



VERDEN

TRANSPORTATION AND SUSTAINABILITY

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This publication presents selected expert outputs of the VERDEN project (2021-2023), which addressed transport from the perspective of sustainable development. This publication is a translated and updated edition of the original work published in the international language Esperanto in 2023.

The authors thank all those who contributed to the VERDEN project and to the preparation of this publication.

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Foreword of the IFEF President

The VERDEN project was the first EU-funded partnership project through the Erasmus+ program, which was carried out over two years (2021-2023) by the community of International Federation of Esperantists Railway Workers (IFEFF).

On the one hand, the project emphasized the importance of developing sustainable transport solutions, showing how railway can contribute to green and energy-efficient mobility, on the other hand, it demonstrated how the use of our green language can show that it is possible to address serious issues through Esperanto.

This project encouraged our federation members to collaborate and to reach out to the outside world, the press, other organizations and show the significant results of international cooperation through Esperanto.

The brochure produced at the end of the VERDEN project (2023) is important from several points of view:

- serves as a reference document summarizing the project's objectives, methodological approach, key findings, and lessons learned throughout its implementation,
- promotes the dissemination of project outcomes among a broad audience, increasing project visibility and supporting the transfer of knowledge and good practices, which may inspire the adoption or continuation of similar initiatives by other organizations.

The team that coordinated the VERDEN project experienced a combination of technical expertise, management skills, cross-cultural understanding, and commitment to the values of sustainability and international cooperation.

Thanks to the International Federation of Esperantists Railway Workers Board, which encouraged and contributed to the effective implementation of the project and the achievement of the proposed goals.

Rodica Todor, IFEF president
Brasov, September, 2023



Introduction

This publication summarizes the outcomes of the VERDEN project, which addressed transport in the context of sustainability between 2021 and 2023. Consequently, the data and information presented reflect the state of knowledge in 2023, the year the project was completed. Therefore, they should be regarded as historical. However, selected sections have been updated and supplemented with new information and developments to ensure the publication remains relevant and up to date. Readers may thus compare the findings with the current situation or gain insight into developments that have occurred in specific areas since the data were collected.

The project initiated IFEF's professional activities in the field of sustainability in general as well as in the field of sustainable transport and its impact on the environment. It fostered new contacts with experts and generated valuable knowledge and experience in an international context. Although the Project has been completed, the topic remains highly relevant and continues to be developed further. The tradition of the "European Railways" international seminars, organized by the Faculty of Transport Engineering, University of Pardubice, Czechia, continues. These seminars feature lectures by foreign experts and ongoing international research into the transport behaviour of IFEF conference participants, students and other groups of respondents.

As part of the Project, an international survey was carried out with the aim to collect information on rail, intermodal freight, and inland waterway transport in European countries. Responses to the survey were provided by experts from ten European Union member states¹, as well Serbia (University of Belgrade, Faculty of Civil Engineering) and India, for a total of twelve countries represented. The survey was structured around four thematic fields: Environmental protection from the perspective of railway carriers and railway infrastructure managers (1); Domestic and regional passenger transport (2); International passenger transport (3); Freight transport (4). The survey results provide an overview of current practices, challenges, and development trends in the participating countries and serve as a basis for the information presented in this publication.

The first four chapters of this publication present the results of the survey (see above), supplemented with updated information obtained from other sources. Chapter five presents the results of the collaborative study conducted by student Bc. Matěj Berka and his supervisor Jaroslav Matuška (UPCE, FTE). The final chapter contains practical recommendations for organising meetings, seminars and other events in a sustainable manner, with a particular focus on reducing their environmental impact.

The authors hope that this publication will contribute to a greater interest in transport-related issues, particularly their environmental impacts in an international context, as well as in the international language Esperanto.

¹ Austria, Belgium, Croatia, Czechia, Denmark, France, Germany, Italy, Slovakia, Sweden.

1 Environmental protection on the railway

Among the various modes of transport, rail transport plays a crucial role in environmental protection due to its relatively low environmental impact. The survey therefore focused on assessing the approaches of railway undertakings and railway infrastructure managers to environmental protection and the measures they employ to reduce their environmental impact. To assess current approaches to environmental protection in the railway sector, respondents were asked the following question: *“How do the railways in your country address environmental protection?”*. The responses were subsequently aggregated and presented in the following sections.

1.1 Electrification

A common theme identified in the responses was the progressive electrification of national railway networks as a key measure for reducing the environmental impact of rail transport. The electrification rates reported for the countries according to (1), supplemented by Eurostat data (2), are presented below.

Austria: there were 4,015 km of electrified railway line, corresponding to an electrification rate of 72 %.

Belgium: 88 % of railway network (3,619 km) is electrified.

Croatia: 995 km of a total length of 2,617 km were electrified, i.e., 38 % of length the Croatian railway network.

Czechia: 3,258 km of a total railway network length of 9,377 km were electrified, representing 34.7 % of the network (2023).

Denmark: 964 km of the 2,633 km railway network were electrified, which corresponds to 36.6 % of the total network length.

France: almost 61 % of the total network (27,600 km) is electrified.

Germany: the proportion of electrified railway lines increased from 60.2 % in 2015 (19,982 km out of a total network length of 33,194 km) to 61.2 % in 2020 (20,365 km out of 33,285 km). The national target is to achieve a 70 % electrification rate.

Italy: 12,184 km of the total length of approximately 16,800 km of railway lines are electrified, i.e. electrification rate of 72.4 %.

Serbia: 1,304 km of the country's 3,382 km railway network were electrified, i.e., an electrification rate of 38.6 %.

Slovakia: the 1,585 km of electrified railway lines of a total network length of 3,627 km gives an electrification rate of 43.7 %.

Sweden: the 75 % of railway lines are electrified. In addition, around 60 % of the electricity used by the railway sector is generated from renewable energy sources.

India: 52,247 km out of 68,103 km of railway lines were electrified, representing approximately 76 % of the national railway network.

1.2 Sustainable rolling stock, electricity, and technologies

Austria and Denmark are switching to 100 % green² electricity supply.

Battery-powered, hybrid, or hydrogen-powered trains are starting to appear on non-electrified lines, among other in Austria, Czechia, Germany, Denmark, France or Italy.

In Austria, ÖBB Postbus has been operating a fleet of battery-powered and hydrogen-powered buses since 2022. ÖBB-Infrastruktur began installing charging stations for customers at Park & Ride facilities in 2018.

In the Czech Republic, Infrastructure manager (Správa železnic) has been installing public charging stations at railway stations since 2024.

In German, Infrastructure manager is building charging stations for electric vehicles at railway stations, such as Berlin, Düsseldorf, Mainz, Frankfurt am Main and Regensburg.

In Italy, the Frecciarossa 1000 (Trenitalia ETR 1000) is the world's first high-speed train to have been awarded an environmental impact certificate. CO₂ emissions amount to 28 grams per passenger per kilometre. Minimal environmental impact of this train continues even after the end of its life cycle, as 93 % of the materials used in its manufacture are recyclable and 96.7 % come from renewable sources.

Austria mentions that, on newly built lines, noise barriers are widely installed in residential areas. Germany aims to reduce the impact of noise on the population by 50 % in 2030 compared to 2020.

² Produced from water, wind or sun.

Railways also take care of waste management – especially hazardous materials, cleaning of used water, e.g., in Austria; in Germany, 60,000 tonnes of waste left behind by travellers per year – partly recycled, partly liquidated by external companies; in Denmark – replacing plastic materials with bamboo, wood, paper, introducing paperless offices.

Indian Railways has implemented bio-toilets throughout its passenger train fleet. Toilets use anaerobic bacteria in onboard biodigesters to break down human waste into water and biogas. This solution reduces environmental pollution, improves hygiene, and lowers maintenance costs by preventing the discharge of untreated waste onto rail tracks.

Other examples of sustainable technologies include the installation of green walls at railway facilities (Milan, Italy; Lublin, Poland).

At Stockholm Central Station (Sweden), the recovery and utilization of body heat generated by passengers contributes to the heating of adjacent administrative building and can reduce energy consumption and heating costs by up to 20 %.

The utilization of solar energy through the installation of photovoltaic panels on the roofs of station buildings and other railway infrastructure is also becoming increasingly widespread, as reported in the Czechia, Italy, Austria (ÖBB) or Germany. Some railway infrastructure managers are also investing in their own solar power plants to increase the share of renewable energy in railway operations and reduce their dependence on external energy suppliers.

In India, Guwahati railway station became the first 100 % solar-powered station of Indian Railways in April 2017. It generates about 0.8 MWh of energy per year. In total, 1,094 railway stations have used solar power systems (2022).

Interesting fact

Austrian Federal Railways (ÖBB) promote biodiversity by greening railway corridors and installing beehives along selected sections of the network. The honey produced in these locations is marketed as “railway honey”.

2 International rail passenger transport

The aim of this text is not to provide an exhaustive overview of train services or statistical data, but rather to illustrate the range of opportunities for long-distance travel by rail. The information presented, including train services and route characteristics, was primarily collected based on the 2022 timetable. Where relevant, the text has been updated to reflect more recent developments.

2.1 Daytime services

This chapter provides a summary of the responses to the question: *“How many daytime cross-border express trains are in operation, connecting the capitals of neighbouring countries?”*.

There are differences between individual European countries both in the number of direct daytime long-distance express trains and in the number of lines connecting neighbouring capitals.

Austria has an extensive network of international daytime rail services. More than 200 long-distance daytime trains operate between Austria and neighbouring countries. From Vienna, direct rail connections are available to numerous European cities, including Prague, Budapest, Bratislava, Warsaw, Zagreb, Zurich, and Venice.

Belgium: from Brussels, direct daytime rail services connect Belgium with four neighbouring countries and their capitals: Paris, London, Amsterdam, and Luxembourg.

Czechia: Prague is connected by direct daytime rail services to four neighbouring capitals: Berlin (five services), Warsaw (three services), Bratislava (in total ten services operated by Czech Railways and RegioJet), and Vienna (eleven services operated by Czech Railways and RegioJet). In addition, daytime direct express trains operate to Budapest (nine services operated by Czech Railways and RegioJet), as well as to Munich and Linz.

Denmark: international direct daytime rail services are operated on two lines to Germany (Copenhagen – Hamburg, Aarhus – Hamburg), and one to Sweden (Copenhagen – Stockholm).

France: direct international rail services connect France with ten major foreign destinations: Brussels, Metz, Geneva, Zurich, Barcelona, Milan, Frankfurt am Main, Cologne, Amsterdam, and London. On a typical weekday, more than 90 international express train services operate between France and these cities, with the highest frequencies on the routes from Paris to Brussels, Amsterdam, and London.

Germany: international daytime passenger rail services are provided on 19 regularly operated long-distance lines. Among these are four from Berlin to foreign capitals: Prague, Warsaw, Amsterdam, and Budapest. In addition, Germany maintains direct long-distance rail connections with several neighbouring countries, including five lines to Switzerland, three to Austria, two to Denmark, and one line each to Hungary, Belgium, Italy, France, and the Netherlands.

Croatia: a total of eight daytime international train services connect Croatia with six destinations: Budapest, Maribor, Vienna, Villach, Munich, and Belgrade in five countries (Hungary, Slovenia, Austria, Germany, and Serbia).

Italy: international daytime high-speed services connect Italy with several neighbouring countries. Connections to Switzerland comprise 21 EuroCity (EC) services, while five high-speed services (TGV and Frecciarossa) operate between Milan and Paris. Eight further EC and ÖBB Railjet services connect Italy with Austria. In addition, numerous regional cross-border trains operate to Switzerland (Lugano), France (Nice), Austria (Innsbruck), and Slovenia (Sežana).

Serbia³: in 2022, only one international daytime express train service operated, connecting Dimitrovgrad with Sofia. International rail services to Hungary and Croatia were limited to regional trains operating on the Subotica – Kelebia and Osijek – Bogojevo lines. One daytime service to Montenegro was still in operation in 2022 but was discontinued in 2023.

³ The limited number of international rail services is expected to increase after the completion of the Hungarian section of the Budapest – Belgrade railway line.

Slovakia: the most intensive daytime international connections are provided by ten daily services to Prague and nine daily services to Budapest. In addition, one daytime express train operates to Warsaw. Connections with Vienna are ensured primarily by regional services, with more than 40 trains per day. Further international express services operate between Žilina and Ostrava, Košice and Budapest, and Košice and Prague.

Sweden: international daytime express train services connect Sweden with Norway via the Stockholm – Oslo and Göteborg – Oslo lines and with Denmark via the Stockholm – Copenhagen line. In addition, a high frequency of regional and long-distance trains operates across the Öresund region between Malmö and Copenhagen.

Interesting fact

The potential of railway transport, including its contribution to sustainability, is demonstrated, e.g., by a study conducted by the Central European Initiative. As part of efforts to improve rail connections between Italy and the Balkan countries, the study examined the establishing of the direct rail connection between Trieste and Belgrade. It supposes the modernisation of current railway infrastructure, followed by the operation of 11 to 14 trains daily on the Trieste – Ljubljana – Zagreb – Belgrade corridor (3).

2.2 Night services

Austria: there are almost 40 overnight trains (with sleeper cars) from Austria to abroad. Most often, Nightjet (NJ) or EuroNight (EN) brand trains run to neighbouring countries (Italy, Germany, Switzerland, Czechia), but also to Poland, Croatia, France, Belgium, the Netherlands, and Sweden. Austria has had the most extensive range of night trains in Europe for many years. More can be found at the website Nightjet (4). In 2024, ÖBB relaunched the NJ train service connecting Vienna, Prague, and Berlin.

Belgium: there is only one overnight express train from Brussels to Vienna.

Czechia: direct EN train to Warsaw (operated by ČD), Bratislava, Vienna, Berlin; to Košice, Slovakia: one EN train operated by ČD and one InterCity (IC) by RegioJet. From March 2024, direct overnight travel between Brussels and Prague is possible, temporarily three times a week (a Dutch Belgian rail operator European Sleeper). New direct train connections (operated by ČD and RegioJet) between Prague and the Polish city of Przemyśl were introduced in March 2022.

Germany: international overnight trains are primarily operated by Austrian Federal Railways (ÖBB), in 2022, 13 Nightjet lines and 4 EuroNight lines serving Germany. Examples include the Zurich – Cologne – Amsterdam, Berlin – Malmö, and Vienna – Munich – Paris lines. More recently, an overnight train has also been introduced between Berlin and Brussels.

Denmark: one EN service is operated between Denmark and Sweden (Stockholm – Hamburg – Berlin line), providing an important overnight connection between Scandinavia and Central Europe.

France: a direct EN service between Paris and Vienna operated from 2021 to 2025. This connection was cancelled in December 2025.

Croatia: one international overnight train connects Croatia with Slovenia, Austria, and Germany. The train also includes direct sleeping cars and coaches to Zurich (Switzerland). In addition, a seasonal overnight service operated by RegioJet connected Croatia with the Czechia via Slovakia, Hungary, and Slovenia during the summer period.⁴

Italy: an overnight express train service (EN) operates to/from Austria with routes to Rome / Milan – Vienna.

Serbia: one overnight train runs between Serbia and Montenegro from Zemun (Belgrade-Centar) to Bar, via Podgorica.

Slovakia: in addition to the overnight trains to the Czech Republic (mentioned above), one can also travel directly from Bratislava to Warsaw (one overnight train service) and Berlin (EN / NJ). During the summer season, two overnight services run to Split (Croatia): RegioJet directly from Bratislava, and ŽSR/ÖBB from Bratislava via Vienna.

⁴ The service ceased operation in summer 2024.

Sweden: there is overnight express train service from Stockholm to Hamburg and Berlin (via Copenhagen) operated by Swedish Railways SJ. Another overnight train connection is offered by Vy Sweden between Stockholm and Narvik, Norway.

India: overnight trains run, e.g., to Bangladesh (two high-speed trains daily), Pakistan (twice weekly) and Nepal (daily).

2.3 Airports and their rail connections

Table 1 and the text that follows cover only those international airports that are directly connected to the rail network. This includes airports with a railway station located on-site or within walking distance up to 500 m⁵. Airports whose nearest railway station is located at a greater distance are excluded from the table and the analysis (1). The last column of the Table lists the categories of trains that stop at the airport station⁶. If the column is empty, trains of different categories stop there.

Table 1: Airport train connections

Country	Airport	Connection to	Services
Austria	Wien Airport	Wien Hbf	S-Bahn, Reg, Ex
	Graz	Flughafen Graz-Feldkirchen	
Belgium	Brussels-Zaventem		
Czechia	Ostrava Airport	Ostrava hl. n.	Loc
Germany	Berlin		
	Düsseldorf		
	Frankfurt (M.)		
	München	München Terminal	
	Dresden Flughafen	Dresden	Reg
	Flughafen Köln/Bonn	Köln/Bonn	
	Leipzig/Halle Flughafen	Leipzig, Halle	
	Stuttgart Flughafen	Stuttgart	
	Hamburg Flughafen	Hamburg	
	Hannover Flughafen	Hannover	
	Lübeck Flughafen	Lübeck	

⁵ e.g. Tallinn Vesse station 800 metres from the airport.

⁶ Ex: express, Reg: regional, Loc: local / stopping train, IC: InterCity, HS: High-speed train, S-Bahn: see List of Abbreviations and Glossary.

Country	Airport	Connection to	Services
Denmark	København / Kastrup		IC
France	Aéroport Paris CDG		Reg, HS
	Orly		
	Nice Saint Augustin		
	Lyon S. Exupéry		
	Basel – Mulhouse – Freiburg		
Italy	Pisa		Pisa Mover
	Bologna Aeroporto		Marconi Express
	Rome – Fiumicino		HS
	Milan Malpensa		
	Elmas Aeroporto	Cagliari	
	Bari Aeroporto	Bari	
	Caselle Aeroporto	Torino	Reg
	Regio Calabria Aeroporto	Regio Calabria	
	Ancona Falconara	Ancona	
Sweden	Stockholm Arlanda		Ex, Reg

Austria: in addition to Vienna and Graz, there is a Klagenfurt Annabichl station at Klagenfurt Airport (about 600 m from the airport). Innsbruck Airport can be reached by tram (with a stop about 400 m from the airport).

Germany: most airports can only be reached by regional express trains. Of those mentioned in the Table 1, long-distance express trains can be used on 13 lines, including abroad to Amsterdam, Basel, and Vienna.

Czech Republic: Ostrava Airport has a rail connection to the city, the train station of Ostrava hl. n. only. Vaclav Havel Airport in Prague does not have a rail connection to the city.

Denmark: domestic IC trains run between Aalborg and Copenhagen / Kastrup airports – in addition, IC trains from western and southern Sweden stop in Kastrup on their way to Copenhagen Central Station.

France: several airports are directly connected to the rail network and are served by regional, express, and in some cases high-speed rail services. These include Paris-Orly Airport, Paris Charles de Gaulle Airport, Nice Côte d’Azur Airport, Lyon Saint-Exupéry Airport and EuroAirport Basel-Mulhouse-Freiburg.

Italy: many Italian airports are connected to the rail network, either directly by railway lines or by automated transit systems, e.g., Bologna Airport (Marconi Express) and Pisa Airport (Pisa Mover).

Depending on the location, airports are served by regional, long-distance, or even high-speed rail services e.g. Rome Fiumicino Airport. Additional examples include Rimini Miramare railway station (1.2 km from Rimini Airport), Catania Aeroporto-Fontanarossa (1.3 km), Genova Sestri Ponente Aeroporto or Ospedaliccchio station, serving Perugia Airport.

Sweden: the Stockholm Arlanda Airport is served by several railway stations, including the Arlanda Central Station, located on the main rail corridor, and the Arlanda Södra, providing access to regional and long-distance train services.

In addition to the airports mentioned in Table 1, these airports also (but not only) have a rail connection:

- United Kingdom: London – Heathrow, Gatwick, City, Stansted, Southend – in all 5 of 6 airports.
- Poland: Warsaw – Lotnisko Chopina; Kraków – Lotnisko; Gdansk – Port Lotniczy; Port Lotniczy Lublin; Port Lotniczy Szczecin Goleniów; Olsztyn-Mazury Lotnisko (Szymany).
- Romania: Bucharest – Aeroport Henri Coandă.

By contrast, Hungary, the Czech Republic, Slovakia, Croatia and Serbia have no rail link between the capital city and the airport. Sofia, Bulgaria, is connected to the airport by a metro line.

In Riga (Latvia), a railway line connecting the airport to the capital has been under construction since 2021 as part of the Rail Baltica project.

Based on the above information, among the Western and Southern European countries, Germany, Italy and France have a well-developed integration between rail and air transport, with some airports directly connected to regional, long-distance or even high-speed rail services. Poland has six airports with direct rail connections, a number that is exceptional among the Central European countries covered by the survey.

Do you know

you can reach the city centre by train or metro within

8 minutes in Pisa, Bologna, Strasbourg, Geneva, Reggio di Calabria and Vilnius;

15 minutes in Frankfurt, Graz, Amsterdam, Vienna and København.

2.4 Travel-time accessibility

The results presented in Table 2 are based on an analysis carried out in spring 2023 by students of the Faculty of Transport Engineering, University of Pardubice (UPCE). The study analysed rail connections to 41 international airports in 25 European countries independently of the countries and airports listed in Table 1.

Table 2 lists 26 airports in 19 countries that are connected to the nearest city by train, metro, or other rail-based transport systems (e.g. tram, U-Bahn, S-Bahn, or another unconventional rail). The table indicates travel times (in minutes) to reach the city centre or, where applicable, specific railway stations, with the last column left blank.

Major airports such as those in Paris or London are not included, as they are typically served by regional or high-speed train connections.

As mentioned above, Pisa Airport is served by the Pisa Mover and Bologna Airport by the Marconi Express. In both cases, these are unconventional rail services with their own dedicated tracks.

Table 2: Time to reach city from the airport (in minutes)⁷

Airport	Train	Metro	Destination
Pisa	5		Pisa Centrale
Bologna Aeroporto	7		Bologna C.le
Strasbourg Aéroport	8		Strasbourg Hbf
Geneva	8		
Reggio Calabria Aeroporto	8		Reggio Calabria Central
Vilnius	8		
Frankfurt am Main	10	19	Frankfurt Hbf
Graz	11		
Amsterdam Schiphol	13		Amsterdam Centraal
Wien-Schwechat	15		Wien Hbf
Bruxelles-Nat.-Aéroport	16		Brussel Central
Vitrolles Aéroport Marseille	16		Marseille St. Charles
Barcelona-El Prat	17	50	Barcelona Sants
Stockholm Arlanda	20		
Lisbon Airport T1	20		Lisbon East
Bucharest Henri Coandă	21		Bucharest Nord Gr.
Ostrava, Airport	22		Ostrava Svinov
København	22	12	
Oslo-Gardermoen	23		
Warsaw-Frédéric Chopin	23		
Helsinki	32		
Rome-Fiumicino	32		
Athene-Eleftheria Venizela	67	44	
Sofia	-	46	
Madrid Airport T4	30		Madrid-Atocha
Berlin Airport-T1	28		Berlin Hbf (tief)

In addition to the “time winners” above-mentioned, the analysis of airport time-accessibility by public transport revealed several other noteworthy findings:

- On average, airports can be reached from the nearest city centre by rail or metro within 19 minutes.
- Nearly 58 % of the surveyed airports are accessible by rail within 20 minutes, and 76 % within 30 minutes.

⁷ Source: UPCE students, compiled and edited by Jaroslav Matuška.

- Frankfurt, Copenhagen, Barcelona, and Athen’s airports are served by both rail and metro systems, whereas the airports of Sofia and Lisbon are only accessible by metro.
- Frankfurt Airport is connected by regional, express and high-speed trains, the S-Bahn and the U-Bahn; Frankfurt Central Station can be reached in 19 minutes.
- Bucharest Airport benefits from one of the newest modernized rail connections to an airport in Europe.
- From Rome Fiumicino Airport, the city centre can be reached in 32 minutes using the dedicated Leonardo Express.

2.5 Websites and applications for international ticket sales

Table 3 provides an overview of the options and languages (in addition to the national language) of websites and applications for purchasing international train tickets, updated for the 2026 timetable. The symbol “√” indicates that other languages are available for purchasing international tickets, beyond the national language.

Table 3: Language versions of websites and applications

Country	Language			Other language
	Eng	Ger	Fr	
Austria	√			ÖBB Scotty also Italian
Belgium	√	√	√	Dutch
Czechia	√			mujvlak.cz: also German
Denmark	√			
France	√			
Germany	√		√	Czech, Danish, Dutch, Italian, Polish, Spanish
Hungary	√			
Italy	√	√	√	Spanish, Chinese
Poland	√			Ukrainian, Russian
Slovakia	√			
Sweden	√			Danish

As shown in the overview in Table 3, German Railways (DB AG) offer the option to search for and purchase international tickets in eight additional language versions, the Italian operator Trenitalia does so in five. Ticketing platform trainline.com in nine languages, in Norwegian and Swedish, among others).

In Croatia, there are no websites to purchase international train tickets (2022). To address this, an international project aims to modernize train ticket sales and reservation. Domestic train tickets are available on the website of Croatian Railways (HŽ-Putnički prijevoz). In Serbia and Croatia, only domestic train tickets can be purchased online; international tickets are available exclusively at ticket offices.

2.6 International train ticket prices

To illustrate the pricing of international train travel, Table 4 presents examples of fares for long-distance international journeys according to (1), i.e. 2022. Unless otherwise stated, the prices refer to adult, second-class travel, exclude seat reservations, discounts, and discount cards.

Table 4: Prices of international train tickets

Journey from – to	Price (EUR)	Note
Vienna – Nuremberg	36.90	special offer
Vienna – Berlin	55.90	EN train
Vienna – Rome	29.90	EN train
Brussels – Amsterdam	26	IC train
Brussels – Luxembourg	21.80	IC train
Brussels – Paris	28	Thalys, incl. seat reservation ⁸
Prague – Vienna	16–36	depending on time of day
Prague – Berlin	24–56	depending on time of day
Hamburg Hbf – Paris Nord	361	Fri – Sun, return
Amsterdam Central – Vienna	267.80	Fri – Sun, best price, return
Copenhagen – Berlin	71–81	return
Paris – London	74.50	early morning connection

⁸ Three months in advance.

Journey from – to	Price (EUR)	Note
Zagreb – Budapest	25 (37)	Budapest Special (return)
Zagreb (or Rijeka) – Munich	79	EN, seat, best price
Milan C.le – Paris-G.-De Lyon	135	HS train, basic fare
Belgrade-Centar – Bar	21	EN train

Update for 2026⁹: Ticket prices are subject to change over time. Examples of fares available in 2026 for an adult travelling, one month in advance, second class on direct services: Berlin – Copenhagen from €118 (return, Super Sparpreis Europa), Vienna – Amsterdam from €140 (NJ, return, best fare), Prague – Vienna from €14.30 (Sparschiene), Zagreb – Munich from €47. A ticket from Milan to Paris for the Frecciarossa (operator Trenitalia, high-speed train) can be purchased for €79.

Interesting fact

Of particular interest is the fare for a journey in a standard-class carriage on the cross-border railway line between Jaynagar (India) and Kurtha (Nepal). The 68 km journey costs only 56 INR, equivalent to approx. 0.60 €, based on an exchange rate of 100 INR ≈ EUR 1.08.

Ticket prices offered by national railway operators can be searched, compared, and purchased through the following websites:

- Austria (ÖBB): <https://www.oebb.at/de/fahrplan>.
- Czech Republic (ČD): <https://www.cd.cz/eshop>.
- Denmark (DSB): <https://www.dsb.dk>.
- France (SNCF): <https://www.sncf.com/fr/itineraire-reservation/reservation-billets>.
- Germany (DB): <https://int.bahn.de>.
- Italy (Trenitalia): <https://www.trenitalia.com/it.html>.
- Croatia (HŽ Putnički prijevoz): <https://prodaja.hzpp.hr/hr/Ticket>.
- Hungary (MÁV-START): <https://jegy.mav.hu/>.
- Poland (PKP Intercity): <https://www.intercity.pl/>.

⁹ Offers of DB, ÖBB, ČD; for Frecciarossa according to trainline.com.

Tickets for rail, bus, and air travel can also be searched, compared, and purchased through the following multimodal booking platforms, regardless of carrier:

- <https://www.omio.com>.
- <https://www.raileurope.com>.
- <https://www.thetrainline.com>.
- <https://www.happyrail.com> – information not only about train travel, in 12 languages.

Note: Information (in English only) about travelling, accommodation and purchasing tickets (train, bus, aeroplane) in nine European countries is available on the website: <https://thesavvybackpacker.com/transportation-europe>.

3 Domestic passenger rail transport

This chapter presents the results of the IFEF survey (1) regarding railway regional passenger transport. It covers state support for regional railways, the continuity of services operated by both state and private transport companies, and the availability of an integrated travel ticket.

3.1 Organizing of regional transport

In our survey, we asked “*How is regional passenger transport organized in your country? Is it centralized, unified, managed by region or other?*”. The answers to this question are presented in Table 5.

Table 5: Organizing of regional passenger transport

Country	Organizing	Comments
Austria	By region.	
Belgium	There is one national transport company, the National Railway Company of Belgium: NMBS / SNCB / NGBE.	Bus companies: De Linj, MIVB, TEC
Czech Republic	Rail passenger services in region are commissioned and funded by each regional authority.	The state reimburses approx. 30 %
Germany	Since 1996, in federal states, state commissions have been responsible for assessing needs, specifying the form and quality of services, and commissioning companies to deliver these services.	The commission for railway traffic, usually valid 10–15 years
Denmark	Operation is partly unified on Danish State Railway (DSB) lines and partly handled regionally by private railway companies.	
France	By region. Each region sets prices, number of trains per day and schedule.	
Croatia	By region. The City of Zagreb operates suburban traffic and connecting regional trains.	
Italy	By region.	
Serbia	By sections which cover several regions.	
Sweden	Partly regional, many companies.	

3.2 Rail carriers' cooperation

Cooperation among passenger carriers, whether within a single mode of transport (e.g., rail-rail) or across different modes (e.g., rail-bus), is a key factor influencing the attractiveness of the overall transport chain. Therefore, the following question was also included in the survey: *"In the case of multiple transport companies, is there timetable coordination across various train connections?"*.

The answers to this question revealed different practices across individual countries. For example, in Austria, the Czech Republic, and Denmark, it can be observed that, with some exceptions, timetable coordination exists between various train connections offered by different transport companies. In Germany, rail traffic generally follows a standardized timetable. A minimum scheduled transit time of five minutes ensures connections, with priority typically given to long-distance services over regional traffic. It is likely that the same principle is applied in the countries mentioned above, although this is not explicitly stated.

In France, each region manages its own network; consequently, there is no timetable coordination between neighbouring networks.

In Croatia and Serbia, a single state-owned passenger transport company operates train services throughout the country.

In Sweden, timetable coordination between different transport companies is limited.

3.3 Integrated travel ticket

In countries where transport services are provided by multiple carriers, the availability of an integrated ticket is of crucial importance. Its presence or absence may have a significant impact on the attractiveness and competitiveness of rail transport. Therefore, the following question was included in the survey: *"Is there an integrated ticket, i.e. multi-region / multi-company, that covers different regions / transport companies?"*.

In most of the countries that responded to the question, the answer was positive, including Austria, Belgium, the Czech Republic, Denmark, France, and Croatia.

In the Czech Republic, can be used an integrated ticket called 'OneTicket' to travel by train with several operators, for example by ČD, RegioJet, Arriva, Leo Express, Die Länderbahn or AŽD Praha.

In Denmark, the integrated ticket (system) is called as "Rejsekort", which can be used electronically using a dedicated credit card or smartphone and provides various discounts in accordance with regional regulations.



In Austria, a "KlimaTicket" is available. It is a nationwide annual pass valid for all regular public transport services¹⁰ – trains, urban public transport, buses, ferries, etc.

In Germany, regional and long-distance fares are different; typically, a long-distance ticket can be used on regional services, but the reverse is not permitted. There are "Deutschlandticket" available. This nationwide ticket has allowed unlimited travel on regional and local public transport throughout the country, while remaining invalid on most long-distance services such as ICE, IC, and EC trains, FlixTrain and some touristic services.

In Sweden, the integrated ticketing system the "Resplus" can be used for trips that involve multiple carriers. This allows passengers to travel using the services of two or more operators (train, bus, ferry, etc.) covered by a one ticket.

By contrast, a negative response was recorded in Italy, although in certain cities or provinces (Lombardy, Piemonte, Lazio etc.) it is possible to purchase an integrated ticket for use on urban transport or for travel between two cities, either by train or bus.

In Belgium and Croatia, rail passenger transport is provided primarily by a single national railway operator. Thus, nationwide integrated ticket for multiple transport companies is generally not required. In Serbia, a similar situation exists, as there is no nationwide integrated ticket valid across all public transport services. Limited integration is available in Belgrade, where the BG Voz suburban rail system is integrated with the city's public transport network and can be used with Belgrade public transport tickets.

¹⁰ Excluding certain private railway services, seasonal tourist bus routes, FlixBus services, and selected boat services.

3.4 Support for regional railway lines

The provision of passenger transport services on low-demand regional and local railway lines has long been an important policy issue. Responsibility for the operation and funding of these services typically lies with regional authorities. For this reason, the following question was included in the survey: *“Does the state subsidise the operation of lightly used regional railway lines?”*.

The responses indicate that many states (their governments) support the operation of regional railway lines with low traffic through loss compensation, including Belgium, the Czech Republic, Germany, Denmark, Croatia, and Serbia. This support is provided because public transport in certain regions typically operates at a financial loss.

In Croatia, the operation of regional railway lines is supported through various forms of subsidies and financial assistance. For many years, this support has covered the costs of passenger transport and provided funding for new capital expenditure, such as the provision of rolling stock financed from the state budget of the Republic of Croatia, as well as for interest repayments. For almost twenty years, revenues – also referred to as subsidies – have been generated for suburban traffic under a contract between Croatian Railways (HŽ) and the Zagreb City Transport Company (ZET), as part of an integrated public transport system. In addition to low passenger volumes, other challenges include difficult operating conditions, additional costs, and social considerations.

In France, regional authorities provide support for loss-making passenger rail services.

In Italy, some railway lines with low passenger volumes remain operational, while many regional lines have ceased passenger services, and some have even been dismantled.

Note: An opportunity for low-demand local railway lines lies in the interest of smaller railway carriers in operating services on such lines. Combined with the use of modern rolling stock, often powered by alternative energy sources such as batteries, this provides a sustainable approach to maintaining rail services. An example can be found in the Piedmont region of Italy, where passenger services on the Cuneo-Saluzzo-Savigliano line were reintroduced in 2025. Since then, Arenaways has operated services using modern Pesa railcars (5).

In Sweden, regional and local railway services are generally financed by regional public transport authorities. These authorities are responsible for planning, procuring, and funding services, many of which are operated under public service contracts. Consequently, the operation of low-demand regional railway lines is supported through public subsidies provided at the regional level.

4 Freight transport

The final section of the international survey focused on rail, intermodal (rail – road), and inland waterway freight transport. All these transport modes are sustainable, with relatively minor negative impacts on the environment.

4.1 International rail freight corridors

High-quality infrastructure is one of basic conditions for efficient and competitive rail freight transport. To facilitate international freight transport, a network of rail freight corridors (RFC) has been established that covers much of Europe. Therefore, the following question was included in the survey: *“Are domestic or international corridors used in your country for the rail transport of intermodal traffic (containers transported by rail and road)?”*.

This chapter presents a summary of the responses to that question.

“Intermodal transport” refers to a transport system that uses two or more different modes of transport to deliver goods to their destination, employing intermodal transport units (UTI, e.g., container, swap body and semi-trailer) that can be easily transferred between ships, trucks, and trains.

In general, container (railroad) transport is widely used in Europe, with a total of 11 rail corridors.

Austria: From Vienna, container transport operates to Moscow, Istanbul, Pescara, Milan, Antwerp, Rotterdam, Bremen, Malmö, and Gdańsk. In total, there are 48 intermodal connections, including eight regular trains and three so-called rolling highways (RoLa).

In Belgium, there is a regular container transport service from the ports of Zeebrugge and Antwerp to destinations such as Germany and other countries. In addition, a significant number of containers are transported by road.

In the Czech Republic, three rail freight corridors¹¹ pass through the country: RFC 5: Baltica – Adriatic rail corridor – from Poland to Austria, Italy, Slovenia; RFC 7: East/West rail corridor – from Germany to Austria, Slovakia, Hungary, Romania, Bulgaria, and Greece, and RFC 9: Rhine – Danube railway corridor – from Germany to Austria, Slovakia (border with Ukraine).

In Denmark, there is a transit rail corridor (RFC 3) Hamburg – Malmö, without service in Denmark.

Germany: Railway operators also offer international combined freight transport from and to certain stations. Of note are stations in major ports (Emden, Hamburg, Kiel, Lübeck, Rostock) and in industrial centres (Duisburg, Cologne, Ludwigshafen, Hanover, Munich, Leipzig). Destinations abroad include Wels (Austria), Verona, Mortara, Trieste (Italy) and others.

France: Domestic and international rail corridors (RFC 2, RFC 4, RFC 6) run between Lille / Bordeaux, Paris / Fos-sur-Mer and Paris to Novara (Italy).

Croatia: Both rail and road offer intermodal freight transport, with maritime transport particularly significant in connection to rail. The largest Croatian seaport, Rijeka, in its Brajdica district, has a dedicated container terminal for intermodal transport, called Jadranska vrata. Additional container terminals exist in Škrlevo, as well as in the seaports of Split and Ploče, where containers are loaded and unloaded. Other cargo seaports include Zadar, Šibenik, and Dubrovnik.

The depth of Croatian seaports varies, allowing in many cases the use of ships with relatively large capacities. A notable development is the new Zagreb Deep Sea Container Terminal – Port of Rijeka, which features a 20 m deep basin, capable of accommodating the largest ships (6).



¹¹ Original numbering according to 2022.

Italy: The main rail freight corridors run through the Brenner (RFC 1) and Gotthard (RFC 3) passes. In many cities, particularly in northern Italy, there are transit ports where combined freight trains depart and arrive. Numerous private companies provide container transport services.

Note: In some countries, e.g., the Czech Republic, Slovakia, Bulgaria, Romania, and Switzerland, discounts are offered on railway infrastructure charges for intermodal services.

4.2 Inland waterway transport

The total length of navigable rivers and artificial canals in Europe is approximately 45,000-47,000 km. However, there are significant differences among individual countries. The Netherlands, Belgium and northern and central Germany have the highest density of navigable waterways, while France, Germany, and the Netherlands possess the most extensive inland waterway networks in total length. To assess public awareness of the role of inland waterways in the European transport system, the following question was included in the survey: *“Are rivers used for freight transport in your country? If so, please provide examples”*.

The use of rivers for freight transport depends on geographical and hydrological conditions.

In Austria, the main waterway is the Danube, which is primarily used for transport of bulk goods.

Belgium has an extensive network of rivers and canals used for freight transport, including major routes such as Antwerp–Brussels–Charleroi and Oostende–Bruges/Gent.

In the Czech Republic, the Elbe River is used for freight transport towards Germany, providing access to Hamburg. The river is navigable from Chvaletice (near Pardubice), with a total usable length of 210 km up to the state border. A theoretically navigable section of the Vltava River runs through Prague, extending from Slapy to Mělník, where it joins the Elbe.

The German inland waterway network has a total length of 7,476 km, of which approximately 75 % consists of rivers and 25 % of canals. Around 4,800 km of these waterways play an important role in freight transport. The largest waterways are the Rhine (844 km from Basel to the North Sea) and the Elbe (727 km from the Czech border to the North Sea).

Croatia: Inland waterway transport uses navigable rivers, or navigable sections of rivers, suitable for freight traffic. According to the website of the Ministry of Sea, Transport, and Infrastructure, the navigable inland waterways network consists of natural river flows of the Danube (137.5 km), Sava (446 km), Drava (198.6 km), and Kupa (5 km). Additional information highlights four



degrees of navigability, including limitations such as shipping permitted only during daylight hours. The main cargo transported are sand, gravel, and wood. Inland waterway traffic is organized through port authorities and directorates (in Croatian Lučka kapetanija and Lučka uprava), headquartered in Sisak, Slavonski Brod (on the Sava River), Osijek (on the Drava River), and Vukovar (on the Danube). These cities are also the main inland ports in Croatia.

Denmark does not have suitable conditions for inland waterway freight transport due to the short length of its rivers.

France: According to publicly available sources (Wikipedia), around 2,500 km of inland waterways in France are dedicated to freight transport, with the main river ports located in Paris, Lille and Strasbourg.

4.3 Domestic rail transport

Private sidings and industrial facilities with their own railway networks are of crucial importance for direct door-to-door rail freight transport. In the past, many sidings were abandoned or decommissioned, and this process continues in the current period. On the other hand, a few sidings have been refurbished and brought back into operation over the last decade. We were therefore interested in the respondents' views on this issue and included the following question in the survey *“Are existing industrial railway lines being reused, or are new lines being constructed in your country?”*.

In the Czech Republic, at least 13 previously unused private industrial railway lines associated with industrial enterprises were renovated between 2018 and 2020.

In Germany, fully separate industrial railway lines still exist in regions with high industrial density, such as the Ruhr area.

New siding tracks are being constructed as an alternative to truck deliveries, for example, in response to requests from communities that provided land for factory construction or due to the need for a transport solution capable of reaching the connected site.



A report by DB Cargo provides an example of reviving a customer track for the recycling company AV Möck (7). The projects worth highlighting are the trimodal (water-road-rail) transshipment facility in Magdeburg (8), and the Hamm multi-hub for the Hamm (Westphalia) marshalling yard in the eastern Ruhr region (9).

In Croatia, the network of sidings in 2020 was 485 km long (by construction length) owned by private companies, and 15 km long by HŽ-Infrastruktura (HŽI), in total of 500 km. The operational length was 330 km (private), and 9 km by HŽI, in total of 339 km (10).

It is worth noting that in the past (several decades ago), industrial railway lines and tracks were used more. At that time, they were often built and maintained because industry and industrial production were larger, and railways were in greater demand from customers.

In Sweden, existing industrial railway lines are being reused to a minimum. Nevertheless, examples of the restoration and development of industrial railways since 2022 include, e.g., the rail connection to the Viscaria copper mine near Kiruna and the new rail connection to the Svartbyn industrial area near Boden in northern Sweden.

5 Calculating transport emissions

This chapter was written by student Matěj Berka and his supervisor, Jaroslav Matuška, both from UPCE, FTE. The chapter was updated and supplemented in 2026.

5.1 Introduction

The carbon footprint means the amount of greenhouse gases (most often expressed in tonnes of CO₂) produced by the implementation of an activity (11). This amount of greenhouse gases can be related to those produced directly by individual activities or to those produced by the products of society. The term “carbon footprint” itself is used to summarize the emissions produced over a period. The combustion of hydrocarbon fuels in the internal operation of engines produces not only CO₂ but also other harmful substances, such as CO, NO_x, SO₂, N₂O, CH₄, and some heavy metals (12). To simplify and clarify the resulting data, the amount of these substances produced is converted into the so-called “CO₂ equivalent”. This quantity, given in units of mass, is derived by converting the amount of other substances polluting the environment into a corresponding amount of CO₂, such that these substances are given a conversion ratio based on their damage to the environment, by which the given amount of these substances increases (13). This ratio is called the “Global Warming Potential” and indicates how many times more one mass unit of a given substance contributes to global warming than one mass unit of CO₂. The Kyoto Protocol defines exposure values for these substances over a one-hundred-year period (14).

Calculating and reporting a company’s carbon footprint is becoming increasingly important and is emerging as a key component of both customer relationship management and ESG¹² reporting. Both are used for marketing purposes (15).

¹² Environment (energy consumption, greenhouse gas emissions, waste etc.) – Social issue (employee relations, health and safety, human rights, etc.) – Governance (business ethics, anti-corruption measures, etc.).

5.2 Emissions calculators

When calculating the carbon footprint of transport, emission calculators are used. An emission calculator is a software application (tools) used to calculate the volume of greenhouse gases. This software can either take the form of a programme that requires installation or can operate as a web-based application.

Emission calculators can be divided into two categories which differ primarily in their input data requirements. The first group consists of calculation models that use average CO₂ emission factors expressed per tonne kilometre (tkm). These factors typically depend on:

- transport means,
- transported quantity (mass),
- transportation distance.

These categories of calculators are called distance-based models (16). Average emission values produced by individual transport modes are available in official databases such as TREMOD, TREMOVE or are freely available (e.g. EcoTransIT World) (17).

Another group of emission calculators consists of models that are based not only on transport distance and cargo volume but also on actual energy or fuel consumption. Input data are typically expressed in litres of fuel or in kilowatt-hours (kWh) of electricity. To estimate greenhouse gas emissions, these models apply conversion factors that relate fuel or energy consumption to the amount of CO₂ emitted. The conversion factors used to convert fuel consumption (in litres or kilogrammes) or electricity consumption (in kWh) into kilogrammes of CO₂ emissions are specified in standard (19). This category of tools is commonly referred to as consumption-based calculators or models.

The first category of calculators is mainly used by companies and factories which subcontract transport and thus do not have direct access to all the necessary data for the second calculation method. Rather, it is used in logistics and transport companies, for which the collection of such data is a common practice. Calculations based on an analysis of the amount of energy and fuel consumed are more accurate.

The ISO 14064-1 international standard (20) and the GHG Protocol (22) are internationally recognized frameworks that standardize the methodology for calculating an organization's carbon footprint. Both frameworks consider not only direct emissions generated by the organization's own activities, but also indirect emissions associated with its operations and value chain. These emissions are categorized into two groups:

- (1) emissions associated with the consumption of purchased electricity, heat, cooling, and other forms of imported energy,
 - (2) all other emissions generated throughout the organization's value chain, including those arising from the procurement and processing of inputs, as well as upstream and downstream logistics activities.
- (18).

The calculation of GHG emissions and the declaration of energy consumption in transport services are covered in detail in the standard (19). This standard, focused on both freight and passenger transport, also classifies emissions into direct and indirect.

Direct emissions are emissions of greenhouse gases generated directly during the transport of passengers or freight because of fuel combustion in the vehicle. These emissions are commonly referred to as Tank-to-Wheels (TTW) emissions.

Indirect emissions, known as Well-to-Tank (WTT) emissions, arise from the extraction, processing, production, and distribution of fuels or energy used in transportation.

Total greenhouse gas emissions associated with a transportation process are referred to as Well-to-Wheels (WTW) emissions. These emissions represent the sum of direct (Tank-to-Wheels) and indirect (Well-to-Tank) emissions, providing a comprehensive assessment of the environmental impact of transport activities.

To calculate the carbon footprint of transport by multiple modes of transport from fuel or energy consumption data in a single consignment, EN 16258 prescribes a procedure for converting different physical units expressing the amount of energy / fuel consumed to a common unit, which is megajoules (MJ).

If transportation takes place using multiple means of transport (transport modes), emissions are calculated separately for each means of transport and then summed up for the individual parts. In this partial calculation, not only the movement of the means of transport during the transport process itself is considered, but also the movement of the vehicle related to this transport process, e.g. trips during and after transportation.

The standard converts the amount of fuel or energy consumed into MJ units and the amount of greenhouse gases produced according to the conversion ratios specified in this standard. The last step consists of summing the values resulting from the individual parts of the route.

EcoTransIT World, NTMCalc Freight, Climate Care, and LOG-NET are among the most widely used calculators to estimate transport-related emissions. The first two calculators comply with the requirements of the EN 16258 standard. EcoTransIT World is designed to estimate emissions generated along freight transport routes using various transport modes, including rail, road, maritime, and air transport. The calculator is used by several transport and logistics companies, such as Trenitalia, DB Schenker, and GEFCO (16). Unlike Map & Guide software, EcoTransIT World considers both direct and indirect energy consumption when calculating transport-related emissions.

5.3 Calculating emissions from passenger transport

The calculation of energy consumption and greenhouse gas emissions during passenger transport is made possible by the EcoPassenger calculator (23). It was developed in collaboration between the International Union of Railways (UIC), Institute for Energy and Environmental Research (IFEU), Heidelberg, Germany and the software company Hacon. It calculates and compares GHG emissions (CO₂, NO_x, PM, non-methane hydrocarbons) during transport by train, car and plane.

EcoPassenger tool is based on internationally accepted methodologies and emission factors. It incorporates the latest scientific knowledge in the field of transport-related greenhouse gas emissions and applies the principles of standards (19) and (21) to ensure a consistent and transparent assessment of environmental impacts.

Calculations of energy consumption and greenhouse gas emissions are performed using country-specific electricity generation mixes, allowing the results to reflect regional differences in the carbon intensity of electricity production.

The EcoPassenger calculator considers both the energy or fuel consumed during the journey itself, as well as the energy required to produce and transport the electricity or fuel.

For air transport, in addition to the time and fuel consumption during the flight. The time and fuel consumption involved in travelling to and from the airport by car or train are also taken into account, provided the journey is longer than 100 km.

Input data for rail transport are derived from environmental strategic reporting systems and include information on national electricity generation mixes with data on the origin and utilization of renewable energy sources by individual railway companies.

This calculator enables detailed analyses of both national and international passenger transport. It allows users to specify a wide range of journey parameters, thereby providing a more accurate assessment of energy consumption and GHG emissions for individual travel scenarios. In addition to environmental performance indicators, the tool provides practical travel information, such as reservation requirements, accessibility conditions for passengers with reduced mobility, and options for transporting bicycles. Examples of emission values for passenger transport calculated using the EcoPassenger tool are presented in (24).

While GHG emissions from passenger cars depend on several factors, for examples on type of engine (diesel, gasoline engine, LPG, battery-electric), its emission class (EURO), vehicle class, and its occupancy rate, emissions from electric rail transport are primarily influenced by the electricity generation mix of the country in which the transport service is provided. The load factor (occupancy rate) is also taken into account for both rail and air transport. Consequently, the environmental performance of electric trains and electrification rate vary significantly across countries (see chapter 1.1), reflecting differences in the carbon intensity of their national energy systems.

Calculations according to (23) indicates that for shorter journeys, for example Prague – Berlin¹³, CO₂ emissions from a passenger car (middle-class, Euro 4 diesel engine) and an electrically powered train are broadly comparable when four passengers travel in the car. For longer journeys, e.g. Vienna – Warsaw¹⁴, a similar level of emissions can be achieved when two to three passengers share the car. However, the results depend on the specifics of a route and national conditions¹⁵. For example, for travel in regions and countries with low railway electrification (see chapter 1) or a less favourable electricity generation mix¹⁶, the emission parity between rail and road transport may be reached with only one to three passengers in the car.

Do you know...

Rail transport (trains, trams, and metro systems) is approximately 7.5 times less energy-efficient than road transport. The main reason for this: the energy efficiency of electric traction systems compared with internal combustion engines, as well as the lower resistance (rolling and aerodynamic) characteristic for rail vehicles. Rail transport's ability to carry large numbers of passengers or large volumes of freight whilst consuming relatively little energy contributes to rail energy efficiency and smaller carbon footprint.

¹³ roundly 350 km.

¹⁴ roundly 700 km.

¹⁵ Motorway, railway network, geographical conditions etc.

¹⁶ e.g. journeys from Warsaw to Belgrade and from Budapest to Bucharest.

6 How to organize meetings sustainably

The following suggestions, questions and recommendations can be regarded as guidelines for the sustainable organisation of meetings, conferences and seminars, including issues relating to preparation, transport and catering during these events.

During the preparation, can be consider:

- Is it necessary to organise all preparatory meetings in person?
- Can remote communication tools be used for some meetings to save time and travel costs and reduce environmental impacts from transport-related emissions?
- Is it necessary to print all documents?
- Can documents be provided in digital format (registration forms, maps, general information, etc.)?

If documents need to be printed:

- Print on both sides to save up to 50 % of paper.
- Use the blank side of previously printed paper for non-essential information or notes.
- Print in black and white rather than in colour (if possible).

Refreshments of participants:

- Where possible, choose large packages instead of multiple small ones (e.g. coffee milk, mineral water).
- Prefer one large carton of milk or tap water served in jugs (where suitable), helping to reduce packaging and waste.

- Where feasible, particularly at smaller events, participants can label their cups and reuse them throughout the event, thereby reducing unnecessary waste. An example is shown in the photograph taken at the IFEF Congress in Žilina in 2025 (Cup parking point: label your cup, leave it here, and reuse it later.



For travel:

- Where possible, use public transport such as trains or buses.
- If travelling by car, carsharing (travelling in pairs or groups) can substantially reduce emissions per person and, in some cases, may approach the environmental impact of other transport modes, such as trains.

It is worth noting

- Air transport generates the highest carbon dioxide emissions per passenger-kilometre compared with rail, bus, and car transport.
- The lower energy intensity of rail transport – and, consequently, its lower greenhouse gas emissions – can be attributed to the fundamental physical properties of the steel wheel-rail interface, which results in very low rolling resistance, as well as to the high efficiency of electric traction.
- The environmental impact associated with different modes of transport and their specific operational characteristics can be estimated using specialized tools such as the EcoPassenger calculator.

About Erasmus+ and VERDEN project

Multi-field Education EU Program Framework

The Erasmus+ programme consists of several strands: school education, higher education, adult education, vocational education and training, youth, and sport.

Adult Education Priorities

- Improving, creating, and supporting educational opportunities and (re)qualification pathways outside formal education.
- Enhancing the competences of teachers and trainers.
- Improving quality assurance and knowledge transfer.
- Promoting intergenerational cooperation, the Erasmus+ programme, and European active citizenship.

Approval notification:

September 2021, 2021-1-NL01-KA210-ADU-000034052

Title of the project:

Go Green and Make a Change! Active Education on Sustainable Development

Start date: November 1, 2021

End date: November 1, 2023

Budget: 60,000 euro.

Partners:

- Universal Esperanto Association (Netherlands, coordinator)
- Parma Esperanto-Association “Giorgio Canuto” (Italy)
- IFEF-Czech Republic
- IFEF-France
- Flemish Esperanto League (Belgium).

Collaborating organizations

- International Federation of Esperantists Railway Workers
- Association of Esperanto-speaking Cyclists.

Project goals

1. Improving the quality of education and training activities in the fields of sustainable development and sustainable transport.
2. Developing training materials, advice, and guidelines that can be used by other individuals and organizations.
3. Raising awareness and engaging individuals and organizations in addressing challenges related to education for sustainable development and sustainable transport in everyday practice.
4. Facilitating the exchange of experiences and good practices among organizations from different countries, with the aim of strengthening existing collaborations and fostering new partnerships.
5. Promoting the Erasmus+ programme framework.

Project assets and milestones

- November 2021: partner kick-off meeting (Parma Esperanto-Association, Italy; November 20-22).
- March-April 2022: partnership meeting (IFEFFrance, Grezillon, France; March 31 to April 4).
- November 2022: training seminar (UEA, Amsterdam, Nederland; November 19-22).
- March 2023: partnership meeting (in connection with a seminar at the University of Pardubice, Czech Republic; March 4-7).
- May 2023: partnership meeting (Flemish Esperanto-League FEL, in conjunction with the IFEF congress in Antwerp, Belgium; May 6-12).
- August 2023: a large publicity event (in connection with the World Esperanto Congress in Turin, Italy; July 29 to August 5).

Project output

- Main output: an expert publication (booklet) focusing on sustainable development and sustainable transport, presented at the Esperanto World Congress held in July–August 2023 in Turin, Italy.
- The booklet continued to evolve through project meetings and seminars held throughout the project's duration.

List of Abbreviations and Glossary

The list does not include abbreviations that are defined in the text, nor commonly known abbreviations for physical units, currencies, and other common terms.

BG Voz	suburban rail system in Belgrade
ČD	Czech Railways, the “national” railway passenger carrier
CH ₄	methane
CO, CO ₂	carbon monoxide, carbon dioxide
De Lijn	a state-owned enterprise run by the Flemish government in Belgium to provide public transport
d.o.o.	Private Limited Company, in Croatian language
DSB	Danish State Railways, the “national” railway passenger carrier
EN	European Standard (Norm)
FEL	Flemish Esperanto-League
GHG	Greenhouse Gas
Hbf / Hl.n.	Central station, in German / Czech language
HŽ	Croatian Railways, the “national” railway passenger carrier
ICE	Category of high-speed train operated by German Railways (DB AG)
IFEF	International Federation of Esperantists Railway Workers
INR	Indian rupee (currency)
INT	International Train (category of train in Serbia)
ISO	International Organization for Standardization
MÁV-START Zrt.	MÁV Passenger Transport Co, a subsidiary of Hungarian State Railways
MIVB	Brussels Intercommunal Transport Company
N ₂ O, NO _x	nitrous oxide, nitrogen oxides
NGBE / NMBS	National Railway Company of Belgium (also SNCB)
PM	particulate matter
RoLa	a rolling road; road trucks carried by rail
SJ	state-owned passenger train operator in Sweden, formed following the restructuring of Swedish Railways
SNCF	National Company of the French Railways

SO ₂	sulphur dioxide
S-Bahn	a hybrid urban–suburban rail system serving a metropolitan region, in German-speaking countries
TEC	a brand name of Public Transport in Wallonia, Belgium
TGV	high speed train (in France)
Thalys	a brand name used for certain international high-speed train services from Paris Gare du Nord station
Trenitalia	the “national” passenger carrier in Italy
U-Bahn	underground urban railway, in German-speaking countries
UEA	Universal Esperanto Association
UPCE, FTE	University of Pardubice, Faculty of Transport Engineering
Vy	a Norwegian government-owned rail and bus company, formerly Norwegian State Railways (NSB)
ŽSR	Railways of the Slovak Republic (Infrastructure manager)

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