,002 | 0,001 | 0,002 | 0,001 | 0,007 | 0,002 | 0,001 | 0,002 | 0,000 | 0,002 | 0,001 | 0,026 |
| Stuttgart | 0,003 | 0,032 | 0,002 | 0,001 | 0,002 | 0,003 | 0,002 | 0,003 | 0,002 | 0,004 | 0,002 | 0,012 | 0,004 | 0,002 | 0,005 | 0,001 | 0,005 | 0,002 | 0,056 |
| Karlsruhe | 0,001 | 0,014 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,002 | 0,001 | 0,006 | 0,002 | 0,001 | 0,002 | 0,000 | 0,002 | 0,001 | 0,028 |
| Strasbourg | 0,001 | 0,011 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,005 | 0,001 | 0,001 | 0,002 | 0,000 | 0,002 | 0,001 | 0,025 |
| Innsbruck | 0,001 | 0,010 | 0,001 | 0,000 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,003 | 0,001 | 0,001 | 0,001 | 0,000 | 0,001 | 0,000 | 0,012 |
| Vorarlberg | 0,001 | 0,006 | 0,000 | 0,000 | 0,000 | 0,001 | 0,000 | 0,001 | 0,000 | 0,001 | 0,000 | 0,002 | 0,001 | 0,000 | 0,001 | 0,000 | 0,001 | 0,000 | 0,010 |
| Zürich | 0,002 | 0,019 | 0,001 | 0,001 | 0,001 | 0,002 | 0,001 | 0,002 | 0,001 | 0,002 | 0,001 | 0,008 | 0,002 | 0,001 | 0,003 | 0,001 | 0,003 | 0,001 | 0,036 |
| Basel | 0,001 | 0,007 | 0,001 | 0,000 | 0,001 | 0,001 | 0,001 | 0,001 | 0,000 | 0,001 | 0,001 | 0,003 | 0,001 | 0,001 | 0,001 | 0,000 | 0,001 | 0,001 | 0,016 |

6,942

Bratislava - Györ: 3,076

Wien - Györ: 3,866

# Brest - Minsk

| | | Minsk | Orsha | Smolensk | Moskwa | Yaroslawl | Vladimir | Nishnij Nowgorod | Ryazan | Saransk | Samara | Tambov | Saratov | Volgograd | Voronesh | Homyel | Bryansk | Orël |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1,89 | 0,12 | 0,33 | 12,86 | 0,60 | 0,53 | 1,26 | 0,53 | 0,30 | 1,17 | 0,28 | 0,84 | 1,02 | 1,00 | 0,48 | 0,41 | 0,32 |
| Brest | 0,31 | 3,30 | 5,31 | 6,42 | 10,10 | 12,59 | 11,87 | 13,99 | 11,94 | 15,49 | 18,99 | 14,18 | 17,65 | 19,09 | 14,46 | 6,11 | 8,57 | 9,45 |
| Białystok | 0,29 | 4,52 | 6,53 | 7,64 | 11,32 | 13,81 | 13,09 | 15,21 | 13,16 | 16,71 | 20,21 | 15,40 | 18,87 | 20,31 | 15,68 | 7,33 | 9,79 | 10,67 |
| Warszawa | 1,71 | 5,15 | 7,16 | 8,27 | 11,95 | 14,44 | 13,72 | 15,84 | 13,79 | 17,34 | 20,84 | 16,03 | 19,50 | 20,94 | 16,31 | 7,96 | 10,42 | 11,30 |
| Gdansk + Gdynia | 0,71 | 8,00 | 10,01 | 11,12 | 14,80 | 17,29 | 16,57 | 18,69 | 16,64 | 20,19 | 23,69 | 18,88 | 22,35 | 23,79 | 19,16 | 10,81 | 13,27 | 14,15 |
| Łódź | 0,72 | 6,31 | 8,32 | 9,43 | 13,11 | 15,60 | 14,88 | 17,00 | 14,95 | 18,50 | 22,00 | 17,19 | 20,66 | 22,10 | 17,47 | 9,12 | 11,58 | 12,46 |
| Poznań | 0,55 | 8,21 | 10,22 | 11,33 | 15,01 | 17,50 | 16,78 | 18,90 | 16,85 | 20,40 | 23,90 | 19,09 | 22,56 | 24,00 | 19,37 | 11,02 | 13,48 | 14,36 |
| Szczecin | 0,41 | 10,19 | 12,20 | 13,31 | 16,99 | 19,48 | 18,76 | 20,88 | 18,83 | 22,38 | 25,88 | 21,07 | 24,54 | 25,98 | 21,35 | 13,00 | 15,46 | 16,34 |
| Berlin + Potsdam | 3,66 | 10,63 | 12,64 | 13,75 | 17,43 | 19,92 | 19,20 | 21,32 | 19,27 | 22,82 | 26,32 | 21,51 | 24,98 | 26,42 | 21,79 | 13,44 | 15,90 | 16,78 |
| Hamburg | 1,79 | 13,16 | 15,17 | 16,28 | 19,96 | 22,45 | 21,73 | 23,85 | 21,80 | 25,35 | 28,85 | 24,04 | 27,51 | 28,95 | 24,32 | 15,97 | 18,43 | 19,31 |
| Hannover | 0,51 | 13,09 | 15,10 | 16,21 | 19,89 | 22,38 | 21,66 | 23,78 | 21,73 | 25,28 | 28,78 | 23,97 | 27,44 | 28,88 | 24,25 | 15,90 | 18,36 | 19,24 |
| Leipzig + Halle | 0,36 | 14,55 | 16,56 | 17,67 | 21,35 | 23,84 | 23,12 | 25,24 | 23,19 | 26,74 | 30,24 | 25,43 | 28,90 | 30,34 | 25,71 | 17,36 | 19,82 | 20,70 |
| Wrocław | 0,63 | 8,16 | 10,17 | 11,28 | 14,96 | 17,45 | 16,73 | 18,85 | 16,80 | 20,35 | 23,85 | 19,04 | 22,51 | 23,95 | 19,32 | 10,97 | 13,43 | 14,31 |
| Praha | 1,27 | 10,37 | 12,38 | 13,49 | 17,17 | 19,66 | 18,94 | 21,06 | 19,01 | 22,56 | 26,06 | 21,25 | 24,72 | 26,16 | 21,53 | 13,18 | 15,64 | 16,52 |
| Katowice + ... | 1,28 | 7,73 | 9,74 | 10,85 | 14,53 | 17,02 | 16,30 | 18,42 | 16,37 | 19,92 | 23,42 | 18,61 | 22,08 | 23,52 | 18,89 | 10,54 | 13,00 | 13,88 |
| Ostrava | 0,30 | 8,48 | 10,49 | 11,60 | 15,28 | 17,77 | 17,05 | 19,17 | 17,12 | 20,67 | 24,17 | 19,36 | 22,83 | 24,27 | 19,64 | 11,29 | 13,75 | 14,63 |
| Brno | 0,39 | 9,91 | 11,92 | 13,03 | 16,71 | 19,20 | 18,48 | 20,60 | 18,55 | 22,10 | 25,60 | 20,79 | 24,26 | 25,70 | 21,07 | 12,72 | 15,18 | 16,06 |
| Wien | 1,84 | 10,63 | 12,64 | 13,75 | 17,43 | 19,92 | 19,20 | 21,32 | 19,27 | 22,82 | 26,32 | 21,51 | 24,98 | 26,42 | 21,79 | 13,44 | 15,90 | 16,78 |
| Bratislava | 0,42 | 10,51 | 12,52 | 13,63 | 17,31 | 19,80 | 19,08 | 21,20 | 19,15 | 22,70 | 26,20 | 21,39 | 24,86 | 26,30 | 21,67 | 13,32 | 15,78 | 16,66 |
| Krakow | 0,76 | 7,69 | 9,70 | 10,81 | 14,49 | 16,98 | 16,26 | 18,38 | 16,33 | 19,88 | 23,38 | 18,57 | 22,04 | 23,48 | 18,85 | 10,50 | 12,96 | 13,84 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Brest | | 0,077 | 0,002 | 0,004 | 0,078 | 0,003 | 0,002 | 0,004 | 0,002 | 0,001 | 0,002 | 0,001 | 0,002 | 0,002 | 0,003 | 0,007 | 0,003 | 0,002 |
| Białystok | | 0,042 | 0,001 | 0,003 | 0,060 | 0,002 | 0,002 | 0,004 | 0,002 | 0,001 | 0,002 | 0,001 | 0,002 | 0,002 | 0,003 | 0,005 | 0,002 | 0,002 |
| Warszawa | | 0,199 | 0,007 | 0,016 | 0,324 | 0,011 | 0,011 | 0,020 | 0,010 | 0,004 | 0,011 | 0,004 | 0,009 | 0,010 | 0,015 | 0,024 | 0,013 | 0,009 |
| Gdansk + Gdynia | | 0,039 | 0,002 | 0,004 | 0,094 | 0,003 | 0,003 | 0,006 | 0,003 | 0,001 | 0,004 | 0,001 | 0,003 | 0,003 | 0,005 | 0,006 | 0,004 | 0,003 |
| Łódź | | 0,059 | 0,002 | 0,005 | 0,117 | 0,004 | 0,004 | 0,007 | 0,004 | 0,002 | 0,004 | 0,002 | 0,004 | 0,004 | 0,006 | 0,008 | 0,005 | 0,003 |
| Poznań | | 0,029 | 0,001 | 0,003 | 0,071 | 0,003 | 0,002 | 0,005 | 0,002 | 0,001 | 0,003 | 0,001 | 0,002 | 0,003 | 0,004 | 0,004 | 0,003 | 0,002 |
| Szczecin | | 0,015 | 0,001 | 0,002 | 0,043 | 0,002 | 0,001 | 0,003 | 0,001 | 0,001 | 0,002 | 0,001 | 0,001 | 0,002 | 0,002 | 0,003 | 0,002 | 0,001 |
| Berlin + Potsdam | | 0,124 | 0,006 | 0,014 | 0,365 | 0,014 | 0,013 | 0,025 | 0,013 | 0,005 | 0,016 | 0,006 | 0,013 | 0,014 | 0,019 | 0,021 | 0,014 | 0,010 |
| Hamburg | | 0,042 | 0,002 | 0,005 | 0,142 | 0,005 | 0,005 | 0,010 | 0,005 | 0,002 | 0,007 | 0,002 | 0,005 | 0,006 | 0,008 | 0,008 | 0,005 | 0,004 |
| Hannover | | 0,012 | 0,001 | 0,001 | 0,041 | 0,002 | 0,001 | 0,003 | 0,001 | 0,001 | 0,002 | 0,001 | 0,002 | 0,002 | 0,002 | 0,002 | 0,001 | 0,001 |
| Leipzig + Halle | | 0,007 | 0,000 | 0,001 | 0,025 | 0,001 | 0,001 | 0,002 | 0,001 | 0,000 | 0,001 | 0,000 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 |
| Wrocław | | 0,034 | 0,001 | 0,003 | 0,082 | 0,003 | 0,003 | 0,005 | 0,003 | 0,001 | 0,003 | 0,001 | 0,003 | 0,003 | 0,004 | 0,005 | 0,003 | 0,002 |
| Praha | | 0,045 | 0,002 | 0,005 | 0,130 | 0,005 | 0,005 | 0,009 | 0,005 | 0,002 | 0,006 | 0,002 | 0,005 | 0,005 | 0,007 | 0,008 | 0,005 | 0,003 |
| Katowice + ... | | 0,075 | 0,003 | 0,007 | 0,174 | 0,006 | 0,006 | 0,011 | 0,006 | 0,002 | 0,007 | 0,002 | 0,006 | 0,006 | 0,009 | 0,011 | 0,007 | 0,005 |
| Ostrava | | 0,015 | 0,001 | 0,002 | 0,037 | 0,001 | 0,001 | 0,002 | 0,001 | 0,001 | 0,002 | 0,001 | 0,001 | 0,001 | 0,002 | 0,002 | 0,001 | 0,001 |
| Brno | | 0,015 | 0,001 | 0,002 | 0,042 | 0,002 | 0,001 | 0,003 | 0,001 | 0,001 | 0,002 | 0,001 | 0,001 | 0,002 | 0,002 | 0,002 | 0,002 | 0,001 |
| Wien | | 0,063 | 0,003 | 0,007 | 0,184 | 0,007 | 0,006 | 0,013 | 0,006 | 0,003 | 0,008 | 0,003 | 0,007 | 0,007 | 0,010 | 0,011 | 0,007 | 0,005 |
| Bratislava | | 0,015 | 0,001 | 0,002 | 0,042 | 0,002 | 0,001 | 0,003 | 0,001 | 0,001 | 0,002 | 0,001 | 0,001 | 0,002 | 0,002 | 0,002 | 0,002 | 0,001 |
| Krakow | | 0,045 | 0,002 | 0,004 | 0,104 | 0,004 | 0,004 | 0,007 | 0,003 | 0,001 | 0,004 | 0,001 | 0,003 | 0,004 | 0,005 | 0,007 | 0,004 | 0,003 |

| |
|---|
| 3,903 |

# Brno - Praha

| | | Praha | Dresden | Berlin | Szczecin | Rostock | Lübeck | Hamburg | Magdeburg | Hannover | Bremen + Oldenburg | Osnabrüch + Münster | Utrecht, Amst., Rott. | Leipzig + Halle | Plzen | Nürnberg | Erfurt | Würzburg | Frankfurt |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1,27 | 0,53 | 3,66 | 0,41 | 0,21 | 0,21 | 1,79 | 0,24 | 0,51 | 0,72 | 0,47 | 1,78 | 0,75 | 0,17 | 0,74 | 0,21 | 0,13 | 1,60 |
| Brno | 0,39 | 1,87 | 3,06 | 4,69 | 5,97 | 6,61 | 7,05 | 7,22 | 5,98 | 7,28 | 8,28 | 8,43 | 10,58 | 4,08 | 2,69 | 4,34 | 6,01 | 5,30 | 6,28 |
| Ostrava | 0,30 | 3,30 | 4,49 | 6,12 | 7,40 | 8,04 | 8,48 | 8,65 | 7,41 | 8,71 | 9,71 | 9,86 | 12,01 | 5,51 | 4,12 | 5,77 | 7,44 | 6,73 | 7,71 |
| Katowice + ... | 1,28 | 4,05 | 5,24 | 6,87 | 8,15 | 8,79 | 9,23 | 9,40 | 8,16 | 9,46 | 10,46 | 10,61 | 12,76 | 6,26 | 4,87 | 6,52 | 8,19 | 7,48 | 8,46 |
| Krakow | 0,76 | 4,51 | 5,70 | 7,33 | 8,61 | 9,25 | 9,69 | 9,86 | 8,62 | 9,92 | 10,92 | 11,07 | 13,22 | 6,72 | 5,33 | 6,98 | 8,65 | 7,94 | 8,92 |
| Lviv | 0,72 | 7,43 | 8,62 | 10,25 | 11,53 | 12,17 | 12,61 | 12,78 | 11,54 | 12,84 | 13,84 | 13,99 | 16,14 | 9,64 | 8,25 | 9,90 | 11,57 | 10,86 | 11,84 |
| Žilina | 0,08 | 3,43 | 4,62 | 6,25 | 7,53 | 8,17 | 8,61 | 8,78 | 7,54 | 8,84 | 9,84 | 9,99 | 12,14 | 5,64 | 4,25 | 5,90 | 7,57 | 6,86 | 7,84 |
| Košice | 0,33 | 5,36 | 6,55 | 8,18 | 9,46 | 10,10 | 10,54 | 10,71 | 9,47 | 10,77 | 11,77 | 11,92 | 14,07 | 7,57 | 6,18 | 7,83 | 9,50 | 8,79 | 9,77 |
| Bratislava | 0,42 | 3,04 | 4,23 | 5,86 | 7,14 | 7,78 | 8,22 | 8,39 | 7,15 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Györ | 0,13 | 3,74 | 4,93 | 6,56 | 7,84 | 8,48 | 8,92 | 9,09 | 7,85 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Budapest | 1,74 | 4,78 | 5,97 | 7,60 | 8,88 | 9,52 | 9,96 | 10,13 | 8,89 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Miskolc | 0,17 | 6,25 | 7,44 | 9,07 | 10,35 | 10,99 | 11,43 | 11,60 | 10,36 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Debrecen | 0,21 | 6,76 | 7,95 | 9,58 | 10,86 | 11,50 | 11,94 | 12,11 | 10,87 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Oradea | 0,20 | 7,02 | 8,21 | 9,84 | 11,12 | 11,76 | 12,20 | 12,37 | 11,13 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Cluj | 0,30 | 8,32 | 9,51 | 11,14 | 12,42 | 13,06 | 13,50 | 13,67 | 12,43 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Arad | 0,16 | 7,02 | 8,21 | 9,84 | 11,12 | 11,76 | 12,20 | 12,37 | 11,13 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Sibiu | 0,43 | 9,22 | 10,41 | 12,04 | 13,32 | 13,96 | 14,40 | 14,57 | 13,33 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Braşov | 0,28 | 10,05 | 11,24 | 12,87 | 14,15 | 14,79 | 15,23 | 15,40 | 14,16 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Bucureşti | 1,88 | 11,47 | 12,66 | 14,29 | 15,57 | 16,21 | 16,65 | 16,82 | 15,58 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Timişoara | 0,32 | 7,37 | 8,56 | 10,19 | 11,47 | 12,11 | 12,55 | 12,72 | 11,48 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Beograd | 1,32 | 7,98 | 9,17 | 10,80 | 12,08 | 12,72 | 13,16 | 13,33 | 12,09 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Wien | 1,84 | 2,92 | 4,11 | 5,74 | 7,02 | 7,66 | 8,10 | 8,27 | 7,03 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Graz | 0,28 | 4,42 | 5,61 | 7,24 | 8,52 | 9,16 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Maribor | 0,09 | 4,98 | 6,17 | 7,80 | 9,08 | 9,72 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Zagreb | 0,79 | 5,84 | 7,03 | 8,66 | 9,94 | 10,58 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Ljubljana | 0,29 | 6,00 | 7,19 | 8,82 | 10,10 | 10,74 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Klagenfurt + Villach | 0,16 | 5,42 | 6,61 | 8,24 | 9,52 | 10,16 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Venezia + ... | 0,47 | 7,55 | 8,74 | 10,37 | 11,65 | 12,29 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Brno | | 0,171 | 0,031 | 0,103 | 0,008 | 0,003 | 0,003 | 0,024 | 0,004 | 0,007 | 0,008 | 0,005 | 0,013 | 0,027 | 0,012 | 0,024 | 0,004 | 0,003 | 0,027 |
| Ostrava | | 0,050 | 0,012 | 0,050 | 0,004 | 0,002 | 0,002 | 0,014 | 0,002 | 0,004 | 0,005 | 0,003 | 0,008 | 0,012 | 0,005 | 0,011 | 0,002 | 0,002 | 0,015 |
| Katowice + ... | | 0,151 | 0,041 | 0,177 | 0,015 | 0,007 | 0,006 | 0,051 | 0,009 | 0,014 | 0,017 | 0,011 | 0,030 | 0,042 | 0,015 | 0,039 | 0,008 | 0,005 | 0,054 |
| Krakow | | 0,075 | 0,021 | 0,094 | 0,008 | 0,004 | 0,003 | 0,028 | 0,005 | 0,008 | 0,009 | 0,006 | 0,017 | 0,022 | 0,008 | 0,021 | 0,004 | 0,003 | 0,029 |
| Lviv | | 0,030 | 0,010 | 0,050 | 0,005 | 0,002 | 0,002 | 0,017 | 0,003 | 0,005 | 0,006 | 0,004 | 0,011 | 0,011 | 0,003 | 0,011 | 0,002 | 0,002 | 0,017 |
| Žilina | | 0,012 | 0,003 | 0,013 | 0,001 | 0,000 | 0,000 | 0,004 | 0,001 | 0,001 | 0,001 | 0,001 | 0,002 | 0,003 | 0,001 | 0,003 | 0,001 | 0,000 | 0,004 |
| Košice | | 0,024 | 0,007 | 0,034 | 0,003 | 0,001 | 0,001 | 0,010 | 0,002 | 0,003 | 0,004 | 0,002 | 0,007 | 0,008 | 0,003 | 0,007 | 0,002 | 0,001 | 0,011 |
| Bratislava | | 0,081 | 0,019 | 0,076 | 0,006 | 0,003 | 0,002 | 0,020 | 0,004 | 0,001 | 0,002 | 0,001 | 0,005 | 0,002 | 0,000 | 0,002 | 0,001 | 0,000 | 0,004 |
| Györ | | 0,018 | 0,005 | 0,019 | 0,002 | 0,001 | 0,001 | 0,005 | 0,001 | 0,000 | 0,001 | 0,000 | 0,001 | 0,001 | 0,000 | 0,001 | 0,000 | 0,000 | 0,001 |
| Budapest | | 0,155 | 0,044 | 0,203 | 0,017 | 0,008 | 0,007 | 0,061 | 0,010 | 0,005 | 0,008 | 0,005 | 0,019 | 0,008 | 0,002 | 0,008 | 0,002 | 0,001 | 0,017 |
| Miskolc | | 0,010 | 0,003 | 0,015 | 0,001 | 0,001 | 0,001 | 0,005 | 0,001 | 0,001 | 0,001 | 0,000 | 0,002 | 0,001 | 0,000 | 0,001 | 0,000 | 0,000 | 0,002 |
| Debrecen | | 0,010 | 0,003 | 0,016 | 0,001 | 0,001 | 0,001 | 0,005 | 0,001 | 0,001 | 0,001 | 0,001 | 0,002 | 0,001 | 0,000 | 0,001 | 0,000 | 0,000 | 0,002 |
| Oradea | | 0,009 | 0,003 | 0,015 | 0,001 | 0,001 | 0,001 | 0,005 | 0,001 | 0,001 | 0,001 | 0,001 | 0,002 | 0,001 | 0,000 | 0,001 | 0,000 | 0,000 | 0,002 |
| Cluj | | 0,010 | 0,003 | 0,018 | 0,002 | 0,001 | 0,001 | 0,006 | 0,001 | 0,001 | 0,001 | 0,001 | 0,003 | 0,001 | 0,000 | 0,001 | 0,000 | 0,000 | 0,003 |
| Arad | | 0,007 | 0,002 | 0,012 | 0,001 | 0,001 | 0,000 | 0,004 | 0,001 | 0,001 | 0,001 | 0,000 | 0,002 | 0,001 | 0,000 | 0,001 | 0,000 | 0,000 | 0,002 |
| Sibiu | | 0,013 | 0,004 | 0,023 | 0,002 | 0,001 | 0,001 | 0,008 | 0,001 | 0,001 | 0,002 | 0,001 | 0,005 | 0,002 | 0,000 | 0,002 | 0,001 | 0,000 | 0,004 |
| Braşov | | 0,007 | 0,002 | 0,013 | 0,001 | 0,001 | 0,001 | 0,005 | 0,001 | 0,001 | 0,001 | 0,001 | 0,003 | 0,001 | 0,000 | 0,001 | 0,000 | 0,000 | 0,003 |
| Bucureşti | | 0,038 | 0,013 | 0,075 | 0,007 | 0,003 | 0,003 | 0,028 | 0,004 | 0,006 | 0,008 | 0,005 | 0,021 | 0,009 | 0,002 | 0,009 | 0,002 | 0,002 | 0,018 |
| Timişoara | | 0,014 | 0,004 | 0,023 | 0,002 | 0,001 | 0,001 | 0,008 | 0,001 | 0,001 | 0,001 | 0,001 | 0,003 | 0,001 | 0,000 | 0,001 | 0,000 | 0,000 | 0,003 |
| Beograd | | 0,049 | 0,016 | 0,085 | 0,008 | 0,004 | 0,003 | 0,029 | 0,005 | 0,004 | 0,006 | 0,004 | 0,014 | 0,006 | 0,001 | 0,006 | 0,002 | 0,001 | 0,013 |
| Wien | | 0,378 | 0,088 | 0,345 | 0,027 | 0,012 | 0,011 | 0,091 | 0,016 | 0,006 | 0,008 | 0,005 | 0,020 | 0,008 | 0,002 | 0,008 | 0,002 | 0,001 | 0,018 |
| Graz | | 0,028 | 0,008 | 0,035 | 0,003 | 0,001 | 0,000 | 0,003 | 0,000 | 0,001 | 0,001 | 0,001 | 0,003 | 0,001 | 0,000 | 0,001 | 0,000 | 0,000 | 0,003 |
| Maribor | | 0,007 | 0,002 | 0,010 | 0,001 | 0,000 | 0,000 | 0,001 | 0,000 | 0,000 | 0,000 | 0,000 | 0,001 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 | 0,001 |
| Zagreb | | 0,050 | 0,015 | 0,074 | 0,007 | 0,003 | 0,001 | 0,009 | 0,001 | 0,002 | 0,003 | 0,002 | 0,009 | 0,004 | 0,001 | 0,004 | 0,001 | 0,001 | 0,008 |
| Ljubljana | | 0,018 | 0,005 | 0,026 | 0,002 | 0,001 | 0,000 | 0,003 | 0,000 | 0,001 | 0,001 | 0,001 | 0,003 | 0,001 | 0,000 | 0,001 | 0,000 | 0,000 | 0,003 |
| Klagenfurt + Villach | | 0,011 | 0,003 | 0,016 | 0,001 | 0,001 | 0,000 | 0,002 | 0,000 | 0,001 | 0,001 | 0,000 | 0,002 | 0,001 | 0,000 | 0,001 | 0,000 | 0,000 | 0,002 |
| Venezia + ... | | 0,019 | 0,006 | 0,032 | 0,003 | 0,001 | 0,001 | 0,005 | 0,001 | 0,001 | 0,002 | 0,001 | 0,005 | 0,002 | 0,000 | 0,002 | 0,001 | 0,000 | 0,005 |

| |
|---|
| 5,453 |

# Bryansk - Moskwa

| | | Moskwa | St. Petersburg | Yaroslawl | Nishnij Nowgorod | Kirov | Perm | Kazan |
|---|---|---|---|---|---|---|---|---|
| | | 12,86 | 4,99 | 0,60 | 1,26 | 0,47 | 1,00 | 1,17 |
| Bryansk | 0,41 | 3,47 | 9,80 | 5,96 | 7,31 | 11,63 | 15,53 | 10,61 |
| Kijiv | 2,80 | 7,58 | 13,91 | 10,07 | 11,42 | 15,74 | 19,64 | 14,72 |
| Vinnitsa | 0,37 | 9,57 | 15,90 | 12,06 | 13,41 | 17,73 | 21,63 | 16,71 |
| Odessa | 1,00 | 13,08 | 19,41 | 15,57 | 16,92 | 21,24 | 25,14 | 20,22 |
| Tiraspol | 0,23 | 12,35 | 18,68 | 14,84 | 16,19 | 20,51 | 24,41 | 19,49 |
| Chisinau | 0,67 | 12,97 | 19,30 | 15,46 | 16,81 | 21,13 | 25,03 | 20,11 |
| Lviv | 0,72 | 12,85 | 19,18 | 15,34 | 16,69 | 21,01 | 24,91 | 19,99 |
| Rzeszow | 0,18 | 14,30 | 20,63 | 16,79 | 18,14 | 22,46 | 26,36 | 21,44 |
| Tarnow | 0,11 | 15,04 | 21,37 | 17,53 | 18,88 | 23,20 | 27,10 | 22,18 |
| Krakow | 0,76 | 15,78 | 22,11 | 18,27 | 19,62 | 23,94 | 27,84 | 22,92 |
| Katowice | 1,28 | 16,47 | 22,80 | 18,96 | 20,31 | 24,63 | 28,53 | 23,61 |
| Wrocław | 0,63 | 18,15 | 24,48 | 20,64 | 21,99 | 26,31 | 30,21 | 25,29 |
| Ostrava | 0,30 | 16,99 | 23,32 | 19,48 | 20,83 | 25,15 | 29,05 | 24,13 |
| Brno | 0,39 | 18,42 | 24,75 | 20,91 | 22,26 | 26,58 | 30,48 | 25,56 |
| Praha | 1,27 | 20,29 | 26,62 | 22,78 | 24,13 | 28,45 | 32,35 | 27,43 |
| Uzhorod | 0,11 | 14,70 | 21,03 | 17,19 | 18,54 | 22,86 | 26,76 | 21,84 |
| Nyiregyhaza | 0,12 | 15,58 | 21,91 | 18,07 | 19,42 | 23,74 | 27,64 | 22,72 |
| Miskolc | 0,17 | 16,27 | 22,60 | 18,76 | 20,11 | 24,43 | 28,33 | 23,41 |
| Budapest | 1,74 | 17,74 | 24,07 | 20,23 | 21,58 | 25,90 | 29,80 | 24,88 |
| Bratislava | 0,42 | 19,48 | 25,81 | 21,97 | 23,32 | 27,64 | 31,54 | 26,62 |
| Wien | 1,84 | 19,93 | 26,26 | 22,42 | 23,77 | 28,09 | 31,99 | 27,07 |
| Debrecen | 0,21 | 16,03 | 22,36 | 18,52 | 19,87 | 24,19 | 28,09 | 23,17 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Bryansk | 0,636 | 0,042 | 0,012 | 0,018 | 0,003 | 0,004 | 0,009 |
| Kijiv | 1,151 | 0,159 | 0,033 | 0,056 | 0,012 | 0,018 | 0,034 |
| Vinnitsa | 0,102 | 0,017 | 0,003 | 0,006 | 0,001 | 0,002 | 0,004 |
| Odessa | 0,163 | 0,032 | 0,006 | 0,010 | 0,003 | 0,004 | 0,007 |
| Tiraspol | 0,041 | 0,008 | 0,001 | 0,003 | 0,001 | 0,001 | 0,002 |
| Chisinau | 0,110 | 0,022 | 0,004 | 0,007 | 0,002 | 0,003 | 0,005 |
| Lviv | 0,121 | 0,024 | 0,004 | 0,008 | 0,002 | 0,003 | 0,005 |
| Rzeszow | 0,025 | 0,005 | 0,001 | 0,002 | 0,000 | 0,001 | 0,001 |
| Tarnow | 0,014 | 0,003 | 0,001 | 0,001 | 0,000 | 0,000 | 0,001 |
| Krakow | 0,090 | 0,020 | 0,003 | 0,006 | 0,002 | 0,003 | 0,004 |
| Katowice | 0,141 | 0,031 | 0,005 | 0,010 | 0,003 | 0,004 | 0,007 |
| Wrocław | 0,059 | 0,014 | 0,002 | 0,004 | 0,001 | 0,002 | 0,003 |
| Ostrava | 0,031 | 0,007 | 0,001 | 0,002 | 0,001 | 0,001 | 0,002 |
| Brno | 0,035 | 0,008 | 0,001 | 0,003 | 0,001 | 0,001 | 0,002 |
| Praha | 0,098 | 0,024 | 0,004 | 0,007 | 0,002 | 0,003 | 0,005 |
| Uzhorod | 0,015 | 0,003 | 0,001 | 0,001 | 0,000 | 0,000 | 0,001 |
| Nyiregyhaza | 0,014 | 0,003 | 0,001 | 0,001 | 0,000 | 0,000 | 0,001 |
| Miskolc | 0,019 | 0,004 | 0,001 | 0,001 | 0,000 | 0,001 | 0,001 |
| Budapest | 0,168 | 0,039 | 0,006 | 0,012 | 0,003 | 0,005 | 0,009 |
| Bratislava | 0,035 | 0,008 | 0,001 | 0,003 | 0,001 | 0,001 | 0,002 |
| Wien | 0,146 | 0,035 | 0,006 | 0,011 | 0,003 | 0,005 | 0,008 |
| Debrecen | 0,024 | 0,005 | 0,001 | 0,002 | 0,000 | 0,001 | 0,001 |

| |
|---|
| 4,238 |

# Bucureşti - Constanţa

| | | Constanţa |
|---|---|---|
| | | 0,30 |
| Bucureşti | 1,88 | 2,03 |
| Ruse | 0,15 | 2,72 |
| Stara Zagora, Plovdiv, Sliven | 0,57 | 4,29 |
| Istanbul | 14,66 | 6,42 |
| Pleven | 0,11 | 3,90 |
| Sofia | 1,21 | 5,22 |
| Craiova | 0,29 | 3,85 |
| Drobeta Turnu Severin | 0,10 | 4,84 |
| Timişoara | 0,32 | 6,49 |
| Ploeşti | 0,22 | 2,59 |
| Buzau | 0,13 | 3,24 |
| Braila + Galaţi | 0,50 | 4,18 |
| Focşani | 0,10 | 3,92 |
| Bacau | 0,17 | 4,90 |
| Iaşi | 0,32 | 5,72 |
| Suceava + Botoşani | 0,22 | 6,21 |
| Chernivtsi | 0,26 | 6,99 |
| Lviv | 0,72 | 9,16 |
| Brasov | 0,28 | 3,45 |
| Sibiu | 0,43 | 4,28 |
| Cluj | 0,30 | 5,45 |
| Baia Mare | 0,12 | 6,44 |
| Satu Mare | 0,11 | 6,99 |
| Arad | 0,16 | 6,48 |
| Oradea | 0,20 | 7,58 |
| Budapest | 1,74 | 8,72 |
| Györ | 0,13 | 9,76 |
| Bratislava | 0,42 | 10,46 |
| Ostrava | 0,30 | 12,49 |
| Katowice + Krakow | 2,04 | 13,24 |
| Warszawa | 1,71 | 15,82 |
| Brno | 0,39 | 11,63 |
| Praha | 1,27 | 13,50 |
| Wien | 1,84 | 10,91 |
| Timioşara | 0,32 | 6,83 |
| Beograd | 1,35 | 8,02 |

| | |
|---|---|
| Bucureşti | 0,169 |
| Ruse | 0,008 |
| Stara Zagora, Plovdiv, Sliven | 0,014 |
| Istanbul | 0,186 |
| Pleven | 0,003 |
| Sofia | 0,022 |
| Craiova | 0,009 |
| Drobeta Turnu Severin | 0,002 |
| Timişoara | 0,004 |
| Ploeşti | 0,013 |
| Buzau | 0,005 |
| Braila + Galaţi | 0,013 |
| Focşani | 0,003 |
| Bacau | 0,003 |
| Iaşi | 0,005 |
| Suceava + Botoşani | 0,003 |
| Chernivtsi | 0,003 |
| Lviv | 0,005 |
| Brasov | 0,010 |
| Sibiu | 0,011 |
| Cluj | 0,005 |
| Baia Mare | 0,002 |
| Satu Mare | 0,001 |
| Arad | 0,002 |
| Oradea | 0,002 |
| Budapest | 0,013 |
| Györ | 0,001 |
| Bratislava | 0,002 |
| Ostrava | 0,001 |
| Katowice + Krakow | 0,008 |
| Warszawa | 0,005 |
| Brno | 0,002 |
| Praha | 0,005 |
| Wien | 0,009 |
| Timioşara | 0,004 |
| Beograd | 0,012 |
| 0,566 | |

# Budapest - Arad

| | | Arad | Cluj | Sibiu | Brasov | Ploeşti | Buzau | Braila + Galaţi | Bucureşti | Constanţa | Ruse | Plovdiv + ... | Istanbul | Timioşara | Drobeta Turnu Severin | Craiova |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0,16 | 0,30 | 0,43 | 0,28 | 0,22 | 0,12 | 0,50 | 1,88 | 0,30 | 0,15 | 0,57 | 14,66 | 0,32 | 0,10 | 0,29 |
| Budapest | 1,74 | 2,24 | 4,04 | 4,44 | 5,27 | 6,13 | 6,78 | 7,72 | 6,69 | 8,72 | 10,29 | 11,44 | 13,57 | 2,59 | 4,24 | 5,23 |
| Trnava | 0,07 | 3,70 | 5,50 | 5,90 | 6,73 | 7,59 | 8,24 | 9,18 | 8,15 | 10,18 | 11,75 | 12,90 | 15,03 | 4,05 | 5,70 | 6,69 |
| Zilina + Trencin | 0,14 | 4,99 | 6,79 | 7,19 | 8,02 | 8,88 | 9,53 | 10,47 | 9,44 | 11,47 | 13,04 | 14,19 | 16,32 | 5,34 | 6,99 | 7,98 |
| Györ | 0,13 | 3,28 | 5,08 | 5,48 | 6,31 | 7,17 | 7,82 | 8,76 | 7,73 | 9,76 | 11,33 | 12,48 | 14,61 | 3,63 | 5,28 | 6,27 |
| Bratislava | 0,42 | 3,98 | 5,78 | 6,18 | 7,01 | 7,87 | 8,52 | 9,46 | 8,43 | 10,46 | 12,03 | 13,18 | 15,31 | 4,33 | 5,98 | 6,97 |
| Ostrava | 0,30 | 6,01 | 7,81 | 8,21 | 9,04 | 9,90 | 10,55 | 11,49 | 10,46 | 12,49 | 14,06 | 15,21 | 17,34 | 6,36 | 8,01 | 9,00 |
| Katowice * ... | 1,28 | 6,76 | 8,56 | 8,96 | 9,79 | 10,65 | 11,30 | 12,24 | 11,21 | 13,24 | 14,81 | 15,96 | 18,09 | 7,11 | 8,76 | 9,75 |
| Krakow | 0,76 | 7,22 | 9,02 | 9,42 | 10,25 | 11,11 | 11,76 | 12,70 | 11,67 | 13,70 | 15,27 | 16,42 | 18,55 | 7,57 | 9,22 | 10,21 |
| Warszawa | 1,71 | 9,34 | 11,14 | 11,54 | 12,37 | 13,23 | 13,88 | 14,82 | 13,79 | 15,82 | 17,39 | 18,54 | 20,67 | 9,69 | 11,34 | 12,33 |
| Brno | 0,39 | 5,15 | 6,95 | 7,35 | 8,18 | 9,04 | 9,69 | 10,63 | 9,60 | 11,63 | 13,20 | 14,35 | 16,48 | 5,50 | 7,15 | 8,14 |
| Praha | 1,27 | 7,02 | 8,82 | 9,22 | 10,05 | 10,91 | 11,56 | 12,50 | 11,47 | 13,50 | 15,07 | 16,22 | 18,35 | 7,37 | 9,02 | 10,01 |
| Wien | 1,84 | 4,43 | 6,23 | 6,63 | 7,46 | 8,32 | 8,97 | 9,91 | 8,88 | 10,91 | 12,48 | 13,63 | 15,76 | 4,78 | 6,43 | 7,42 |
| Linz + Wels | 0,26 | 5,96 | 7,76 | 8,16 | 8,99 | 9,85 | 10,50 | 11,44 | 10,41 | 12,44 | 14,01 | 15,16 | 17,29 | 6,31 | 7,96 | 8,95 |
| Regensburg | 0,15 | 7,78 | 9,58 | 9,98 | 10,81 | 11,67 | 12,32 | 13,26 | 12,23 | 14,26 | 15,83 | 16,98 | 19,11 | 8,13 | 9,78 | 10,77 |
| Nürnberg | 0,74 | 8,65 | 10,45 | 10,85 | 11,68 | 12,54 | 13,19 | 14,13 | 13,10 | 15,13 | 16,70 | 17,85 | 19,98 | 9,00 | 10,65 | 11,64 |
| Würzburg | 0,13 | 9,61 | 11,41 | 11,81 | 12,64 | 13,50 | 14,15 | 15,09 | 14,06 | 16,09 | 17,66 | 18,81 | 20,94 | 9,96 | 11,61 | 12,60 |
| Frankfurt | 1,60 | 10,59 | 12,39 | 12,79 | 13,62 | 14,48 | 15,13 | 16,07 | 15,04 | 17,07 | 18,64 | 19,79 | 21,92 | 10,94 | 12,59 | 13,58 |
| Salzburg | 0,15 | 7,08 | 8,88 | 9,28 | 10,11 | 10,97 | 11,62 | 12,56 | 11,53 | 13,56 | 15,13 | 16,28 | 18,41 | 7,43 | 9,08 | 10,07 |
| München | 1,45 | 8,26 | 10,06 | 10,46 | 11,29 | 12,15 | 12,80 | 13,74 | 12,71 | 14,74 | 16,31 | 17,46 | 19,59 | 8,61 | 10,26 | 11,25 |
| Ausburg | 0,29 | 8,82 | 10,62 | 11,02 | 11,85 | 12,71 | 13,36 | 14,30 | 13,27 | 15,30 | 16,87 | 18,02 | 20,15 | 9,17 | 10,82 | 11,81 |
| Stuttgart | 0,62 | 10,16 | 11,96 | 12,36 | 13,19 | 14,05 | 14,70 | 15,64 | 14,61 | 16,64 | 18,21 | 19,36 | 21,49 | 10,51 | 12,16 | 13,15 |
| Karlsruhe | 0,31 | 10,77 | 12,57 | 12,97 | 13,80 | 14,66 | 15,31 | 16,25 | 15,22 | 17,25 | 18,82 | 19,97 | 22,10 | 11,12 | 12,77 | 13,76 |
| Innsbruck | 0,13 | 8,44 | 10,24 | 10,64 | 11,47 | 12,33 | 12,98 | 13,92 | 12,89 | 14,92 | 16,49 | 17,64 | 19,77 | 8,79 | 10,44 | 11,43 |
| Zürich | 0,40 | 10,58 | 12,38 | 12,78 | 13,61 | 14,47 | 15,12 | 16,06 | 15,03 | 17,06 | 18,63 | 19,78 | 21,91 | 10,93 | 12,58 | 13,57 |
| Szekesfehervar | 0,10 | 2,82 | 4,62 | 5,02 | 5,85 | 6,71 | 7,36 | 8,30 | 7,27 | 9,30 | 10,87 | 12,02 | 14,15 | 3,17 | 4,82 | 5,81 |
| Szombathely | 0,08 | 4,15 | 5,95 | 6,35 | 7,18 | 8,04 | 8,69 | 9,63 | 8,60 | 10,63 | 12,20 | 13,35 | 15,48 | 4,50 | 6,15 | 7,14 |
| Graz | 0,28 | 5,09 | 6,89 | 7,29 | 8,12 | 8,98 | 9,63 | 10,57 | 9,54 | 11,57 | 13,14 | 14,29 | 16,42 | 5,44 | 7,09 | 8,08 |
| Klagenfurt + Vill. | 0,16 | 6,09 | 7,89 | 8,29 | 9,12 | 9,98 | 10,63 | 11,57 | 10,54 | 12,57 | 14,14 | 15,29 | 17,42 | 6,44 | 8,09 | 9,08 |
| Venezia + Pad. | 0,55 | 7,83 | 9,63 | 10,03 | 10,86 | 11,72 | 12,37 | 13,31 | 12,28 | 14,31 | 15,88 | 17,03 | 19,16 | 8,18 | 9,83 | 10,82 |
| Ljubljana | 0,29 | 6,25 | 8,05 | 8,45 | 9,28 | 10,14 | 10,79 | 11,73 | 10,70 | 12,73 | 14,30 | 15,45 | 17,58 | 6,60 | 8,25 | 9,24 |
| Zagreb | 0,79 | 4,30 | 6,10 | 6,50 | 7,33 | 8,19 | 8,84 | 9,78 | 8,75 | 10,78 | 12,35 | 13,50 | 15,63 | 4,65 | 6,30 | 7,29 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Budapest | | 0,071 | 0,049 | 0,059 | 0,029 | 0,018 | 0,008 | 0,027 | 0,129 | 0,013 | 0,005 | 0,016 | 0,303 | 0,110 | 0,015 | 0,030 |
| Trnava | | 0,001 | 0,001 | 0,001 | 0,001 | 0,000 | 0,000 | 0,001 | 0,004 | 0,000 | 0,000 | 0,001 | 0,010 | 0,002 | 0,000 | 0,001 |
| Zilina + Trencin | | 0,001 | 0,002 | 0,002 | 0,001 | 0,001 | 0,000 | 0,001 | 0,006 | 0,001 | 0,000 | 0,001 | 0,018 | 0,003 | 0,001 | 0,001 |
| Györ | | 0,003 | 0,002 | 0,003 | 0,002 | 0,001 | 0,000 | 0,002 | 0,008 | 0,001 | 0,000 | 0,001 | 0,020 | 0,005 | 0,001 | 0,002 |
| Bratislava | | 0,006 | 0,006 | 0,008 | 0,004 | 0,003 | 0,001 | 0,005 | 0,021 | 0,002 | 0,001 | 0,003 | 0,060 | 0,011 | 0,002 | 0,004 |
| Ostrava | | 0,002 | 0,003 | 0,004 | 0,002 | 0,001 | 0,001 | 0,002 | 0,010 | 0,001 | 0,001 | 0,002 | 0,034 | 0,004 | 0,001 | 0,002 |
| Katowice | | 0,008 | 0,010 | 0,013 | 0,007 | 0,005 | 0,002 | 0,009 | 0,040 | 0,005 | 0,002 | 0,007 | 0,137 | 0,015 | 0,003 | 0,008 |
| Krakow | | 0,004 | 0,005 | 0,007 | 0,004 | 0,003 | 0,001 | 0,005 | 0,022 | 0,003 | 0,001 | 0,004 | 0,078 | 0,008 | 0,002 | 0,004 |
| Warszawa | | 0,006 | 0,009 | 0,012 | 0,007 | 0,005 | 0,002 | 0,009 | 0,037 | 0,005 | 0,002 | 0,007 | 0,146 | 0,012 | 0,003 | 0,007 |
| Brno | | 0,004 | 0,004 | 0,006 | 0,003 | 0,002 | 0,001 | 0,004 | 0,016 | 0,002 | 0,001 | 0,002 | 0,049 | 0,007 | 0,001 | 0,003 |
| Praha | | 0,007 | 0,009 | 0,013 | 0,007 | 0,005 | 0,002 | 0,009 | 0,038 | 0,005 | 0,002 | 0,006 | 0,132 | 0,014 | 0,003 | 0,007 |
| Wien | | 0,023 | 0,025 | 0,032 | 0,017 | 0,011 | 0,005 | 0,019 | 0,084 | 0,009 | 0,004 | 0,012 | 0,248 | 0,041 | 0,008 | 0,018 |
| Linz + Wels | | 0,002 | 0,002 | 0,003 | 0,002 | 0,001 | 0,001 | 0,002 | 0,009 | 0,001 | 0,000 | 0,001 | 0,030 | 0,004 | 0,001 | 0,002 |
| Regensburg | | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,000 | 0,001 | 0,004 | 0,000 | 0,000 | 0,001 | 0,015 | 0,001 | 0,000 | 0,001 |
| Nürnberg | | 0,003 | 0,004 | 0,006 | 0,003 | 0,002 | 0,001 | 0,004 | 0,018 | 0,002 | 0,001 | 0,003 | 0,067 | 0,006 | 0,001 | 0,003 |
| Würzburg | | 0,000 | 0,001 | 0,001 | 0,000 | 0,000 | 0,000 | 0,001 | 0,003 | 0,000 | 0,000 | 0,001 | 0,011 | 0,001 | 0,000 | 0,001 |
| Frankfurt | | 0,005 | 0,007 | 0,009 | 0,005 | 0,004 | 0,002 | 0,007 | 0,030 | 0,004 | 0,002 | 0,006 | 0,123 | 0,009 | 0,002 | 0,006 |
| Salzburg | | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,000 | 0,001 | 0,004 | 0,001 | 0,000 | 0,001 | 0,016 | 0,002 | 0,000 | 0,001 |
| München | | 0,006 | 0,009 | 0,012 | 0,007 | 0,005 | 0,002 | 0,008 | 0,036 | 0,004 | 0,002 | 0,006 | 0,135 | 0,012 | 0,003 | 0,007 |
| Ausburg | | 0,001 | 0,002 | 0,002 | 0,001 | 0,001 | 0,000 | 0,002 | 0,007 | 0,001 | 0,000 | 0,001 | 0,026 | 0,002 | 0,001 | 0,001 |
| Stuttgart | | 0,002 | 0,003 | 0,004 | 0,002 | 0,002 | 0,001 | 0,003 | 0,012 | 0,002 | 0,001 | 0,002 | 0,049 | 0,004 | 0,001 | 0,002 |
| Karlsruhe | | 0,001 | 0,001 | 0,002 | 0,001 | 0,001 | 0,000 | 0,001 | 0,006 | 0,001 | 0,000 | 0,001 | 0,024 | 0,002 | 0,000 | 0,001 |
| Innsbruck | | 0,001 | 0,001 | 0,001 | 0,001 | 0,000 | 0,000 | 0,001 | 0,003 | 0,000 | 0,000 | 0,001 | 0,012 | 0,001 | 0,000 | 0,001 |
| Zürich | | 0,001 | 0,002 | 0,002 | 0,001 | 0,001 | 0,000 | 0,002 | 0,008 | 0,001 | 0,000 | 0,001 | 0,031 | 0,002 | 0,001 | 0,001 |
| Szekesfehervar | | 0,003 | 0,002 | 0,003 | 0,001 | 0,001 | 0,000 | 0,001 | 0,006 | 0,001 | 0,000 | 0,001 | 0,016 | 0,005 | 0,001 | 0,001 |
| Szombathely | | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,000 | 0,001 | 0,004 | 0,000 | 0,000 | 0,001 | 0,011 | 0,002 | 0,000 | 0,001 |
| Graz | | 0,003 | 0,003 | 0,004 | 0,002 | 0,001 | 0,001 | 0,003 | 0,011 | 0,001 | 0,001 | 0,002 | 0,035 | 0,005 | 0,001 | 0,002 |
| Klagenfurt + Vill. | | 0,001 | 0,001 | 0,002 | 0,001 | 0,001 | 0,000 | 0,001 | 0,005 | 0,001 | 0,000 | 0,001 | 0,018 | 0,002 | 0,000 | 0,001 |
| Venezia + Pad. | | 0,003 | 0,004 | 0,005 | 0,003 | 0,002 | 0,001 | 0,003 | 0,015 | 0,002 | 0,001 | 0,003 | 0,053 | 0,005 | 0,001 | 0,003 |
| Ljubljana | | 0,002 | 0,003 | 0,003 | 0,002 | 0,001 | 0,001 | 0,002 | 0,010 | 0,001 | 0,000 | 0,002 | 0,033 | 0,004 | 0,001 | 0,002 |
| Zagreb | | 0,011 | 0,011 | 0,014 | 0,007 | 0,005 | 0,002 | 0,008 | 0,037 | 0,004 | 0,002 | 0,005 | 0,108 | 0,019 | 0,003 | 0,008 |

4,396

# Budapest - Novi Sad

| | | Novi Sad | Beograd | Podgorica + Bar | Tirana + Durres | Priština | Niš | Skopje | Thessaloniki | Athenai | Sofia | Stara Zagora, Plovdiv, Sliven | Edirne | Istanbul (40%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0,25 | 1,23 | 0,20 | 0,60 | 0,21 | 0,26 | 0,54 | 0,33 | 3,75 | 1,21 | 0,57 | 0,15 | 14,66 |
| Budapest | 1,74 | 2,56 | 3,28 | 6,10 | 7,40 | 5,78 | 5,27 | 6,77 | 8,73 | 11,75 | 6,63 | 7,95 | 9,56 | 11,69 |
| Debrecen | 0,21 | 4,54 | 5,26 | 8,08 | 9,38 | 7,76 | 7,25 | 8,75 | 10,71 | 13,73 | 8,61 | 9,93 | 11,54 | 13,67 |
| Miskolc | 0,17 | 4,03 | 4,75 | 7,57 | 8,87 | 7,25 | 6,74 | 8,24 | 10,20 | 13,22 | 8,10 | 9,42 | 11,03 | 13,16 |
| Nyiregyhaza | 0,12 | 4,72 | 5,44 | 8,26 | 9,56 | 7,94 | 7,43 | 8,93 | 10,89 | 13,91 | 8,79 | 10,11 | 11,72 | 13,85 |
| Trnava | 0,07 | 4,02 | 4,74 | 7,56 | 8,86 | 7,24 | 6,73 | 8,23 | 10,19 | 13,21 | 8,09 | 9,41 | 11,02 | 13,15 |
| Zilina + Trencin | 0,14 | 5,31 | 6,03 | 8,85 | 10,15 | 8,53 | 8,02 | 9,52 | 11,48 | 14,50 | 9,38 | 10,70 | 12,31 | 14,44 |
| Györ | 0,13 | 3,60 | 4,32 | 7,14 | 8,44 | 6,82 | 6,31 | 7,81 | 9,77 | 12,79 | 7,67 | 8,99 | 10,60 | 12,73 |
| Bratislava | 0,42 | 4,30 | 5,02 | 7,84 | 9,14 | 7,52 | 7,01 | 8,51 | 10,47 | 13,49 | 8,37 | 9,69 | 11,30 | 13,43 |
| Ostrava | 0,30 | 6,33 | 7,05 | 9,87 | 11,17 | 9,55 | 9,04 | 10,54 | 12,50 | 15,52 | 10,40 | 11,72 | 13,33 | 15,46 |
| Katowice + ... | 1,28 | 7,08 | 7,80 | 10,62 | 11,92 | 10,30 | 9,79 | 11,29 | 13,25 | 16,27 | 11,15 | 12,47 | 14,08 | 16,21 |
| Krakow | 0,76 | 7,54 | 8,26 | 11,08 | 12,38 | 10,76 | 10,25 | 11,75 | 13,71 | 16,73 | 11,61 | 12,93 | 14,54 | 16,67 |
| Warszawa | 1,71 | 9,66 | 10,38 | 13,20 | 14,50 | 12,88 | 12,37 | 13,87 | 15,83 | 18,85 | 13,73 | 15,05 | 16,66 | 18,79 |
| Wrocław | 0,63 | 8,76 | 9,48 | 12,30 | 13,60 | 11,98 | 11,47 | 12,97 | 14,93 | 17,95 | 12,83 | 14,15 | 15,76 | 17,89 |
| Brno | 0,39 | 5,47 | 6,19 | 9,01 | 10,31 | 8,69 | 8,18 | 9,68 | 11,64 | 14,66 | 9,54 | 10,86 | 12,47 | 14,60 |
| Praha | 1,27 | 7,34 | 8,06 | 10,88 | 12,18 | 10,56 | 10,05 | 11,55 | 13,51 | 16,53 | 11,41 | 12,73 | 14,34 | 16,47 |
| Wien | 1,84 | 4,75 | 5,47 | 8,29 | 9,59 | 7,97 | 7,46 | 8,96 | 10,92 | 13,94 | 8,82 | 10,14 | 11,75 | 13,88 |
| Linz + Wels | 0,26 | 6,28 | 7,00 | 9,82 | 11,12 | 9,50 | 8,99 | 10,49 | 12,45 | 15,47 | 10,35 | 11,67 | 13,28 | 15,41 |
| Regensburg | 0,15 | 8,10 | 8,82 | 11,64 | 12,94 | 11,32 | 10,81 | 12,31 | 14,27 | 17,29 | 12,17 | 13,49 | 15,10 | 17,23 |
| Nürnberg | 0,74 | 8,97 | 9,69 | 12,51 | 13,81 | 12,19 | 11,68 | 13,18 | 15,14 | 18,16 | 13,04 | 14,36 | 15,97 | 18,10 |
| Würzburg | 0,13 | 9,93 | 10,65 | 13,47 | 14,77 | 13,15 | 12,64 | 14,14 | 16,10 | 19,12 | 14,00 | 15,32 | 16,93 | 19,06 |
| Frankfurt | 1,60 | 10,91 | 11,63 | 14,45 | 15,75 | 14,13 | 13,62 | 15,12 | 17,08 | 20,10 | 14,98 | 16,30 | 17,91 | 20,04 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Budapest | | 0,088 | 0,284 | 0,016 | 0,035 | 0,019 | 0,027 | 0,036 | 0,014 | 0,099 | 0,084 | 0,029 | 0,006 | 0,390 |
| Debrecen | | 0,004 | 0,015 | 0,001 | 0,003 | 0,001 | 0,002 | 0,003 | 0,001 | 0,009 | 0,007 | 0,002 | 0,000 | 0,036 |
| Miskolc | | 0,004 | 0,015 | 0,001 | 0,002 | 0,001 | 0,002 | 0,003 | 0,001 | 0,008 | 0,006 | 0,002 | 0,000 | 0,031 |
| Nyiregyhaza | | 0,002 | 0,008 | 0,001 | 0,002 | 0,001 | 0,001 | 0,002 | 0,001 | 0,005 | 0,004 | 0,001 | 0,000 | 0,020 |
| Trnava | | 0,002 | 0,006 | 0,000 | 0,001 | 0,001 | 0,001 | 0,001 | 0,000 | 0,003 | 0,002 | 0,001 | 0,000 | 0,013 |
| Zilina + Trencin | | 0,002 | 0,008 | 0,001 | 0,002 | 0,001 | 0,001 | 0,002 | 0,001 | 0,006 | 0,004 | 0,001 | 0,000 | 0,022 |
| Györ | | 0,004 | 0,013 | 0,001 | 0,002 | 0,001 | 0,001 | 0,002 | 0,001 | 0,006 | 0,005 | 0,002 | 0,000 | 0,025 |
| Bratislava | | 0,009 | 0,033 | 0,003 | 0,006 | 0,003 | 0,004 | 0,006 | 0,003 | 0,019 | 0,014 | 0,005 | 0,001 | 0,074 |
| Ostrava | | 0,003 | 0,013 | 0,001 | 0,003 | 0,001 | 0,002 | 0,003 | 0,001 | 0,011 | 0,007 | 0,003 | 0,001 | 0,042 |
| Katowice + ... | | 0,011 | 0,048 | 0,005 | 0,011 | 0,005 | 0,007 | 0,011 | 0,005 | 0,042 | 0,026 | 0,010 | 0,002 | 0,165 |
| Krakow | | 0,006 | 0,026 | 0,003 | 0,006 | 0,003 | 0,004 | 0,006 | 0,003 | 0,024 | 0,014 | 0,006 | 0,001 | 0,093 |
| Warszawa | | 0,009 | 0,039 | 0,004 | 0,011 | 0,005 | 0,006 | 0,011 | 0,005 | 0,044 | 0,024 | 0,010 | 0,002 | 0,171 |
| Wrocław | | 0,004 | 0,017 | 0,002 | 0,004 | 0,002 | 0,003 | 0,004 | 0,002 | 0,017 | 0,010 | 0,004 | 0,001 | 0,069 |
| Brno | | 0,005 | 0,022 | 0,002 | 0,004 | 0,002 | 0,003 | 0,004 | 0,002 | 0,015 | 0,010 | 0,004 | 0,001 | 0,060 |
| Praha | | 0,011 | 0,045 | 0,004 | 0,011 | 0,005 | 0,007 | 0,011 | 0,005 | 0,040 | 0,025 | 0,010 | 0,002 | 0,159 |
| Wien | | 0,033 | 0,126 | 0,010 | 0,024 | 0,011 | 0,016 | 0,024 | 0,010 | 0,078 | 0,055 | 0,020 | 0,004 | 0,308 |
| Linz + Wels | | 0,003 | 0,012 | 0,001 | 0,003 | 0,001 | 0,002 | 0,003 | 0,001 | 0,009 | 0,006 | 0,002 | 0,000 | 0,036 |
| Regensburg | | 0,001 | 0,005 | 0,000 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,004 | 0,003 | 0,001 | 0,000 | 0,017 |
| Nürnberg | | 0,004 | 0,019 | 0,002 | 0,005 | 0,002 | 0,003 | 0,005 | 0,002 | 0,020 | 0,011 | 0,005 | 0,001 | 0,079 |
| Würzburg | | 0,001 | 0,003 | 0,000 | 0,001 | 0,000 | 0,000 | 0,001 | 0,000 | 0,003 | 0,002 | 0,001 | 0,000 | 0,013 |
| Frankfurt | | 0,007 | 0,030 | 0,003 | 0,009 | 0,004 | 0,005 | 0,009 | 0,004 | 0,037 | 0,019 | 0,008 | 0,002 | 0,144 |

| |
|---|
| 4,542 |

# Dresden - Berlin

| | | Berlin | Szczecin | Rostock | Lübeck | Hamburg | Magdeburg | Hannover | Bremen + Oldenburg | Osnabrüch + Münster | Utrecht, Amst., Rott. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 3,66 | 0,41 | 0,21 | 0,21 | 1,79 | 0,24 | 0,51 | 0,72 | 0,47 | 1,78 |
| Dresden | 0,53 | 1,63 | 2,91 | 3,55 | 3,99 | 4,16 | 2,92 | 4,22 | 5,22 | 5,37 | 7,52 |
| Praha | 1,27 | 2,81 | 4,09 | 4,73 | 5,17 | 5,34 | 4,10 | 5,40 | 6,40 | 6,55 | 8,70 |
| Pardubice + Hr. Kralove | 0,18 | 3,81 | 5,09 | 5,73 | 6,17 | 6,34 | 5,10 | 6,40 | 7,40 | 7,55 | 9,70 |
| Ostrava | 0,30 | 5,62 | 6,90 | 7,54 | 7,98 | 8,15 | 6,91 | 8,21 | 9,21 | 9,36 | 11,51 |
| Žilina | 0,08 | 6,37 | 7,65 | 8,29 | 8,73 | 8,90 | 7,66 | 8,96 | 9,96 | 10,11 | 12,26 |
| Košice | 0,24 | 8,30 | 9,58 | 10,22 | 10,66 | 10,83 | 9,59 | 10,89 | 11,89 | 12,04 | 14,19 |
| Brno | 0,39 | 4,68 | 5,96 | 6,60 | 7,04 | 7,21 | 5,97 | 7,27 | 8,27 | 8,42 | 10,57 |
| Bratislava | 0,42 | 5,85 | 7,13 | 7,77 | 8,21 | 8,38 | 7,14 | 8,44 | 9,44 | 9,59 | 11,74 |
| Györ | 0,13 | 6,55 | 7,83 | 8,47 | 8,91 | 9,08 | 7,84 | 9,14 | 10,14 | 10,29 | 12,44 |
| Budapest | 1,74 | 7,59 | 8,87 | 9,51 | 9,95 | 10,12 | 8,88 | 10,18 | 11,18 | 11,33 | 13,48 |
| Debrecen | 0,21 | 9,57 | 10,85 | 11,49 | 11,93 | 12,10 | 10,86 | 12,16 | 13,16 | 13,31 | 15,46 |
| Arad | 0,16 | 9,83 | 11,11 | 11,75 | 12,19 | 12,36 | 11,12 | 12,42 | 13,42 | 13,57 | 15,72 |
| Sibiu | 0,43 | 12,03 | 13,31 | 13,95 | 14,39 | 14,56 | 13,32 | 14,62 | 15,62 | 15,77 | 17,92 |
| Braşov | 0,28 | 12,86 | 14,14 | 14,78 | 15,22 | 15,39 | 14,15 | 15,45 | 16,45 | 16,60 | 18,75 |
| Bucureşţi | 1,88 | 14,28 | 15,56 | 16,20 | 16,64 | 16,81 | 15,57 | 16,87 | 17,87 | 18,02 | 20,17 |
| Timişoara | 0,32 | 10,18 | 11,46 | 12,10 | 12,54 | 12,71 | 11,47 | 12,77 | 13,77 | 13,92 | 16,07 |
| Beograd | 1,32 | 10,79 | 12,07 | 12,71 | 13,15 | 13,32 | 12,08 | 13,38 | 14,38 | 14,53 | 16,68 |
| Wien | 1,84 | 5,73 | 7,01 | 7,65 | 8,09 | 8,26 | 7,02 | 20,00 | 20,00 | 20,00 | 20,00 |
| C. Budejovice | 0,09 | 4,04 | 5,32 | 5,96 | 6,40 | 6,57 | 5,33 | 6,63 | 7,63 | 7,78 | 9,93 |
| Linz + Wels | 0,20 | 4,82 | 6,10 | 6,74 | 7,18 | 7,35 | 6,11 | 20,00 | 20,00 | 20,00 | 20,00 |
| Graz | 0,28 | 6,45 | 7,73 | 8,37 | 8,81 | 8,98 | 7,74 | 20,00 | 20,00 | 20,00 | 20,00 |
| Maribor | 0,09 | 7,01 | 8,29 | 8,93 | 9,37 | 9,54 | 8,30 | 20,00 | 20,00 | 20,00 | 20,00 |
| Zagreb | 0,79 | 7,87 | 9,15 | 9,79 | 10,23 | 10,40 | 9,16 | 20,00 | 20,00 | 20,00 | 20,00 |
| Salzburg | 0,15 | 5,94 | 7,22 | 7,86 | 8,30 | 8,47 | 7,23 | 20,00 | 20,00 | 20,00 | 20,00 |
| Klagenfurt + Villach | 0,16 | 7,34 | 8,62 | 9,26 | 9,70 | 9,87 | 8,63 | 20,00 | 20,00 | 20,00 | 20,00 |
| Ljubljana | 0,29 | 8,18 | 9,46 | 10,10 | 10,54 | 10,71 | 9,47 | 20,00 | 20,00 | 20,00 | 20,00 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Dresden | 0,845 | 0,035 | 0,013 | 0,011 | 0,084 | 0,021 | 0,023 | 0,023 | 0,014 | 0,031 |
| Praha | 0,803 | 0,047 | 0,019 | 0,016 | 0,132 | 0,028 | 0,037 | 0,039 | 0,024 | 0,057 |
| Pardubice + Hr. Kralove | 0,068 | 0,005 | 0,002 | 0,002 | 0,014 | 0,003 | 0,004 | 0,004 | 0,003 | 0,007 |
| Ostrava | 0,058 | 0,005 | 0,002 | 0,002 | 0,015 | 0,003 | 0,004 | 0,005 | 0,003 | 0,008 |
| Žilina | 0,013 | 0,001 | 0,000 | 0,000 | 0,003 | 0,001 | 0,001 | 0,001 | 0,001 | 0,002 |
| Košice | 0,024 | 0,002 | 0,001 | 0,001 | 0,007 | 0,001 | 0,002 | 0,003 | 0,002 | 0,005 |
| Brno | 0,104 | 0,008 | 0,003 | 0,003 | 0,024 | 0,004 | 0,007 | 0,008 | 0,005 | 0,013 |
| Bratislava | 0,076 | 0,006 | 0,003 | 0,002 | 0,020 | 0,004 | 0,006 | 0,007 | 0,004 | 0,011 |
| Györ | 0,019 | 0,002 | 0,001 | 0,001 | 0,005 | 0,001 | 0,002 | 0,002 | 0,001 | 0,003 |
| Budapest | 0,203 | 0,017 | 0,008 | 0,007 | 0,061 | 0,010 | 0,017 | 0,021 | 0,013 | 0,037 |
| Debrecen | 0,017 | 0,001 | 0,001 | 0,001 | 0,005 | 0,001 | 0,002 | 0,002 | 0,001 | 0,004 |
| Arad | 0,012 | 0,001 | 0,001 | 0,000 | 0,004 | 0,001 | 0,001 | 0,001 | 0,001 | 0,003 |
| Sibiu | 0,023 | 0,002 | 0,001 | 0,001 | 0,008 | 0,001 | 0,002 | 0,003 | 0,002 | 0,006 |
| Braşov | 0,013 | 0,001 | 0,001 | 0,001 | 0,005 | 0,001 | 0,001 | 0,002 | 0,001 | 0,003 |
| Bucureşţi | 0,075 | 0,007 | 0,003 | 0,003 | 0,028 | 0,004 | 0,008 | 0,010 | 0,006 | 0,020 |
| Timişoara | 0,023 | 0,002 | 0,001 | 0,001 | 0,008 | 0,001 | 0,002 | 0,003 | 0,002 | 0,005 |
| Beograd | 0,085 | 0,008 | 0,004 | 0,003 | 0,029 | 0,005 | 0,008 | 0,010 | 0,007 | 0,020 |
| Wien | 0,346 | 0,028 | 0,012 | 0,011 | 0,091 | 0,016 | 0,006 | 0,008 | 0,005 | 0,020 |
| C. Budejovice | 0,031 | 0,002 | 0,001 | 0,001 | 0,007 | 0,001 | 0,002 | 0,002 | 0,001 | 0,003 |
| Linz + Wels | 0,051 | 0,004 | 0,002 | 0,001 | 0,012 | 0,002 | 0,001 | 0,001 | 0,001 | 0,002 |
| Graz | 0,043 | 0,004 | 0,002 | 0,001 | 0,012 | 0,002 | 0,001 | 0,001 | 0,001 | 0,003 |
| Maribor | 0,012 | 0,001 | 0,000 | 0,000 | 0,003 | 0,001 | 0,000 | 0,000 | 0,000 | 0,001 |
| Zagreb | 0,087 | 0,008 | 0,003 | 0,003 | 0,026 | 0,004 | 0,002 | 0,003 | 0,002 | 0,009 |
| Salzburg | 0,027 | 0,002 | 0,001 | 0,001 | 0,007 | 0,001 | 0,000 | 0,001 | 0,000 | 0,002 |
| Klagenfurt + Villach | 0,020 | 0,002 | 0,001 | 0,001 | 0,006 | 0,001 | 0,001 | 0,001 | 0,000 | 0,002 |
| Ljubljana | 0,030 | 0,003 | 0,001 | 0,001 | 0,009 | 0,002 | 0,001 | 0,001 | 0,001 | 0,003 |

4,901

# Edirne - Istanbul

| | | Istanbul | Eskişehir | Ankara | Konya | Izmir |
|---|---|---|---|---|---|---|
| | | 14,66 | 0,69 | 4,59 | 1,22 | 4,11 |
| Edirne | 0,15 | 2,13 | 4,43 | 6,49 | 7,19 | 8,31 |
| Plovdiv + … | 0,57 | 3,74 | 6,04 | 8,10 | 8,80 | 9,92 |
| Ruse | 0,15 | 5,31 | 7,61 | 9,67 | 10,37 | 11,49 |
| Bucuresti | 1,88 | 6,00 | 8,30 | 10,36 | 11,06 | 12,18 |
| Constanta | 0,30 | 8,03 | 10,33 | 12,39 | 13,09 | 14,21 |
| Ploesti | 0,22 | 6,56 | 8,86 | 10,92 | 11,62 | 12,74 |
| Braila + Galati | 0,50 | 8,15 | 10,45 | 12,51 | 13,21 | 14,33 |
| Brasov | 0,28 | 7,42 | 9,72 | 11,78 | 12,48 | 13,60 |
| Sibiu | 0,43 | 8,25 | 10,55 | 12,61 | 13,31 | 14,43 |
| Cluj | 0,30 | 9,42 | 11,72 | 13,78 | 14,48 | 15,60 |
| Sofia | 1,21 | 5,06 | 7,36 | 9,42 | 10,12 | 11,24 |
| Niš | 0,26 | 6,42 | 8,72 | 10,78 | 11,48 | 12,60 |
| Beograd | 1,23 | 8,41 | 10,71 | 12,77 | 13,47 | 14,59 |
| Timişoara | 0,32 | 9,60 | 11,90 | 13,96 | 14,66 | 15,78 |
| Arad | 0,16 | 9,95 | 12,25 | 14,31 | 15,01 | 16,13 |
| Oradea | 0,20 | 11,05 | 13,35 | 15,41 | 16,11 | 17,23 |
| Novi Sad | 0,25 | 9,13 | 11,43 | 13,49 | 14,19 | 15,31 |
| Subotica | 0,10 | 10,02 | 12,32 | 14,38 | 15,08 | 16,20 |
| Budapest | 1,74 | 11,69 | 13,99 | 16,05 | 16,75 | 17,87 |
| Bratislava | 0,42 | 13,43 | 15,73 | 17,79 | 18,49 | 19,61 |
| Ostrava | 0,30 | 15,46 | 17,76 | 19,82 | 20,52 | 21,64 |
| Katowice, … | 1,73 | 16,21 | 18,51 | 20,57 | 21,27 | 22,39 |
| Brno | 0,39 | 14,60 | 16,90 | 18,96 | 19,66 | 20,78 |
| Praha | 1,27 | 16,47 | 18,77 | 20,83 | 21,53 | 22,65 |
| Wien | 1,84 | 13,88 | 16,18 | 18,24 | 18,94 | 20,06 |
| Nürnberg, Fürth, … | 0,74 | 18,10 | 20,40 | 22,46 | 23,16 | 24,28 |
| Frankfurt, … | 1,60 | 20,04 | 22,34 | 24,40 | 25,10 | 26,22 |
| Sarajewo | 0,53 | 11,35 | 13,65 | 15,71 | 16,41 | 17,53 |
| Zagreb | 0,79 | 12,13 | 14,43 | 16,49 | 17,19 | 18,31 |
| Graz | 0,28 | 13,55 | 15,85 | 17,91 | 18,61 | 19,73 |
| Ljubljana | 0,29 | 13,27 | 15,57 | 17,63 | 18,33 | 19,45 |
| Trieste | 0,20 | 14,01 | 16,31 | 18,37 | 19,07 | 20,19 |
| Venezia + Treviso | 0,34 | 15,16 | 17,46 | 19,52 | 20,22 | 21,34 |
| Verona | 0,26 | 16,15 | 18,45 | 20,51 | 21,21 | 22,33 |
| Milano | 1,35 | 17,57 | 19,87 | 21,93 | 22,63 | 23,75 |
| München | 1,45 | 16,69 | 18,99 | 21,05 | 21,75 | 22,87 |
| Stuttgart | 0,62 | 18,59 | 20,89 | 22,95 | 23,65 | 24,77 |

| | | | | | |
|---|---|---|---|---|---|
| Edirne | 0,608 | 0,008 | 0,029 | 0,006 | 0,017 |
| Plovdiv + … | 0,887 | 0,018 | 0,075 | 0,017 | 0,047 |
| Ruse | 0,129 | 0,003 | 0,015 | 0,003 | 0,010 |
| Bucuresti | 1,310 | 0,036 | 0,162 | 0,039 | 0,110 |
| Constanta | 0,127 | 0,004 | 0,019 | 0,005 | 0,014 |
| Ploesti | 0,132 | 0,004 | 0,017 | 0,004 | 0,012 |
| Braila + Galati | 0,207 | 0,006 | 0,031 | 0,008 | 0,022 |
| Brasov | 0,136 | 0,004 | 0,019 | 0,005 | 0,014 |
| Sibiu | 0,174 | 0,005 | 0,027 | 0,006 | 0,019 |
| Cluj | 0,097 | 0,003 | 0,016 | 0,004 | 0,012 |
| Sofia | 1,127 | 0,028 | 0,123 | 0,029 | 0,081 |
| Niš | 0,162 | 0,005 | 0,021 | 0,005 | 0,014 |
| Beograd | 0,483 | 0,015 | 0,074 | 0,018 | 0,053 |
| Timişoara | 0,100 | 0,003 | 0,017 | 0,004 | 0,012 |
| Arad | 0,047 | 0,002 | 0,008 | 0,002 | 0,006 |
| Oradea | 0,049 | 0,002 | 0,009 | 0,002 | 0,007 |
| Novi Sad | 0,085 | 0,003 | 0,014 | 0,003 | 0,010 |
| Subotica | 0,029 | 0,001 | 0,005 | 0,001 | 0,004 |
| Budapest | 0,390 | 0,014 | 0,071 | 0,018 | 0,053 |
| Bratislava | 0,074 | 0,003 | 0,014 | 0,004 | 0,011 |
| Ostrava | 0,042 | 0,002 | 0,009 | 0,002 | 0,007 |
| Katowice, … | 0,223 | 0,008 | 0,046 | 0,012 | 0,036 |
| Brno | 0,060 | 0,002 | 0,012 | 0,003 | 0,009 |
| Praha | 0,159 | 0,006 | 0,033 | 0,008 | 0,026 |
| Wien | 0,308 | 0,011 | 0,061 | 0,015 | 0,046 |
| Nürnberg, Fürth, … | 0,079 | 0,003 | 0,017 | 0,004 | 0,013 |
| Frankfurt, … | 0,144 | 0,006 | 0,032 | 0,008 | 0,025 |
| Sarajewo | 0,125 | 0,004 | 0,023 | 0,006 | 0,017 |
| Zagreb | 0,166 | 0,006 | 0,031 | 0,008 | 0,023 |
| Graz | 0,049 | 0,002 | 0,010 | 0,002 | 0,007 |
| Ljubljana | 0,052 | 0,002 | 0,010 | 0,003 | 0,008 |
| Trieste | 0,033 | 0,001 | 0,007 | 0,002 | 0,005 |
| Venezia + Treviso | 0,049 | 0,002 | 0,010 | 0,003 | 0,008 |
| Verona | 0,034 | 0,001 | 0,007 | 0,002 | 0,005 |
| Milano | 0,151 | 0,006 | 0,033 | 0,008 | 0,025 |
| München | 0,178 | 0,007 | 0,037 | 0,009 | 0,029 |
| Stuttgart | 0,063 | 0,002 | 0,014 | 0,003 | 0,011 |
| 10,105 | | | | | |

# Erzurum - Tbilisi

| | | Tbilisi | Kutaisi | Batumi | Sotchi | Krasnodar | Rustavi | Gence | Sumqayit | Baku |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1,17 | 0,20 | 0,13 | 0,36 | 0,75 | 0,12 | 0,32 | 0,32 | 2,14 |
| Erzurum | 0,37 | 3,64 | 5,57 | 6,67 | 8,37 | 10,06 | 3,96 | 5,24 | 8,02 | 8,30 |
| Sivas | 0,35 | 7,62 | 9,55 | 10,65 | 12,35 | 14,04 | 7,94 | 9,22 | 12,00 | 12,28 |
| Kirikkale | 0,19 | 10,52 | 12,45 | 13,55 | 15,25 | 16,94 | 10,84 | 12,12 | 14,90 | 15,18 |
| Ankara | 4,59 | 10,73 | 12,66 | 13,76 | 15,46 | 17,15 | 11,05 | 12,33 | 15,11 | 15,39 |
| Eskişehir | 0,69 | 12,79 | 14,72 | 15,82 | 17,52 | 19,21 | 13,11 | 14,39 | 17,17 | 17,45 |
| Adopazani | 0,27 | 13,84 | 15,77 | 16,87 | 18,57 | 20,26 | 14,16 | 15,44 | 18,22 | 18,50 |
| Istanbul | 14,66 | 15,09 | 17,02 | 18,12 | 19,82 | 21,51 | 15,41 | 16,69 | 19,47 | 19,75 |
| Edirne | 0,15 | 17,22 | 19,15 | 20,25 | 21,95 | 23,64 | 17,54 | 18,82 | 21,60 | 21,88 |
| Bucureşti | 1,88 | 20,63 | 22,56 | 23,66 | 25,36 | 27,05 | 20,95 | 22,23 | 25,01 | 25,29 |
| Sofia | 1,21 | 20,15 | 22,08 | 23,18 | 24,88 | 26,57 | 20,47 | 21,75 | 24,53 | 24,81 |
| Beograd | 1,35 | 23,50 | 25,43 | 26,53 | 28,23 | 29,92 | 23,82 | 25,10 | 27,88 | 28,16 |
| Kütakya | 0,20 | 13,36 | 15,29 | 16,39 | 18,09 | 19,78 | 13,68 | 14,96 | 17,74 | 18,02 |
| Balikeşir | 1,19 | 15,14 | 17,07 | 18,17 | 19,87 | 21,56 | 15,46 | 16,74 | 19,52 | 19,80 |
| Manisa | 0,28 | 16,38 | 18,31 | 19,41 | 21,11 | 22,80 | 16,70 | 17,98 | 20,76 | 21,04 |
| Izmir | 4,11 | 16,67 | 18,60 | 19,70 | 21,40 | 23,09 | 16,99 | 18,27 | 21,05 | 21,33 |
| Afyon | 0,21 | 14,31 | 16,24 | 17,34 | 19,04 | 20,73 | 14,63 | 15,91 | 18,69 | 18,97 |
| Denizli | 1,00 | 15,38 | 17,31 | 18,41 | 20,11 | 21,80 | 15,70 | 16,98 | 19,76 | 20,04 |
| Konya | 1,22 | 13,01 | 14,94 | 16,04 | 17,74 | 19,43 | 13,33 | 14,61 | 17,39 | 17,67 |
| Antalya | 2,22 | 14,94 | 16,87 | 17,97 | 19,67 | 21,36 | 15,26 | 16,54 | 19,32 | 19,60 |
| Alanya | 0,29 | 14,53 | 16,46 | 17,56 | 19,26 | 20,95 | 14,85 | 16,13 | 18,91 | 19,19 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Erzurum | | 0,048 | 0,004 | 0,002 | 0,004 | 0,005 | 0,004 | 0,007 | 0,003 | 0,022 |
| Sivas | | 0,013 | 0,002 | 0,001 | 0,002 | 0,003 | 0,001 | 0,003 | 0,002 | 0,011 |
| Kirikkale | | 0,004 | 0,001 | 0,000 | 0,001 | 0,001 | 0,000 | 0,001 | 0,001 | 0,004 |
| Ankara | | 0,095 | 0,012 | 0,007 | 0,016 | 0,027 | 0,009 | 0,021 | 0,015 | 0,094 |
| Eskişehir | | 0,011 | 0,001 | 0,001 | 0,002 | 0,003 | 0,001 | 0,002 | 0,002 | 0,011 |
| Adopazani | | 0,004 | 0,000 | 0,000 | 0,001 | 0,001 | 0,000 | 0,001 | 0,001 | 0,004 |
| Istanbul | | 0,170 | 0,024 | 0,014 | 0,033 | 0,060 | 0,017 | 0,039 | 0,030 | 0,197 |
| Edirne | | 0,001 | 0,000 | 0,000 | 0,000 | 0,001 | 0,000 | 0,000 | 0,000 | 0,002 |
| Bucureşti | | 0,013 | 0,002 | 0,001 | 0,003 | 0,005 | 0,001 | 0,003 | 0,003 | 0,017 |
| Sofia | | 0,009 | 0,001 | 0,001 | 0,002 | 0,003 | 0,001 | 0,002 | 0,002 | 0,011 |
| Beograd | | 0,007 | 0,001 | 0,001 | 0,002 | 0,003 | 0,001 | 0,002 | 0,002 | 0,010 |
| Kütakya | | 0,003 | 0,000 | 0,000 | 0,001 | 0,001 | 0,000 | 0,001 | 0,000 | 0,003 |
| Balikeşir | | 0,014 | 0,002 | 0,001 | 0,003 | 0,005 | 0,001 | 0,003 | 0,002 | 0,016 |
| Manisa | | 0,003 | 0,000 | 0,000 | 0,001 | 0,001 | 0,000 | 0,001 | 0,001 | 0,003 |
| Izmir | | 0,040 | 0,006 | 0,003 | 0,008 | 0,015 | 0,004 | 0,009 | 0,007 | 0,048 |
| Afyon | | 0,003 | 0,000 | 0,000 | 0,001 | 0,001 | 0,000 | 0,001 | 0,000 | 0,003 |
| Denizli | | 0,011 | 0,002 | 0,001 | 0,002 | 0,004 | 0,001 | 0,003 | 0,002 | 0,013 |
| Konya | | 0,018 | 0,002 | 0,001 | 0,003 | 0,006 | 0,002 | 0,004 | 0,003 | 0,020 |
| Antalya | | 0,026 | 0,004 | 0,002 | 0,005 | 0,009 | 0,003 | 0,006 | 0,005 | 0,030 |
| Alanya | | 0,004 | 0,000 | 0,000 | 0,001 | 0,001 | 0,000 | 0,001 | 0,001 | 0,004 |

| | | | |
|---|---|---|---|
| 1,603 | | including Kars: | ≈ 1,65 |

# Eskişehir - Istanbul

| | | Istanbul | Edirne | Alexandroupo | Thessaloniki | Plovdiv | Sofia | Niš | Beograd | Budapest | Stara Zagora | Ruse | Bucureşti |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 14,66 | 0,15 | 0,07 | 0,33 | 0,37 | 1,21 | 0,26 | 1,35 | 1,74 | 0,14 | 0,15 | 1,88 |
| Eskişehir | 0,69 | 2,30 | 4,43 | 5,53 | 7,91 | 6,04 | 7,36 | 8,68 | 10,67 | 12,97 | 5,58 | 7,15 | 7,84 |
| Afyon | 0,21 | 3,41 | 5,54 | 6,64 | 9,02 | 7,15 | 8,47 | 9,79 | 11,78 | 14,08 | 6,69 | 8,26 | 8,95 |
| Manisa | 0,28 | 6,08 | 8,21 | 9,31 | 11,69 | 9,82 | 11,14 | 12,46 | 14,45 | 16,75 | 9,36 | 10,93 | 11,62 |
| Izmir | 4,11 | 6,37 | 8,50 | 9,60 | 11,98 | 10,11 | 11,43 | 12,75 | 14,74 | 17,04 | 9,65 | 11,22 | 11,91 |
| Konya | 1,22 | 5,34 | 7,47 | 8,57 | 10,95 | 9,08 | 10,40 | 11,72 | 13,71 | 16,01 | 8,62 | 10,19 | 10,88 |
| Mersin | 0,96 | 8,32 | 10,45 | 11,55 | 13,93 | 12,06 | 13,38 | 14,70 | 16,69 | 18,99 | 11,60 | 13,17 | 13,86 |
| Adana | 1,72 | 8,06 | 10,19 | 11,29 | 13,67 | 11,80 | 13,12 | 14,44 | 16,43 | 18,73 | 11,34 | 12,91 | 13,60 |
| Aleppo | 2,30 | 10,45 | 12,58 | 13,68 | 16,06 | 14,19 | 15,51 | 16,83 | 18,82 | 21,12 | 13,73 | 15,30 | 15,99 |
| Damascus | 1,71 | 13,59 | 15,72 | 16,82 | 19,20 | 17,33 | 18,65 | 19,97 | 21,96 | 24,26 | 16,87 | 18,44 | 19,13 |
| Gaziantep | 1,56 | 10,43 | 12,56 | 13,66 | 16,04 | 14,17 | 15,49 | 16,81 | 18,80 | 21,10 | 13,71 | 15,28 | 15,97 |
| Mosul | 0,66 | 15,53 | 17,66 | 18,76 | 21,14 | 19,27 | 20,59 | 21,91 | 23,90 | 26,20 | 18,81 | 20,38 | 21,07 |
| Baghdad | 3,84 | 19,07 | 21,20 | 22,30 | 24,68 | 22,81 | 24,13 | 25,45 | 27,44 | 29,74 | 22,35 | 23,92 | 24,61 |
| Ankara | 4,59 | 4,36 | 6,49 | 7,59 | 9,97 | 8,10 | 9,42 | 10,74 | 12,73 | 15,03 | 7,64 | 9,21 | 9,90 |
| Kırıkkale | 0,19 | 4,87 | 7,00 | 8,10 | 10,48 | 8,61 | 9,93 | 11,25 | 13,24 | 15,54 | 8,15 | 9,72 | 10,41 |
| Kayserı | 1,06 | 6,92 | 9,05 | 10,15 | 12,53 | 10,66 | 11,98 | 13,30 | 15,29 | 17,59 | 10,20 | 11,77 | 12,46 |
| Sivas | 0,35 | 7,77 | 9,90 | 11,00 | 13,38 | 11,51 | 12,83 | 14,15 | 16,14 | 18,44 | 11,05 | 12,62 | 13,31 |
| Samsun | 0,61 | 7,65 | 9,78 | 10,88 | 13,26 | 11,39 | 12,71 | 14,03 | 16,02 | 18,32 | 10,93 | 12,50 | 13,19 |
| Malatya | 0,43 | 9,72 | 11,85 | 12,95 | 15,33 | 13,46 | 14,78 | 16,10 | 18,09 | 20,39 | 13,00 | 14,57 | 15,26 |
| Diyarbakır | 0,93 | 11,57 | 13,70 | 14,80 | 17,18 | 15,31 | 16,63 | 17,95 | 19,94 | 22,24 | 14,85 | 16,42 | 17,11 |
| Van | 0,35 | 13,32 | 15,45 | 16,55 | 18,93 | 17,06 | 18,38 | 19,70 | 21,69 | 23,99 | 16,60 | 18,17 | 18,86 |
| Tabriz | 1,50 | 15,96 | 18,09 | 19,19 | 21,57 | 19,70 | 21,02 | 22,34 | 24,33 | 26,63 | 19,24 | 20,81 | 21,50 |
| Teheran | 8,15 | 21,19 | 23,32 | 24,42 | 26,80 | 24,93 | 26,25 | 27,57 | 29,56 | 31,86 | 24,47 | 26,04 | 26,73 |
| Erzurum | 0,37 | 11,75 | 13,88 | 14,98 | 17,36 | 15,49 | 16,81 | 18,13 | 20,12 | 22,42 | 15,03 | 16,60 | 17,29 |
| Tbilisi | 1,17 | 15,36 | 17,49 | 18,59 | 20,97 | 19,10 | 20,42 | 21,74 | 23,73 | 26,03 | 18,64 | 20,21 | 20,90 |
| Baku | 2,14 | 19,78 | 21,91 | 23,01 | 25,39 | 23,52 | 24,84 | 26,16 | 28,15 | 30,45 | 23,06 | 24,63 | 25,32 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Eskişehir | | 2,455 | 0,008 | 0,003 | 0,007 | 0,012 | 0,028 | 0,005 | 0,017 | 0,015 | 0,005 | 0,004 | 0,039 |
| Afyon | | 0,383 | 0,002 | 0,001 | 0,002 | 0,003 | 0,007 | 0,001 | 0,004 | 0,004 | 0,001 | 0,001 | 0,010 |
| Manisa | | 0,191 | 0,001 | 0,000 | 0,001 | 0,002 | 0,006 | 0,001 | 0,004 | 0,004 | 0,001 | 0,001 | 0,008 |
| Izmir | | 2,588 | 0,016 | 0,006 | 0,020 | 0,030 | 0,079 | 0,014 | 0,057 | 0,058 | 0,012 | 0,010 | 0,115 |
| Konya | | 1,037 | 0,006 | 0,002 | 0,007 | 0,011 | 0,028 | 0,005 | 0,019 | 0,019 | 0,004 | 0,004 | 0,040 |
| Mersin | | 0,384 | 0,003 | 0,001 | 0,004 | 0,005 | 0,014 | 0,003 | 0,011 | 0,011 | 0,002 | 0,002 | 0,021 |
| Adana | | 0,726 | 0,005 | 0,002 | 0,007 | 0,010 | 0,026 | 0,005 | 0,020 | 0,021 | 0,004 | 0,003 | 0,038 |
| Aleppo | | 0,624 | 0,005 | 0,002 | 0,007 | 0,009 | 0,026 | 0,005 | 0,021 | 0,022 | 0,004 | 0,003 | 0,039 |
| Damascus | | 0,297 | 0,002 | 0,001 | 0,004 | 0,005 | 0,014 | 0,003 | 0,012 | 0,013 | 0,002 | 0,002 | 0,021 |
| Gaziantep | | 0,425 | 0,003 | 0,001 | 0,005 | 0,006 | 0,018 | 0,003 | 0,014 | 0,015 | 0,003 | 0,002 | 0,026 |
| Mosul | | 0,091 | 0,001 | 0,000 | 0,001 | 0,002 | 0,005 | 0,001 | 0,004 | 0,004 | 0,001 | 0,001 | 0,007 |
| Baghdad | | 0,375 | 0,003 | 0,001 | 0,005 | 0,007 | 0,021 | 0,004 | 0,019 | 0,021 | 0,003 | 0,003 | 0,031 |
| Ankara | | 5,506 | 0,029 | 0,010 | 0,030 | 0,048 | 0,123 | 0,021 | 0,082 | 0,080 | 0,020 | 0,016 | 0,175 |
| Kırıkkale | | 0,189 | 0,001 | 0,000 | 0,001 | 0,002 | 0,005 | 0,001 | 0,003 | 0,003 | 0,001 | 0,001 | 0,007 |
| Kayserı | | 0,580 | 0,004 | 0,001 | 0,005 | 0,007 | 0,019 | 0,003 | 0,014 | 0,014 | 0,003 | 0,002 | 0,027 |
| Sivas | | 0,157 | 0,001 | 0,000 | 0,001 | 0,002 | 0,006 | 0,001 | 0,004 | 0,004 | 0,001 | 0,001 | 0,008 |
| Samsun | | 0,281 | 0,002 | 0,001 | 0,002 | 0,004 | 0,010 | 0,002 | 0,007 | 0,008 | 0,001 | 0,001 | 0,014 |
| Malatya | | 0,132 | 0,001 | 0,000 | 0,001 | 0,002 | 0,005 | 0,001 | 0,004 | 0,004 | 0,001 | 0,001 | 0,008 |
| Diyarbakır | | 0,212 | 0,002 | 0,001 | 0,002 | 0,003 | 0,009 | 0,002 | 0,008 | 0,008 | 0,001 | 0,001 | 0,014 |
| Van | | 0,063 | 0,001 | 0,000 | 0,001 | 0,001 | 0,003 | 0,001 | 0,003 | 0,003 | 0,000 | 0,000 | 0,004 |
| Tabriz | | 0,198 | 0,002 | 0,001 | 0,003 | 0,003 | 0,010 | 0,002 | 0,009 | 0,010 | 0,001 | 0,001 | 0,015 |
| Teheran | | 0,665 | 0,006 | 0,002 | 0,010 | 0,013 | 0,038 | 0,008 | 0,035 | 0,039 | 0,005 | 0,005 | 0,057 |
| Erzurum | | 0,082 | 0,001 | 0,000 | 0,001 | 0,001 | 0,004 | 0,001 | 0,003 | 0,003 | 0,001 | 0,000 | 0,005 |
| Tbilisi | | 0,165 | 0,001 | 0,001 | 0,002 | 0,003 | 0,008 | 0,002 | 0,007 | 0,008 | 0,001 | 0,001 | 0,013 |
| Baku | | 0,196 | 0,002 | 0,001 | 0,003 | 0,004 | 0,011 | 0,002 | 0,010 | 0,011 | 0,001 | 0,001 | 0,017 |

19,336

# Firenze - Roma

| | | Roma | Napoli | Bari | Taranto + Brindisi | Reggio C. + Messina | Palermo |
|---|---|---|---|---|---|---|---|
| | | 2,87 | 1,00 | 0,31 | 0,29 | 0,24 | 0,66 |
| Firenze | 0,36 | 2,30 | 4,14 | 5,38 | 6,18 | 7,44 | 9,41 |
| Livorno + Pisa | 0,25 | 3,06 | 4,90 | 6,14 | 6,94 | 8,20 | 10,17 |
| Bologna | 0,39 | 3,08 | 4,92 | 6,16 | 6,96 | 8,22 | 10,19 |
| Milano | 1,35 | 5,06 | 6,90 | 8,14 | 8,94 | 10,20 | 12,17 |
| Torino | 0,89 | 6,31 | 8,15 | 9,39 | 10,19 | 11,45 | 13,42 |
| Lyon | 2,19 | 8,64 | 10,48 | 11,72 | 12,52 | 13,78 | 15,75 |
| Paris | 12,40 | 12,60 | 14,44 | 15,68 | 16,48 | 17,74 | 19,71 |
| Genève | 0,20 | 7,55 | 9,39 | 10,63 | 11,43 | 12,69 | 14,66 |
| Bern | 0,14 | 7,16 | 9,00 | 10,24 | 11,04 | 12,30 | 14,27 |
| Zürich | 0,40 | 7,26 | 9,10 | 10,34 | 11,14 | 12,40 | 14,37 |
| Basel | 0,18 | 7,99 | 9,83 | 11,07 | 11,87 | 13,13 | 15,10 |
| Mannheim-L. | 0,63 | 10,39 | 12,23 | 13,47 | 14,27 | 15,53 | 17,50 |
| Frankfurt | 1,60 | 11,12 | 12,96 | 14,20 | 15,00 | 16,26 | 18,23 |
| Verona | 0,26 | 4,15 | 5,99 | 7,23 | 8,03 | 9,29 | 11,26 |
| Trento | 0,11 | 4,86 | 6,70 | 7,94 | 8,74 | 10,00 | 11,97 |
| Bozen/Bolzano | 0,10 | 5,36 | 7,20 | 8,44 | 9,24 | 10,50 | 12,47 |
| Innsbruck | 0,13 | 6,20 | 8,04 | 9,28 | 10,08 | 11,34 | 13,31 |
| München | 1,45 | 7,24 | 9,08 | 10,32 | 11,12 | 12,38 | 14,35 |
| Augsburg | 0,29 | 7,80 | 9,64 | 10,88 | 11,68 | 12,94 | 14,91 |
| Stuttgart | 0,62 | 9,14 | 10,98 | 12,22 | 13,02 | 14,28 | 16,25 |
| Nürnberg | 0,74 | 8,72 | 10,56 | 11,80 | 12,60 | 13,86 | 15,83 |
| Padova | 0,21 | 4,19 | 6,03 | 7,27 | 8,07 | 9,33 | 11,30 |
| Venezia | 0,34 | 4,53 | 6,37 | 7,61 | 8,41 | 9,67 | 11,64 |
| Klagenft.+Vill. | 0,16 | 6,58 | 8,42 | 9,66 | 10,46 | 11,72 | 13,69 |
| Graz | 0,28 | 7,58 | 9,42 | 10,66 | 11,46 | 12,72 | 14,69 |
| Wien | 1,84 | 9,08 | 10,92 | 12,16 | 12,96 | 14,22 | 16,19 |
| Brno | 0,39 | 10,13 | 11,97 | 13,21 | 14,01 | 15,27 | 17,24 |
| Ostrava | 0,30 | 11,23 | 13,07 | 14,31 | 15,11 | 16,37 | 18,34 |
| Katowice+...*) | 1,73 | 11,98 | 13,82 | 15,06 | 15,86 | 17,12 | 19,09 |
| Bratislava | 0,42 | 9,63 | 11,47 | 12,71 | 13,51 | 14,77 | 16,74 |
| Trieste | 0,20 | 5,73 | 7,57 | 8,81 | 9,61 | 10,87 | 12,84 |
| Ljubljana | 0,29 | 6,48 | 8,32 | 9,56 | 10,36 | 11,62 | 13,59 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Firenze | 0,251 | 0,032 | 0,006 | 0,005 | 0,003 | 0,005 |
| Livorno + Pisa | 0,107 | 0,017 | 0,004 | 0,003 | 0,002 | 0,003 |
| Bologna | 0,165 | 0,026 | 0,005 | 0,004 | 0,003 | 0,005 |
| Milano | 0,246 | 0,051 | 0,012 | 0,009 | 0,006 | 0,013 |
| Torino | 0,111 | 0,025 | 0,006 | 0,005 | 0,003 | 0,007 |
| Lyon | 0,161 | 0,040 | 0,010 | 0,009 | 0,006 | 0,013 |
| Paris | 0,479 | 0,132 | 0,036 | 0,031 | 0,022 | 0,052 |
| Genève | 0,018 | 0,004 | 0,001 | 0,001 | 0,001 | 0,001 |
| Bern | 0,014 | 0,003 | 0,001 | 0,001 | 0,000 | 0,001 |
| Zürich | 0,039 | 0,009 | 0,002 | 0,002 | 0,001 | 0,003 |
| Basel | 0,015 | 0,004 | 0,001 | 0,001 | 0,001 | 0,001 |
| Mannheim-L. | 0,034 | 0,009 | 0,002 | 0,002 | 0,001 | 0,003 |
| Frankfurt | 0,076 | 0,021 | 0,005 | 0,005 | 0,003 | 0,008 |
| Verona | 0,066 | 0,012 | 0,003 | 0,002 | 0,001 | 0,003 |
| Trento | 0,021 | 0,004 | 0,001 | 0,001 | 0,001 | 0,001 |
| Bozen/Bolzano | 0,017 | 0,003 | 0,001 | 0,001 | 0,000 | 0,001 |
| Innsbruck | 0,017 | 0,004 | 0,001 | 0,001 | 0,001 | 0,001 |
| München | 0,144 | 0,034 | 0,009 | 0,007 | 0,005 | 0,010 |
| Augsburg | 0,025 | 0,006 | 0,002 | 0,001 | 0,001 | 0,002 |
| Stuttgart | 0,041 | 0,011 | 0,003 | 0,002 | 0,002 | 0,004 |
| Nürnberg | 0,053 | 0,013 | 0,003 | 0,003 | 0,002 | 0,004 |
| Padova | 0,053 | 0,010 | 0,002 | 0,002 | 0,001 | 0,002 |
| Venezia | 0,075 | 0,015 | 0,003 | 0,003 | 0,002 | 0,003 |
| Klagenft.+Vill. | 0,019 | 0,004 | 0,001 | 0,001 | 0,001 | 0,001 |
| Graz | 0,026 | 0,006 | 0,002 | 0,001 | 0,001 | 0,002 |
| Wien | 0,124 | 0,032 | 0,008 | 0,007 | 0,005 | 0,011 |
| Brno | 0,022 | 0,006 | 0,002 | 0,001 | 0,001 | 0,002 |
| Ostrava | 0,014 | 0,004 | 0,001 | 0,001 | 0,001 | 0,001 |
| Katowice+...*) | 0,073 | 0,020 | 0,005 | 0,005 | 0,003 | 0,008 |
| Bratislava | 0,026 | 0,007 | 0,002 | 0,001 | 0,001 | 0,002 |
| Trieste | 0,030 | 0,006 | 0,002 | 0,001 | 0,001 | 0,002 |
| Ljubljana | 0,035 | 0,008 | 0,002 | 0,002 | 0,001 | 0,002 |

3,700

## Gence - Sumqayit/Baku

| | | Sumqayit | Makhachkala | Baku | Rasht |
|---|---|---|---|---|---|
| | | 0,32 | 0,58 | 2,14 | 0,64 |
| Gence | 0,32 | 2,78 | 5,89 | 3,06 | 6,58 |
| Rustavi | 0,12 | 4,06 | 7,17 | 4,34 | 7,86 |
| Tbilisi | 1,17 | 4,38 | 7,49 | 4,66 | 8,18 |
| Yerevan | 1,06 | 6,07 | 9,18 | 6,35 | 9,87 |
| Kutaisi | 0,20 | 6,31 | 9,42 | 6,59 | 10,11 |
| Batumi | 0,13 | 7,41 | 10,52 | 7,69 | 11,21 |
| Sotchi | 0,36 | 9,11 | 12,22 | 9,39 | 12,91 |
| Krasnodar | 0,75 | 10,80 | 13,91 | 11,08 | 14,60 |
| Rostow n.D. | 1,87 | 13,29 | 16,40 | 13,57 | 17,09 |
| Erzurum | 0,37 | 8,02 | 11,13 | 8,30 | 11,82 |
| Sivas | 0,35 | 12,00 | 15,11 | 12,28 | 15,80 |
| Ankara | 4,59 | 15,41 | 18,52 | 15,69 | 19,21 |
| Eskişehir | 0,69 | 17,47 | 20,58 | 17,75 | 21,27 |
| Istanbul | 14,66 | 19,77 | 22,88 | 20,05 | 23,57 |
| Izmir | 4,11 | 21,35 | 24,46 | 21,63 | 25,15 |
| Denizli | 1,00 | 20,06 | 23,17 | 20,34 | 23,86 |
| Konya | 1,22 | 17,69 | 20,80 | 17,97 | 21,49 |
| Antalya | 2,22 | 19,62 | 22,73 | 19,90 | 23,42 |

| | | | | |
|---|---|---|---|---|
| Gence | 0,018 | 0,009 | 0,102 | 0,008 |
| Rustavi | 0,004 | 0,002 | 0,021 | 0,002 |
| Tbilisi | 0,030 | 0,022 | 0,183 | 0,021 |
| Yerevan | 0,016 | 0,014 | 0,098 | 0,014 |
| Kutaisi | 0,003 | 0,003 | 0,017 | 0,003 |
| Batumi | 0,001 | 0,001 | 0,009 | 0,001 |
| Sotchi | 0,003 | 0,003 | 0,017 | 0,003 |
| Krasnodar | 0,004 | 0,005 | 0,027 | 0,005 |
| Rostow n.D. | 0,007 | 0,009 | 0,048 | 0,010 |
| Erzurum | 0,003 | 0,004 | 0,022 | 0,004 |
| Sivas | 0,002 | 0,002 | 0,011 | 0,002 |
| Ankara | 0,014 | 0,019 | 0,091 | 0,019 |
| Eskişehir | 0,002 | 0,002 | 0,011 | 0,002 |
| Istanbul | 0,029 | 0,042 | 0,192 | 0,044 |
| Izmir | 0,007 | 0,010 | 0,047 | 0,011 |
| Denizli | 0,002 | 0,003 | 0,013 | 0,003 |
| Konya | 0,003 | 0,004 | 0,019 | 0,004 |
| Antalya | 0,005 | 0,006 | 0,029 | 0,007 |

1,433

# Graz - Wien

| | | Wien | Brno | Praha | Dresden | Berlin | Ostrava | Katowice + ... | Wroclaw | Łodz | Warszawa | Gdansk, Gdyn | Krakow | Bratislava | Zilina | Kosice | Györ | Budapest |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1,84 | 0,39 | 1,27 | 0,53 | 3,66 | 0,30 | 1,28 | 0,63 | 0,72 | 1,71 | 0,71 | 0,76 | 0,42 | 0,08 | 0,33 | 0,13 | 1,74 |
| Graz | 0,28 | 1,50 | 2,55 | 4,42 | 5,61 | 7,24 | 3,65 | 4,40 | 6,08 | 6,10 | 6,98 | 9,83 | 4,66 | 2,05 | 3,72 | 5,65 | 2,65 | 3,69 |
| Klagenfurt | 0,10 | 2,50 | 3,55 | 5,42 | 6,61 | 8,24 | 4,65 | 5,40 | 7,08 | 7,10 | 7,98 | 10,83 | 5,66 | 3,05 | 4,72 | 6,65 | 3,65 | 4,69 |
| Villach | 0,06 | 2,89 | 3,94 | 5,81 | 7,00 | 8,63 | 5,04 | 5,79 | 7,47 | 7,49 | 8,37 | 11,22 | 6,05 | 3,44 | 5,11 | 7,04 | 4,04 | 5,08 |
| Maribor | 0,09 | 2,06 | 3,11 | 4,98 | 6,17 | 7,80 | 4,21 | 4,96 | 6,64 | 6,66 | 7,54 | 10,39 | 5,22 | 2,61 | 4,28 | 6,21 | 3,21 | 4,25 |
| Ljubljana | 0,29 | 3,08 | 4,13 | 6,00 | 7,19 | 8,82 | 5,23 | 5,98 | 7,66 | 7,68 | 8,56 | 11,41 | 6,24 | 3,63 | 5,30 | 7,23 | 4,23 | 5,27 |
| Trieste | 0,20 | 3,82 | 4,87 | 6,74 | 7,93 | 9,56 | 5,97 | 6,72 | 8,40 | 8,42 | 9,30 | 12,15 | 6,98 | 4,37 | 6,04 | 7,97 | 4,97 | 6,01 |
| Zagreb | 0,79 | 2,92 | 3,97 | 5,84 | 7,03 | 8,66 | 5,07 | 5,82 | 7,50 | 7,52 | 8,40 | 11,25 | 6,08 | 3,47 | 5,14 | 7,07 | 4,07 | 5,11 |
| Vinkovci + ... | 0,17 | 5,24 | 6,29 | 8,16 | 9,35 | 10,98 | 7,39 | 8,14 | 9,82 | 9,84 | 10,72 | 13,57 | 8,40 | 5,79 | 7,46 | 9,39 | 6,39 | 7,43 |
| Sarajewo | 0,53 | 6,78 | 7,83 | 9,70 | 10,89 | 12,52 | 8,93 | 9,68 | 11,36 | 11,38 | 12,26 | 15,11 | 9,94 | 7,33 | 9,00 | 10,93 | 7,93 | 8,97 |
| Beograd | 1,23 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Venezia | 0,34 | 4,63 | 5,68 | 7,55 | 8,74 | 10,37 | 6,78 | 7,53 | 9,21 | 9,23 | 10,11 | 12,96 | 7,79 | 5,18 | 6,85 | 8,78 | 5,78 | 6,82 |
| Padova | 0,21 | 4,97 | 6,02 | 7,89 | 9,08 | 10,71 | 7,12 | 7,87 | 9,55 | 9,57 | 10,45 | 13,30 | 8,13 | 5,52 | 7,19 | 9,12 | 6,12 | 7,16 |
| Bologna | 0,39 | 6,08 | 7,13 | 9,00 | 10,19 | 11,82 | 8,23 | 8,98 | 10,66 | 10,68 | 11,56 | 14,41 | 9,24 | 6,63 | 8,30 | 10,23 | 7,23 | 8,27 |
| Firenze | 0,36 | 6,86 | 7,91 | 9,78 | 10,97 | 12,60 | 9,01 | 9,76 | 11,44 | 11,46 | 12,34 | 15,19 | 10,02 | 7,41 | 9,08 | 11,01 | 8,01 | 9,05 |
| Roma | 2,87 | 9,16 | 10,21 | 12,08 | 13,27 | 14,90 | 11,31 | 12,06 | 13,74 | 13,76 | 14,64 | 17,49 | 12,32 | 9,71 | 11,38 | 13,31 | 10,31 | 11,35 |
| Verona | 0,26 | 5,62 | 6,67 | 8,54 | 9,73 | 11,36 | 7,77 | 8,52 | 10,20 | 10,22 | 11,10 | 13,95 | 8,78 | 6,17 | 7,84 | 9,77 | 6,77 | 7,81 |
| Milano | 1,35 | 7,04 | 8,09 | 9,96 | 11,15 | 12,78 | 9,19 | 9,94 | 11,62 | 11,64 | 12,52 | 15,37 | 10,20 | 7,59 | 9,26 | 11,19 | 8,19 | 9,23 |
| Torino | 0,89 | 8,29 | 9,34 | 11,21 | 12,40 | 14,03 | 10,44 | 11,19 | 12,87 | 12,89 | 13,77 | 16,62 | 11,45 | 8,84 | 10,51 | 12,44 | 9,44 | 10,48 |
| Bozen/Bolz. | 0,10 | 4,76 | 5,81 | 7,68 | 8,87 | 10,50 | 6,91 | 7,66 | 9,34 | 9,36 | 10,24 | 13,09 | 7,92 | 5,31 | 6,98 | 8,91 | 5,91 | 6,95 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Graz | | 0,259 | 0,022 | 0,028 | 0,008 | 0,035 | 0,009 | 0,029 | 0,008 | 0,009 | 0,018 | 0,004 | 0,016 | 0,035 | 0,002 | 0,005 | 0,007 | 0,053 |
| Klagenfurt | | 0,039 | 0,005 | 0,007 | 0,002 | 0,010 | 0,002 | 0,007 | 0,002 | 0,003 | 0,005 | 0,001 | 0,004 | 0,006 | 0,001 | 0,001 | 0,001 | 0,013 |
| Villach | | 0,018 | 0,002 | 0,004 | 0,001 | 0,006 | 0,001 | 0,004 | 0,001 | 0,001 | 0,003 | 0,001 | 0,002 | 0,003 | 0,000 | 0,001 | 0,001 | 0,007 |
| Maribor | | 0,048 | 0,005 | 0,007 | 0,002 | 0,010 | 0,002 | 0,008 | 0,002 | 0,003 | 0,005 | 0,001 | 0,004 | 0,007 | 0,001 | 0,001 | 0,002 | 0,013 |
| Ljubljana | | 0,079 | 0,010 | 0,018 | 0,005 | 0,026 | 0,005 | 0,018 | 0,006 | 0,007 | 0,013 | 0,003 | 0,010 | 0,014 | 0,001 | 0,003 | 0,003 | 0,030 |
| Trieste | | 0,038 | 0,005 | 0,010 | 0,003 | 0,016 | 0,003 | 0,010 | 0,003 | 0,004 | 0,008 | 0,002 | 0,006 | 0,007 | 0,001 | 0,002 | 0,002 | 0,017 |
| Zagreb | | 0,235 | 0,030 | 0,050 | 0,015 | 0,074 | 0,015 | 0,051 | 0,016 | 0,018 | 0,036 | 0,009 | 0,028 | 0,040 | 0,004 | 0,009 | 0,009 | 0,086 |
| Vinkovci + ... | | 0,019 | 0,003 | 0,006 | 0,002 | 0,011 | 0,002 | 0,006 | 0,002 | 0,003 | 0,005 | 0,001 | 0,003 | 0,004 | 0,000 | 0,001 | 0,001 | 0,010 |
| Sarajewo | | 0,038 | 0,006 | 0,014 | 0,005 | 0,026 | 0,004 | 0,014 | 0,005 | 0,006 | 0,013 | 0,004 | 0,008 | 0,008 | 0,001 | 0,003 | 0,002 | 0,022 |
| Beograd | | 0,014 | 0,003 | 0,010 | 0,004 | 0,028 | 0,002 | 0,010 | 0,005 | 0,005 | 0,013 | 0,005 | 0,006 | 0,003 | 0,001 | 0,002 | 0,001 | 0,013 |
| Venezia | | 0,046 | 0,007 | 0,014 | 0,005 | 0,023 | 0,004 | 0,014 | 0,005 | 0,006 | 0,011 | 0,003 | 0,008 | 0,009 | 0,001 | 0,003 | 0,002 | 0,023 |
| Padova | | 0,025 | 0,004 | 0,008 | 0,003 | 0,014 | 0,002 | 0,008 | 0,003 | 0,003 | 0,007 | 0,002 | 0,005 | 0,005 | 0,001 | 0,002 | 0,001 | 0,013 |
| Bologna | | 0,033 | 0,005 | 0,012 | 0,004 | 0,021 | 0,003 | 0,012 | 0,004 | 0,005 | 0,010 | 0,003 | 0,007 | 0,007 | 0,001 | 0,002 | 0,002 | 0,019 |
| Firenze | | 0,025 | 0,004 | 0,009 | 0,003 | 0,018 | 0,003 | 0,010 | 0,004 | 0,004 | 0,009 | 0,003 | 0,005 | 0,005 | 0,001 | 0,002 | 0,001 | 0,015 |
| Roma | | 0,122 | 0,022 | 0,053 | 0,019 | 0,106 | 0,014 | 0,053 | 0,021 | 0,024 | 0,051 | 0,016 | 0,031 | 0,025 | 0,004 | 0,012 | 0,007 | 0,080 |
| Verona | | 0,025 | 0,004 | 0,009 | 0,003 | 0,015 | 0,002 | 0,009 | 0,003 | 0,004 | 0,007 | 0,002 | 0,005 | 0,005 | 0,001 | 0,002 | 0,001 | 0,014 |
| Milano | | 0,090 | 0,015 | 0,034 | 0,012 | 0,065 | 0,009 | 0,035 | 0,013 | 0,015 | 0,031 | 0,009 | 0,020 | 0,018 | 0,002 | 0,007 | 0,005 | 0,054 |
| Torino | | 0,045 | 0,008 | 0,019 | 0,007 | 0,037 | 0,005 | 0,019 | 0,007 | 0,008 | 0,018 | 0,005 | 0,011 | 0,009 | 0,001 | 0,004 | 0,003 | 0,029 |
| Bozen/Bolz. | | 0,013 | 0,002 | 0,004 | 0,001 | 0,007 | 0,001 | 0,004 | 0,001 | 0,002 | 0,003 | 0,001 | 0,002 | 0,002 | 0,000 | 0,001 | 0,001 | 0,006 |

4,379

# Györ - Budapest

| | | Budapest | Miskolc | Nyiregyhaza | Ushgorod | Debrecen | Oradea | Cluj | Arad | Sibiu | Brasov | Bucureşti | Timioşara | Szeged | Belgrade | Niš | Sofia | Istanbul |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1,74 | 0,17 | 0,12 | 0,20 | 0,21 | 0,20 | 0,30 | 0,16 | 0,43 | 0,28 | 1,88 | 0,32 | 0,17 | 1,23 | 0,26 | 1,21 | 14,66 |
| Györ | 0,13 | 1,04 | 2,51 | 3,20 | 4,08 | 3,02 | 3,28 | 4,58 | 3,28 | 5,48 | 6,31 | 7,73 | 3,63 | 2,67 | 4,24 | 6,23 | 7,59 | 12,65 |
| Bratislava | 0,42 | 1,74 | 3,21 | 3,90 | 4,78 | 3,72 | 3,98 | 5,28 | 3,98 | 6,18 | 7,01 | 8,43 | 4,33 | 3,37 | 4,94 | 6,93 | 8,29 | 13,35 |
| Ostrava | 0,30 | 3,77 | 5,24 | 5,93 | 6,81 | 5,75 | 6,01 | 7,31 | 6,01 | 8,21 | 9,04 | 10,46 | 6,36 | 5,40 | 6,97 | 8,96 | 10,32 | 15,38 |
| Katowice + ... | 1,28 | 4,52 | 5,99 | 6,68 | 7,56 | 6,50 | 6,76 | 8,06 | 6,76 | 8,96 | 9,79 | 11,21 | 7,11 | 6,15 | 7,72 | 9,71 | 11,07 | 16,13 |
| Krakow | 0,76 | 4,78 | 6,25 | 6,94 | 7,82 | 6,76 | 7,02 | 8,32 | 7,02 | 9,22 | 10,05 | 11,47 | 7,37 | 6,41 | 7,98 | 9,97 | 11,33 | 16,39 |
| Warszawa | 1,71 | 7,10 | 8,57 | 9,26 | 10,14 | 9,08 | 9,34 | 10,64 | 9,34 | 11,54 | 12,37 | 13,79 | 9,69 | 8,73 | 10,30 | 12,29 | 13,65 | 18,71 |
| Wrocław | 0,63 | 6,20 | 7,67 | 8,36 | 9,24 | 8,18 | 8,44 | 9,74 | 8,44 | 10,64 | 11,47 | 12,89 | 8,79 | 7,83 | 9,40 | 11,39 | 12,75 | 17,81 |
| Brno | 0,39 | 2,91 | 4,38 | 5,07 | 5,95 | 4,89 | 5,15 | 6,45 | 5,15 | 7,35 | 8,18 | 9,60 | 5,50 | 4,54 | 6,11 | 8,10 | 9,46 | 14,52 |
| Praha | 1,27 | 4,78 | 6,25 | 6,94 | 7,82 | 6,76 | 7,02 | 8,32 | 7,02 | 9,22 | 10,05 | 11,47 | 7,37 | 6,41 | 7,98 | 9,97 | 11,33 | 16,39 |
| Wien | 1,84 | 2,19 | 3,66 | 4,35 | 5,23 | 4,17 | 4,43 | 5,73 | 4,43 | 6,63 | 7,46 | 8,88 | 4,78 | 3,82 | 5,39 | 7,38 | 8,74 | 13,80 |
| Linz + Wels | 0,26 | 3,72 | 5,19 | 5,88 | 6,76 | 5,70 | 5,96 | 7,26 | 5,96 | 8,16 | 8,99 | 10,41 | 6,31 | 5,35 | 6,92 | 8,91 | 10,27 | 15,33 |
| Passau | 0,06 | 4,45 | 5,92 | 6,61 | 7,49 | 6,43 | 6,69 | 7,99 | 6,69 | 8,89 | 9,72 | 11,14 | 7,04 | 6,08 | 7,65 | 9,64 | 11,00 | 16,06 |
| Regensburg | 0,15 | 5,54 | 7,01 | 7,70 | 8,58 | 7,52 | 7,78 | 9,08 | 7,78 | 9,98 | 10,81 | 12,23 | 8,13 | 7,17 | 8,74 | 10,73 | 12,09 | 17,15 |
| Nürnberg | 0,74 | 6,41 | 7,88 | 8,57 | 9,45 | 8,39 | 8,65 | 9,95 | 8,65 | 10,85 | 11,68 | 13,10 | 9,00 | 8,04 | 9,61 | 11,60 | 12,96 | 18,02 |
| Würzburg | 0,13 | 7,37 | 8,84 | 9,53 | 10,41 | 9,35 | 9,61 | 10,91 | 9,61 | 11,81 | 12,64 | 14,06 | 9,96 | 9,00 | 10,57 | 12,56 | 13,92 | 18,98 |
| Frankfurt | 1,60 | 8,35 | 9,82 | 10,51 | 11,39 | 10,33 | 10,59 | 11,89 | 10,59 | 12,79 | 13,62 | 15,04 | 10,94 | 9,98 | 11,55 | 13,54 | 14,90 | 19,96 |
| Salzburg | 0,15 | 4,84 | 6,31 | 7,00 | 7,88 | 6,82 | 7,08 | 8,38 | 7,08 | 9,28 | 10,11 | 11,53 | 7,43 | 6,47 | 20,00 | 20,00 | 20,00 | 20,00 |
| München | 1,45 | 6,02 | 7,49 | 8,18 | 9,06 | 8,00 | 8,26 | 9,56 | 8,26 | 10,46 | 11,29 | 12,71 | 8,61 | 7,65 | 20,00 | 20,00 | 20,00 | 20,00 |
| Ausburg | 0,29 | 6,58 | 8,05 | 8,74 | 9,62 | 8,56 | 8,82 | 10,12 | 8,82 | 11,02 | 11,85 | 13,27 | 9,17 | 8,21 | 20,00 | 20,00 | 20,00 | 20,00 |
| Stuttgart | 0,62 | 7,92 | 9,39 | 10,08 | 10,96 | 9,90 | 10,16 | 11,46 | 10,16 | 12,36 | 13,19 | 14,61 | 10,51 | 9,55 | 20,00 | 20,00 | 20,00 | 20,00 |
| Karlsruhe | 0,31 | 8,53 | 10,00 | 10,69 | 11,57 | 10,51 | 10,77 | 12,07 | 10,77 | 12,97 | 13,80 | 15,22 | 11,12 | 10,16 | 20,00 | 20,00 | 20,00 | 20,00 |
| Strasbourg | 0,28 | 9,20 | 10,67 | 11,36 | 12,24 | 11,18 | 11,44 | 12,74 | 11,44 | 13,64 | 14,47 | 15,89 | 11,79 | 10,83 | 20,00 | 20,00 | 20,00 | 20,00 |
| Innsbruck | 0,13 | 6,20 | 7,67 | 8,36 | 9,24 | 8,18 | 8,44 | 9,74 | 8,44 | 10,64 | 11,47 | 12,89 | 8,79 | 7,83 | 20,00 | 20,00 | 20,00 | 20,00 |
| Vorarlberg | 0,11 | 7,53 | 9,00 | 9,69 | 10,57 | 9,51 | 9,77 | 11,07 | 9,77 | 11,97 | 12,80 | 14,22 | 10,12 | 9,16 | 20,00 | 20,00 | 20,00 | 20,00 |
| Zürich | 0,40 | 8,34 | 9,81 | 10,50 | 11,38 | 10,32 | 10,58 | 11,88 | 10,58 | 12,78 | 13,61 | 15,03 | 10,93 | 9,97 | 20,00 | 20,00 | 20,00 | 20,00 |
| Basel | 0,18 | 9,07 | 10,54 | 11,23 | 12,11 | 11,05 | 11,31 | 12,61 | 11,31 | 13,51 | 14,34 | 15,76 | 11,66 | 10,70 | 20,00 | 20,00 | 20,00 | 20,00 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Györ | | 0,212 | 0,005 | 0,002 | 0,002 | 0,004 | 0,003 | 0,003 | 0,003 | 0,003 | 0,002 | 0,008 | 0,005 | 0,004 | 0,014 | 0,002 | 0,005 | 0,025 |
| Bratislava | | 0,285 | 0,010 | 0,005 | 0,006 | 0,009 | 0,008 | 0,007 | 0,006 | 0,008 | 0,004 | 0,021 | 0,011 | 0,009 | 0,034 | 0,004 | 0,014 | 0,075 |
| Ostrava | | 0,055 | 0,003 | 0,002 | 0,002 | 0,003 | 0,003 | 0,003 | 0,002 | 0,004 | 0,002 | 0,010 | 0,004 | 0,003 | 0,014 | 0,002 | 0,007 | 0,042 |
| Katowice | | 0,171 | 0,010 | 0,006 | 0,008 | 0,011 | 0,010 | 0,011 | 0,008 | 0,013 | 0,007 | 0,040 | 0,015 | 0,010 | 0,049 | 0,007 | 0,026 | 0,166 |
| Krakow | | 0,093 | 0,006 | 0,003 | 0,005 | 0,006 | 0,006 | 0,006 | 0,004 | 0,007 | 0,004 | 0,023 | 0,008 | 0,005 | 0,027 | 0,004 | 0,015 | 0,096 |
| Warszawa | | 0,106 | 0,008 | 0,005 | 0,007 | 0,008 | 0,008 | 0,009 | 0,006 | 0,012 | 0,007 | 0,037 | 0,012 | 0,007 | 0,040 | 0,006 | 0,024 | 0,172 |
| Wrocław | | 0,049 | 0,003 | 0,002 | 0,003 | 0,004 | 0,003 | 0,004 | 0,003 | 0,005 | 0,003 | 0,015 | 0,005 | 0,003 | 0,017 | 0,003 | 0,010 | 0,069 |
| Brno | | 0,110 | 0,005 | 0,003 | 0,004 | 0,006 | 0,005 | 0,005 | 0,004 | 0,006 | 0,003 | 0,016 | 0,007 | 0,005 | 0,022 | 0,003 | 0,010 | 0,061 |
| Praha | | 0,155 | 0,010 | 0,006 | 0,008 | 0,010 | 0,009 | 0,010 | 0,007 | 0,013 | 0,007 | 0,038 | 0,014 | 0,009 | 0,046 | 0,007 | 0,025 | 0,160 |
| Wien | | 0,845 | 0,034 | 0,018 | 0,022 | 0,034 | 0,029 | 0,028 | 0,023 | 0,032 | 0,017 | 0,084 | 0,041 | 0,032 | 0,129 | 0,016 | 0,056 | 0,311 |
| Linz + Wels | | 0,048 | 0,003 | 0,002 | 0,002 | 0,003 | 0,003 | 0,003 | 0,002 | 0,003 | 0,002 | 0,009 | 0,004 | 0,003 | 0,012 | 0,002 | 0,006 | 0,037 |
| Passau | | 0,008 | 0,000 | 0,000 | 0,000 | 0,001 | 0,000 | 0,001 | 0,000 | 0,001 | 0,000 | 0,002 | 0,001 | 0,000 | 0,002 | 0,000 | 0,001 | 0,008 |
| Regensburg | | 0,014 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,004 | 0,001 | 0,001 | 0,005 | 0,001 | 0,003 | 0,018 |
| Nürnberg | | 0,055 | 0,004 | 0,002 | 0,003 | 0,004 | 0,004 | 0,004 | 0,003 | 0,006 | 0,003 | 0,018 | 0,006 | 0,004 | 0,019 | 0,003 | 0,011 | 0,080 |
| Würzburg | | 0,008 | 0,001 | 0,000 | 0,000 | 0,001 | 0,001 | 0,001 | 0,000 | 0,001 | 0,000 | 0,003 | 0,001 | 0,001 | 0,003 | 0,000 | 0,002 | 0,013 |
| Frankfurt | | 0,075 | 0,006 | 0,004 | 0,005 | 0,006 | 0,006 | 0,007 | 0,005 | 0,009 | 0,005 | 0,030 | 0,009 | 0,005 | 0,031 | 0,005 | 0,020 | 0,145 |
| Salzburg | | 0,018 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,004 | 0,002 | 0,001 | 0,001 | 0,000 | 0,001 | 0,014 |
| München | | 0,119 | 0,008 | 0,005 | 0,007 | 0,009 | 0,008 | 0,009 | 0,006 | 0,012 | 0,007 | 0,036 | 0,012 | 0,008 | 0,011 | 0,002 | 0,011 | 0,131 |
| Ausburg | | 0,021 | 0,001 | 0,001 | 0,001 | 0,002 | 0,001 | 0,002 | 0,001 | 0,002 | 0,001 | 0,007 | 0,002 | 0,001 | 0,002 | 0,000 | 0,002 | 0,026 |
| Stuttgart | | 0,032 | 0,002 | 0,001 | 0,002 | 0,003 | 0,002 | 0,003 | 0,002 | 0,004 | 0,002 | 0,012 | 0,004 | 0,002 | 0,005 | 0,001 | 0,005 | 0,056 |
| Karlsruhe | | 0,014 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,002 | 0,001 | 0,006 | 0,002 | 0,001 | 0,002 | 0,000 | 0,002 | 0,028 |
| Strasbourg | | 0,011 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,005 | 0,001 | 0,001 | 0,002 | 0,000 | 0,002 | 0,025 |
| Innsbruck | | 0,010 | 0,001 | 0,000 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,003 | 0,001 | 0,001 | 0,001 | 0,000 | 0,001 | 0,012 |
| Vorarlberg | | 0,006 | 0,000 | 0,000 | 0,000 | 0,001 | 0,000 | 0,001 | 0,000 | 0,001 | 0,000 | 0,002 | 0,001 | 0,000 | 0,001 | 0,000 | 0,001 | 0,010 |
| Zürich | | 0,019 | 0,001 | 0,001 | 0,001 | 0,002 | 0,001 | 0,002 | 0,001 | 0,002 | 0,001 | 0,008 | 0,002 | 0,001 | 0,003 | 0,001 | 0,003 | 0,036 |
| Basel | | 0,007 | 0,001 | 0,000 | 0,001 | 0,001 | 0,001 | 0,001 | 0,000 | 0,001 | 0,001 | 0,003 | 0,001 | 0,001 | 0,001 | 0,000 | 0,001 | 0,016 |

4,820

# Ishevsk - Yekaterinburg

| | | Yekaterinburg | Omsk | Novosibirsk | Chelyabinsk |
|---|---|---|---|---|---|
| | | 1,39 | 1,16 | 1,51 | 1,15 |
| Ishevsk | 0,63 | 3,01 | 11,11 | 17,16 | 4,96 |
| Kazan | 1,17 | 5,77 | 13,87 | 19,92 | 7,72 |
| Nishnij Nowgorod | 1,26 | 9,07 | 17,17 | 23,22 | 11,02 |
| Vladimir | 0,35 | 11,19 | 19,29 | 25,34 | 13,14 |
| Moskwa | 12,86 | 12,96 | 21,06 | 27,11 | 14,91 |
| St. Petersburg | 4,99 | 19,29 | 27,39 | 33,44 | 21,24 |
| Helsinki | 0,90 | 22,74 | 30,84 | 36,89 | 24,69 |
| Tallinn | 0,41 | 22,49 | 30,59 | 36,64 | 24,44 |
| Smolensk | 0,33 | 16,64 | 24,74 | 30,79 | 18,59 |
| Minsk | 1,89 | 19,76 | 27,86 | 33,91 | 21,71 |
| Vilnius | 0,54 | 21,48 | 29,58 | 35,63 | 23,43 |
| Kaunas | 0,31 | 22,38 | 30,48 | 36,53 | 24,33 |
| Kaliningrad | 0,44 | 24,59 | 32,69 | 38,74 | 26,54 |
| Brest | 0,31 | 23,06 | 31,16 | 37,21 | 25,01 |
| Warszawa | 1,71 | 24,91 | 33,01 | 39,06 | 26,86 |
| Bryansk | 0,41 | 16,43 | 24,53 | 30,58 | 18,38 |
| Homyel | 0,48 | 18,89 | 26,99 | 33,04 | 20,84 |
| Kijiv | 2,80 | 20,84 | 28,94 | 34,99 | 22,79 |
| Lviv | 0,72 | 25,54 | 33,64 | 39,69 | 27,49 |
| Tula | 0,50 | 14,69 | 22,79 | 28,84 | 16,64 |
| Orël | 0,32 | 16,39 | 24,49 | 30,54 | 18,34 |

| | | | | | |
|---|---|---|---|---|---|
| Moskwa | | 0,083 | 0,016 | 0,011 | 0,042 |
| St. Petersburg | | 0,041 | 0,012 | 0,009 | 0,025 |
| Helsinki | | 0,008 | 0,003 | 0,002 | 0,005 |
| Tallinn | | 0,230 | 0,084 | 0,071 | 0,150 |
| Smolensk | | 0,045 | 0,021 | 0,019 | 0,032 |
| Minsk | | 0,006 | 0,003 | 0,003 | 0,004 |
| Vilnius | | 0,003 | 0,001 | 0,001 | 0,002 |
| Kaunas | | 0,004 | 0,002 | 0,001 | 0,003 |
| Kaliningrad | | 0,016 | 0,008 | 0,007 | 0,012 |
| Brest | | 0,004 | 0,002 | 0,002 | 0,003 |
| Warszawa | | 0,002 | 0,001 | 0,001 | 0,002 |
| Bryansk | | 0,003 | 0,001 | 0,001 | 0,002 |
| Homyel | | 0,002 | 0,001 | 0,001 | 0,001 |
| Kijiv | | 0,010 | 0,005 | 0,005 | 0,007 |
| Lviv | | 0,005 | 0,002 | 0,002 | 0,003 |
| Tula | | 0,005 | 0,002 | 0,002 | 0,003 |
| Orël | | 0,022 | 0,011 | 0,010 | 0,016 |

| |
|---|
| 1,123 |

## Kaunas - Riga

| | | Riga | Tallinn | Helsinki + Espoo | Lahti | Tampere |
|---|---|---|---|---|---|---|
| | | 0,64 | 0,41 | 0,90 | 0,10 | 0,23 |
| Kaunas | 0,31 | 2,23 | 5,04 | 5,86 | 6,84 | 7,46 |
| Vilnius | 0,54 | 3,13 | 5,94 | 6,76 | 7,74 | 8,36 |
| Minsk | 1,89 | 4,85 | 7,66 | 8,48 | 9,46 | 10,08 |
| Kaliningrad | 0,44 | 4,44 | 7,25 | 8,07 | 9,05 | 9,67 |
| Gdańsk + Gdynia | 0,71 | 5,72 | 8,53 | 9,35 | 10,33 | 10,95 |
| Białystok | 0,29 | 4,23 | 7,04 | 7,86 | 8,84 | 9,46 |
| Warszawa | 1,71 | 6,01 | 8,82 | 9,64 | 10,62 | 11,24 |
| Lublin | 0,35 | 7,57 | 10,38 | 11,20 | 12,18 | 12,80 |
| Lviv | 0,72 | 9,44 | 12,25 | 13,07 | 14,05 | 14,67 |
| Krakow | 0,76 | 8,54 | 11,35 | 12,17 | 13,15 | 13,77 |
| Tarnov | 0,11 | 9,28 | 12,09 | 12,91 | 13,89 | 14,51 |
| Kosice | 0,24 | 11,05 | 13,86 | 14,68 | 15,66 | 16,28 |
| Katowice | 1,28 | 8,59 | 11,40 | 12,22 | 13,20 | 13,82 |
| Ostrava | 0,30 | 9,34 | 12,15 | 12,97 | 13,95 | 14,57 |
| Brno | 0,39 | 10,77 | 13,58 | 14,40 | 15,38 | 16,00 |
| Wien | 1,84 | 11,49 | 14,30 | 15,12 | 16,10 | 16,72 |
| Bratislava | 0,42 | 11,37 | 14,18 | 15,00 | 15,98 | 16,60 |
| Budapest | 1,74 | 13,11 | 15,92 | 16,74 | 17,72 | 18,34 |
| Łodz | 0,72 | 7,17 | 9,98 | 10,80 | 11,78 | 12,40 |
| Wrocław | 0,63 | 9,02 | 11,83 | 12,65 | 13,63 | 14,25 |
| Praha | 1,27 | 11,26 | 14,07 | 14,89 | 15,87 | 16,49 |
| Poznań | 0,55 | 9,07 | 11,88 | 12,70 | 13,68 | 14,30 |
| Berlin | 3,66 | 11,49 | 14,30 | 15,12 | 16,10 | 16,72 |
| Leipzig + Halle | 0,75 | 12,95 | 15,76 | 16,58 | 17,56 | 18,18 |
| Hannover | 0,51 | 14,08 | 16,89 | 17,71 | 18,69 | 19,31 |
| Hamburg | 1,79 | 14,02 | 16,83 | 17,65 | 18,63 | 19,25 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Kaunas | | 0,051 | 0,008 | 0,014 | 0,001 | 0,002 |
| Vilnius | | 0,050 | 0,011 | 0,019 | 0,002 | 0,003 |
| Minsk | | 0,083 | 0,024 | 0,045 | 0,004 | 0,009 |
| Kaliningrad | | 0,022 | 0,006 | 0,011 | 0,001 | 0,002 |
| Gdańsk + Gdynia | | 0,023 | 0,008 | 0,014 | 0,001 | 0,003 |
| Białystok | | 0,016 | 0,004 | 0,008 | 0,001 | 0,001 |
| Warszawa | | 0,052 | 0,017 | 0,033 | 0,003 | 0,006 |
| Lublin | | 0,007 | 0,003 | 0,005 | 0,000 | 0,001 |
| Lviv | | 0,010 | 0,004 | 0,008 | 0,001 | 0,002 |
| Krakow | | 0,013 | 0,005 | 0,010 | 0,001 | 0,002 |
| Tarnov | | 0,002 | 0,001 | 0,001 | 0,000 | 0,000 |
| Kosice | | 0,003 | 0,001 | 0,002 | 0,000 | 0,000 |
| Katowice | | 0,021 | 0,008 | 0,016 | 0,002 | 0,003 |
| Ostrava | | 0,004 | 0,002 | 0,003 | 0,000 | 0,001 |
| Brno | | 0,004 | 0,002 | 0,004 | 0,000 | 0,001 |
| Wien | | 0,019 | 0,008 | 0,016 | 0,002 | 0,004 |
| Bratislava | | 0,004 | 0,002 | 0,004 | 0,000 | 0,001 |
| Budapest | | 0,014 | 0,006 | 0,013 | 0,001 | 0,003 |
| Łodz | | 0,016 | 0,006 | 0,011 | 0,001 | 0,002 |
| Wrocław | | 0,010 | 0,004 | 0,008 | 0,001 | 0,002 |
| Praha | | 0,013 | 0,006 | 0,012 | 0,001 | 0,002 |
| Poznań | | 0,008 | 0,003 | 0,007 | 0,001 | 0,001 |
| Berlin | | 0,037 | 0,016 | 0,033 | 0,003 | 0,007 |
| Leipzig + Halle | | 0,006 | 0,003 | 0,006 | 0,001 | 0,001 |
| Hannover | | 0,004 | 0,002 | 0,003 | 0,000 | 0,001 |
| Hamburg | | 0,013 | 0,006 | 0,012 | 0,001 | 0,003 |

| |
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| 1,084 |

# Kaunas - Vilnius

| | | Vilnius | Daugavpils | Pskow | St. Petersburg | Minsk | Orsha | Smolensk | Moskwa | Homyel | Bryansk | Kijiv |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0,54 | 0,09 | 0,21 | 4,99 | 1,89 | 0,12 | 0,33 | 12,86 | 0,48 | 0,41 | 2,80 |
| Kaunas | 0,31 | 0,90 | 2,46 | 4,88 | 7,50 | 2,62 | 4,63 | 5,74 | 9,42 | 5,43 | 7,89 | 7,65 |
| Riga | 0,64 | 3,13 | 4,69 | 7,11 | 9,73 | 4,85 | 6,86 | 7,97 | 11,65 | 7,66 | 10,12 | 9,88 |
| Tallinn | 0,41 | 5,94 | 7,50 | 9,92 | 12,54 | 7,66 | 9,67 | 10,78 | 14,46 | 10,47 | 12,93 | 12,69 |
| Helsinki + Espoo | 0,90 | 6,76 | 8,32 | 10,74 | 13,36 | 8,48 | 10,49 | 11,60 | 15,28 | 11,29 | 13,75 | 13,51 |
| Siauliai | 0,11 | 2,09 | 3,65 | 6,07 | 8,69 | 3,81 | 5,82 | 6,93 | 10,61 | 6,62 | 9,08 | 8,84 |
| Klaipeda | 0,16 | 3,47 | 5,03 | 7,45 | 10,07 | 5,19 | 7,20 | 8,31 | 11,99 | 8,00 | 10,46 | 10,22 |
| Kaliningrad | 0,44 | 3,11 | 4,67 | 7,09 | 9,71 | 4,83 | 6,84 | 7,95 | 11,63 | 7,64 | 10,10 | 9,86 |
| Gdańsk + Gdynia | 0,71 | 4,39 | 5,95 | 8,37 | 10,99 | 6,11 | 8,12 | 9,23 | 12,91 | 8,92 | 11,38 | 11,14 |
| Szczecin | 0,41 | 7,29 | 8,85 | 11,27 | 13,89 | 9,01 | 11,02 | 12,13 | 15,81 | 11,82 | 14,28 | 14,04 |
| Białystok | 0,29 | 2,90 | 4,46 | 6,88 | 9,50 | 4,62 | 6,63 | 7,74 | 11,42 | 7,43 | 9,89 | 9,65 |
| Warszawa | 1,71 | 4,68 | 6,24 | 8,66 | 11,28 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Lublin | 0,35 | 6,24 | 7,80 | 10,22 | 12,84 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Krakow | 0,76 | 7,21 | 8,77 | 11,19 | 13,81 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Katowice | 1,28 | 7,26 | 8,82 | 11,24 | 13,86 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Ostrava | 0,30 | 8,01 | 9,57 | 11,99 | 14,61 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Brno | 0,39 | 9,44 | 11,00 | 13,42 | 16,04 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Wien | 1,84 | 10,16 | 11,72 | 14,14 | 16,76 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Bratislava | 0,42 | 10,04 | 11,60 | 14,02 | 16,64 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Łodz | 0,72 | 5,84 | 7,40 | 9,82 | 12,44 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Wrocław | 0,63 | 7,69 | 9,25 | 11,67 | 14,29 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Praha | 1,27 | 9,93 | 11,49 | 13,91 | 16,53 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Poznań | 0,55 | 7,74 | 9,30 | 11,72 | 14,34 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Berlin | 3,66 | 10,16 | 11,72 | 14,14 | 16,76 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Leipzig + Halle | 0,75 | 11,62 | 13,18 | 15,60 | 18,22 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Hannover | 0,51 | 12,75 | 14,31 | 16,73 | 19,35 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Hamburg | 1,79 | 12,69 | 14,25 | 16,67 | 19,29 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Kaunas | 0,200 | 0,006 | 0,004 | 0,050 | 0,114 | 0,003 | 0,005 | 0,088 | 0,008 | 0,004 | 0,027 |
| Riga | 0,050 | 0,004 | 0,005 | 0,067 | 0,083 | 0,003 | 0,006 | 0,127 | 0,010 | 0,005 | 0,036 |
| Tallinn | 0,011 | 0,001 | 0,002 | 0,028 | 0,024 | 0,001 | 0,002 | 0,056 | 0,004 | 0,002 | 0,015 |
| Helsinki + Espoo | 0,019 | 0,002 | 0,003 | 0,055 | 0,045 | 0,002 | 0,005 | 0,112 | 0,007 | 0,004 | 0,030 |
| Siauliai | 0,017 | 0,001 | 0,001 | 0,014 | 0,021 | 0,001 | 0,001 | 0,026 | 0,002 | 0,001 | 0,008 |
| Klaipeda | 0,010 | 0,001 | 0,001 | 0,016 | 0,018 | 0,001 | 0,001 | 0,030 | 0,002 | 0,001 | 0,009 |
| Kaliningrad | 0,035 | 0,003 | 0,003 | 0,046 | 0,057 | 0,002 | 0,004 | 0,087 | 0,007 | 0,004 | 0,025 |
| Gdańsk + Gdynia | 0,031 | 0,003 | 0,004 | 0,060 | 0,062 | 0,002 | 0,005 | 0,118 | 0,008 | 0,005 | 0,033 |
| Szczecin | 0,008 | 0,001 | 0,001 | 0,023 | 0,018 | 0,001 | 0,002 | 0,048 | 0,003 | 0,002 | 0,013 |
| Białystok | 0,026 | 0,002 | 0,002 | 0,032 | 0,041 | 0,001 | 0,003 | 0,059 | 0,005 | 0,002 | 0,017 |
| Warszawa | 0,067 | 0,007 | 0,009 | 0,139 | 0,020 | 0,001 | 0,003 | 0,135 | 0,005 | 0,004 | 0,029 |
| Lublin | 0,008 | 0,001 | 0,001 | 0,023 | 0,004 | 0,000 | 0,001 | 0,028 | 0,001 | 0,001 | 0,006 |
| Krakow | 0,014 | 0,002 | 0,003 | 0,044 | 0,009 | 0,001 | 0,002 | 0,060 | 0,002 | 0,002 | 0,013 |
| Katowice | 0,024 | 0,003 | 0,004 | 0,073 | 0,015 | 0,001 | 0,003 | 0,101 | 0,004 | 0,003 | 0,022 |
| Ostrava | 0,005 | 0,001 | 0,001 | 0,016 | 0,003 | 0,000 | 0,001 | 0,024 | 0,001 | 0,001 | 0,005 |
| Brno | 0,005 | 0,001 | 0,001 | 0,017 | 0,005 | 0,000 | 0,001 | 0,031 | 0,001 | 0,001 | 0,007 |
| Wien | 0,019 | 0,003 | 0,004 | 0,076 | 0,021 | 0,001 | 0,004 | 0,145 | 0,005 | 0,005 | 0,032 |
| Bratislava | 0,004 | 0,001 | 0,001 | 0,018 | 0,005 | 0,000 | 0,001 | 0,033 | 0,001 | 0,001 | 0,007 |
| Łodz | 0,019 | 0,002 | 0,003 | 0,049 | 0,008 | 0,001 | 0,001 | 0,057 | 0,002 | 0,002 | 0,012 |
| Wrocław | 0,011 | 0,001 | 0,002 | 0,034 | 0,007 | 0,000 | 0,001 | 0,050 | 0,002 | 0,002 | 0,011 |
| Praha | 0,014 | 0,002 | 0,003 | 0,054 | 0,015 | 0,001 | 0,003 | 0,100 | 0,004 | 0,003 | 0,022 |
| Poznań | 0,009 | 0,001 | 0,002 | 0,030 | 0,006 | 0,000 | 0,001 | 0,043 | 0,002 | 0,001 | 0,009 |
| Berlin | 0,038 | 0,005 | 0,009 | 0,151 | 0,042 | 0,003 | 0,007 | 0,289 | 0,011 | 0,009 | 0,063 |
| Leipzig + Halle | 0,006 | 0,001 | 0,001 | 0,027 | 0,009 | 0,001 | 0,002 | 0,059 | 0,002 | 0,002 | 0,013 |
| Hannover | 0,004 | 0,000 | 0,001 | 0,017 | 0,006 | 0,000 | 0,001 | 0,040 | 0,002 | 0,001 | 0,009 |
| Hamburg | 0,013 | 0,002 | 0,003 | 0,058 | 0,021 | 0,001 | 0,004 | 0,141 | 0,005 | 0,005 | 0,031 |

5,566

## Kazan - Ishevsk

| | | Ishevsk | Yekaterinburg | Omsk | Novosibirsk | Chelyabinsk |
|---|---|---|---|---|---|---|
| | | 0,63 | 1,39 | 1,16 | 1,51 | 1,15 |
| Kazan | 1,17 | 2,76 | 5,77 | 13,87 | 19,92 | 7,72 |
| Nishnij Nowgorod | 1,26 | 6,06 | 9,07 | 17,17 | 23,22 | 11,02 |
| Vladimir | 0,35 | 8,18 | 11,19 | 19,29 | 25,34 | 13,14 |
| Moskwa | 12,86 | 9,95 | 12,96 | 21,06 | 27,11 | 14,91 |
| St. Petersburg | 4,99 | 16,28 | 19,29 | 27,39 | 33,44 | 21,24 |
| Helsinki | 0,90 | 19,73 | 22,74 | 30,84 | 36,89 | 24,69 |
| Tallinn | 0,41 | 19,48 | 22,49 | 30,59 | 36,64 | 24,44 |
| Smolensk | 0,33 | 13,63 | 16,64 | 24,74 | 30,79 | 18,59 |
| Minsk | 1,89 | 16,75 | 19,76 | 27,86 | 33,91 | 21,71 |
| Vilnius | 0,54 | 18,47 | 21,48 | 29,58 | 35,63 | 23,43 |
| Kaunas | 0,31 | 19,37 | 22,38 | 30,48 | 36,53 | 24,33 |
| Kaliningrad | 0,44 | 21,58 | 24,59 | 32,69 | 38,74 | 26,54 |
| Brest | 0,31 | 20,05 | 23,06 | 31,16 | 37,21 | 25,01 |
| Warszawa | 1,71 | 21,90 | 24,91 | 33,01 | 39,06 | 26,86 |
| Bryansk | 0,41 | 13,42 | 16,43 | 24,53 | 30,58 | 18,38 |
| Homyel | 0,48 | 15,88 | 18,89 | 26,99 | 33,04 | 20,84 |
| Kijiv | 2,80 | 17,83 | 20,84 | 28,94 | 34,99 | 22,79 |
| Lviv | 0,72 | 22,53 | 25,54 | 33,64 | 39,69 | 27,49 |
| Tula | 0,50 | 11,68 | 14,69 | 22,79 | 28,84 | 16,64 |
| Orël | 0,32 | 13,38 | 16,39 | 24,49 | 30,54 | 18,34 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Moskwa | | 0,131 | 0,083 | 0,016 | 0,011 | 0,042 |
| St. Petersburg | | 0,037 | 0,041 | 0,012 | 0,009 | 0,025 |
| Helsinki | | 0,006 | 0,008 | 0,003 | 0,002 | 0,005 |
| Tallinn | | 0,163 | 0,230 | 0,084 | 0,071 | 0,150 |
| Smolensk | | 0,027 | 0,045 | 0,021 | 0,019 | 0,032 |
| Minsk | | 0,004 | 0,006 | 0,003 | 0,003 | 0,004 |
| Vilnius | | 0,002 | 0,003 | 0,001 | 0,001 | 0,002 |
| Kaunas | | 0,002 | 0,004 | 0,002 | 0,001 | 0,003 |
| Kaliningrad | | 0,010 | 0,016 | 0,008 | 0,007 | 0,012 |
| Brest | | 0,002 | 0,004 | 0,002 | 0,002 | 0,003 |
| Warszawa | | 0,001 | 0,002 | 0,001 | 0,001 | 0,002 |
| Bryansk | | 0,001 | 0,003 | 0,001 | 0,001 | 0,002 |
| Homyel | | 0,001 | 0,002 | 0,001 | 0,001 | 0,001 |
| Kijiv | | 0,006 | 0,010 | 0,005 | 0,005 | 0,007 |
| Lviv | | 0,003 | 0,005 | 0,002 | 0,002 | 0,003 |
| Tula | | 0,003 | 0,005 | 0,002 | 0,002 | 0,003 |
| Orël | | 0,013 | 0,022 | 0,011 | 0,010 | 0,016 |

| |
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| 1,537 |

## Kijiv - Bryansk

| | | Bryansk | Moskwa | St. Petersburg | Yaroslawl | Nishnij Nowgorod | Kirov | Perm | Kazan |
|---|---|---|---|---|---|---|---|---|---|
| | | 0,41 | 12,86 | 4,99 | 0,60 | 1,26 | 0,47 | 1,00 | 1,17 |
| Kijiv | 2,80 | 4,11 | 7,58 | 13,91 | 10,07 | 11,42 | 15,74 | 19,64 | 14,72 |
| Vinnitsa | 0,37 | 6,10 | 9,57 | 15,90 | 12,06 | 13,41 | 17,73 | 21,63 | 16,71 |
| Odessa | 1,00 | 9,61 | 13,08 | 19,41 | 15,57 | 16,92 | 21,24 | 25,14 | 20,22 |
| Tiraspol | 0,23 | 8,88 | 12,35 | 18,68 | 14,84 | 16,19 | 20,51 | 24,41 | 19,49 |
| Chisinau | 0,67 | 9,50 | 12,97 | 19,30 | 15,46 | 16,81 | 21,13 | 25,03 | 20,11 |
| Lviv | 0,72 | 9,38 | 12,85 | 19,18 | 15,34 | 16,69 | 21,01 | 24,91 | 19,99 |
| Rzeszow | 0,18 | 10,83 | 14,30 | 20,63 | 16,79 | 18,14 | 22,46 | 26,36 | 21,44 |
| Tarnow | 0,11 | 11,57 | 15,04 | 21,37 | 17,53 | 18,88 | 23,20 | 27,10 | 22,18 |
| Krakow | 0,76 | 12,31 | 15,78 | 22,11 | 18,27 | 19,62 | 23,94 | 27,84 | 22,92 |
| Katowice | 1,28 | 13,00 | 16,47 | 22,80 | 18,96 | 20,31 | 24,63 | 28,53 | 23,61 |
| Wrocław | 0,63 | 14,68 | 18,15 | 24,48 | 20,64 | 21,99 | 26,31 | 30,21 | 25,29 |
| Ostrava | 0,30 | 13,52 | 16,99 | 23,32 | 19,48 | 20,83 | 25,15 | 29,05 | 24,13 |
| Brno | 0,39 | 14,95 | 18,42 | 24,75 | 20,91 | 22,26 | 26,58 | 30,48 | 25,56 |
| Praha | 1,27 | 16,82 | 20,29 | 26,62 | 22,78 | 24,13 | 28,45 | 32,35 | 27,43 |
| Uzhorod | 0,11 | 11,23 | 14,70 | 21,03 | 17,19 | 18,54 | 22,86 | 26,76 | 21,84 |
| Nyiregyhaza | 0,12 | 12,11 | 15,58 | 21,91 | 18,07 | 19,42 | 23,74 | 27,64 | 22,72 |
| Miskolc | 0,17 | 12,80 | 16,27 | 22,60 | 18,76 | 20,11 | 24,43 | 28,33 | 23,41 |
| Budapest | 1,74 | 14,27 | 17,74 | 24,07 | 20,23 | 21,58 | 25,90 | 29,80 | 24,88 |
| Bratislava | 0,42 | 16,01 | 19,48 | 25,81 | 21,97 | 23,32 | 27,64 | 31,54 | 26,62 |
| Wien | 1,84 | 16,46 | 19,93 | 26,26 | 22,42 | 23,77 | 28,09 | 31,99 | 27,07 |
| Debrecen | 0,21 | 15,56 | 16,03 | 22,36 | 18,52 | 19,87 | 24,19 | 28,09 | 23,17 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Kijiv | 0,104 | 1,151 | 0,159 | 0,033 | 0,056 | 0,012 | 0,018 | 0,034 |
| Vinnitsa | 0,007 | 0,102 | 0,017 | 0,003 | 0,006 | 0,001 | 0,002 | 0,004 |
| Odessa | 0,009 | 0,163 | 0,032 | 0,006 | 0,010 | 0,003 | 0,004 | 0,007 |
| Tiraspol | 0,002 | 0,041 | 0,008 | 0,001 | 0,003 | 0,001 | 0,001 | 0,002 |
| Chisinau | 0,006 | 0,110 | 0,022 | 0,004 | 0,007 | 0,002 | 0,003 | 0,005 |
| Lviv | 0,007 | 0,121 | 0,024 | 0,004 | 0,008 | 0,002 | 0,003 | 0,005 |
| Rzeszow | 0,001 | 0,025 | 0,005 | 0,001 | 0,002 | 0,000 | 0,001 | 0,001 |
| Tarnow | 0,001 | 0,014 | 0,003 | 0,001 | 0,001 | 0,000 | 0,000 | 0,001 |
| Krakow | 0,004 | 0,090 | 0,020 | 0,003 | 0,006 | 0,002 | 0,003 | 0,004 |
| Katowice | 0,007 | 0,141 | 0,031 | 0,005 | 0,010 | 0,003 | 0,004 | 0,007 |
| Wrocław | 0,003 | 0,059 | 0,014 | 0,002 | 0,004 | 0,001 | 0,002 | 0,003 |
| Ostrava | 0,001 | 0,031 | 0,007 | 0,001 | 0,002 | 0,001 | 0,001 | 0,002 |
| Brno | 0,002 | 0,035 | 0,008 | 0,001 | 0,003 | 0,001 | 0,001 | 0,002 |
| Praha | 0,004 | 0,098 | 0,024 | 0,004 | 0,007 | 0,002 | 0,003 | 0,005 |
| Uzhorod | 0,001 | 0,015 | 0,003 | 0,001 | 0,001 | 0,000 | 0,000 | 0,001 |
| Nyiregyhaza | 0,001 | 0,014 | 0,003 | 0,001 | 0,001 | 0,000 | 0,000 | 0,001 |
| Miskolc | 0,001 | 0,019 | 0,004 | 0,001 | 0,001 | 0,000 | 0,001 | 0,001 |
| Budapest | 0,008 | 0,168 | 0,039 | 0,006 | 0,012 | 0,003 | 0,005 | 0,009 |
| Bratislava | 0,002 | 0,035 | 0,008 | 0,001 | 0,003 | 0,001 | 0,001 | 0,002 |
| Wien | 0,006 | 0,146 | 0,035 | 0,006 | 0,011 | 0,003 | 0,005 | 0,008 |
| Debrecen | 0,001 | 0,024 | 0,005 | 0,001 | 0,002 | 0,000 | 0,001 | 0,001 |

3,691

# Kirikkale - Sivas

| | | Sivas | Maltya | Diyarbakir | Van | Tabriz | Teheran | Erzurum | Kars | Tbilisi | Baku |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0,35 | 0,35 | 0,93 | 0,35 | 1,50 | 8,15 | 0,37 | 0,08 | 1,17 | 2,14 |
| Kirikkale | 0,19 | 2,90 | 4,85 | 6,70 | 8,45 | 10,99 | 16,22 | 6,88 | 8,59 | 10,52 | 14,94 |
| Ankara | 4,59 | 3,41 | 5,36 | 7,21 | 8,96 | 11,50 | 16,73 | 7,39 | 9,10 | 11,03 | 15,45 |
| Eskişehir | 0,69 | 5,47 | 7,42 | 9,27 | 11,02 | 13,56 | 18,79 | 9,45 | 11,16 | 13,09 | 17,51 |
| Adopazani | 0,27 | 6,52 | 8,47 | 10,32 | 12,07 | 14,61 | 19,84 | 10,50 | 12,21 | 14,14 | 18,56 |
| Istanbul | 14,66 | 7,77 | 9,72 | 11,57 | 13,32 | 15,86 | 21,09 | 11,75 | 13,46 | 15,39 | 19,81 |
| Edirne | 0,15 | 9,90 | 11,85 | 13,70 | 15,45 | 17,99 | 23,22 | 13,88 | 15,59 | 17,52 | 21,94 |
| Bucureşti | 1,88 | 13,31 | 15,26 | 17,11 | 18,86 | 21,40 | 26,63 | 17,29 | 19,00 | 20,93 | 25,35 |
| Sofia | 1,21 | 12,83 | 14,78 | 16,63 | 18,38 | 20,92 | 26,15 | 16,81 | 18,52 | 20,45 | 24,87 |
| Beograd | 1,35 | 16,18 | 18,13 | 19,98 | 21,73 | 24,27 | 29,50 | 20,16 | 21,87 | 23,80 | 28,22 |
| Kütakya | 0,20 | 6,04 | 7,99 | 9,84 | 11,59 | 14,13 | 19,36 | 10,02 | 11,73 | 13,66 | 18,08 |
| Balikeşir | 1,19 | 7,82 | 9,77 | 11,62 | 13,37 | 15,91 | 21,14 | 11,80 | 13,51 | 15,44 | 19,86 |
| Manisa | 0,28 | 9,06 | 11,01 | 12,86 | 14,61 | 17,15 | 22,38 | 13,04 | 14,75 | 16,68 | 21,10 |
| Izmir | 4,11 | 9,35 | 11,30 | 13,15 | 14,90 | 17,44 | 22,67 | 13,33 | 15,04 | 16,97 | 21,39 |
| Afyon | 0,21 | 6,99 | 8,94 | 10,79 | 12,54 | 15,08 | 20,31 | 10,97 | 12,68 | 14,61 | 19,03 |
| Denizli | 1,00 | 8,06 | 10,01 | 11,86 | 13,61 | 16,15 | 21,38 | 12,04 | 13,75 | 15,68 | 20,10 |
| Konya | 1,22 | 5,69 | 7,64 | 9,49 | 11,24 | 13,78 | 19,01 | 9,67 | 11,38 | 13,31 | 17,73 |
| Antalya | 2,22 | 7,62 | 9,57 | 11,42 | 13,17 | 15,71 | 20,94 | 11,60 | 13,31 | 15,24 | 19,66 |
| Alanya | 0,29 | 7,21 | 9,16 | 11,01 | 12,76 | 15,30 | 20,53 | 11,19 | 12,90 | 14,83 | 19,25 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Kirikkale | 0,011 | 0,005 | 0,007 | 0,002 | 0,005 | 0,014 | 0,003 | 0,000 | 0,004 | 0,004 |
| Ankara | 0,200 | 0,093 | 0,149 | 0,039 | 0,108 | 0,311 | 0,057 | 0,009 | 0,091 | 0,094 |
| Eskişehir | 0,013 | 0,008 | 0,015 | 0,004 | 0,012 | 0,038 | 0,006 | 0,001 | 0,010 | 0,011 |
| Adopazani | 0,004 | 0,003 | 0,005 | 0,001 | 0,004 | 0,014 | 0,002 | 0,000 | 0,003 | 0,004 |
| Istanbul | 0,157 | 0,107 | 0,212 | 0,063 | 0,200 | 0,670 | 0,082 | 0,014 | 0,164 | 0,196 |
| Edirne | 0,001 | 0,001 | 0,002 | 0,001 | 0,002 | 0,006 | 0,001 | 0,000 | 0,001 | 0,002 |
| Bucureşti | 0,008 | 0,006 | 0,014 | 0,004 | 0,015 | 0,058 | 0,005 | 0,001 | 0,013 | 0,017 |
| Sofia | 0,006 | 0,004 | 0,009 | 0,003 | 0,010 | 0,038 | 0,004 | 0,001 | 0,008 | 0,011 |
| Beograd | 0,004 | 0,003 | 0,008 | 0,003 | 0,009 | 0,035 | 0,003 | 0,001 | 0,007 | 0,010 |
| Kütakya | 0,003 | 0,002 | 0,004 | 0,001 | 0,003 | 0,011 | 0,001 | 0,000 | 0,003 | 0,003 |
| Balikeşir | 0,013 | 0,009 | 0,017 | 0,005 | 0,016 | 0,054 | 0,007 | 0,001 | 0,013 | 0,016 |
| Manisa | 0,002 | 0,002 | 0,003 | 0,001 | 0,003 | 0,012 | 0,001 | 0,000 | 0,003 | 0,003 |
| Izmir | 0,032 | 0,023 | 0,048 | 0,015 | 0,048 | 0,166 | 0,019 | 0,003 | 0,039 | 0,048 |
| Afyon | 0,003 | 0,002 | 0,003 | 0,001 | 0,003 | 0,010 | 0,001 | 0,000 | 0,003 | 0,003 |
| Denizli | 0,010 | 0,007 | 0,014 | 0,004 | 0,013 | 0,045 | 0,005 | 0,001 | 0,011 | 0,013 |
| Konya | 0,022 | 0,013 | 0,025 | 0,007 | 0,021 | 0,067 | 0,010 | 0,002 | 0,018 | 0,020 |
| Antalya | 0,025 | 0,017 | 0,033 | 0,010 | 0,031 | 0,103 | 0,013 | 0,002 | 0,025 | 0,030 |
| Alanya | 0,004 | 0,002 | 0,005 | 0,001 | 0,004 | 0,014 | 0,002 | 0,000 | 0,003 | 0,004 |

4,900

# Köln - Frankfurt

| | | Köln | Aachen | Liège | Bruxelles | Düsseldorf + Ruhrgebiet | Arnhem + Nijmegen | Rotterdam | Amsterdam | Müster | Osnabrück | Bremen + Oldenburg | Hamburg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1,06 | 0,25 | 0,20 | 1,83 | 5,71 | 0,32 | 0,63 | 0,84 | 0,31 | 0,16 | 0,72 | 1,79 |
| Frankfurt *) | 1,60 | 1,50 | 2,13 | 2,51 | 3,41 | 1,95 | 2,95 | 3,90 | 3,91 | 2,80 | 3,25 | 20,00 | 20,00 |
| Würzburg | 0,13 | 2,48 | 3,11 | 3,49 | 4,39 | 2,93 | 3,93 | 4,88 | 4,89 | 3,78 | 4,23 | 20,00 | 20,00 |
| Nürnberg | 0,74 | 3,44 | 4,07 | 4,45 | 5,35 | 3,89 | 4,89 | 5,84 | 5,85 | 4,74 | 5,19 | 20,00 | 20,00 |
| Plzeň | 0,17 | 5,09 | 5,72 | 6,10 | 7,00 | 5,54 | 6,54 | 7,49 | 7,50 | 20,00 | 20,00 | 20,00 | 20,00 |
| Praha | 1,27 | 5,92 | 6,55 | 6,93 | 7,83 | 6,37 | 7,37 | 8,32 | 8,33 | 20,00 | 20,00 | 20,00 | 20,00 |
| Regensburg | 0,15 | 4,31 | 4,94 | 5,32 | 6,22 | 4,76 | 5,76 | 6,71 | 6,72 | 5,61 | 6,06 | 20,00 | 20,00 |
| Linz + Wels | 0,26 | 6,13 | 6,76 | 7,14 | 8,04 | 6,58 | 7,58 | 8,61 | 8,54 | 7,43 | 7,88 | 20,00 | 20,00 |
| Wien | 1,84 | 7,66 | 8,29 | 8,67 | 9,57 | 8,11 | 9,11 | 10,14 | 10,07 | 8,96 | 9,41 | 20,00 | 20,00 |
| Bratislava | 0,42 | 8,21 | 8,84 | 9,22 | 10,12 | 8,66 | 9,66 | 10,69 | 10,62 | 9,51 | 9,96 | 20,00 | 20,00 |
| Budapest | 1,74 | 9,85 | 10,48 | 10,86 | 11,76 | 10,30 | 11,30 | 12,33 | 12,26 | 11,15 | 11,60 | 20,00 | 20,00 |
| München**) | 0,74 | 4,92 | 5,55 | 5,93 | 6,83 | 5,37 | 6,37 | 7,32 | 7,33 | 6,22 | 6,67 | 20,00 | 20,00 |
| Mannheim-L. | 0,63 | 2,23 | 2,86 | 3,24 | 4,14 | 2,68 | 3,68 | 4,63 | 4,64 | 3,53 | 3,98 | 20,00 | 20,00 |
| Stuttgart | 0,62 | 3,14 | 3,77 | 4,15 | 5,06 | 3,59 | 4,59 | 5,54 | 5,55 | 4,44 | 4,89 | 20,00 | 20,00 |
| Augsburg | 0,29 | 4,48 | 5,11 | 5,49 | 6,40 | 4,93 | 5,93 | 6,88 | 6,89 | 5,78 | 6,23 | 20,00 | 20,00 |
| München **) | 0,71 | 5,04 | 5,67 | 6,05 | 6,96 | 5,49 | 6,49 | 7,44 | 7,45 | 6,34 | 6,79 | 20,00 | 20,00 |
| Karlsruhe | 0,31 | 2,77 | 3,40 | 3,78 | 4,68 | 3,22 | 4,22 | 5,17 | 5,18 | 4,07 | 4,52 | 20,00 | 20,00 |
| Freiburg | 0,23 | 3,97 | 4,60 | 4,98 | 5,88 | 4,42 | 5,42 | 6,37 | 6,38 | 5,27 | 5,72 | 20,00 | 20,00 |
| Basel | 0,18 | 4,53 | 5,16 | 5,54 | 6,44 | 4,98 | 5,98 | 6,93 | 6,94 | 5,83 | 6,28 | 20,00 | 20,00 |
| Zürich | 0,40 | 5,26 | 5,89 | 6,27 | 7,17 | 5,71 | 6,71 | 7,66 | 7,67 | 6,56 | 7,01 | 20,00 | 20,00 |
| Milano | 1,35 | 7,46 | 8,09 | 8,47 | 9,37 | 7,91 | 8,91 | 9,86 | 9,87 | 8,76 | 9,21 | 20,00 | 20,00 |
| Bern | 0,14 | 5,22 | 5,85 | 6,23 | 7,13 | 5,67 | 6,67 | 7,62 | 7,63 | 6,52 | 6,97 | 20,00 | 20,00 |
| Genève | 0,20 | 6,52 | 7,15 | 7,53 | 8,43 | 6,97 | 7,97 | 8,92 | 8,93 | 7,82 | 8,27 | 20,00 | 20,00 |
| Strasbourg | 0,28 | 3,44 | 4,07 | 20,00 | 20,00 | 3,89 | 4,89 | 20,00 | 20,00 | 4,74 | 5,19 | 20,00 | 20,00 |
| Mulhouse | 0,11 | 4,47 | 5,10 | 20,00 | 20,00 | 4,92 | 5,92 | 20,00 | 20,00 | 5,77 | 6,22 | 20,00 | 20,00 |
| Dijon | 0,15 | 6,19 | 6,82 | 20,00 | 20,00 | 6,64 | 7,64 | 20,00 | 20,00 | 7,49 | 7,94 | 20,00 | 20,00 |
| Lyon | 2,19 | 7,90 | 8,53 | 20,00 | 20,00 | 8,35 | 9,35 | 20,00 | 20,00 | 9,20 | 9,65 | 20,00 | 20,00 |
| Marseille | 0,86 | 10,70 | 11,33 | 20,00 | 20,00 | 11,15 | 12,15 | 20,00 | 20,00 | 12,00 | 12,45 | 20,00 | 20,00 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frankfurt *) | | 0,851 | 0,111 | 0,067 | 0,364 | 2,936 | 0,081 | 0,100 | 0,132 | 0,086 | 0,035 | 0,007 | 0,018 |
| Würzburg | | 0,029 | 0,005 | 0,003 | 0,019 | 0,119 | 0,004 | 0,006 | 0,007 | 0,004 | 0,002 | 0,001 | 0,001 |
| Nürnberg | | 0,096 | 0,017 | 0,012 | 0,078 | 0,420 | 0,016 | 0,023 | 0,031 | 0,016 | 0,007 | 0,003 | 0,008 |
| Plzeň | | 0,011 | 0,002 | 0,002 | 0,011 | 0,053 | 0,002 | 0,003 | 0,005 | 0,000 | 0,000 | 0,001 | 0,002 |
| Praha | | 0,065 | 0,013 | 0,009 | 0,070 | 0,311 | 0,014 | 0,022 | 0,029 | 0,002 | 0,001 | 0,006 | 0,014 |
| Regensburg | | 0,013 | 0,002 | 0,002 | 0,012 | 0,060 | 0,002 | 0,004 | 0,005 | 0,002 | 0,001 | 0,001 | 0,002 |
| Linz | | 0,013 | 0,003 | 0,002 | 0,014 | 0,060 | 0,003 | 0,004 | 0,006 | 0,003 | 0,001 | 0,001 | 0,003 |
| Wien | | 0,061 | 0,013 | 0,009 | 0,072 | 0,299 | 0,014 | 0,023 | 0,030 | 0,014 | 0,007 | 0,008 | 0,020 |
| | | 0,012 | 0,003 | 0,002 | 0,015 | 0,061 | 0,003 | 0,005 | 0,006 | 0,003 | 0,001 | 0,002 | 0,005 |
| | | 0,038 | 0,008 | 0,006 | 0,048 | 0,189 | 0,009 | 0,015 | 0,021 | 0,009 | 0,004 | 0,008 | 0,019 |
| München**) | | 0,052 | 0,010 | 0,007 | 0,052 | 0,243 | 0,010 | 0,016 | 0,021 | 0,010 | 0,005 | 0,003 | 0,008 |
| Mannheim-L. | | 0,171 | 0,026 | 0,017 | 0,103 | 0,673 | 0,022 | 0,029 | 0,039 | 0,023 | 0,010 | 0,003 | 0,007 |
| Stuttgart | | 0,094 | 0,016 | 0,011 | 0,072 | 0,403 | 0,015 | 0,021 | 0,028 | 0,015 | 0,007 | 0,003 | 0,007 |
| Augsburg | | 0,024 | 0,005 | 0,003 | 0,023 | 0,110 | 0,005 | 0,007 | 0,009 | 0,005 | 0,002 | 0,001 | 0,003 |
| München **) | | 0,048 | 0,009 | 0,007 | 0,048 | 0,224 | 0,009 | 0,015 | 0,020 | 0,010 | 0,004 | 0,003 | 0,008 |
| Karlsruhe | | 0,058 | 0,010 | 0,006 | 0,041 | 0,242 | 0,009 | 0,012 | 0,016 | 0,009 | 0,004 | 0,001 | 0,003 |
| Freiburg | | 0,023 | 0,004 | 0,003 | 0,021 | 0,105 | 0,004 | 0,006 | 0,008 | 0,004 | 0,002 | 0,001 | 0,003 |
| Basel | | 0,015 | 0,003 | 0,002 | 0,014 | 0,067 | 0,003 | 0,004 | 0,006 | 0,003 | 0,001 | 0,001 | 0,002 |
| Zürich | | 0,025 | 0,005 | 0,004 | 0,026 | 0,118 | 0,005 | 0,008 | 0,011 | 0,005 | 0,002 | 0,002 | 0,004 |
| Milano | | 0,047 | 0,010 | 0,007 | 0,055 | 0,229 | 0,010 | 0,017 | 0,023 | 0,010 | 0,005 | 0,006 | 0,015 |
| Bern | | 0,009 | 0,002 | 0,001 | 0,009 | 0,042 | 0,002 | 0,003 | 0,004 | 0,002 | 0,001 | 0,001 | 0,002 |
| Genève | | 0,009 | 0,002 | 0,001 | 0,010 | 0,042 | 0,002 | 0,003 | 0,004 | 0,002 | 0,001 | 0,001 | 0,002 |
| Strasbourg | | 0,036 | 0,006 | 0,000 | 0,003 | 0,159 | 0,006 | 0,001 | 0,001 | 0,006 | 0,003 | 0,001 | 0,003 |
| Mulhouse | | 0,009 | 0,002 | 0,000 | 0,001 | 0,042 | 0,002 | 0,000 | 0,001 | 0,002 | 0,001 | 0,000 | 0,001 |
| Dijon | | 0,007 | 0,001 | 0,000 | 0,002 | 0,034 | 0,002 | 0,001 | 0,001 | 0,002 | 0,001 | 0,001 | 0,002 |
| Lyon | | 0,069 | 0,014 | 0,003 | 0,025 | 0,339 | 0,016 | 0,008 | 0,011 | 0,016 | 0,007 | 0,010 | 0,024 |
| Marseille | | 0,016 | 0,003 | 0,001 | 0,010 | 0,081 | 0,004 | 0,003 | 0,004 | 0,004 | 0,002 | 0,004 | 0,009 |

12,247

## Krakow/Katowice - Warszawa/Lodz

| | | Warszawa | Brest | Minsk | Orsha | Smolensk | Moskwa | Bialystok | Kaunas | Vilnius | Riga | Tallinn | Olsztyn | Gdansk + Gdynia | Lodz | Turun | Bydgoszcz |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1,71 | 0,31 | 1,98 | 0,12 | 0,33 | 12,86 | 0,29 | 0,31 | 0,54 | 0,64 | 0,41 | 0,18 | 0,71 | 0,72 | 0,20 | 0,36 |
| Krakow | 0,76 | 2,53 | 4,38 | 7,68 | 9,69 | 10,80 | 14,48 | 4,31 | 6,31 | 7,21 | 8,54 | 11,35 | 4,25 | 5,38 | 1,92 | 3,44 | 3,87 |
| Tarnov | 0,11 | 3,27 | 5,12 | 8,42 | 10,43 | 11,54 | 15,22 | 5,05 | 7,05 | 7,95 | 9,28 | 12,09 | 4,99 | 6,12 | 2,66 | 4,18 | 4,61 |
| Kosice | 0,24 | 5,04 | 6,89 | 10,19 | 12,20 | 13,31 | 16,99 | 6,82 | 8,82 | 9,72 | 11,05 | 13,86 | 6,76 | 7,89 | 4,43 | 5,95 | 6,38 |
| Katowice | 1,28 | 2,58 | 4,43 | 7,73 | 9,74 | 10,85 | 14,53 | 4,36 | 6,36 | 7,26 | 8,59 | 11,40 | 4,30 | 5,43 | 1,97 | 3,49 | 3,92 |
| Ostrava | 0,30 | 3,33 | 5,18 | 8,48 | 10,49 | 11,60 | 15,28 | 5,11 | 7,11 | 8,01 | 9,34 | 12,15 | 5,05 | 6,18 | 2,72 | 4,24 | 4,67 |
| Brno | 0,39 | 4,76 | 6,61 | 9,91 | 11,92 | 13,03 | 16,71 | 6,54 | 8,54 | 9,44 | 10,77 | 13,58 | 6,48 | 7,61 | 4,15 | 5,67 | 6,10 |
| Wien | 1,84 | 5,48 | 7,33 | 10,63 | 12,64 | 13,75 | 17,43 | 7,26 | 9,26 | 10,16 | 11,49 | 14,30 | 7,20 | 8,33 | 4,87 | 6,39 | 6,82 |
| Linz + Wels | 0,20 | 7,01 | 8,86 | 12,16 | 14,17 | 15,28 | 18,96 | 8,79 | 10,79 | 11,69 | 13,02 | 15,83 | 8,73 | 9,86 | 6,40 | 7,92 | 8,35 |
| Salzburg | 0,15 | 8,13 | 9,98 | 13,28 | 15,29 | 16,40 | 20,08 | 9,91 | 11,91 | 12,81 | 14,14 | 16,95 | 9,85 | 10,98 | 7,52 | 9,04 | 9,47 |
| Innsbruck | 0,13 | 9,47 | 11,32 | 14,62 | 16,63 | 17,74 | 21,42 | 11,25 | 13,25 | 14,15 | 15,48 | 18,29 | 11,19 | 12,32 | 8,86 | 10,38 | 10,81 |
| Graz | 0,28 | 6,98 | 8,83 | 12,13 | 14,14 | 15,25 | 18,93 | 8,76 | 10,76 | 11,66 | 12,99 | 15,80 | 8,70 | 9,83 | 6,37 | 7,89 | 8,32 |
| Klagenfurt + ... | 0,16 | 7,98 | 9,83 | 13,13 | 15,14 | 16,25 | 19,93 | 9,76 | 11,76 | 12,66 | 13,99 | 16,80 | 9,70 | 10,83 | 7,37 | 8,89 | 9,32 |
| Venezia + ... | 0,55 | 10,11 | 11,96 | 15,26 | 17,27 | 18,38 | 22,06 | 11,89 | 13,89 | 14,79 | 16,12 | 18,93 | 11,83 | 12,96 | 9,50 | 11,02 | 11,45 |
| Maribor | 0,09 | 7,54 | 9,39 | 12,69 | 14,70 | 15,81 | 19,49 | 9,32 | 11,32 | 12,22 | 13,55 | 16,36 | 9,26 | 10,39 | 6,93 | 8,45 | 8,88 |
| Ljubljana | 0,28 | 8,56 | 10,41 | 13,71 | 15,72 | 16,83 | 20,51 | 10,34 | 12,34 | 13,24 | 14,57 | 17,38 | 10,28 | 11,41 | 7,95 | 9,47 | 9,90 |
| Trieste | 0,20 | 9,30 | 11,15 | 14,45 | 16,46 | 17,57 | 21,25 | 11,08 | 13,08 | 13,98 | 15,31 | 18,12 | 11,02 | 12,15 | 8,69 | 10,21 | 10,64 |
| Zagreb | 0,79 | 8,40 | 10,25 | 13,55 | 15,56 | 16,67 | 20,35 | 10,18 | 12,18 | 13,08 | 14,41 | 17,22 | 10,12 | 11,25 | 7,79 | 9,31 | 9,74 |
| Bratislava | 0,42 | 5,36 | 7,21 | 10,51 | 12,52 | 13,63 | 17,31 | 7,14 | 9,14 | 10,04 | 11,37 | 14,18 | 7,08 | 8,21 | 4,75 | 6,27 | 6,70 |
| Györ | 0,13 | 6,06 | 7,91 | 11,21 | 13,22 | 14,33 | 18,01 | 7,84 | 9,84 | 10,74 | 12,07 | 14,88 | 7,78 | 8,91 | 5,45 | 6,97 | 7,40 |
| Budapest | 1,74 | 7,10 | 8,95 | 12,25 | 14,26 | 15,37 | 19,05 | 8,88 | 10,88 | 11,78 | 13,11 | 15,92 | 8,82 | 9,95 | 6,49 | 8,01 | 8,44 |
| Debrecen | 0,21 | 9,08 | 10,93 | 14,23 | 16,24 | 17,35 | 21,03 | 10,86 | 12,86 | 13,76 | 15,09 | 17,90 | 10,80 | 11,93 | 8,47 | 9,99 | 10,42 |
| Arad | 0,16 | 9,34 | 11,19 | 14,49 | 16,50 | 17,61 | 21,29 | 11,12 | 13,12 | 14,02 | 15,35 | 18,16 | 11,06 | 12,19 | 8,73 | 10,25 | 10,68 |
| Timisoara | 0,32 | 9,69 | 11,54 | 14,84 | 16,85 | 17,96 | 21,64 | 11,47 | 13,47 | 14,37 | 15,70 | 18,51 | 11,41 | 12,54 | 9,08 | 10,60 | 11,03 |
| Szeged | 0,17 | 8,73 | 10,58 | 13,88 | 15,89 | 17,00 | 20,68 | 10,51 | 12,51 | 13,41 | 14,74 | 17,55 | 10,45 | 11,58 | 8,12 | 9,64 | 10,07 |
| Beograd | 1,23 | 10,30 | 12,15 | 15,45 | 17,46 | 18,57 | 22,25 | 12,08 | 14,08 | 14,98 | 16,31 | 19,12 | 12,02 | 13,15 | 9,69 | 11,21 | 11,64 |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Krakow | | 0,268 | 0,019 | 0,047 | 0,002 | 0,004 | 0,104 | 0,018 | 0,010 | 0,014 | 0,013 | 0,005 | 0,012 | 0,031 | 0,181 | 0,019 | 0,027 |
| Tarnow | | 0,025 | 0,002 | 0,006 | 0,000 | 0,001 | 0,014 | 0,002 | 0,001 | 0,002 | 0,002 | 0,001 | 0,001 | 0,004 | 0,015 | 0,002 | 0,003 |
| Kosice | | 0,026 | 0,003 | 0,009 | 0,000 | 0,001 | 0,025 | 0,003 | 0,002 | 0,003 | 0,003 | 0,001 | 0,002 | 0,005 | 0,014 | 0,002 | 0,004 |
| Katowice | | 0,437 | 0,032 | 0,078 | 0,003 | 0,007 | 0,174 | 0,030 | 0,017 | 0,024 | 0,021 | 0,008 | 0,019 | 0,051 | 0,291 | 0,031 | 0,045 |
| Ostrava | | 0,066 | 0,006 | 0,016 | 0,001 | 0,002 | 0,037 | 0,005 | 0,003 | 0,005 | 0,004 | 0,002 | 0,003 | 0,010 | 0,039 | 0,005 | 0,008 |
| Brno | | 0,047 | 0,005 | 0,016 | 0,001 | 0,002 | 0,042 | 0,005 | 0,003 | 0,005 | 0,004 | 0,002 | 0,003 | 0,009 | 0,025 | 0,004 | 0,006 |
| Wien | | 0,175 | 0,019 | 0,066 | 0,003 | 0,007 | 0,184 | 0,018 | 0,013 | 0,019 | 0,019 | 0,008 | 0,012 | 0,036 | 0,090 | 0,016 | 0,025 |
| Linz + Wels | | 0,012 | 0,002 | 0,006 | 0,000 | 0,001 | 0,017 | 0,001 | 0,001 | 0,002 | 0,002 | 0,001 | 0,001 | 0,003 | 0,006 | 0,001 | 0,002 |
| Salzburg | | 0,007 | 0,001 | 0,004 | 0,000 | 0,000 | 0,012 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,002 | 0,003 | 0,001 | 0,001 |
| Innsbruck | | 0,005 | 0,001 | 0,003 | 0,000 | 0,000 | 0,009 | 0,001 | 0,000 | 0,001 | 0,001 | 0,000 | 0,000 | 0,001 | 0,002 | 0,000 | 0,001 |
| Graz | | 0,018 | 0,002 | 0,008 | 0,000 | 0,001 | 0,024 | 0,002 | 0,002 | 0,002 | 0,002 | 0,001 | 0,001 | 0,004 | 0,009 | 0,002 | 0,003 |
| Klagenfurt + ... | | 0,008 | 0,001 | 0,004 | 0,000 | 0,000 | 0,013 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,002 | 0,004 | 0,001 | 0,001 |
| Venezia + ... | | 0,018 | 0,003 | 0,011 | 0,001 | 0,001 | 0,037 | 0,002 | 0,002 | 0,003 | 0,003 | 0,002 | 0,001 | 0,005 | 0,009 | 0,002 | 0,003 |
| Maribor | | 0,005 | 0,001 | 0,002 | 0,000 | 0,000 | 0,007 | 0,001 | 0,000 | 0,001 | 0,001 | 0,000 | 0,000 | 0,001 | 0,002 | 0,000 | 0,001 |
| Ljubljana | | 0,012 | 0,002 | 0,006 | 0,000 | 0,001 | 0,021 | 0,002 | 0,001 | 0,002 | 0,002 | 0,001 | 0,001 | 0,003 | 0,006 | 0,001 | 0,002 |
| Trieste | | 0,008 | 0,001 | 0,004 | 0,000 | 0,001 | 0,014 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,002 | 0,004 | 0,001 | 0,001 |
| Zagreb | | 0,036 | 0,005 | 0,019 | 0,001 | 0,002 | 0,061 | 0,004 | 0,003 | 0,005 | 0,005 | 0,003 | 0,003 | 0,009 | 0,017 | 0,004 | 0,006 |
| Bratislava | | 0,041 | 0,005 | 0,015 | 0,001 | 0,002 | 0,042 | 0,004 | 0,003 | 0,004 | 0,004 | 0,002 | 0,003 | 0,008 | 0,021 | 0,004 | 0,006 |
| Györ | | 0,010 | 0,001 | 0,004 | 0,000 | 0,000 | 0,012 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,002 | 0,005 | 0,001 | 0,002 |
| Budapest | | 0,106 | 0,013 | 0,049 | 0,002 | 0,006 | 0,149 | 0,012 | 0,009 | 0,014 | 0,014 | 0,006 | 0,008 | 0,025 | 0,052 | 0,010 | 0,017 |
| Debrecen | | 0,008 | 0,001 | 0,005 | 0,000 | 0,001 | 0,015 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,002 | 0,004 | 0,001 | 0,001 |
| Arad | | 0,006 | 0,001 | 0,003 | 0,000 | 0,000 | 0,011 | 0,001 | 0,001 | 0,001 | 0,001 | 0,000 | 0,000 | 0,002 | 0,003 | 0,001 | 0,001 |
| Timisoara | | 0,012 | 0,002 | 0,006 | 0,000 | 0,001 | 0,022 | 0,001 | 0,001 | 0,002 | 0,002 | 0,001 | 0,001 | 0,003 | 0,005 | 0,001 | 0,002 |
| Szeged | | 0,007 | 0,001 | 0,004 | 0,000 | 0,000 | 0,013 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,002 | 0,003 | 0,001 | 0,001 |
| Beograd | | 0,040 | 0,005 | 0,023 | 0,001 | 0,003 | 0,081 | 0,005 | 0,004 | 0,007 | 0,007 | 0,003 | 0,003 | 0,011 | 0,019 | 0,004 | 0,007 |

5,082

# Krasnodar - Rostow n.D.

| | | Rostow n.D. | Donetsk | Dnipropetrowsk | Charkiv | Voronesh | Kursk | Ryazan | Mokwa | Smolensk | Minsk | St.Petersburg | Tallinn | Helsinki | Yaroslawl | Vladimir | Nishnij Nowgorod |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1,87 | 2,19 | 0,99 | 1,43 | 1,00 | 0,42 | 0,53 | 12,86 | 0,33 | 1,89 | 4,99 | 0,41 | 0,90 | 0,60 | 0,35 | 1,26 |
| Krasnodar | 0,75 | 2,49 | 4,18 | 6,25 | 6,66 | 7,40 | 9,48 | 10,72 | 12,56 | 16,24 | 19,36 | 18,89 | 22,09 | 22,34 | 15,05 | 14,33 | 16,45 |
| Sotchi | 0,36 | 4,18 | 5,87 | 7,94 | 8,35 | 9,09 | 11,17 | 12,41 | 14,25 | 17,93 | 21,05 | 20,58 | 23,78 | 24,03 | 16,74 | 16,02 | 18,14 |
| Kutaisi | 0,20 | 6,98 | 8,67 | 10,74 | 11,15 | 11,89 | 13,97 | 15,21 | 17,05 | 20,73 | 23,85 | 23,38 | 26,58 | 26,83 | 19,54 | 18,82 | 20,94 |
| Tbilisi | 1,17 | 8,91 | 10,60 | 12,67 | 13,08 | 13,82 | 15,90 | 17,14 | 18,98 | 22,66 | 25,78 | 25,31 | 28,51 | 28,76 | 21,47 | 20,75 | 22,87 |
| Yerevan | 1,06 | 10,60 | 12,29 | 14,36 | 14,77 | 15,51 | 17,59 | 18,83 | 20,67 | 24,35 | 27,47 | 27,00 | 30,20 | 30,45 | 23,16 | 22,44 | 24,56 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Krasnodar | 0,297 | 0,144 | 0,033 | 0,043 | 0,025 | 0,007 | 0,007 | 0,131 | 0,002 | 0,009 | 0,025 | 0,002 | 0,003 | 0,004 | 0,003 | 0,008 |
| Sotchi | 0,059 | 0,039 | 0,011 | 0,014 | 0,008 | 0,002 | 0,003 | 0,051 | 0,001 | 0,004 | 0,011 | 0,001 | 0,001 | 0,002 | 0,001 | 0,003 |
| Kutaisi | 0,014 | 0,011 | 0,003 | 0,005 | 0,003 | 0,001 | 0,001 | 0,021 | 0,000 | 0,002 | 0,005 | 0,000 | 0,001 | 0,001 | 0,000 | 0,001 |
| Tbilisi | 0,053 | 0,046 | 0,015 | 0,021 | 0,013 | 0,004 | 0,005 | 0,101 | 0,002 | 0,009 | 0,024 | 0,002 | 0,003 | 0,004 | 0,002 | 0,007 |
| Yerevan | 0,036 | 0,033 | 0,011 | 0,016 | 0,010 | 0,003 | 0,004 | 0,079 | 0,002 | 0,007 | 0,020 | 0,001 | 0,003 | 0,003 | 0,002 | 0,006 |

0,667

# Linz - Wien

| | | Wien | Brno | Ostrava | Katowice + Krakow | Warszawa | Bratislava | Zilina | Kosice | Györ | Budapest | Miskolc | Debrecen | Szeged | Arad | Timisoara | Belgrade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1,84 | 0,39 | 0,30 | 2,04 | 1,71 | 0,42 | 0,08 | 0,33 | 0,13 | 1,74 | 0,17 | 0,21 | 0,17 | 0,16 | 0,32 | 1,23 |
| Linz + Wels | 0,26 | 1,53 | 2,58 | 3,68 | 4,43 | 7,01 | 2,08 | 3,75 | 5,58 | 2,68 | 3,72 | 5,19 | 5,70 | 5,35 | 5,96 | 6,41 | 6,92 |
| Passau | 0,06 | 2,25 | 3,30 | 4,40 | 5,15 | 7,73 | 2,80 | 4,47 | 6,30 | 3,40 | 4,44 | 5,91 | 6,42 | 6,07 | 6,68 | 7,13 | 7,64 |
| Regensburg | 0,15 | 3,35 | 4,40 | 5,50 | 6,25 | 8,83 | 3,90 | 5,57 | 7,40 | 4,50 | 5,54 | 7,01 | 7,52 | 7,17 | 7,78 | 8,23 | 8,74 |
| Nürnberg | 0,74 | 4,22 | 20,00 | 20,00 | 20,00 | 20,00 | 4,77 | 20,00 | 20,00 | 5,37 | 6,41 | 7,88 | 8,39 | 8,04 | 8,65 | 9,10 | 9,61 |
| Würzburg | 0,13 | 5,18 | 20,00 | 20,00 | 20,00 | 20,00 | 5,73 | 20,00 | 20,00 | 6,33 | 7,37 | 8,84 | 9,35 | 9,00 | 9,61 | 10,06 | 10,57 |
| Frankfurt | 1,60 | 6,16 | 20,00 | 20,00 | 20,00 | 20,00 | 6,71 | 20,00 | 20,00 | 7,31 | 8,35 | 9,82 | 10,33 | 9,98 | 10,59 | 11,04 | 11,55 |
| Köln | 1,06 | 7,66 | 20,00 | 20,00 | 20,00 | 20,00 | 8,21 | 20,00 | 20,00 | 8,81 | 9,85 | 11,32 | 11,83 | 11,39 | 12,09 | 12,54 | 13,05 |
| Ddf. + Ruhrg. | 5,71 | 8,11 | 20,00 | 20,00 | 20,00 | 20,00 | 8,66 | 20,00 | 20,00 | 9,26 | 10,30 | 11,77 | 12,28 | 11,84 | 12,54 | 12,99 | 13,50 |
| Salzburg | 0,15 | 2,65 | 3,70 | 4,80 | 5,55 | 8,13 | 3,20 | 4,87 | 6,70 | 3,80 | 4,84 | 6,31 | 6,82 | 6,47 | 7,08 | 7,53 | 20,00 |
| München | 1,45 | 3,83 | 4,88 | 5,98 | 6,73 | 9,31 | 4,38 | 6,05 | 7,88 | 4,98 | 6,02 | 7,49 | 8,00 | 7,65 | 8,26 | 8,71 | 20,00 |
| Ausburg | 0,29 | 4,39 | 5,44 | 6,54 | 7,29 | 9,87 | 4,94 | 6,61 | 8,44 | 5,54 | 6,58 | 8,05 | 8,56 | 8,21 | 8,82 | 9,27 | 20,00 |
| Stuttgart | 0,62 | 5,73 | 6,78 | 7,88 | 8,63 | 11,21 | 6,28 | 7,95 | 9,78 | 6,88 | 7,92 | 9,39 | 9,90 | 9,55 | 10,16 | 10,61 | 20,00 |
| Mannheim-L. | 0,63 | 6,64 | 20,00 | 20,00 | 20,00 | 20,00 | 7,19 | 8,86 | 10,69 | 7,79 | 8,83 | 10,30 | 10,81 | 10,46 | 11,07 | 11,52 | 20,00 |
| Karlsruhe | 0,31 | 6,34 | 20,00 | 20,00 | 20,00 | 20,00 | 6,89 | 8,56 | 10,39 | 7,49 | 8,53 | 10,00 | 10,51 | 10,16 | 10,77 | 11,22 | 20,00 |
| Strasbourg | 0,28 | 7,01 | 20,00 | 20,00 | 20,00 | 20,00 | 7,56 | 9,23 | 11,06 | 8,16 | 9,20 | 10,67 | 11,18 | 10,83 | 11,44 | 11,89 | 20,00 |
| Paris | 12,4 | 10,98 | 20,00 | 20,00 | 20,00 | 20,00 | 11,53 | 13,20 | 15,03 | 12,13 | 13,17 | 14,64 | 15,15 | 14,80 | 15,41 | 15,86 | 20,00 |
| Innsbruck | 0,13 | 4,01 | 5,06 | 6,16 | 6,91 | 9,49 | 4,56 | 6,23 | 8,06 | 5,16 | 6,20 | 7,67 | 8,18 | 7,83 | 8,44 | 8,89 | 20,00 |
| Vorarlberg | 0,11 | 5,34 | 6,39 | 7,49 | 8,24 | 10,82 | 5,89 | 7,56 | 9,39 | 6,49 | 7,53 | 9,00 | 9,51 | 9,16 | 9,77 | 10,22 | 20,00 |
| Zürich | 0,40 | 6,15 | 7,20 | 8,30 | 9,05 | 11,63 | 6,70 | 8,37 | 10,20 | 7,30 | 8,34 | 9,81 | 10,32 | 9,97 | 10,58 | 11,03 | 20,00 |
| Basel | 0,18 | 6,88 | 7,93 | 9,03 | 9,78 | 12,36 | 7,43 | 9,10 | 10,93 | 8,03 | 9,07 | 10,54 | 11,05 | 10,70 | 11,31 | 11,76 | 20,00 |
| Bern | 0,14 | 7,08 | 8,13 | 9,23 | 9,98 | 12,56 | 7,63 | 9,30 | 11,13 | 8,23 | 9,27 | 10,74 | 11,25 | 10,90 | 11,51 | 11,96 | 20,00 |
| Genève | 0,20 | 8,38 | 9,43 | 10,53 | 11,28 | 13,86 | 8,93 | 10,60 | 12,43 | 9,53 | 10,57 | 12,04 | 12,55 | 12,20 | 12,81 | 13,26 | 20,00 |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Linz + Wels | | 0,232 | 0,020 | 0,009 | 0,042 | 0,016 | 0,031 | 0,002 | 0,005 | 0,006 | 0,048 | 0,003 | 0,003 | 0,003 | 0,002 | 0,004 | 0,012 |
| Passau | | 0,028 | 0,003 | 0,001 | 0,008 | 0,003 | 0,004 | 0,000 | 0,001 | 0,001 | 0,008 | 0,000 | 0,001 | 0,000 | 0,000 | 0,001 | 0,002 |
| Regensburg | | 0,035 | 0,005 | 0,002 | 0,014 | 0,006 | 0,006 | 0,001 | 0,002 | 0,002 | 0,014 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,005 |
| Nürnberg | | 0,118 | 0,002 | 0,001 | 0,009 | 0,008 | 0,022 | 0,000 | 0,001 | 0,006 | 0,055 | 0,004 | 0,004 | 0,004 | 0,003 | 0,006 | 0,019 |
| Würzburg | | 0,015 | 0,000 | 0,000 | 0,002 | 0,001 | 0,003 | 0,000 | 0,000 | 0,001 | 0,008 | 0,001 | 0,001 | 0,001 | 0,000 | 0,001 | 0,003 |
| Frankfurt | | 0,134 | 0,004 | 0,003 | 0,020 | 0,017 | 0,026 | 0,001 | 0,003 | 0,007 | 0,075 | 0,006 | 0,006 | 0,005 | 0,005 | 0,009 | 0,031 |
| Köln | | 0,061 | 0,003 | 0,002 | 0,013 | 0,011 | 0,012 | 0,001 | 0,002 | 0,003 | 0,038 | 0,003 | 0,003 | 0,003 | 0,002 | 0,005 | 0,017 |
| Ddf. + Ruhrg. | | 0,299 | 0,014 | 0,011 | 0,072 | 0,060 | 0,061 | 0,003 | 0,012 | 0,017 | 0,189 | 0,015 | 0,017 | 0,015 | 0,012 | 0,023 | 0,084 |
| Salzburg | | 0,053 | 0,006 | 0,003 | 0,017 | 0,007 | 0,009 | 0,001 | 0,002 | 0,002 | 0,018 | 0,001 | 0,001 | 0,001 | 0,001 | 0,002 | 0,001 |
| München | | 0,272 | 0,038 | 0,021 | 0,116 | 0,056 | 0,049 | 0,005 | 0,014 | 0,012 | 0,119 | 0,008 | 0,009 | 0,008 | 0,006 | 0,012 | 0,011 |
| Ausburg | | 0,043 | 0,006 | 0,004 | 0,020 | 0,010 | 0,008 | 0,001 | 0,003 | 0,002 | 0,021 | 0,001 | 0,002 | 0,001 | 0,001 | 0,002 | 0,002 |
| Stuttgart | | 0,059 | 0,009 | 0,006 | 0,032 | 0,017 | 0,011 | 0,001 | 0,004 | 0,003 | 0,032 | 0,002 | 0,003 | 0,002 | 0,002 | 0,004 | 0,005 |
| Mannheim-L. | | 0,046 | 0,002 | 0,001 | 0,008 | 0,007 | 0,009 | 0,001 | 0,004 | 0,002 | 0,027 | 0,002 | 0,002 | 0,002 | 0,002 | 0,003 | 0,005 |
| Karlsruhe | | 0,025 | 0,001 | 0,001 | 0,004 | 0,003 | 0,005 | 0,001 | 0,002 | 0,001 | 0,014 | 0,001 | 0,001 | 0,001 | 0,001 | 0,002 | 0,002 |
| Strasbourg | | 0,019 | 0,001 | 0,001 | 0,004 | 0,003 | 0,004 | 0,001 | 0,002 | 0,001 | 0,011 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,002 |
| Paris | | 0,388 | 0,030 | 0,023 | 0,155 | 0,130 | 0,082 | 0,012 | 0,041 | 0,023 | 0,270 | 0,022 | 0,026 | 0,022 | 0,019 | 0,036 | 0,094 |
| Innsbruck | | 0,023 | 0,003 | 0,002 | 0,010 | 0,005 | 0,004 | 0,000 | 0,001 | 0,001 | 0,010 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 |
| Vorarlberg | | 0,012 | 0,002 | 0,001 | 0,006 | 0,003 | 0,002 | 0,000 | 0,001 | 0,001 | 0,006 | 0,000 | 0,001 | 0,000 | 0,000 | 0,001 | 0,001 |
| Zürich | | 0,034 | 0,005 | 0,003 | 0,019 | 0,011 | 0,007 | 0,001 | 0,003 | 0,002 | 0,019 | 0,001 | 0,002 | 0,001 | 0,001 | 0,002 | 0,003 |
| Basel | | 0,012 | 0,002 | 0,001 | 0,008 | 0,004 | 0,002 | 0,000 | 0,001 | 0,001 | 0,007 | 0,001 | 0,001 | 0,001 | 0,000 | 0,001 | 0,001 |
| Bern | | 0,009 | 0,002 | 0,001 | 0,006 | 0,003 | 0,002 | 0,000 | 0,001 | 0,001 | 0,006 | 0,000 | 0,000 | 0,000 | 0,000 | 0,001 | 0,001 |
| Genève | | 0,010 | 0,002 | 0,001 | 0,007 | 0,004 | 0,002 | 0,000 | 0,001 | 0,001 | 0,006 | 0,000 | 0,001 | 0,000 | 0,000 | 0,001 | 0,002 |

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|---|
| 5,469 |

# Ljubljana - Zidani Most

| | | Ljubljana | Rijeka | Koper | Trieste | Venezia | Padova | Bologna | Firenze | Roma | Verona | Milano | Klagenfurt + Villach | Salzburg | Innsbruck | München | Augsburg | Stuttgart | Mannheim-L. | Frankfurt | Nürnberg | Regensburg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0,29 | 0,13 | 0,03 | 0,20 | 0,34 | 0,21 | 0,39 | 0,36 | 2,87 | 0,26 | 1,35 | 0,16 | 0,15 | 0,13 | 1,45 | 0,29 | 0,62 | 0,63 | 1,60 | 0,74 | 0,15 |
| Maribor | 0,09 | 1,16 | 1,92 | 2,06 | 1,90 | 3,05 | 3,39 | 4,50 | 2,28 | 7,58 | 4,04 | 5,46 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Graz | 0,28 | 1,72 | 2,48 | 2,62 | 2,46 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Wien | 1,84 | 3,22 | 3,98 | 4,12 | 3,96 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Brno | 0,59 | 4,27 | 5,03 | 5,17 | 5,01 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Ostrava | 0,30 | 5,37 | 6,13 | 6,27 | 6,11 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Katowice | 1,28 | 6,12 | 6,88 | 7,02 | 6,86 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Warszawa | 1,71 | 8,70 | 9,46 | 9,60 | 9,44 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Krakow | 0,76 | 7,33 | 8,09 | 8,23 | 8,07 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Bratislava | 0,42 | 3,77 | 4,53 | 4,67 | 4,51 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Szombathely | 0,08 | 2,25 | 3,01 | 3,15 | 2,99 | 4,14 | 4,48 | 5,59 | 3,37 | 8,67 | 5,13 | 6,55 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Budapest | 1,74 | 4,16 | 4,92 | 5,06 | 4,90 | 6,05 | 6,39 | 7,50 | 5,28 | 10,58 | 7,04 | 8,46 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Miskolc | 0,17 | 5,63 | 6,39 | 6,53 | 6,37 | 7,52 | 7,86 | 8,97 | 6,75 | 12,05 | 8,51 | 9,93 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Debrecen | 0,21 | 6,14 | 6,90 | 7,04 | 6,88 | 8,03 | 8,37 | 9,48 | 7,26 | 12,56 | 9,02 | 10,44 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Györ | 0,13 | 3,14 | 3,90 | 4,04 | 3,88 | 5,03 | 5,37 | 6,48 | 4,26 | 9,56 | 6,02 | 7,44 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Zagreb | 0,79 | 1,14 | 20,00 | 2,04 | 1,88 | 3,03 | 3,37 | 4,48 | 5,26 | 7,56 | 4,02 | 5,44 | 1,98 | 3,38 | 4,74 | 4,56 | 5,12 | 6,46 | 7,37 | 8,10 | 6,04 | 5,58 |
| Pecs | 0,15 | 2,90 | 20,00 | 3,80 | 3,64 | 4,79 | 5,13 | 6,24 | 7,02 | 9,32 | 5,78 | 7,20 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Vinkovci, Osijek | 0,17 | 3,46 | 20,00 | 4,36 | 4,20 | 5,35 | 5,69 | 6,80 | 7,58 | 9,88 | 6,34 | 7,76 | 4,30 | 5,70 | 7,06 | 6,88 | 7,44 | 8,78 | 9,69 | 10,42 | 8,36 | 7,90 |
| Sarajewo | 0,53 | 5,00 | 20,00 | 5,90 | 5,74 | 6,89 | 7,23 | 8,34 | 9,12 | 11,42 | 7,88 | 9,30 | 5,84 | 7,24 | 8,60 | 8,42 | 8,98 | 10,32 | 11,23 | 11,96 | 9,90 | 9,44 |
| Mostar | 0,13 | 5,71 | 20,00 | 6,61 | 6,45 | 7,60 | 7,94 | 9,05 | 9,83 | 12,13 | 8,59 | 10,01 | 6,55 | 7,95 | 9,31 | 9,13 | 9,69 | 11,03 | 11,94 | 12,67 | 10,61 | 10,15 |
| Beograd | 1,23 | 4,86 | 20,00 | 5,76 | 5,60 | 6,75 | 7,09 | 8,20 | 8,98 | 11,28 | 7,74 | 9,16 | 5,70 | 7,10 | 8,46 | 8,28 | 8,84 | 10,18 | 11,09 | 20,00 | 20,00 | 20,00 |
| Timişoara | 0,32 | 6,05 | 20,00 | 6,95 | 6,79 | 7,94 | 8,28 | 9,39 | 10,17 | 12,47 | 8,93 | 10,35 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Arad | 0,16 | 6,40 | 20,00 | 7,30 | 7,14 | 8,29 | 8,63 | 9,74 | 10,52 | 12,82 | 9,28 | 10,70 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Niš | 0,26 | 6,85 | 20,00 | 7,75 | 7,59 | 8,74 | 9,08 | 10,19 | 10,97 | 13,27 | 9,73 | 11,15 | 7,69 | 9,09 | 10,45 | 10,27 | 10,83 | 12,17 | 13,08 | 20,00 | 20,00 | 20,00 |
| Sofia | 1,21 | 8,21 | 20,00 | 9,11 | 8,95 | 10,10 | 10,44 | 11,55 | 12,33 | 14,63 | 11,09 | 12,51 | 9,05 | 10,45 | 11,81 | 11,63 | 12,19 | 13,53 | 14,44 | 20,00 | 20,00 | 20,00 |
| Plovdiv + ... | 0,57 | 9,53 | 20,00 | 10,43 | 10,27 | 11,42 | 11,76 | 12,87 | 13,65 | 15,95 | 12,41 | 13,83 | 10,37 | 11,77 | 13,13 | 12,95 | 13,51 | 14,85 | 15,76 | 20,00 | 20,00 | 20,00 |
| Istanbul | 14,66 | 13,27 | 20,00 | 14,17 | 14,01 | 15,16 | 15,50 | 16,61 | 17,39 | 19,69 | 16,15 | 17,57 | 14,11 | 15,51 | 16,87 | 16,69 | 17,25 | 18,59 | 19,50 | 20,00 | 20,00 | 20,00 |
| Skopje | 0,54 | 8,35 | 20,00 | 9,25 | 9,09 | 10,24 | 10,58 | 11,69 | 12,47 | 14,77 | 11,23 | 12,65 | 9,19 | 10,59 | 11,95 | 11,77 | 12,33 | 13,67 | 14,58 | 20,00 | 20,00 | 20,00 |
| Thessaloniki | 0,33 | 10,31 | 20,00 | 11,21 | 11,05 | 12,20 | 12,54 | 13,65 | 14,43 | 16,73 | 13,19 | 14,61 | 11,15 | 12,55 | 13,91 | 13,73 | 14,29 | 15,63 | 16,54 | 20,00 | 20,00 | 20,00 |
| Athenai | 3,75 | 13,33 | 20,00 | 14,23 | 14,07 | 15,22 | 15,56 | 16,67 | 17,45 | 19,75 | 16,21 | 17,63 | 14,17 | 15,57 | 16,93 | 16,75 | 17,31 | 18,65 | 19,56 | 20,00 | 20,00 | 20,00 |
| Priština | 0,21 | 7,36 | 20,00 | 8,26 | 8,10 | 9,25 | 9,59 | 10,70 | 11,48 | 13,78 | 10,24 | 11,66 | 8,20 | 9,60 | 10,96 | 10,78 | 11,34 | 12,68 | 13,59 | 20,00 | 20,00 | 20,00 |
| Podgorica | 0,20 | 7,68 | 20,00 | 8,58 | 8,42 | 9,57 | 9,91 | 11,02 | 11,80 | 14,10 | 10,56 | 11,98 | 8,52 | 9,92 | 11,28 | 11,10 | 11,66 | 13,00 | 13,91 | 20,00 | 20,00 | 20,00 |
| Tirana + Durres | 0,60 | 8,98 | 20,00 | 9,88 | 9,72 | 10,87 | 11,21 | 12,32 | 13,10 | 15,40 | 11,86 | 13,28 | 9,82 | 11,22 | 12,58 | 12,40 | 12,96 | 14,30 | 15,21 | 20,00 | 20,00 | 20,00 |

| | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Maribor | | 0,020 | 0,004 | 0,001 | 0,006 | 0,005 | 0,002 | 0,003 | 0,008 | 0,008 | 0,002 | 0,007 | 0,000 | 0,000 | 0,000 | 0,001 | 0,000 | 0,000 | 0,000 | 0,001 | 0,000 | 0,000 |
| Graz | | 0,032 | 0,008 | 0,002 | 0,012 | 0,001 | 0,000 | 0,001 | 0,001 | 0,005 | 0,000 | 0,002 | 0,000 | 0,000 | 0,000 | 0,002 | 0,000 | 0,001 | 0,001 | 0,003 | 0,001 | 0,000 |
| Wien | | 0,073 | 0,023 | 0,005 | 0,035 | 0,004 | 0,002 | 0,004 | 0,004 | 0,032 | 0,003 | 0,015 | 0,002 | 0,002 | 0,001 | 0,016 | 0,003 | 0,007 | 0,007 | 0,018 | 0,008 | 0,002 |
| Brno | | 0,015 | 0,005 | 0,001 | 0,008 | 0,001 | 0,001 | 0,001 | 0,001 | 0,010 | 0,001 | 0,005 | 0,001 | 0,001 | 0,000 | 0,005 | 0,001 | 0,002 | 0,002 | 0,006 | 0,003 | 0,001 |
| Ostrava | | 0,005 | 0,002 | 0,000 | 0,003 | 0,001 | 0,000 | 0,001 | 0,001 | 0,005 | 0,000 | 0,002 | 0,000 | 0,000 | 0,000 | 0,003 | 0,001 | 0,001 | 0,001 | 0,003 | 0,001 | 0,000 |
| Katowice | | 0,017 | 0,006 | 0,001 | 0,010 | 0,003 | 0,002 | 0,003 | 0,003 | 0,023 | 0,002 | 0,011 | 0,001 | 0,001 | 0,001 | 0,011 | 0,002 | 0,005 | 0,005 | 0,013 | 0,006 | 0,001 |
| Warszawa | | 0,013 | 0,005 | 0,001 | 0,008 | 0,004 | 0,002 | 0,004 | 0,004 | 0,030 | 0,003 | 0,014 | 0,002 | 0,002 | 0,001 | 0,015 | 0,003 | 0,007 | 0,007 | 0,017 | 0,008 | 0,002 |
| Krakow | | 0,007 | 0,003 | 0,001 | 0,004 | 0,002 | 0,001 | 0,002 | 0,002 | 0,013 | 0,001 | 0,006 | 0,001 | 0,001 | 0,001 | 0,007 | 0,001 | 0,003 | 0,003 | 0,007 | 0,003 | 0,001 |
| Bratislava | | 0,013 | 0,004 | 0,001 | 0,006 | 0,001 | 0,001 | 0,001 | 0,001 | 0,007 | 0,001 | 0,003 | 0,000 | 0,000 | 0,000 | 0,004 | 0,001 | 0,002 | 0,002 | 0,004 | 0,002 | 0,000 |
| Szombathely | | 0,006 | 0,002 | 0,000 | 0,002 | 0,002 | 0,001 | 0,002 | 0,004 | 0,006 | 0,001 | 0,004 | 0,000 | 0,000 | 0,000 | 0,001 | 0,000 | 0,000 | 0,000 | 0,001 | 0,000 | 0,000 |
| Budapest | | 0,045 | 0,015 | 0,003 | 0,023 | 0,028 | 0,016 | 0,022 | 0,037 | 0,091 | 0,016 | 0,062 | 0,002 | 0,002 | 0,001 | 0,015 | 0,003 | 0,007 | 0,007 | 0,017 | 0,008 | 0,002 |
| Miskolc | | 0,003 | 0,001 | 0,000 | 0,001 | 0,002 | 0,001 | 0,002 | 0,002 | 0,007 | 0,001 | 0,005 | 0,000 | 0,000 | 0,000 | 0,002 | 0,000 | 0,001 | 0,001 | 0,002 | 0,001 | 0,000 |
| Debrecen | | 0,003 | 0,001 | 0,000 | 0,002 | 0,002 | 0,001 | 0,002 | 0,003 | 0,008 | 0,001 | 0,005 | 0,000 | 0,000 | 0,000 | 0,002 | 0,000 | 0,001 | 0,001 | 0,002 | 0,001 | 0,000 |
| Györ | | 0,005 | 0,002 | 0,000 | 0,003 | 0,003 | 0,002 | 0,002 | 0,004 | 0,008 | 0,002 | 0,006 | 0,000 | 0,000 | 0,000 | 0,001 | 0,000 | 0,000 | 0,001 | 0,001 | 0,001 | 0,000 |
| Zagreb | | 0,183 | 0,001 | 0,007 | 0,054 | 0,041 | 0,021 | 0,024 | 0,017 | 0,073 | 0,019 | 0,060 | 0,040 | 0,015 | 0,007 | 0,087 | 0,014 | 0,021 | 0,017 | 0,036 | 0,027 | 0,006 |
| Pecs | | 0,007 | 0,000 | 0,000 | 0,003 | 0,004 | 0,002 | 0,003 | 0,002 | 0,010 | 0,002 | 0,007 | 0,000 | 0,000 | 0,000 | 0,001 | 0,000 | 0,001 | 0,001 | 0,001 | 0,001 | 0,000 |
| Vinkovci, Osijek | | 0,006 | 0,000 | 0,000 | 0,003 | 0,003 | 0,002 | 0,003 | 0,002 | 0,010 | 0,002 | 0,007 | 0,002 | 0,001 | 0,001 | 0,009 | 0,002 | 0,003 | 0,002 | 0,005 | 0,003 | 0,001 |
| Sarajewo | | 0,010 | 0,000 | 0,001 | 0,005 | 0,007 | 0,004 | 0,006 | 0,004 | 0,024 | 0,004 | 0,016 | 0,004 | 0,003 | 0,002 | 0,021 | 0,004 | 0,006 | 0,005 | 0,012 | 0,008 | 0,002 |
| Mostar | | 0,002 | 0,000 | 0,000 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,005 | 0,001 | 0,003 | 0,001 | 0,001 | 0,000 | 0,004 | 0,001 | 0,001 | 0,001 | 0,003 | 0,002 | 0,000 |
| Beograd | | 0,024 | 0,001 | 0,002 | 0,013 | 0,016 | 0,009 | 0,013 | 0,011 | 0,057 | 0,010 | 0,038 | 0,010 | 0,007 | 0,004 | 0,049 | 0,009 | 0,015 | 0,013 | 0,012 | 0,006 | 0,001 |
| Timişoara | | 0,004 | 0,000 | 0,000 | 0,002 | 0,003 | 0,002 | 0,003 | 0,002 | 0,013 | 0,002 | 0,008 | 0,000 | 0,000 | 0,000 | 0,003 | 0,001 | 0,001 | 0,001 | 0,003 | 0,001 | 0,000 |
| Arad | | 0,002 | 0,000 | 0,000 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,006 | 0,001 | 0,004 | 0,000 | 0,000 | 0,000 | 0,001 | 0,000 | 0,001 | 0,001 | 0,002 | 0,001 | 0,000 |
| Niš | | 0,003 | 0,000 | 0,000 | 0,002 | 0,002 | 0,001 | 0,002 | 0,002 | 0,009 | 0,001 | 0,006 | 0,001 | 0,001 | 0,001 | 0,007 | 0,001 | 0,002 | 0,002 | 0,003 | 0,001 | 0,000 |
| Sofia | | 0,010 | 0,001 | 0,001 | 0,006 | 0,008 | 0,005 | 0,007 | 0,006 | 0,036 | 0,005 | 0,022 | 0,005 | 0,003 | 0,002 | 0,027 | 0,005 | 0,009 | 0,008 | 0,012 | 0,005 | 0,001 |
| Plovdiv + ... | | 0,004 | 0,000 | 0,000 | 0,002 | 0,003 | 0,002 | 0,003 | 0,002 | 0,015 | 0,002 | 0,009 | 0,002 | 0,001 | 0,001 | 0,011 | 0,002 | 0,004 | 0,003 | 0,006 | 0,003 | 0,001 |
| Istanbul | | 0,052 | 0,012 | 0,005 | 0,033 | 0,049 | 0,029 | 0,048 | 0,041 | 0,265 | 0,034 | 0,151 | 0,026 | 0,021 | 0,016 | 0,178 | 0,034 | 0,063 | 0,059 | 0,144 | 0,067 | 0,014 |
| Skopje | | 0,004 | 0,000 | 0,000 | 0,003 | 0,004 | 0,002 | 0,003 | 0,003 | 0,016 | 0,002 | 0,010 | 0,002 | 0,001 | 0,001 | 0,012 | 0,002 | 0,004 | 0,004 | 0,005 | 0,002 | 0,000 |
| Thessaloniki | | 0,002 | 0,000 | 0,000 | 0,001 | 0,002 | 0,001 | 0,002 | 0,001 | 0,008 | 0,001 | 0,005 | 0,001 | 0,001 | 0,000 | 0,006 | 0,001 | 0,002 | 0,002 | 0,003 | 0,001 | 0,000 |
| Athenai | | 0,013 | 0,003 | 0,001 | 0,008 | 0,012 | 0,007 | 0,012 | 0,010 | 0,068 | 0,009 | 0,039 | 0,007 | 0,005 | 0,004 | 0,045 | 0,009 | 0,016 | 0,015 | 0,037 | 0,017 | 0,003 |
| Priština | | 0,002 | 0,000 | 0,000 | 0,001 | 0,002 | 0,001 | 0,001 | 0,001 | 0,007 | 0,001 | 0,004 | 0,001 | 0,001 | 0,000 | 0,005 | 0,001 | 0,002 | 0,002 | 0,002 | 0,001 | 0,000 |
| Podgorica | | 0,002 | 0,000 | 0,000 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,006 | 0,001 | 0,004 | 0,001 | 0,001 | 0,000 | 0,005 | 0,001 | 0,002 | 0,001 | 0,002 | 0,001 | 0,000 |
| Tirana + Durres | | 0,004 | 0,000 | 0,000 | 0,003 | 0,004 | 0,002 | 0,003 | 0,003 | 0,016 | 0,002 | 0,010 | 0,002 | 0,001 | 0,001 | 0,012 | 0,002 | 0,004 | 0,004 | 0,006 | 0,003 | 0,001 |

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| 5,200 | Ljubljana - Maribor: 1,476 | Ljubljana - Zagreb: 3,724 |

# Łódź - Poznań/Wrocław

| | | Poznań | Szczecin | Berlin + Potsdam | Hamburg | Hannover | Bremen + Oldenburg | Münster + Osnabrück | Utrecht + Amst. + Rott. | Düsseldorf + Ruhrgebiet | Köln | Leipzig + Halle | Wrocław | Dresden | Praha | Regensburg | München |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0,55 | 0,41 | 3,66 | 1,79 | 0,51 | 0,72 | 0,47 | 1,78 | 5,71 | 1,06 | 0,76 | 0,63 | 0,53 | 1,27 | 0,15 | 1,45 |
| Łódź | 0,72 | 1,90 | 3,88 | 4,32 | 6,85 | 6,80 | 7,81 | 7,95 | 10,00 | 9,00 | 9,45 | 5,78 | 1,85 | 4,16 | 4,06 | 6,10 | 7,13 |
| Warzsawa | 1,71 | 3,06 | 5,04 | 5,48 | 8,01 | 7,96 | 8,97 | 9,11 | 11,16 | 10,16 | 10,61 | 6,94 | 3,01 | 5,32 | 5,22 | 7,26 | 8,29 |
| Białystok | 0,29 | 4,84 | 6,82 | 7,26 | 9,79 | 9,74 | 10,75 | 10,89 | 12,94 | 11,94 | 12,39 | 8,72 | 4,79 | 7,10 | 7,00 | 9,04 | 10,07 |
| Kaunas | 0,31 | 6,84 | 8,82 | 9,26 | 11,79 | 11,74 | 12,75 | 12,89 | 14,94 | 13,94 | 14,39 | 10,72 | 6,79 | 9,10 | 9,00 | 11,04 | 12,07 |
| Vilnius | 0,54 | 7,74 | 9,72 | 10,16 | 12,69 | 12,64 | 13,65 | 13,79 | 15,84 | 14,84 | 15,29 | 11,62 | 7,69 | 10,00 | 9,90 | 11,94 | 12,97 |
| Riga | 0,64 | 9,07 | 11,05 | 11,49 | 14,02 | 13,97 | 14,98 | 15,12 | 17,17 | 16,17 | 16,62 | 12,95 | 9,02 | 11,33 | 11,23 | 13,27 | 14,30 |
| Tallinn | 0,41 | 11,88 | 13,86 | 14,30 | 16,83 | 16,78 | 17,79 | 17,93 | 19,98 | 18,98 | 19,43 | 15,76 | 11,83 | 14,14 | 14,04 | 16,08 | 17,11 |
| Brest | 0,31 | 4,91 | 6,89 | 7,33 | 9,86 | 9,81 | 10,82 | 10,96 | 13,01 | 12,01 | 12,46 | 8,79 | 4,86 | 7,17 | 7,07 | 9,11 | 10,14 |
| Minsk | 1,89 | 8,21 | 10,19 | 10,63 | 13,16 | 13,11 | 14,12 | 14,26 | 16,31 | 15,31 | 15,76 | 12,09 | 8,16 | 10,47 | 10,37 | 12,41 | 13,44 |
| Smolensk | 0,33 | 11,33 | 13,31 | 13,75 | 16,28 | 16,23 | 17,24 | 17,38 | 19,43 | 18,43 | 18,88 | 15,21 | 11,28 | 13,59 | 13,49 | 15,53 | 16,56 |
| Moskwa + ... | 12,86 | 15,01 | 16,99 | 17,43 | 19,96 | 19,91 | 20,92 | 21,06 | 23,11 | 22,11 | 22,56 | 18,89 | 14,96 | 17,27 | 17,17 | 19,21 | 20,24 |
| Lublin | 0,34 | 4,62 | 6,60 | 7,04 | 9,57 | 9,52 | 10,53 | 10,67 | 12,72 | 11,72 | 12,17 | 8,50 | 4,57 | 6,88 | 6,78 | 8,82 | 9,85 |
| Kijiv | 2,80 | 10,28 | 12,26 | 12,70 | 15,23 | 15,18 | 16,19 | 16,33 | 18,38 | 17,38 | 17,83 | 14,16 | 10,23 | 12,54 | 12,44 | 14,48 | 15,51 |
| Krakow | 0,76 | 3,82 | 5,80 | 6,24 | 8,77 | 8,72 | 9,73 | 9,87 | 11,92 | 10,92 | 11,37 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Lviv | 0,72 | 6,74 | 8,72 | 9,16 | 11,69 | 11,64 | 12,65 | 12,79 | 14,84 | 13,84 | 14,29 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Katowice | 1,28 | 3,60 | 5,58 | 6,02 | 8,55 | 8,50 | 9,51 | 9,65 | 11,70 | 10,70 | 11,15 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Ostrava | 0,30 | 4,35 | 6,33 | 6,77 | 9,30 | 9,25 | 10,26 | 10,40 | 12,45 | 11,45 | 11,90 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Brno | 0,39 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Wien | 1,84 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Bratislava | 0,42 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Łódź | | 0,133 | 0,029 | 0,219 | 0,049 | 0,014 | 0,016 | 0,010 | 0,026 | 0,098 | 0,017 | 0,028 | 0,159 | 0,034 | 0,084 | 0,005 | 0,037 |
| Warzsawa | | 0,140 | 0,045 | 0,347 | 0,089 | 0,026 | 0,030 | 0,019 | 0,050 | 0,190 | 0,033 | 0,048 | 0,165 | 0,053 | 0,131 | 0,009 | 0,068 |
| Białystok | | 0,011 | 0,005 | 0,036 | 0,011 | 0,003 | 0,004 | 0,002 | 0,007 | 0,024 | 0,004 | 0,006 | 0,013 | 0,005 | 0,013 | 0,001 | 0,008 |
| Kaunas | | 0,006 | 0,003 | 0,026 | 0,008 | 0,002 | 0,003 | 0,002 | 0,006 | 0,020 | 0,004 | 0,004 | 0,008 | 0,004 | 0,009 | 0,001 | 0,007 |
| Vilnius | | 0,009 | 0,005 | 0,038 | 0,013 | 0,004 | 0,005 | 0,003 | 0,009 | 0,031 | 0,006 | 0,006 | 0,011 | 0,006 | 0,014 | 0,001 | 0,010 |
| Riga | | 0,008 | 0,004 | 0,037 | 0,013 | 0,004 | 0,005 | 0,003 | 0,009 | 0,032 | 0,006 | 0,006 | 0,010 | 0,005 | 0,013 | 0,001 | 0,010 |
| Brest | | 0,003 | 0,002 | 0,016 | 0,006 | 0,002 | 0,002 | 0,001 | 0,004 | 0,016 | 0,003 | 0,003 | 0,004 | 0,002 | 0,006 | 0,001 | 0,005 |
| Minsk | | 0,011 | 0,005 | 0,038 | 0,011 | 0,003 | 0,004 | 0,002 | 0,007 | 0,026 | 0,005 | 0,006 | 0,013 | 0,006 | 0,014 | 0,001 | 0,009 |
| Smolensk | | 0,029 | 0,015 | 0,124 | 0,042 | 0,012 | 0,015 | 0,010 | 0,029 | 0,104 | 0,018 | 0,021 | 0,034 | 0,018 | 0,045 | 0,004 | 0,033 |
| Moskwa + ... | | 0,003 | 0,002 | 0,014 | 0,005 | 0,001 | 0,002 | 0,001 | 0,004 | 0,013 | 0,002 | 0,002 | 0,003 | 0,002 | 0,005 | 0,000 | 0,004 |
| Lublin | | 0,071 | 0,043 | 0,365 | 0,142 | 0,041 | 0,053 | 0,034 | 0,110 | 0,380 | 0,068 | 0,066 | 0,082 | 0,054 | 0,130 | 0,013 | 0,112 |
| Kijiv | | 0,014 | 0,006 | 0,045 | 0,013 | 0,004 | 0,004 | 0,003 | 0,008 | 0,030 | 0,005 | 0,007 | 0,016 | 0,007 | 0,017 | 0,001 | 0,010 |
| Krakow | | 0,029 | 0,016 | 0,136 | 0,049 | 0,014 | 0,018 | 0,011 | 0,035 | 0,125 | 0,022 | 0,024 | 0,034 | 0,020 | 0,049 | 0,004 | 0,038 |
| Lviv | | 0,043 | 0,016 | 0,124 | 0,034 | 0,010 | 0,011 | 0,007 | 0,020 | 0,075 | 0,013 | 0,004 | 0,003 | 0,002 | 0,006 | 0,001 | 0,007 |
| Katowice | | 0,015 | 0,007 | 0,061 | 0,020 | 0,006 | 0,007 | 0,004 | 0,013 | 0,047 | 0,008 | 0,003 | 0,003 | 0,002 | 0,006 | 0,001 | 0,006 |
| Ostrava | | 0,080 | 0,028 | 0,222 | 0,060 | 0,017 | 0,020 | 0,013 | 0,035 | 0,130 | 0,022 | 0,006 | 0,005 | 0,004 | 0,010 | 0,001 | 0,011 |
| Brno | | 0,014 | 0,005 | 0,043 | 0,012 | 0,003 | 0,004 | 0,003 | 0,007 | 0,027 | 0,005 | 0,001 | 0,001 | 0,001 | 0,002 | 0,000 | 0,003 |
| Wien | | 0,001 | 0,001 | 0,009 | 0,004 | 0,001 | 0,002 | 0,001 | 0,004 | 0,014 | 0,003 | 0,002 | 0,002 | 0,001 | 0,003 | 0,000 | 0,003 |
| Bratislava | | 0,006 | 0,005 | 0,041 | 0,020 | 0,006 | 0,008 | 0,005 | 0,020 | 0,065 | 0,012 | 0,009 | 0,007 | 0,006 | 0,014 | 0,002 | 0,016 |

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| 8,113 |

# Lviv - Vinnitsa

| | | Vinnitsa | Kijiv | Bryansk | Moskwa | St. Petersburg | Yaroslawl | Nishnij Nowgorod | Kirov | Perm | Kazan | Charkiv | Voronesh | Donetsk | Rostow n.D. | Krasnodar | Dnipropetrowsk | Kirovohrad | Krivyi Rih | Zaporishya | Odessa |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0,37 | 2,80 | 0,41 | 12,86 | 4,99 | 0,60 | 1,26 | 0,47 | 1,00 | 1,17 | 1,43 | 1,00 | 2,19 | 1,87 | 0,75 | 0,99 | 0,23 | 0,65 | 0,76 | 1,00 |
| Lviv | 0,72 | 3,28 | 5,27 | 9,38 | 12,85 | 19,18 | 15,34 | 16,69 | 21,01 | 24,91 | 19,99 | 9,38 | 12,13 | 11,20 | 12,89 | 15,38 | 9,20 | 6,14 | 7,20 | 8,55 | 6,79 |
| Lublin | 0,35 | 5,15 | 7,14 | 11,25 | 14,72 | 21,05 | 17,21 | 18,56 | 22,88 | 26,78 | 21,86 | 11,25 | 14,00 | 13,07 | 14,76 | 17,25 | 11,07 | 8,01 | 9,07 | 10,42 | 8,66 |
| Warszawa | 1,71 | 6,71 | 8,70 | 12,81 | 16,28 | 22,61 | 18,77 | 20,12 | 24,44 | 28,34 | 23,42 | 12,81 | 15,56 | 14,63 | 16,32 | 18,81 | 12,63 | 9,57 | 10,63 | 11,98 | 10,22 |
| Gdańsk + Gdynia | 0,71 | 9,56 | 11,55 | 15,66 | 19,13 | 25,46 | 21,62 | 22,97 | 27,29 | 31,19 | 26,27 | 15,66 | 18,41 | 17,48 | 19,17 | 21,66 | 15,48 | 12,42 | 13,48 | 14,83 | 13,07 |
| Łodz | 0,72 | 7,87 | 9,86 | 13,97 | 17,44 | 23,77 | 19,93 | 21,28 | 25,60 | 29,50 | 24,58 | 13,97 | 16,72 | 15,79 | 17,48 | 19,97 | 13,79 | 10,73 | 11,79 | 13,14 | 11,38 |
| Poznań | 0,55 | 9,77 | 11,76 | 15,87 | 19,34 | 25,67 | 21,83 | 23,18 | 27,50 | 31,40 | 26,48 | 15,87 | 18,62 | 17,69 | 19,38 | 21,87 | 15,69 | 12,63 | 13,69 | 15,04 | 13,28 |
| Berlin | 3,66 | 12,19 | 14,18 | 18,29 | 21,76 | 28,09 | 24,25 | 25,60 | 29,92 | 33,82 | 28,90 | 18,29 | 21,04 | 20,11 | 21,80 | 24,29 | 18,11 | 15,05 | 16,11 | 17,46 | 15,70 |
| Rzeszow | 0,18 | 4,73 | 6,72 | 10,83 | 14,30 | 20,63 | 16,79 | 18,14 | 22,46 | 26,36 | 21,44 | 10,83 | 13,58 | 12,65 | 14,34 | 16,83 | 10,65 | 7,59 | 8,65 | 10,00 | 8,24 |
| Tarnow | 0,11 | 5,47 | 7,46 | 11,57 | 15,04 | 21,37 | 17,53 | 18,88 | 23,20 | 27,10 | 22,18 | 11,57 | 14,32 | 13,39 | 15,08 | 17,57 | 11,39 | 8,33 | 9,39 | 10,74 | 8,98 |
| Krakow | 0,76 | 6,21 | 8,20 | 12,31 | 15,78 | 22,11 | 18,27 | 19,62 | 23,94 | 27,84 | 22,92 | 12,31 | 15,06 | 14,13 | 15,82 | 18,31 | 12,13 | 9,07 | 10,13 | 11,48 | 9,72 |
| Katowice | 1,28 | 6,90 | 8,89 | 13,00 | 16,47 | 22,80 | 18,96 | 20,31 | 24,63 | 28,53 | 23,61 | 13,00 | 15,75 | 14,82 | 16,51 | 19,00 | 12,82 | 9,76 | 10,82 | 12,17 | 10,41 |
| Wrocław | 0,63 | 8,58 | 10,57 | 14,68 | 18,15 | 24,48 | 20,64 | 21,99 | 26,31 | 30,21 | 25,29 | 14,68 | 17,43 | 16,50 | 18,19 | 20,68 | 14,50 | 11,44 | 12,50 | 13,85 | 12,09 |
| Ostrava | 0,30 | 7,42 | 9,41 | 13,52 | 16,99 | 23,32 | 19,48 | 20,83 | 25,15 | 29,05 | 24,13 | 13,52 | 16,27 | 15,34 | 17,03 | 19,52 | 13,34 | 10,28 | 11,34 | 12,69 | 10,93 |
| Brno | 0,39 | 8,85 | 10,84 | 14,95 | 18,42 | 24,75 | 20,91 | 22,26 | 26,58 | 30,48 | 25,56 | 14,95 | 17,70 | 16,77 | 18,46 | 20,95 | 14,77 | 11,71 | 12,77 | 14,12 | 12,36 |
| Praha | 1,27 | 10,72 | 12,71 | 16,82 | 20,29 | 26,62 | 22,78 | 24,13 | 28,45 | 32,35 | 27,43 | 16,82 | 19,57 | 18,64 | 20,33 | 22,82 | 16,64 | 13,58 | 14,64 | 15,99 | 14,23 |
| Uzhorod | 0,11 | 5,13 | 7,12 | 11,23 | 14,70 | 21,03 | 17,19 | 18,54 | 22,86 | 26,76 | 21,84 | 11,23 | 13,98 | 13,05 | 14,74 | 17,23 | 11,05 | 7,99 | 9,05 | 10,40 | 8,64 |
| Nyiregyhaza | 0,12 | 6,01 | 8,00 | 12,11 | 15,58 | 21,91 | 18,07 | 19,42 | 23,74 | 27,64 | 22,72 | 12,11 | 14,86 | 13,93 | 15,62 | 18,11 | 11,93 | 8,87 | 9,93 | 11,28 | 9,52 |
| Miskolc | 0,17 | 6,70 | 8,69 | 12,80 | 16,27 | 22,60 | 18,76 | 20,11 | 24,43 | 28,33 | 23,41 | 12,80 | 15,55 | 14,62 | 16,31 | 18,80 | 12,62 | 9,56 | 10,62 | 11,97 | 10,21 |
| Budapest | 1,74 | 8,17 | 10,16 | 14,27 | 17,74 | 24,07 | 20,23 | 21,58 | 25,90 | 29,80 | 24,88 | 14,27 | 17,02 | 16,09 | 17,78 | 20,27 | 14,09 | 11,03 | 12,09 | 13,44 | 11,68 |
| Bratislava | 0,42 | 9,91 | 11,90 | 16,01 | 19,48 | 25,81 | 21,97 | 23,32 | 27,64 | 31,54 | 26,62 | 16,01 | 18,76 | 17,83 | 19,52 | 22,01 | 15,83 | 12,77 | 13,83 | 15,18 | 13,42 |
| Wien | 1,84 | 10,36 | 12,35 | 16,46 | 19,93 | 26,26 | 22,42 | 23,77 | 28,09 | 31,99 | 27,07 | 16,46 | 19,21 | 18,28 | 19,97 | 22,46 | 16,28 | 13,22 | 14,28 | 15,63 | 13,87 |
| Debrecen | 0,21 | 6,46 | 8,45 | 12,56 | 16,03 | 22,36 | 18,52 | 19,87 | 24,19 | 28,09 | 23,17 | 12,56 | 15,31 | 14,38 | 16,07 | 18,56 | 12,38 | 9,32 | 10,38 | 11,73 | 9,97 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lviv | 0,035 | 0,120 | 0,007 | 0,121 | 0,024 | 0,004 | 0,008 | 0,002 | 0,003 | 0,005 | 0,023 | 0,010 | 0,026 | 0,017 | 0,005 | 0,016 | 0,008 | 0,016 | 0,014 | 0,028 |
| Lublin | 0,008 | 0,035 | 0,002 | 0,047 | 0,010 | 0,002 | 0,003 | 0,001 | 0,001 | 0,002 | 0,008 | 0,004 | 0,010 | 0,007 | 0,002 | 0,006 | 0,002 | 0,005 | 0,005 | 0,009 |
| Warszawa | 0,025 | 0,121 | 0,009 | 0,192 | 0,043 | 0,007 | 0,013 | 0,004 | 0,006 | 0,009 | 0,032 | 0,016 | 0,039 | 0,028 | 0,009 | 0,023 | 0,008 | 0,020 | 0,019 | 0,033 |
| Gdańsk + Gdynia | 0,006 | 0,031 | 0,003 | 0,060 | 0,014 | 0,002 | 0,004 | 0,001 | 0,002 | 0,003 | 0,009 | 0,005 | 0,012 | 0,009 | 0,003 | 0,007 | 0,002 | 0,006 | 0,006 | 0,009 |
| Łodz | 0,008 | 0,041 | 0,003 | 0,072 | 0,016 | 0,003 | 0,005 | 0,001 | 0,002 | 0,004 | 0,012 | 0,006 | 0,014 | 0,010 | 0,003 | 0,008 | 0,003 | 0,007 | 0,007 | 0,012 |
| Poznań | 0,004 | 0,023 | 0,002 | 0,046 | 0,011 | 0,002 | 0,003 | 0,001 | 0,002 | 0,002 | 0,007 | 0,004 | 0,009 | 0,007 | 0,002 | 0,005 | 0,002 | 0,004 | 0,004 | 0,007 |
| Berlin | 0,019 | 0,113 | 0,011 | 0,250 | 0,063 | 0,010 | 0,019 | 0,005 | 0,009 | 0,014 | 0,037 | 0,021 | 0,049 | 0,036 | 0,012 | 0,026 | 0,008 | 0,021 | 0,022 | 0,034 |
| Rzeszow | 0,005 | 0,020 | 0,001 | 0,025 | 0,005 | 0,001 | 0,002 | 0,000 | 0,001 | 0,001 | 0,004 | 0,002 | 0,005 | 0,004 | 0,001 | 0,003 | 0,001 | 0,003 | 0,003 | 0,005 |
| Tarnow | 0,002 | 0,010 | 0,001 | 0,014 | 0,003 | 0,001 | 0,001 | 0,000 | 0,000 | 0,001 | 0,002 | 0,001 | 0,003 | 0,002 | 0,001 | 0,002 | 0,001 | 0,002 | 0,001 | 0,003 |
| Krakow | 0,013 | 0,059 | 0,004 | 0,090 | 0,020 | 0,003 | 0,006 | 0,002 | 0,003 | 0,004 | 0,015 | 0,008 | 0,018 | 0,013 | 0,004 | 0,011 | 0,004 | 0,010 | 0,009 | 0,016 |
| Katowice | 0,018 | 0,087 | 0,007 | 0,141 | 0,031 | 0,005 | 0,010 | 0,003 | 0,004 | 0,007 | 0,023 | 0,012 | 0,029 | 0,020 | 0,006 | 0,017 | 0,006 | 0,015 | 0,014 | 0,024 |
| Wrocław | 0,006 | 0,032 | 0,003 | 0,059 | 0,014 | 0,002 | 0,004 | 0,001 | 0,002 | 0,003 | 0,009 | 0,005 | 0,012 | 0,009 | 0,003 | 0,007 | 0,002 | 0,006 | 0,005 | 0,009 |
| Ostrava | 0,004 | 0,019 | 0,001 | 0,031 | 0,007 | 0,001 | 0,002 | 0,001 | 0,001 | 0,002 | 0,005 | 0,003 | 0,006 | 0,005 | 0,001 | 0,004 | 0,001 | 0,003 | 0,003 | 0,005 |
| Brno | 0,004 | 0,019 | 0,002 | 0,035 | 0,008 | 0,001 | 0,003 | 0,001 | 0,001 | 0,002 | 0,006 | 0,003 | 0,007 | 0,005 | 0,002 | 0,004 | 0,001 | 0,003 | 0,003 | 0,005 |
| Praha | 0,008 | 0,047 | 0,004 | 0,098 | 0,024 | 0,004 | 0,007 | 0,002 | 0,003 | 0,005 | 0,015 | 0,008 | 0,019 | 0,014 | 0,005 | 0,011 | 0,003 | 0,009 | 0,009 | 0,014 |
| Uzhorod | 0,003 | 0,011 | 0,001 | 0,015 | 0,003 | 0,001 | 0,001 | 0,000 | 0,000 | 0,001 | 0,003 | 0,001 | 0,003 | 0,002 | 0,001 | 0,002 | 0,001 | 0,002 | 0,002 | 0,003 |
| Nyiregyhaza | 0,002 | 0,010 | 0,001 | 0,014 | 0,003 | 0,001 | 0,001 | 0,000 | 0,000 | 0,001 | 0,002 | 0,001 | 0,003 | 0,002 | 0,001 | 0,002 | 0,001 | 0,002 | 0,001 | 0,003 |
| Miskolc | 0,002 | 0,012 | 0,001 | 0,019 | 0,004 | 0,001 | 0,001 | 0,000 | 0,001 | 0,001 | 0,003 | 0,002 | 0,004 | 0,003 | 0,001 | 0,002 | 0,001 | 0,002 | 0,002 | 0,003 |
| Budapest | 0,018 | 0,095 | 0,008 | 0,168 | 0,039 | 0,006 | 0,012 | 0,003 | 0,005 | 0,009 | 0,027 | 0,014 | 0,034 | 0,024 | 0,008 | 0,019 | 0,007 | 0,016 | 0,016 | 0,027 |
| Bratislava | 0,003 | 0,017 | 0,002 | 0,035 | 0,008 | 0,001 | 0,003 | 0,001 | 0,001 | 0,002 | 0,005 | 0,003 | 0,007 | 0,005 | 0,002 | 0,004 | 0,001 | 0,003 | 0,003 | 0,005 |
| Wien | 0,013 | 0,072 | 0,006 | 0,146 | 0,035 | 0,006 | 0,011 | 0,003 | 0,005 | 0,008 | 0,023 | 0,012 | 0,029 | 0,021 | 0,007 | 0,016 | 0,005 | 0,013 | 0,013 | 0,021 |
| Debrecen | 0,003 | 0,016 | 0,001 | 0,024 | 0,005 | 0,001 | 0,002 | 0,000 | 0,001 | 0,001 | 0,004 | 0,002 | 0,005 | 0,003 | 0,001 | 0,003 | 0,001 | 0,003 | 0,002 | 0,004 |

5,713

## Lyon - Marseille

| | | Marseille | Toulon | Nice | Nîmes | Montpellier | Perpignan | Barcelona | Madrid |
|---|---|---|---|---|---|---|---|---|---|
| | | 0,86 | 0,16 | 0,34 | 0,15 | 0,27 | 0,12 | 1,60 | 3,14 |
| Lyon | 2,19 | 2,80 | 3,28 | 4,50 | 2,40 | 2,82 | 4,09 | 5,14 | 10,19 |
| Paris | 12,40 | 6,76 | 7,24 | 8,46 | 6,36 | 6,78 | 8,05 | 9,10 | 14,15 |
| Rouen | 0,11 | 7,81 | 8,29 | 9,51 | 7,41 | 7,83 | 9,10 | 10,15 | 15,20 |
| Le Havre | 0,17 | 8,48 | 8,96 | 10,18 | 8,08 | 8,50 | 9,77 | 10,82 | 15,87 |
| Lille | 0,27 | 8,76 | 9,24 | 10,46 | 8,36 | 8,78 | 10,05 | 11,10 | 16,15 |
| London | 13,61 | 11,10 | 11,58 | 12,80 | 10,70 | 11,12 | 12,39 | 13,44 | 18,49 |
| Bruxelles | 1,83 | 9,72 | 10,20 | 11,42 | 9,32 | 9,74 | 11,01 | 12,06 | 17,11 |
| Amsterdam | 0,84 | 11,38 | 11,86 | 12,38 | 10,98 | 11,40 | 12,67 | 13,72 | 18,77 |
| Dijon | 0,15 | 4,51 | 4,99 | 6,21 | 4,11 | 4,53 | 5,80 | 6,85 | 11,90 |
| Mulhouse | 0,11 | 6,23 | 6,71 | 7,93 | 5,83 | 6,25 | 7,52 | 8,56 | 13,62 |
| Basel | 0,18 | 6,57 | 7,05 | 8,27 | 6,17 | 6,59 | 7,86 | 8,90 | 13,96 |
| Strasbourg | 0,28 | 7,26 | 7,74 | 8,96 | 6,86 | 7,28 | 8,55 | 9,59 | 14,65 |
| Mannh.-Lud. | 0,63 | 8,40 | 8,88 | 10,08 | 8,00 | 8,42 | 9,69 | 10,73 | 15,79 |
| Frankf.-Mainz | 1,60 | 9,13 | 9,61 | 10,81 | 8,73 | 9,15 | 10,42 | 11,46 | 16,52 |
| Köln | 1,06 | 10,63 | 11,11 | 12,31 | 10,23 | 10,65 | 11,92 | 12,96 | 18,02 |
| Düssdf.+Ruhr | 5,71 | 11,08 | 11,56 | 13,76 | 10,68 | 11,10 | 12,37 | 13,41 | 18,47 |
| Genève | 0,20 | 3,88 | 4,36 | 5,58 | 3,48 | 3,90 | 5,17 | 6,22 | 11,27 |
| Torino | 0,89 | 5,13 | 11,22 | 13,66 | 4,73 | 5,15 | 6,42 | 7,47 | 12,52 |
| Milano | 1,35 | 6,38 | 13,72 | 16,22 | 5,98 | 6,40 | 7,67 | 8,72 | 13,77 |
| Verona | 0,26 | 7,80 | 16,56 | 19,06 | 7,40 | 7,82 | 9,09 | 10,14 | 15,19 |
| Padova | 0,21 | 8,45 | 17,86 | 20,36 | 8,05 | 8,47 | 9,74 | 10,79 | 15,84 |
| Venezia | 0,34 | 8,79 | 18,54 | 21,04 | 8,39 | 8,81 | 10,08 | 11,13 | 16,18 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Lyon | | 0,327 | 0,047 | 0,058 | 0,074 | 0,101 | 0,024 | 0,217 | 0,133 |
| Paris | | 0,414 | 0,069 | 0,112 | 0,080 | 0,129 | 0,043 | 0,465 | 0,431 |
| Rouen | | 0,003 | 0,000 | 0,001 | 0,001 | 0,001 | 0,000 | 0,003 | 0,003 |
| Le Havre | | 0,004 | 0,001 | 0,001 | 0,001 | 0,001 | 0,000 | 0,005 | 0,005 |
| Lille | | 0,006 | 0,001 | 0,002 | 0,001 | 0,002 | 0,001 | 0,007 | 0,007 |
| London | | 0,196 | 0,034 | 0,061 | 0,036 | 0,061 | 0,023 | 0,263 | 0,300 |
| Bruxelles | | 0,033 | 0,006 | 0,010 | 0,006 | 0,010 | 0,004 | 0,042 | 0,046 |
| Amsterdam | | 0,012 | 0,002 | 0,004 | 0,002 | 0,004 | 0,001 | 0,016 | 0,018 |
| Dijon | | 0,010 | 0,002 | 0,002 | 0,002 | 0,003 | 0,001 | 0,009 | 0,007 |
| Mulhouse | | 0,004 | 0,001 | 0,001 | 0,001 | 0,001 | 0,000 | 0,005 | 0,004 |
| Basel | | 0,006 | 0,001 | 0,002 | 0,001 | 0,002 | 0,001 | 0,007 | 0,006 |
| Strasbourg | | 0,008 | 0,001 | 0,002 | 0,002 | 0,003 | 0,001 | 0,010 | 0,009 |
| Mannh.-Lud. | | 0,015 | 0,002 | 0,004 | 0,003 | 0,005 | 0,002 | 0,018 | 0,018 |
| Frankf.-Mainz | | 0,032 | 0,005 | 0,010 | 0,006 | 0,010 | 0,004 | 0,041 | 0,043 |
| Köln | | 0,016 | 0,003 | 0,005 | 0,003 | 0,005 | 0,002 | 0,022 | 0,024 |
| Düssdf.+Ruhr | | 0,082 | 0,014 | 0,023 | 0,015 | 0,026 | 0,010 | 0,111 | 0,126 |
| Genève | | 0,017 | 0,003 | 0,004 | 0,004 | 0,005 | 0,001 | 0,014 | 0,010 |
| Torino | | 0,047 | 0,002 | 0,004 | 0,010 | 0,015 | 0,005 | 0,047 | 0,038 |
| Milano | | 0,050 | 0,003 | 0,004 | 0,010 | 0,016 | 0,005 | 0,054 | 0,049 |
| Verona | | 0,007 | 0,000 | 0,001 | 0,001 | 0,002 | 0,001 | 0,008 | 0,008 |
| Padova | | 0,005 | 0,000 | 0,000 | 0,001 | 0,002 | 0,001 | 0,006 | 0,006 |
| Venezia | | 0,007 | 0,000 | 0,001 | 0,001 | 0,002 | 0,001 | 0,009 | 0,009 |

| |
|---|
| 5,250 |

## Milano - Bologna

| | | Bologna | Rimini | Ancona | Pescara | Firenze | Livorno + Pisa | Roma | Napoli | Bari | Taranto + Brindisi | Reggio C. + M | Palermo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1,06 | 0,25 | 0,20 | 1,83 | 5,71 | 0,25 | 0,32 | 0,63 | 0,84 | 0,31 | 0,16 | 1,79 |
| Milano | 1,35 | 1,98 | 3,06 | 3,90 | 5,36 | 2,76 | 3,52 | 5,06 | 6,30 | 7,10 | 7,90 | 10,20 | 12,17 |
| Torino | 0,89 | 3,23 | 4,31 | 5,15 | 6,61 | 4,01 | 4,77 | 6,31 | 7,55 | 8,35 | 9,15 | 11,45 | 13,42 |
| Lyon | 2,19 | 5,56 | 6,64 | 7,48 | 8,94 | 6,34 | 7,10 | 8,64 | 9,88 | 10,68 | 11,48 | 13,78 | 15,75 |
| Paris | 12,40 | 9,52 | 10,60 | 11,44 | 12,90 | 10,30 | 11,06 | 12,60 | 13,84 | 14,64 | 15,44 | 17,74 | 19,71 |
| Genève | 0,20 | 4,47 | 5,55 | 6,39 | 7,85 | 5,25 | 6,01 | 7,55 | 8,79 | 9,59 | 10,39 | 12,69 | 14,66 |
| Bern | 0,14 | 4,08 | 5,16 | 6,00 | 7,46 | 4,86 | 5,62 | 7,16 | 8,40 | 9,20 | 10,00 | 12,30 | 14,27 |
| Zürich | 0,40 | 4,18 | 5,26 | 6,10 | 7,56 | 4,96 | 5,72 | 7,26 | 8,50 | 9,30 | 10,10 | 12,40 | 14,37 |
| Basel | 0,18 | 4,91 | 5,99 | 6,83 | 8,29 | 5,69 | 6,45 | 7,99 | 9,23 | 10,03 | 10,83 | 13,13 | 15,10 |
| Mannheim-L. | 0,63 | 7,31 | 8,39 | 9,23 | 10,69 | 8,09 | 8,85 | 10,39 | 11,63 | 12,43 | 13,23 | 15,53 | 17,50 |
| Frankfurt | 1,60 | 8,04 | 9,12 | 9,96 | 11,42 | 8,82 | 9,58 | 11,12 | 12,36 | 13,16 | 13,96 | 16,26 | 18,23 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Milano | | 0,448 | 0,050 | 0,027 | 0,142 | 1,372 | 0,040 | 0,027 | 0,037 | 0,041 | 0,012 | 0,004 | 0,035 |
| Torino | | 0,129 | 0,019 | 0,011 | 0,066 | 0,479 | 0,016 | 0,012 | 0,018 | 0,020 | 0,006 | 0,002 | 0,019 |
| Lyon | | 0,126 | 0,022 | 0,014 | 0,097 | 0,541 | 0,020 | 0,018 | 0,028 | 0,033 | 0,011 | 0,004 | 0,036 |
| Paris | | 0,285 | 0,056 | 0,039 | 0,294 | 1,343 | 0,052 | 0,053 | 0,090 | 0,109 | 0,037 | 0,015 | 0,140 |
| Genève | | 0,017 | 0,003 | 0,002 | 0,011 | 0,068 | 0,002 | 0,002 | 0,003 | 0,004 | 0,001 | 0,000 | 0,004 |
| Bern | | 0,014 | 0,002 | 0,001 | 0,008 | 0,054 | 0,002 | 0,002 | 0,002 | 0,003 | 0,001 | 0,000 | 0,003 |
| Zürich | | 0,037 | 0,006 | 0,004 | 0,023 | 0,150 | 0,005 | 0,004 | 0,007 | 0,008 | 0,002 | 0,001 | 0,008 |
| Basel | | 0,013 | 0,002 | 0,001 | 0,009 | 0,053 | 0,002 | 0,002 | 0,003 | 0,003 | 0,001 | 0,000 | 0,003 |
| Mannheim-L. | | 0,023 | 0,004 | 0,003 | 0,021 | 0,103 | 0,004 | 0,004 | 0,006 | 0,007 | 0,002 | 0,001 | 0,009 |
| Frankfurt | | 0,049 | 0,009 | 0,006 | 0,047 | 0,226 | 0,009 | 0,009 | 0,014 | 0,017 | 0,006 | 0,002 | 0,021 |

| |
|---|
| 7,652 |

# Minsk -Orsha

| | | Orsha | Smolensk | Moskwa | Yaroslawl | Vladimir | Nishnij Nowgorod | Ryazan | Saransk | Samara | Tambov | Saratov | Volgograd | Voronesh |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0,12 | 0,33 | 12,86 | 0,60 | 0,53 | 1,26 | 0,53 | 0,30 | 1,17 | 0,28 | 0,84 | 1,02 | 1,00 |
| Minsk | 1,89 | 2,01 | 3,12 | 6,80 | 9,29 | 8,57 | 10,69 | 8,64 | 12,19 | 15,69 | 10,88 | 14,35 | 15,79 | 11,26 |
| Vilnius | 0,54 | 3,74 | 4,85 | 8,53 | 11,02 | 10,30 | 12,42 | 10,37 | 13,92 | 17,42 | 12,61 | 16,08 | 17,52 | 12,99 |
| Siauliai | 0,11 | 5,60 | 6,71 | 10,39 | 12,88 | 12,16 | 14,28 | 12,23 | 15,78 | 19,28 | 14,47 | 17,94 | 19,38 | 14,85 |
| Riga | 0,64 | 6,83 | 7,94 | 11,62 | 14,11 | 13,39 | 15,51 | 13,46 | 17,01 | 20,51 | 15,70 | 19,17 | 20,61 | 16,08 |
| Kaunas | 0,31 | 4,65 | 5,76 | 9,44 | 11,93 | 11,21 | 13,33 | 11,28 | 14,83 | 18,33 | 13,52 | 16,99 | 18,43 | 13,90 |
| Kaliningrad | 0,44 | 6,88 | 7,99 | 11,67 | 14,16 | 13,44 | 15,56 | 13,51 | 17,06 | 20,56 | 15,75 | 19,22 | 20,66 | 16,13 |
| Hrodna | 0,35 | 4,46 | 5,57 | 9,25 | 11,74 | 11,02 | 13,14 | 11,09 | 14,64 | 18,14 | 13,33 | 16,80 | 18,24 | 13,71 |
| Brest | 0,31 | 5,31 | 6,42 | 10,10 | 12,59 | 11,87 | 13,99 | 11,94 | 15,49 | 18,99 | 14,18 | 17,65 | 19,09 | 14,56 |
| Białystok | 0,29 | 6,53 | 7,64 | 11,32 | 13,81 | 13,09 | 15,21 | 13,16 | 16,71 | 20,21 | 15,40 | 18,87 | 20,31 | 15,78 |
| Warszawa | 1,71 | 7,16 | 8,27 | 11,95 | 14,44 | 13,72 | 15,84 | 13,79 | 17,34 | 20,84 | 16,03 | 19,50 | 20,94 | 16,41 |
| Gdansk + Gdynia | 0,71 | 10,01 | 11,12 | 14,80 | 17,29 | 16,57 | 18,69 | 16,64 | 20,19 | 23,69 | 18,88 | 22,35 | 23,79 | 19,26 |
| Łódź | 0,72 | 8,32 | 9,43 | 13,11 | 15,60 | 14,88 | 17,00 | 14,95 | 18,50 | 22,00 | 17,19 | 20,66 | 22,10 | 17,57 |
| Poznań | 0,55 | 10,22 | 11,33 | 15,01 | 17,50 | 16,78 | 18,90 | 16,85 | 20,40 | 23,90 | 19,09 | 22,56 | 24,00 | 19,47 |
| Szczecin | 0,41 | 12,20 | 13,31 | 16,99 | 19,48 | 18,76 | 20,88 | 18,83 | 22,38 | 25,88 | 21,07 | 24,54 | 25,98 | 21,45 |
| Berlin + Potsdam | 3,66 | 12,64 | 13,75 | 17,43 | 19,92 | 19,20 | 21,32 | 19,27 | 22,82 | 26,32 | 21,51 | 24,98 | 26,42 | 21,89 |
| Hamburg | 1,79 | 15,17 | 16,28 | 19,96 | 22,45 | 21,73 | 23,85 | 21,80 | 25,35 | 28,85 | 24,04 | 27,51 | 28,95 | 24,42 |
| Hannover | 0,51 | 15,10 | 16,21 | 19,89 | 22,38 | 21,66 | 23,78 | 21,73 | 25,28 | 28,78 | 23,97 | 27,44 | 28,88 | 24,35 |
| Leipzig + Halle | 0,36 | 16,56 | 17,67 | 21,35 | 23,84 | 23,12 | 25,24 | 23,19 | 26,74 | 30,24 | 25,43 | 28,90 | 30,34 | 25,81 |
| Wrocław | 0,63 | 10,17 | 11,28 | 14,96 | 17,45 | 16,73 | 18,85 | 16,80 | 20,35 | 23,85 | 19,04 | 22,51 | 23,95 | 19,42 |
| Praha | 1,27 | 12,38 | 13,49 | 17,17 | 19,66 | 18,94 | 21,06 | 19,01 | 22,56 | 26,06 | 21,25 | 24,72 | 26,16 | 21,63 |
| Katowice + ... | 1,28 | 9,74 | 10,85 | 14,53 | 17,02 | 16,30 | 18,42 | 16,37 | 19,92 | 23,42 | 18,61 | 22,08 | 23,52 | 18,99 |
| Ostrava | 0,30 | 10,49 | 11,60 | 15,28 | 17,77 | 17,05 | 19,17 | 17,12 | 20,67 | 24,17 | 19,36 | 22,83 | 24,27 | 19,74 |
| Brno | 0,39 | 11,92 | 13,03 | 16,71 | 19,20 | 18,48 | 20,60 | 18,55 | 22,10 | 25,60 | 20,79 | 24,26 | 25,70 | 21,17 |
| Wien | 1,84 | 12,64 | 13,75 | 17,43 | 19,92 | 19,20 | 21,32 | 19,27 | 22,82 | 26,32 | 21,51 | 24,98 | 26,42 | 21,89 |
| Bratislava | 0,42 | 12,52 | 13,63 | 17,31 | 19,80 | 19,08 | 21,20 | 19,15 | 22,70 | 26,20 | 21,39 | 24,86 | 26,30 | 21,77 |
| Krakow | 0,76 | 9,70 | 10,81 | 14,49 | 16,98 | 16,26 | 18,38 | 16,33 | 19,88 | 23,38 | 18,57 | 22,04 | 23,48 | 18,95 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Minsk | | 0,069 | 0,090 | 0,934 | 0,026 | 0,026 | 0,042 | 0,026 | 0,008 | 0,021 | 0,009 | 0,017 | 0,018 | 0,031 |
| Vilnius | | 0,007 | 0,012 | 0,182 | 0,005 | 0,005 | 0,009 | 0,005 | 0,002 | 0,005 | 0,002 | 0,004 | 0,004 | 0,007 |
| Siauliai | | 0,001 | 0,001 | 0,026 | 0,001 | 0,001 | 0,002 | 0,001 | 0,000 | 0,001 | 0,000 | 0,001 | 0,001 | 0,001 |
| Riga | | 0,003 | 0,006 | 0,127 | 0,004 | 0,004 | 0,008 | 0,004 | 0,002 | 0,004 | 0,002 | 0,004 | 0,004 | 0,006 |
| Kaunas | | 0,003 | 0,005 | 0,088 | 0,003 | 0,003 | 0,005 | 0,003 | 0,001 | 0,003 | 0,001 | 0,002 | 0,002 | 0,004 |
| Kaliningrad | | 0,002 | 0,004 | 0,087 | 0,003 | 0,003 | 0,005 | 0,003 | 0,001 | 0,003 | 0,001 | 0,002 | 0,003 | 0,004 |
| Hrodna | | 0,003 | 0,006 | 0,103 | 0,003 | 0,003 | 0,006 | 0,003 | 0,001 | 0,003 | 0,001 | 0,002 | 0,003 | 0,004 |
| Brest | | 0,002 | 0,004 | 0,078 | 0,003 | 0,002 | 0,004 | 0,002 | 0,001 | 0,002 | 0,001 | 0,002 | 0,002 | 0,003 |
| Białystok | | 0,001 | 0,003 | 0,060 | 0,002 | 0,002 | 0,004 | 0,002 | 0,001 | 0,002 | 0,001 | 0,002 | 0,002 | 0,003 |
| Warszawa | | 0,007 | 0,016 | 0,324 | 0,011 | 0,011 | 0,020 | 0,010 | 0,004 | 0,011 | 0,004 | 0,009 | 0,010 | 0,015 |
| Gdansk + Gdynia | | 0,002 | 0,004 | 0,094 | 0,003 | 0,003 | 0,006 | 0,003 | 0,001 | 0,004 | 0,001 | 0,003 | 0,003 | 0,005 |
| Łódź | | 0,002 | 0,005 | 0,117 | 0,004 | 0,004 | 0,007 | 0,004 | 0,002 | 0,004 | 0,002 | 0,004 | 0,004 | 0,006 |
| Poznań | | 0,001 | 0,003 | 0,071 | 0,003 | 0,002 | 0,005 | 0,002 | 0,001 | 0,003 | 0,001 | 0,002 | 0,003 | 0,004 |
| Szczecin | | 0,001 | 0,002 | 0,043 | 0,002 | 0,001 | 0,003 | 0,001 | 0,001 | 0,002 | 0,001 | 0,001 | 0,002 | 0,002 |
| Berlin + Potsdam | | 0,006 | 0,014 | 0,365 | 0,014 | 0,013 | 0,025 | 0,013 | 0,005 | 0,016 | 0,006 | 0,013 | 0,014 | 0,019 |
| Hamburg | | 0,002 | 0,005 | 0,142 | 0,005 | 0,005 | 0,010 | 0,005 | 0,002 | 0,007 | 0,002 | 0,005 | 0,006 | 0,008 |
| Hannover | | 0,001 | 0,001 | 0,041 | 0,002 | 0,001 | 0,003 | 0,001 | 0,001 | 0,002 | 0,001 | 0,002 | 0,002 | 0,002 |
| Leipzig + Halle | | 0,000 | 0,001 | 0,025 | 0,001 | 0,001 | 0,002 | 0,001 | 0,000 | 0,001 | 0,000 | 0,001 | 0,001 | 0,001 |
| Wrocław | | 0,001 | 0,003 | 0,082 | 0,003 | 0,003 | 0,005 | 0,003 | 0,001 | 0,003 | 0,001 | 0,003 | 0,003 | 0,004 |
| Praha | | 0,002 | 0,005 | 0,130 | 0,005 | 0,005 | 0,009 | 0,005 | 0,002 | 0,006 | 0,002 | 0,005 | 0,005 | 0,007 |
| Katowice + ... | | 0,003 | 0,007 | 0,174 | 0,006 | 0,006 | 0,011 | 0,006 | 0,002 | 0,007 | 0,002 | 0,006 | 0,006 | 0,009 |
| Ostrava | | 0,001 | 0,002 | 0,037 | 0,001 | 0,001 | 0,002 | 0,001 | 0,001 | 0,002 | 0,001 | 0,001 | 0,001 | 0,002 |
| Brno | | 0,001 | 0,002 | 0,042 | 0,002 | 0,001 | 0,003 | 0,001 | 0,001 | 0,002 | 0,001 | 0,001 | 0,002 | 0,002 |
| Wien | | 0,003 | 0,007 | 0,184 | 0,007 | 0,006 | 0,013 | 0,006 | 0,003 | 0,008 | 0,003 | 0,007 | 0,007 | 0,010 |
| Bratislava | | 0,001 | 0,002 | 0,042 | 0,002 | 0,001 | 0,003 | 0,001 | 0,001 | 0,002 | 0,001 | 0,001 | 0,002 | 0,002 |
| Krakow | | 0,002 | 0,004 | 0,104 | 0,004 | 0,004 | 0,007 | 0,003 | 0,001 | 0,004 | 0,001 | 0,003 | 0,004 | 0,005 |

5,222

# Moskwa - Smolensk

| | | Smolensk | Orsha | Minsk | Vilnius | Riga | Kaunas | Kaliningrad | Hrodna | Brest | Warszawa | Gdansk + Gdynia | Łódź | Berlin + Potsdam | Hamburg | Praha | Katowice + ... | Wien | Bratislava | Krakow |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0,33 | 0,12 | 1,89 | 0,54 | 0,64 | 0,31 | 0,44 | 0,35 | 0,31 | 1,71 | 0,71 | 0,72 | 3,66 | 1,79 | 1,27 | 1,28 | 1,84 | 0,42 | 0,76 |
| Moskwa | 12,86 | 3,68 | 4,79 | 6,80 | 8,53 | 11,62 | 9,44 | 11,67 | 9,25 | 10,10 | 11,95 | 14,80 | 13,11 | 17,43 | 19,96 | 19,89 | 14,53 | 17,43 | 17,31 | 14,49 |
| Yaroslawl | 0,60 | 6,17 | 7,28 | 9,29 | 11,02 | 14,11 | 11,93 | 14,16 | 11,74 | 12,59 | 14,44 | 17,29 | 15,60 | 19,92 | 22,45 | 22,38 | 17,02 | 19,92 | 19,80 | 16,98 |
| Vologda | 0,31 | 8,01 | 9,12 | 11,13 | 12,86 | 15,95 | 13,77 | 16,00 | 13,58 | 14,43 | 16,28 | 19,13 | 17,44 | 21,76 | 24,29 | 24,22 | 18,86 | 21,76 | 21,64 | 18,82 |
| Vladimir | 0,35 | 5,45 | 6,56 | 8,57 | 10,30 | 13,39 | 11,21 | 13,44 | 11,02 | 11,87 | 13,72 | 16,57 | 14,88 | 19,20 | 21,73 | 21,66 | 16,30 | 19,20 | 19,08 | 16,26 |
| N. Nowgorod | 1,26 | 7,57 | 8,68 | 10,69 | 12,42 | 15,51 | 13,33 | 15,56 | 13,14 | 13,99 | 15,84 | 18,69 | 17,00 | 21,32 | 23,85 | 23,78 | 18,42 | 21,32 | 21,20 | 18,38 |
| Kirow | 0,47 | 11,89 | 13,00 | 15,01 | 16,74 | 19,83 | 17,65 | 19,88 | 17,46 | 18,31 | 20,16 | 23,01 | 21,32 | 25,64 | 28,17 | 28,10 | 22,74 | 25,64 | 25,52 | 22,70 |
| Perm | 1,00 | 15,79 | 16,90 | 18,91 | 20,64 | 23,73 | 21,55 | 23,78 | 21,36 | 22,21 | 24,06 | 26,91 | 25,22 | 29,54 | 32,07 | 32,00 | 26,64 | 29,54 | 29,42 | 26,60 |
| Kazan | 1,17 | 10,87 | 11,98 | 13,99 | 15,72 | 18,81 | 16,63 | 18,86 | 16,44 | 17,29 | 19,14 | 21,99 | 20,30 | 24,62 | 27,15 | 27,08 | 21,72 | 24,62 | 24,50 | 21,68 |
| Ryazan | 0,53 | 5,52 | 6,63 | 8,64 | 10,37 | 13,46 | 11,28 | 13,51 | 11,09 | 11,94 | 13,79 | 16,64 | 14,95 | 19,27 | 21,80 | 21,73 | 16,37 | 19,27 | 19,15 | 16,33 |
| Saransk | 0,30 | 9,07 | 10,18 | 12,19 | 13,92 | 17,01 | 14,83 | 17,06 | 14,64 | 15,49 | 17,34 | 20,19 | 18,50 | 22,82 | 25,35 | 25,28 | 19,92 | 22,82 | 22,70 | 19,88 |
| Ulyanow | 0,61 | 11,14 | 12,25 | 14,26 | 15,99 | 19,08 | 16,90 | 19,13 | 16,71 | 17,56 | 19,41 | 22,26 | 20,57 | 24,89 | 27,42 | 27,35 | 21,99 | 24,89 | 24,77 | 21,95 |
| Samara | 1,17 | 12,57 | 13,68 | 15,69 | 17,42 | 20,51 | 18,33 | 20,56 | 18,14 | 18,99 | 20,84 | 23,69 | 22,00 | 26,32 | 28,85 | 28,78 | 23,42 | 26,32 | 26,20 | 23,38 |
| Penza | 0,52 | 9,31 | 10,42 | 12,43 | 14,16 | 17,25 | 15,07 | 17,30 | 14,88 | 15,73 | 17,58 | 20,43 | 18,74 | 23,06 | 25,59 | 25,52 | 20,16 | 23,06 | 22,94 | 20,12 |
| Tambov | 0,28 | 7,76 | 8,87 | 10,88 | 12,61 | 15,70 | 13,52 | 15,75 | 13,33 | 14,18 | 16,03 | 18,88 | 17,19 | 21,51 | 24,04 | 23,97 | 18,61 | 21,51 | 21,39 | 18,57 |
| Saratov | 0,84 | 11,23 | 12,34 | 14,35 | 16,08 | 19,17 | 16,99 | 19,22 | 16,80 | 17,65 | 19,50 | 22,35 | 20,66 | 24,98 | 27,51 | 27,44 | 22,08 | 24,98 | 24,86 | 22,04 |
| Volgograd | 1,02 | 12,67 | 13,78 | 15,79 | 17,52 | 20,61 | 18,43 | 20,66 | 18,24 | 19,09 | 20,94 | 23,79 | 22,10 | 26,42 | 28,95 | 28,88 | 23,52 | 26,42 | 26,30 | 23,48 |
| Voronesh | 1,00 | 8,14 | 9,25 | 11,26 | 12,99 | 16,08 | 13,90 | 16,13 | 13,71 | 14,56 | 16,41 | 19,26 | 17,57 | 21,89 | 24,42 | 24,35 | 18,99 | 21,89 | 21,77 | 18,95 |
| Rostow n.D. | 1,09 | 13,05 | 14,16 | 16,17 | 17,90 | 20,99 | 18,81 | 21,04 | 18,62 | 19,47 | 21,32 | 24,17 | 22,48 | 26,80 | 29,33 | 29,26 | 23,90 | 26,80 | 26,68 | 23,86 |
| Krasnodar | 0,75 | 15,54 | 16,65 | 18,66 | 20,39 | 23,48 | 21,30 | 23,53 | 21,11 | 21,96 | 23,81 | 26,66 | 24,97 | 29,29 | 31,82 | 31,75 | 26,39 | 29,29 | 29,17 | 26,35 |

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Moskwa | | 0,463 | 0,108 | 0,934 | 0,182 | 0,127 | 0,088 | 0,087 | 0,103 | 0,078 | 0,324 | 0,094 | 0,117 | 0,365 | 0,142 | 0,101 | 0,174 | 0,184 | 0,042 | 0,104 |
| Yaroslawl | | 0,009 | 0,002 | 0,026 | 0,005 | 0,004 | 0,003 | 0,003 | 0,003 | 0,003 | 0,011 | 0,003 | 0,004 | 0,014 | 0,005 | 0,004 | 0,006 | 0,007 | 0,002 | 0,004 |
| Vologda | | 0,003 | 0,001 | 0,010 | 0,002 | 0,002 | 0,001 | 0,001 | 0,001 | 0,001 | 0,005 | 0,001 | 0,002 | 0,006 | 0,002 | 0,002 | 0,003 | 0,003 | 0,001 | 0,002 |
| Vladimir | | 0,006 | 0,002 | 0,017 | 0,004 | 0,003 | 0,002 | 0,002 | 0,002 | 0,002 | 0,007 | 0,002 | 0,003 | 0,008 | 0,003 | 0,002 | 0,004 | 0,004 | 0,001 | 0,002 |
| N. Nowgorod | | 0,013 | 0,004 | 0,042 | 0,009 | 0,008 | 0,005 | 0,005 | 0,006 | 0,004 | 0,020 | 0,006 | 0,007 | 0,025 | 0,010 | 0,007 | 0,011 | 0,013 | 0,003 | 0,007 |
| Kirow | | 0,002 | 0,001 | 0,009 | 0,002 | 0,002 | 0,001 | 0,001 | 0,001 | 0,001 | 0,005 | 0,002 | 0,002 | 0,007 | 0,003 | 0,002 | 0,003 | 0,003 | 0,001 | 0,002 |
| Perm | | 0,003 | 0,001 | 0,013 | 0,003 | 0,003 | 0,002 | 0,002 | 0,002 | 0,002 | 0,008 | 0,003 | 0,003 | 0,012 | 0,005 | 0,004 | 0,005 | 0,006 | 0,001 | 0,003 |
| Kazan | | 0,007 | 0,002 | 0,025 | 0,006 | 0,005 | 0,003 | 0,003 | 0,004 | 0,003 | 0,013 | 0,004 | 0,005 | 0,018 | 0,008 | 0,005 | 0,008 | 0,009 | 0,002 | 0,005 |
| Ryazan | | 0,010 | 0,003 | 0,026 | 0,005 | 0,004 | 0,003 | 0,003 | 0,003 | 0,002 | 0,010 | 0,003 | 0,004 | 0,013 | 0,005 | 0,004 | 0,006 | 0,006 | 0,001 | 0,003 |
| Saransk | | 0,002 | 0,001 | 0,008 | 0,002 | 0,002 | 0,001 | 0,001 | 0,001 | 0,001 | 0,004 | 0,001 | 0,002 | 0,005 | 0,002 | 0,002 | 0,002 | 0,003 | 0,001 | 0,001 |
| Ulyanow | | 0,003 | 0,001 | 0,013 | 0,003 | 0,003 | 0,002 | 0,002 | 0,002 | 0,001 | 0,007 | 0,002 | 0,003 | 0,009 | 0,004 | 0,003 | 0,004 | 0,005 | 0,001 | 0,002 |
| Samara | | 0,005 | 0,002 | 0,021 | 0,005 | 0,004 | 0,003 | 0,003 | 0,003 | 0,002 | 0,011 | 0,004 | 0,004 | 0,016 | 0,007 | 0,005 | 0,007 | 0,008 | 0,002 | 0,004 |
| Penza | | 0,004 | 0,001 | 0,014 | 0,003 | 0,003 | 0,002 | 0,002 | 0,002 | 0,001 | 0,007 | 0,002 | 0,003 | 0,009 | 0,004 | 0,003 | 0,004 | 0,005 | 0,001 | 0,002 |
| Tambov | | 0,003 | 0,001 | 0,009 | 0,002 | 0,002 | 0,001 | 0,001 | 0,001 | 0,001 | 0,004 | 0,001 | 0,002 | 0,006 | 0,002 | 0,002 | 0,002 | 0,003 | 0,001 | 0,001 |
| Saratov | | 0,005 | 0,001 | 0,017 | 0,004 | 0,004 | 0,002 | 0,002 | 0,002 | 0,002 | 0,009 | 0,003 | 0,004 | 0,013 | 0,005 | 0,004 | 0,006 | 0,007 | 0,001 | 0,003 |
| Volgograd | | 0,004 | 0,001 | 0,018 | 0,004 | 0,004 | 0,002 | 0,003 | 0,003 | 0,002 | 0,010 | 0,003 | 0,004 | 0,014 | 0,006 | 0,004 | 0,006 | 0,007 | 0,002 | 0,004 |
| Voronesh | | 0,009 | 0,003 | 0,031 | 0,007 | 0,006 | 0,004 | 0,004 | 0,004 | 0,003 | 0,015 | 0,005 | 0,006 | 0,019 | 0,008 | 0,006 | 0,009 | 0,010 | 0,002 | 0,005 |
| Rostow n.D. | | 0,005 | 0,001 | 0,018 | 0,004 | 0,004 | 0,002 | 0,003 | 0,003 | 0,002 | 0,010 | 0,003 | 0,004 | 0,015 | 0,006 | 0,004 | 0,006 | 0,007 | 0,002 | 0,004 |
| Krasnodar | | 0,002 | 0,001 | 0,010 | 0,002 | 0,002 | 0,001 | 0,002 | 0,001 | 0,001 | 0,006 | 0,002 | 0,002 | 0,009 | 0,004 | 0,003 | 0,004 | 0,004 | 0,001 | 0,002 |

5,499

# Moscow - St.Petersburg

| | | St.Petersburg | Pskow | Tallinn | Vyborg | Helsinki | Turku | Tampere |
|---|---|---|---|---|---|---|---|---|
| | | 4,99 | 0,21 | 0,41 | 0,08 | 0,90 | 0,18 | 0,23 |
| Moscow | 11,92 | 6,33 | 8,91 | 9,50 | 8,55 | 9,78 | 11,30 | 11,36 |
| Jaroslawl | 0,60 | 8,82 | 11,40 | 11,99 | 11,04 | 12,27 | 13,79 | 13,85 |
| Vladimir | 0,35 | 8,10 | 10,68 | 11,27 | 10,32 | 11,55 | 13,07 | 13,13 |
| Nishnij Nowgorod | 1,26 | 10,22 | 12,80 | 13,39 | 12,44 | 13,67 | 15,19 | 15,25 |
| Kirow | 0,47 | 14,54 | 17,12 | 17,71 | 16,76 | 17,99 | 19,51 | 19,57 |
| Perm | 1,00 | 18,44 | 21,02 | 21,61 | 20,66 | 21,89 | 23,41 | 23,47 |
| Kazan | 1,17 | 13,52 | 16,10 | 16,69 | 15,74 | 16,97 | 18,49 | 18,55 |
| Ryazan | 0,53 | 8,17 | 10,75 | 11,34 | 10,39 | 11,62 | 13,14 | 13,20 |
| Saransk | 0,30 | 11,72 | 14,30 | 14,89 | 13,94 | 15,17 | 16,69 | 16,75 |
| Samara | 1,17 | 15,22 | 17,80 | 18,39 | 17,44 | 18,67 | 20,19 | 20,25 |
| Tambow | 0,28 | 10,41 | 12,99 | 13,58 | 12,63 | 13,86 | 15,38 | 15,44 |
| Saratow | 0,84 | 13,88 | 16,46 | 17,05 | 16,10 | 17,33 | 18,85 | 18,91 |
| Volgograd | 1,02 | 15,32 | 17,90 | 18,49 | 17,54 | 18,77 | 20,29 | 20,35 |
| Voronesh | 1,00 | 10,79 | 13,37 | 13,96 | 13,01 | 14,24 | 15,76 | 15,82 |
| Rostow n. D. | 1,09 | 15,70 | 18,28 | 18,87 | 17,92 | 19,15 | 20,67 | 20,73 |
| Krasnodar | 0,75 | 18,19 | 20,77 | 21,36 | 20,41 | 21,64 | 23,16 | 23,22 |
| Tula | 0,50 | 8,06 | 10,64 | 11,23 | 10,28 | 11,51 | 13,03 | 13,09 |
| Orjol | 0,32 | 9,16 | 11,74 | 12,33 | 11,38 | 12,61 | 14,13 | 14,19 |
| Charkiw | 1,43 | 12,47 | 15,05 | 15,64 | 14,69 | 15,92 | 17,44 | 17,50 |
| Donezsk | 0,94 | 14,95 | 17,53 | 18,12 | 17,17 | 18,40 | 19,92 | 19,98 |
| Dnjepropetrowsk | 0,99 | 14,34 | 16,92 | 17,51 | 16,56 | 17,79 | 19,31 | 19,37 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Moscow | | 3,105 | 0,076 | 0,133 | 0,031 | 0,279 | 0,044 | 0,056 |
| Jaroslawl | | 0,092 | 0,003 | 0,005 | 0,001 | 0,010 | 0,002 | 0,002 |
| Vladimir | | 0,061 | 0,002 | 0,003 | 0,001 | 0,006 | 0,001 | 0,001 |
| N. Nowgorod | | 0,153 | 0,004 | 0,008 | 0,002 | 0,017 | 0,003 | 0,004 |
| Kirow | | 0,032 | 0,001 | 0,002 | 0,000 | 0,004 | 0,001 | 0,001 |
| Perm | | 0,047 | 0,002 | 0,003 | 0,001 | 0,006 | 0,001 | 0,001 |
| Kazan | | 0,091 | 0,003 | 0,005 | 0,001 | 0,011 | 0,002 | 0,003 |
| Ryazan | | 0,092 | 0,002 | 0,004 | 0,001 | 0,009 | 0,002 | 0,002 |
| Saransk | | 0,029 | 0,001 | 0,002 | 0,000 | 0,003 | 0,001 | 0,001 |
| Samara | | 0,075 | 0,002 | 0,005 | 0,001 | 0,010 | 0,002 | 0,002 |
| Tambow | | 0,033 | 0,001 | 0,002 | 0,000 | 0,004 | 0,001 | 0,001 |
| Saratow | | 0,062 | 0,002 | 0,004 | 0,001 | 0,008 | 0,001 | 0,002 |
| Volgograd | | 0,065 | 0,002 | 0,004 | 0,001 | 0,008 | 0,001 | 0,002 |
| Voronesh | | 0,111 | 0,003 | 0,006 | 0,001 | 0,013 | 0,002 | 0,003 |
| Rostow n. D. | | 0,066 | 0,002 | 0,004 | 0,001 | 0,009 | 0,002 | 0,002 |
| Krasnodar | | 0,036 | 0,001 | 0,002 | 0,000 | 0,005 | 0,001 | 0,001 |
| Tula | | 0,088 | 0,002 | 0,004 | 0,001 | 0,009 | 0,001 | 0,002 |
| Orjol | | 0,046 | 0,001 | 0,002 | 0,001 | 0,005 | 0,001 | 0,001 |
| Charkiw | | 0,126 | 0,004 | 0,007 | 0,002 | 0,015 | 0,003 | 0,003 |
| Donezsk | | 0,062 | 0,002 | 0,004 | 0,001 | 0,008 | 0,001 | 0,002 |
| Dnjepropetrowsk | | 0,070 | 0,002 | 0,004 | 0,001 | 0,009 | 0,002 | 0,002 |

| |
|---|
| 5,541 |

# Moscow - St.Petersburg

| | | St.Petersburg | Pskow | Tallinn | Vyborg | Helsinki | Turku | Tampere |
|---|---|---|---|---|---|---|---|---|
| | | 4,99 | 0,21 | 0,41 | 0,08 | 0,90 | 0,18 | 0,23 |
| Moscow | 12,86 | 6,33 | 8,91 | 9,50 | 8,55 | 9,78 | 11,30 | 11,36 |
| Jaroslawl | 0,60 | 8,82 | 11,40 | 11,99 | 11,04 | 12,27 | 13,79 | 13,85 |
| Vladimir | 0,35 | 8,10 | 10,68 | 11,27 | 10,32 | 11,55 | 13,07 | 13,13 |
| Nishnij Nowgorod | 1,26 | 10,22 | 12,80 | 13,39 | 12,44 | 13,67 | 15,19 | 15,25 |
| Kirow | 0,47 | 14,54 | 17,12 | 17,71 | 16,76 | 17,99 | 19,51 | 19,57 |
| Perm | 1,00 | 18,44 | 21,02 | 21,61 | 20,66 | 21,89 | 23,41 | 23,47 |
| Kazan | 1,17 | 13,52 | 16,10 | 16,69 | 15,74 | 16,97 | 18,49 | 18,55 |
| Ryazan | 0,53 | 8,17 | 10,75 | 11,34 | 10,39 | 11,62 | 13,14 | 13,20 |
| Saransk | 0,30 | 11,72 | 14,30 | 14,89 | 13,94 | 15,17 | 16,69 | 16,75 |
| Samara | 1,17 | 15,22 | 17,80 | 18,39 | 17,44 | 18,67 | 20,19 | 20,25 |
| Tambow | 0,28 | 10,41 | 12,99 | 13,58 | 12,63 | 13,86 | 15,38 | 15,44 |
| Saratow | 0,84 | 13,88 | 16,46 | 17,05 | 16,10 | 17,33 | 18,85 | 18,91 |
| Volgograd | 1,02 | 15,32 | 17,90 | 18,49 | 17,54 | 18,77 | 20,29 | 20,35 |
| Voronesh | 1,00 | 10,79 | 13,37 | 13,96 | 13,01 | 14,24 | 15,76 | 15,82 |
| Rostow n. D. | 1,09 | 15,70 | 18,28 | 18,87 | 17,92 | 19,15 | 20,67 | 20,73 |
| Krasnodar | 0,75 | 18,19 | 20,77 | 21,36 | 20,41 | 21,64 | 23,16 | 23,22 |
| Tula | 0,50 | 8,06 | 10,64 | 11,23 | 10,28 | 11,51 | 13,03 | 13,09 |
| Orjol | 0,32 | 9,16 | 11,74 | 12,33 | 11,38 | 12,61 | 14,13 | 14,19 |
| Charkiw | 1,43 | 12,47 | 15,05 | 15,64 | 14,69 | 15,92 | 17,44 | 17,50 |
| Donetsk | 2,19 | 14,95 | 17,53 | 18,12 | 17,17 | 18,40 | 19,92 | 19,98 |
| Dnjepropetrowsk | 0,99 | 14,34 | 16,92 | 17,51 | 16,56 | 17,79 | 19,31 | 19,37 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Moscow | | 2,786 | 0,066 | 0,115 | 0,027 | 0,240 | 0,038 | 0,048 |
| Jaroslawl | | 0,074 | 0,002 | 0,004 | 0,001 | 0,008 | 0,001 | 0,002 |
| Vladimir | | 0,050 | 0,001 | 0,002 | 0,001 | 0,005 | 0,001 | 0,001 |
| N. Nowgorod | | 0,121 | 0,003 | 0,006 | 0,001 | 0,013 | 0,002 | 0,003 |
| Kirow | | 0,025 | 0,001 | 0,001 | 0,000 | 0,003 | 0,001 | 0,001 |
| Perm | | 0,035 | 0,001 | 0,002 | 0,000 | 0,005 | 0,001 | 0,001 |
| Kazan | | 0,070 | 0,002 | 0,004 | 0,001 | 0,009 | 0,001 | 0,002 |
| Ryazan | | 0,074 | 0,002 | 0,004 | 0,001 | 0,007 | 0,001 | 0,002 |
| Saransk | | 0,023 | 0,001 | 0,001 | 0,000 | 0,003 | 0,000 | 0,001 |
| Samara | | 0,057 | 0,002 | 0,003 | 0,001 | 0,007 | 0,001 | 0,002 |
| Tambow | | 0,026 | 0,001 | 0,001 | 0,000 | 0,003 | 0,000 | 0,001 |
| Saratow | | 0,048 | 0,002 | 0,003 | 0,001 | 0,006 | 0,001 | 0,001 |
| Volgograd | | 0,049 | 0,002 | 0,003 | 0,001 | 0,006 | 0,001 | 0,001 |
| Voronesh | | 0,087 | 0,003 | 0,005 | 0,001 | 0,010 | 0,002 | 0,002 |
| Rostow n. D. | | 0,050 | 0,002 | 0,003 | 0,001 | 0,006 | 0,001 | 0,001 |
| Krasnodar | | 0,027 | 0,001 | 0,002 | 0,000 | 0,004 | 0,001 | 0,001 |
| Tula | | 0,072 | 0,002 | 0,003 | 0,001 | 0,007 | 0,001 | 0,001 |
| Orjol | | 0,037 | 0,001 | 0,002 | 0,000 | 0,004 | 0,001 | 0,001 |
| Charkiw | | 0,098 | 0,003 | 0,005 | 0,001 | 0,012 | 0,002 | 0,003 |
| Donetsk | | 0,110 | 0,004 | 0,007 | 0,001 | 0,014 | 0,002 | 0,003 |
| Dnjepropetrowsk | | 0,053 | 0,002 | 0,003 | 0,001 | 0,007 | 0,001 | 0,001 |

| |
|---|
| 4,810 |

## Moskwa - Vladimir

| | | Vladimir | Nishnij Nowgorod | Kirow | Perm | Kazan | Ishevsk | Yekaterinburg | Omsk | Novosibirsk | Chelyabinsk |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0,35 | 1,26 | 0,47 | 1,00 | 1,17 | 0,63 | 1,39 | 1,16 | 1,51 | 1,15 |
| Moskwa | 12,86 | 1,77 | 3,89 | 8,21 | 12,11 | 7,19 | 9,95 | 12,96 | 21,06 | 27,11 | 14,91 |
| St. Petersburg | 4,99 | 8,10 | 10,22 | 14,54 | 18,44 | 13,52 | 16,28 | 19,29 | 27,39 | 33,44 | 21,24 |
| Helsinki | 0,90 | 11,55 | 13,67 | 17,99 | 21,89 | 16,97 | 19,73 | 22,74 | 30,84 | 36,89 | 24,69 |
| Tallinn | 0,41 | 11,30 | 13,42 | 17,74 | 21,64 | 16,72 | 19,48 | 22,49 | 30,59 | 36,64 | 24,44 |
| Smolensk | 0,33 | 5,45 | 7,57 | 11,89 | 15,79 | 10,87 | 13,63 | 16,64 | 24,74 | 30,79 | 18,59 |
| Minsk | 1,89 | 8,57 | 10,69 | 15,01 | 18,91 | 13,99 | 16,75 | 19,76 | 27,86 | 33,91 | 21,71 |
| Vilnius | 0,54 | 10,29 | 12,41 | 16,73 | 20,63 | 15,71 | 18,47 | 21,48 | 29,58 | 35,63 | 23,43 |
| Kaunas | 0,31 | 11,19 | 13,31 | 17,63 | 21,53 | 16,61 | 19,37 | 22,38 | 30,48 | 36,53 | 24,33 |
| Kaliningrad | 0,44 | 13,40 | 15,52 | 19,84 | 23,74 | 18,82 | 21,58 | 24,59 | 32,69 | 38,74 | 26,54 |
| Brest | 0,31 | 11,87 | 13,99 | 18,31 | 22,21 | 17,29 | 20,05 | 23,06 | 31,16 | 37,21 | 25,01 |
| Warszawa | 1,71 | 13,72 | 15,84 | 20,16 | 24,06 | 19,14 | 21,90 | 24,91 | 33,01 | 39,06 | 26,86 |
| Bryansk | 0,41 | 5,24 | 7,36 | 11,68 | 15,58 | 10,66 | 13,42 | 16,43 | 24,53 | 30,58 | 18,38 |
| Homyel | 0,48 | 7,70 | 9,82 | 14,14 | 18,04 | 13,12 | 15,88 | 18,89 | 26,99 | 33,04 | 20,84 |
| Kijiv | 2,80 | 9,65 | 11,77 | 16,09 | 19,99 | 15,07 | 17,83 | 20,84 | 28,94 | 34,99 | 22,79 |
| Lviv | 0,72 | 14,35 | 16,47 | 20,79 | 24,69 | 19,77 | 22,53 | 25,54 | 33,64 | 39,69 | 27,49 |
| Tula | 0,50 | 3,50 | 5,62 | 9,94 | 13,84 | 8,92 | 11,68 | 14,69 | 22,79 | 28,84 | 16,64 |
| Orël | 0,32 | 5,20 | 7,32 | 11,64 | 15,54 | 10,62 | 13,38 | 16,39 | 24,49 | 30,54 | 18,34 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Moskwa | | 1,705 | 1,610 | 0,169 | 0,185 | 0,526 | 0,163 | 0,230 | 0,084 | 0,071 | 0,150 |
| St. Petersburg | | 0,050 | 0,121 | 0,025 | 0,035 | 0,070 | 0,027 | 0,045 | 0,021 | 0,019 | 0,032 |
| Helsinki | | 0,005 | 0,013 | 0,003 | 0,005 | 0,009 | 0,004 | 0,006 | 0,003 | 0,003 | 0,004 |
| Tallinn | | 0,002 | 0,006 | 0,001 | 0,002 | 0,004 | 0,002 | 0,003 | 0,001 | 0,001 | 0,002 |
| Smolensk | | 0,006 | 0,013 | 0,002 | 0,003 | 0,007 | 0,002 | 0,004 | 0,002 | 0,001 | 0,003 |
| Minsk | | 0,017 | 0,042 | 0,009 | 0,013 | 0,025 | 0,010 | 0,016 | 0,008 | 0,007 | 0,012 |
| Vilnius | | 0,004 | 0,009 | 0,002 | 0,003 | 0,006 | 0,002 | 0,004 | 0,002 | 0,002 | 0,003 |
| Kaunas | | 0,002 | 0,005 | 0,001 | 0,002 | 0,003 | 0,001 | 0,002 | 0,001 | 0,001 | 0,002 |
| Kaliningrad | | 0,002 | 0,005 | 0,001 | 0,002 | 0,004 | 0,001 | 0,003 | 0,001 | 0,001 | 0,002 |
| Brest | | 0,002 | 0,004 | 0,001 | 0,002 | 0,003 | 0,001 | 0,002 | 0,001 | 0,001 | 0,001 |
| Warszawa | | 0,007 | 0,020 | 0,005 | 0,008 | 0,013 | 0,006 | 0,010 | 0,005 | 0,005 | 0,007 |
| Bryansk | | 0,009 | 0,017 | 0,003 | 0,004 | 0,009 | 0,003 | 0,005 | 0,002 | 0,002 | 0,003 |
| Homyel | | 0,005 | 0,012 | 0,002 | 0,004 | 0,007 | 0,003 | 0,005 | 0,002 | 0,002 | 0,003 |
| Kijiv | | 0,021 | 0,053 | 0,012 | 0,017 | 0,033 | 0,013 | 0,022 | 0,011 | 0,010 | 0,016 |
| Lviv | | 0,003 | 0,008 | 0,002 | 0,003 | 0,005 | 0,002 | 0,004 | 0,002 | 0,002 | 0,003 |
| Tula | | 0,021 | 0,033 | 0,005 | 0,006 | 0,014 | 0,005 | 0,007 | 0,003 | 0,002 | 0,005 |
| Orël | | 0,007 | 0,014 | 0,002 | 0,003 | 0,007 | 0,002 | 0,004 | 0,002 | 0,001 | 0,003 |

| |
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| 6,293 |

# Niš - Skopje

| | | Skopje | Tetovo + Gostivar | Tiranë + Durrës | Thesaloniki | Athenai | Patras | Alexandroupoli |
|---|---|---|---|---|---|---|---|---|
| | | 0,54 | 0,09 | 0,60 | 0,33 | 3,75 | 0,17 | 0,07 |
| Niš | 0,26 | 1,50 | 2,01 | 3,05 | 3,46 | 6,48 | 8,22 | 5,84 |
| Beograd | 1,23 | 3,49 | 4,00 | 5,04 | 5,45 | 8,47 | 10,21 | 7,83 |
| Timişoara | 0,32 | 4,68 | 5,19 | 6,23 | 6,64 | 9,66 | 11,40 | 9,02 |
| Arad | 0,16 | 5,03 | 5,54 | 6,58 | 6,99 | 10,01 | 11,75 | 9,37 |
| Oradea | 0,20 | 6,13 | 6,64 | 7,68 | 8,09 | 11,11 | 12,85 | 10,47 |
| Novi Sad | 0,25 | 4,21 | 4,72 | 5,76 | 6,17 | 9,19 | 10,93 | 8,55 |
| Budapest | 1,74 | 6,77 | 7,28 | 8,32 | 8,73 | 11,75 | 13,49 | 11,11 |
| Trnava | 0,07 | 8,23 | 8,74 | 9,78 | 10,19 | 13,21 | 14,95 | 12,57 |
| Zilina + Trenčin | 0,14 | 9,52 | 10,03 | 11,07 | 11,48 | 14,50 | 16,24 | 13,86 |
| Györ | 0,13 | 7,81 | 8,32 | 9,36 | 9,77 | 12,79 | 14,53 | 12,15 |
| Bratislava | 0,42 | 8,51 | 9,02 | 10,06 | 10,47 | 13,49 | 15,23 | 12,85 |
| Ostrava | 0,30 | 10,54 | 11,05 | 12,09 | 12,50 | 15,52 | 17,26 | 14,88 |
| Katowice + ... | 1,28 | 11,29 | 11,80 | 12,84 | 13,25 | 16,27 | 18,01 | 15,63 |
| Krakow | 0,76 | 11,75 | 12,26 | 13,30 | 13,71 | 16,73 | 18,47 | 16,09 |
| Warszawa | 1,71 | 13,87 | 14,38 | 15,42 | 15,83 | 18,85 | 20,59 | 18,21 |
| Brno | 0,39 | 9,68 | 10,19 | 11,23 | 11,64 | 14,66 | 16,40 | 14,02 |
| Praha | 1,27 | 11,55 | 12,06 | 13,10 | 13,51 | 16,53 | 18,27 | 15,89 |
| Wien | 1,84 | 8,96 | 9,47 | 10,51 | 10,92 | 13,94 | 15,68 | 13,30 |
| Linz + Wels | 0,26 | 10,49 | 11,00 | 12,04 | 12,45 | 15,47 | 17,21 | 14,83 |
| Regensburg | 0,15 | 12,31 | 12,82 | 13,86 | 14,27 | 17,29 | 19,03 | 16,65 |
| Nürnberg | 0,74 | 13,18 | 13,69 | 14,73 | 15,14 | 18,16 | 19,90 | 17,52 |
| Frankfurt | 1,60 | 15,12 | 15,63 | 16,67 | 17,08 | 20,10 | 21,84 | 19,46 |
| Vinkovci + ... | 0,17 | 4,89 | 5,40 | 6,44 | 6,85 | 9,87 | 11,61 | 9,23 |
| Zagreb | 0,79 | 7,21 | 7,72 | 8,76 | 9,17 | 12,19 | 13,93 | 11,55 |
| Graz | 0,28 | 8,07 | 8,58 | 9,62 | 10,03 | 13,05 | 14,79 | 12,41 |
| Ljubljana | 0,29 | 8,35 | 8,86 | 9,90 | 10,31 | 13,33 | 15,07 | 12,69 |
| Salzburg | 0,15 | 10,59 | 11,10 | 12,14 | 12,55 | 15,57 | 17,31 | 14,93 |
| München | 1,45 | 11,77 | 12,28 | 13,32 | 13,73 | 16,75 | 18,49 | 16,11 |
| Ausburg | 0,29 | 12,33 | 12,84 | 13,88 | 14,29 | 17,31 | 19,05 | 16,67 |
| Stuttgart | 0,62 | 13,67 | 14,18 | 15,22 | 15,63 | 18,65 | 20,39 | 18,01 |
| Trieste | 0,20 | 9,09 | 9,60 | 10,64 | 11,05 | 14,07 | 15,81 | 13,43 |
| Venezia + ... | 0,55 | 10,24 | 10,75 | 11,79 | 12,20 | 15,22 | 16,96 | 14,58 |
| Verona | 0,26 | 11,23 | 11,74 | 12,78 | 13,19 | 16,21 | 17,95 | 15,57 |
| Milano | 1,35 | 12,65 | 13,16 | 14,20 | 14,61 | 17,63 | 19,37 | 16,99 |
| Torino | 0,89 | 13,90 | 14,41 | 15,45 | 15,86 | 18,88 | 20,62 | 18,24 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Niš | | 0,070 | 0,007 | 0,023 | 0,010 | 0,041 | 0,001 | 0,001 |
| Beograd | | 0,079 | 0,010 | 0,047 | 0,023 | 0,122 | 0,004 | 0,003 |
| Timişoara | | 0,013 | 0,002 | 0,009 | 0,004 | 0,025 | 0,001 | 0,001 |
| Arad | | 0,006 | 0,001 | 0,004 | 0,002 | 0,012 | 0,000 | 0,000 |
| Oradea | | 0,005 | 0,001 | 0,004 | 0,002 | 0,013 | 0,000 | 0,000 |
| Novi Sad | | 0,012 | 0,002 | 0,008 | 0,004 | 0,022 | 0,001 | 0,000 |
| Budapest | | 0,036 | 0,005 | 0,028 | 0,014 | 0,099 | 0,004 | 0,002 |
| Trnava | | 0,001 | 0,000 | 0,001 | 0,000 | 0,003 | 0,000 | 0,000 |
| Zilina + Trenčin | | 0,002 | 0,000 | 0,001 | 0,001 | 0,006 | 0,000 | 0,000 |
| Györ | | 0,002 | 0,000 | 0,002 | 0,001 | 0,006 | 0,000 | 0,000 |
| Bratislava | | 0,006 | 0,001 | 0,005 | 0,003 | 0,019 | 0,001 | 0,000 |
| Ostrava | | 0,003 | 0,000 | 0,003 | 0,001 | 0,011 | 0,000 | 0,000 |
| Katowice + ... | | 0,011 | 0,002 | 0,010 | 0,005 | 0,042 | 0,002 | 0,001 |
| Krakow | | 0,006 | 0,001 | 0,006 | 0,003 | 0,024 | 0,001 | 0,000 |
| Warszawa | | 0,011 | 0,002 | 0,010 | 0,005 | 0,044 | 0,002 | 0,001 |
| Brno | | 0,004 | 0,001 | 0,004 | 0,002 | 0,015 | 0,001 | 0,000 |
| Praha | | 0,011 | 0,002 | 0,010 | 0,005 | 0,040 | 0,002 | 0,001 |
| Wien | | 0,024 | 0,004 | 0,020 | 0,010 | 0,078 | 0,003 | 0,002 |
| Linz + Wels | | 0,003 | 0,000 | 0,002 | 0,001 | 0,009 | 0,000 | 0,000 |
| Regensburg | | 0,001 | 0,000 | 0,001 | 0,001 | 0,004 | 0,000 | 0,000 |
| Nürnberg | | 0,005 | 0,001 | 0,005 | 0,002 | 0,020 | 0,001 | 0,000 |
| Frankfurt | | 0,009 | 0,001 | 0,008 | 0,004 | 0,037 | 0,001 | 0,001 |
| Vinkovci + ... | | 0,006 | 0,001 | 0,004 | 0,002 | 0,013 | 0,000 | 0,000 |
| Zagreb | | 0,015 | 0,002 | 0,012 | 0,006 | 0,042 | 0,002 | 0,001 |
| Graz | | 0,004 | 0,001 | 0,004 | 0,002 | 0,013 | 0,000 | 0,000 |
| Ljubljana | | 0,004 | 0,001 | 0,004 | 0,002 | 0,013 | 0,000 | 0,000 |
| Salzburg | | 0,001 | 0,000 | 0,001 | 0,001 | 0,005 | 0,000 | 0,000 |
| München | | 0,012 | 0,002 | 0,011 | 0,006 | 0,045 | 0,002 | 0,001 |
| Ausburg | | 0,002 | 0,000 | 0,002 | 0,001 | 0,009 | 0,000 | 0,000 |
| Stuttgart | | 0,004 | 0,001 | 0,004 | 0,002 | 0,016 | 0,001 | 0,000 |
| Trieste | | 0,003 | 0,000 | 0,002 | 0,001 | 0,008 | 0,000 | 0,000 |
| Venezia + ... | | 0,006 | 0,001 | 0,005 | 0,003 | 0,020 | 0,001 | 0,000 |
| Verona | | 0,002 | 0,000 | 0,002 | 0,001 | 0,009 | 0,000 | 0,000 |
| Milano | | 0,010 | 0,002 | 0,009 | 0,005 | 0,039 | 0,001 | 0,001 |
| Torino | | 0,005 | 0,001 | 0,005 | 0,003 | 0,023 | 0,001 | 0,000 |

| |
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| 1,859 |

# Niš - Sofia

| | | Sofia | Plovdiv + ... | Varna | Burgas | Edirne | Istanbul |
|---|---|---|---|---|---|---|---|
| | | 1,21 | 0,57 | 0,33 | 0,20 | 0,15 | 14,66 |
| Niš | 0,26 | 1,36 | 2,68 | 5,51 | 4,95 | 4,29 | 6,42 |
| Beograd | 1,23 | 3,35 | 4,67 | 7,50 | 6,94 | 6,20 | 8,41 |
| Timişoara | 0,32 | 4,54 | 5,86 | 8,69 | 8,13 | 7,39 | 9,60 |
| Arad | 0,16 | 4,89 | 6,21 | 9,04 | 8,48 | 7,74 | 9,95 |
| Oradea | 0,20 | 5,99 | 7,31 | 10,14 | 9,58 | 8,84 | 11,05 |
| Novi Sad | 0,25 | 4,07 | 5,39 | 8,22 | 7,66 | 6,92 | 9,13 |
| Subotica | 0,10 | 4,96 | 6,28 | 9,11 | 8,55 | 7,81 | 10,02 |
| Budapest | 1,74 | 6,63 | 7,95 | 10,78 | 10,22 | 9,48 | 11,69 |
| Miskolc | 0,17 | 8,10 | 9,42 | 12,25 | 11,69 | 10,95 | 13,16 |
| Trnava | 0,07 | 8,09 | 9,41 | 12,24 | 11,68 | 10,94 | 13,15 |
| Žilina + Trenčin | 0,14 | 9,38 | 10,70 | 13,53 | 12,97 | 12,23 | 14,44 |
| Györ | 0,13 | 7,67 | 8,99 | 11,82 | 11,26 | 10,52 | 12,73 |
| Bratislava | 0,42 | 8,37 | 9,69 | 12,52 | 11,96 | 11,22 | 13,43 |
| Ostrava | 0,30 | 10,40 | 11,72 | 14,55 | 13,99 | 13,25 | 15,46 |
| Katowice + Krakow | 2,04 | 11,15 | 12,47 | 15,30 | 14,74 | 14,00 | 16,21 |
| Brno | 0,39 | 9,54 | 10,86 | 13,69 | 13,13 | 12,39 | 14,60 |
| Praha | 1,27 | 11,41 | 12,73 | 15,56 | 15,00 | 14,26 | 16,47 |
| Wien | 1,84 | 8,82 | 10,14 | 12,97 | 12,41 | 11,67 | 13,88 |
| Linz + Wels | 0,20 | 10,35 | 11,67 | 14,50 | 13,94 | 13,20 | 15,41 |
| Regensburg | 0,15 | 12,17 | 13,49 | 16,32 | 15,76 | 15,02 | 17,23 |
| Nürnberg, Fürth, ... | 0,74 | 13,04 | 14,36 | 17,19 | 16,63 | 15,89 | 18,10 |
| Frankfurt, ... | 1,60 | 14,98 | 16,30 | 19,13 | 18,57 | 17,83 | 20,04 |
| Vinkovci, Osijek, ... | 0,17 | 4,75 | 6,07 | 8,90 | 8,34 | 7,60 | 9,81 |
| Pecs | 0,15 | 5,69 | 7,01 | 9,84 | 9,28 | 8,54 | 10,75 |
| Sarajewo | 0,53 | 6,29 | 7,61 | 10,44 | 9,88 | 9,14 | 11,35 |
| Mostar | 0,13 | 7,00 | 8,32 | 11,15 | 10,59 | 9,85 | 12,06 |
| Zagreb | 0,79 | 7,07 | 8,39 | 11,22 | 10,66 | 9,92 | 12,13 |
| Maribor | 0,09 | 7,93 | 9,25 | 12,08 | 11,52 | 10,78 | 12,99 |
| Graz | 0,28 | 8,49 | 9,81 | 12,64 | 12,08 | 11,34 | 13,55 |
| Rijeka | 0,13 | 8,37 | 9,69 | 12,52 | 11,96 | 11,22 | 13,43 |
| Zadar | 0,08 | 9,03 | 10,35 | 13,18 | 12,62 | 11,88 | 14,09 |
| Split | 0,18 | 9,65 | 10,97 | 13,80 | 13,24 | 12,50 | 14,71 |
| Ljubljana | 0,29 | 8,21 | 9,53 | 12,36 | 11,80 | 11,06 | 13,27 |
| Trieste | 0,20 | 8,95 | 10,27 | 13,10 | 12,54 | 11,80 | 14,01 |
| Venezia + Treviso | 0,34 | 10,10 | 11,42 | 14,25 | 13,69 | 12,95 | 15,16 |
| Padova | 0,21 | 10,44 | 11,76 | 14,59 | 14,03 | 13,29 | 15,50 |
| Bologna | 0,39 | 11,55 | 12,87 | 15,70 | 15,14 | 14,40 | 16,61 |
| Verona | 0,26 | 11,09 | 12,41 | 15,24 | 14,68 | 13,94 | 16,15 |
| Milano | 1,35 | 12,51 | 13,83 | 16,66 | 16,10 | 15,36 | 17,57 |
| Klagenfurt + Villach | 0,16 | 9,05 | 10,37 | 13,20 | 12,64 | 11,90 | 14,11 |
| Salzburg | 0,15 | 10,45 | 11,77 | 14,60 | 14,04 | 13,30 | 15,51 |
| München | 1,45 | 11,63 | 12,95 | 15,78 | 15,22 | 14,48 | 16,69 |
| Augsburg | 0,29 | 12,19 | 13,51 | 16,34 | 15,78 | 15,04 | 17,25 |
| Stuttgart | 0,62 | 13,53 | 14,85 | 17,68 | 17,12 | 16,38 | 18,59 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Niš | 0,187 | 0,028 | 0,005 | 0,003 | 0,003 | 0,162 |
| Beograd | 0,191 | 0,051 | 0,013 | 0,009 | 0,008 | 0,483 |
| Timişoara | 0,030 | 0,009 | 0,003 | 0,002 | 0,002 | 0,100 |
| Arad | 0,013 | 0,004 | 0,001 | 0,001 | 0,001 | 0,047 |
| Oradea | 0,012 | 0,004 | 0,001 | 0,001 | 0,001 | 0,049 |
| Novi Sad | 0,028 | 0,008 | 0,002 | 0,002 | 0,001 | 0,085 |
| Subotica | 0,008 | 0,003 | 0,001 | 0,001 | 0,000 | 0,029 |
| Budapest | 0,084 | 0,029 | 0,010 | 0,007 | 0,006 | 0,390 |
| Miskolc | 0,006 | 0,002 | 0,001 | 0,001 | 0,000 | 0,031 |
| Trnava | 0,002 | 0,001 | 0,000 | 0,000 | 0,000 | 0,013 |
| Žilina + Trenčin | 0,004 | 0,001 | 0,001 | 0,000 | 0,000 | 0,022 |
| Györ | 0,005 | 0,002 | 0,001 | 0,000 | 0,000 | 0,025 |
| Bratislava | 0,014 | 0,005 | 0,002 | 0,001 | 0,001 | 0,074 |
| Ostrava | 0,007 | 0,003 | 0,001 | 0,001 | 0,001 | 0,042 |
| Katowice + Krakow | 0,041 | 0,016 | 0,007 | 0,004 | 0,003 | 0,263 |
| Brno | 0,010 | 0,004 | 0,002 | 0,001 | 0,001 | 0,060 |
| Praha | 0,025 | 0,010 | 0,004 | 0,003 | 0,002 | 0,159 |
| Wien | 0,055 | 0,020 | 0,008 | 0,005 | 0,004 | 0,308 |
| Linz + Wels | 0,005 | 0,002 | 0,001 | 0,000 | 0,000 | 0,028 |
| Regensburg | 0,003 | 0,001 | 0,000 | 0,000 | 0,000 | 0,017 |
| Nürnberg, Fürth, ... | 0,011 | 0,005 | 0,002 | 0,001 | 0,001 | 0,079 |
| Frankfurt, ... | 0,019 | 0,008 | 0,003 | 0,002 | 0,002 | 0,144 |
| Vinkovci, Osijek, ... | 0,015 | 0,005 | 0,001 | 0,001 | 0,001 | 0,051 |
| Pecs | 0,009 | 0,003 | 0,001 | 0,001 | 0,001 | 0,039 |
| Sarajewo | 0,028 | 0,010 | 0,003 | 0,002 | 0,002 | 0,125 |
| Mostar | 0,006 | 0,002 | 0,001 | 0,000 | 0,000 | 0,028 |
| Zagreb | 0,034 | 0,012 | 0,004 | 0,003 | 0,002 | 0,166 |
| Maribor | 0,003 | 0,001 | 0,000 | 0,000 | 0,000 | 0,017 |
| Graz | 0,009 | 0,003 | 0,001 | 0,001 | 0,001 | 0,049 |
| Rijeka | 0,004 | 0,002 | 0,001 | 0,000 | 0,000 | 0,023 |
| Zadar | 0,002 | 0,001 | 0,000 | 0,000 | 0,000 | 0,013 |
| Split | 0,005 | 0,002 | 0,001 | 0,000 | 0,000 | 0,027 |
| Ljubljana | 0,010 | 0,004 | 0,001 | 0,001 | 0,001 | 0,052 |
| Trieste | 0,006 | 0,002 | 0,001 | 0,001 | 0,000 | 0,033 |
| Venezia + Treviso | 0,008 | 0,003 | 0,001 | 0,001 | 0,001 | 0,049 |
| Padova | 0,005 | 0,002 | 0,001 | 0,000 | 0,000 | 0,029 |
| Bologna | 0,007 | 0,003 | 0,001 | 0,001 | 0,001 | 0,048 |
| Verona | 0,005 | 0,002 | 0,001 | 0,001 | 0,000 | 0,034 |
| Milano | 0,022 | 0,009 | 0,004 | 0,002 | 0,002 | 0,151 |
| Klagenfurt + Villach | 0,005 | 0,002 | 0,001 | 0,000 | 0,000 | 0,026 |
| Salzburg | 0,003 | 0,001 | 0,001 | 0,000 | 0,000 | 0,021 |
| München | 0,027 | 0,011 | 0,004 | 0,003 | 0,002 | 0,178 |
| Augsburg | 0,005 | 0,002 | 0,001 | 0,001 | 0,000 | 0,034 |
| Stuttgart | 0,009 | 0,004 | 0,002 | 0,001 | 0,001 | 0,063 |

5,373

## Nishnij Nowgorod - Kazan

| | | Kazan | Ishevsk | Yekaterinburg | Omsk | Novosibirsk | Chelyabinsk |
|---|---|---|---|---|---|---|---|
| | | 1,17 | 0,63 | 1,39 | 1,16 | 1,51 | 1,15 |
| Nishnij Nowgorod | 1,26 | 3,30 | 6,06 | 9,07 | 17,17 | 23,22 | 11,02 |
| Vladimir | 0,35 | 5,42 | 8,18 | 11,19 | 19,29 | 25,34 | 13,14 |
| Moskwa | 12,86 | 7,19 | 9,95 | 12,96 | 21,06 | 27,11 | 14,91 |
| St. Petersburg | 4,99 | 13,52 | 16,28 | 19,29 | 27,39 | 33,44 | 21,24 |
| Helsinki | 0,90 | 16,97 | 19,73 | 22,74 | 30,84 | 36,89 | 24,69 |
| Tallinn | 0,41 | 16,72 | 19,48 | 22,49 | 30,59 | 36,64 | 24,44 |
| Smolensk | 0,33 | 10,87 | 13,63 | 16,64 | 24,74 | 30,79 | 18,59 |
| Minsk | 1,89 | 13,99 | 16,75 | 19,76 | 27,86 | 33,91 | 21,71 |
| Vilnius | 0,54 | 15,71 | 18,47 | 21,48 | 29,58 | 35,63 | 23,43 |
| Kaunas | 0,31 | 16,61 | 19,37 | 22,38 | 30,48 | 36,53 | 24,33 |
| Kaliningrad | 0,44 | 18,82 | 21,58 | 24,59 | 32,69 | 38,74 | 26,54 |
| Brest | 0,31 | 17,29 | 20,05 | 23,06 | 31,16 | 37,21 | 25,01 |
| Warszawa | 1,71 | 19,14 | 21,90 | 24,91 | 33,01 | 39,06 | 26,86 |
| Bryansk | 0,41 | 10,66 | 13,42 | 16,43 | 24,53 | 30,58 | 18,38 |
| Homyel | 0,48 | 13,12 | 15,88 | 18,89 | 26,99 | 33,04 | 20,84 |
| Kijiv | 2,80 | 15,07 | 17,83 | 20,84 | 28,94 | 34,99 | 22,79 |
| Lviv | 0,72 | 19,77 | 22,53 | 25,54 | 33,64 | 39,69 | 27,49 |
| Tula | 0,50 | 8,92 | 11,68 | 14,69 | 22,79 | 28,84 | 16,64 |
| Orël | 0,32 | 10,62 | 13,38 | 16,39 | 24,49 | 30,54 | 18,34 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Moskwa | | 0,194 | 0,037 | 0,041 | 0,012 | 0,009 | 0,025 |
| St. Petersburg | | 0,023 | 0,006 | 0,008 | 0,003 | 0,002 | 0,005 |
| Helsinki | | 0,526 | 0,163 | 0,230 | 0,084 | 0,071 | 0,150 |
| Tallinn | | 0,070 | 0,027 | 0,045 | 0,021 | 0,019 | 0,032 |
| Smolensk | | 0,009 | 0,004 | 0,006 | 0,003 | 0,003 | 0,004 |
| Minsk | | 0,004 | 0,002 | 0,003 | 0,001 | 0,001 | 0,002 |
| Vilnius | | 0,007 | 0,002 | 0,004 | 0,002 | 0,001 | 0,003 |
| Kaunas | | 0,025 | 0,010 | 0,016 | 0,008 | 0,007 | 0,012 |
| Kaliningrad | | 0,006 | 0,002 | 0,004 | 0,002 | 0,002 | 0,003 |
| Brest | | 0,003 | 0,001 | 0,002 | 0,001 | 0,001 | 0,002 |
| Warszawa | | 0,004 | 0,001 | 0,003 | 0,001 | 0,001 | 0,002 |
| Bryansk | | 0,003 | 0,001 | 0,002 | 0,001 | 0,001 | 0,001 |
| Homyel | | 0,013 | 0,006 | 0,010 | 0,005 | 0,005 | 0,007 |
| Kijiv | | 0,009 | 0,003 | 0,005 | 0,002 | 0,002 | 0,003 |
| Lviv | | 0,007 | 0,003 | 0,005 | 0,002 | 0,002 | 0,003 |
| Tula | | 0,033 | 0,013 | 0,022 | 0,011 | 0,010 | 0,016 |
| Orël | | 0,005 | 0,002 | 0,004 | 0,002 | 0,002 | 0,003 |

| |
|---|
| 2,207 |

## Novi Sad - Beograd

| | | Beograd | Podgorica + Bar | Tirana + Durres | Priština | Niš | Skopje | Thessaloniki | Athenai | Sofia | Stara Zagora, Plovdiv, Sliven | Edirne | Istanbul (40%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1,23 | 0,20 | 0,60 | 0,21 | 0,26 | 0,54 | 0,33 | 3,75 | 1,21 | 0,57 | 0,15 | 14,66 |
| Novi Sad | 0,25 | 0,72 | 3,54 | 4,84 | 3,22 | 2,71 | 4,21 | 6,17 | 9,19 | 4,07 | 5,39 | 7,00 | 9,13 |
| Budapest | 1,74 | 3,28 | 6,10 | 7,40 | 5,78 | 5,27 | 6,77 | 8,73 | 11,75 | 6,63 | 7,95 | 9,56 | 11,69 |
| Debrecen | 0,21 | 5,26 | 8,08 | 9,38 | 7,76 | 7,25 | 8,75 | 10,71 | 13,73 | 8,61 | 9,93 | 11,54 | 13,67 |
| Miskolc | 0,17 | 4,75 | 7,57 | 8,87 | 7,25 | 6,74 | 8,24 | 10,20 | 13,22 | 8,10 | 9,42 | 11,03 | 13,16 |
| Nyiregyhaza | 0,12 | 5,44 | 8,26 | 9,56 | 7,94 | 7,43 | 8,93 | 10,89 | 13,91 | 8,79 | 10,11 | 11,72 | 13,85 |
| Trnava | 0,07 | 4,74 | 7,56 | 8,86 | 7,24 | 6,73 | 8,23 | 10,19 | 13,21 | 8,09 | 9,41 | 11,02 | 13,15 |
| Zilina + Trencin | 0,14 | 6,03 | 8,85 | 10,15 | 8,53 | 8,02 | 9,52 | 11,48 | 14,50 | 9,38 | 10,70 | 12,31 | 14,44 |
| Györ | 0,13 | 4,32 | 7,14 | 8,44 | 6,82 | 6,31 | 7,81 | 9,77 | 12,79 | 7,67 | 8,99 | 10,60 | 12,73 |
| Bratislava | 0,42 | 5,02 | 7,84 | 9,14 | 7,52 | 7,01 | 8,51 | 10,47 | 13,49 | 8,37 | 9,69 | 11,30 | 13,43 |
| Ostrava | 0,30 | 7,05 | 9,87 | 11,17 | 9,55 | 9,04 | 10,54 | 12,50 | 15,52 | 10,40 | 11,72 | 13,33 | 15,46 |
| Katowice + ... | 1,28 | 7,80 | 10,62 | 11,92 | 10,30 | 9,79 | 11,29 | 13,25 | 16,27 | 11,15 | 12,47 | 14,08 | 16,21 |
| Krakow | 0,76 | 8,26 | 11,08 | 12,38 | 10,76 | 10,25 | 11,75 | 13,71 | 16,73 | 11,61 | 12,93 | 14,54 | 16,67 |
| Warszawa | 1,71 | 10,38 | 13,20 | 14,50 | 12,88 | 12,37 | 13,87 | 15,83 | 18,85 | 13,73 | 15,05 | 16,66 | 18,79 |
| Wrocław | 0,63 | 9,48 | 12,30 | 13,60 | 11,98 | 11,47 | 12,97 | 14,93 | 17,95 | 12,83 | 14,15 | 15,76 | 17,89 |
| Brno | 0,39 | 6,19 | 9,01 | 10,31 | 8,69 | 8,18 | 9,68 | 11,64 | 14,66 | 9,54 | 10,86 | 12,47 | 14,60 |
| Praha | 1,27 | 8,06 | 10,88 | 12,18 | 10,56 | 10,05 | 11,55 | 13,51 | 16,53 | 11,41 | 12,73 | 14,34 | 16,47 |
| Wien | 1,84 | 5,47 | 8,29 | 9,59 | 7,97 | 7,46 | 8,96 | 10,92 | 13,94 | 8,82 | 10,14 | 11,75 | 13,88 |
| Linz + Wels | 0,26 | 7,00 | 9,82 | 11,12 | 9,50 | 8,99 | 10,49 | 12,45 | 15,47 | 10,35 | 11,67 | 13,28 | 15,41 |
| Regensburg | 0,15 | 8,82 | 11,64 | 12,94 | 11,32 | 10,81 | 12,31 | 14,27 | 17,29 | 12,17 | 13,49 | 15,10 | 17,23 |
| Nürnberg | 0,74 | 9,69 | 12,51 | 13,81 | 12,19 | 11,68 | 13,18 | 15,14 | 18,16 | 13,04 | 14,36 | 15,97 | 18,10 |
| Würzburg | 0,13 | 10,65 | 13,47 | 14,77 | 13,15 | 12,64 | 14,14 | 16,10 | 19,12 | 14,00 | 15,32 | 16,93 | 19,06 |
| Frankfurt | 1,60 | 11,63 | 14,45 | 15,75 | 14,13 | 13,62 | 15,12 | 17,08 | 20,10 | 14,98 | 16,30 | 17,91 | 20,04 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Novi Sad | 0,538 | 0,006 | 0,010 | 0,007 | 0,012 | 0,012 | 0,004 | 0,022 | 0,028 | 0,008 | 0,001 | 0,085 |
| Budapest | 0,284 | 0,016 | 0,035 | 0,019 | 0,027 | 0,036 | 0,014 | 0,099 | 0,084 | 0,029 | 0,006 | 0,390 |
| Debrecen | 0,015 | 0,001 | 0,003 | 0,001 | 0,002 | 0,003 | 0,001 | 0,009 | 0,007 | 0,002 | 0,000 | 0,036 |
| Miskolc | 0,015 | 0,001 | 0,002 | 0,001 | 0,002 | 0,003 | 0,001 | 0,008 | 0,006 | 0,002 | 0,000 | 0,031 |
| Nyiregyhaza | 0,008 | 0,001 | 0,002 | 0,001 | 0,001 | 0,002 | 0,001 | 0,005 | 0,004 | 0,001 | 0,000 | 0,020 |
| Trnava | 0,006 | 0,000 | 0,001 | 0,001 | 0,001 | 0,001 | 0,000 | 0,003 | 0,002 | 0,001 | 0,000 | 0,013 |
| Zilina + Trencin | 0,008 | 0,001 | 0,002 | 0,001 | 0,001 | 0,002 | 0,001 | 0,006 | 0,004 | 0,001 | 0,000 | 0,022 |
| Györ | 0,013 | 0,001 | 0,002 | 0,001 | 0,001 | 0,002 | 0,001 | 0,006 | 0,005 | 0,002 | 0,000 | 0,025 |
| Bratislava | 0,033 | 0,003 | 0,006 | 0,003 | 0,004 | 0,006 | 0,003 | 0,019 | 0,014 | 0,005 | 0,001 | 0,074 |
| Ostrava | 0,013 | 0,001 | 0,003 | 0,001 | 0,002 | 0,003 | 0,001 | 0,011 | 0,007 | 0,003 | 0,001 | 0,042 |
| Katowice + ... | 0,048 | 0,005 | 0,011 | 0,005 | 0,007 | 0,011 | 0,005 | 0,042 | 0,026 | 0,010 | 0,002 | 0,165 |
| Krakow | 0,026 | 0,003 | 0,006 | 0,003 | 0,004 | 0,006 | 0,003 | 0,024 | 0,014 | 0,006 | 0,001 | 0,093 |
| Warszawa | 0,039 | 0,004 | 0,011 | 0,005 | 0,006 | 0,011 | 0,005 | 0,044 | 0,024 | 0,010 | 0,002 | 0,171 |
| Wrocław | 0,017 | 0,002 | 0,004 | 0,002 | 0,003 | 0,004 | 0,002 | 0,017 | 0,010 | 0,004 | 0,001 | 0,069 |
| Brno | 0,022 | 0,002 | 0,004 | 0,002 | 0,003 | 0,004 | 0,002 | 0,015 | 0,010 | 0,004 | 0,001 | 0,060 |
| Praha | 0,045 | 0,004 | 0,011 | 0,005 | 0,007 | 0,011 | 0,005 | 0,040 | 0,025 | 0,010 | 0,002 | 0,159 |
| Wien | 0,126 | 0,010 | 0,024 | 0,011 | 0,016 | 0,024 | 0,010 | 0,078 | 0,055 | 0,020 | 0,004 | 0,308 |
| Linz + Wels | 0,012 | 0,001 | 0,003 | 0,001 | 0,002 | 0,003 | 0,001 | 0,009 | 0,006 | 0,002 | 0,000 | 0,036 |
| Regensburg | 0,005 | 0,000 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,004 | 0,003 | 0,001 | 0,000 | 0,017 |
| Nürnberg | 0,019 | 0,002 | 0,005 | 0,002 | 0,003 | 0,005 | 0,002 | 0,020 | 0,011 | 0,005 | 0,001 | 0,079 |
| Würzburg | 0,003 | 0,000 | 0,001 | 0,000 | 0,000 | 0,001 | 0,000 | 0,003 | 0,002 | 0,001 | 0,000 | 0,013 |
| Frankfurt | 0,030 | 0,003 | 0,009 | 0,004 | 0,005 | 0,009 | 0,004 | 0,037 | 0,019 | 0,008 | 0,002 | 0,144 |

| |
|---|
| 5,062 |

# Orsha - Smolensk

| | | Smolensk | Moskwa | Yaroslawl | Vladimir | Nishnij Nowgorod | Ryazan | Saransk | Samara | Tambov | Saratov | Volgograd | Voronesh |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0,33 | 12,86 | 0,60 | 0,53 | 1,26 | 0,53 | 0,30 | 1,17 | 0,28 | 0,84 | 1,02 | 1,00 |
| Orsha | 0,12 | 1,11 | 4,79 | 7,28 | 6,56 | 8,68 | 6,63 | 10,18 | 13,68 | 8,87 | 12,34 | 13,78 | 9,25 |
| Minsk | 1,89 | 3,12 | 6,80 | 9,29 | 8,57 | 10,69 | 8,64 | 12,19 | 15,69 | 10,88 | 14,35 | 15,79 | 11,26 |
| Vilnius | 0,54 | 4,85 | 8,53 | 11,02 | 10,30 | 12,42 | 10,37 | 13,92 | 17,42 | 12,61 | 16,08 | 17,52 | 12,99 |
| Siauliai | 0,11 | 6,71 | 10,39 | 12,88 | 12,16 | 14,28 | 12,23 | 15,78 | 19,28 | 14,47 | 17,94 | 19,38 | 14,85 |
| Riga | 0,64 | 7,94 | 11,62 | 14,11 | 13,39 | 15,51 | 13,46 | 17,01 | 20,51 | 15,70 | 19,17 | 20,61 | 16,08 |
| Kaunas | 0,31 | 5,76 | 9,44 | 11,93 | 11,21 | 13,33 | 11,28 | 14,83 | 18,33 | 13,52 | 16,99 | 18,43 | 13,90 |
| Kaliningrad | 0,44 | 7,99 | 11,67 | 14,16 | 13,44 | 15,56 | 13,51 | 17,06 | 20,56 | 15,75 | 19,22 | 20,66 | 16,13 |
| Hrodna | 0,35 | 5,57 | 9,25 | 11,74 | 11,02 | 13,14 | 11,09 | 14,64 | 18,14 | 13,33 | 16,80 | 18,24 | 13,71 |
| Brest | 0,31 | 6,42 | 10,10 | 12,59 | 11,87 | 13,99 | 11,94 | 15,49 | 18,99 | 14,18 | 17,65 | 19,09 | 14,56 |
| Białystok | 0,29 | 7,64 | 11,32 | 13,81 | 13,09 | 15,21 | 13,16 | 16,71 | 20,21 | 15,40 | 18,87 | 20,31 | 15,78 |
| Warszawa | 1,71 | 8,27 | 11,95 | 14,44 | 13,72 | 15,84 | 13,79 | 17,34 | 20,84 | 16,03 | 19,50 | 20,94 | 16,41 |
| Gdansk + Gdynia | 0,71 | 11,12 | 14,80 | 17,29 | 16,57 | 18,69 | 16,64 | 20,19 | 23,69 | 18,88 | 22,35 | 23,79 | 19,26 |
| Łódź | 0,72 | 9,43 | 13,11 | 15,60 | 14,88 | 17,00 | 14,95 | 18,50 | 22,00 | 17,19 | 20,66 | 22,10 | 17,57 |
| Poznań | 0,55 | 11,33 | 15,01 | 17,50 | 16,78 | 18,90 | 16,85 | 20,40 | 23,90 | 19,09 | 22,56 | 24,00 | 19,47 |
| Szczecin | 0,41 | 13,31 | 16,99 | 19,48 | 18,76 | 20,88 | 18,83 | 22,38 | 25,88 | 21,07 | 24,54 | 25,98 | 21,45 |
| Berlin + Potsdam | 3,66 | 13,75 | 17,43 | 19,92 | 19,20 | 21,32 | 19,27 | 22,82 | 26,32 | 21,51 | 24,98 | 26,42 | 21,89 |
| Hamburg | 1,79 | 16,28 | 19,96 | 22,45 | 21,73 | 23,85 | 21,80 | 25,35 | 28,85 | 24,04 | 27,51 | 28,95 | 24,42 |
| Hannover | 0,51 | 16,21 | 19,89 | 22,38 | 21,66 | 23,78 | 21,73 | 25,28 | 28,78 | 23,97 | 27,44 | 28,88 | 24,35 |
| Leipzig + Halle | 0,36 | 17,67 | 21,35 | 23,84 | 23,12 | 25,24 | 23,19 | 26,74 | 30,24 | 25,43 | 28,90 | 30,34 | 25,81 |
| Wrocław | 0,63 | 11,28 | 14,96 | 17,45 | 16,73 | 18,85 | 16,80 | 20,35 | 23,85 | 19,04 | 22,51 | 23,95 | 19,42 |
| Praha | 1,27 | 13,49 | 17,17 | 19,66 | 18,94 | 21,06 | 19,01 | 22,56 | 26,06 | 21,25 | 24,72 | 26,16 | 21,63 |
| Katowice + ... | 1,28 | 10,85 | 14,53 | 17,02 | 16,30 | 18,42 | 16,37 | 19,92 | 23,42 | 18,61 | 22,08 | 23,52 | 18,99 |
| Ostrava | 0,30 | 11,60 | 15,28 | 17,77 | 17,05 | 19,17 | 17,12 | 20,67 | 24,17 | 19,36 | 22,83 | 24,27 | 19,74 |
| Brno | 0,39 | 13,03 | 16,71 | 19,20 | 18,48 | 20,60 | 18,55 | 22,10 | 25,60 | 20,79 | 24,26 | 25,70 | 21,17 |
| Wien | 1,84 | 13,75 | 17,43 | 19,92 | 19,20 | 21,32 | 19,27 | 22,82 | 26,32 | 21,51 | 24,98 | 26,42 | 21,89 |
| Bratislava | 0,42 | 13,63 | 17,31 | 19,80 | 19,08 | 21,20 | 19,15 | 22,70 | 26,20 | 21,39 | 24,86 | 26,30 | 21,77 |
| Krakow | 0,76 | 10,81 | 14,49 | 16,98 | 16,26 | 18,38 | 16,33 | 19,88 | 23,38 | 18,57 | 22,04 | 23,48 | 18,95 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Orsha | 0,033 | 0,108 | 0,002 | 0,003 | 0,004 | 0,003 | 0,001 | 0,002 | 0,001 | 0,001 | 0,001 | 0,003 |
| Minsk | 0,090 | 0,934 | 0,026 | 0,026 | 0,042 | 0,026 | 0,008 | 0,021 | 0,009 | 0,017 | 0,018 | 0,031 |
| Vilnius | 0,012 | 0,182 | 0,005 | 0,005 | 0,009 | 0,005 | 0,002 | 0,005 | 0,002 | 0,004 | 0,004 | 0,007 |
| Siauliai | 0,001 | 0,026 | 0,001 | 0,001 | 0,002 | 0,001 | 0,000 | 0,001 | 0,000 | 0,001 | 0,001 | 0,001 |
| Riga | 0,006 | 0,127 | 0,004 | 0,004 | 0,008 | 0,004 | 0,002 | 0,004 | 0,002 | 0,004 | 0,004 | 0,006 |
| Kaunas | 0,005 | 0,088 | 0,003 | 0,003 | 0,005 | 0,003 | 0,001 | 0,003 | 0,001 | 0,002 | 0,002 | 0,004 |
| Kaliningrad | 0,004 | 0,087 | 0,003 | 0,003 | 0,005 | 0,003 | 0,001 | 0,003 | 0,001 | 0,002 | 0,003 | 0,004 |
| Hrodna | 0,006 | 0,103 | 0,003 | 0,003 | 0,006 | 0,003 | 0,001 | 0,003 | 0,001 | 0,002 | 0,003 | 0,004 |
| Brest | 0,004 | 0,078 | 0,003 | 0,002 | 0,004 | 0,002 | 0,001 | 0,002 | 0,001 | 0,002 | 0,002 | 0,003 |
| Białystok | 0,003 | 0,060 | 0,002 | 0,002 | 0,004 | 0,002 | 0,001 | 0,002 | 0,001 | 0,002 | 0,002 | 0,003 |
| Warszawa | 0,016 | 0,324 | 0,011 | 0,011 | 0,020 | 0,010 | 0,004 | 0,011 | 0,004 | 0,009 | 0,010 | 0,015 |
| Gdansk + Gdynia | 0,004 | 0,094 | 0,003 | 0,003 | 0,006 | 0,003 | 0,001 | 0,004 | 0,001 | 0,003 | 0,003 | 0,005 |
| Łódź | 0,005 | 0,117 | 0,004 | 0,004 | 0,007 | 0,004 | 0,002 | 0,004 | 0,002 | 0,004 | 0,004 | 0,006 |
| Poznań | 0,003 | 0,071 | 0,003 | 0,002 | 0,005 | 0,002 | 0,001 | 0,003 | 0,001 | 0,002 | 0,003 | 0,004 |
| Szczecin | 0,002 | 0,043 | 0,002 | 0,001 | 0,003 | 0,001 | 0,001 | 0,002 | 0,001 | 0,001 | 0,002 | 0,002 |
| Berlin + Potsdam | 0,014 | 0,365 | 0,014 | 0,013 | 0,025 | 0,013 | 0,005 | 0,016 | 0,006 | 0,013 | 0,014 | 0,019 |
| Hamburg | 0,005 | 0,142 | 0,005 | 0,005 | 0,010 | 0,005 | 0,002 | 0,007 | 0,002 | 0,005 | 0,006 | 0,008 |
| Hannover | 0,001 | 0,041 | 0,002 | 0,001 | 0,003 | 0,001 | 0,001 | 0,002 | 0,001 | 0,002 | 0,002 | 0,002 |
| Leipzig + Halle | 0,001 | 0,025 | 0,001 | 0,001 | 0,002 | 0,001 | 0,000 | 0,001 | 0,000 | 0,001 | 0,001 | 0,001 |
| Wrocław | 0,003 | 0,082 | 0,003 | 0,003 | 0,005 | 0,003 | 0,001 | 0,003 | 0,001 | 0,003 | 0,003 | 0,004 |
| Praha | 0,005 | 0,130 | 0,005 | 0,005 | 0,009 | 0,005 | 0,002 | 0,006 | 0,002 | 0,005 | 0,005 | 0,007 |
| Katowice + ... | 0,007 | 0,174 | 0,006 | 0,006 | 0,011 | 0,006 | 0,002 | 0,007 | 0,002 | 0,006 | 0,006 | 0,009 |
| Ostrava | 0,002 | 0,037 | 0,001 | 0,001 | 0,002 | 0,001 | 0,001 | 0,002 | 0,001 | 0,001 | 0,001 | 0,002 |
| Brno | 0,002 | 0,042 | 0,002 | 0,001 | 0,003 | 0,001 | 0,001 | 0,002 | 0,001 | 0,001 | 0,002 | 0,002 |
| Wien | 0,007 | 0,184 | 0,007 | 0,006 | 0,013 | 0,006 | 0,003 | 0,008 | 0,003 | 0,007 | 0,007 | 0,010 |
| Bratislava | 0,002 | 0,042 | 0,002 | 0,001 | 0,003 | 0,001 | 0,001 | 0,002 | 0,001 | 0,001 | 0,002 | 0,002 |
| Krakow | 0,004 | 0,104 | 0,004 | 0,004 | 0,007 | 0,003 | 0,001 | 0,004 | 0,001 | 0,003 | 0,004 | 0,005 |

2,830

# Ostrava - Krakow/Katowice

| | | Krakow | Tarnow | Rzeszow | Lviv | Katowice + ... | Warszawa | Brest | Minsk | Orsha | Smolensk | Moskwa | Bialystok | Kaunas | Vilnius | Riga | Tallinn | Olsztyn | Gdansk + Gdynia | Lodz | Turun | Bydgoszcz |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0,76 | 0,11 | 0,18 | 0,72 | 1,28 | 1,71 | 0,31 | 1,98 | 0,12 | 0,33 | 12,86 | 0,29 | 0,31 | 0,54 | 0,64 | 0,41 | 0,18 | 0,71 | 0,72 | 0,20 | 0,36 |
| Ostrava | 0,30 | 1,21 | 1,95 | 2,69 | 4,14 | 0,75 | 3,33 | 5,18 | 8,48 | 10,49 | 11,60 | 15,28 | 5,11 | 7,11 | 8,01 | 9,34 | 12,15 | 5,05 | 6,18 | 2,72 | 4,24 | 4,67 |
| Brno | 0,39 | 2,64 | 3,38 | 4,12 | 5,57 | 2,18 | 4,76 | 6,61 | 9,91 | 11,92 | 13,03 | 16,71 | 6,54 | 8,54 | 9,44 | 10,77 | 13,58 | 6,48 | 7,61 | 4,15 | 5,67 | 6,10 |
| Wien | 1,84 | 3,36 | 4,10 | 4,84 | 6,29 | 2,90 | 5,48 | 7,33 | 10,63 | 12,64 | 13,75 | 17,43 | 7,26 | 9,26 | 10,16 | 11,49 | 14,30 | 7,20 | 8,33 | 4,87 | 6,39 | 6,82 |
| Linz + Wels | 0,20 | 4,89 | 5,63 | 6,37 | 7,82 | 4,43 | 7,01 | 8,86 | 12,16 | 14,17 | 15,28 | 18,96 | 8,79 | 10,79 | 11,69 | 13,02 | 15,83 | 8,73 | 9,86 | 6,40 | 7,92 | 8,35 |
| Salzburg | 0,15 | 6,01 | 6,75 | 7,49 | 8,94 | 5,55 | 8,13 | 9,98 | 13,28 | 15,29 | 16,40 | 20,08 | 9,91 | 11,91 | 12,81 | 14,14 | 16,95 | 9,85 | 10,98 | 7,52 | 9,04 | 9,47 |
| Innsbruck | 0,13 | 7,35 | 8,09 | 8,83 | 10,28 | 6,89 | 9,47 | 11,32 | 14,62 | 16,63 | 17,74 | 21,42 | 11,25 | 13,25 | 14,15 | 15,48 | 18,29 | 11,19 | 12,32 | 8,86 | 10,38 | 10,81 |
| Graz | 0,28 | 4,86 | 5,60 | 6,34 | 7,79 | 4,40 | 6,98 | 8,83 | 12,13 | 14,14 | 15,25 | 18,93 | 8,76 | 10,76 | 11,66 | 12,99 | 15,80 | 8,70 | 9,83 | 6,37 | 7,89 | 8,32 |
| Klagenfurt + ... | 0,16 | 5,86 | 6,60 | 7,34 | 8,79 | 5,40 | 7,98 | 9,83 | 13,13 | 15,14 | 16,25 | 19,93 | 9,76 | 11,76 | 12,66 | 13,99 | 16,80 | 9,70 | 10,83 | 7,37 | 8,89 | 9,32 |
| Venezia + ... | 0,55 | 7,99 | 8,73 | 9,47 | 10,92 | 7,53 | 10,11 | 11,96 | 15,26 | 17,27 | 18,38 | 22,06 | 11,89 | 13,89 | 14,79 | 16,12 | 18,93 | 11,83 | 12,96 | 9,50 | 11,02 | 11,45 |
| Maribor | 0,09 | 5,42 | 6,16 | 6,90 | 8,35 | 4,96 | 7,54 | 9,39 | 12,69 | 14,70 | 15,81 | 19,49 | 9,32 | 11,32 | 12,22 | 13,55 | 16,36 | 9,26 | 10,39 | 6,93 | 8,45 | 8,88 |
| Ljubljana | 0,28 | 6,44 | 7,18 | 7,92 | 9,37 | 5,98 | 8,56 | 10,41 | 13,71 | 15,72 | 16,83 | 20,51 | 10,34 | 12,34 | 13,24 | 14,57 | 17,38 | 10,28 | 11,41 | 7,95 | 9,47 | 9,90 |
| Trieste | 0,20 | 7,18 | 7,92 | 8,66 | 10,11 | 6,72 | 9,30 | 11,15 | 14,45 | 16,46 | 17,57 | 21,25 | 11,08 | 13,08 | 13,98 | 15,31 | 18,12 | 11,02 | 12,15 | 8,69 | 10,21 | 10,64 |
| Zagreb | 0,79 | 6,28 | 7,02 | 7,76 | 9,21 | 5,82 | 8,40 | 10,25 | 13,55 | 15,56 | 16,67 | 20,35 | 10,18 | 12,18 | 13,08 | 14,41 | 17,22 | 10,12 | 11,25 | 7,79 | 9,31 | 9,74 |
| Bratislava | 0,42 | 3,24 | 3,98 | 4,72 | 6,17 | 2,78 | 5,36 | 7,21 | 10,51 | 12,52 | 13,63 | 17,31 | 7,14 | 9,14 | 10,04 | 11,37 | 14,18 | 7,08 | 8,21 | 4,75 | 6,27 | 6,70 |
| Györ | 0,13 | 3,94 | 4,68 | 5,42 | 6,87 | 3,48 | 6,06 | 7,91 | 11,21 | 13,22 | 14,33 | 18,01 | 7,84 | 9,84 | 10,74 | 12,07 | 14,88 | 7,78 | 8,91 | 5,45 | 6,97 | 7,40 |
| Budapest | 1,74 | 4,98 | 5,72 | 6,46 | 7,91 | 4,52 | 7,10 | 8,95 | 12,25 | 14,26 | 15,37 | 19,05 | 8,88 | 10,88 | 11,78 | 13,11 | 15,92 | 8,82 | 9,95 | 6,49 | 8,01 | 8,44 |
| Debrecen | 0,21 | 20,00 | 20,00 | 20,00 | 20,00 | 6,50 | 9,08 | 10,93 | 14,23 | 16,24 | 17,35 | 21,03 | 10,86 | 12,86 | 13,76 | 15,09 | 17,90 | 10,80 | 11,93 | 8,47 | 9,99 | 10,42 |
| Arad | 0,16 | 20,00 | 20,00 | 20,00 | 20,00 | 6,76 | 9,34 | 11,19 | 14,49 | 16,50 | 17,61 | 21,29 | 11,12 | 13,12 | 14,02 | 15,35 | 18,16 | 11,06 | 12,19 | 8,73 | 10,25 | 10,68 |
| Timisoara | 0,32 | 20,00 | 20,00 | 20,00 | 20,00 | 7,11 | 9,69 | 11,54 | 14,84 | 16,85 | 17,96 | 21,64 | 11,47 | 13,47 | 14,37 | 15,70 | 18,51 | 11,41 | 12,54 | 9,08 | 10,60 | 11,03 |
| Szeged | 0,17 | 20,00 | 20,00 | 20,00 | 20,00 | 6,15 | 8,73 | 10,58 | 13,88 | 15,89 | 17,00 | 20,68 | 10,51 | 12,51 | 13,41 | 14,74 | 17,55 | 10,45 | 11,58 | 8,12 | 9,64 | 10,07 |
| Beograd | 1,23 | 20,00 | 20,00 | 20,00 | 20,00 | 7,72 | 10,30 | 12,15 | 15,45 | 17,46 | 18,57 | 22,25 | 12,08 | 14,08 | 14,98 | 16,31 | 19,12 | 12,02 | 13,15 | 9,69 | 11,21 | 11,64 |

| | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ostrava | | 0,165 | 0,011 | 0,010 | 0,019 | 0,626 | 0,066 | 0,006 | 0,016 | 0,001 | 0,002 | 0,037 | 0,005 | 0,003 | 0,005 | 0,004 | 0,002 | 0,003 | 0,010 | 0,039 | 0,005 | 0,008 |
| Brno | | 0,057 | 0,005 | 0,006 | 0,015 | 0,133 | 0,047 | 0,005 | 0,016 | 0,001 | 0,002 | 0,042 | 0,005 | 0,003 | 0,005 | 0,004 | 0,002 | 0,003 | 0,009 | 0,025 | 0,004 | 0,006 |
| Wien | | 0,178 | 0,018 | 0,023 | 0,058 | 0,385 | 0,175 | 0,019 | 0,066 | 0,003 | 0,007 | 0,184 | 0,018 | 0,013 | 0,019 | 0,019 | 0,008 | 0,012 | 0,036 | 0,090 | 0,016 | 0,025 |
| Linz + Wels | | 0,010 | 0,001 | 0,002 | 0,004 | 0,020 | 0,012 | 0,002 | 0,006 | 0,000 | 0,001 | 0,017 | 0,001 | 0,001 | 0,002 | 0,002 | 0,001 | 0,001 | 0,003 | 0,006 | 0,001 | 0,002 |
| Salzburg | | 0,005 | 0,001 | 0,001 | 0,003 | 0,010 | 0,007 | 0,001 | 0,004 | 0,000 | 0,000 | 0,012 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,002 | 0,003 | 0,001 | 0,001 |
| Innsbruck | | 0,003 | 0,000 | 0,001 | 0,002 | 0,006 | 0,005 | 0,001 | 0,003 | 0,000 | 0,000 | 0,009 | 0,001 | 0,000 | 0,001 | 0,001 | 0,000 | 0,000 | 0,001 | 0,002 | 0,000 | 0,001 |
| Graz | | 0,014 | 0,002 | 0,002 | 0,006 | 0,029 | 0,018 | 0,002 | 0,008 | 0,000 | 0,001 | 0,024 | 0,002 | 0,002 | 0,002 | 0,002 | 0,001 | 0,001 | 0,004 | 0,009 | 0,002 | 0,003 |
| Klagenfurt + ... | | 0,006 | 0,001 | 0,001 | 0,003 | 0,012 | 0,008 | 0,001 | 0,004 | 0,000 | 0,000 | 0,013 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,002 | 0,004 | 0,001 | 0,001 |
| Venezia + ... | | 0,012 | 0,002 | 0,002 | 0,007 | 0,023 | 0,018 | 0,003 | 0,011 | 0,001 | 0,001 | 0,037 | 0,002 | 0,002 | 0,003 | 0,003 | 0,002 | 0,001 | 0,005 | 0,009 | 0,002 | 0,003 |
| Maribor | | 0,004 | 0,000 | 0,001 | 0,002 | 0,008 | 0,005 | 0,001 | 0,002 | 0,000 | 0,000 | 0,007 | 0,001 | 0,000 | 0,001 | 0,001 | 0,000 | 0,000 | 0,001 | 0,002 | 0,000 | 0,001 |
| Ljubljana | | 0,009 | 0,001 | 0,001 | 0,004 | 0,017 | 0,012 | 0,002 | 0,006 | 0,000 | 0,001 | 0,021 | 0,002 | 0,001 | 0,002 | 0,002 | 0,001 | 0,001 | 0,003 | 0,006 | 0,001 | 0,002 |
| Trieste | | 0,005 | 0,001 | 0,001 | 0,003 | 0,010 | 0,008 | 0,001 | 0,004 | 0,000 | 0,001 | 0,014 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,002 | 0,004 | 0,001 | 0,001 |
| Zagreb | | 0,026 | 0,003 | 0,004 | 0,013 | 0,051 | 0,036 | 0,005 | 0,019 | 0,001 | 0,002 | 0,061 | 0,004 | 0,003 | 0,005 | 0,005 | 0,003 | 0,003 | 0,009 | 0,017 | 0,004 | 0,006 |
| Bratislava | | 0,043 | 0,004 | 0,005 | 0,014 | 0,095 | 0,041 | 0,005 | 0,015 | 0,001 | 0,002 | 0,042 | 0,004 | 0,003 | 0,004 | 0,004 | 0,002 | 0,003 | 0,008 | 0,021 | 0,004 | 0,006 |
| Györ | | 0,010 | 0,001 | 0,001 | 0,004 | 0,020 | 0,010 | 0,001 | 0,004 | 0,000 | 0,000 | 0,012 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,002 | 0,005 | 0,001 | 0,002 |
| Budapest | | 0,086 | 0,010 | 0,013 | 0,037 | 0,171 | 0,106 | 0,013 | 0,049 | 0,002 | 0,006 | 0,149 | 0,012 | 0,009 | 0,014 | 0,014 | 0,006 | 0,008 | 0,025 | 0,052 | 0,010 | 0,017 |
| Debrecen | | 0,001 | 0,000 | 0,000 | 0,001 | 0,011 | 0,008 | 0,001 | 0,005 | 0,000 | 0,001 | 0,015 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,002 | 0,004 | 0,001 | 0,001 |
| Arad | | 0,001 | 0,000 | 0,000 | 0,001 | 0,008 | 0,006 | 0,001 | 0,003 | 0,000 | 0,000 | 0,011 | 0,001 | 0,001 | 0,001 | 0,001 | 0,000 | 0,000 | 0,002 | 0,003 | 0,001 | 0,001 |
| Timisoara | | 0,001 | 0,000 | 0,000 | 0,001 | 0,015 | 0,012 | 0,002 | 0,006 | 0,000 | 0,001 | 0,022 | 0,001 | 0,001 | 0,002 | 0,002 | 0,001 | 0,001 | 0,003 | 0,005 | 0,001 | 0,002 |
| Szeged | | 0,001 | 0,000 | 0,000 | 0,001 | 0,010 | 0,007 | 0,001 | 0,004 | 0,000 | 0,000 | 0,013 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,002 | 0,003 | 0,001 | 0,001 |
| Beograd | | 0,006 | 0,001 | 0,001 | 0,005 | 0,049 | 0,040 | 0,005 | 0,023 | 0,001 | 0,003 | 0,081 | 0,005 | 0,004 | 0,007 | 0,007 | 0,003 | 0,003 | 0,011 | 0,019 | 0,004 | 0,007 |

5,553

Ostrava - Krakov: 0,988

Ostrava - Katowice: 4,565

# Paris - Lyon

| | | Paris | Rouen | Le Havre | Lille | London | Bruxelles | Antwerpen | Rotterdam | Amsterdam |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 12,40 | 0,11 | 0,17 | 0,27 | 13,61 | 1,83 | 0,52 | 0,63 | 0,84 |
| Lyon | 2,19 | 3,96 | 5,01 | 5,68 | 5,96 | 8,30 | 6,92 | 7,32 | 8,12 | 8,65 |
| Dijon | 0,15 | 2,67 | 3,72 | 4,39 | 4,67 | 7,01 | 5,63 | 6,03 | 6,83 | 7,36 |
| Mulhouse | 0,11 | 4,39 | 5,44 | 6,11 | 6,39 | 8,73 | 7,35 | 7,75 | 8,55 | 9,08 |
| Basel | 0,18 | 4,73 | 5,78 | 6,45 | 6,73 | 9,07 | 7,69 | 8,09 | 8,89 | 9,42 |
| Genève | 0,20 | 5,04 | 6,09 | 6,76 | 7,04 | 9,38 | 8,00 | 8,40 | 9,20 | 9,73 |
| Torino | 0,89 | 6,29 | 7,34 | 8,01 | 8,29 | 10,63 | 9,25 | 9,65 | 10,45 | 10,98 |
| Milano | 1,35 | 7,54 | 8,59 | 9,26 | 9,54 | 11,88 | 10,50 | 10,90 | 11,70 | 12,23 |
| Verona | 0,26 | 8,96 | 10,01 | 10,68 | 10,96 | 13,30 | 11,92 | 12,32 | 13,12 | 13,65 |
| Padova | 0,21 | 9,91 | 10,66 | 11,33 | 11,61 | 13,95 | 12,57 | 12,97 | 13,77 | 14,30 |
| Venezia | 0,34 | 10,25 | 11,00 | 11,67 | 11,95 | 14,29 | 12,91 | 13,31 | 14,11 | 14,64 |
| Bologna | 0,39 | 9,52 | 10,57 | 11,24 | 11,52 | 13,86 | 12,48 | 12,88 | 13,68 | 14,21 |
| Roma | 2,87 | 12,55 | 13,60 | 14,27 | 14,55 | 16,89 | 15,51 | 15,91 | 16,71 | 17,24 |
| Grnoble | 0,16 | 4,94 | 5,99 | 6,66 | 6,94 | 9,28 | 7,90 | 8,30 | 9,10 | 9,63 |
| Marseille | 0,86 | 6,76 | 7,81 | 8,48 | 8,76 | 11,10 | 9,72 | 10,12 | 10,92 | 11,45 |
| Toulon | 0,16 | 7,24 | 8,29 | 8,96 | 9,24 | 11,58 | 10,20 | 10,60 | 11,40 | 11,93 |
| Nice | 0,34 | 8,46 | 9,51 | 10,18 | 10,46 | 12,80 | 10,68 | 11,08 | 12,62 | 13,15 |
| Nîmes | 0,15 | 6,36 | 7,41 | 8,08 | 8,36 | 10,70 | 9,32 | 9,72 | 10,52 | 11,05 |
| Montpellier | 0,27 | 6,78 | 7,83 | 8,50 | 8,78 | 11,12 | 9,74 | 10,14 | 10,94 | 11,47 |
| Perpignan | 0,16 | 8,05 | 9,10 | 9,77 | 10,05 | 12,39 | 11,01 | 11,71 | 12,21 | 12,74 |
| Barcelona | 1,60 | 9,63 | 10,68 | 11,35 | 11,63 | 13,97 | 12,59 | 13,29 | 13,79 | 14,32 |
| Madrid | 3,14 | 14,68 | 15,73 | 16,40 | 16,68 | 19,02 | 17,64 | 18,34 | 18,84 | 19,37 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Lyon | 2,617 | 0,016 | 0,019 | 0,028 | 0,816 | 0,150 | 0,039 | 0,039 | 0,047 |
| Dijon | 0,350 | 0,002 | 0,002 | 0,003 | 0,075 | 0,015 | 0,004 | 0,004 | 0,004 |
| Mulhouse | 0,110 | 0,001 | 0,001 | 0,001 | 0,038 | 0,007 | 0,002 | 0,002 | 0,002 |
| Basel | 0,159 | 0,001 | 0,001 | 0,002 | 0,058 | 0,010 | 0,003 | 0,003 | 0,003 |
| Genève | 0,159 | 0,001 | 0,001 | 0,002 | 0,061 | 0,011 | 0,003 | 0,003 | 0,004 |
| Torino | 0,484 | 0,003 | 0,004 | 0,007 | 0,218 | 0,037 | 0,010 | 0,010 | 0,013 |
| Milano | 0,540 | 0,004 | 0,005 | 0,008 | 0,274 | 0,045 | 0,012 | 0,013 | 0,016 |
| Verona | 0,078 | 0,001 | 0,001 | 0,001 | 0,043 | 0,007 | 0,002 | 0,002 | 0,003 |
| Padova | 0,053 | 0,000 | 0,001 | 0,001 | 0,032 | 0,005 | 0,001 | 0,002 | 0,002 |
| Venezia | 0,081 | 0,001 | 0,001 | 0,001 | 0,050 | 0,008 | 0,002 | 0,002 | 0,003 |
| Bologna | 0,105 | 0,001 | 0,001 | 0,002 | 0,061 | 0,010 | 0,003 | 0,003 | 0,004 |
| Roma | 0,483 | 0,004 | 0,005 | 0,008 | 0,320 | 0,050 | 0,014 | 0,015 | 0,019 |
| Grnoble | 0,131 | 0,001 | 0,001 | 0,002 | 0,049 | 0,009 | 0,002 | 0,002 | 0,003 |
| Marseille | 0,414 | 0,003 | 0,004 | 0,006 | 0,196 | 0,033 | 0,009 | 0,009 | 0,011 |
| Toulon | 0,069 | 0,000 | 0,001 | 0,001 | 0,034 | 0,006 | 0,002 | 0,002 | 0,002 |
| Nice | 0,112 | 0,001 | 0,001 | 0,002 | 0,061 | 0,011 | 0,003 | 0,003 | 0,004 |
| Nîmes | 0,080 | 0,001 | 0,001 | 0,001 | 0,036 | 0,006 | 0,002 | 0,002 | 0,002 |
| Montpellier | 0,129 | 0,001 | 0,001 | 0,002 | 0,061 | 0,010 | 0,003 | 0,003 | 0,004 |
| Perpignan | 0,057 | 0,000 | 0,001 | 0,001 | 0,030 | 0,005 | 0,001 | 0,001 | 0,002 |
| Barcelona | 0,422 | 0,003 | 0,004 | 0,007 | 0,246 | 0,039 | 0,010 | 0,012 | 0,015 |
| Madrid | 0,404 | 0,003 | 0,005 | 0,007 | 0,286 | 0,044 | 0,012 | 0,013 | 0,017 |

11,256

# Ploeşti - Bucureşti

| | | Bucureşti | Constanţa | Ruse | Shumen | Varna | Stara Zagora, Plovdiv, Sliven | Istanbul | Pleven | Sofia | Craiova | Drobeta Turnu Severin |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1,88 | 0,30 | 0,15 | 0,08 | 0,33 | 0,57 | 14,33 | 0,11 | 1,21 | 0,29 | 0,10 |
| Ploeşti | 0,22 | 0,56 | 2,59 | 1,25 | 2,25 | 3,04 | 2,82 | 6,10 | 2,43 | 3,75 | 2,38 | 3,37 |
| Buzau | 0,13 | 1,21 | 3,24 | 1,90 | 2,90 | 3,69 | 3,47 | 6,75 | 3,08 | 4,40 | 3,03 | 4,02 |
| Braila + Galaţi | 0,50 | 2,15 | 4,18 | 2,84 | 3,84 | 4,63 | 4,41 | 7,69 | 4,02 | 5,34 | 3,97 | 4,96 |
| Focşani | 0,10 | 1,89 | 3,92 | 2,58 | 3,58 | 4,37 | 4,15 | 7,43 | 3,76 | 5,08 | 3,71 | 4,70 |
| Bacau | 0,17 | 2,87 | 4,90 | 3,56 | 4,56 | 5,35 | 5,13 | 8,41 | 4,74 | 6,06 | 4,69 | 5,68 |
| Iaşi | 0,32 | 3,69 | 5,72 | 4,38 | 5,38 | 6,17 | 5,95 | 9,23 | 5,56 | 6,88 | 5,51 | 6,50 |
| Chişinau | 0,67 | 4,64 | 6,67 | 5,33 | 6,33 | 7,12 | 6,90 | 10,18 | 6,51 | 7,83 | 6,46 | 7,45 |
| Suceava + Botoşani | 0,22 | 4,18 | 6,21 | 4,87 | 5,87 | 6,66 | 6,44 | 9,72 | 6,05 | 7,37 | 6,00 | 6,99 |
| Chernivtsi | 0,26 | 4,96 | 6,99 | 5,65 | 6,65 | 7,44 | 7,22 | 10,50 | 6,83 | 8,15 | 6,78 | 7,77 |
| Kiyiv | 2,80 | 9,05 | 11,08 | 9,74 | 10,74 | 11,53 | 11,31 | 14,59 | 10,92 | 12,24 | 10,87 | 11,86 |
| Lviv | 0,72 | 7,13 | 9,16 | 7,82 | 8,82 | 9,61 | 9,39 | 12,67 | 9,00 | 10,32 | 8,95 | 9,94 |
| Brasov | 0,28 | 1,42 | 3,45 | 2,11 | 3,11 | 3,90 | 3,68 | 6,96 | 3,29 | 4,61 | 3,24 | 4,23 |
| Sibiu | 0,43 | 2,25 | 4,28 | 2,94 | 3,94 | 4,73 | 4,51 | 7,79 | 4,12 | 5,44 | 4,07 | 5,06 |
| Cluj | 0,30 | 3,42 | 5,45 | 4,11 | 5,11 | 5,90 | 5,68 | 8,96 | 5,29 | 6,61 | 5,24 | 6,23 |
| Baia Mare | 0,12 | 4,41 | 6,44 | 5,10 | 6,10 | 6,89 | 6,67 | 9,95 | 6,28 | 7,60 | 6,23 | 7,22 |
| Satu Mare | 0,11 | 4,96 | 6,99 | 5,65 | 6,65 | 7,44 | 7,22 | 10,50 | 6,83 | 8,15 | 6,78 | 7,77 |
| Arad | 0,16 | 4,45 | 6,48 | 5,14 | 6,14 | 6,93 | 6,71 | 9,99 | 6,32 | 7,64 | 6,27 | 7,26 |
| Oradea | 0,20 | 5,55 | 7,58 | 6,24 | 7,24 | 8,03 | 7,81 | 11,09 | 7,42 | 8,74 | 7,37 | 8,36 |
| Budapest | 1,74 | 6,69 | 8,72 | 7,38 | 8,38 | 9,17 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Trnava | 0,07 | 8,15 | 10,18 | 8,84 | 9,84 | 10,63 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Zilina + Trencin | 0,14 | 9,44 | 11,47 | 10,13 | 11,13 | 11,92 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Györ | 0,13 | 7,73 | 9,76 | 8,42 | 9,42 | 10,21 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Bratislava | 0,42 | 8,43 | 10,46 | 9,12 | 10,12 | 10,91 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Ostrava | 0,30 | 10,46 | 12,49 | 11,15 | 12,15 | 12,94 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Katowice + ... | 1,28 | 11,21 | 13,24 | 11,90 | 12,90 | 13,69 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Krakow | 0,76 | 11,67 | 13,70 | 12,36 | 13,36 | 14,15 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Warszawa | 1,71 | 13,79 | 15,82 | 14,48 | 15,48 | 16,27 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Brno | 0,39 | 9,60 | 11,63 | 10,29 | 11,29 | 12,08 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Praha | 1,27 | 11,47 | 13,50 | 12,16 | 13,16 | 13,95 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Wien | 1,84 | 8,88 | 10,91 | 9,57 | 10,57 | 11,36 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Linz + Wels | 0,26 | 10,41 | 12,44 | 11,10 | 12,10 | 12,89 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Regensburg | 0,15 | 12,23 | 14,26 | 12,92 | 13,92 | 14,71 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Nürnberg | 0,74 | 13,10 | 15,13 | 13,79 | 14,79 | 15,58 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Frankfurt | 1,60 | 15,04 | 17,07 | 15,73 | 16,73 | 17,52 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Salzburg | 0,15 | 11,53 | 13,56 | 12,22 | 13,22 | 14,01 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| München | 1,45 | 12,71 | 14,74 | 13,40 | 14,40 | 15,19 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Ausburg | 0,29 | 13,27 | 15,30 | 13,96 | 14,96 | 15,75 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Stuttgart | 0,62 | 14,61 | 16,64 | 15,30 | 16,30 | 17,09 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Zürich | 0,40 | 15,03 | 17,06 | 15,72 | 16,72 | 17,51 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Timioşara | 0,32 | 4,80 | 6,83 | 5,49 | 6,49 | 7,28 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Beograd | 1,35 | 5,99 | 8,02 | 6,68 | 7,68 | 8,47 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Ploeşti | 1,108 | 0,013 | 0,023 | 0,004 | 0,011 | 0,022 | 0,146 | 0,005 | 0,028 | 0,015 | 0,003 |
| Buzau | 0,177 | 0,005 | 0,007 | 0,002 | 0,005 | 0,009 | 0,073 | 0,002 | 0,013 | 0,006 | 0,001 |
| Braila + Galaţi | 0,256 | 0,013 | 0,013 | 0,004 | 0,012 | 0,023 | 0,223 | 0,005 | 0,035 | 0,014 | 0,003 |
| Focşani | 0,064 | 0,003 | 0,003 | 0,001 | 0,003 | 0,005 | 0,047 | 0,001 | 0,008 | 0,003 | 0,001 |
| Bacau | 0,053 | 0,003 | 0,003 | 0,001 | 0,003 | 0,006 | 0,065 | 0,001 | 0,010 | 0,004 | 0,001 |
| Iaşi | 0,065 | 0,005 | 0,004 | 0,001 | 0,005 | 0,009 | 0,105 | 0,002 | 0,015 | 0,005 | 0,001 |
| Chişinau | 0,093 | 0,008 | 0,006 | 0,002 | 0,008 | 0,014 | 0,186 | 0,003 | 0,025 | 0,008 | 0,002 |
| Suceava + Botoşani | 0,036 | 0,003 | 0,002 | 0,001 | 0,003 | 0,005 | 0,066 | 0,001 | 0,009 | 0,003 | 0,001 |
| Chernivtsi | 0,032 | 0,003 | 0,002 | 0,001 | 0,003 | 0,005 | 0,068 | 0,001 | 0,009 | 0,003 | 0,001 |
| Kiyiv | 0,124 | 0,014 | 0,009 | 0,004 | 0,014 | 0,026 | 0,421 | 0,005 | 0,048 | 0,014 | 0,004 |
| Lviv | 0,048 | 0,005 | 0,003 | 0,001 | 0,005 | 0,009 | 0,138 | 0,002 | 0,016 | 0,005 | 0,001 |
| Brasov | 0,290 | 0,010 | 0,012 | 0,003 | 0,009 | 0,017 | 0,148 | 0,004 | 0,025 | 0,011 | 0,002 |
| Sibiu | 0,204 | 0,011 | 0,010 | 0,003 | 0,010 | 0,019 | 0,188 | 0,004 | 0,029 | 0,011 | 0,003 |
| Cluj | 0,070 | 0,005 | 0,004 | 0,001 | 0,005 | 0,009 | 0,103 | 0,002 | 0,015 | 0,005 | 0,001 |
| Baia Mare | 0,018 | 0,002 | 0,001 | 0,000 | 0,001 | 0,003 | 0,035 | 0,001 | 0,005 | 0,002 | 0,000 |
| Satu Mare | 0,014 | 0,001 | 0,001 | 0,000 | 0,001 | 0,002 | 0,029 | 0,000 | 0,004 | 0,001 | 0,000 |
| Arad | 0,024 | 0,002 | 0,001 | 0,001 | 0,002 | 0,004 | 0,046 | 0,001 | 0,006 | 0,002 | 0,001 |
| Oradea | 0,020 | 0,002 | 0,001 | 0,001 | 0,002 | 0,003 | 0,048 | 0,001 | 0,006 | 0,002 | 0,001 |
| Budapest | 0,129 | 0,013 | 0,009 | 0,004 | 0,013 | 0,006 | 0,153 | 0,001 | 0,013 | 0,003 | 0,001 |
| Trnava | 0,004 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 | 0,006 | 0,000 | 0,001 | 0,000 | 0,000 |
| Zilina + Trencin | 0,006 | 0,001 | 0,000 | 0,000 | 0,001 | 0,000 | 0,012 | 0,000 | 0,001 | 0,000 | 0,000 |
| Györ | 0,008 | 0,001 | 0,001 | 0,000 | 0,001 | 0,000 | 0,011 | 0,000 | 0,001 | 0,000 | 0,000 |
| Bratislava | 0,021 | 0,002 | 0,001 | 0,001 | 0,002 | 0,001 | 0,037 | 0,000 | 0,003 | 0,001 | 0,000 |
| Ostrava | 0,010 | 0,001 | 0,001 | 0,000 | 0,001 | 0,001 | 0,026 | 0,000 | 0,002 | 0,001 | 0,000 |
| Katowice | 0,040 | 0,005 | 0,003 | 0,001 | 0,005 | 0,004 | 0,113 | 0,001 | 0,010 | 0,002 | 0,001 |
| Krakow | 0,022 | 0,003 | 0,002 | 0,001 | 0,003 | 0,003 | 0,067 | 0,001 | 0,006 | 0,001 | 0,000 |
| Warszawa | 0,037 | 0,005 | 0,003 | 0,001 | 0,005 | 0,006 | 0,150 | 0,001 | 0,013 | 0,003 | 0,001 |
| Brno | 0,016 | 0,002 | 0,001 | 0,001 | 0,002 | 0,001 | 0,034 | 0,000 | 0,003 | 0,001 | 0,000 |
| Praha | 0,038 | 0,005 | 0,003 | 0,001 | 0,005 | 0,004 | 0,112 | 0,001 | 0,009 | 0,002 | 0,001 |
| Wien | 0,084 | 0,009 | 0,006 | 0,003 | 0,010 | 0,006 | 0,162 | 0,001 | 0,014 | 0,003 | 0,001 |
| Linz + Wels | 0,009 | 0,001 | 0,001 | 0,000 | 0,001 | 0,001 | 0,023 | 0,000 | 0,002 | 0,000 | 0,000 |
| Regensburg | 0,004 | 0,000 | 0,000 | 0,000 | 0,001 | 0,001 | 0,013 | 0,000 | 0,001 | 0,000 | 0,000 |
| Nürnberg | 0,018 | 0,002 | 0,001 | 0,001 | 0,002 | 0,003 | 0,065 | 0,000 | 0,005 | 0,001 | 0,000 |
| Frankfurt | 0,030 | 0,004 | 0,002 | 0,001 | 0,004 | 0,006 | 0,141 | 0,001 | 0,012 | 0,003 | 0,001 |
| Salzburg | 0,004 | 0,001 | 0,000 | 0,000 | 0,001 | 0,001 | 0,013 | 0,000 | 0,001 | 0,000 | 0,000 |
| München | 0,036 | 0,004 | 0,003 | 0,001 | 0,005 | 0,005 | 0,128 | 0,001 | 0,011 | 0,003 | 0,001 |
| Ausburg | 0,007 | 0,001 | 0,000 | 0,000 | 0,001 | 0,001 | 0,026 | 0,000 | 0,002 | 0,001 | 0,000 |
| Stuttgart | 0,012 | 0,002 | 0,001 | 0,000 | 0,002 | 0,002 | 0,055 | 0,000 | 0,005 | 0,001 | 0,000 |
| Zürich | 0,008 | 0,001 | 0,001 | 0,000 | 0,001 | 0,001 | 0,035 | 0,000 | 0,003 | 0,001 | 0,000 |
| Timioşara | 0,042 | 0,004 | 0,003 | 0,001 | 0,004 | 0,001 | 0,028 | 0,000 | 0,002 | 0,001 | 0,000 |
| Beograd | 0,121 | 0,012 | 0,008 | 0,003 | 0,012 | 0,005 | 0,119 | 0,001 | 0,010 | 0,002 | 0,001 |

8,565

# Plovdiv/Stara Zagora/Sliven - Edirne

| | | Edirne | Istanbul | Ankara |
|---|---|---|---|---|
| | | 0,15 | 14,66 | 4,59 |
| Plovdiv + ... | 0,57 | 1,61 | 3,74 | 8,10 |
| Ruse | 0,15 | 3,18 | 5,31 | 9,67 |
| Bucuresti | 1,88 | 3,87 | 6,00 | 10,36 |
| Constanta | 0,30 | 5,90 | 8,03 | 12,39 |
| Ploesti | 0,22 | 4,43 | 6,56 | 10,92 |
| Braila + Galati | 0,50 | 6,02 | 8,15 | 12,51 |
| Brasov | 0,28 | 5,29 | 7,42 | 11,78 |
| Sibiu | 0,43 | 6,12 | 8,25 | 12,61 |
| Cluj | 0,30 | 7,29 | 9,42 | 13,78 |
| Sofia | 1,21 | 2,93 | 5,06 | 9,42 |
| Niš | 0,26 | 4,29 | 6,42 | 10,78 |
| Beograd | 1,23 | 6,28 | 8,41 | 12,77 |
| Timişoara | 0,32 | 7,47 | 9,60 | 13,96 |
| Arad | 0,16 | 7,82 | 9,95 | 14,31 |
| Oradea | 0,20 | 8,92 | 11,05 | 15,41 |
| Novi Sad | 0,25 | 7,00 | 9,13 | 13,49 |
| Subotica | 0,10 | 7,89 | 10,02 | 14,38 |
| Budapest | 1,74 | 9,56 | 11,69 | 16,05 |
| Bratislava | 0,42 | 11,30 | 13,43 | 17,79 |
| Ostrava | 0,30 | 13,33 | 15,46 | 19,82 |
| Katowice + Krakow | 2,04 | 14,08 | 16,21 | 20,57 |
| Brno | 0,39 | 12,47 | 14,60 | 18,96 |
| Praha | 1,27 | 14,34 | 16,47 | 20,83 |
| Wien | 1,84 | 11,75 | 13,88 | 18,24 |
| Nürnberg, Fürth, ... | 0,74 | 15,97 | 18,10 | 22,46 |
| Frankfurt, ... | 1,60 | 17,91 | 20,04 | 24,40 |
| Sarajewo | 0,53 | 9,22 | 11,35 | 15,71 |
| Zagreb | 0,79 | 10,00 | 12,13 | 16,49 |
| Graz | 0,28 | 11,42 | 13,55 | 17,91 |
| Ljubljana | 0,29 | 11,14 | 13,27 | 17,63 |
| Trieste | 0,20 | 11,88 | 14,01 | 18,37 |
| Venezia + Treviso | 0,34 | 13,03 | 15,16 | 19,52 |
| Verona | 0,26 | 14,02 | 16,15 | 20,51 |
| Milano | 1,35 | 15,44 | 17,57 | 21,93 |
| München | 1,45 | 14,56 | 16,69 | 21,05 |
| Stuttgart | 0,62 | 16,46 | 18,59 | 22,95 |

| | | | |
|---|---|---|---|
| Plovdiv + ... | 0,038 | 0,887 | 0,075 |
| Ruse | 0,003 | 0,129 | 0,015 |
| Bucuresti | 0,028 | 1,310 | 0,162 |
| Constanta | 0,002 | 0,127 | 0,019 |
| Ploesti | 0,003 | 0,132 | 0,017 |
| Braila + Galati | 0,004 | 0,207 | 0,031 |
| Brasov | 0,002 | 0,136 | 0,019 |
| Sibiu | 0,003 | 0,174 | 0,027 |
| Cluj | 0,002 | 0,097 | 0,016 |
| Sofia | 0,029 | 1,127 | 0,123 |
| Niš | 0,003 | 0,162 | 0,021 |
| Beograd | 0,008 | 0,483 | 0,074 |
| Timişoara | 0,002 | 0,100 | 0,017 |
| Arad | 0,001 | 0,047 | 0,008 |
| Oradea | 0,001 | 0,049 | 0,009 |
| Novi Sad | 0,001 | 0,085 | 0,014 |
| Subotica | 0,000 | 0,029 | 0,005 |
| Budapest | 0,006 | 0,390 | 0,071 |
| Bratislava | 0,001 | 0,074 | 0,014 |
| Ostrava | 0,001 | 0,042 | 0,009 |
| Katowice, ... | 0,003 | 0,263 | 0,055 |
| Brno | 0,001 | 0,060 | 0,012 |
| Praha | 0,002 | 0,159 | 0,033 |
| Wien | 0,004 | 0,308 | 0,061 |
| Nürnberg, Fürth, ... | 0,001 | 0,079 | 0,017 |
| Frankfurt, ... | 0,002 | 0,144 | 0,032 |
| Sarajewo | 0,002 | 0,125 | 0,023 |
| Zagreb | 0,002 | 0,166 | 0,031 |
| Graz | 0,001 | 0,049 | 0,010 |
| Ljubljana | 0,001 | 0,052 | 0,010 |
| Trieste | 0,000 | 0,033 | 0,007 |
| Venezia + Treviso | 0,001 | 0,049 | 0,010 |
| Verona | 0,000 | 0,034 | 0,007 |
| Milano | 0,002 | 0,151 | 0,033 |
| München | 0,002 | 0,178 | 0,037 |
| Stuttgart | 0,001 | 0,063 | 0,014 |

9,001

# Polatlı - Afyon

| | | Afyon | Manisa | Izmir | Denizli | Aydin |
|---|---|---|---|---|---|---|
| | | 0,21 | 0,28 | 4,11 | 1,00 | 0,19 |
| Ankara | 4,59 | 2,43 | 5,10 | 5,39 | 3,50 | 4,60 |
| Kırıkkale | 0,19 | 2,94 | 5,61 | 5,90 | 4,01 | 5,11 |
| Kayserı | 1,06 | 4,99 | 7,66 | 7,95 | 6,06 | 7,16 |
| Sivas | 0,35 | 5,84 | 8,51 | 8,80 | 6,91 | 8,01 |
| Samsun | 0,61 | 5,72 | 8,39 | 8,68 | 6,79 | 7,89 |
| Malatya | 0,43 | 7,79 | 10,46 | 10,75 | 8,86 | 9,96 |
| Diyarbakır | 0,93 | 9,64 | 12,31 | 12,60 | 10,71 | 11,81 |
| Van | 0,35 | 11,39 | 14,06 | 14,35 | 12,46 | 13,56 |
| Tabriz | 1,50 | 14,03 | 16,70 | 16,99 | 15,10 | 16,20 |
| Teheran | 8,15 | 19,26 | 21,93 | 22,22 | 20,33 | 21,43 |
| Erzurum | 0,37 | 9,82 | 12,49 | 12,78 | 10,89 | 11,99 |
| Tbilisi | 1,17 | 13,46 | 16,13 | 16,42 | 14,53 | 15,63 |
| Baku | 2,14 | 18,12 | 20,79 | 21,08 | 19,19 | 20,29 |

| | | | | | |
|---|---|---|---|---|---|
| Ankara | 0,213 | 0,081 | 1,076 | 0,546 | 0,065 |
| Kırıkkale | 0,006 | 0,003 | 0,038 | 0,018 | 0,002 |
| Kayserı | 0,014 | 0,009 | 0,128 | 0,050 | 0,007 |
| Sivas | 0,004 | 0,003 | 0,036 | 0,013 | 0,002 |
| Samsun | 0,007 | 0,005 | 0,064 | 0,024 | 0,003 |
| Malatya | 0,003 | 0,002 | 0,031 | 0,011 | 0,002 |
| Diyarbakır | 0,004 | 0,004 | 0,051 | 0,017 | 0,003 |
| Van | 0,001 | 0,001 | 0,016 | 0,005 | 0,001 |
| Tabriz | 0,004 | 0,004 | 0,050 | 0,015 | 0,003 |
| Teheran | 0,011 | 0,012 | 0,172 | 0,049 | 0,008 |
| Erzurum | 0,002 | 0,001 | 0,020 | 0,006 | 0,001 |
| Tbilisi | 0,003 | 0,003 | 0,041 | 0,012 | 0,002 |
| Baku | 0,003 | 0,003 | 0,049 | 0,014 | 0,002 |

| |
|---|
| 3,057 |

# Polatlı - Eskişehir

| | | Eskişehir | Kütakya | Balıkesir | Adopazari | Istanbul | Edirne | Alexandroupolis | Thessaloniki | Plovdiv | Sofia | Niš | Beograd | Budapest | Stara Zagora | Ruse | Bucureşti |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0,69 | 0,20 | 1,19 | 0,27 | 14,66 | 0,15 | 0,07 | 0,33 | 0,37 | 1,21 | 0,26 | 1,35 | 1,74 | 0,14 | 0,15 | 1,88 |
| Ankara | 4,59 | 2,06 | 2,63 | 4,41 | 3,11 | 4,36 | 6,49 | 7,59 | 9,97 | 8,10 | 9,42 | 10,78 | 12,77 | 15,97 | 7,64 | 9,21 | 9,90 |
| Kırıkkale | 0,19 | 2,57 | 3,14 | 4,92 | 3,62 | 4,87 | 7,00 | 8,10 | 10,48 | 8,61 | 9,93 | 11,29 | 13,28 | 16,48 | 8,15 | 9,72 | 10,41 |
| Kayserı | 1,06 | 4,62 | 5,19 | 6,97 | 5,67 | 6,92 | 9,05 | 10,15 | 12,53 | 10,66 | 11,98 | 13,34 | 15,33 | 18,53 | 10,20 | 11,77 | 12,46 |
| Sivas | 0,35 | 5,47 | 6,04 | 7,82 | 6,52 | 7,77 | 9,90 | 11,00 | 13,38 | 11,51 | 12,83 | 14,19 | 16,18 | 19,38 | 11,05 | 12,62 | 13,31 |
| Samsun | 0,61 | 5,35 | 5,92 | 7,70 | 6,40 | 7,65 | 9,78 | 10,88 | 13,26 | 11,39 | 12,71 | 14,07 | 16,06 | 19,26 | 10,93 | 12,50 | 13,19 |
| Malatya | 0,43 | 7,42 | 7,99 | 9,77 | 8,47 | 9,72 | 11,85 | 12,95 | 15,33 | 13,46 | 14,78 | 16,14 | 18,13 | 21,33 | 13,00 | 14,57 | 15,26 |
| Diyarbakır | 0,93 | 9,27 | 9,84 | 11,62 | 10,32 | 11,57 | 13,70 | 14,80 | 17,18 | 15,31 | 16,63 | 17,99 | 19,98 | 23,18 | 14,85 | 16,42 | 17,11 |
| Van | 0,35 | 11,02 | 11,59 | 13,37 | 12,07 | 13,32 | 15,45 | 16,55 | 18,93 | 17,06 | 18,38 | 19,74 | 21,73 | 24,93 | 16,60 | 18,17 | 18,86 |
| Tabriz | 1,50 | 13,66 | 14,23 | 16,01 | 14,71 | 15,96 | 18,09 | 19,19 | 21,57 | 19,70 | 21,02 | 22,38 | 24,37 | 27,57 | 19,24 | 20,81 | 21,50 |
| Teheran | 8,15 | 18,89 | 19,46 | 21,24 | 19,94 | 21,19 | 23,32 | 24,42 | 26,80 | 24,93 | 26,25 | 27,61 | 29,60 | 32,80 | 24,47 | 26,04 | 26,73 |
| Erzurum | 0,37 | 9,45 | 10,02 | 11,80 | 10,50 | 11,75 | 13,88 | 14,98 | 17,36 | 15,49 | 16,81 | 18,17 | 20,16 | 23,36 | 15,03 | 16,60 | 17,29 |
| Tbilisi | 1,17 | 13,06 | 13,63 | 15,41 | 14,11 | 15,36 | 17,49 | 18,59 | 20,97 | 19,10 | 20,42 | 21,78 | 23,77 | 26,97 | 18,64 | 20,21 | 20,90 |
| Baku | 2,14 | 17,48 | 18,05 | 19,83 | 18,53 | 19,78 | 21,91 | 23,01 | 25,39 | 23,52 | 24,84 | 26,20 | 28,19 | 31,39 | 23,06 | 24,63 | 25,32 |
| Konya | 1,22 | 2,76 | 20,00 | 20,00 | 3,81 | 5,06 | 7,19 | 8,29 | 10,67 | 8,80 | 10,12 | 11,48 | 13,47 | 16,67 | 8,34 | 9,91 | 10,60 |
| Mersin | 0,96 | 5,74 | 20,00 | 20,00 | 6,79 | 8,04 | 10,17 | 11,27 | 13,65 | 11,78 | 13,10 | 14,46 | 16,45 | 19,65 | 11,32 | 12,89 | 13,58 |
| Adana | 1,72 | 5,48 | 20,00 | 20,00 | 6,53 | 7,78 | 9,91 | 11,01 | 13,39 | 11,52 | 12,84 | 14,20 | 16,19 | 19,39 | 11,06 | 12,63 | 13,32 |
| Aleppo | 2,30 | 7,87 | 20,00 | 20,00 | 8,92 | 10,17 | 12,30 | 13,40 | 15,78 | 13,91 | 15,23 | 16,59 | 18,58 | 21,78 | 13,45 | 15,02 | 15,71 |
| Damascus | 1,71 | 11,01 | 20,00 | 20,00 | 12,06 | 13,31 | 15,44 | 16,54 | 18,92 | 17,05 | 18,37 | 19,73 | 21,72 | 24,92 | 16,59 | 18,16 | 18,85 |
| Gaziantep | 1,56 | 7,85 | 20,00 | 20,00 | 8,90 | 10,15 | 12,28 | 13,38 | 15,76 | 13,89 | 15,21 | 16,57 | 18,56 | 21,76 | 13,43 | 15,00 | 15,69 |
| Mosul | 0,66 | 12,95 | 20,00 | 20,00 | 14,00 | 15,25 | 17,38 | 18,48 | 20,86 | 18,99 | 20,31 | 21,67 | 23,66 | 26,86 | 18,53 | 20,10 | 20,79 |
| Baghdad | 3,84 | 16,49 | 20,00 | 20,00 | 17,54 | 18,79 | 20,92 | 22,02 | 24,40 | 22,53 | 23,85 | 25,21 | 27,20 | 30,40 | 22,07 | 23,64 | 24,33 |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ankara | | 0,927 | 0,177 | 0,438 | 0,180 | 5,506 | 0,029 | 0,010 | 0,030 | 0,048 | 0,123 | 0,021 | 0,082 | 0,072 | 0,020 | 0,016 | 0,175 |
| Kırıkkale | | 0,026 | 0,005 | 0,015 | 0,006 | 0,189 | 0,001 | 0,000 | 0,001 | 0,002 | 0,005 | 0,001 | 0,003 | 0,003 | 0,001 | 0,001 | 0,007 |
| Kayserı | | 0,054 | 0,013 | 0,046 | 0,015 | 0,580 | 0,004 | 0,001 | 0,005 | 0,007 | 0,019 | 0,003 | 0,014 | 0,013 | 0,003 | 0,002 | 0,027 |
| Sivas | | 0,013 | 0,003 | 0,013 | 0,004 | 0,157 | 0,001 | 0,000 | 0,001 | 0,002 | 0,006 | 0,001 | 0,004 | 0,004 | 0,001 | 0,001 | 0,008 |
| Samsun | | 0,024 | 0,006 | 0,023 | 0,007 | 0,281 | 0,002 | 0,001 | 0,002 | 0,004 | 0,010 | 0,002 | 0,007 | 0,007 | 0,001 | 0,001 | 0,014 |
| Malatya | | 0,010 | 0,003 | 0,011 | 0,003 | 0,132 | 0,001 | 0,000 | 0,001 | 0,002 | 0,005 | 0,001 | 0,004 | 0,004 | 0,001 | 0,001 | 0,008 |
| Diyarbakır | | 0,015 | 0,004 | 0,017 | 0,005 | 0,212 | 0,002 | 0,001 | 0,002 | 0,003 | 0,009 | 0,002 | 0,008 | 0,008 | 0,001 | 0,001 | 0,014 |
| Van | | 0,004 | 0,001 | 0,005 | 0,001 | 0,063 | 0,001 | 0,000 | 0,001 | 0,001 | 0,003 | 0,001 | 0,003 | 0,003 | 0,000 | 0,000 | 0,004 |
| Tabriz | | 0,012 | 0,003 | 0,016 | 0,004 | 0,198 | 0,002 | 0,001 | 0,003 | 0,003 | 0,010 | 0,002 | 0,009 | 0,009 | 0,001 | 0,001 | 0,015 |
| Teheran | | 0,038 | 0,010 | 0,054 | 0,014 | 0,665 | 0,006 | 0,002 | 0,010 | 0,013 | 0,038 | 0,008 | 0,035 | 0,038 | 0,005 | 0,005 | 0,057 |
| Erzurum | | 0,006 | 0,001 | 0,007 | 0,002 | 0,082 | 0,001 | 0,000 | 0,001 | 0,001 | 0,004 | 0,001 | 0,003 | 0,003 | 0,001 | 0,000 | 0,005 |
| Tbilisi | | 0,010 | 0,003 | 0,013 | 0,004 | 0,165 | 0,001 | 0,001 | 0,002 | 0,003 | 0,008 | 0,002 | 0,007 | 0,008 | 0,001 | 0,001 | 0,013 |
| Baku | | 0,011 | 0,003 | 0,016 | 0,004 | 0,196 | 0,002 | 0,001 | 0,003 | 0,004 | 0,011 | 0,002 | 0,010 | 0,011 | 0,001 | 0,001 | 0,017 |
| Konya | | 0,150 | 0,001 | 0,009 | 0,034 | 1,136 | 0,006 | 0,002 | 0,007 | 0,011 | 0,029 | 0,005 | 0,020 | 0,018 | 0,005 | 0,004 | 0,041 |
| Mersin | | 0,034 | 0,001 | 0,007 | 0,010 | 0,407 | 0,003 | 0,001 | 0,004 | 0,005 | 0,015 | 0,003 | 0,011 | 0,011 | 0,002 | 0,002 | 0,021 |
| Adana | | 0,066 | 0,002 | 0,013 | 0,019 | 0,771 | 0,005 | 0,002 | 0,007 | 0,010 | 0,027 | 0,005 | 0,020 | 0,019 | 0,004 | 0,003 | 0,040 |
| Aleppo | | 0,048 | 0,003 | 0,017 | 0,015 | 0,654 | 0,005 | 0,002 | 0,007 | 0,010 | 0,027 | 0,005 | 0,022 | 0,021 | 0,004 | 0,003 | 0,040 |
| Damascus | | 0,020 | 0,002 | 0,012 | 0,007 | 0,308 | 0,002 | 0,001 | 0,004 | 0,005 | 0,015 | 0,003 | 0,012 | 0,013 | 0,002 | 0,002 | 0,022 |
| Gaziantep | | 0,032 | 0,002 | 0,011 | 0,010 | 0,445 | 0,003 | 0,001 | 0,005 | 0,007 | 0,018 | 0,003 | 0,015 | 0,014 | 0,003 | 0,002 | 0,027 |
| Mosul | | 0,006 | 0,001 | 0,005 | 0,002 | 0,094 | 0,001 | 0,000 | 0,001 | 0,002 | 0,005 | 0,001 | 0,004 | 0,004 | 0,001 | 0,001 | 0,007 |
| Baghdad | | 0,023 | 0,005 | 0,028 | 0,008 | 0,384 | 0,003 | 0,001 | 0,006 | 0,007 | 0,021 | 0,004 | 0,019 | 0,020 | 0,003 | 0,003 | 0,032 |

17,701

## Polatlı - Konya

| | | Konya | Adana | Gaziantep | Aleppo | Damascus | Iskenderun | Mersin | Alanya | Antalya |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1,22 | 1,72 | 1,56 | 2,30 | 1,71 | 0,24 | 0,96 | 0,29 | 2,22 |
| Ankara | 4,59 | 2,28 | 5,00 | 7,37 | 7,39 | 10,53 | 7,37 | 5,26 | 3,80 | 4,21 |
| Kırıkkale | 0,19 | 2,79 | 5,51 | 7,88 | 7,90 | 11,04 | 7,88 | 5,77 | 4,31 | 4,72 |
| Sivas | 0,35 | 5,69 | 8,41 | 10,78 | 10,80 | 13,94 | 10,78 | 8,67 | 7,21 | 7,62 |
| Samsun | 0,61 | 5,57 | 8,29 | 10,66 | 10,68 | 13,82 | 10,66 | 8,55 | 7,09 | 7,50 |
| Karabük | 0,24 | 4,47 | 7,19 | 9,56 | 9,58 | 12,72 | 9,56 | 7,45 | 5,99 | 6,40 |
| Zonguldaz | 0,21 | 5,21 | 7,93 | 10,30 | 10,32 | 13,46 | 10,30 | 8,19 | 6,73 | 7,14 |
| Eskişehir | 0,69 | 2,76 | 5,48 | 7,85 | 7,87 | 11,01 | 7,85 | 5,74 | 4,28 | 4,69 |
| Adapazari | 0,27 | 3,81 | 6,53 | 8,90 | 8,92 | 12,06 | 8,90 | 6,79 | 5,33 | 5,74 |
| Istanbul | 14,66 | 5,06 | 7,78 | 10,15 | 10,17 | 13,31 | 10,15 | 8,04 | 6,58 | 6,99 |
| Edirne | 0,15 | 7,19 | 9,91 | 12,28 | 12,30 | 15,44 | 12,28 | 10,17 | 8,71 | 9,12 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Ankara | 1,379 | 0,512 | 0,240 | 0,352 | 0,143 | 0,037 | 0,262 | 0,138 | 0,885 |
| Kırıkkale | 0,041 | 0,018 | 0,009 | 0,013 | 0,005 | 0,001 | 0,009 | 0,005 | 0,030 |
| Sivas | 0,022 | 0,016 | 0,010 | 0,014 | 0,007 | 0,001 | 0,009 | 0,004 | 0,025 |
| Samsdun | 0,040 | 0,029 | 0,017 | 0,025 | 0,012 | 0,003 | 0,015 | 0,006 | 0,044 |
| Karabük | 0,023 | 0,014 | 0,008 | 0,012 | 0,005 | 0,001 | 0,008 | 0,003 | 0,023 |
| Zonguldaz | 0,015 | 0,011 | 0,006 | 0,009 | 0,004 | 0,001 | 0,006 | 0,002 | 0,016 |
| Eskişehir | 0,150 | 0,066 | 0,032 | 0,048 | 0,020 | 0,005 | 0,034 | 0,017 | 0,111 |
| Adapazari | 0,034 | 0,019 | 0,010 | 0,015 | 0,007 | 0,002 | 0,010 | 0,005 | 0,031 |
| Istanbul | 1,136 | 0,771 | 0,445 | 0,654 | 0,308 | 0,068 | 0,407 | 0,173 | 1,194 |
| Edirne | 0,006 | 0,005 | 0,003 | 0,005 | 0,002 | 0,001 | 0,003 | 0,001 | 0,008 |

| |
|---|
| 10,350 |

# Poznań - Berlin

| | | Berlin + Potsdam | Rostock | Lübeck | Hamburg | Magdeburg | Hannover | Bremen + Oldenburg | Münster + Osnabrück | Utrecht + Amst. + Rott. | Düsseldorf + Ruhrgebiet | Köln | Bruxelles | Leipzig + Halle | Erfurt | Frankfurt + ... | Würzburg | Stuttgart | Nürnberg | München |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 3,66 | 0,21 | 0,21 | 1,79 | 0,24 | 0,51 | 0,72 | 0,47 | 1,78 | 5,71 | 1,06 | 1,83 | 0,76 | 0,21 | 1,60 | 0,13 | 0,62 | 0,74 | 1,45 |
| Poznań | 0,55 | 2,42 | 4,34 | 4,24 | 4,78 | 3,71 | 5,01 | 6,01 | 6,16 | 8,31 | 7,21 | 7,66 | 9,57 | 3,88 | 4,90 | 6,77 | 6,38 | 7,65 | 6,57 | 8,05 |
| Toruń | 0,20 | 3,66 | 5,58 | 5,48 | 6,02 | 4,95 | 6,25 | 7,25 | 7,40 | 9,55 | 8,45 | 8,90 | 10,81 | 5,12 | 6,14 | 8,01 | 7,62 | 8,89 | 7,81 | 9,29 |
| Olsztyn | 0,18 | 5,46 | 7,38 | 7,28 | 7,82 | 6,75 | 8,05 | 9,05 | 9,20 | 11,35 | 10,25 | 10,70 | 12,61 | 6,92 | 7,94 | 9,81 | 9,42 | 10,69 | 9,61 | 11,09 |
| Łódź | 0,72 | 4,32 | 6,24 | 6,14 | 6,68 | 5,61 | 6,91 | 7,91 | 8,06 | 10,21 | 9,11 | 9,56 | 11,47 | 5,78 | 6,80 | 8,67 | 8,28 | 9,55 | 8,47 | 9,95 |
| Warzsawa | 1,71 | 5,48 | 7,40 | 7,30 | 7,84 | 6,77 | 8,07 | 9,07 | 9,22 | 11,37 | 10,27 | 10,72 | 12,63 | 6,94 | 7,96 | 9,83 | 9,44 | 10,71 | 9,63 | 11,11 |
| Białystok | 0,29 | 7,26 | 9,18 | 9,08 | 9,62 | 8,55 | 9,85 | 10,85 | 11,00 | 13,15 | 12,05 | 12,50 | 14,41 | 8,72 | 9,74 | 11,61 | 11,22 | 12,49 | 11,41 | 12,89 |
| Kaunas | 0,31 | 9,26 | 11,18 | 11,08 | 11,62 | 10,55 | 11,85 | 12,85 | 13,00 | 15,15 | 14,05 | 14,50 | 16,41 | 10,72 | 11,74 | 13,61 | 13,22 | 14,49 | 13,41 | 14,89 |
| Vilnius | 0,54 | 10,16 | 12,08 | 11,98 | 12,52 | 11,45 | 12,75 | 13,75 | 13,90 | 16,05 | 14,95 | 15,40 | 17,31 | 11,62 | 12,64 | 14,51 | 14,12 | 15,39 | 14,31 | 15,79 |
| Riga | 0,64 | 11,49 | 13,41 | 13,31 | 13,85 | 12,78 | 14,08 | 15,08 | 15,23 | 17,38 | 16,28 | 16,73 | 18,64 | 12,95 | 13,97 | 15,84 | 15,45 | 16,72 | 15,64 | 17,12 |
| Tallinn | 0,41 | 14,30 | 16,22 | 16,12 | 16,66 | 15,59 | 16,89 | 17,89 | 18,04 | 20,19 | 19,09 | 19,54 | 21,45 | 15,76 | 16,78 | 18,65 | 18,26 | 19,53 | 18,45 | 19,93 |
| Brest | 0,31 | 7,33 | 9,25 | 9,15 | 9,69 | 8,62 | 9,92 | 10,92 | 11,07 | 13,22 | 12,12 | 12,57 | 14,48 | 8,79 | 9,81 | 11,68 | 11,29 | 12,56 | 11,48 | 12,96 |
| Minsk | 1,89 | 10,63 | 12,55 | 12,45 | 12,99 | 11,92 | 13,22 | 14,22 | 14,37 | 16,52 | 15,42 | 15,87 | 17,78 | 12,09 | 13,11 | 14,98 | 14,59 | 15,86 | 14,78 | 16,26 |
| Smolensk | 0,33 | 13,75 | 15,67 | 15,57 | 16,11 | 15,04 | 16,34 | 17,34 | 17,49 | 19,64 | 18,54 | 18,99 | 20,90 | 15,21 | 16,23 | 18,10 | 17,71 | 18,98 | 17,90 | 19,38 |
| Moskwa + ... | 12,86 | 17,43 | 19,35 | 19,25 | 19,79 | 18,72 | 20,02 | 21,02 | 21,17 | 23,32 | 22,22 | 22,67 | 24,58 | 18,89 | 19,91 | 21,78 | 21,39 | 22,66 | 21,58 | 23,06 |
| Lublin | 0,34 | 7,04 | 8,96 | 8,86 | 9,40 | 8,33 | 9,63 | 10,63 | 10,78 | 12,93 | 11,83 | 12,28 | 14,19 | 8,50 | 9,52 | 11,39 | 11,00 | 12,27 | 11,19 | 12,67 |
| Kijiv | 2,80 | 12,70 | 14,62 | 14,52 | 15,06 | 13,99 | 15,29 | 16,29 | 16,44 | 18,59 | 17,49 | 17,94 | 19,85 | 14,16 | 15,18 | 17,05 | 16,66 | 17,93 | 16,85 | 18,33 |
| Krakow | 0,76 | 6,24 | 8,16 | 8,06 | 8,60 | 7,53 | 8,83 | 9,83 | 9,98 | 12,13 | 11,03 | 11,48 | 13,39 | 7,70 | 8,72 | 10,59 | 10,20 | 11,47 | 10,39 | 11,87 |
| Lviv | 0,72 | 9,16 | 11,08 | 10,98 | 11,52 | 10,45 | 11,75 | 12,75 | 12,90 | 15,05 | 13,95 | 14,40 | 16,31 | 10,62 | 11,64 | 13,51 | 13,12 | 14,39 | 13,31 | 14,79 |
| Katowice | 1,28 | 6,02 | 7,94 | 7,84 | 8,38 | 7,31 | 8,61 | 9,61 | 9,76 | 11,91 | 10,81 | 11,26 | 13,17 | 7,48 | 8,50 | 10,37 | 9,98 | 11,25 | 10,17 | 11,65 |
| Ostrava | 0,30 | 6,77 | 8,69 | 8,59 | 9,13 | 8,06 | 9,36 | 10,36 | 10,51 | 12,66 | 11,56 | 12,01 | 13,92 | 8,23 | 9,25 | 11,12 | 10,73 | 12,00 | 10,92 | 12,40 |
| Wrocław | 0,63 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Poznań | 0,448 | 0,010 | 0,010 | 0,069 | 0,014 | 0,018 | 0,019 | 0,012 | 0,027 | 0,109 | 0,018 | 0,022 | 0,042 | 0,008 | 0,034 | 0,003 | 0,011 | 0,017 | 0,023 |
| Toruń | 0,081 | 0,002 | 0,002 | 0,017 | 0,003 | 0,005 | 0,005 | 0,003 | 0,008 | 0,030 | 0,005 | 0,006 | 0,009 | 0,002 | 0,009 | 0,001 | 0,003 | 0,004 | 0,007 |
| Olsztyn | 0,037 | 0,001 | 0,001 | 0,010 | 0,002 | 0,003 | 0,003 | 0,002 | 0,005 | 0,020 | 0,003 | 0,004 | 0,005 | 0,001 | 0,006 | 0,001 | 0,002 | 0,003 | 0,004 |
| Łódź | 0,219 | 0,007 | 0,007 | 0,051 | 0,009 | 0,014 | 0,015 | 0,010 | 0,025 | 0,096 | 0,016 | 0,021 | 0,028 | 0,006 | 0,029 | 0,003 | 0,010 | 0,014 | 0,021 |
| Warzsawa | 0,347 | 0,012 | 0,012 | 0,092 | 0,016 | 0,025 | 0,029 | 0,018 | 0,049 | 0,186 | 0,032 | 0,042 | 0,048 | 0,011 | 0,056 | 0,005 | 0,019 | 0,027 | 0,041 |
| Białystok | 0,036 | 0,001 | 0,001 | 0,011 | 0,002 | 0,003 | 0,004 | 0,002 | 0,006 | 0,024 | 0,004 | 0,006 | 0,006 | 0,001 | 0,007 | 0,001 | 0,002 | 0,003 | 0,005 |
| Kaunas | 0,026 | 0,001 | 0,001 | 0,009 | 0,001 | 0,002 | 0,003 | 0,002 | 0,005 | 0,020 | 0,003 | 0,005 | 0,004 | 0,001 | 0,006 | 0,001 | 0,002 | 0,003 | 0,005 |
| Vilnius | 0,038 | 0,002 | 0,002 | 0,013 | 0,002 | 0,004 | 0,005 | 0,003 | 0,009 | 0,031 | 0,005 | 0,008 | 0,006 | 0,002 | 0,009 | 0,001 | 0,003 | 0,004 | 0,007 |
| Riga | 0,037 | 0,002 | 0,002 | 0,013 | 0,002 | 0,004 | 0,005 | 0,003 | 0,009 | 0,032 | 0,006 | 0,008 | 0,006 | 0,002 | 0,009 | 0,001 | 0,003 | 0,004 | 0,007 |
| Tallinn | 0,016 | 0,001 | 0,001 | 0,006 | 0,001 | 0,002 | 0,002 | 0,001 | 0,004 | 0,016 | 0,003 | 0,004 | 0,003 | 0,001 | 0,005 | 0,000 | 0,002 | 0,002 | 0,004 |
| Brest | 0,038 | 0,001 | 0,002 | 0,012 | 0,002 | 0,003 | 0,004 | 0,002 | 0,007 | 0,025 | 0,004 | 0,006 | 0,006 | 0,001 | 0,008 | 0,001 | 0,003 | 0,004 | 0,006 |
| Minsk | 0,124 | 0,005 | 0,005 | 0,043 | 0,007 | 0,012 | 0,015 | 0,010 | 0,029 | 0,103 | 0,018 | 0,026 | 0,021 | 0,005 | 0,030 | 0,003 | 0,011 | 0,014 | 0,024 |
| Smolensk | 0,014 | 0,001 | 0,001 | 0,005 | 0,001 | 0,001 | 0,002 | 0,001 | 0,004 | 0,013 | 0,002 | 0,003 | 0,002 | 0,001 | 0,004 | 0,000 | 0,001 | 0,002 | 0,003 |
| Moskwa + ... | 0,365 | 0,018 | 0,018 | 0,144 | 0,021 | 0,040 | 0,052 | 0,034 | 0,108 | 0,377 | 0,068 | 0,102 | 0,066 | 0,017 | 0,109 | 0,009 | 0,040 | 0,051 | 0,090 |
| Lublin | 0,045 | 0,002 | 0,002 | 0,013 | 0,002 | 0,004 | 0,004 | 0,003 | 0,008 | 0,029 | 0,005 | 0,007 | 0,007 | 0,002 | 0,009 | 0,001 | 0,003 | 0,004 | 0,007 |
| Kijiv | 0,136 | 0,006 | 0,006 | 0,050 | 0,008 | 0,014 | 0,018 | 0,011 | 0,035 | 0,123 | 0,022 | 0,032 | 0,024 | 0,006 | 0,036 | 0,003 | 0,013 | 0,017 | 0,029 |
| Krakow | 0,124 | 0,004 | 0,005 | 0,035 | 0,006 | 0,010 | 0,011 | 0,007 | 0,019 | 0,073 | 0,013 | 0,017 | 0,018 | 0,004 | 0,022 | 0,002 | 0,007 | 0,011 | 0,016 |
| Lviv | 0,061 | 0,003 | 0,003 | 0,020 | 0,003 | 0,006 | 0,007 | 0,004 | 0,013 | 0,047 | 0,008 | 0,011 | 0,010 | 0,002 | 0,014 | 0,001 | 0,005 | 0,007 | 0,011 |
| Katowice | 0,222 | 0,008 | 0,008 | 0,062 | 0,010 | 0,017 | 0,020 | 0,013 | 0,034 | 0,128 | 0,022 | 0,029 | 0,032 | 0,007 | 0,038 | 0,003 | 0,013 | 0,018 | 0,029 |
| Ostrava | 0,043 | 0,002 | 0,002 | 0,013 | 0,002 | 0,003 | 0,004 | 0,003 | 0,007 | 0,027 | 0,005 | 0,006 | 0,006 | 0,001 | 0,008 | 0,001 | 0,003 | 0,004 | 0,006 |
| Wrocław | 0,014 | 0,001 | 0,001 | 0,007 | 0,001 | 0,002 | 0,003 | 0,002 | 0,007 | 0,022 | 0,004 | 0,007 | 0,003 | 0,001 | 0,006 | 0,001 | 0,002 | 0,003 | 0,006 |

8,265

# Praha - Dresden

| | | Dresden | Berlin | Szczecin | Rostock | Lübeck | Hamburg | Magdeburg | Hannover | Bremen + Oldenburg | Osnabrüch + Münster | Utrecht, Amst., Rott. | Leipzig + Halle | Erfurt | Frankfurt |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0,53 | 3,66 | 0,41 | 0,21 | 0,21 | 1,79 | 0,24 | 0,51 | 0,72 | 0,47 | 1,78 | 0,75 | 0,21 | 1,60 |
| Praha | 1,27 | 1,19 | 2,82 | 4,10 | 4,74 | 5,18 | 5,35 | 4,11 | 5,41 | 6,41 | 6,56 | 8,71 | 2,21 | 3,23 | 5,10 |
| Pardubice + Hr. Kralove | 0,18 | 2,19 | 3,82 | 5,10 | 5,74 | 6,18 | 6,35 | 5,11 | 6,41 | 7,41 | 7,56 | 9,71 | 3,21 | 4,23 | 6,10 |
| Ostrava | 0,30 | 4,00 | 5,63 | 6,91 | 7,55 | 7,99 | 8,16 | 6,92 | 8,22 | 9,22 | 9,37 | 11,52 | 5,02 | 6,04 | 7,91 |
| Žilina | 0,08 | 4,75 | 6,38 | 7,66 | 8,30 | 8,74 | 8,91 | 7,67 | 8,97 | 9,97 | 10,12 | 12,27 | 5,77 | 6,79 | 8,66 |
| Košice + Prešov | 0,33 | 6,68 | 8,31 | 9,59 | 10,23 | 10,67 | 10,84 | 9,60 | 10,90 | 11,90 | 12,05 | 14,20 | 7,70 | 8,72 | 10,59 |
| Brno | 0,39 | 3,06 | 4,69 | 5,97 | 6,61 | 7,05 | 7,22 | 5,98 | 7,28 | 8,28 | 8,43 | 10,58 | 4,08 | 5,10 | 6,97 |
| Bratislava | 0,42 | 4,23 | 5,86 | 7,14 | 7,78 | 8,22 | 8,39 | 7,15 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Györ | 0,13 | 4,93 | 6,56 | 7,84 | 8,48 | 8,92 | 9,09 | 7,85 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Budapest | 1,74 | 5,97 | 7,60 | 8,88 | 9,52 | 9,96 | 10,13 | 8,89 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Debrecen | 0,21 | 7,95 | 9,58 | 10,86 | 11,50 | 11,94 | 12,11 | 10,87 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Arad | 0,16 | 8,21 | 9,84 | 11,12 | 11,76 | 12,20 | 12,37 | 11,13 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Sibiu | 0,43 | 10,41 | 12,04 | 13,32 | 13,96 | 14,40 | 14,57 | 13,33 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Braşov | 0,28 | 11,24 | 12,87 | 14,15 | 14,79 | 15,23 | 15,40 | 14,16 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Bucureşti | 1,88 | 12,66 | 14,29 | 15,57 | 16,21 | 16,65 | 16,82 | 15,58 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Timişoara | 0,32 | 8,56 | 10,19 | 11,47 | 12,11 | 12,55 | 12,72 | 11,48 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Beograd | 1,32 | 9,17 | 10,80 | 12,08 | 12,72 | 13,16 | 13,33 | 12,09 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Wien | 1,84 | 4,11 | 5,74 | 7,02 | 7,66 | 8,10 | 8,27 | 7,03 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| C. Budejovice | 0,09 | 2,42 | 4,05 | 5,33 | 5,97 | 6,41 | 6,58 | 5,34 | 6,64 | 7,64 | 7,79 | 9,94 | 3,44 | 4,46 | 6,33 |
| Linz + Wels | 0,20 | 3,20 | 4,83 | 6,11 | 6,75 | 7,19 | 7,36 | 6,12 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Graz | 0,28 | 4,83 | 6,46 | 7,74 | 8,38 | 8,82 | 8,99 | 7,75 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Maribor | 0,09 | 5,39 | 7,02 | 8,30 | 8,94 | 9,38 | 9,55 | 8,31 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Zagreb | 0,79 | 6,25 | 7,88 | 9,16 | 9,80 | 10,24 | 10,41 | 9,17 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Salzburg | 0,15 | 4,32 | 5,95 | 7,23 | 7,87 | 8,31 | 8,48 | 7,24 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Klagenfurt + Villach | 0,16 | 5,72 | 7,35 | 8,63 | 9,27 | 9,71 | 9,88 | 8,64 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Ljubljana | 0,29 | 6,56 | 8,19 | 9,47 | 10,11 | 10,55 | 10,72 | 9,48 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Praha | 0,501 | 0,798 | 0,047 | 0,019 | 0,016 | 0,131 | 0,028 | 0,037 | 0,039 | 0,024 | 0,057 | 0,247 | 0,036 | 0,127 |
| Pardubice + Hr. Kralove | 0,025 | 0,067 | 0,005 | 0,002 | 0,002 | 0,014 | 0,003 | 0,004 | 0,004 | 0,003 | 0,007 | 0,019 | 0,003 | 0,013 |
| Ostrava | 0,015 | 0,058 | 0,005 | 0,002 | 0,002 | 0,015 | 0,003 | 0,004 | 0,005 | 0,003 | 0,008 | 0,014 | 0,003 | 0,014 |
| Žilina | 0,003 | 0,013 | 0,001 | 0,000 | 0,000 | 0,003 | 0,001 | 0,001 | 0,001 | 0,001 | 0,002 | 0,003 | 0,001 | 0,003 |
| Košice + Prešov | 0,007 | 0,033 | 0,003 | 0,001 | 0,001 | 0,010 | 0,002 | 0,003 | 0,004 | 0,002 | 0,006 | 0,008 | 0,002 | 0,010 |
| Brno | 0,031 | 0,103 | 0,008 | 0,003 | 0,003 | 0,024 | 0,004 | 0,007 | 0,008 | 0,005 | 0,013 | 0,027 | 0,005 | 0,023 |
| Bratislava | 0,019 | 0,076 | 0,006 | 0,003 | 0,002 | 0,020 | 0,004 | 0,001 | 0,002 | 0,001 | 0,005 | 0,002 | 0,001 | 0,004 |
| Györ | 0,005 | 0,019 | 0,002 | 0,001 | 0,001 | 0,005 | 0,001 | 0,000 | 0,001 | 0,000 | 0,001 | 0,001 | 0,000 | 0,001 |
| Budapest | 0,044 | 0,203 | 0,017 | 0,008 | 0,007 | 0,061 | 0,010 | 0,005 | 0,008 | 0,005 | 0,019 | 0,008 | 0,002 | 0,017 |
| Debrecen | 0,003 | 0,016 | 0,001 | 0,001 | 0,001 | 0,005 | 0,001 | 0,001 | 0,001 | 0,001 | 0,002 | 0,001 | 0,000 | 0,002 |
| Arad | 0,002 | 0,012 | 0,001 | 0,001 | 0,000 | 0,004 | 0,001 | 0,001 | 0,001 | 0,000 | 0,002 | 0,001 | 0,000 | 0,002 |
| Sibiu | 0,004 | 0,023 | 0,002 | 0,001 | 0,001 | 0,008 | 0,001 | 0,001 | 0,002 | 0,001 | 0,005 | 0,002 | 0,001 | 0,004 |
| Braşov | 0,002 | 0,013 | 0,001 | 0,001 | 0,001 | 0,005 | 0,001 | 0,001 | 0,001 | 0,001 | 0,003 | 0,001 | 0,000 | 0,003 |
| Bucureşti | 0,013 | 0,075 | 0,007 | 0,003 | 0,003 | 0,028 | 0,004 | 0,006 | 0,008 | 0,005 | 0,021 | 0,009 | 0,002 | 0,018 |
| Timişoara | 0,004 | 0,023 | 0,002 | 0,001 | 0,001 | 0,008 | 0,001 | 0,001 | 0,001 | 0,001 | 0,003 | 0,001 | 0,000 | 0,003 |
| Beograd | 0,016 | 0,085 | 0,008 | 0,004 | 0,003 | 0,029 | 0,005 | 0,004 | 0,006 | 0,004 | 0,014 | 0,006 | 0,002 | 0,013 |
| Wien | 0,088 | 0,345 | 0,027 | 0,012 | 0,011 | 0,091 | 0,016 | 0,006 | 0,008 | 0,005 | 0,020 | 0,008 | 0,002 | 0,018 |
| C. Budejovice | 0,011 | 0,031 | 0,002 | 0,001 | 0,001 | 0,007 | 0,001 | 0,002 | 0,002 | 0,001 | 0,003 | 0,008 | 0,001 | 0,006 |
| Linz + Wels | 0,015 | 0,050 | 0,004 | 0,002 | 0,001 | 0,012 | 0,002 | 0,001 | 0,001 | 0,001 | 0,002 | 0,001 | 0,000 | 0,002 |
| Graz | 0,010 | 0,043 | 0,004 | 0,002 | 0,001 | 0,012 | 0,002 | 0,001 | 0,001 | 0,001 | 0,003 | 0,001 | 0,000 | 0,003 |
| Maribor | 0,003 | 0,012 | 0,001 | 0,000 | 0,000 | 0,003 | 0,001 | 0,000 | 0,000 | 0,000 | 0,001 | 0,000 | 0,000 | 0,001 |
| Zagreb | 0,019 | 0,086 | 0,008 | 0,003 | 0,003 | 0,026 | 0,004 | 0,002 | 0,003 | 0,002 | 0,009 | 0,004 | 0,001 | 0,008 |
| Salzburg | 0,007 | 0,026 | 0,002 | 0,001 | 0,001 | 0,007 | 0,001 | 0,000 | 0,001 | 0,000 | 0,002 | 0,001 | 0,000 | 0,001 |
| Klagenfurt + Villach | 0,004 | 0,020 | 0,002 | 0,001 | 0,001 | 0,006 | 0,001 | 0,001 | 0,001 | 0,000 | 0,002 | 0,001 | 0,000 | 0,002 |
| Ljubljana | 0,006 | 0,030 | 0,003 | 0,001 | 0,001 | 0,009 | 0,002 | 0,001 | 0,001 | 0,001 | 0,003 | 0,001 | 0,000 | 0,003 |

4,439

## Riga - Tallinn

| | | Tallinn | St. Petersburg | Helsinki + Espoo | Lahti | Tampere |
|---|---|---|---|---|---|---|
| | | 0,41 | 4,99 | 0,90 | 0,10 | 0,23 |
| Riga | 0,64 | 2,81 | 6,01 | 3,63 | 4,61 | 5,23 |
| Daugavpils | 0,09 | 4,69 | 7,89 | 5,51 | 6,49 | 7,11 |
| Kaunas | 0,31 | 5,04 | 8,24 | 5,86 | 6,84 | 7,46 |
| Vilnius | 0,54 | 5,94 | 9,14 | 6,76 | 7,74 | 8,36 |
| Minsk | 1,89 | 7,66 | 10,86 | 8,48 | 9,46 | 10,08 |
| Kaliningrad | 0,44 | 7,25 | 10,45 | 8,07 | 9,05 | 9,67 |
| Gdańsk + Gdynia | 0,71 | 8,53 | 11,73 | 9,35 | 10,33 | 10,95 |
| Białystok | 0,29 | 7,04 | 10,24 | 7,86 | 8,84 | 9,46 |
| Warszawa | 1,71 | 8,82 | 12,02 | 9,64 | 10,62 | 11,24 |
| Lublin | 0,35 | 10,38 | 13,58 | 11,20 | 12,18 | 12,80 |
| Lviv | 0,72 | 12,25 | 15,45 | 13,07 | 14,05 | 14,67 |
| Krakow | 0,76 | 11,35 | 14,55 | 12,17 | 13,15 | 13,77 |
| Tarnov | 0,11 | 12,09 | 15,29 | 12,91 | 13,89 | 14,51 |
| Kosice | 0,24 | 13,86 | 17,06 | 14,68 | 15,66 | 16,28 |
| Katowice | 1,28 | 11,40 | 14,60 | 12,22 | 13,20 | 13,82 |
| Ostrava | 0,30 | 12,15 | 15,35 | 12,97 | 13,95 | 14,57 |
| Brno | 0,39 | 13,58 | 16,78 | 14,40 | 15,38 | 16,00 |
| Wien | 1,84 | 14,30 | 17,50 | 15,12 | 16,10 | 16,72 |
| Bratislava | 0,42 | 14,18 | 17,38 | 15,00 | 15,98 | 16,60 |
| Budapest | 1,74 | 15,92 | 19,12 | 16,74 | 17,72 | 18,34 |
| Łodz | 0,72 | 9,98 | 13,18 | 10,80 | 11,78 | 12,40 |
| Wrocław | 0,63 | 11,83 | 15,03 | 12,65 | 13,63 | 14,25 |
| Praha | 1,27 | 14,07 | 17,27 | 14,89 | 15,87 | 16,49 |
| Poznań | 0,55 | 11,88 | 15,08 | 12,70 | 13,68 | 14,30 |
| Berlin | 3,66 | 14,30 | 17,50 | 15,12 | 16,10 | 16,72 |
| Leipzig + Halle | 0,75 | 15,76 | 18,96 | 16,58 | 17,56 | 18,18 |
| Hannover | 0,51 | 16,89 | 20,09 | 17,71 | 18,69 | 19,31 |
| Hamburg | 1,79 | 16,83 | 20,03 | 17,65 | 18,63 | 19,25 |

| | | | | | |
|---|---|---|---|---|---|
| Riga | 0,045 | 0,151 | 0,064 | 0,005 | 0,009 |
| Daugavpils | 0,003 | 0,013 | 0,004 | 0,000 | 0,001 |
| Kaunas | 0,008 | 0,043 | 0,014 | 0,001 | 0,002 |
| Vilnius | 0,011 | 0,063 | 0,019 | 0,002 | 0,003 |
| Minsk | 0,024 | 0,164 | 0,045 | 0,004 | 0,009 |
| Kaliningrad | 0,006 | 0,041 | 0,011 | 0,001 | 0,002 |
| Gdańsk + Gdynia | 0,008 | 0,054 | 0,014 | 0,001 | 0,003 |
| Białystok | 0,004 | 0,028 | 0,008 | 0,001 | 0,001 |
| Warszawa | 0,017 | 0,125 | 0,033 | 0,003 | 0,006 |
| Lublin | 0,003 | 0,021 | 0,005 | 0,000 | 0,001 |
| Lviv | 0,004 | 0,034 | 0,008 | 0,001 | 0,002 |
| Krakow | 0,005 | 0,040 | 0,010 | 0,001 | 0,002 |
| Tarnov | 0,001 | 0,005 | 0,001 | 0,000 | 0,000 |
| Kosice | 0,001 | 0,010 | 0,002 | 0,000 | 0,000 |
| Katowice | 0,008 | 0,067 | 0,016 | 0,002 | 0,003 |
| Ostrava | 0,002 | 0,014 | 0,003 | 0,000 | 0,001 |
| Brno | 0,002 | 0,016 | 0,004 | 0,000 | 0,001 |
| Wien | 0,008 | 0,071 | 0,016 | 0,002 | 0,004 |
| Bratislava | 0,002 | 0,016 | 0,004 | 0,000 | 0,001 |
| Budapest | 0,006 | 0,058 | 0,013 | 0,001 | 0,003 |
| Łodz | 0,006 | 0,045 | 0,011 | 0,001 | 0,002 |
| Wrocław | 0,004 | 0,031 | 0,008 | 0,001 | 0,002 |
| Praha | 0,006 | 0,050 | 0,012 | 0,001 | 0,002 |
| Poznań | 0,003 | 0,027 | 0,007 | 0,001 | 0,001 |
| Berlin | 0,016 | 0,141 | 0,033 | 0,003 | 0,007 |
| Leipzig + Halle | 0,003 | 0,025 | 0,006 | 0,001 | 0,001 |
| Hannover | 0,002 | 0,016 | 0,003 | 0,000 | 0,001 |
| Hamburg | 0,006 | 0,055 | 0,012 | 0,001 | 0,003 |

2,133

# Rostow n.D. - Voronesh

| | | Voronesh | Kursk | Ryazan | Mokwa | Smolensk | Minsk | Vilnius | St.Petersburg | Pskow | Tallinn | Helsinki | Yaroslawl | Rybinsk | Vologda | Kostroma | Vladimir | Nishnij Nowgorod |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1,00 | 0,42 | 0,53 | 12,86 | 0,33 | 1,89 | 0,54 | 4,99 | 0,21 | 0,41 | 0,90 | 0,60 | 0,20 | 0,31 | 0,27 | 0,35 | 1,26 |
| Rostow n. D. | 1,87 | 4,91 | 6,99 | 8,23 | 10,07 | 13,75 | 16,87 | 18,59 | 16,40 | 19,02 | 19,60 | 19,85 | 12,56 | 13,33 | 14,40 | 13,23 | 11,84 | 13,96 |
| Krasnodar | 0,75 | 7,40 | 9,48 | 10,72 | 12,56 | 16,24 | 19,36 | 21,08 | 18,89 | 21,51 | 22,09 | 22,34 | 15,05 | 15,82 | 16,89 | 15,72 | 14,33 | 16,45 |
| Sotchi | 0,36 | 9,09 | 11,17 | 12,41 | 14,25 | 17,93 | 21,05 | 22,77 | 20,58 | 23,20 | 23,78 | 24,03 | 16,74 | 17,51 | 18,58 | 17,41 | 16,02 | 18,14 |
| Kutaisi | 0,20 | 11,89 | 13,97 | 15,21 | 17,05 | 20,73 | 23,85 | 25,57 | 23,38 | 26,00 | 26,58 | 26,83 | 19,54 | 20,31 | 21,38 | 20,21 | 18,82 | 20,94 |
| Tbilisi | 1,17 | 13,82 | 15,90 | 17,14 | 18,98 | 22,66 | 25,78 | 27,50 | 25,31 | 27,93 | 28,51 | 28,76 | 21,47 | 22,24 | 23,31 | 22,14 | 20,75 | 22,87 |
| Yerevan | 1,06 | 15,51 | 17,59 | 18,83 | 20,67 | 24,35 | 27,47 | 29,19 | 27,00 | 29,62 | 30,20 | 30,45 | 23,16 | 23,93 | 25,00 | 23,83 | 22,44 | 24,56 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rostow n. D. | 0,125 | 0,029 | 0,028 | 0,474 | 0,007 | 0,029 | 0,007 | 0,080 | 0,003 | 0,005 | 0,010 | 0,015 | 0,005 | 0,006 | 0,006 | 0,010 | 0,027 |
| Krasnodar | 0,025 | 0,007 | 0,007 | 0,131 | 0,002 | 0,009 | 0,002 | 0,025 | 0,001 | 0,002 | 0,003 | 0,004 | 0,001 | 0,002 | 0,002 | 0,003 | 0,008 |
| Sotchi | 0,008 | 0,002 | 0,003 | 0,051 | 0,001 | 0,004 | 0,001 | 0,011 | 0,000 | 0,001 | 0,001 | 0,002 | 0,001 | 0,001 | 0,001 | 0,001 | 0,003 |
| Kutaisi | 0,003 | 0,001 | 0,001 | 0,021 | 0,000 | 0,002 | 0,000 | 0,005 | 0,000 | 0,000 | 0,001 | 0,001 | 0,000 | 0,000 | 0,000 | 0,000 | 0,001 |
| Tbilisi | 0,013 | 0,004 | 0,005 | 0,101 | 0,002 | 0,009 | 0,002 | 0,024 | 0,001 | 0,002 | 0,003 | 0,004 | 0,001 | 0,002 | 0,002 | 0,002 | 0,007 |
| Yerevan | 0,010 | 0,003 | 0,004 | 0,079 | 0,002 | 0,007 | 0,002 | 0,020 | 0,001 | 0,001 | 0,003 | 0,003 | 0,001 | 0,001 | 0,001 | 0,002 | 0,006 |

| |
|---|
| 1,560 |

## Ryazan - Moscow

| | | Mokwa | Smolensk | Minsk | Vilnius | St.Petersburg | Pskow | Tallinn | Helsinki | Yaroslawl | Rybinsk | Vologda | Kostroma | Vladimir | Nishnij Nowgorod |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 12,86 | 0,33 | 1,89 | 0,54 | 4,99 | 0,21 | 0,41 | 0,90 | 0,60 | 0,20 | 0,31 | 0,27 | 0,35 | 1,26 |
| Ryazan | 0,53 | 1,84 | 5,52 | 8,64 | 10,36 | 8,17 | 10,79 | 11,37 | 11,62 | 4,33 | 5,10 | 6,17 | 5,00 | 3,61 | 5,73 |
| Saransk | 0,30 | 5,39 | 9,07 | 12,19 | 13,91 | 11,72 | 14,34 | 14,92 | 15,17 | 7,88 | 8,65 | 9,72 | 8,55 | 7,16 | 9,28 |
| Samara | 1,17 | 8,89 | 12,57 | 15,69 | 17,41 | 15,22 | 17,84 | 18,42 | 18,67 | 11,38 | 12,15 | 13,22 | 12,05 | 10,66 | 12,78 |
| Penza | 0,52 | 6,51 | 10,19 | 13,31 | 15,03 | 12,84 | 15,46 | 16,04 | 16,29 | 9,00 | 9,77 | 10,84 | 9,67 | 8,28 | 10,40 |
| Saratow | 0,84 | 7,21 | 10,89 | 14,01 | 15,73 | 13,54 | 16,16 | 16,74 | 16,99 | 9,70 | 10,47 | 11,54 | 10,37 | 8,98 | 11,10 |
| Volgograd | 1,02 | 9,13 | 12,81 | 15,93 | 17,65 | 15,46 | 18,08 | 18,66 | 18,91 | 11,62 | 12,39 | 13,46 | 12,29 | 10,90 | 13,02 |
| Voronesh | 1,00 | 5,16 | 8,84 | 11,96 | 13,68 | 11,49 | 14,11 | 14,69 | 14,94 | 7,65 | 8,42 | 9,49 | 8,32 | 6,93 | 9,05 |
| Rostow n. D. | 1,87 | 10,07 | 13,75 | 16,87 | 18,59 | 16,40 | 19,02 | 19,60 | 19,85 | 12,56 | 13,33 | 14,40 | 13,23 | 11,84 | 13,96 |
| Krasnodar | 0,75 | 12,56 | 16,24 | 19,36 | 21,08 | 18,89 | 21,51 | 22,09 | 22,34 | 15,05 | 15,82 | 16,89 | 15,72 | 14,33 | 16,45 |
| Sotchi | 0,36 | 14,25 | 17,93 | 21,05 | 22,77 | 20,58 | 23,20 | 23,78 | 24,03 | 16,74 | 17,51 | 18,58 | 17,41 | 16,02 | 18,14 |
| Kutaisi | 0,20 | 17,05 | 20,73 | 23,85 | 25,57 | 23,38 | 26,00 | 26,58 | 26,83 | 19,54 | 20,31 | 21,38 | 20,21 | 18,82 | 20,94 |
| Tbilisi | 1,17 | 18,98 | 22,66 | 25,78 | 27,50 | 25,31 | 27,93 | 28,51 | 28,76 | 21,47 | 22,24 | 23,31 | 22,14 | 20,75 | 22,87 |
| Yerevan | 1,06 | 20,67 | 24,35 | 27,47 | 29,19 | 27,00 | 29,62 | 30,20 | 30,45 | 23,16 | 23,93 | 25,00 | 23,83 | 22,44 | 24,56 |
| Charkiw | 1,43 | 7,91 | 11,59 | 14,71 | 16,43 | 14,24 | 16,86 | 17,44 | 17,69 | 10,40 | 11,17 | 12,24 | 11,07 | 9,68 | 11,80 |
| Dnjepropetrowsk | 0,99 | 9,78 | 13,46 | 16,58 | 18,30 | 16,11 | 18,73 | 19,31 | 19,56 | 12,27 | 13,04 | 14,11 | 12,94 | 11,55 | 13,67 |
| Donetsk | 2,19 | 9,33 | 13,01 | 16,13 | 17,85 | 15,66 | 18,28 | 18,86 | 19,11 | 11,82 | 12,59 | 13,66 | 12,49 | 11,10 | 13,22 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ryazan | 2,417 | 0,010 | 0,026 | 0,005 | 0,074 | 0,002 | 0,003 | 0,007 | 0,026 | 0,007 | 0,007 | 0,009 | 0,021 | 0,034 |
| Saransk | 0,220 | 0,002 | 0,008 | 0,002 | 0,023 | 0,001 | 0,001 | 0,003 | 0,005 | 0,002 | 0,002 | 0,002 | 0,004 | 0,009 |
| Samara | 0,367 | 0,005 | 0,021 | 0,005 | 0,057 | 0,002 | 0,003 | 0,007 | 0,011 | 0,003 | 0,005 | 0,005 | 0,007 | 0,019 |
| Penza | 0,277 | 0,003 | 0,012 | 0,003 | 0,034 | 0,001 | 0,002 | 0,004 | 0,007 | 0,002 | 0,003 | 0,003 | 0,005 | 0,012 |
| Saratow | 0,376 | 0,005 | 0,018 | 0,004 | 0,050 | 0,002 | 0,003 | 0,006 | 0,011 | 0,003 | 0,004 | 0,004 | 0,007 | 0,018 |
| Volgograd | 0,306 | 0,004 | 0,017 | 0,004 | 0,048 | 0,002 | 0,003 | 0,006 | 0,009 | 0,003 | 0,004 | 0,004 | 0,006 | 0,016 |
| Voronesh | 0,790 | 0,008 | 0,028 | 0,006 | 0,079 | 0,002 | 0,004 | 0,009 | 0,019 | 0,005 | 0,007 | 0,007 | 0,013 | 0,030 |
| Rostow n. D. | 0,474 | 0,007 | 0,029 | 0,007 | 0,080 | 0,003 | 0,005 | 0,010 | 0,015 | 0,005 | 0,006 | 0,006 | 0,010 | 0,027 |
| Krasnodar | 0,131 | 0,002 | 0,009 | 0,002 | 0,025 | 0,001 | 0,002 | 0,003 | 0,004 | 0,001 | 0,002 | 0,002 | 0,003 | 0,008 |
| Sotchi | 0,051 | 0,001 | 0,004 | 0,001 | 0,011 | 0,000 | 0,001 | 0,001 | 0,002 | 0,001 | 0,001 | 0,001 | 0,001 | 0,003 |
| Kutaisi | 0,021 | 0,000 | 0,002 | 0,000 | 0,005 | 0,000 | 0,000 | 0,001 | 0,001 | 0,000 | 0,000 | 0,000 | 0,000 | 0,001 |
| Tbilisi | 0,101 | 0,002 | 0,009 | 0,002 | 0,024 | 0,001 | 0,002 | 0,003 | 0,004 | 0,001 | 0,002 | 0,002 | 0,002 | 0,007 |
| Yerevan | 0,079 | 0,002 | 0,007 | 0,002 | 0,020 | 0,001 | 0,001 | 0,003 | 0,003 | 0,001 | 0,001 | 0,001 | 0,002 | 0,006 |
| Charkiw | 0,547 | 0,007 | 0,028 | 0,007 | 0,078 | 0,002 | 0,005 | 0,010 | 0,016 | 0,005 | 0,006 | 0,006 | 0,011 | 0,027 |
| Donezsk | 0,264 | 0,004 | 0,016 | 0,004 | 0,044 | 0,001 | 0,003 | 0,006 | 0,008 | 0,003 | 0,003 | 0,003 | 0,005 | 0,015 |
| Dnjepropetrowsk | 0,632 | 0,009 | 0,037 | 0,009 | 0,102 | 0,003 | 0,006 | 0,013 | 0,020 | 0,006 | 0,008 | 0,008 | 0,013 | 0,034 |

9,084

## Salzburg - Linz

| | | Linz + Wels | C.Budejovice | Praha | Wien | Brno | Ostrava | Katowice + Krakow | Warszawa | Bratislava | Zilina | Kosice | Györ | Budapest |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0,26 | 0,09 | 1,27 | 1,84 | 0,39 | 0,30 | 2,04 | 1,71 | 0,42 | 0,08 | 0,33 | 0,13 | 1,74 |
| Salzburg | 0,15 | 1,12 | 1,90 | 3,13 | 2,65 | 3,70 | 4,15 | 4,90 | 7,48 | 3,20 | 4,87 | 6,80 | 3,80 | 4,84 |
| München | 1,45 | 2,30 | 3,08 | 20,00 | 3,83 | 4,88 | 5,33 | 6,08 | 8,66 | 4,38 | 6,05 | 7,98 | 4,98 | 6,02 |
| Augsburg | 0,29 | 2,86 | 3,64 | 20,00 | 4,39 | 5,44 | 5,89 | 6,64 | 9,22 | 4,94 | 6,61 | 8,54 | 5,54 | 6,58 |
| Stuttgart | 0,62 | 4,20 | 4,98 | 20,00 | 5,73 | 6,78 | 7,23 | 7,98 | 10,56 | 6,28 | 7,95 | 9,88 | 6,88 | 7,87 |
| Mannheim-L. | 0,63 | 5,11 | 5,89 | 20,00 | 6,64 | 7,69 | 8,14 | 8,89 | 11,47 | 7,19 | 8,86 | 10,79 | 7,79 | 8,78 |
| Karlsruhe | 0,31 | 4,81 | 5,59 | 20,00 | 6,34 | 7,39 | 7,84 | 8,59 | 11,17 | 6,89 | 8,56 | 10,49 | 7,49 | 8,48 |
| Strasbourg | 0,28 | 5,48 | 6,26 | 20,00 | 7,01 | 8,06 | 8,51 | 9,26 | 11,84 | 7,56 | 9,23 | 11,16 | 8,16 | 9,15 |
| Paris | 12,40 | 9,45 | 10,23 | 20,00 | 10,98 | 12,03 | 12,48 | 13,23 | 15,81 | 11,53 | 13,20 | 15,13 | 12,13 | 13,12 |
| Innsbruck | 0,13 | 2,98 | 3,76 | 4,99 | 4,01 | 5,06 | 5,06 | 5,06 | 5,06 | 5,06 | 5,06 | 8,16 | 5,16 | 6,20 |
| Vorarlberg | 0,11 | 4,31 | 5,09 | 6,32 | 5,34 | 6,39 | 6,39 | 6,39 | 6,39 | 6,39 | 6,39 | 9,49 | 6,49 | 7,53 |
| Zürich | 0,40 | 5,12 | 5,90 | 7,13 | 6,15 | 7,20 | 7,20 | 7,20 | 7,20 | 7,20 | 7,20 | 10,30 | 7,30 | 8,34 |
| Basel | 0,18 | 5,85 | 6,63 | 7,86 | 6,88 | 7,93 | 7,93 | 7,93 | 7,93 | 7,93 | 7,93 | 11,03 | 8,03 | 9,07 |
| Bern | 0,14 | 6,05 | 6,83 | 8,06 | 7,08 | 8,13 | 8,13 | 8,13 | 8,13 | 8,13 | 8,13 | 11,23 | 8,23 | 9,27 |
| Genève | 0,20 | 7,35 | 8,13 | 9,36 | 8,38 | 9,43 | 9,43 | 9,43 | 9,43 | 9,43 | 9,43 | 12,53 | 9,53 | 10,57 |
| Villach | 0,06 | 2,52 | 3,30 | 4,53 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Klagenfurt | 0,10 | 2,91 | 3,69 | 4,92 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Ljubljana | 0,29 | 3,36 | 4,14 | 5,37 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Zagreb | 0,79 | 4,50 | 5,28 | 6,51 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Salzburg | | 0,032 | 0,005 | 0,027 | 0,053 | 0,006 | 0,004 | 0,021 | 0,008 | 0,009 | 0,001 | 0,002 | 0,002 | 0,018 |
| München | | 0,091 | 0,019 | 0,011 | 0,272 | 0,038 | 0,025 | 0,138 | 0,063 | 0,049 | 0,005 | 0,014 | 0,012 | 0,119 |
| Augsburg | | 0,013 | 0,003 | 0,002 | 0,043 | 0,006 | 0,004 | 0,024 | 0,011 | 0,008 | 0,001 | 0,002 | 0,002 | 0,021 |
| Stuttgart | | 0,014 | 0,004 | 0,005 | 0,059 | 0,009 | 0,006 | 0,037 | 0,019 | 0,011 | 0,001 | 0,004 | 0,003 | 0,032 |
| Mannheim-L. | | 0,010 | 0,003 | 0,005 | 0,046 | 0,008 | 0,005 | 0,031 | 0,017 | 0,009 | 0,001 | 0,004 | 0,002 | 0,027 |
| Karlsruhe | | 0,006 | 0,001 | 0,002 | 0,025 | 0,004 | 0,003 | 0,016 | 0,009 | 0,005 | 0,001 | 0,002 | 0,001 | 0,014 |
| Strasbourg | | 0,004 | 0,001 | 0,002 | 0,019 | 0,003 | 0,002 | 0,013 | 0,007 | 0,004 | 0,001 | 0,002 | 0,001 | 0,011 |
| Paris | | 0,071 | 0,021 | 0,097 | 0,388 | 0,070 | 0,051 | 0,314 | 0,194 | 0,082 | 0,012 | 0,040 | 0,023 | 0,271 |
| Innsbruck | | 0,005 | 0,001 | 0,011 | 0,023 | 0,003 | 0,002 | 0,017 | 0,014 | 0,003 | 0,001 | 0,001 | 0,001 | 0,010 |
| Vorarlberg | | 0,002 | 0,001 | 0,006 | 0,012 | 0,002 | 0,001 | 0,010 | 0,008 | 0,002 | 0,000 | 0,001 | 0,001 | 0,006 |
| Zürich | | 0,006 | 0,002 | 0,018 | 0,034 | 0,005 | 0,004 | 0,028 | 0,024 | 0,006 | 0,001 | 0,003 | 0,002 | 0,019 |
| Basel | | 0,002 | 0,001 | 0,007 | 0,012 | 0,002 | 0,002 | 0,011 | 0,009 | 0,002 | 0,000 | 0,001 | 0,001 | 0,007 |
| Bern | | 0,002 | 0,000 | 0,005 | 0,009 | 0,002 | 0,001 | 0,008 | 0,007 | 0,002 | 0,000 | 0,001 | 0,001 | 0,006 |
| Genève | | 0,002 | 0,001 | 0,006 | 0,010 | 0,002 | 0,001 | 0,009 | 0,008 | 0,002 | 0,000 | 0,001 | 0,001 | 0,006 |
| Villach | | 0,003 | 0,001 | 0,006 | 0,001 | 0,000 | 0,000 | 0,001 | 0,001 | 0,000 | 0,000 | 0,000 | 0,000 | 0,001 |
| Klagenfurt | | 0,004 | 0,001 | 0,008 | 0,001 | 0,000 | 0,000 | 0,001 | 0,001 | 0,000 | 0,000 | 0,000 | 0,000 | 0,001 |
| Ljubljana | | 0,010 | 0,002 | 0,021 | 0,003 | 0,001 | 0,001 | 0,004 | 0,003 | 0,001 | 0,000 | 0,001 | 0,000 | 0,003 |
| Zagreb | | 0,016 | 0,004 | 0,042 | 0,009 | 0,002 | 0,001 | 0,010 | 0,008 | 0,002 | 0,000 | 0,002 | 0,001 | 0,008 |

3,988

# Sibiu - Brasov

| | | Brasov | Ploeşti | Buzau | Braila + Galaţi | Bucureşti | Constanţa | Ruse | Plovdiv + ... | Istanbul |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 0,28 | 0,22 | 0,12 | 0,50 | 1,88 | 0,30 | 0,15 | 0,57 | 14,66 |
| Sibiu | 0,43 | 0,83 | 1,69 | 2,34 | 3,28 | 2,25 | 4,28 | 2,94 | 4,51 | 7,79 |
| Cluj | 0,30 | 2,00 | 2,86 | 3,51 | 4,45 | 3,42 | 5,45 | 4,11 | 5,68 | 8,96 |
| Baia Mare | 0,12 | 2,99 | 3,85 | 4,50 | 5,44 | 4,41 | 6,44 | 5,10 | 6,67 | 9,95 |
| Satu Mare | 0,11 | 3,54 | 4,40 | 5,05 | 5,99 | 4,96 | 6,99 | 5,65 | 7,22 | 10,50 |
| Arad | 0,16 | 3,03 | 3,89 | 4,54 | 5,48 | 4,45 | 6,48 | 7,17 | 8,74 | 12,02 |
| Budapest | 1,74 | 5,27 | 6,13 | 6,78 | 7,72 | 6,69 | 8,72 | 9,41 | 10,98 | 14,26 |
| Trnava | 0,07 | 6,73 | 7,59 | 8,24 | 9,18 | 8,15 | 10,18 | 10,87 | 12,44 | 15,72 |
| Zilina + Trencin | 0,14 | 8,02 | 8,88 | 9,53 | 10,47 | 9,44 | 11,47 | 12,16 | 13,73 | 17,01 |
| Györ | 0,13 | 6,31 | 7,17 | 7,82 | 8,76 | 7,73 | 9,76 | 10,45 | 12,02 | 15,30 |
| Bratislava | 0,42 | 7,01 | 7,87 | 8,52 | 9,46 | 8,43 | 10,46 | 11,15 | 12,72 | 16,00 |
| Ostrava | 0,30 | 9,04 | 9,90 | 10,55 | 11,49 | 10,46 | 12,49 | 13,18 | 14,75 | 18,03 |
| Katowice + ... | 1,28 | 9,79 | 10,65 | 11,30 | 12,24 | 11,21 | 13,24 | 13,93 | 15,50 | 18,78 |
| Krakow | 0,76 | 10,25 | 11,11 | 11,76 | 12,70 | 11,67 | 13,70 | 14,39 | 15,96 | 19,24 |
| Warszawa | 1,71 | 12,37 | 13,23 | 13,88 | 14,82 | 13,79 | 15,82 | 16,51 | 18,08 | 21,36 |
| Brno | 0,39 | 8,18 | 9,04 | 9,69 | 10,63 | 9,60 | 11,63 | 12,32 | 13,89 | 17,17 |
| Praha | 1,27 | 10,05 | 10,91 | 11,56 | 12,50 | 11,47 | 13,50 | 14,19 | 15,76 | 19,04 |
| Wien | 1,84 | 7,46 | 8,32 | 8,97 | 9,91 | 8,88 | 10,91 | 11,60 | 13,17 | 16,45 |
| Linz + Wels | 0,26 | 8,99 | 9,85 | 10,50 | 11,44 | 10,41 | 12,44 | 13,13 | 14,70 | 17,98 |
| Regensburg | 0,15 | 10,81 | 11,67 | 12,32 | 13,26 | 12,23 | 14,26 | 14,95 | 16,52 | 19,80 |
| Nürnberg | 0,74 | 11,68 | 12,54 | 13,19 | 14,13 | 13,10 | 15,13 | 15,82 | 17,39 | 20,67 |
| Frankfurt | 1,60 | 13,62 | 14,48 | 15,13 | 16,07 | 15,04 | 17,07 | 17,76 | 19,33 | 22,61 |
| Salzburg | 0,15 | 10,11 | 10,97 | 11,62 | 12,56 | 11,53 | 13,56 | 14,25 | 15,82 | 19,10 |
| München | 1,45 | 11,29 | 12,15 | 12,80 | 13,74 | 12,71 | 14,74 | 15,43 | 17,00 | 20,28 |
| Ausburg | 0,29 | 11,85 | 12,71 | 13,36 | 14,30 | 13,27 | 15,30 | 15,99 | 17,56 | 20,84 |
| Stuttgart | 0,62 | 13,19 | 14,05 | 14,70 | 15,64 | 14,61 | 16,64 | 17,33 | 18,90 | 22,18 |
| Zürich | 0,40 | 13,61 | 14,47 | 15,12 | 16,06 | 15,03 | 17,06 | 17,75 | 19,32 | 22,60 |
| Szekesfehervar | 0,10 | 5,85 | 6,71 | 7,36 | 8,30 | 7,27 | 9,30 | 9,99 | 11,56 | 14,84 |
| Graz | 0,28 | 8,12 | 8,98 | 9,63 | 10,57 | 9,54 | 11,57 | 12,26 | 20,00 | 20,00 |
| Venezia + Pad. | 0,55 | 11,25 | 12,11 | 12,76 | 13,70 | 12,67 | 14,70 | 15,39 | 20,00 | 20,00 |
| Timioşara | 0,32 | 3,38 | 4,24 | 4,89 | 5,83 | 4,80 | 6,83 | 7,52 | 20,00 | 20,00 |
| Beograd | 1,35 | 4,57 | 5,43 | 6,08 | 7,02 | 5,99 | 8,02 | 8,71 | 20,00 | 20,00 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Sibiu | | 0,165 | 0,039 | 0,012 | 0,029 | 0,204 | 0,011 | 0,010 | 0,019 | 0,192 |
| Cluj | | 0,026 | 0,011 | 0,004 | 0,012 | 0,070 | 0,005 | 0,004 | 0,009 | 0,106 |
| Baia Mare | | 0,005 | 0,003 | 0,001 | 0,003 | 0,018 | 0,002 | 0,001 | 0,003 | 0,035 |
| Satu Mare | | 0,004 | 0,002 | 0,001 | 0,003 | 0,014 | 0,001 | 0,001 | 0,002 | 0,030 |
| Arad | | 0,007 | 0,003 | 0,001 | 0,004 | 0,024 | 0,002 | 0,001 | 0,002 | 0,034 |
| Budapest | | 0,029 | 0,018 | 0,008 | 0,027 | 0,129 | 0,013 | 0,006 | 0,017 | 0,278 |
| Trnava | | 0,001 | 0,000 | 0,000 | 0,001 | 0,004 | 0,000 | 0,000 | 0,001 | 0,009 |
| Zilina + Trencin | | 0,001 | 0,001 | 0,000 | 0,001 | 0,006 | 0,001 | 0,000 | 0,001 | 0,017 |
| Györ | | 0,002 | 0,001 | 0,000 | 0,002 | 0,008 | 0,001 | 0,000 | 0,001 | 0,018 |
| Bratislava | | 0,004 | 0,003 | 0,001 | 0,005 | 0,021 | 0,002 | 0,001 | 0,003 | 0,055 |
| Ostrava | | 0,002 | 0,001 | 0,001 | 0,002 | 0,010 | 0,001 | 0,001 | 0,002 | 0,032 |
| Katowice + ... | | 0,007 | 0,005 | 0,002 | 0,009 | 0,040 | 0,005 | 0,002 | 0,007 | 0,128 |
| Krakow | | 0,004 | 0,003 | 0,001 | 0,005 | 0,022 | 0,003 | 0,001 | 0,004 | 0,073 |
| Warszawa | | 0,007 | 0,005 | 0,002 | 0,009 | 0,037 | 0,005 | 0,002 | 0,007 | 0,138 |
| Brno | | 0,003 | 0,002 | 0,001 | 0,004 | 0,016 | 0,002 | 0,001 | 0,003 | 0,046 |
| Praha | | 0,007 | 0,005 | 0,002 | 0,009 | 0,038 | 0,005 | 0,002 | 0,007 | 0,124 |
| Wien | | 0,017 | 0,011 | 0,005 | 0,019 | 0,084 | 0,009 | 0,004 | 0,013 | 0,231 |
| Linz + Wels | | 0,002 | 0,001 | 0,001 | 0,002 | 0,009 | 0,001 | 0,000 | 0,002 | 0,028 |
| Regensburg | | 0,001 | 0,001 | 0,000 | 0,001 | 0,004 | 0,000 | 0,000 | 0,001 | 0,014 |
| Nürnberg | | 0,003 | 0,002 | 0,001 | 0,004 | 0,018 | 0,002 | 0,001 | 0,003 | 0,063 |
| Frankfurt | | 0,005 | 0,004 | 0,002 | 0,007 | 0,030 | 0,004 | 0,002 | 0,006 | 0,117 |
| Salzburg | | 0,001 | 0,001 | 0,000 | 0,001 | 0,004 | 0,001 | 0,000 | 0,001 | 0,015 |
| München | | 0,007 | 0,005 | 0,002 | 0,008 | 0,036 | 0,004 | 0,002 | 0,007 | 0,127 |
| Ausburg | | 0,001 | 0,001 | 0,000 | 0,002 | 0,007 | 0,001 | 0,000 | 0,001 | 0,024 |
| Stuttgart | | 0,002 | 0,002 | 0,001 | 0,003 | 0,012 | 0,002 | 0,001 | 0,002 | 0,047 |
| Zürich | | 0,001 | 0,001 | 0,000 | 0,002 | 0,008 | 0,001 | 0,000 | 0,001 | 0,029 |
| Szekesfehervar | | 0,001 | 0,001 | 0,000 | 0,001 | 0,006 | 0,001 | 0,000 | 0,001 | 0,015 |
| Graz | | 0,002 | 0,001 | 0,001 | 0,003 | 0,011 | 0,001 | 0,001 | 0,001 | 0,025 |
| Venezia + Pad. | | 0,003 | 0,002 | 0,001 | 0,003 | 0,014 | 0,002 | 0,001 | 0,002 | 0,050 |
| Timioşara | | 0,011 | 0,006 | 0,003 | 0,008 | 0,042 | 0,004 | 0,002 | 0,001 | 0,029 |
| Beograd | | 0,029 | 0,017 | 0,008 | 0,025 | 0,121 | 0,012 | 0,005 | 0,005 | 0,122 |

4,399

# Sivas - Erzurum

| | | Maltya | Diyarbakir | Van | Tabriz | Teheran | Erzurum | Kars | Tbilisi | Baku |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 0,35 | 0,93 | 0,35 | 1,50 | 8,15 | 0,37 | 0,08 | 1,17 | 2,14 |
| Sivas | 0,35 | 1,95 | 3,80 | 5,55 | 8,09 | 13,32 | 3,98 | 5,69 | 7,62 | 12,04 |
| Kirikkale | 0,19 | 4,85 | 6,70 | 8,45 | 10,99 | 16,22 | 6,88 | 8,59 | 10,52 | 14,94 |
| Ankara | 4,59 | 5,36 | 7,21 | 8,96 | 11,50 | 16,73 | 7,39 | 9,10 | 11,03 | 15,45 |
| Eskişehir | 0,69 | 7,42 | 9,27 | 11,02 | 13,56 | 18,79 | 9,45 | 11,16 | 13,09 | 17,51 |
| Adopazani | 0,27 | 8,47 | 10,32 | 12,07 | 14,61 | 19,84 | 10,50 | 12,21 | 14,14 | 18,56 |
| Istanbul | 14,66 | 9,72 | 11,57 | 13,32 | 15,86 | 21,09 | 11,75 | 13,46 | 15,39 | 19,81 |
| Edirne | 0,15 | 11,85 | 13,70 | 15,45 | 17,99 | 23,22 | 13,88 | 15,59 | 17,52 | 21,94 |
| Bucureşţi | 1,88 | 15,26 | 17,11 | 18,86 | 21,40 | 26,63 | 17,29 | 19,00 | 20,93 | 25,35 |
| Sofia | 1,21 | 14,78 | 16,63 | 18,38 | 20,92 | 26,15 | 16,81 | 18,52 | 20,45 | 24,87 |
| Beograd | 1,35 | 18,13 | 19,98 | 21,73 | 24,27 | 29,50 | 20,16 | 21,87 | 23,80 | 28,22 |
| Kütakya | 0,20 | 7,99 | 9,84 | 11,59 | 14,13 | 19,36 | 10,02 | 11,73 | 13,66 | 18,08 |
| Balikeşir | 1,19 | 9,77 | 11,62 | 13,37 | 15,91 | 21,14 | 11,80 | 13,51 | 15,44 | 19,86 |
| Manisa | 0,28 | 11,01 | 12,86 | 14,61 | 17,15 | 22,38 | 13,04 | 14,75 | 16,68 | 21,10 |
| Izmir | 4,11 | 11,30 | 13,15 | 14,90 | 17,44 | 22,67 | 13,33 | 15,04 | 16,97 | 21,39 |
| Afyon | 0,21 | 8,94 | 10,79 | 12,54 | 15,08 | 20,31 | 10,97 | 12,68 | 14,61 | 19,03 |
| Denizli | 1,00 | 10,01 | 11,86 | 13,61 | 16,15 | 21,38 | 12,04 | 13,75 | 15,68 | 20,10 |
| Konya | 1,22 | 7,64 | 9,49 | 11,24 | 13,78 | 19,01 | 9,67 | 11,38 | 13,31 | 17,73 |
| Antalya | 2,22 | 9,57 | 11,42 | 13,17 | 15,71 | 20,94 | 11,60 | 13,31 | 15,24 | 19,66 |
| Alanya | 0,29 | 9,16 | 11,01 | 12,76 | 15,30 | 20,53 | 11,19 | 12,90 | 14,83 | 19,25 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Sivas | | 0,039 | 0,034 | 0,007 | 0,015 | 0,035 | 0,012 | 0,001 | 0,013 | 0,011 |
| Kirikkale | | 0,005 | 0,007 | 0,002 | 0,005 | 0,014 | 0,003 | 0,000 | 0,004 | 0,004 |
| Ankara | | 0,093 | 0,149 | 0,039 | 0,108 | 0,311 | 0,057 | 0,009 | 0,091 | 0,094 |
| Eskişehir | | 0,008 | 0,015 | 0,004 | 0,012 | 0,038 | 0,006 | 0,001 | 0,010 | 0,011 |
| Adopazani | | 0,003 | 0,005 | 0,001 | 0,004 | 0,014 | 0,002 | 0,000 | 0,003 | 0,004 |
| Istanbul | | 0,107 | 0,212 | 0,063 | 0,200 | 0,670 | 0,082 | 0,014 | 0,164 | 0,196 |
| Edirne | | 0,001 | 0,002 | 0,001 | 0,002 | 0,006 | 0,001 | 0,000 | 0,001 | 0,002 |
| Bucureşţi | | 0,006 | 0,014 | 0,004 | 0,015 | 0,058 | 0,005 | 0,001 | 0,013 | 0,017 |
| Sofia | | 0,004 | 0,009 | 0,003 | 0,010 | 0,038 | 0,004 | 0,001 | 0,008 | 0,011 |
| Beograd | | 0,003 | 0,008 | 0,003 | 0,009 | 0,035 | 0,003 | 0,001 | 0,007 | 0,010 |
| Kütakya | | 0,002 | 0,004 | 0,001 | 0,003 | 0,011 | 0,001 | 0,000 | 0,003 | 0,003 |
| Balikeşir | | 0,009 | 0,017 | 0,005 | 0,016 | 0,054 | 0,007 | 0,001 | 0,013 | 0,016 |
| Manisa | | 0,002 | 0,003 | 0,001 | 0,003 | 0,012 | 0,001 | 0,000 | 0,003 | 0,003 |
| Izmir | | 0,023 | 0,048 | 0,015 | 0,048 | 0,166 | 0,019 | 0,003 | 0,039 | 0,048 |
| Afyon | | 0,002 | 0,003 | 0,001 | 0,003 | 0,010 | 0,001 | 0,000 | 0,003 | 0,003 |
| Denizli | | 0,007 | 0,014 | 0,004 | 0,013 | 0,045 | 0,005 | 0,001 | 0,011 | 0,013 |
| Konya | | 0,013 | 0,025 | 0,007 | 0,021 | 0,067 | 0,010 | 0,002 | 0,018 | 0,020 |
| Antalya | | 0,017 | 0,033 | 0,010 | 0,031 | 0,103 | 0,013 | 0,002 | 0,025 | 0,030 |
| Alanya | | 0,002 | 0,005 | 0,001 | 0,004 | 0,014 | 0,002 | 0,000 | 0,003 | 0,004 |

| | | | |
|---|---|---|---|
| 4,550 | Sivas - Malatya: 3,347 | | Sivas - Erzurum: 1,203 |

# Skopje - Thessaloniki

| | | Thesaloniki | Athenai | Patras | Alexandroupoli | Edirne | Istanbul |
|---|---|---|---|---|---|---|---|
| | | 0,33 | 3,75 | 0,17 | 0,07 | 0,15 | 14,66 |
| Skopje | 0,54 | 1,96 | 4,98 | 6,72 | 4,34 | 5,44 | 7,57 |
| Priština | 0,21 | 2,74 | 5,76 | 7,50 | 5,12 | 8,14 | 9,88 |
| Tetovo + Gostivar | 0,09 | 2,47 | 5,49 | 7,23 | 4,85 | 7,87 | 9,61 |
| Tiranë + Durrës | 0,60 | 3,51 | 6,53 | 8,27 | 5,89 | 8,91 | 10,65 |
| Niš | 0,26 | 3,46 | 6,48 | 8,22 | 5,84 | 8,86 | 10,60 |
| Beograd | 1,23 | 5,45 | 8,47 | 10,21 | 7,83 | 10,85 | 12,59 |
| Timişoara | 0,32 | 6,64 | 9,66 | 11,40 | 9,02 | 12,04 | 13,78 |
| Arad | 0,16 | 6,99 | 10,01 | 11,75 | 9,37 | 12,39 | 14,13 |
| Oradea | 0,20 | 8,09 | 11,11 | 12,85 | 10,47 | 13,49 | 15,23 |
| Novi Sad | 0,25 | 6,17 | 9,19 | 10,93 | 8,55 | 11,57 | 13,31 |
| Budapest | 1,74 | 8,73 | 11,75 | 13,49 | 11,11 | 14,13 | 15,87 |
| Trnava | 0,07 | 10,19 | 13,21 | 14,95 | 12,57 | 15,59 | 17,33 |
| Zilina + Trenčin | 0,14 | 11,48 | 14,50 | 16,24 | 13,86 | 16,88 | 18,62 |
| Györ | 0,13 | 9,77 | 12,79 | 14,53 | 12,15 | 15,17 | 16,91 |
| Bratislava | 0,42 | 10,47 | 13,49 | 15,23 | 12,85 | 15,87 | 17,61 |
| Ostrava | 0,30 | 12,50 | 15,52 | 17,26 | 14,88 | 17,90 | 19,64 |
| Katowice + ... | 1,28 | 13,25 | 16,27 | 18,01 | 15,63 | 18,65 | 20,39 |
| Krakow | 0,76 | 13,71 | 16,73 | 18,47 | 16,09 | 19,11 | 20,85 |
| Warszawa | 1,71 | 15,83 | 18,85 | 20,59 | 18,21 | 21,23 | 22,97 |
| Brno | 0,39 | 11,64 | 14,66 | 16,40 | 14,02 | 17,04 | 18,78 |
| Praha | 1,27 | 13,51 | 16,53 | 18,27 | 15,89 | 18,91 | 20,65 |
| Wien | 1,84 | 10,92 | 13,94 | 15,68 | 13,30 | 16,32 | 18,06 |
| Linz + Wels | 0,26 | 12,45 | 15,47 | 17,21 | 14,83 | 17,85 | 19,59 |
| Regensburg | 0,15 | 14,27 | 17,29 | 19,03 | 16,65 | 19,67 | 21,41 |
| Nürnberg | 0,74 | 15,14 | 18,16 | 19,90 | 17,52 | 20,54 | 22,28 |
| Frankfurt | 1,60 | 17,08 | 20,10 | 21,84 | 19,46 | 22,48 | 24,22 |
| Vinkovci + ... | 0,17 | 6,85 | 9,87 | 11,61 | 9,23 | 12,25 | 13,99 |
| Zagreb | 0,79 | 9,17 | 12,19 | 13,93 | 11,55 | 14,57 | 16,31 |
| Graz | 0,28 | 10,03 | 13,05 | 14,79 | 12,41 | 15,43 | 17,17 |
| Ljubljana | 0,29 | 10,31 | 13,33 | 15,07 | 12,69 | 15,71 | 17,45 |
| Salzburg | 0,15 | 12,55 | 15,57 | 17,31 | 14,93 | 17,95 | 19,69 |
| München | 1,45 | 13,73 | 16,75 | 18,49 | 16,11 | 19,13 | 20,87 |
| Ausburg | 0,29 | 14,29 | 17,31 | 19,05 | 16,67 | 19,69 | 21,43 |
| Stuttgart | 0,62 | 15,63 | 18,65 | 20,39 | 18,01 | 21,03 | 22,77 |
| Trieste | 0,20 | 11,05 | 14,07 | 15,81 | 13,43 | 16,45 | 18,19 |
| Venezia + ... | 0,55 | 12,20 | 15,22 | 16,96 | 14,58 | 17,60 | 19,34 |
| Verona | 0,26 | 13,19 | 16,21 | 17,95 | 15,57 | 18,59 | 20,33 |
| Milano | 1,35 | 14,61 | 17,63 | 19,37 | 16,99 | 20,01 | 21,75 |
| Torino | 0,89 | 15,86 | 18,88 | 20,62 | 18,24 | 21,26 | 23,00 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Skopje | 0,057 | 0,132 | 0,004 | 0,003 | 0,005 | 0,254 |
| Priština | 0,012 | 0,040 | 0,001 | 0,001 | 0,001 | 0,063 |
| Tetovo + Gostivar | 0,006 | 0,019 | 0,001 | 0,000 | 0,000 | 0,028 |
| Tiranë + Durrës | 0,023 | 0,093 | 0,003 | 0,002 | 0,002 | 0,158 |
| Niš | 0,010 | 0,041 | 0,001 | 0,001 | 0,001 | 0,069 |
| Beograd | 0,023 | 0,122 | 0,004 | 0,003 | 0,003 | 0,243 |
| Timişoara | 0,004 | 0,025 | 0,001 | 0,001 | 0,001 | 0,054 |
| Arad | 0,002 | 0,012 | 0,000 | 0,000 | 0,000 | 0,026 |
| Oradea | 0,002 | 0,013 | 0,000 | 0,000 | 0,000 | 0,029 |
| Novi Sad | 0,004 | 0,022 | 0,001 | 0,000 | 0,001 | 0,045 |
| Budapest | 0,014 | 0,099 | 0,004 | 0,002 | 0,003 | 0,232 |
| Trnava | 0,000 | 0,003 | 0,000 | 0,000 | 0,000 | 0,008 |
| Zilina + Trenčin | 0,001 | 0,006 | 0,000 | 0,000 | 0,000 | 0,014 |
| Györ | 0,001 | 0,006 | 0,000 | 0,000 | 0,000 | 0,016 |
| Bratislava | 0,003 | 0,019 | 0,001 | 0,000 | 0,001 | 0,047 |
| Ostrava | 0,001 | 0,011 | 0,000 | 0,000 | 0,000 | 0,028 |
| Katowice + ... | 0,005 | 0,042 | 0,002 | 0,001 | 0,001 | 0,112 |
| Krakow | 0,003 | 0,024 | 0,001 | 0,000 | 0,001 | 0,064 |
| Warszawa | 0,005 | 0,044 | 0,002 | 0,001 | 0,001 | 0,122 |
| Brno | 0,002 | 0,015 | 0,001 | 0,000 | 0,000 | 0,039 |
| Praha | 0,005 | 0,040 | 0,002 | 0,001 | 0,001 | 0,108 |
| Wien | 0,010 | 0,078 | 0,003 | 0,002 | 0,002 | 0,197 |
| Linz + Wels | 0,001 | 0,009 | 0,000 | 0,000 | 0,000 | 0,024 |
| Regensburg | 0,001 | 0,004 | 0,000 | 0,000 | 0,000 | 0,012 |
| Nürnberg | 0,002 | 0,020 | 0,001 | 0,000 | 0,001 | 0,055 |
| Frankfurt | 0,004 | 0,037 | 0,001 | 0,001 | 0,001 | 0,104 |
| Vinkovci + ... | 0,002 | 0,013 | 0,000 | 0,000 | 0,000 | 0,028 |
| Zagreb | 0,006 | 0,042 | 0,002 | 0,001 | 0,001 | 0,101 |
| Graz | 0,002 | 0,013 | 0,000 | 0,000 | 0,000 | 0,033 |
| Ljubljana | 0,002 | 0,013 | 0,000 | 0,000 | 0,000 | 0,033 |
| Salzburg | 0,001 | 0,005 | 0,000 | 0,000 | 0,000 | 0,014 |
| München | 0,006 | 0,045 | 0,002 | 0,001 | 0,001 | 0,121 |
| Ausburg | 0,001 | 0,009 | 0,000 | 0,000 | 0,000 | 0,023 |
| Stuttgart | 0,002 | 0,016 | 0,001 | 0,000 | 0,001 | 0,045 |
| Trieste | 0,001 | 0,008 | 0,000 | 0,000 | 0,000 | 0,021 |
| Venezia + ... | 0,003 | 0,020 | 0,001 | 0,000 | 0,001 | 0,052 |
| Verona | 0,001 | 0,009 | 0,000 | 0,000 | 0,000 | 0,023 |
| Milano | 0,005 | 0,039 | 0,001 | 0,001 | 0,001 | 0,105 |
| Torino | 0,003 | 0,023 | 0,001 | 0,000 | 0,001 | 0,063 |

3,476

Without Istanbul: 1,535

## Sofia - Plovdiv/Stara Zagora/Sliven

| | | Plovdiv + ... | Varna | Burgas | Edirne | Istanbul |
|---|---|---|---|---|---|---|
| | | 0,57 | 0,33 | 0,20 | 0,15 | 14,66 |
| Sofia | 1,21 | 1,32 | 4,15 | 3,59 | 2,93 | 5,06 |
| Niš | 0,26 | 2,68 | 5,51 | 5,45 | 4,29 | 6,42 |
| Beograd | 1,23 | 4,67 | 7,50 | 6,94 | 6,20 | 8,41 |
| Timişoara | 0,32 | 5,86 | 8,69 | 8,13 | 7,39 | 9,60 |
| Arad | 0,16 | 6,21 | 9,04 | 8,48 | 7,74 | 9,95 |
| Oradea | 0,20 | 7,31 | 10,14 | 9,58 | 8,84 | 11,05 |
| Novi Sad | 0,25 | 5,39 | 8,22 | 7,66 | 6,92 | 9,13 |
| Subotica | 0,10 | 6,28 | 9,11 | 8,55 | 7,81 | 10,02 |
| Budapest | 1,74 | 7,95 | 10,78 | 10,22 | 9,48 | 11,69 |
| Bratislava | 0,42 | 9,69 | 12,52 | 11,96 | 11,22 | 13,43 |
| Ostrava | 0,30 | 11,72 | 14,55 | 13,99 | 13,25 | 15,46 |
| Katowice + Krakow | 2,04 | 12,47 | 15,30 | 14,74 | 14,00 | 16,21 |
| Brno | 0,39 | 10,86 | 13,69 | 13,13 | 12,39 | 14,60 |
| Praha | 1,27 | 12,73 | 15,56 | 15,00 | 14,26 | 16,47 |
| Wien | 1,84 | 10,14 | 12,97 | 12,41 | 11,67 | 13,88 |
| Nürnberg, Fürth, ... | 0,74 | 14,36 | 17,19 | 16,63 | 15,89 | 18,10 |
| Frankfurt, ... | 1,60 | 16,30 | 19,13 | 18,57 | 17,83 | 20,04 |
| Sarajewo | 0,53 | 7,61 | 10,44 | 9,88 | 9,14 | 11,35 |
| Zagreb | 0,79 | 8,39 | 11,22 | 10,66 | 9,92 | 12,13 |
| Graz | 0,28 | 9,81 | 12,64 | 12,08 | 11,34 | 13,55 |
| Ljubljana | 0,29 | 9,53 | 12,36 | 11,80 | 11,06 | 13,27 |
| Trieste | 0,20 | 10,27 | 13,10 | 12,54 | 11,80 | 14,01 |
| Venezia + Treviso | 0,34 | 11,42 | 14,25 | 13,69 | 12,95 | 15,16 |
| Verona | 0,26 | 12,41 | 15,24 | 14,68 | 13,94 | 16,15 |
| Milano | 1,35 | 13,83 | 16,66 | 16,10 | 15,36 | 17,57 |
| München | 1,45 | 12,95 | 15,78 | 15,22 | 14,48 | 16,69 |
| Stuttgart | 0,62 | 14,85 | 17,68 | 17,12 | 16,38 | 18,59 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Sofia | | 0,430 | 0,036 | 0,028 | 0,029 | 1,127 |
| Niš | | 0,028 | 0,005 | 0,003 | 0,003 | 0,162 |
| Beograd | | 0,051 | 0,013 | 0,009 | 0,008 | 0,483 |
| Timişoara | | 0,009 | 0,003 | 0,002 | 0,002 | 0,100 |
| Arad | | 0,004 | 0,001 | 0,001 | 0,001 | 0,047 |
| Oradea | | 0,004 | 0,001 | 0,001 | 0,001 | 0,049 |
| Novi Sad | | 0,008 | 0,002 | 0,002 | 0,001 | 0,085 |
| Subotica | | 0,003 | 0,001 | 0,001 | 0,000 | 0,029 |
| Budapest | | 0,029 | 0,010 | 0,007 | 0,006 | 0,390 |
| Bratislava | | 0,005 | 0,002 | 0,001 | 0,001 | 0,074 |
| Ostrava | | 0,003 | 0,001 | 0,001 | 0,001 | 0,042 |
| Katowice + Krakow | | 0,016 | 0,007 | 0,004 | 0,003 | 0,263 |
| Brno | | 0,004 | 0,002 | 0,001 | 0,001 | 0,060 |
| Praha | | 0,010 | 0,004 | 0,003 | 0,002 | 0,159 |
| Wien | | 0,020 | 0,008 | 0,005 | 0,004 | 0,308 |
| Nürnberg, Fürth, ... | | 0,005 | 0,002 | 0,001 | 0,001 | 0,079 |
| Frankfurt, ... | | 0,008 | 0,003 | 0,002 | 0,002 | 0,144 |
| Sarajewo | | 0,010 | 0,003 | 0,002 | 0,002 | 0,125 |
| Zagreb | | 0,012 | 0,004 | 0,003 | 0,002 | 0,166 |
| Graz | | 0,003 | 0,001 | 0,001 | 0,001 | 0,049 |
| Ljubljana | | 0,004 | 0,001 | 0,001 | 0,001 | 0,052 |
| Trieste | | 0,002 | 0,001 | 0,001 | 0,000 | 0,033 |
| Venezia + Treviso | | 0,003 | 0,001 | 0,001 | 0,001 | 0,049 |
| Verona | | 0,002 | 0,001 | 0,001 | 0,000 | 0,034 |
| Milano | | 0,009 | 0,004 | 0,002 | 0,002 | 0,151 |
| München | | 0,011 | 0,004 | 0,003 | 0,002 | 0,178 |
| Stuttgart | | 0,004 | 0,002 | 0,001 | 0,001 | 0,063 |

5,483

## Tbilisi - Gence

| | | Gence | Sumqayit | Makhachkala | Baku | Rasht |
|---|---|---|---|---|---|---|
| | | 0,32 | 0,32 | 0,58 | 2,14 | 0,64 |
| Tbilisi | 1,17 | 1,60 | 4,38 | 7,49 | 4,66 | 8,18 |
| Yerevan | 1,06 | 3,29 | 6,07 | 9,18 | 6,35 | 9,87 |
| Kutaisi | 0,20 | 3,53 | 6,31 | 9,42 | 6,59 | 10,11 |
| Batumi | 0,13 | 4,63 | 7,41 | 10,52 | 7,69 | 11,21 |
| Sotchi | 0,36 | 6,33 | 9,11 | 12,22 | 9,39 | 12,91 |
| Krasnodar | 0,75 | 8,02 | 10,80 | 13,91 | 11,08 | 14,60 |
| Rostow n.D. | 1,87 | 10,51 | 13,29 | 16,40 | 13,57 | 17,09 |
| Erzurum | 0,37 | 5,24 | 8,02 | 11,13 | 8,30 | 11,82 |
| Sivas | 0,35 | 9,22 | 12,00 | 15,11 | 12,28 | 15,80 |
| Ankara | 4,59 | 12,63 | 15,41 | 18,52 | 15,69 | 19,21 |
| Eskişehir | 0,69 | 14,69 | 17,47 | 20,58 | 17,75 | 21,27 |
| Istanbul | 14,66 | 16,99 | 19,77 | 22,88 | 20,05 | 23,57 |
| Izmir | 4,11 | 18,57 | 21,35 | 24,46 | 21,63 | 25,15 |
| Denizli | 1,00 | 17,28 | 20,06 | 23,17 | 20,34 | 23,86 |
| Konya | 1,22 | 14,91 | 17,69 | 20,80 | 17,97 | 21,49 |
| Antalya | 2,22 | 16,84 | 19,62 | 22,73 | 19,90 | 23,42 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Tbilisi | | 0,168 | 0,030 | 0,022 | 0,183 | 0,021 |
| Yerevan | | 0,045 | 0,016 | 0,014 | 0,098 | 0,014 |
| Kutaisi | | 0,007 | 0,003 | 0,003 | 0,017 | 0,003 |
| Batumi | | 0,003 | 0,001 | 0,001 | 0,009 | 0,001 |
| Sotchi | | 0,005 | 0,003 | 0,003 | 0,017 | 0,003 |
| Krasnodar | | 0,007 | 0,004 | 0,005 | 0,027 | 0,005 |
| Rostow n.D. | | 0,011 | 0,007 | 0,009 | 0,048 | 0,010 |
| Erzurum | | 0,007 | 0,003 | 0,004 | 0,022 | 0,004 |
| Sivas | | 0,003 | 0,002 | 0,002 | 0,011 | 0,002 |
| Ankara | | 0,020 | 0,014 | 0,019 | 0,091 | 0,019 |
| Eskişehir | | 0,002 | 0,002 | 0,002 | 0,011 | 0,002 |
| Istanbul | | 0,038 | 0,029 | 0,042 | 0,192 | 0,044 |
| Izmir | | 0,009 | 0,007 | 0,010 | 0,047 | 0,011 |
| Denizli | | 0,003 | 0,002 | 0,003 | 0,013 | 0,003 |
| Konya | | 0,004 | 0,003 | 0,004 | 0,019 | 0,004 |
| Antalya | | 0,006 | 0,005 | 0,006 | 0,029 | 0,007 |

| |
|---|
| 1,604 |

# Thessaloniki - Athenai

| | | Athenai | Patras |
|---|---|---|---|
| | | 3,75 | 0,17 |
| Thassaloniki | 0,33 | 3,02 | 4,76 |
| Sofia | 1,21 | 5,35 | 7,09 |
| Pleven | 0,11 | 6,67 | 8,41 |
| Ruse | 0,15 | 7,85 | 9,59 |
| Bucureşti | 1,88 | 8,54 | 10,28 |
| Alexandroupoli | 0,07 | 5,40 | 7,14 |
| Edirne | 0,15 | 6,50 | 8,24 |
| Istanbul | 14,66 | 8,63 | 10,37 |
| Skopje | 0,54 | 4,98 | 6,72 |
| Priština | 0,21 | 7,31 | 9,05 |
| Tetovo + Gostivar | 0,09 | 8,63 | 10,37 |
| Tiranë + Durrës | 0,60 | 9,81 | 11,55 |
| Niš | 0,26 | 10,50 | 12,24 |
| Beograd | 1,23 | 7,36 | 9,10 |
| Timişoara | 0,32 | 8,46 | 10,20 |
| Arad | 0,16 | 10,59 | 12,33 |
| Oradea | 0,20 | 6,94 | 8,68 |
| Novi Sad | 0,25 | 9,27 | 11,01 |
| Budapest | 1,74 | 10,59 | 12,33 |
| Trnava | 0,07 | 11,77 | 13,51 |
| Zilina + Trenčin | 0,14 | 12,46 | 14,20 |
| Györ | 0,13 | 9,32 | 11,06 |
| Bratislava | 0,42 | 10,42 | 12,16 |
| Ostrava | 0,30 | 12,55 | 14,29 |
| Katowice + ... | 1,28 | 8,90 | 10,64 |
| Krakow | 0,76 | 11,23 | 12,97 |
| Warszawa | 1,71 | 12,55 | 14,29 |
| Brno | 0,39 | 13,73 | 15,47 |
| Praha | 1,27 | 14,42 | 16,16 |
| Wien | 1,84 | 11,28 | 13,02 |
| Linz + Wels | 0,26 | 12,38 | 14,12 |
| Regensburg | 0,15 | 14,51 | 16,25 |
| Nürnberg | 0,74 | 10,86 | 12,60 |
| Frankfurt | 1,60 | 13,19 | 14,93 |
| Vinkovci + ... | 0,17 | 14,51 | 16,25 |
| Zagreb | 0,79 | 15,69 | 17,43 |
| Graz | 0,28 | 16,38 | 18,12 |
| Ljubljana | 0,29 | 13,24 | 14,98 |
| Salzburg | 0,15 | 14,34 | 16,08 |
| München | 1,45 | 16,47 | 18,21 |
| Ausburg | 0,29 | 12,82 | 14,56 |
| Stuttgart | 0,62 | 15,15 | 16,89 |
| Trieste | 0,20 | 16,47 | 18,21 |
| Venezia + ... | 0,55 | 17,65 | 19,39 |
| Verona | 0,26 | 18,34 | 20,08 |
| Milano | 1,35 | 15,20 | 16,94 |
| Torino | 0,89 | 16,30 | 18,04 |

| | | |
|---|---|---|
| Thassaloniki | 0,189 | 0,004 |
| Sofia | 0,262 | 0,007 |
| Pleven | 0,016 | 0,001 |
| Ruse | 0,017 | 0,001 |
| Bucureşti | 0,184 | 0,006 |
| Alexandroupoli | 0,015 | 0,000 |
| Edirne | 0,023 | 0,001 |
| Istanbul | 1,409 | 0,047 |
| Skopje | 0,132 | 0,004 |
| Priština | 0,027 | 0,001 |
| Tetovo + Gostivar | 0,009 | 0,000 |
| Tiranë + Durrës | 0,046 | 0,002 |
| Niš | 0,018 | 0,001 |
| Beograd | 0,155 | 0,005 |
| Timişoara | 0,032 | 0,001 |
| Arad | 0,011 | 0,000 |
| Oradea | 0,028 | 0,001 |
| Novi Sad | 0,021 | 0,001 |
| Budapest | 0,118 | 0,004 |
| Trnava | 0,004 | 0,000 |
| Zilina + Trenčin | 0,007 | 0,000 |
| Györ | 0,011 | 0,000 |
| Bratislava | 0,029 | 0,001 |
| Ostrava | 0,015 | 0,001 |
| Katowice + ... | 0,117 | 0,004 |
| Krakow | 0,047 | 0,002 |
| Warszawa | 0,087 | 0,003 |
| Brno | 0,017 | 0,001 |
| Praha | 0,051 | 0,002 |
| Wien | 0,112 | 0,004 |
| Linz + Wels | 0,014 | 0,000 |
| Regensburg | 0,006 | 0,000 |
| Nürnberg | 0,048 | 0,002 |
| Frankfurt | 0,075 | 0,003 |
| Vinkovci + ... | 0,007 | 0,000 |
| Zagreb | 0,027 | 0,001 |
| Graz | 0,009 | 0,000 |
| Ljubljana | 0,013 | 0,000 |
| Salzburg | 0,006 | 0,000 |
| München | 0,046 | 0,002 |
| Ausburg | 0,014 | 0,001 |
| Stuttgart | 0,023 | 0,001 |
| Trieste | 0,006 | 0,000 |
| Venezia + ... | 0,016 | 0,001 |
| Verona | 0,007 | 0,000 |
| Milano | 0,050 | 0,002 |
| Torino | 0,029 | 0,001 |

3,724

## Vilnius - Minsk

| | | Minsk | Orsha | Smolensk | Moskwa | Yaroslawl | Vladimir | Nishnij Nowgorod | Ryazan | Tula | Homyel | Bryansk | Kijiv |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1,89 | 0,12 | 0,33 | 12,86 | 0,60 | 0,35 | 1,26 | 0,53 | 0,50 | 0,48 | 0,41 | 2,80 |
| Vilnius | 0,54 | 1,72 | 3,73 | 4,84 | 8,52 | 11,01 | 10,29 | 12,41 | 10,36 | 8,49 | 4,53 | 6,99 | 6,75 |
| Kaunas | 0,31 | 2,62 | 4,63 | 5,74 | 9,42 | 11,91 | 11,19 | 13,31 | 11,26 | 9,39 | 5,43 | 7,89 | 7,65 |
| Riga | 0,64 | 4,85 | 6,86 | 7,97 | 11,65 | 14,14 | 13,42 | 15,54 | 13,49 | 11,62 | 7,66 | 10,12 | 9,88 |
| Tallinn | 0,41 | 7,66 | 9,67 | 10,78 | 14,46 | 16,95 | 16,23 | 18,35 | 16,30 | 14,43 | 10,47 | 12,93 | 12,69 |
| Helsinki + Espoo | 0,90 | 8,48 | 10,49 | 11,60 | 15,28 | 17,77 | 17,05 | 19,17 | 17,12 | 15,25 | 11,29 | 13,75 | 13,51 |
| Siauliai | 0,11 | 3,81 | 5,82 | 6,93 | 10,61 | 13,10 | 12,38 | 14,50 | 12,45 | 10,58 | 6,62 | 9,08 | 8,84 |
| Klaipeda | 0,16 | 5,19 | 7,20 | 8,31 | 11,99 | 14,48 | 13,76 | 15,88 | 13,83 | 11,96 | 8,00 | 10,46 | 10,22 |
| Kaliningrad | 0,44 | 4,83 | 6,84 | 7,95 | 11,63 | 14,12 | 13,40 | 15,52 | 13,47 | 11,60 | 7,64 | 10,10 | 9,86 |
| Gdańsk + Gdynia | 0,71 | 6,11 | 8,12 | 9,23 | 12,91 | 15,40 | 14,68 | 16,80 | 14,75 | 12,88 | 8,92 | 11,38 | 11,14 |
| Szczecin | 0,41 | 9,01 | 11,02 | 12,13 | 15,81 | 18,30 | 17,58 | 19,70 | 17,65 | 15,78 | 11,82 | 14,28 | 14,04 |
| Białystok | 0,29 | 4,62 | 6,63 | 7,74 | 11,42 | 13,91 | 13,19 | 15,31 | 13,26 | 11,39 | 7,43 | 9,89 | 9,65 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vilnius | | 0,406 | 0,007 | 0,012 | 0,182 | 0,005 | 0,004 | 0,009 | 0,005 | 0,007 | 0,020 | 0,008 | 0,059 |
| Kaunas | | 0,114 | 0,003 | 0,005 | 0,088 | 0,003 | 0,002 | 0,005 | 0,003 | 0,003 | 0,008 | 0,004 | 0,027 |
| Riga | | 0,083 | 0,003 | 0,006 | 0,127 | 0,004 | 0,003 | 0,008 | 0,004 | 0,005 | 0,010 | 0,005 | 0,036 |
| Tallinn | | 0,024 | 0,001 | 0,002 | 0,056 | 0,002 | 0,001 | 0,004 | 0,002 | 0,002 | 0,004 | 0,002 | 0,015 |
| Helsinki + Espoo | | 0,045 | 0,002 | 0,005 | 0,112 | 0,004 | 0,003 | 0,007 | 0,004 | 0,004 | 0,007 | 0,004 | 0,030 |
| Siauliai | | 0,021 | 0,001 | 0,001 | 0,026 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,002 | 0,001 | 0,008 |
| Klaipeda | | 0,018 | 0,001 | 0,001 | 0,030 | 0,001 | 0,001 | 0,002 | 0,001 | 0,001 | 0,002 | 0,001 | 0,009 |
| Kaliningrad | | 0,057 | 0,002 | 0,004 | 0,087 | 0,003 | 0,002 | 0,005 | 0,003 | 0,003 | 0,007 | 0,004 | 0,025 |
| Gdańsk + Gdynia | | 0,062 | 0,002 | 0,005 | 0,118 | 0,004 | 0,003 | 0,007 | 0,004 | 0,005 | 0,008 | 0,005 | 0,033 |
| Szczecin | | 0,018 | 0,001 | 0,002 | 0,048 | 0,002 | 0,001 | 0,003 | 0,002 | 0,002 | 0,003 | 0,002 | 0,013 |
| Białystok | | 0,041 | 0,001 | 0,003 | 0,059 | 0,002 | 0,001 | 0,004 | 0,002 | 0,002 | 0,005 | 0,002 | 0,017 |

2,454

# Vinkovci - Beograd

| | | Beograd | Timişoara | Arad | Niš | Sofia | Plovdiv + ... | Istanbul | Skopje | Thessaloniki | Athenai | Priština | Podgorica | Tirana + Durres |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1,23 | 0,32 | 0,16 | 0,26 | 1,21 | 0,57 | 14,66 | 0,54 | 0,33 | 3,75 | 0,21 | 0,20 | 0,60 |
| Vinkovci, Osijek | 0,17 | 1,40 | 2,59 | 2,94 | 3,39 | 4,75 | 6,07 | 9,81 | 4,89 | 6,85 | 9,87 | 3,90 | 4,22 | 5,52 |
| Pecs | 0,15 | 2,34 | 3,53 | 3,88 | 4,33 | 5,69 | 7,01 | 10,75 | 5,83 | 7,79 | 10,81 | 4,84 | 5,16 | 6,46 |
| Sarajewo | 0,53 | 2,94 | 4,13 | 4,48 | 4,93 | 6,29 | 7,61 | 11,35 | 6,43 | 8,39 | 11,41 | 5,44 | 5,76 | 7,06 |
| Mostar | 0,13 | 3,65 | 4,84 | 5,19 | 5,64 | 7,00 | 8,32 | 12,06 | 7,14 | 9,10 | 12,12 | 6,15 | 6,47 | 7,77 |
| Zagreb | 0,79 | 3,72 | 4,91 | 5,26 | 5,71 | 7,07 | 8,39 | 12,13 | 7,21 | 9,17 | 12,19 | 6,22 | 6,54 | 7,84 |
| Rijeka | 0,13 | 5,02 | 6,21 | 6,56 | 7,01 | 8,37 | 9,69 | 13,43 | 8,51 | 10,47 | 13,49 | 7,52 | 7,84 | 9,14 |
| Zadar | 0,08 | 5,68 | 6,87 | 7,22 | 7,67 | 9,03 | 10,35 | 14,09 | 9,17 | 11,13 | 14,15 | 8,18 | 8,50 | 9,80 |
| Split | 0,18 | 6,30 | 7,49 | 7,84 | 8,29 | 9,65 | 10,97 | 14,71 | 9,79 | 11,75 | 14,77 | 8,80 | 9,12 | 10,42 |
| Ljubljana | 0,29 | 4,87 | 6,06 | 6,41 | 6,86 | 8,22 | 9,54 | 13,28 | 8,36 | 10,32 | 13,34 | 7,37 | 7,69 | 8,99 |
| Koper | 0,03 | 5,77 | 6,96 | 7,31 | 7,76 | 9,12 | 10,44 | 14,18 | 9,26 | 11,22 | 14,24 | 8,27 | 8,59 | 9,89 |
| Trieste | 0,20 | 5,61 | 6,80 | 7,15 | 7,60 | 8,96 | 10,28 | 14,02 | 9,10 | 11,06 | 14,08 | 8,11 | 8,43 | 9,73 |
| Venezia | 0,34 | 6,76 | 7,95 | 8,30 | 8,75 | 10,11 | 11,43 | 15,17 | 10,25 | 12,21 | 15,23 | 9,26 | 9,58 | 10,88 |
| Padova | 0,21 | 7,10 | 8,29 | 8,64 | 9,09 | 10,45 | 11,77 | 15,51 | 10,59 | 12,55 | 15,57 | 9,60 | 9,92 | 11,22 |
| Bologna | 0,39 | 8,21 | 9,40 | 9,75 | 10,20 | 11,56 | 12,88 | 16,62 | 11,70 | 13,66 | 16,68 | 10,71 | 11,03 | 12,33 |
| Firenze | 0,36 | 8,99 | 10,18 | 10,53 | 10,98 | 12,34 | 13,66 | 17,40 | 12,48 | 14,44 | 17,46 | 11,49 | 11,81 | 13,11 |
| Roma | 2,87 | 11,29 | 12,48 | 12,83 | 13,28 | 14,64 | 15,96 | 19,70 | 14,78 | 16,74 | 19,76 | 13,79 | 14,11 | 15,41 |
| Verona | 0,26 | 7,75 | 8,94 | 9,29 | 9,74 | 11,10 | 12,42 | 16,16 | 11,24 | 13,20 | 16,22 | 10,25 | 10,57 | 11,87 |
| Milano | 1,35 | 9,17 | 10,36 | 10,71 | 11,16 | 12,52 | 13,84 | 17,58 | 12,66 | 14,62 | 17,64 | 11,67 | 11,99 | 13,29 |
| Klagenfurt + Villach | 0,16 | 5,71 | 6,90 | 7,25 | 7,70 | 9,06 | 10,38 | 14,12 | 9,20 | 11,16 | 14,18 | 8,21 | 8,53 | 9,83 |
| Salzburg | 0,15 | 7,11 | 8,30 | 8,65 | 9,10 | 10,46 | 11,78 | 15,52 | 10,60 | 12,56 | 15,58 | 9,61 | 9,93 | 11,23 |
| Innsbruck | 0,13 | 8,47 | 9,66 | 10,01 | 10,46 | 11,82 | 13,14 | 16,88 | 11,96 | 13,92 | 16,94 | 10,97 | 11,29 | 12,59 |
| München | 1,45 | 8,29 | 9,48 | 9,83 | 10,28 | 11,64 | 12,96 | 16,70 | 11,78 | 13,74 | 16,76 | 10,79 | 11,11 | 12,41 |
| Augsburg | 0,29 | 8,85 | 10,04 | 10,39 | 10,84 | 12,20 | 13,52 | 17,26 | 12,34 | 14,30 | 17,32 | 11,35 | 11,67 | 12,97 |
| Stuttgart | 0,62 | 10,19 | 11,38 | 11,73 | 12,18 | 13,54 | 14,86 | 18,60 | 13,68 | 15,64 | 18,66 | 12,69 | 13,01 | 14,31 |
| Maribor | 0,09 | 4,97 | 6,16 | 6,51 | 6,96 | 8,32 | 9,64 | 13,38 | 8,46 | 10,42 | 13,44 | 7,47 | 7,79 | 9,09 |
| Graz | 0,28 | 5,53 | 6,72 | 7,07 | 7,52 | 8,88 | 10,20 | 13,94 | 9,02 | 10,98 | 14,00 | 8,03 | 8,35 | 9,65 |
| Wien | 1,84 | 7,03 | 8,22 | 8,57 | 9,02 | 10,38 | 11,70 | 15,44 | 10,52 | 12,48 | 15,50 | 9,53 | 9,85 | 11,15 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vinkovci, Osijek | 0,118 | 0,011 | 0,004 | 0,006 | 0,015 | 0,005 | 0,051 | 0,006 | 0,002 | 0,013 | 0,004 | 0,003 | 0,006 |
| Pecs | 0,043 | 0,006 | 0,002 | 0,003 | 0,009 | 0,003 | 0,039 | 0,004 | 0,002 | 0,010 | 0,002 | 0,002 | 0,004 |
| Sarajewo | 0,104 | 0,015 | 0,007 | 0,009 | 0,028 | 0,010 | 0,125 | 0,012 | 0,005 | 0,032 | 0,006 | 0,005 | 0,011 |
| Mostar | 0,018 | 0,003 | 0,001 | 0,002 | 0,006 | 0,002 | 0,028 | 0,002 | 0,001 | 0,007 | 0,001 | 0,001 | 0,002 |
| Zagreb | 0,104 | 0,017 | 0,008 | 0,011 | 0,034 | 0,012 | 0,166 | 0,015 | 0,006 | 0,042 | 0,007 | 0,006 | 0,014 |
| Rijeka | 0,010 | 0,002 | 0,001 | 0,001 | 0,004 | 0,002 | 0,023 | 0,002 | 0,001 | 0,006 | 0,001 | 0,001 | 0,002 |
| Zadar | 0,005 | 0,001 | 0,000 | 0,001 | 0,002 | 0,001 | 0,013 | 0,001 | 0,000 | 0,003 | 0,000 | 0,000 | 0,001 |
| Split | 0,010 | 0,002 | 0,001 | 0,001 | 0,005 | 0,002 | 0,027 | 0,002 | 0,001 | 0,007 | 0,001 | 0,001 | 0,002 |
| Ljubljana | 0,024 | 0,004 | 0,002 | 0,003 | 0,010 | 0,004 | 0,052 | 0,004 | 0,002 | 0,013 | 0,002 | 0,002 | 0,004 |
| Koper | 0,002 | 0,000 | 0,000 | 0,000 | 0,001 | 0,000 | 0,005 | 0,000 | 0,000 | 0,001 | 0,000 | 0,000 | 0,000 |
| Trieste | 0,013 | 0,002 | 0,001 | 0,002 | 0,006 | 0,002 | 0,033 | 0,003 | 0,001 | 0,008 | 0,001 | 0,001 | 0,003 |
| Venezia | 0,016 | 0,003 | 0,001 | 0,002 | 0,008 | 0,003 | 0,049 | 0,004 | 0,002 | 0,012 | 0,002 | 0,001 | 0,004 |
| Padova | 0,009 | 0,002 | 0,001 | 0,001 | 0,005 | 0,002 | 0,029 | 0,002 | 0,001 | 0,007 | 0,001 | 0,001 | 0,002 |
| Bologna | 0,013 | 0,003 | 0,001 | 0,002 | 0,007 | 0,003 | 0,048 | 0,003 | 0,002 | 0,012 | 0,001 | 0,001 | 0,003 |
| Firenze | 0,011 | 0,002 | 0,001 | 0,002 | 0,006 | 0,002 | 0,041 | 0,003 | 0,001 | 0,010 | 0,001 | 0,001 | 0,003 |
| Roma | 0,057 | 0,013 | 0,006 | 0,009 | 0,036 | 0,015 | 0,265 | 0,016 | 0,008 | 0,067 | 0,007 | 0,006 | 0,016 |
| Verona | 0,010 | 0,002 | 0,001 | 0,001 | 0,005 | 0,002 | 0,034 | 0,002 | 0,001 | 0,009 | 0,001 | 0,001 | 0,002 |
| Milano | 0,038 | 0,008 | 0,004 | 0,006 | 0,022 | 0,009 | 0,151 | 0,010 | 0,005 | 0,038 | 0,004 | 0,004 | 0,010 |
| Klagenfurt + Villach | 0,010 | 0,002 | 0,001 | 0,001 | 0,005 | 0,002 | 0,026 | 0,002 | 0,001 | 0,007 | 0,001 | 0,001 | 0,002 |
| Salzburg | 0,007 | 0,001 | 0,001 | 0,001 | 0,003 | 0,001 | 0,021 | 0,001 | 0,001 | 0,005 | 0,001 | 0,001 | 0,001 |
| Innsbruck | 0,004 | 0,001 | 0,000 | 0,001 | 0,002 | 0,001 | 0,016 | 0,001 | 0,000 | 0,004 | 0,000 | 0,000 | 0,001 |
| München | 0,049 | 0,010 | 0,005 | 0,007 | 0,027 | 0,011 | 0,177 | 0,012 | 0,006 | 0,045 | 0,005 | 0,005 | 0,012 |
| Augsburg | 0,009 | 0,002 | 0,001 | 0,001 | 0,005 | 0,002 | 0,034 | 0,002 | 0,001 | 0,009 | 0,001 | 0,001 | 0,002 |
| Stuttgart | 0,015 | 0,003 | 0,002 | 0,002 | 0,009 | 0,004 | 0,063 | 0,004 | 0,002 | 0,016 | 0,002 | 0,002 | 0,004 |
| Maribor | 0,007 | 0,001 | 0,001 | 0,001 | 0,003 | 0,001 | 0,016 | 0,001 | 0,001 | 0,004 | 0,001 | 0,001 | 0,001 |
| Graz | 0,019 | 0,004 | 0,002 | 0,002 | 0,008 | 0,003 | 0,047 | 0,004 | 0,002 | 0,012 | 0,002 | 0,002 | 0,004 |
| Wien | 0,082 | 0,016 | 0,008 | 0,011 | 0,042 | 0,016 | 0,257 | 0,018 | 0,008 | 0,065 | 0,008 | 0,008 | 0,018 |

4,287

# Vinnitsa - Kijiv

| | | Kijiv | Bryansk | Moskwa | St. Petersburg | Yaroslawl | Nishnij Nowgorod | Kirov | Perm | Kazan | Charkiv | Voronesh | Donetsk | Rostow n.D. | Krasnodar | Dnipropetrowsk |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2,80 | 0,41 | 12,86 | 4,99 | 0,60 | 1,26 | 0,47 | 1,00 | 1,17 | 1,43 | 1,00 | 2,19 | 1,87 | 0,75 | 0,99 |
| Vinnitsa | 0,37 | 1,99 | 6,10 | 9,57 | 15,90 | 12,06 | 13,41 | 17,73 | 21,63 | 16,71 | 6,10 | 8,85 | 7,92 | 9,61 | 12,10 | 5,92 |
| Odessa | 1,00 | 5,50 | 9,61 | 13,08 | 19,41 | 15,57 | 16,92 | 21,24 | 25,14 | 20,22 | 9,61 | 12,36 | 11,43 | 13,12 | 15,61 | 9,43 |
| Tiraspol | 0,23 | 4,77 | 8,88 | 12,35 | 18,68 | 14,84 | 16,19 | 20,51 | 24,41 | 19,49 | 8,88 | 11,63 | 10,70 | 12,39 | 14,88 | 8,70 |
| Chisinau | 0,67 | 5,39 | 9,50 | 12,97 | 19,30 | 15,46 | 16,81 | 21,13 | 25,03 | 20,11 | 9,50 | 12,25 | 11,32 | 13,01 | 15,50 | 9,32 |
| Lviv | 0,72 | 5,27 | 9,38 | 12,85 | 19,18 | 15,34 | 16,69 | 21,01 | 24,91 | 19,99 | 9,38 | 12,13 | 11,20 | 12,89 | 15,38 | 9,20 |
| Lublin | 0,35 | 7,14 | 11,25 | 14,72 | 21,05 | 17,21 | 18,56 | 22,88 | 26,78 | 21,86 | 11,25 | 14,00 | 13,07 | 14,76 | 17,25 | 11,07 |
| Warszawa | 1,71 | 8,70 | 12,81 | 16,28 | 22,61 | 18,77 | 20,12 | 24,44 | 28,34 | 23,42 | 12,81 | 15,56 | 14,63 | 16,32 | 18,81 | 12,63 |
| Gdańsk + Gdynia | 0,71 | 11,55 | 15,66 | 19,13 | 25,46 | 21,62 | 22,97 | 27,29 | 31,19 | 26,27 | 15,66 | 18,41 | 17,48 | 19,17 | 21,66 | 15,48 |
| Łodz | 0,72 | 9,86 | 13,97 | 17,44 | 23,77 | 19,93 | 21,28 | 25,60 | 29,50 | 24,58 | 13,97 | 16,72 | 15,79 | 17,48 | 19,97 | 13,79 |
| Poznań | 0,55 | 11,76 | 15,87 | 19,34 | 25,67 | 21,83 | 23,18 | 27,50 | 31,40 | 26,48 | 15,87 | 18,62 | 17,69 | 19,38 | 21,87 | 15,69 |
| Berlin | 3,66 | 14,18 | 18,29 | 21,76 | 28,09 | 24,25 | 25,60 | 29,92 | 33,82 | 28,90 | 18,29 | 21,04 | 20,11 | 21,80 | 24,29 | 18,11 |
| Rzeszow | 0,18 | 6,72 | 10,83 | 14,30 | 20,63 | 16,79 | 18,14 | 22,46 | 26,36 | 21,44 | 10,83 | 13,58 | 12,65 | 14,34 | 16,83 | 10,65 |
| Tarnow | 0,11 | 7,46 | 11,57 | 15,04 | 21,37 | 17,53 | 18,88 | 23,20 | 27,10 | 22,18 | 11,57 | 14,32 | 13,39 | 15,08 | 17,57 | 11,39 |
| Krakow | 0,76 | 8,20 | 12,31 | 15,78 | 22,11 | 18,27 | 19,62 | 23,94 | 27,84 | 22,92 | 12,31 | 15,06 | 14,13 | 15,82 | 18,31 | 12,13 |
| Katowice | 1,28 | 8,89 | 13,00 | 16,47 | 22,80 | 18,96 | 20,31 | 24,63 | 28,53 | 23,61 | 13,00 | 15,75 | 14,82 | 16,51 | 19,00 | 12,82 |
| Wrocław | 0,63 | 10,57 | 14,68 | 18,15 | 24,48 | 20,64 | 21,99 | 26,31 | 30,21 | 25,29 | 14,68 | 17,43 | 16,50 | 18,19 | 20,68 | 14,50 |
| Ostrava | 0,30 | 9,41 | 13,52 | 16,99 | 23,32 | 19,48 | 20,83 | 25,15 | 29,05 | 24,13 | 13,52 | 16,27 | 15,34 | 17,03 | 19,52 | 13,34 |
| Brno | 0,39 | 10,84 | 14,95 | 18,42 | 24,75 | 20,91 | 22,26 | 26,58 | 30,48 | 25,56 | 14,95 | 17,70 | 16,77 | 18,46 | 20,95 | 14,77 |
| Praha | 1,27 | 12,71 | 16,82 | 20,29 | 26,62 | 22,78 | 24,13 | 28,45 | 32,35 | 27,43 | 16,82 | 19,57 | 18,64 | 20,33 | 22,82 | 16,64 |
| Uzhorod | 0,11 | 7,12 | 11,23 | 14,70 | 21,03 | 17,19 | 18,54 | 22,86 | 26,76 | 21,84 | 11,23 | 13,98 | 13,05 | 14,74 | 17,23 | 11,05 |
| Nyiregyhaza | 0,12 | 8,00 | 12,11 | 15,58 | 21,91 | 18,07 | 19,42 | 23,74 | 27,64 | 22,72 | 12,11 | 14,86 | 13,93 | 15,62 | 18,11 | 11,93 |
| Miskolc | 0,17 | 8,69 | 12,80 | 16,27 | 22,60 | 18,76 | 20,11 | 24,43 | 28,33 | 23,41 | 12,80 | 15,55 | 14,62 | 16,31 | 18,80 | 12,62 |
| Budapest | 1,74 | 10,16 | 14,27 | 17,74 | 24,07 | 20,23 | 21,58 | 25,90 | 29,80 | 24,88 | 14,27 | 17,02 | 16,09 | 17,78 | 20,27 | 14,09 |
| Bratislava | 0,42 | 11,90 | 16,01 | 19,48 | 25,81 | 21,97 | 23,32 | 27,64 | 31,54 | 26,62 | 16,01 | 18,76 | 17,83 | 19,52 | 22,01 | 15,83 |
| Wien | 1,84 | 12,35 | 16,46 | 19,93 | 26,26 | 22,42 | 23,77 | 28,09 | 31,99 | 27,07 | 16,46 | 19,21 | 18,28 | 19,97 | 22,46 | 16,28 |
| Debrecen | 0,21 | 8,45 | 12,56 | 16,03 | 22,36 | 18,52 | 19,87 | 24,19 | 28,09 | 23,17 | 12,56 | 15,31 | 14,38 | 16,07 | 18,56 | 12,38 |

| | | Kijiv | Bryansk | Moskwa | St. Petersburg | Yaroslawl | Nishnij Nowgorod | Kirov | Perm | Kazan | Charkiv | Voronesh | Donetsk | Rostow n.D. | Krasnodar | Dnipropetrowsk |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vinnitsa | | 0,322 | 0,007 | 0,102 | 0,017 | 0,003 | 0,006 | 0,001 | 0,002 | 0,004 | 0,024 | 0,009 | 0,024 | 0,015 | 0,004 | 0,018 |
| Odessa | | 0,154 | 0,009 | 0,163 | 0,032 | 0,006 | 0,010 | 0,003 | 0,004 | 0,007 | 0,031 | 0,014 | 0,035 | 0,024 | 0,007 | 0,022 |
| Tiraspol | | 0,045 | 0,002 | 0,041 | 0,008 | 0,001 | 0,003 | 0,001 | 0,001 | 0,002 | 0,008 | 0,004 | 0,009 | 0,006 | 0,002 | 0,006 |
| Chisinau | | 0,107 | 0,006 | 0,110 | 0,022 | 0,004 | 0,007 | 0,002 | 0,003 | 0,005 | 0,021 | 0,009 | 0,024 | 0,016 | 0,005 | 0,015 |
| Lviv | | 0,120 | 0,007 | 0,121 | 0,024 | 0,004 | 0,008 | 0,002 | 0,003 | 0,005 | 0,023 | 0,010 | 0,026 | 0,017 | 0,005 | 0,016 |
| Lublin | | 0,035 | 0,002 | 0,047 | 0,010 | 0,002 | 0,003 | 0,001 | 0,001 | 0,002 | 0,008 | 0,004 | 0,010 | 0,007 | 0,002 | 0,006 |
| Warszawa | | 0,121 | 0,009 | 0,192 | 0,043 | 0,007 | 0,013 | 0,004 | 0,006 | 0,009 | 0,032 | 0,016 | 0,039 | 0,028 | 0,009 | 0,023 |
| Gdańsk + Gdynia | | 0,031 | 0,003 | 0,060 | 0,014 | 0,002 | 0,004 | 0,001 | 0,002 | 0,003 | 0,009 | 0,005 | 0,012 | 0,009 | 0,003 | 0,007 |
| Łodz | | 0,041 | 0,003 | 0,072 | 0,016 | 0,003 | 0,005 | 0,001 | 0,002 | 0,004 | 0,012 | 0,006 | 0,014 | 0,010 | 0,003 | 0,008 |
| Poznań | | 0,023 | 0,002 | 0,046 | 0,011 | 0,002 | 0,003 | 0,001 | 0,002 | 0,002 | 0,007 | 0,004 | 0,009 | 0,007 | 0,002 | 0,005 |
| Berlin | | 0,113 | 0,011 | 0,250 | 0,063 | 0,010 | 0,019 | 0,005 | 0,009 | 0,014 | 0,037 | 0,021 | 0,049 | 0,036 | 0,012 | 0,026 |
| Rzeszow | | 0,020 | 0,001 | 0,025 | 0,005 | 0,001 | 0,002 | 0,000 | 0,001 | 0,001 | 0,004 | 0,002 | 0,005 | 0,004 | 0,001 | 0,003 |
| Tarnow | | 0,010 | 0,001 | 0,014 | 0,003 | 0,001 | 0,001 | 0,000 | 0,000 | 0,001 | 0,002 | 0,001 | 0,003 | 0,002 | 0,001 | 0,002 |
| Krakow | | 0,059 | 0,004 | 0,090 | 0,020 | 0,003 | 0,006 | 0,002 | 0,003 | 0,004 | 0,015 | 0,008 | 0,018 | 0,013 | 0,004 | 0,011 |
| Katowice | | 0,087 | 0,007 | 0,141 | 0,031 | 0,005 | 0,010 | 0,003 | 0,004 | 0,007 | 0,023 | 0,012 | 0,029 | 0,020 | 0,006 | 0,017 |
| Wrocław | | 0,032 | 0,003 | 0,059 | 0,014 | 0,002 | 0,004 | 0,001 | 0,002 | 0,003 | 0,009 | 0,005 | 0,012 | 0,009 | 0,003 | 0,007 |
| Ostrava | | 0,019 | 0,001 | 0,031 | 0,007 | 0,001 | 0,002 | 0,001 | 0,001 | 0,002 | 0,005 | 0,003 | 0,006 | 0,005 | 0,001 | 0,004 |
| Brno | | 0,019 | 0,002 | 0,035 | 0,008 | 0,001 | 0,003 | 0,001 | 0,001 | 0,002 | 0,006 | 0,003 | 0,007 | 0,005 | 0,002 | 0,004 |
| Praha | | 0,047 | 0,004 | 0,098 | 0,024 | 0,004 | 0,007 | 0,002 | 0,003 | 0,005 | 0,015 | 0,008 | 0,019 | 0,014 | 0,005 | 0,011 |
| Uzhorod | | 0,011 | 0,001 | 0,015 | 0,003 | 0,001 | 0,001 | 0,000 | 0,000 | 0,001 | 0,003 | 0,001 | 0,003 | 0,002 | 0,001 | 0,002 |
| Nyiregyhaza | | 0,010 | 0,001 | 0,014 | 0,003 | 0,001 | 0,001 | 0,000 | 0,000 | 0,001 | 0,002 | 0,001 | 0,003 | 0,002 | 0,001 | 0,002 |
| Miskolc | | 0,012 | 0,001 | 0,019 | 0,004 | 0,001 | 0,001 | 0,000 | 0,001 | 0,001 | 0,003 | 0,002 | 0,004 | 0,003 | 0,001 | 0,002 |
| Budapest | | 0,095 | 0,008 | 0,168 | 0,039 | 0,006 | 0,012 | 0,003 | 0,005 | 0,009 | 0,027 | 0,014 | 0,034 | 0,024 | 0,008 | 0,019 |
| Bratislava | | 0,017 | 0,002 | 0,035 | 0,008 | 0,001 | 0,003 | 0,001 | 0,001 | 0,002 | 0,005 | 0,003 | 0,007 | 0,005 | 0,002 | 0,004 |
| Wien | | 0,072 | 0,006 | 0,146 | 0,035 | 0,006 | 0,011 | 0,003 | 0,005 | 0,008 | 0,023 | 0,012 | 0,029 | 0,021 | 0,007 | 0,016 |
| Debrecen | | 0,016 | 0,001 | 0,024 | 0,005 | 0,001 | 0,002 | 0,000 | 0,001 | 0,001 | 0,004 | 0,002 | 0,005 | 0,003 | 0,001 | 0,003 |

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| 6,393 |

## Vladimir - Nishnij Nowgorod

| | | Nishnij Nowgorod | Kirow | Perm | Kazan | Ishevsk | Yekaterinburg | Omsk | Novosibirsk | Chelyabinsk |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1,26 | 0,47 | 1,00 | 1,17 | 0,63 | 1,39 | 1,16 | 1,51 | 1,15 |
| Vladimir | 0,35 | 2,12 | 6,44 | 10,34 | 5,42 | 8,18 | 11,19 | 19,29 | 25,34 | 13,14 |
| Moskwa | 12,86 | 3,89 | 8,21 | 12,11 | 7,19 | 9,95 | 12,96 | 21,06 | 27,11 | 14,91 |
| St. Petersburg | 4,99 | 10,22 | 14,54 | 18,44 | 13,52 | 16,28 | 19,29 | 27,39 | 33,44 | 21,24 |
| Helsinki | 0,90 | 13,67 | 17,99 | 21,89 | 16,97 | 19,73 | 22,74 | 30,84 | 36,89 | 24,69 |
| Tallinn | 0,41 | 13,42 | 17,74 | 21,64 | 16,72 | 19,48 | 22,49 | 30,59 | 36,64 | 24,44 |
| Smolensk | 0,33 | 7,57 | 11,89 | 15,79 | 10,87 | 13,63 | 16,64 | 24,74 | 30,79 | 18,59 |
| Minsk | 1,89 | 10,69 | 15,01 | 18,91 | 13,99 | 16,75 | 19,76 | 27,86 | 33,91 | 21,71 |
| Vilnius | 0,54 | 12,41 | 16,73 | 20,63 | 15,71 | 18,47 | 21,48 | 29,58 | 35,63 | 23,43 |
| Kaunas | 0,31 | 13,31 | 17,63 | 21,53 | 16,61 | 19,37 | 22,38 | 30,48 | 36,53 | 24,33 |
| Kaliningrad | 0,44 | 15,52 | 19,84 | 23,74 | 18,82 | 21,58 | 24,59 | 32,69 | 38,74 | 26,54 |
| Brest | 0,31 | 13,99 | 18,31 | 22,21 | 17,29 | 20,05 | 23,06 | 31,16 | 37,21 | 25,01 |
| Warszawa | 1,71 | 15,84 | 20,16 | 24,06 | 19,14 | 21,90 | 24,91 | 33,01 | 39,06 | 26,86 |
| Bryansk | 0,41 | 7,36 | 11,68 | 15,58 | 10,66 | 13,42 | 16,43 | 24,53 | 30,58 | 18,38 |
| Homyel | 0,48 | 9,82 | 14,14 | 18,04 | 13,12 | 15,88 | 18,89 | 26,99 | 33,04 | 20,84 |
| Kijiv | 2,80 | 11,77 | 16,09 | 19,99 | 15,07 | 17,83 | 20,84 | 28,94 | 34,99 | 22,79 |
| Lviv | 0,72 | 16,47 | 20,79 | 24,69 | 19,77 | 22,53 | 25,54 | 33,64 | 39,69 | 27,49 |
| Tula | 0,50 | 5,62 | 9,94 | 13,84 | 8,92 | 11,68 | 14,69 | 22,79 | 28,84 | 16,64 |
| Orël | 0,32 | 7,32 | 11,64 | 15,54 | 10,62 | 13,38 | 16,39 | 24,49 | 30,54 | 18,34 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Moskwa | 0,123 | 0,007 | 0,007 | 0,023 | 0,006 | 0,008 | 0,003 | 0,002 | 0,005 |
| St. Petersburg | 1,610 | 0,169 | 0,185 | 0,526 | 0,163 | 0,230 | 0,084 | 0,071 | 0,150 |
| Helsinki | 0,121 | 0,025 | 0,035 | 0,070 | 0,027 | 0,045 | 0,021 | 0,019 | 0,032 |
| Tallinn | 0,013 | 0,003 | 0,005 | 0,009 | 0,004 | 0,006 | 0,003 | 0,003 | 0,004 |
| Smolensk | 0,006 | 0,001 | 0,002 | 0,004 | 0,002 | 0,003 | 0,001 | 0,001 | 0,002 |
| Minsk | 0,013 | 0,002 | 0,003 | 0,007 | 0,002 | 0,004 | 0,002 | 0,001 | 0,003 |
| Vilnius | 0,042 | 0,009 | 0,013 | 0,025 | 0,010 | 0,016 | 0,008 | 0,007 | 0,012 |
| Kaunas | 0,009 | 0,002 | 0,003 | 0,006 | 0,002 | 0,004 | 0,002 | 0,002 | 0,003 |
| Kaliningrad | 0,005 | 0,001 | 0,002 | 0,003 | 0,001 | 0,002 | 0,001 | 0,001 | 0,002 |
| Brest | 0,005 | 0,001 | 0,002 | 0,004 | 0,001 | 0,003 | 0,001 | 0,001 | 0,002 |
| Warszawa | 0,004 | 0,001 | 0,002 | 0,003 | 0,001 | 0,002 | 0,001 | 0,001 | 0,001 |
| Bryansk | 0,020 | 0,005 | 0,008 | 0,013 | 0,006 | 0,010 | 0,005 | 0,005 | 0,007 |
| Homyel | 0,017 | 0,003 | 0,004 | 0,009 | 0,003 | 0,005 | 0,002 | 0,002 | 0,003 |
| Kijiv | 0,012 | 0,002 | 0,004 | 0,007 | 0,003 | 0,005 | 0,002 | 0,002 | 0,003 |
| Lviv | 0,053 | 0,012 | 0,017 | 0,033 | 0,013 | 0,022 | 0,011 | 0,010 | 0,016 |
| Tula | 0,008 | 0,002 | 0,003 | 0,005 | 0,002 | 0,004 | 0,002 | 0,002 | 0,003 |
| Orël | 0,033 | 0,005 | 0,006 | 0,014 | 0,005 | 0,007 | 0,003 | 0,002 | 0,005 |

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| 4,572 |

# Voronesh - Ryazan

| | | Ryazan | Mokwa | Smolensk | Minsk | Vilnius | St.Petersburg | Pskow | Tallinn | Helsinki | Yaroslawl | Rybinsk | Vologda | Kostroma | Vladimir | Nishnij Nowgorod |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0,53 | 12,86 | 0,33 | 1,89 | 0,54 | 4,99 | 0,21 | 0,41 | 0,90 | 0,60 | 0,20 | 0,31 | 0,27 | 0,35 | 1,26 |
| Saratow | 0,84 | 5,37 | 7,21 | 10,89 | 14,01 | 15,73 | 13,54 | 16,16 | 16,74 | 16,99 | 9,70 | 10,47 | 11,54 | 10,37 | 8,98 | 11,10 |
| Volgograd | 1,02 | 7,29 | 9,13 | 12,81 | 15,93 | 17,65 | 15,46 | 18,08 | 18,66 | 18,91 | 11,62 | 12,39 | 13,46 | 12,29 | 10,90 | 13,02 |
| Voronesh | 1,00 | 3,32 | 5,16 | 8,84 | 11,96 | 13,68 | 11,49 | 14,11 | 14,69 | 14,94 | 7,65 | 8,42 | 9,49 | 8,32 | 6,93 | 9,05 |
| Rostow n. D. | 1,87 | 8,23 | 10,07 | 13,75 | 16,87 | 18,59 | 16,40 | 19,02 | 19,60 | 19,85 | 12,56 | 13,33 | 14,40 | 13,23 | 11,84 | 13,96 |
| Krasnodar | 0,75 | 10,72 | 12,56 | 16,24 | 19,36 | 21,08 | 18,89 | 21,51 | 22,09 | 22,34 | 15,05 | 15,82 | 16,89 | 15,72 | 14,33 | 16,45 |
| Sotchi | 0,36 | 12,41 | 14,25 | 17,93 | 21,05 | 22,77 | 20,58 | 23,20 | 23,78 | 24,03 | 16,74 | 17,51 | 18,58 | 17,41 | 16,02 | 18,14 |
| Kutaisi | 0,20 | 15,21 | 17,05 | 20,73 | 23,85 | 25,57 | 23,38 | 26,00 | 26,58 | 26,83 | 19,54 | 20,31 | 21,38 | 20,21 | 18,82 | 20,94 |
| Tbilisi | 1,17 | 17,14 | 18,98 | 22,66 | 25,78 | 27,50 | 25,31 | 27,93 | 28,51 | 28,76 | 21,47 | 22,24 | 23,31 | 22,14 | 20,75 | 22,87 |
| Yerevan | 1,06 | 18,83 | 20,67 | 24,35 | 27,47 | 29,19 | 27,00 | 29,62 | 30,20 | 30,45 | 23,16 | 23,93 | 25,00 | 23,83 | 22,44 | 24,56 |
| Charkiw | 1,43 | 6,07 | 7,91 | 11,59 | 14,71 | 16,43 | 14,24 | 16,86 | 17,44 | 17,69 | 10,40 | 11,17 | 12,24 | 11,07 | 9,68 | 11,80 |
| Dnjepropetrowsk | 0,99 | 7,94 | 9,78 | 13,46 | 16,58 | 18,30 | 16,11 | 18,73 | 19,31 | 19,56 | 12,27 | 13,04 | 14,11 | 12,94 | 11,55 | 13,67 |
| Donetsk | 2,19 | 7,49 | 9,33 | 13,01 | 16,13 | 17,85 | 15,66 | 18,28 | 18,86 | 19,11 | 11,82 | 12,59 | 13,66 | 12,49 | 11,10 | 13,22 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Saratow | 0,026 | 0,376 | 0,005 | 0,018 | 0,004 | 0,050 | 0,002 | 0,003 | 0,006 | 0,011 | 0,003 | 0,004 | 0,004 | 0,007 | 0,018 |
| Volgograd | 0,018 | 0,306 | 0,004 | 0,017 | 0,004 | 0,048 | 0,002 | 0,003 | 0,006 | 0,009 | 0,003 | 0,004 | 0,004 | 0,006 | 0,016 |
| Voronesh | 0,069 | 0,790 | 0,008 | 0,028 | 0,006 | 0,079 | 0,002 | 0,004 | 0,009 | 0,019 | 0,005 | 0,007 | 0,007 | 0,013 | 0,030 |
| Rostow n. D. | 0,028 | 0,474 | 0,007 | 0,029 | 0,007 | 0,080 | 0,003 | 0,005 | 0,010 | 0,015 | 0,005 | 0,006 | 0,006 | 0,010 | 0,027 |
| Krasnodar | 0,007 | 0,131 | 0,002 | 0,009 | 0,002 | 0,025 | 0,001 | 0,002 | 0,003 | 0,004 | 0,001 | 0,002 | 0,002 | 0,003 | 0,008 |
| Sotchi | 0,003 | 0,051 | 0,001 | 0,004 | 0,001 | 0,011 | 0,000 | 0,001 | 0,001 | 0,002 | 0,001 | 0,001 | 0,001 | 0,001 | 0,003 |
| Kutaisi | 0,001 | 0,021 | 0,000 | 0,002 | 0,000 | 0,005 | 0,000 | 0,000 | 0,001 | 0,001 | 0,000 | 0,000 | 0,000 | 0,000 | 0,001 |
| Tbilisi | 0,005 | 0,101 | 0,002 | 0,009 | 0,002 | 0,024 | 0,001 | 0,002 | 0,003 | 0,004 | 0,001 | 0,002 | 0,002 | 0,002 | 0,007 |
| Yerevan | 0,004 | 0,079 | 0,002 | 0,007 | 0,002 | 0,020 | 0,001 | 0,001 | 0,003 | 0,003 | 0,001 | 0,001 | 0,001 | 0,002 | 0,006 |
| Charkiw | 0,035 | 0,547 | 0,007 | 0,028 | 0,007 | 0,078 | 0,002 | 0,005 | 0,010 | 0,016 | 0,005 | 0,006 | 0,006 | 0,011 | 0,027 |
| Donezsk | 0,015 | 0,264 | 0,004 | 0,016 | 0,004 | 0,044 | 0,001 | 0,003 | 0,006 | 0,008 | 0,003 | 0,003 | 0,003 | 0,005 | 0,015 |
| Dnjepropetrowsk | 0,038 | 0,632 | 0,009 | 0,037 | 0,009 | 0,102 | 0,003 | 0,006 | 0,013 | 0,020 | 0,006 | 0,008 | 0,008 | 0,013 | 0,034 |

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| 5,514 |

# Warszawa - Białystok

| | | Bialystok | Kaunas | Vilnius | Daugavpils | Pskow | St. Petersburg | Riga | Tallinn | Helsinki + Espoo | Lahti | Tampere |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0,29 | 0,31 | 0,54 | 0,09 | 0,21 | 4,99 | 0,64 | 0,41 | 0,90 | 0,10 | 0,23 |
| Warszawa | 1,71 | 1,78 | 3,78 | 4,68 | 6,24 | 8,66 | 11,28 | 6,01 | 8,82 | 9,64 | 10,62 | 11,24 |
| Lublin | 0,35 | 3,34 | 5,34 | 6,24 | 7,80 | 10,22 | 12,84 | 7,57 | 10,38 | 11,20 | 12,18 | 12,80 |
| Lviv | 0,72 | 5,21 | 7,21 | 8,11 | 9,67 | 12,09 | 14,71 | 9,44 | 12,25 | 13,07 | 14,05 | 14,67 |
| Krakow | 0,76 | 4,31 | 6,31 | 7,21 | 8,77 | 11,19 | 13,81 | 8,54 | 11,35 | 12,17 | 13,15 | 13,77 |
| Tarnov | 0,11 | 5,05 | 7,05 | 7,95 | 9,51 | 11,93 | 14,55 | 9,28 | 12,09 | 12,91 | 13,89 | 14,51 |
| Kosice | 0,24 | 6,82 | 8,82 | 9,72 | 11,28 | 13,70 | 16,32 | 11,05 | 13,86 | 14,68 | 15,66 | 16,28 |
| Katowice | 1,28 | 4,36 | 6,36 | 7,26 | 8,82 | 11,24 | 13,86 | 8,59 | 11,40 | 12,22 | 13,20 | 13,82 |
| Ostrava | 0,30 | 5,11 | 7,11 | 8,01 | 9,57 | 11,99 | 14,61 | 9,34 | 12,15 | 12,97 | 13,95 | 14,57 |
| Brno | 0,39 | 6,54 | 8,54 | 9,44 | 11,00 | 13,42 | 16,04 | 10,77 | 13,58 | 14,40 | 15,38 | 16,00 |
| Wien | 1,84 | 7,26 | 9,26 | 10,16 | 11,72 | 14,14 | 16,76 | 11,49 | 14,30 | 15,12 | 16,10 | 16,72 |
| Bratislava | 0,42 | 7,14 | 9,14 | 10,04 | 11,60 | 14,02 | 16,64 | 11,37 | 14,18 | 15,00 | 15,98 | 16,60 |
| Budapest | 1,74 | 8,88 | 10,88 | 11,78 | 13,34 | 15,76 | 18,38 | 13,11 | 15,92 | 16,74 | 17,72 | 18,34 |
| Łodz | 0,72 | 2,94 | 4,94 | 5,84 | 7,40 | 9,82 | 12,44 | 7,17 | 9,98 | 10,80 | 11,78 | 12,40 |
| Wrocław | 0,63 | 4,79 | 6,79 | 7,69 | 9,25 | 11,67 | 14,29 | 9,02 | 11,83 | 12,65 | 13,63 | 14,25 |
| Praha | 1,27 | 7,03 | 9,03 | 9,93 | 11,49 | 13,91 | 16,53 | 11,26 | 14,07 | 14,89 | 15,87 | 16,49 |
| Poznań | 0,55 | 4,84 | 6,84 | 7,74 | 9,30 | 11,72 | 14,34 | 9,07 | 11,88 | 12,70 | 13,68 | 14,30 |
| Berlin | 3,66 | 7,26 | 9,26 | 10,16 | 11,72 | 14,14 | 16,76 | 11,49 | 14,30 | 15,12 | 16,10 | 16,72 |
| Leipzig + Halle | 0,75 | 8,72 | 10,72 | 11,62 | 13,18 | 15,60 | 18,22 | 12,95 | 15,76 | 16,58 | 17,56 | 18,18 |
| Hannover | 0,51 | 9,85 | 11,85 | 12,75 | 14,31 | 16,73 | 19,35 | 14,08 | 16,89 | 17,71 | 18,69 | 19,31 |
| Hamburg | 1,79 | 9,79 | 11,79 | 12,69 | 14,25 | 16,67 | 19,29 | 14,02 | 16,83 | 17,65 | 18,63 | 19,25 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Warszawa | | 0,186 | 0,055 | 0,067 | 0,007 | 0,009 | 0,139 | 0,052 | 0,017 | 0,033 | 0,003 | 0,006 |
| Lublin | | 0,013 | 0,006 | 0,008 | 0,001 | 0,001 | 0,023 | 0,007 | 0,003 | 0,005 | 0,000 | 0,001 |
| Lviv | | 0,013 | 0,008 | 0,011 | 0,001 | 0,002 | 0,037 | 0,010 | 0,004 | 0,008 | 0,001 | 0,002 |
| Krakow | | 0,018 | 0,010 | 0,014 | 0,002 | 0,003 | 0,044 | 0,013 | 0,005 | 0,010 | 0,001 | 0,002 |
| Tarnov | | 0,002 | 0,001 | 0,002 | 0,000 | 0,000 | 0,006 | 0,002 | 0,001 | 0,001 | 0,000 | 0,000 |
| Kosice | | 0,003 | 0,002 | 0,003 | 0,000 | 0,001 | 0,010 | 0,003 | 0,001 | 0,002 | 0,000 | 0,000 |
| Katowice | | 0,030 | 0,017 | 0,024 | 0,003 | 0,004 | 0,073 | 0,021 | 0,008 | 0,016 | 0,002 | 0,003 |
| Ostrava | | 0,005 | 0,003 | 0,005 | 0,001 | 0,001 | 0,016 | 0,004 | 0,002 | 0,003 | 0,000 | 0,001 |
| Brno | | 0,005 | 0,003 | 0,005 | 0,001 | 0,001 | 0,017 | 0,004 | 0,002 | 0,004 | 0,000 | 0,001 |
| Wien | | 0,018 | 0,013 | 0,019 | 0,003 | 0,004 | 0,076 | 0,019 | 0,008 | 0,016 | 0,002 | 0,004 |
| Bratislava | | 0,004 | 0,003 | 0,004 | 0,001 | 0,001 | 0,018 | 0,004 | 0,002 | 0,004 | 0,000 | 0,001 |
| Budapest | | 0,012 | 0,009 | 0,014 | 0,002 | 0,003 | 0,062 | 0,014 | 0,006 | 0,013 | 0,001 | 0,003 |
| Łodz | | 0,033 | 0,015 | 0,019 | 0,002 | 0,003 | 0,049 | 0,016 | 0,006 | 0,011 | 0,001 | 0,002 |
| Wrocław | | 0,013 | 0,008 | 0,011 | 0,001 | 0,002 | 0,034 | 0,010 | 0,004 | 0,008 | 0,001 | 0,002 |
| Praha | | 0,013 | 0,009 | 0,014 | 0,002 | 0,003 | 0,054 | 0,013 | 0,006 | 0,012 | 0,001 | 0,002 |
| Poznań | | 0,011 | 0,006 | 0,009 | 0,001 | 0,002 | 0,030 | 0,008 | 0,003 | 0,007 | 0,001 | 0,001 |
| Berlin | | 0,036 | 0,026 | 0,038 | 0,005 | 0,009 | 0,151 | 0,037 | 0,016 | 0,033 | 0,003 | 0,007 |
| Leipzig + Halle | | 0,005 | 0,004 | 0,006 | 0,001 | 0,001 | 0,027 | 0,006 | 0,003 | 0,006 | 0,001 | 0,001 |
| Hannover | | 0,003 | 0,002 | 0,004 | 0,000 | 0,001 | 0,017 | 0,004 | 0,002 | 0,003 | 0,000 | 0,001 |
| Hamburg | | 0,011 | 0,008 | 0,013 | 0,002 | 0,003 | 0,058 | 0,013 | 0,006 | 0,012 | 0,001 | 0,003 |

2,604

## Warszawa - Brest

| | | Brest | Minsk | Orsha | Smolensk | Moskwa | Homyel | Bryansk |
|---|---|---|---|---|---|---|---|---|
| | | 0,31 | 1,89 | 0,12 | 0,33 | 12,86 | 0,48 | 0,41 |
| Warszawa | 1,71 | 1,85 | 5,15 | 7,16 | 8,27 | 11,95 | 7,96 | 10,42 |
| Gdansk + Gdynia | 0,71 | 4,70 | 8,00 | 10,01 | 11,12 | 14,80 | 10,81 | 13,27 |
| Łódź | 0,72 | 3,01 | 6,31 | 8,32 | 9,43 | 13,11 | 9,12 | 11,58 |
| Poznań | 0,55 | 4,91 | 8,21 | 10,22 | 11,33 | 15,01 | 11,02 | 13,48 |
| Szczecin | 0,41 | 6,89 | 10,19 | 12,20 | 13,31 | 16,99 | 13,00 | 15,46 |
| Berlin + Potsdam | 3,66 | 7,33 | 10,63 | 12,64 | 13,75 | 17,43 | 13,44 | 15,90 |
| Hamburg | 1,79 | 9,86 | 13,16 | 15,17 | 16,28 | 19,96 | 15,97 | 18,43 |
| Hannover | 0,51 | 9,79 | 13,09 | 15,10 | 16,21 | 19,89 | 15,90 | 18,36 |
| Leipzig + Halle | 0,36 | 8,79 | 12,09 | 14,10 | 15,21 | 18,89 | 14,90 | 17,36 |
| Wrocław | 0,63 | 4,86 | 8,16 | 10,17 | 11,28 | 14,96 | 10,97 | 13,43 |
| Praha | 1,27 | 7,07 | 10,37 | 12,38 | 13,49 | 17,17 | 13,18 | 15,64 |
| Katowice + ... | 1,28 | 4,43 | 7,73 | 9,74 | 10,85 | 14,53 | 10,54 | 13,00 |
| Ostrava | 0,30 | 5,18 | 8,48 | 10,49 | 11,60 | 15,28 | 11,29 | 13,75 |
| Brno | 0,39 | 6,61 | 9,91 | 11,92 | 13,03 | 16,71 | 12,72 | 15,18 |
| Wien | 1,84 | 7,33 | 10,63 | 12,64 | 13,75 | 17,43 | 13,44 | 15,90 |
| Bratislava | 0,42 | 7,21 | 10,51 | 12,52 | 13,63 | 17,31 | 13,32 | 15,78 |
| Krakow | 0,76 | 4,39 | 7,69 | 9,70 | 10,81 | 14,49 | 10,50 | 12,96 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Warszawa | 0,186 | 0,199 | 0,007 | 0,016 | 0,324 | 0,024 | 0,013 |
| Gdansk + Gdynia | 0,016 | 0,039 | 0,002 | 0,004 | 0,094 | 0,006 | 0,004 |
| Łódź | 0,034 | 0,059 | 0,002 | 0,005 | 0,117 | 0,008 | 0,005 |
| Poznań | 0,011 | 0,029 | 0,001 | 0,003 | 0,071 | 0,004 | 0,003 |
| Szczecin | 0,005 | 0,015 | 0,001 | 0,002 | 0,043 | 0,003 | 0,002 |
| Berlin + Potsdam | 0,038 | 0,124 | 0,006 | 0,014 | 0,365 | 0,021 | 0,014 |
| Hamburg | 0,011 | 0,042 | 0,002 | 0,005 | 0,142 | 0,008 | 0,005 |
| Hannover | 0,003 | 0,012 | 0,001 | 0,001 | 0,041 | 0,002 | 0,001 |
| Leipzig + Halle | 0,003 | 0,010 | 0,000 | 0,001 | 0,031 | 0,002 | 0,001 |
| Wrocław | 0,013 | 0,034 | 0,001 | 0,003 | 0,082 | 0,005 | 0,003 |
| Praha | 0,014 | 0,045 | 0,002 | 0,005 | 0,130 | 0,008 | 0,005 |
| Katowice + ... | 0,032 | 0,075 | 0,003 | 0,007 | 0,174 | 0,011 | 0,007 |
| Ostrava | 0,006 | 0,015 | 0,001 | 0,002 | 0,037 | 0,002 | 0,001 |
| Brno | 0,005 | 0,015 | 0,001 | 0,002 | 0,042 | 0,002 | 0,002 |
| Wien | 0,019 | 0,063 | 0,003 | 0,007 | 0,184 | 0,011 | 0,007 |
| Bratislava | 0,005 | 0,015 | 0,001 | 0,002 | 0,042 | 0,002 | 0,002 |
| Krakow | 0,019 | 0,045 | 0,002 | 0,004 | 0,104 | 0,007 | 0,004 |

3,601

# Wien - Bratislava

| | | Bratislava | Trnava | Trenčin | Zilina | Kosice | Uzhorod | Lviv | Zvolen + Banska Bystrica | Budapest | Miskolc | Debrecen |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0,42 | 0,07 | 0,06 | 0,08 | 0,33 | 0,12 | 0,72 | 0,12 | 1,74 | 0,17 | 0,21 |
| Wien | 1,84 | 0,55 | 0,98 | 1,62 | 2,23 | 4,16 | 4,91 | 6,75 | 2,05 | 20,00 | 20,00 | 20,00 |
| Linz + Wels | 0,26 | 2,08 | 2,51 | 3,15 | 3,76 | 5,69 | 6,44 | 8,28 | 3,58 | 20,00 | 20,00 | 20,00 |
| Passau | 0,06 | 2,80 | 3,23 | 3,87 | 4,48 | 6,41 | 7,16 | 9,00 | 4,30 | 20,00 | 20,00 | 20,00 |
| Regensburg | 0,15 | 3,90 | 4,33 | 4,97 | 5,58 | 7,51 | 8,26 | 10,10 | 5,40 | 20,00 | 20,00 | 20,00 |
| Nürnberg | 0,74 | 4,77 | 5,20 | 5,84 | 20,00 | 20,00 | 20,00 | 20,00 | 6,27 | 20,00 | 20,00 | 20,00 |
| Würzburg | 0,13 | 5,73 | 6,16 | 6,80 | 20,00 | 20,00 | 20,00 | 20,00 | 7,23 | 20,00 | 20,00 | 20,00 |
| Frankfurt | 1,60 | 6,71 | 7,14 | 7,78 | 20,00 | 20,00 | 20,00 | 20,00 | 8,21 | 20,00 | 20,00 | 20,00 |
| Köln | 1,06 | 8,21 | 8,64 | 9,28 | 20,00 | 20,00 | 20,00 | 20,00 | 9,71 | 20,00 | 20,00 | 20,00 |
| Ddf. + Ruhrg. | 5,71 | 8,66 | 9,09 | 9,73 | 20,00 | 20,00 | 20,00 | 20,00 | 10,16 | 20,00 | 20,00 | 20,00 |
| Salzburg | 0,15 | 3,20 | 3,63 | 4,27 | 4,88 | 6,81 | 7,56 | 9,40 | 4,70 | 20,00 | 20,00 | 20,00 |
| München | 1,45 | 4,38 | 4,81 | 5,45 | 6,06 | 7,99 | 8,74 | 10,58 | 5,88 | 20,00 | 20,00 | 20,00 |
| Ausburg | 0,29 | 4,94 | 5,37 | 6,01 | 6,62 | 8,55 | 9,30 | 11,14 | 6,44 | 20,00 | 20,00 | 20,00 |
| Stuttgart | 0,62 | 6,28 | 6,71 | 7,35 | 7,96 | 9,89 | 10,64 | 12,48 | 7,78 | 20,00 | 20,00 | 20,00 |
| Mannheim-L. | 0,63 | 7,19 | 7,62 | 8,26 | 8,87 | 10,80 | 11,55 | 13,39 | 8,69 | 20,00 | 20,00 | 20,00 |
| Karlsruhe | 0,31 | 6,89 | 7,32 | 7,96 | 8,57 | 10,50 | 11,25 | 13,09 | 8,39 | 20,00 | 20,00 | 20,00 |
| Strasbourg | 0,28 | 7,56 | 7,99 | 8,63 | 9,24 | 11,17 | 11,92 | 13,76 | 9,06 | 20,00 | 20,00 | 20,00 |
| Paris | 12,4 | 11,53 | 11,96 | 12,60 | 13,21 | 15,14 | 15,89 | 17,73 | 13,03 | 20,00 | 20,00 | 20,00 |
| Innsbruck | 0,13 | 4,56 | 4,99 | 5,63 | 6,24 | 8,17 | 8,92 | 10,76 | 6,06 | 20,00 | 20,00 | 20,00 |
| Vorarlberg | 0,11 | 5,89 | 6,32 | 6,96 | 7,57 | 9,50 | 10,25 | 12,09 | 7,39 | 20,00 | 20,00 | 20,00 |
| Zürich | 0,40 | 6,70 | 7,13 | 7,77 | 8,38 | 10,31 | 11,06 | 12,90 | 8,20 | 20,00 | 20,00 | 20,00 |
| Basel | 0,18 | 7,43 | 7,86 | 8,50 | 9,11 | 11,04 | 11,79 | 13,63 | 8,93 | 20,00 | 20,00 | 20,00 |
| Graz | 0,28 | 2,05 | 2,48 | 3,12 | 3,73 | 5,66 | 6,41 | 8,25 | 3,55 | 20,00 | 20,00 | 20,00 |
| Klagenfurt + V. | 0,16 | 3,05 | 3,48 | 4,12 | 4,73 | 6,66 | 7,41 | 9,25 | 4,55 | 20,00 | 20,00 | 20,00 |
| Maribor | 0,09 | 2,61 | 3,04 | 3,68 | 4,29 | 6,22 | 6,97 | 8,81 | 4,11 | 20,00 | 20,00 | 20,00 |
| Ljubljana | 0,29 | 3,63 | 4,06 | 4,70 | 5,31 | 7,24 | 7,99 | 9,83 | 5,13 | 20,00 | 20,00 | 20,00 |
| Trieste | 0,2 | 4,37 | 4,80 | 5,44 | 6,05 | 7,98 | 8,73 | 10,57 | 5,87 | 20,00 | 20,00 | 20,00 |
| Zagreb | 0,79 | 3,47 | 3,90 | 4,54 | 5,15 | 7,08 | 7,83 | 9,67 | 4,97 | 20,00 | 20,00 | 20,00 |
| Venezia + ... | 0,55 | 5,18 | 5,61 | 6,25 | 6,86 | 8,79 | 9,54 | 11,38 | 6,68 | 20,00 | 20,00 | 20,00 |
| Bologna | 0,39 | 6,63 | 7,06 | 7,70 | 8,31 | 10,24 | 10,99 | 12,83 | 8,13 | 20,00 | 20,00 | 20,00 |
| Firenze | 0,36 | 7,41 | 7,84 | 8,48 | 9,09 | 11,02 | 11,77 | 13,61 | 8,91 | 20,00 | 20,00 | 20,00 |
| Roma | 2,87 | 9,71 | 10,14 | 10,78 | 11,39 | 13,32 | 14,07 | 15,91 | 11,21 | 20,00 | 20,00 | 20,00 |
| Verona | 0,26 | 6,17 | 6,60 | 7,24 | 7,85 | 9,78 | 10,53 | 12,37 | 7,67 | 20,00 | 20,00 | 20,00 |
| Milano | 1,35 | 7,59 | 8,02 | 8,66 | 9,27 | 11,20 | 11,95 | 13,79 | 9,09 | 20,00 | 20,00 | 20,00 |
| Torino | 0,89 | 8,84 | 9,27 | 9,91 | 10,52 | 12,45 | 13,20 | 15,04 | 10,34 | 20,00 | 20,00 | 20,00 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wien | | 2,135 | 0,133 | 0,049 | 0,038 | 0,054 | 0,015 | 0,052 | 0,065 | 0,020 | 0,002 | 0,002 |
| Linz + Wels | | 0,031 | 0,004 | 0,002 | 0,002 | 0,004 | 0,001 | 0,005 | 0,004 | 0,003 | 0,000 | 0,000 |
| Passau | | 0,004 | 0,001 | 0,000 | 0,000 | 0,001 | 0,000 | 0,001 | 0,001 | 0,001 | 0,000 | 0,000 |
| Regensburg | | 0,006 | 0,001 | 0,001 | 0,001 | 0,002 | 0,000 | 0,002 | 0,001 | 0,002 | 0,000 | 0,000 |
| Nürnberg | | 0,022 | 0,003 | 0,002 | 0,000 | 0,001 | 0,001 | 0,003 | 0,004 | 0,008 | 0,001 | 0,001 |
| Würzburg | | 0,003 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 | 0,001 | 0,001 | 0,001 | 0,000 | 0,000 |
| Frankfurt | | 0,026 | 0,004 | 0,003 | 0,001 | 0,003 | 0,001 | 0,007 | 0,005 | 0,017 | 0,002 | 0,002 |
| Köln | | 0,012 | 0,002 | 0,001 | 0,001 | 0,002 | 0,001 | 0,005 | 0,003 | 0,011 | 0,001 | 0,001 |
| Ddf. + Ruhrg. | | 0,061 | 0,009 | 0,007 | 0,003 | 0,012 | 0,004 | 0,025 | 0,013 | 0,061 | 0,006 | 0,007 |
| Salzburg | | 0,009 | 0,001 | 0,001 | 0,001 | 0,002 | 0,001 | 0,002 | 0,001 | 0,002 | 0,000 | 0,000 |
| München | | 0,049 | 0,007 | 0,005 | 0,005 | 0,014 | 0,004 | 0,019 | 0,009 | 0,015 | 0,002 | 0,002 |
| Ausburg | | 0,008 | 0,001 | 0,001 | 0,001 | 0,002 | 0,001 | 0,003 | 0,001 | 0,003 | 0,000 | 0,000 |
| Stuttgart | | 0,011 | 0,002 | 0,001 | 0,001 | 0,004 | 0,001 | 0,006 | 0,002 | 0,007 | 0,001 | 0,001 |
| Mannheim-L. | | 0,009 | 0,001 | 0,001 | 0,001 | 0,004 | 0,001 | 0,006 | 0,002 | 0,007 | 0,001 | 0,001 |
| Karlsruhe | | 0,005 | 0,001 | 0,001 | 0,001 | 0,002 | 0,001 | 0,003 | 0,001 | 0,003 | 0,000 | 0,000 |
| Strasbourg | | 0,004 | 0,001 | 0,000 | 0,001 | 0,002 | 0,000 | 0,002 | 0,001 | 0,003 | 0,000 | 0,000 |
| Paris | | 0,082 | 0,013 | 0,010 | 0,012 | 0,040 | 0,014 | 0,067 | 0,019 | 0,133 | 0,013 | 0,016 |
| Innsbruck | | 0,004 | 0,001 | 0,000 | 0,000 | 0,001 | 0,000 | 0,002 | 0,001 | 0,001 | 0,000 | 0,000 |
| Vorarlberg | | 0,002 | 0,000 | 0,000 | 0,000 | 0,001 | 0,000 | 0,001 | 0,000 | 0,001 | 0,000 | 0,000 |
| Zürich | | 0,007 | 0,001 | 0,001 | 0,001 | 0,003 | 0,001 | 0,004 | 0,001 | 0,004 | 0,000 | 0,001 |
| Basel | | 0,002 | 0,000 | 0,000 | 0,000 | 0,001 | 0,000 | 0,002 | 0,001 | 0,002 | 0,000 | 0,000 |
| Graz | | 0,035 | 0,004 | 0,002 | 0,002 | 0,005 | 0,001 | 0,006 | 0,004 | 0,003 | 0,000 | 0,000 |
| Klagenfurt + V. | | 0,010 | 0,001 | 0,001 | 0,001 | 0,002 | 0,001 | 0,003 | 0,001 | 0,002 | 0,000 | 0,000 |
| Maribor | | 0,007 | 0,001 | 0,001 | 0,001 | 0,001 | 0,000 | 0,002 | 0,001 | 0,001 | 0,000 | 0,000 |
| Ljubljana | | 0,014 | 0,002 | 0,001 | 0,001 | 0,003 | 0,001 | 0,004 | 0,002 | 0,003 | 0,000 | 0,000 |
| Trieste | | 0,007 | 0,001 | 0,001 | 0,001 | 0,002 | 0,001 | 0,003 | 0,001 | 0,002 | 0,000 | 0,000 |
| Zagreb | | 0,040 | 0,005 | 0,004 | 0,004 | 0,009 | 0,003 | 0,012 | 0,006 | 0,008 | 0,001 | 0,001 |
| Venezia + ... | | 0,014 | 0,002 | 0,001 | 0,002 | 0,005 | 0,001 | 0,006 | 0,003 | 0,006 | 0,001 | 0,001 |
| Bologna | | 0,007 | 0,001 | 0,001 | 0,001 | 0,002 | 0,001 | 0,004 | 0,001 | 0,004 | 0,000 | 0,001 |
| Firenze | | 0,005 | 0,001 | 0,001 | 0,001 | 0,002 | 0,001 | 0,003 | 0,001 | 0,004 | 0,000 | 0,000 |
| Roma | | 0,025 | 0,004 | 0,003 | 0,004 | 0,012 | 0,004 | 0,019 | 0,006 | 0,031 | 0,003 | 0,004 |
| Verona | | 0,005 | 0,001 | 0,001 | 0,001 | 0,002 | 0,001 | 0,003 | 0,001 | 0,003 | 0,000 | 0,000 |
| Milano | | 0,018 | 0,003 | 0,002 | 0,002 | 0,007 | 0,002 | 0,011 | 0,004 | 0,014 | 0,001 | 0,002 |
| Torino | | 0,009 | 0,001 | 0,001 | 0,001 | 0,004 | 0,001 | 0,006 | 0,002 | 0,010 | 0,001 | 0,001 |

| |
|---|
| 3,829 |

# Wien/Bratislava - Brno

| | | Brno | Pardubice + Hradec Kralove | Praha | Dresden | Berlin | Szczecin | Rostock | Lübeck | Hamburg | Magdeburg | Hannover | Bremen + Oldenburg | Leipzig + Halle | Plzen | Nürnberg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0,39 | 0,18 | 1,27 | 0,53 | 3,66 | 0,41 | 0,21 | 0,21 | 1,79 | 0,24 | 0,51 | 0,72 | 0,75 | 0,17 | 0,74 |
| Wien | 1,84 | 1,05 | 2,17 | 2,92 | 4,11 | 5,74 | 7,02 | 7,66 | 8,10 | 8,27 | 7,03 | 20,00 | 20,00 | 5,13 | 3,74 | 20,00 |
| Linz + Wels | 0,20 | 2,58 | 3,70 | 4,45 | 5,64 | 7,27 | 8,55 | 9,19 | 9,63 | 9,80 | 8,56 | 20,00 | 20,00 | 6,66 | 5,27 | 20,00 |
| Salzburg | 0,15 | 3,70 | 4,82 | 5,57 | 6,76 | 8,39 | 9,67 | 10,31 | 10,75 | 10,92 | 9,68 | 20,00 | 20,00 | 7,78 | 6,39 | 20,00 |
| Innsbruck | 0,13 | 5,04 | 6,16 | 6,91 | 8,10 | 9,73 | 11,01 | 11,65 | 12,09 | 12,26 | 11,02 | 20,00 | 20,00 | 9,12 | 7,73 | 20,00 |
| Graz | 0,28 | 2,55 | 3,67 | 4,42 | 5,61 | 7,24 | 8,52 | 9,16 | 9,60 | 9,77 | 8,53 | 20,00 | 20,00 | 6,63 | 5,24 | 20,00 |
| Klagenfurt + ... | 0,16 | 3,55 | 4,67 | 5,42 | 6,61 | 8,24 | 9,52 | 10,16 | 10,60 | 10,77 | 9,53 | 20,00 | 20,00 | 7,63 | 6,24 | 20,00 |
| Venezia + ... | 0,55 | 5,68 | 6,80 | 7,55 | 8,74 | 10,37 | 11,65 | 12,29 | 12,73 | 12,90 | 11,66 | 20,00 | 20,00 | 9,76 | 8,37 | 20,00 |
| Maribor | 0,09 | 3,11 | 4,23 | 4,98 | 6,17 | 7,80 | 9,08 | 9,72 | 10,16 | 10,33 | 9,09 | 20,00 | 20,00 | 7,19 | 5,80 | 20,00 |
| Ljubljana | 0,28 | 4,13 | 5,25 | 6,00 | 7,19 | 8,82 | 10,10 | 10,74 | 11,18 | 11,35 | 10,11 | 20,00 | 20,00 | 8,21 | 6,82 | 20,00 |
| Trieste | 0,20 | 4,87 | 5,99 | 6,74 | 7,93 | 9,56 | 10,84 | 11,48 | 11,92 | 12,09 | 10,85 | 20,00 | 20,00 | 8,95 | 7,56 | 20,00 |
| Zagreb | 0,79 | 3,97 | 5,09 | 5,84 | 7,03 | 8,66 | 9,94 | 10,58 | 11,02 | 11,19 | 9,95 | 20,00 | 20,00 | 8,05 | 6,66 | 20,00 |
| Bratislava | 0,42 | 1,17 | 2,29 | 3,04 | 4,23 | 5,86 | 7,14 | 7,78 | 8,22 | 8,39 | 7,15 | 8,45 | 9,45 | 5,25 | 3,86 | 20,00 |
| Györ | 0,13 | 1,87 | 2,99 | 3,74 | 4,93 | 6,56 | 7,84 | 8,48 | 8,92 | 9,09 | 7,85 | 9,15 | 10,15 | 5,95 | 4,56 | 20,00 |
| Budapest | 1,74 | 2,91 | 4,03 | 4,78 | 5,97 | 7,60 | 8,88 | 9,52 | 9,96 | 10,13 | 8,89 | 10,19 | 11,19 | 6,99 | 5,60 | 20,00 |
| Debrecen | 0,21 | 4,89 | 6,01 | 6,76 | 7,95 | 9,58 | 10,86 | 11,50 | 11,94 | 12,11 | 10,87 | 12,17 | 13,17 | 8,97 | 7,58 | 20,00 |
| Arad | 0,16 | 5,15 | 6,27 | 7,02 | 8,21 | 9,84 | 11,12 | 11,76 | 12,20 | 12,37 | 11,13 | 12,43 | 13,43 | 9,23 | 7,84 | 20,00 |
| Timisoara | 0,32 | 5,50 | 6,62 | 7,37 | 8,56 | 10,19 | 11,47 | 12,11 | 12,55 | 12,72 | 11,48 | 12,78 | 13,78 | 9,58 | 8,19 | 20,00 |
| Szeged | 0,17 | 4,54 | 5,66 | 6,41 | 7,60 | 9,23 | 10,51 | 11,15 | 11,59 | 11,76 | 10,52 | 11,82 | 12,82 | 8,62 | 7,23 | 20,00 |
| Beograd | 1,23 | 6,11 | 7,23 | 7,98 | 9,17 | 10,80 | 12,08 | 12,72 | 13,16 | 13,33 | 12,09 | 13,39 | 14,39 | 10,19 | 8,80 | 20,00 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wien | 0,660 | 0,089 | 0,378 | 0,088 | 0,345 | 0,027 | 0,012 | 0,011 | 0,091 | 0,016 | 0,006 | 0,008 | 0,086 | 0,033 | 0,008 |
| Linz + Wels | 0,016 | 0,004 | 0,020 | 0,006 | 0,025 | 0,002 | 0,001 | 0,001 | 0,007 | 0,001 | 0,001 | 0,001 | 0,006 | 0,002 | 0,001 |
| Salzburg | 0,006 | 0,002 | 0,010 | 0,003 | 0,015 | 0,001 | 0,001 | 0,001 | 0,005 | 0,001 | 0,000 | 0,001 | 0,003 | 0,001 | 0,001 |
| Innsbruck | 0,003 | 0,001 | 0,006 | 0,002 | 0,010 | 0,001 | 0,000 | 0,000 | 0,003 | 0,001 | 0,000 | 0,001 | 0,002 | 0,001 | 0,001 |
| Graz | 0,022 | 0,006 | 0,028 | 0,008 | 0,035 | 0,003 | 0,001 | 0,001 | 0,010 | 0,002 | 0,001 | 0,001 | 0,008 | 0,003 | 0,001 |
| Klagenfurt + ... | 0,007 | 0,002 | 0,011 | 0,003 | 0,016 | 0,001 | 0,001 | 0,001 | 0,005 | 0,001 | 0,001 | 0,001 | 0,004 | 0,001 | 0,001 |
| Venezia + ... | 0,011 | 0,004 | 0,022 | 0,007 | 0,038 | 0,003 | 0,002 | 0,002 | 0,013 | 0,002 | 0,002 | 0,002 | 0,009 | 0,003 | 0,002 |
| Maribor | 0,005 | 0,001 | 0,007 | 0,002 | 0,010 | 0,001 | 0,000 | 0,000 | 0,003 | 0,001 | 0,000 | 0,000 | 0,002 | 0,001 | 0,000 |
| Ljubljana | 0,010 | 0,003 | 0,017 | 0,005 | 0,025 | 0,002 | 0,001 | 0,001 | 0,008 | 0,001 | 0,001 | 0,001 | 0,006 | 0,002 | 0,001 |
| Trieste | 0,005 | 0,002 | 0,010 | 0,003 | 0,016 | 0,001 | 0,001 | 0,001 | 0,005 | 0,001 | 0,001 | 0,001 | 0,004 | 0,001 | 0,001 |
| Zagreb | 0,030 | 0,009 | 0,050 | 0,015 | 0,074 | 0,007 | 0,003 | 0,003 | 0,023 | 0,004 | 0,002 | 0,003 | 0,017 | 0,005 | 0,004 |
| Bratislava | 0,125 | 0,018 | 0,081 | 0,019 | 0,076 | 0,006 | 0,003 | 0,002 | 0,020 | 0,004 | 0,006 | 0,007 | 0,019 | 0,007 | 0,002 |
| Györ | 0,017 | 0,004 | 0,018 | 0,005 | 0,019 | 0,002 | 0,001 | 0,001 | 0,005 | 0,001 | 0,002 | 0,002 | 0,005 | 0,002 | 0,001 |
| Budapest | 0,110 | 0,029 | 0,155 | 0,044 | 0,203 | 0,017 | 0,008 | 0,007 | 0,061 | 0,010 | 0,017 | 0,021 | 0,048 | 0,016 | 0,008 |
| Debrecen | 0,006 | 0,002 | 0,010 | 0,003 | 0,016 | 0,001 | 0,001 | 0,001 | 0,005 | 0,001 | 0,002 | 0,002 | 0,004 | 0,001 | 0,001 |
| Arad | 0,004 | 0,001 | 0,007 | 0,002 | 0,012 | 0,001 | 0,001 | 0,000 | 0,004 | 0,001 | 0,001 | 0,001 | 0,003 | 0,001 | 0,001 |
| Timisoara | 0,007 | 0,002 | 0,014 | 0,004 | 0,023 | 0,002 | 0,001 | 0,001 | 0,008 | 0,001 | 0,002 | 0,003 | 0,005 | 0,002 | 0,001 |
| Szeged | 0,005 | 0,002 | 0,009 | 0,003 | 0,014 | 0,001 | 0,001 | 0,001 | 0,005 | 0,001 | 0,001 | 0,002 | 0,003 | 0,001 | 0,001 |
| Beograd | 0,022 | 0,008 | 0,046 | 0,015 | 0,079 | 0,007 | 0,003 | 0,003 | 0,027 | 0,004 | 0,008 | 0,010 | 0,018 | 0,005 | 0,006 |

4,478

Wien - Brno: 2,766

Bratislava - Brno: 1,712

# Wien/Bratislava - Ostrava

| | | Ostrava | Krakow | Tarnow | Rzeszow | Lviv | Katowice + ... | Warszawa | Brest | Minsk | Orsha | Smolensk | Moskwa | Bialystok | Kaunas | Vilnius | Riga | Tallinn | Olsztyn | Gdansk + Gdynia | Lodz | Turun | Bydgoszcz |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0,30 | 0,76 | 0,11 | 0,18 | 0,72 | 1,28 | 1,71 | 0,31 | 1,98 | 0,12 | 0,33 | 12,86 | 0,29 | 0,31 | 0,54 | 0,64 | 0,41 | 0,18 | 0,71 | 0,72 | 0,20 | 0,36 |
| Wien | 1,84 | 2,15 | 3,36 | 4,10 | 4,84 | 6,29 | 2,90 | 5,48 | 7,33 | 10,63 | 12,64 | 13,75 | 17,43 | 7,26 | 9,26 | 10,16 | 11,49 | 14,30 | 7,20 | 8,33 | 4,87 | 6,39 | 6,82 |
| Linz + Wels | 0,20 | 3,68 | 4,89 | 5,63 | 6,37 | 7,82 | 4,43 | 7,01 | 8,86 | 12,16 | 14,17 | 15,28 | 18,96 | 8,79 | 10,79 | 11,69 | 13,02 | 15,83 | 8,73 | 9,86 | 6,40 | 7,92 | 8,35 |
| Salzburg | 0,15 | 4,80 | 6,01 | 6,75 | 7,49 | 8,94 | 5,55 | 8,13 | 9,98 | 13,28 | 15,29 | 16,40 | 20,08 | 9,91 | 11,91 | 12,81 | 14,14 | 16,95 | 9,85 | 10,98 | 7,52 | 9,04 | 9,47 |
| Innsbruck | 0,13 | 6,14 | 7,35 | 8,09 | 8,83 | 10,28 | 6,89 | 9,47 | 11,32 | 14,62 | 16,63 | 17,74 | 21,42 | 11,25 | 13,25 | 14,15 | 15,48 | 18,29 | 11,19 | 12,32 | 8,86 | 10,38 | 10,81 |
| Graz | 0,28 | 3,65 | 4,86 | 5,60 | 6,34 | 7,79 | 4,40 | 6,98 | 8,83 | 12,13 | 14,14 | 15,25 | 18,93 | 8,76 | 10,76 | 11,66 | 12,99 | 15,80 | 8,70 | 9,83 | 6,37 | 7,89 | 8,32 |
| Klagenfurt + ... | 0,16 | 4,65 | 5,86 | 6,60 | 7,34 | 8,79 | 5,40 | 7,98 | 9,83 | 13,13 | 15,14 | 16,25 | 19,93 | 9,76 | 11,76 | 12,66 | 13,99 | 16,80 | 9,70 | 10,83 | 7,37 | 8,89 | 9,32 |
| Venezia + ... | 0,55 | 6,78 | 7,99 | 8,73 | 9,47 | 10,92 | 7,53 | 10,11 | 11,96 | 15,26 | 17,27 | 18,38 | 22,06 | 11,89 | 13,89 | 14,79 | 16,12 | 18,93 | 11,83 | 12,96 | 9,50 | 11,02 | 11,45 |
| Maribor | 0,09 | 4,21 | 5,42 | 6,16 | 6,90 | 8,35 | 4,96 | 7,54 | 9,39 | 12,69 | 14,70 | 15,81 | 19,49 | 9,32 | 11,32 | 12,22 | 13,55 | 16,36 | 9,26 | 10,39 | 6,93 | 8,45 | 8,88 |
| Ljubljana | 0,28 | 5,23 | 6,44 | 7,18 | 7,92 | 9,37 | 5,98 | 8,56 | 10,41 | 13,71 | 15,72 | 16,83 | 20,51 | 10,34 | 12,34 | 13,24 | 14,57 | 17,38 | 10,28 | 11,41 | 7,95 | 9,47 | 9,90 |
| Trieste | 0,20 | 5,97 | 7,18 | 7,92 | 8,66 | 10,11 | 6,72 | 9,30 | 11,15 | 14,45 | 16,46 | 17,57 | 21,25 | 11,08 | 13,08 | 13,98 | 15,31 | 18,12 | 11,02 | 12,15 | 8,69 | 10,21 | 10,64 |
| Zagreb | 0,79 | 5,07 | 6,28 | 7,02 | 7,76 | 9,21 | 5,82 | 8,40 | 10,25 | 13,55 | 15,56 | 16,67 | 20,35 | 10,18 | 12,18 | 13,08 | 14,41 | 17,22 | 10,12 | 11,25 | 7,79 | 9,31 | 9,74 |
| Bratislava | 0,42 | 2,03 | 3,24 | 3,98 | 4,72 | 6,17 | 2,78 | 5,36 | 7,21 | 10,51 | 12,52 | 13,63 | 17,31 | 7,14 | 9,14 | 10,04 | 11,37 | 14,18 | 7,08 | 8,21 | 4,75 | 6,27 | 6,70 |
| Györ | 0,13 | 2,73 | 3,94 | 4,68 | 5,42 | 6,87 | 3,48 | 6,06 | 7,91 | 11,21 | 13,22 | 14,33 | 18,01 | 7,84 | 9,84 | 10,74 | 12,07 | 14,88 | 7,78 | 8,91 | 5,45 | 6,97 | 7,40 |
| Budapest | 1,74 | 3,77 | 4,98 | 5,72 | 6,46 | 7,91 | 4,52 | 7,10 | 8,95 | 12,25 | 14,26 | 15,37 | 19,05 | 8,88 | 10,88 | 11,78 | 13,11 | 15,92 | 8,82 | 9,95 | 6,49 | 8,01 | 8,44 |
| Debrecen | 0,21 | 5,75 | 6,96 | 7,70 | 8,44 | 9,89 | 6,50 | 9,08 | 10,93 | 14,23 | 16,24 | 17,35 | 21,03 | 10,86 | 12,86 | 13,76 | 15,09 | 17,90 | 10,80 | 11,93 | 8,47 | 9,99 | 10,42 |
| Arad | 0,16 | 6,01 | 7,22 | 7,96 | 8,70 | 10,15 | 6,76 | 9,34 | 11,19 | 14,49 | 16,50 | 17,61 | 21,29 | 11,12 | 13,12 | 14,02 | 15,35 | 18,16 | 11,06 | 12,19 | 8,73 | 10,25 | 10,68 |
| Timisoara | 0,32 | 6,36 | 7,57 | 8,31 | 9,05 | 10,50 | 7,11 | 9,69 | 11,54 | 14,84 | 16,85 | 17,96 | 21,64 | 11,47 | 13,47 | 14,37 | 15,70 | 18,51 | 11,41 | 12,54 | 9,08 | 10,60 | 11,03 |
| Szeged | 0,17 | 5,40 | 6,61 | 7,35 | 8,09 | 9,54 | 6,15 | 8,73 | 10,58 | 13,88 | 15,89 | 17,00 | 20,68 | 10,51 | 12,51 | 13,41 | 14,74 | 17,55 | 10,45 | 11,58 | 8,12 | 9,64 | 10,07 |
| Beograd | 1,23 | 6,97 | 8,18 | 8,92 | 9,66 | 11,11 | 7,72 | 10,30 | 12,15 | 15,45 | 17,46 | 18,57 | 22,25 | 12,08 | 14,08 | 14,98 | 16,31 | 19,12 | 12,02 | 13,15 | 9,69 | 11,21 | 11,64 |

| | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wien | 0,150 | 0,178 | 0,018 | 0,023 | 0,058 | 0,385 | 0,175 | 0,019 | 0,066 | 0,003 | 0,007 | 0,184 | 0,018 | 0,013 | 0,019 | 0,019 | 0,008 | 0,012 | 0,036 | 0,090 | 0,016 | 0,025 |
| Linz + Wels | 0,007 | 0,010 | 0,001 | 0,002 | 0,004 | 0,020 | 0,012 | 0,002 | 0,006 | 0,000 | 0,001 | 0,017 | 0,001 | 0,001 | 0,002 | 0,002 | 0,001 | 0,001 | 0,003 | 0,006 | 0,001 | 0,002 |
| Salzburg | 0,003 | 0,005 | 0,001 | 0,001 | 0,003 | 0,010 | 0,007 | 0,001 | 0,004 | 0,000 | 0,000 | 0,012 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,002 | 0,003 | 0,001 | 0,001 |
| Innsbruck | 0,002 | 0,003 | 0,000 | 0,001 | 0,002 | 0,006 | 0,005 | 0,001 | 0,003 | 0,000 | 0,000 | 0,009 | 0,001 | 0,000 | 0,001 | 0,001 | 0,000 | 0,000 | 0,001 | 0,002 | 0,000 | 0,001 |
| Graz | 0,009 | 0,014 | 0,002 | 0,002 | 0,006 | 0,029 | 0,018 | 0,002 | 0,008 | 0,000 | 0,001 | 0,024 | 0,002 | 0,002 | 0,002 | 0,002 | 0,001 | 0,001 | 0,004 | 0,009 | 0,002 | 0,003 |
| Klagenfurt + ... | 0,004 | 0,006 | 0,001 | 0,001 | 0,003 | 0,012 | 0,008 | 0,001 | 0,004 | 0,000 | 0,000 | 0,013 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,002 | 0,004 | 0,001 | 0,001 |
| Venezia + ... | 0,006 | 0,012 | 0,002 | 0,002 | 0,007 | 0,023 | 0,018 | 0,003 | 0,011 | 0,001 | 0,001 | 0,037 | 0,002 | 0,002 | 0,003 | 0,003 | 0,002 | 0,001 | 0,005 | 0,009 | 0,002 | 0,003 |
| Maribor | 0,002 | 0,004 | 0,000 | 0,001 | 0,002 | 0,008 | 0,005 | 0,001 | 0,002 | 0,000 | 0,000 | 0,007 | 0,001 | 0,000 | 0,001 | 0,001 | 0,000 | 0,000 | 0,001 | 0,002 | 0,000 | 0,001 |
| Ljubljana | 0,005 | 0,009 | 0,001 | 0,001 | 0,004 | 0,017 | 0,012 | 0,002 | 0,006 | 0,000 | 0,001 | 0,021 | 0,002 | 0,001 | 0,002 | 0,002 | 0,001 | 0,001 | 0,003 | 0,006 | 0,001 | 0,002 |
| Trieste | 0,003 | 0,005 | 0,001 | 0,001 | 0,003 | 0,010 | 0,008 | 0,001 | 0,004 | 0,000 | 0,001 | 0,014 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,002 | 0,004 | 0,001 | 0,001 |
| Zagreb | 0,015 | 0,026 | 0,003 | 0,004 | 0,013 | 0,051 | 0,036 | 0,005 | 0,019 | 0,001 | 0,002 | 0,061 | 0,004 | 0,003 | 0,005 | 0,005 | 0,003 | 0,003 | 0,009 | 0,017 | 0,004 | 0,006 |
| Bratislava | 0,038 | 0,043 | 0,004 | 0,005 | 0,014 | 0,095 | 0,041 | 0,005 | 0,015 | 0,001 | 0,002 | 0,042 | 0,004 | 0,003 | 0,004 | 0,004 | 0,002 | 0,003 | 0,008 | 0,021 | 0,004 | 0,006 |
| Györ | 0,007 | 0,010 | 0,001 | 0,001 | 0,004 | 0,020 | 0,010 | 0,001 | 0,004 | 0,000 | 0,000 | 0,012 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,002 | 0,005 | 0,001 | 0,002 |
| Budapest | 0,055 | 0,086 | 0,010 | 0,013 | 0,037 | 0,171 | 0,106 | 0,013 | 0,049 | 0,002 | 0,006 | 0,149 | 0,012 | 0,009 | 0,014 | 0,014 | 0,006 | 0,008 | 0,025 | 0,052 | 0,010 | 0,017 |
| Debrecen | 0,003 | 0,006 | 0,001 | 0,001 | 0,003 | 0,011 | 0,008 | 0,001 | 0,005 | 0,000 | 0,001 | 0,015 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,002 | 0,004 | 0,001 | 0,001 |
| Arad | 0,002 | 0,004 | 0,001 | 0,001 | 0,002 | 0,008 | 0,006 | 0,001 | 0,003 | 0,000 | 0,000 | 0,011 | 0,001 | 0,001 | 0,001 | 0,001 | 0,000 | 0,000 | 0,002 | 0,003 | 0,001 | 0,001 |
| Timisoara | 0,004 | 0,008 | 0,001 | 0,001 | 0,004 | 0,015 | 0,012 | 0,002 | 0,006 | 0,000 | 0,001 | 0,022 | 0,001 | 0,001 | 0,002 | 0,002 | 0,001 | 0,001 | 0,003 | 0,005 | 0,001 | 0,002 |
| Szeged | 0,003 | 0,005 | 0,001 | 0,001 | 0,003 | 0,010 | 0,007 | 0,001 | 0,004 | 0,000 | 0,000 | 0,013 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,002 | 0,003 | 0,001 | 0,001 |
| Beograd | 0,014 | 0,026 | 0,003 | 0,005 | 0,015 | 0,049 | 0,040 | 0,005 | 0,023 | 0,001 | 0,003 | 0,081 | 0,005 | 0,004 | 0,007 | 0,007 | 0,003 | 0,003 | 0,011 | 0,019 | 0,004 | 0,007 |

4,515

Wien - Ostrava: 2,587

Bratislava - Ostrava: 1,928

# Zagreb - Vinkovci

| | | Vinkovci, Osijek | Sarajewo | Mostar | Beograd | Timişoara | Arad | Niš | Sofia | Plovdiv + ... | Istanbul | Skopje | Thessaloniki | Athenai | Priština | Podgorica | Tirana + Durres |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0,17 | 0,53 | 0,13 | 1,23 | 0,32 | 0,16 | 0,26 | 1,21 | 0,57 | 14,66 | 0,54 | 0,33 | 3,75 | 0,21 | 0,20 | 0,60 |
| Zagreb | 0,79 | 2,32 | 3,86 | 4,57 | 3,72 | 4,91 | 5,26 | 5,71 | 7,07 | 8,39 | 12,13 | 7,21 | 9,17 | 12,19 | 6,22 | 6,54 | 7,84 |
| Rijeka | 0,13 | 3,62 | 5,16 | 5,87 | 5,02 | 6,21 | 6,56 | 7,01 | 8,37 | 9,69 | 13,43 | 8,51 | 10,47 | 13,49 | 7,52 | 7,84 | 9,14 |
| Zadar | 0,08 | 4,28 | 5,82 | 6,53 | 5,68 | 6,87 | 7,22 | 7,67 | 9,03 | 10,35 | 14,09 | 9,17 | 11,13 | 14,15 | 8,18 | 8,50 | 9,80 |
| Split | 0,18 | 4,90 | 6,44 | 7,15 | 6,30 | 7,49 | 7,84 | 8,29 | 9,65 | 10,97 | 14,71 | 9,79 | 11,75 | 14,77 | 8,80 | 9,12 | 10,42 |
| Ljubljana | 0,29 | 3,47 | 5,01 | 5,72 | 4,87 | 6,06 | 6,41 | 6,86 | 8,22 | 9,54 | 13,28 | 8,36 | 10,32 | 13,34 | 7,37 | 7,69 | 8,99 |
| Koper | 0,03 | 4,37 | 5,91 | 6,62 | 5,77 | 6,96 | 7,31 | 7,76 | 9,12 | 10,44 | 14,18 | 9,26 | 11,22 | 14,24 | 8,27 | 8,59 | 9,89 |
| Trieste | 0,20 | 4,21 | 5,75 | 6,46 | 5,61 | 6,80 | 7,15 | 7,60 | 8,96 | 10,28 | 14,02 | 9,10 | 11,06 | 14,08 | 8,11 | 8,43 | 9,73 |
| Venezia | 0,34 | 5,36 | 6,90 | 7,61 | 6,76 | 7,95 | 8,30 | 8,75 | 10,11 | 11,43 | 15,17 | 10,25 | 12,21 | 15,23 | 9,26 | 9,58 | 10,88 |
| Padova | 0,21 | 5,70 | 7,24 | 7,95 | 7,10 | 8,29 | 8,64 | 9,09 | 10,45 | 11,77 | 15,51 | 10,59 | 12,55 | 15,57 | 9,60 | 9,92 | 11,22 |
| Bologna | 0,39 | 6,81 | 8,35 | 9,06 | 8,21 | 9,40 | 9,75 | 10,20 | 11,56 | 12,88 | 16,62 | 11,70 | 13,66 | 16,68 | 10,71 | 11,03 | 12,33 |
| Firenze | 0,36 | 7,59 | 9,13 | 9,84 | 8,99 | 10,18 | 10,53 | 10,98 | 12,34 | 13,66 | 17,40 | 12,48 | 14,44 | 17,46 | 11,49 | 11,81 | 13,11 |
| Roma | 2,87 | 9,89 | 11,43 | 12,14 | 11,29 | 12,48 | 12,83 | 13,28 | 14,64 | 15,96 | 19,70 | 14,78 | 16,74 | 19,76 | 13,79 | 14,11 | 15,41 |
| Verona | 0,26 | 6,35 | 7,89 | 8,60 | 7,75 | 8,94 | 9,29 | 9,74 | 11,10 | 12,42 | 16,16 | 11,24 | 13,20 | 16,22 | 10,25 | 10,57 | 11,87 |
| Milano | 1,35 | 7,77 | 9,31 | 10,02 | 9,17 | 10,36 | 10,71 | 11,16 | 12,52 | 13,84 | 17,58 | 12,66 | 14,62 | 17,64 | 11,67 | 11,99 | 13,29 |
| Klagenfurt + Villach | 0,16 | 4,31 | 5,85 | 6,56 | 5,71 | 6,90 | 7,25 | 7,70 | 9,06 | 10,38 | 14,12 | 9,20 | 11,16 | 14,18 | 8,21 | 8,53 | 9,83 |
| Salzburg | 0,15 | 5,71 | 7,25 | 7,96 | 7,11 | 8,30 | 8,65 | 9,10 | 10,46 | 11,78 | 15,52 | 10,60 | 12,56 | 15,58 | 9,61 | 9,93 | 11,23 |
| Innsbruck | 0,13 | 7,07 | 8,61 | 9,32 | 8,47 | 9,66 | 10,01 | 10,46 | 11,82 | 13,14 | 16,88 | 11,96 | 13,92 | 16,94 | 10,97 | 11,29 | 12,59 |
| München | 1,45 | 6,89 | 8,43 | 9,14 | 8,29 | 9,48 | 9,83 | 10,28 | 11,64 | 12,96 | 16,70 | 11,78 | 13,74 | 16,76 | 10,79 | 11,11 | 12,41 |
| Augsburg | 0,29 | 7,45 | 8,99 | 9,70 | 8,85 | 10,04 | 10,39 | 10,84 | 12,20 | 13,52 | 17,26 | 12,34 | 14,30 | 17,32 | 11,35 | 11,67 | 12,97 |
| Stuttgart | 0,62 | 8,79 | 10,33 | 11,04 | 10,19 | 11,38 | 11,73 | 12,18 | 13,54 | 14,86 | 18,60 | 13,68 | 15,64 | 18,66 | 12,69 | 13,01 | 14,31 |
| Maribor | 0,09 | 3,57 | 5,11 | 5,82 | 4,97 | 6,16 | 6,51 | 6,96 | 8,32 | 9,64 | 13,38 | 8,46 | 10,42 | 13,44 | 7,47 | 7,79 | 9,09 |
| Graz | 0,28 | 4,13 | 5,67 | 6,38 | 5,53 | 6,72 | 7,07 | 7,52 | 8,88 | 10,20 | 13,94 | 9,02 | 10,98 | 14,00 | 8,03 | 8,35 | 9,65 |
| Wien | 1,84 | 5,63 | 7,17 | 7,88 | 7,03 | 8,22 | 8,57 | 9,02 | 10,38 | 11,70 | 15,44 | 10,52 | 12,48 | 15,50 | 9,53 | 9,85 | 11,15 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Zagreb | 0,032 | 0,042 | 0,008 | 0,104 | 0,017 | 0,008 | 0,011 | 0,034 | 0,012 | 0,166 | 0,015 | 0,006 | 0,042 | 0,007 | 0,006 | 0,014 |
| Rijeka | 0,002 | 0,004 | 0,001 | 0,010 | 0,002 | 0,001 | 0,001 | 0,004 | 0,002 | 0,023 | 0,002 | 0,001 | 0,006 | 0,001 | 0,001 | 0,002 |
| Zadar | 0,001 | 0,002 | 0,000 | 0,005 | 0,001 | 0,000 | 0,001 | 0,002 | 0,001 | 0,013 | 0,001 | 0,000 | 0,003 | 0,000 | 0,000 | 0,001 |
| Split | 0,002 | 0,004 | 0,001 | 0,010 | 0,002 | 0,001 | 0,001 | 0,005 | 0,002 | 0,027 | 0,002 | 0,001 | 0,007 | 0,001 | 0,001 | 0,002 |
| Ljubljana | 0,006 | 0,010 | 0,002 | 0,024 | 0,004 | 0,002 | 0,003 | 0,010 | 0,004 | 0,052 | 0,004 | 0,002 | 0,013 | 0,002 | 0,002 | 0,004 |
| Koper | 0,000 | 0,001 | 0,000 | 0,002 | 0,000 | 0,000 | 0,000 | 0,001 | 0,000 | 0,005 | 0,000 | 0,000 | 0,001 | 0,000 | 0,000 | 0,000 |
| Trieste | 0,003 | 0,005 | 0,001 | 0,013 | 0,002 | 0,001 | 0,002 | 0,006 | 0,002 | 0,033 | 0,003 | 0,001 | 0,008 | 0,001 | 0,001 | 0,003 |
| Venezia | 0,003 | 0,007 | 0,001 | 0,016 | 0,003 | 0,001 | 0,002 | 0,008 | 0,003 | 0,049 | 0,004 | 0,002 | 0,012 | 0,002 | 0,001 | 0,004 |
| Padova | 0,002 | 0,004 | 0,001 | 0,009 | 0,002 | 0,001 | 0,001 | 0,005 | 0,002 | 0,029 | 0,002 | 0,001 | 0,007 | 0,001 | 0,001 | 0,002 |
| Bologna | 0,003 | 0,006 | 0,001 | 0,013 | 0,003 | 0,001 | 0,002 | 0,007 | 0,003 | 0,048 | 0,003 | 0,002 | 0,012 | 0,001 | 0,001 | 0,003 |
| Firenze | 0,002 | 0,004 | 0,001 | 0,011 | 0,002 | 0,001 | 0,002 | 0,006 | 0,002 | 0,041 | 0,003 | 0,001 | 0,010 | 0,001 | 0,001 | 0,003 |
| Roma | 0,010 | 0,024 | 0,005 | 0,057 | 0,013 | 0,006 | 0,009 | 0,036 | 0,015 | 0,265 | 0,016 | 0,008 | 0,067 | 0,007 | 0,006 | 0,016 |
| Verona | 0,002 | 0,004 | 0,001 | 0,010 | 0,002 | 0,001 | 0,001 | 0,005 | 0,002 | 0,034 | 0,002 | 0,001 | 0,009 | 0,001 | 0,001 | 0,002 |
| Milano | 0,007 | 0,016 | 0,003 | 0,038 | 0,008 | 0,004 | 0,006 | 0,022 | 0,009 | 0,151 | 0,010 | 0,005 | 0,038 | 0,004 | 0,004 | 0,010 |
| Klagenfurt + Villach | 0,002 | 0,004 | 0,001 | 0,010 | 0,002 | 0,001 | 0,001 | 0,005 | 0,002 | 0,026 | 0,002 | 0,001 | 0,007 | 0,001 | 0,001 | 0,002 |
| Salzburg | 0,001 | 0,003 | 0,001 | 0,007 | 0,001 | 0,001 | 0,001 | 0,003 | 0,001 | 0,021 | 0,001 | 0,001 | 0,005 | 0,001 | 0,001 | 0,001 |
| Innsbruck | 0,001 | 0,002 | 0,000 | 0,004 | 0,001 | 0,000 | 0,001 | 0,002 | 0,001 | 0,016 | 0,001 | 0,000 | 0,004 | 0,000 | 0,000 | 0,001 |
| München | 0,009 | 0,020 | 0,004 | 0,049 | 0,010 | 0,005 | 0,007 | 0,027 | 0,011 | 0,177 | 0,012 | 0,006 | 0,045 | 0,005 | 0,005 | 0,012 |
| Augsburg | 0,002 | 0,004 | 0,001 | 0,009 | 0,002 | 0,001 | 0,001 | 0,005 | 0,002 | 0,034 | 0,002 | 0,001 | 0,009 | 0,001 | 0,001 | 0,002 |
| Stuttgart | 0,003 | 0,006 | 0,001 | 0,015 | 0,003 | 0,002 | 0,002 | 0,009 | 0,004 | 0,063 | 0,004 | 0,002 | 0,016 | 0,002 | 0,002 | 0,004 |
| Maribor | 0,002 | 0,003 | 0,001 | 0,007 | 0,001 | 0,001 | 0,001 | 0,003 | 0,001 | 0,016 | 0,001 | 0,001 | 0,004 | 0,001 | 0,001 | 0,001 |
| Graz | 0,004 | 0,008 | 0,002 | 0,019 | 0,004 | 0,002 | 0,002 | 0,008 | 0,003 | 0,047 | 0,004 | 0,002 | 0,012 | 0,002 | 0,002 | 0,004 |
| Wien | 0,017 | 0,034 | 0,007 | 0,082 | 0,016 | 0,008 | 0,011 | 0,042 | 0,016 | 0,257 | 0,018 | 0,008 | 0,065 | 0,008 | 0,008 | 0,018 |

| |
|---|
| 3,850 |

# Zidani Most - Zagreb

| | | Zagreb | Pecs | Vinkovci, Osijek | Sarajewo | Mostar | Beograd | Timişoara | Arad | Niš | Sofia | Plovdiv + ... | Istanbul | Skopje | Thessaloniki | Athenai | Priština | Podgorica | Tirana + Durres |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0,79 | 0,15 | 0,17 | 0,53 | 0,13 | 1,23 | 0,32 | 0,16 | 0,26 | 1,21 | 0,57 | 14,66 | 0,54 | 0,33 | 3,75 | 0,21 | 0,20 | 0,60 |
| Ljubljana | 0,29 | 1,15 | 2,91 | 3,47 | 5,01 | 5,72 | 4,87 | 6,06 | 6,41 | 6,86 | 8,22 | 9,54 | 13,28 | 8,36 | 10,32 | 13,34 | 7,37 | 7,69 | 8,99 |
| Koper | 0,03 | 2,05 | 3,81 | 4,37 | 5,91 | 6,62 | 5,77 | 6,96 | 7,31 | 7,76 | 9,12 | 10,44 | 14,18 | 9,26 | 11,22 | 14,24 | 8,27 | 8,59 | 9,89 |
| Trieste | 0,20 | 1,89 | 3,65 | 4,21 | 5,75 | 6,46 | 5,61 | 6,80 | 7,15 | 7,60 | 8,96 | 10,28 | 14,02 | 9,10 | 11,06 | 14,08 | 8,11 | 8,43 | 9,73 |
| Venezia | 0,34 | 3,04 | 4,80 | 5,36 | 6,90 | 7,61 | 6,76 | 7,95 | 8,30 | 8,75 | 10,11 | 11,43 | 15,17 | 10,25 | 12,21 | 15,23 | 9,26 | 9,58 | 10,88 |
| Padova | 0,21 | 3,38 | 5,14 | 5,70 | 7,24 | 7,95 | 7,10 | 8,29 | 8,64 | 9,09 | 10,45 | 11,77 | 15,51 | 10,59 | 12,55 | 15,57 | 9,60 | 9,92 | 11,22 |
| Bologna | 0,39 | 4,49 | 6,25 | 6,81 | 8,35 | 9,06 | 8,21 | 9,40 | 9,75 | 10,20 | 11,56 | 12,88 | 16,62 | 11,70 | 13,66 | 16,68 | 10,71 | 11,03 | 12,33 |
| Firenze | 0,36 | 5,27 | 7,03 | 7,59 | 9,13 | 9,84 | 8,99 | 10,18 | 10,53 | 10,98 | 12,34 | 13,66 | 17,40 | 12,48 | 14,44 | 17,46 | 11,49 | 11,81 | 13,11 |
| Roma | 2,87 | 7,57 | 9,33 | 9,89 | 11,43 | 12,14 | 11,29 | 12,48 | 12,83 | 13,28 | 14,64 | 15,96 | 19,70 | 14,78 | 16,74 | 19,76 | 13,79 | 14,11 | 15,41 |
| Verona | 0,26 | 4,03 | 5,79 | 6,35 | 7,89 | 8,60 | 7,75 | 8,94 | 9,29 | 9,74 | 11,10 | 12,42 | 16,16 | 11,24 | 13,20 | 16,22 | 10,25 | 10,57 | 11,87 |
| Milano | 1,35 | 5,45 | 7,21 | 7,77 | 9,31 | 10,02 | 9,17 | 10,36 | 10,71 | 11,16 | 12,52 | 13,84 | 17,58 | 12,66 | 14,62 | 17,64 | 11,67 | 11,99 | 13,29 |
| Klagenfurt + Villach | 0,16 | 1,99 | 20,00 | 4,31 | 5,85 | 6,56 | 5,71 | 6,90 | 7,25 | 7,70 | 9,06 | 10,38 | 14,12 | 9,20 | 11,16 | 14,18 | 8,21 | 8,53 | 9,83 |
| Salzburg | 0,15 | 3,39 | 20,00 | 5,71 | 7,25 | 7,96 | 7,11 | 8,30 | 8,65 | 9,10 | 10,46 | 11,78 | 15,52 | 10,60 | 12,56 | 15,58 | 9,61 | 9,93 | 11,23 |
| Innsbruck | 0,13 | 4,75 | 20,00 | 7,07 | 8,61 | 9,32 | 8,47 | 9,66 | 10,01 | 10,46 | 11,82 | 13,14 | 16,88 | 11,96 | 13,92 | 16,94 | 10,97 | 11,29 | 12,59 |
| München | 1,45 | 4,57 | 20,00 | 6,89 | 8,43 | 9,14 | 8,29 | 9,48 | 9,83 | 10,28 | 11,64 | 12,96 | 16,70 | 11,78 | 13,74 | 16,76 | 10,79 | 11,11 | 12,41 |
| Augsburg | 0,29 | 5,13 | 20,00 | 7,45 | 8,99 | 9,70 | 8,85 | 10,04 | 10,39 | 10,84 | 12,20 | 13,52 | 17,26 | 12,34 | 14,30 | 17,32 | 11,35 | 11,67 | 12,97 |
| Stuttgart | 0,62 | 6,47 | 20,00 | 8,79 | 10,33 | 11,04 | 10,19 | 11,38 | 11,73 | 12,18 | 13,54 | 14,86 | 18,60 | 13,68 | 15,64 | 18,66 | 12,69 | 13,01 | 14,31 |
| Mannheim-L. | 0,63 | 7,38 | 20,00 | 9,70 | 11,24 | 11,95 | 11,10 | 12,29 | 12,64 | 13,09 | 14,45 | 15,77 | 19,51 | 14,59 | 16,55 | 19,57 | 13,60 | 13,92 | 15,22 |
| Frankfurt | 1,60 | 8,11 | 20,00 | 10,43 | 11,97 | 12,68 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Nürnberg | 0,74 | 6,05 | 20,00 | 8,37 | 9,91 | 10,62 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Regensburg | 0,15 | 5,59 | 20,00 | 7,91 | 9,45 | 10,16 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Maribor | 0,09 | 1,25 | 20,00 | 3,57 | 5,11 | 5,82 | 4,97 | 6,16 | 6,51 | 6,96 | 8,32 | 9,64 | 13,38 | 8,46 | 10,42 | 13,44 | 7,47 | 7,79 | 9,09 |
| Graz | 0,28 | 1,81 | 20,00 | 4,13 | 5,67 | 6,38 | 5,53 | 6,72 | 7,07 | 7,52 | 8,88 | 10,20 | 13,94 | 9,02 | 10,98 | 14,00 | 8,03 | 8,35 | 9,65 |
| Wien | 1,84 | 3,31 | 20,00 | 5,63 | 7,17 | 7,88 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Brno | 0,39 | 4,36 | 20,00 | 6,68 | 8,22 | 8,93 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Ostrava | 0,33 | 5,46 | 20,00 | 7,78 | 9,32 | 10,03 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Katowice + ... | 1,28 | 6,21 | 20,00 | 8,53 | 10,07 | 10,78 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Warszawa | 1,71 | 8,79 | 20,00 | 11,11 | 12,65 | 13,36 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Krakow | 0,76 | 6,67 | 20,00 | 8,99 | 10,53 | 11,24 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |
| Bratislava | 0,42 | 3,86 | 20,00 | 6,18 | 7,72 | 8,43 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 | 20,00 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ljubljana | 0,181 | 0,007 | 0,006 | 0,010 | 0,002 | 0,024 | 0,004 | 0,002 | 0,003 | 0,010 | 0,004 | 0,052 | 0,004 | 0,002 | 0,013 | 0,002 | 0,002 | 0,004 |
| Koper | 0,007 | 0,000 | 0,000 | 0,001 | 0,000 | 0,002 | 0,000 | 0,000 | 0,000 | 0,001 | 0,000 | 0,005 | 0,000 | 0,000 | 0,001 | 0,000 | 0,000 | 0,000 |
| Trieste | 0,054 | 0,003 | 0,003 | 0,005 | 0,001 | 0,013 | 0,002 | 0,001 | 0,002 | 0,006 | 0,002 | 0,033 | 0,003 | 0,001 | 0,008 | 0,001 | 0,001 | 0,003 |
| Venezia | 0,041 | 0,004 | 0,003 | 0,007 | 0,001 | 0,016 | 0,003 | 0,001 | 0,002 | 0,008 | 0,003 | 0,049 | 0,004 | 0,002 | 0,012 | 0,002 | 0,001 | 0,004 |
| Padova | 0,021 | 0,002 | 0,002 | 0,004 | 0,001 | 0,009 | 0,002 | 0,001 | 0,001 | 0,005 | 0,002 | 0,029 | 0,002 | 0,001 | 0,007 | 0,001 | 0,001 | 0,002 |
| Bologna | 0,024 | 0,003 | 0,003 | 0,006 | 0,001 | 0,013 | 0,003 | 0,001 | 0,002 | 0,007 | 0,003 | 0,048 | 0,003 | 0,002 | 0,012 | 0,001 | 0,001 | 0,003 |
| Firenze | 0,017 | 0,002 | 0,002 | 0,004 | 0,001 | 0,011 | 0,002 | 0,001 | 0,002 | 0,006 | 0,002 | 0,041 | 0,003 | 0,001 | 0,010 | 0,001 | 0,001 | 0,003 |
| Roma | 0,073 | 0,010 | 0,010 | 0,024 | 0,005 | 0,057 | 0,013 | 0,006 | 0,009 | 0,036 | 0,015 | 0,265 | 0,016 | 0,008 | 0,067 | 0,007 | 0,006 | 0,016 |
| Verona | 0,019 | 0,002 | 0,002 | 0,004 | 0,001 | 0,010 | 0,002 | 0,001 | 0,001 | 0,005 | 0,002 | 0,034 | 0,002 | 0,001 | 0,009 | 0,001 | 0,001 | 0,002 |
| Milano | 0,060 | 0,007 | 0,007 | 0,016 | 0,003 | 0,038 | 0,008 | 0,004 | 0,006 | 0,022 | 0,009 | 0,151 | 0,010 | 0,005 | 0,038 | 0,004 | 0,004 | 0,010 |
| Klagenfurt + Villach | 0,039 | 0,000 | 0,002 | 0,004 | 0,001 | 0,010 | 0,002 | 0,001 | 0,001 | 0,005 | 0,002 | 0,026 | 0,002 | 0,001 | 0,007 | 0,001 | 0,001 | 0,002 |
| Salzburg | 0,015 | 0,000 | 0,001 | 0,003 | 0,001 | 0,007 | 0,001 | 0,001 | 0,001 | 0,003 | 0,001 | 0,021 | 0,001 | 0,001 | 0,005 | 0,001 | 0,001 | 0,001 |
| Innsbruck | 0,007 | 0,000 | 0,001 | 0,002 | 0,000 | 0,004 | 0,001 | 0,000 | 0,001 | 0,002 | 0,001 | 0,016 | 0,001 | 0,000 | 0,004 | 0,000 | 0,000 | 0,001 |
| München | 0,087 | 0,001 | 0,009 | 0,020 | 0,004 | 0,049 | 0,010 | 0,005 | 0,007 | 0,027 | 0,011 | 0,177 | 0,012 | 0,006 | 0,045 | 0,005 | 0,005 | 0,012 |
| Augsburg | 0,014 | 0,000 | 0,002 | 0,004 | 0,001 | 0,009 | 0,002 | 0,001 | 0,001 | 0,005 | 0,002 | 0,034 | 0,002 | 0,001 | 0,009 | 0,001 | 0,001 | 0,002 |
| Stuttgart | 0,020 | 0,001 | 0,003 | 0,006 | 0,001 | 0,015 | 0,003 | 0,002 | 0,002 | 0,009 | 0,004 | 0,063 | 0,004 | 0,002 | 0,016 | 0,002 | 0,002 | 0,004 |
| Mannheim-L. | 0,017 | 0,001 | 0,002 | 0,005 | 0,001 | 0,013 | 0,003 | 0,001 | 0,002 | 0,008 | 0,003 | 0,059 | 0,004 | 0,002 | 0,015 | 0,002 | 0,001 | 0,004 |
| Frankfurt | 0,036 | 0,001 | 0,005 | 0,012 | 0,003 | 0,012 | 0,003 | 0,002 | 0,003 | 0,012 | 0,006 | 0,144 | 0,005 | 0,003 | 0,037 | 0,002 | 0,002 | 0,006 |
| Nürnberg | 0,027 | 0,001 | 0,003 | 0,008 | 0,002 | 0,006 | 0,001 | 0,001 | 0,001 | 0,005 | 0,003 | 0,067 | 0,002 | 0,001 | 0,017 | 0,001 | 0,001 | 0,003 |
| Regensburg | 0,006 | 0,000 | 0,001 | 0,002 | 0,000 | 0,001 | 0,000 | 0,000 | 0,000 | 0,001 | 0,001 | 0,014 | 0,000 | 0,000 | 0,003 | 0,000 | 0,000 | 0,001 |
| Maribor | 0,049 | 0,000 | 0,002 | 0,003 | 0,001 | 0,007 | 0,001 | 0,001 | 0,001 | 0,003 | 0,001 | 0,016 | 0,001 | 0,001 | 0,004 | 0,001 | 0,001 | 0,001 |
| Graz | 0,081 | 0,000 | 0,004 | 0,008 | 0,002 | 0,019 | 0,004 | 0,002 | 0,002 | 0,008 | 0,003 | 0,047 | 0,004 | 0,002 | 0,012 | 0,002 | 0,002 | 0,004 |
| Wien | 0,190 | 0,002 | 0,017 | 0,034 | 0,007 | 0,014 | 0,004 | 0,002 | 0,003 | 0,014 | 0,006 | 0,166 | 0,006 | 0,004 | 0,042 | 0,002 | 0,002 | 0,007 |
| Brno | 0,025 | 0,000 | 0,003 | 0,006 | 0,001 | 0,003 | 0,001 | 0,000 | 0,001 | 0,003 | 0,001 | 0,035 | 0,001 | 0,001 | 0,009 | 0,001 | 0,000 | 0,001 |
| Ostrava | 0,015 | 0,000 | 0,002 | 0,004 | 0,001 | 0,002 | 0,001 | 0,000 | 0,001 | 0,002 | 0,001 | 0,030 | 0,001 | 0,001 | 0,008 | 0,000 | 0,000 | 0,001 |
| Katowice + ... | 0,045 | 0,001 | 0,006 | 0,013 | 0,003 | 0,010 | 0,003 | 0,001 | 0,002 | 0,010 | 0,004 | 0,115 | 0,004 | 0,003 | 0,029 | 0,002 | 0,002 | 0,005 |
| Warszawa | 0,034 | 0,002 | 0,005 | 0,012 | 0,003 | 0,013 | 0,003 | 0,002 | 0,003 | 0,013 | 0,006 | 0,154 | 0,006 | 0,003 | 0,039 | 0,002 | 0,002 | 0,006 |
| Krakow | 0,024 | 0,001 | 0,003 | 0,007 | 0,002 | 0,006 | 0,001 | 0,001 | 0,001 | 0,006 | 0,003 | 0,068 | 0,003 | 0,002 | 0,018 | 0,001 | 0,001 | 0,003 |
| Bratislava | 0,033 | 0,000 | 0,003 | 0,007 | 0,001 | 0,003 | 0,001 | 0,000 | 0,001 | 0,003 | 0,001 | 0,038 | 0,001 | 0,001 | 0,010 | 0,001 | 0,001 | 0,002 |

5,517

Ljubljana - Zagreb: 3,717

Maribor - Zagreb: 1,800


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# Annex IV: Cost Benefit Analysis excel tool

## Micro-economic Assessment

| Micro-economic indicators | quantities *) | unit benefits **) | benefits**) |
|---|---|---|---|
| Long-distance passenger traffic | | | |
| Revenues from long-distance passenger traffic | | | 0 |
| Operational costs of long-distance passenger traffic | | | 0 |
| Infrastructure fees for long-distance passenger traffic | | | 0 |
| Result for long-distance passener traffic | | | 0 |
| Regional passenger traffic | | | |
| Revenues from regional passenger traffic | | | 0 |
| Operational costs of regional passenger traffic | | | 0 |
| Infrastructure fees for regional passenger traffic | | | 0 |
| Result for regional passenger traffic | | | 0 |
| Freight Traffic | | | |
| Revenues from freight traffic | | | 0 |
| Operational costs of freight traffic | | | 0 |
| Infrastructure fees for freight traffic | | | 0 |
| Result for freight traffic | | | 0 |
| Infrastructure | | | |
| Revenues from infrastructure fees | | | 0 |
| Operational costs of infrastructure | | | 0 |
| Energy costs | | | 0 |
| Maintenance costs | | | 0 |
| Result for Infrastructure | | | 0 |
| Total result of micro-economic cost-benefit analysis | | | 0 |

*) Variations due to project: number of passengers, tons of freight, number of trains

**) Costs are negative (-) benefits.

## Macro-economic Assessment

| Macro-economic indicators | quantities *) | unit benefits **) | benefits**) |
|---|---|---|---|
| **Environment and climate** | | | |
| Polluting emissions | | | 0 |
| Noise immissions | | | 0 |
| Greenhouse gas emissions | | | 0 |
| External costs of traction energy | | | 0 |
| **Environmental and climate benefits** | | | 0 |
| **Economy** | | | |
| Operational costs of long-distance passenger traffic | | | 0 |
| Operational costs of regional passenger traffic | | | 0 |
| Operational costs of freight traffic | | | 0 |
| Operational costs of infrastructure | | | 0 |
| Annuities for infrastructure investment | | | 0 |
| Energy costs | | | 0 |
| Maintenance costs | | | 0 |
| Travelling time reduction for passengers (monetised) | | | 0 |
| Transport time reduction for freight (monetised) | | | 0 |
| Benefits of induced long-distance passenger traffic on rail (monetised) | | | 0 |
| Benefits of induced regional passenger traffic on rail (monetised) | | | 0 |
| Benefits of induced passenger on rail (monetised) | | | 0 |
| **Economic benefits** | | | 0 |
| **Society** | | | |
| Reduction of accidents | | | 0 |
| **Societal benefits** | | | 0 |
| **Total result of macro-economic cost-benefit analysis** | | | 0 |

*) Variations due to project: quantities of emissions, immissions, unit values of time, etc.
**) Costs are negative (-) benefits.

# Notes

# Trans-European Railway High-Speed Master Plan Study

Phase 1

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