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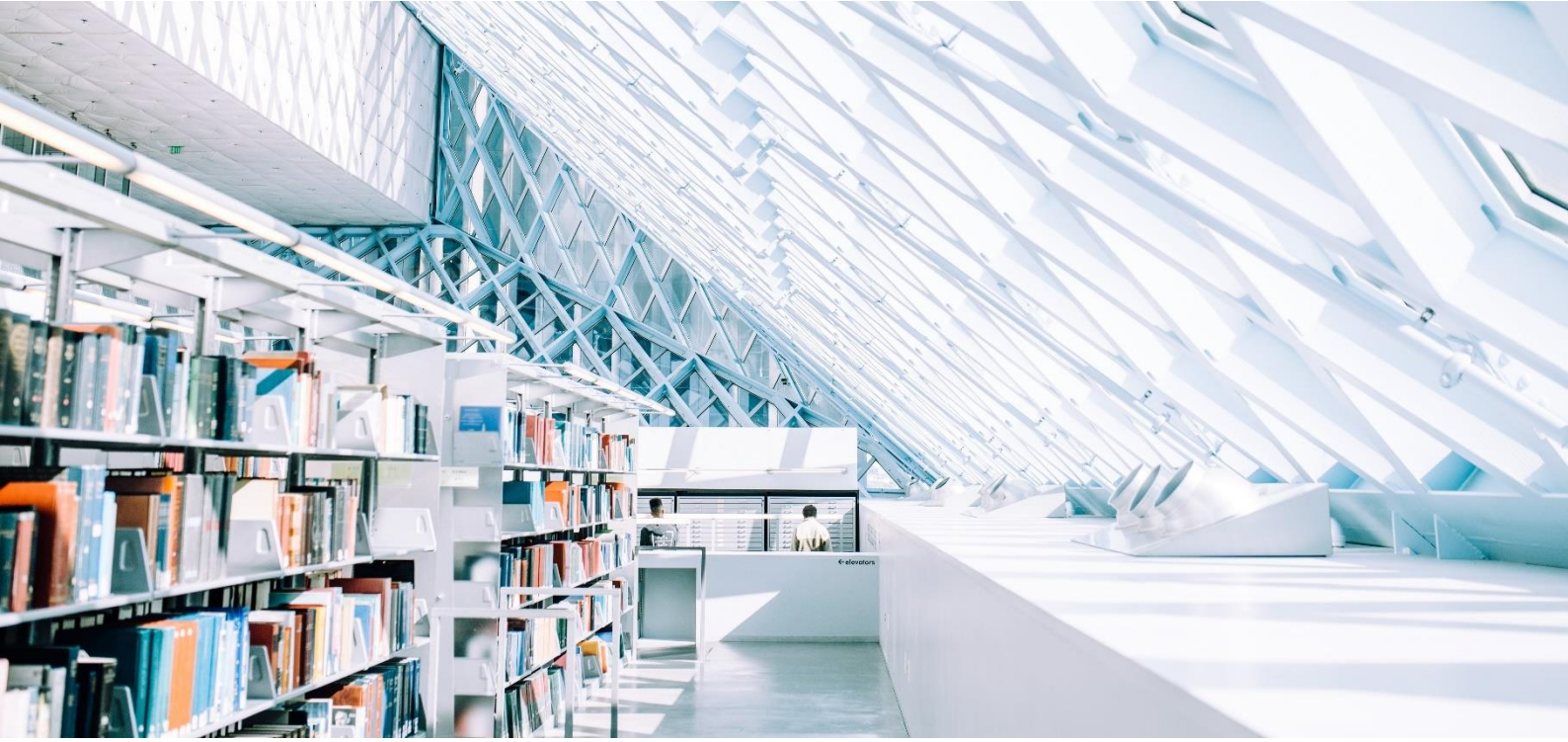
PUSH-PULL TRAINS EUROPEAN MARKET TRENDS

Open Access passenger markets and Intercity train market

2022



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PUSH-PULL TRAINS – EUROPEAN MARKET TRENDS
Open Access passenger markets and Intercity train market
Cologne, May 2022

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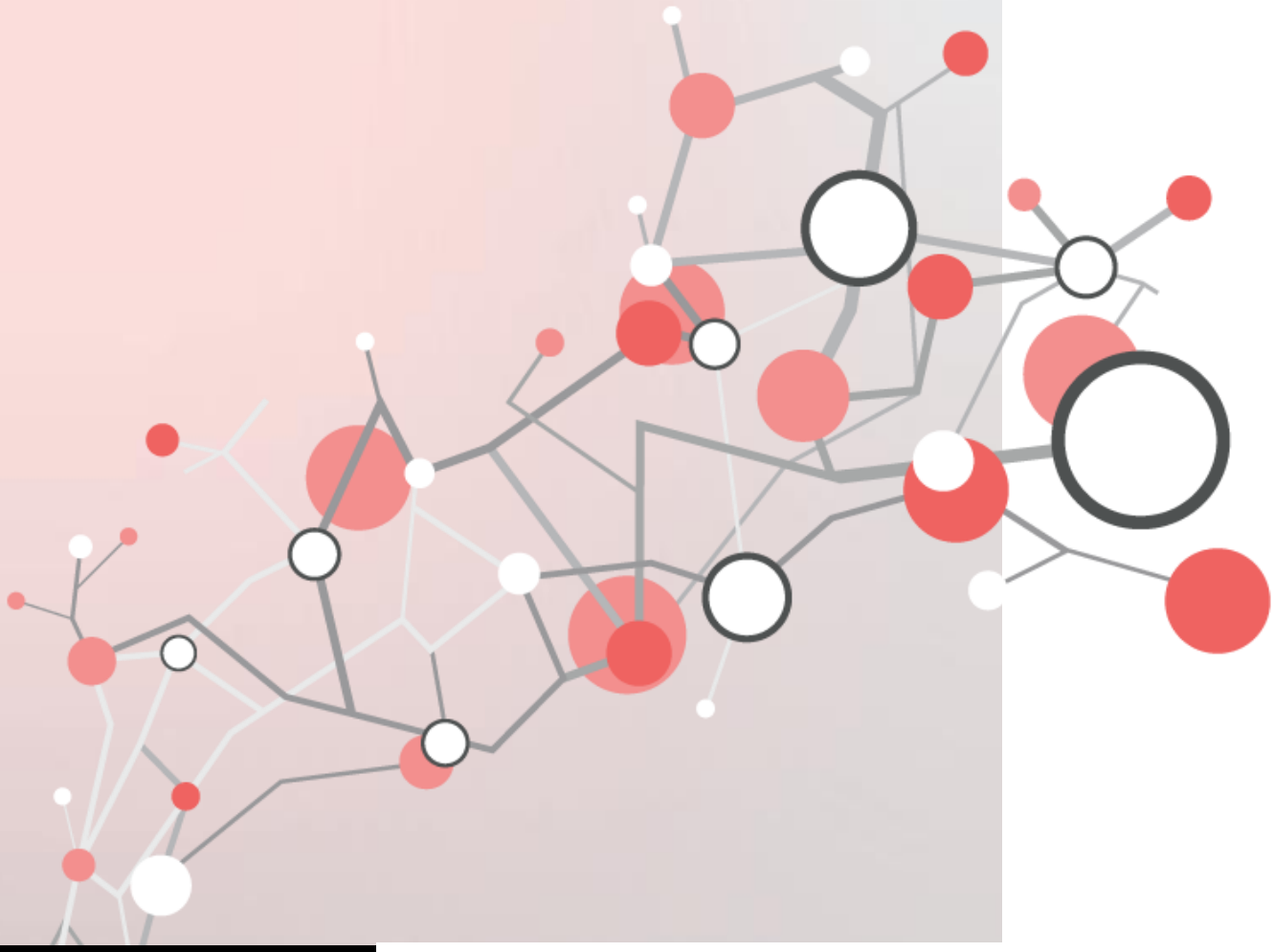
SCI Verkehr is in close communication with stakeholders such as freight forwarders, rail operators, lessors and the rail manufacturing industry. We try to incorporate current developments and industry expectations into our regular forecasts.

Going forward, we expect significantly more uncertainty in developments and an increasing volatility, both temporally and geographically, in prices, delivery / construction numbers and demand dynamics in the global rail business.

This applies to all statements made here concerning the development of the rail markets. We must also emphasize that the assessments of market developments and asset valuations made in the past are highly likely not to be applicable against the background of the current crisis and its impacts and must be reviewed before any decision is taken based on it.

CONTENT



1 Executive Summary

1 Executive Summary

In the scope of ongoing climate debates and the EU's decarbonisation agenda up to 2050, push-pull trainsets have recently gained in importance, especially in intercity transport services, and are set to be increasingly competitive compared to air and high-speed railway transport in the future.

In this MultiClient study, SCI Verkehr, for the first time, conducts a push-pull market analysis and outlook in Continental Europe on the base of two integral elements of each push-pull trainset: coaches, the passenger-carry element, and locomotive, the traction element. For both elements, with the focus on intercity transport, positive market development and outlook are observed in Continental Europe. The planned reduction of short-distance flights will additionally contribute to the rail modal shift and drive the intercity railway market.

The overall market analysed comprises 28 national markets in Continental Europe, excluding the UK and broad-gauge markets of Iberia, Baltic states and Finland due its specifics. To show the development in the different regions, SCI Verkehr has analysed the five focus markets Germany, Italy, Sweden, Poland and the Czech Republic.

Siemens Vectron
for DSB

……
Starting with a recent relatively low procurement level of EUR 90 million in 2021, the intercity passenger locomotives OEM market is set to grow in the next 5-year …

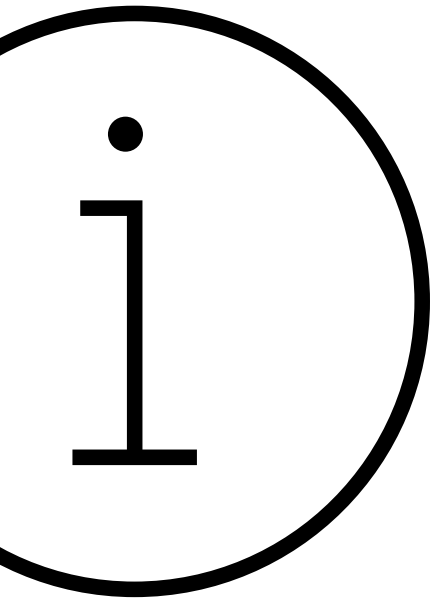
In 2021, transport performance in Continental Europe was still impacted by the Covid-19 crisis but rose slightly compared to the previous year to xx billion pkm. SCI Verkehr expects a recovery to pre-crisis level in 2023.

…

Expansion and upgrade of infrastructure, further liberalisation of the markets, improved technical and operational characteristics of push-pull trainsets as well as rising environmental awareness will be the main drivers for the overall push-pull market in Europe.

Definition of intercity market

SCI Verkehr defines the intercity market in this study as part of the long-distance transport market. It entails mainly passenger transportation services at speeds of 160 km/h to 249 km/h, whose average travel distance is over 50 km. In addition, the deployed rolling stock serves as an additional parameter for the segmentation. For example, locomotive-hauled trainsets are often used in intercity transport services. However, special multiple units are also operated, which reach a speed of up to 230 km/h (e.g., Stadler FLIRT IC) as well as high-speed trains in a few cases. The equipment of the trains has usually a comparatively high quality.



Another part of the long-distance market is high-speed transport, which operates at speeds of ≥250 km/h with corresponding high-speed trains. Some of this transport operates on its own infrastructure, namely dedicated high-speed lines that have been introduced in the past decades allowing for speeds beyond 250 km/h. An exact differentiation is not always possible. In Germany, for example, ICE trains from Siemens are also used on intercity routes (e.g., Cologne - Hamburg). Official statistics also do not allow a distinction to be made.

In addition to long-distance transport, there is also regional and commuter transport. Here, distances of less than 50 km are usually covered. Rolling stock also has special characteristics. The trains reach a maximum speed of 160 km/h. …

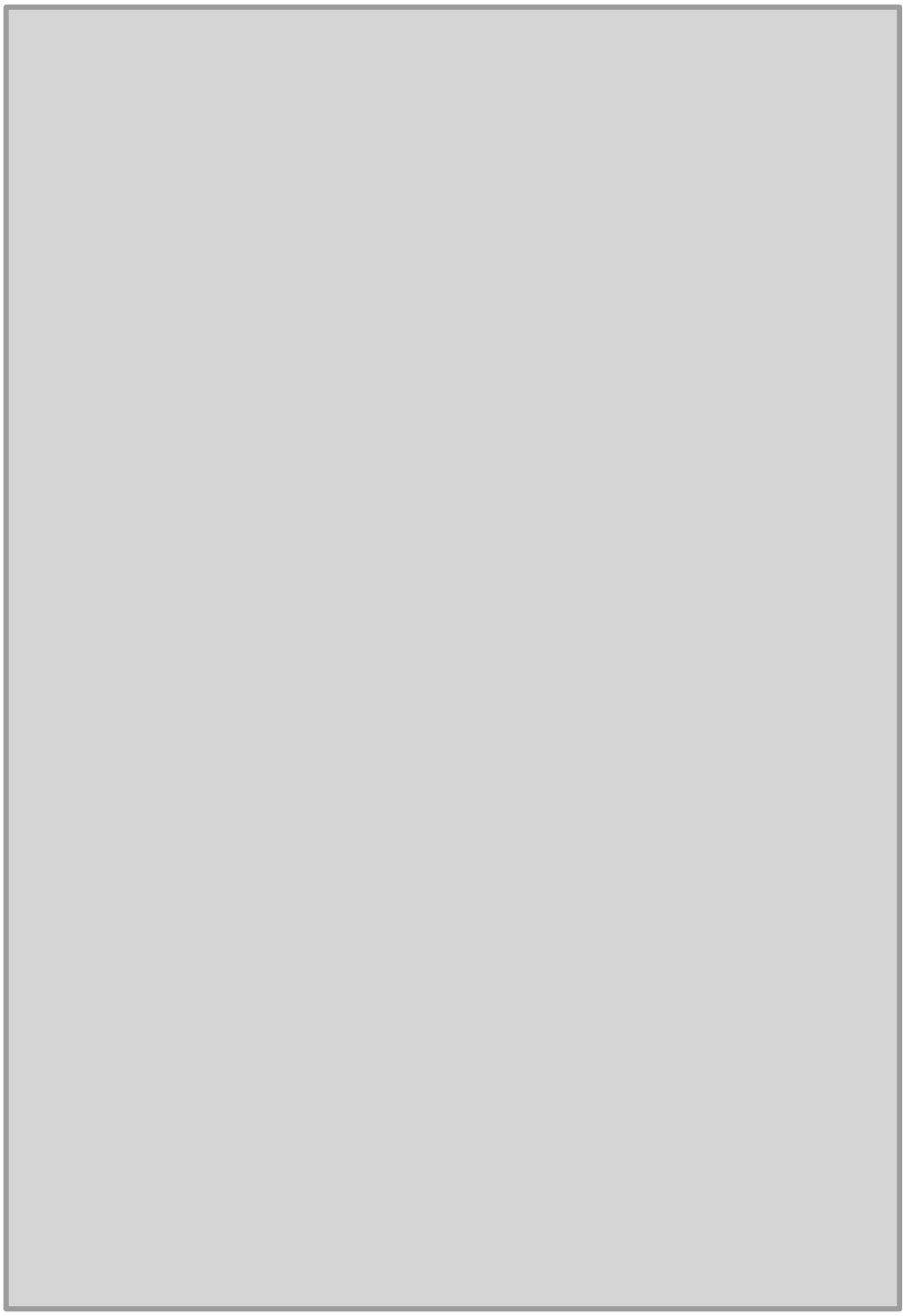
1

European intercity markets provide growth potential

European intercity markets provide growth potential

The intercity market in Continental Europe is growing strongly and disproportionally compared to the overall rail performance as the demand is increasing. The total passenger transport performance has been rising steadily in pre-Covid-19 years to xx billion pkm in 2019 and SCI Verkehr expects the transport performance to recover to pre-Covid-19 level by 2023 (xx billion pkm). Between 2025 and 2030, a continuous growth of 2.4% per year is expected by SCI Verkehr.

Between **2025** and **2030**, an average **growth of xx%** per year is expected by SCI Verkehr

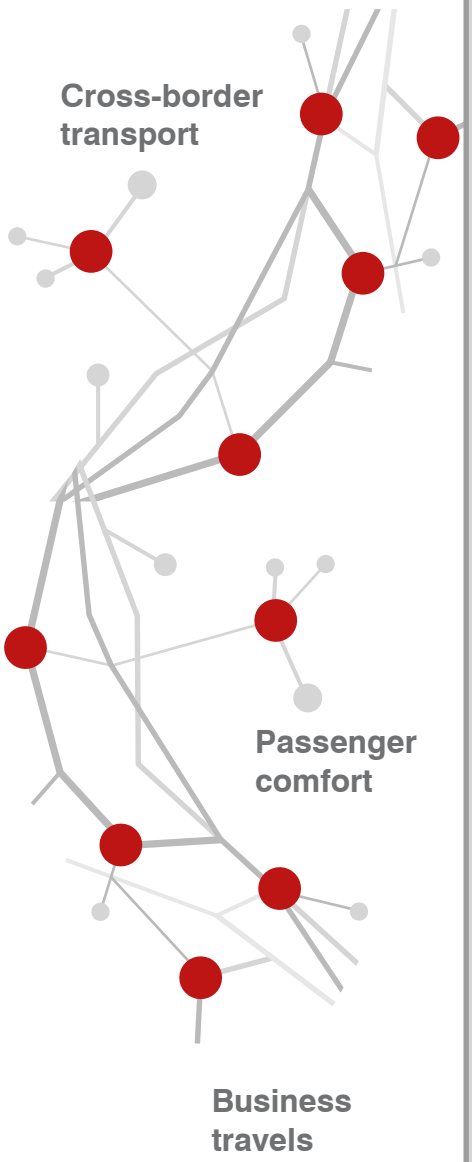


Trends and drivers
impacting the push-pull market
in Continental Europe

2 New players enter the open-access passenger transport market

Push-pull trains are advantageous especially in international transport

SCI Verkehr has identified several technical and operational characteristics pointing out the push-pull train's suitability especially for the intercity transport services.



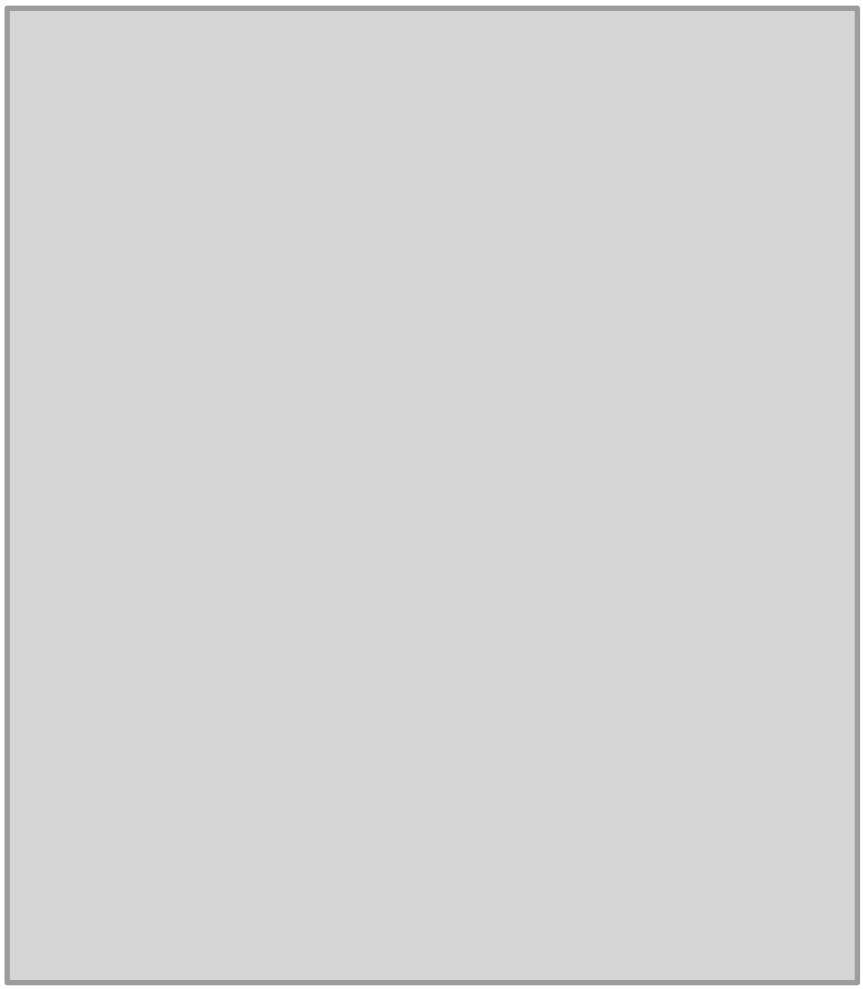
Trends and drivers
impacting the push-pull market
in Continental Europe

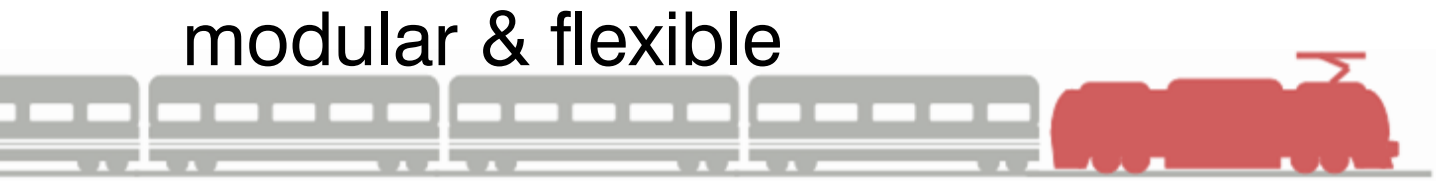
3

Passenger coaches become more modular and can thus be deployed more flexibly

Passenger coaches become more modular and can thus be deployed more flexibly

The train composition consists of passenger coaches and one or two locomotives on both composition's ends. The preferred solution is with one locomotive at one end of the composition and a special passenger coach type (driving trailer coach) on the other. Each individual train part can be separately put out of operation and replaced in case of maintenance or malfunction without affecting train operation. Moreover, different maintenance cycles of locomotives and passenger coaches mean that practically no idle times are occurring.





Trends and drivers
impacting the push-pull market
in Continental Europe

4

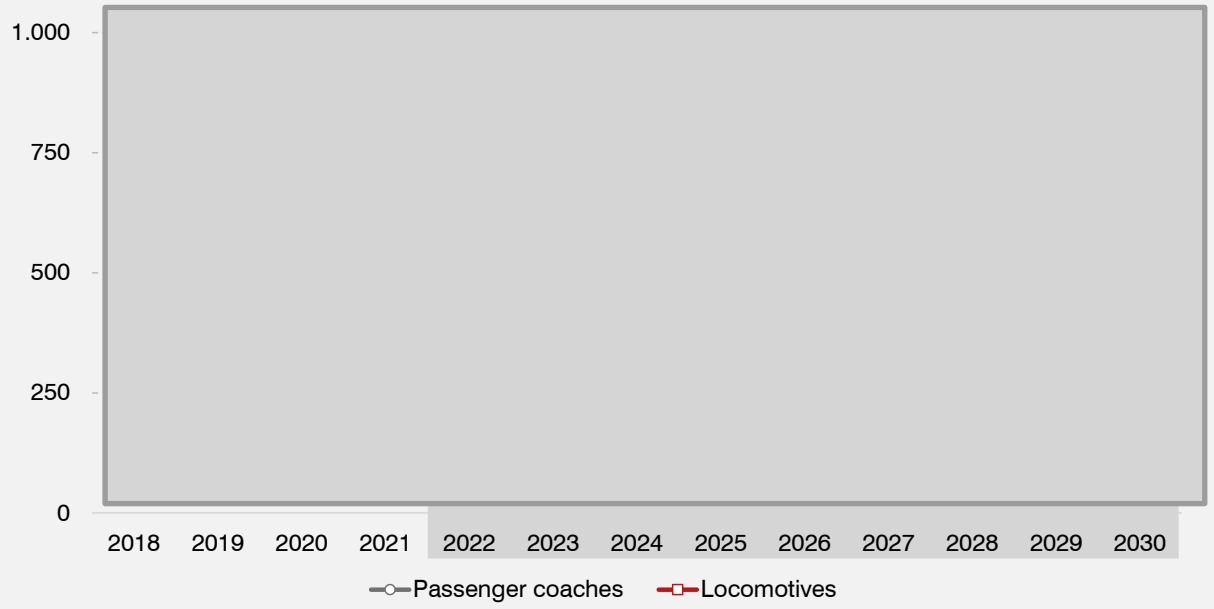
The market for push-pull trains is set to ……..

The market for push-pull trains is set to grow significantly by 2030

In aftermath of the Covid-19 crisis, demand for passenger transport services is increasing again, especially in intercity segment. SCI Verkehr has recently observed an increased interest and a positive market outlook for push-pull trains depicted in plans for future passenger coach procurements in various country markets, such as Germany, Hungary, Italy, and Poland. This is taken into consideration as well in the future market forecast, as from 2022 to 2026, the intercity coaches OEM market is expected to grow at a CAGR of xx%. Replacement demand is pronounced as the overall intercity passenger coach fleet in Continental Europe is almost 35 years old on average, with more than one-third of total feet being 40 or more years old. Moreover, the night train market is also expected to grow, as the topic recently became relevant again on the level of national railways, but also on the broader level of the EU.

Following high procurement levels and after coaches from major orders are delivered around 2025, the OEM market is expected to show signs of consolidation at some lower yearly levels of around EUR xx million on average from 2026 to 2030.

Intercity passenger coaches and locomotives OEM market volume in Continental Europe (in EUR million)



After a period of lower procurement levels, passenger locomotives for passenger transport services are being increasingly procured again. Demanded are modern multi-system locomotives capable for cross-border transport along different European catenary systems and with higher maximum speed. The latest trends shows that speed of 160 km/h is not any more competitive in the intercity transport segment, at least in Western Europe, although lines in

Eastern Europe are being upgraded to answer this demand better ……

Another important driver is the future development of short-distance flight markets in Europe. The short-distance flight became increasingly popular over the last decades, characterised by low-cost offers from regional carriers. However, this trend recently started to change, already setting a path for further modal shift in future. In efforts to minimise the carbon footprint in the scope of the EU's decarbonisation plans for climate neutrality by 2050, governments are imposing restrictions on short-distance flights.

Trends and drivers impacting the push-pull market in Continental Europe

5 The market for night trains is experiencing a revival

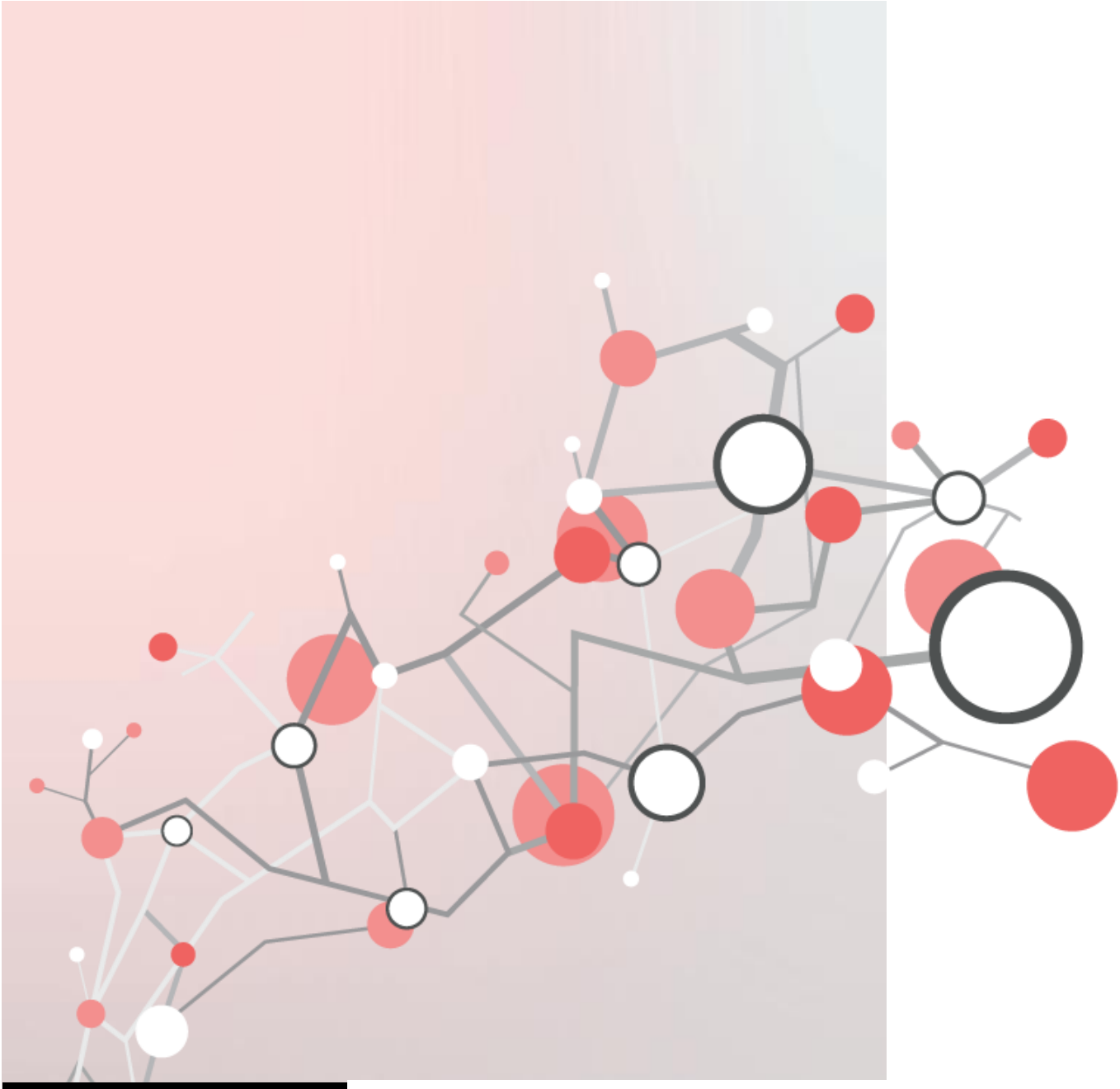
The market for night trains is experiencing a revival

Recently, the night train topic became relevant again, as the concept was revived by a rising debate in the EU about decreasing the ecological footprint through sustainable mobility. Thus, night trains are seen as a viable alternative to air and road transport. Several initiatives and campaigns for supporting the Europeans ……..

The night train passenger coach OEM market volume in EUR is expected to increase by **18.4%** p.a. between 2022 and 2026

.....

Siemens Viaggio Rzw
für den Nachtzugverkehr



2

Intercity transport market in Continental Europe

2 Intercity transport market in Continental Europe

2.1 Overview

Socio-economic data
Population (million)
CAGR Population 2021-26 (%)
Degree of urbanisation (%)
GDP per capita (PPP, USD)
GDP (current prices, EUR bn)
CAGR GDP (real) 2021-26 (%)
Rail infrastructure
Mainline railway network (km)
High-speed railway network (km)
Transport market
Transport performance (bn pkm)
Rail modal share (%, 2019)
Share of PSO (%, 2019)
Share of Open-access (%, 2019)
Intercity passenger rail fleet
EMU (units)
DMU (units)
High-speed train (units)
Passenger coach (cars)
Electric locomotive[1] (units)
Diesel locomotive[1] (units)

Sources: Eurostat, IMF, IRG, SCI/DATABASE
Figure 1: Continental Europe – overview passenger transport

The market analysed comprises 28 national markets in Continental Europe. The European markets with broad-gauge (e.g., Spain, Finland, Baltic states) and, due to its special characteristics, the UK market are not included in this MultiClient Study. In total, the passenger transport market in Continental Europe is valued at xxbillion pkm in 2021. The pre-crisis level in 2019 was xx billion pkm. In 2020, this high performance level collapsed by about xx% to xx billion pkm as a result of the Covid-19 pandemic. The rail modal share was almost 8% in 2019 and it was significantly lower in 2020, as public transport lost market share due to the crisis. In 2021, transport performance recorded a growth of 22% compared to 2020. However, SCI Verkehr expects a recovery to the pre-crisis level in 2023.

The EU has been promoting the rail sector through a series of reforms towards market liberalisation since 2001. The EU vision is to create a European dimension for rail transport, establishing a Single European Railway Area. This requires not only economic reforms but also technical and legal ones. EU regulation has a major impact on the development of the passenger rail sector in Eastern Europe. Although not all countries of the region are member-states, EU rules serve as guidelines for the sector's development.

The largest operators in the passenger transport market in Continental Europe are the two state-owned railways xx which are also active abroad through subsidiaries. So far, there are only a few private operators in open-access transport, e.g., xx.

[1] Deployed in passenger transport services

Differences in the markets analysed can be seen not only in terms of size but also in terms of the conditions for intercity transport with speeds of up to 250 km/h. While some markets like Germany have their own network of intercity trains, other markets (e.g., Netherlands or Hungary) do not allow a clear distinction between regional and long-distance transport because of their size and the top speeds.

…….

2.2 Intercity transport market

2.2.1 Passenger transport market development

The passenger transport market in Continental Europe is valued at xx billion pkm in 2021. Germany and France are the largest markets and account for nearly half of the region's performance. In third and fourth place are Italy and xx respectively. The fifth largest market in Continental Europe is yxx Together, these five markets account for three quarters of passenger rail performance in the region. The larger markets United Kingdom and Spain are not considered within this study focussing only on Continental Europe.

Continental Europe: Top 5 passenger rail transport markets 2021 (bn pkm)

Source: Eurostat, Forecast: SCI Verkehr

Figure 2: Continental Europe – Passenger rail transport by country and top 5 markets

With the exception of a slight decline in 2009/10, passenger rail transport has been showing dynamic growth since 2005 with an average annual growth rate of xx% in the past decade (2010-20). Growth has been increasing since 2015 and averaged xx% per year until 2019. Momentum came in particular from Eastern Europe, with transport in Poland and the Czech Republic growing significantly due to the modernisation of infrastructure and rolling stock and the establishment of competition.

Continental Europe: Development of passenger rail performance, GDP and modal share
(Index = 2005)

Source: IMF, Eurostat, SCI Verkehr

Figure 3: Continental Europe – Passenger rail transport development till 2020

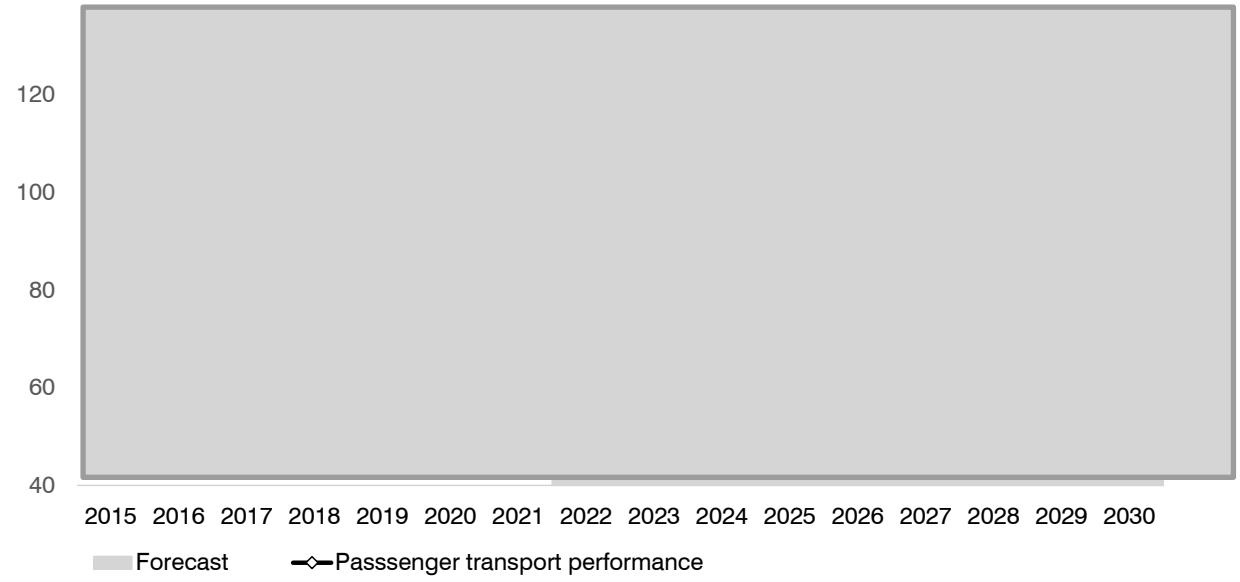
Performance development is not homogeneous in Europe. For example, passenger rail transport performance in Eastern Europe declined almost continuously in the period between 2000 und 2014. Since 2014, the passenger rail transport market has been growing again. This movement is strongly influenced by the development of passenger rail in Slovakia (xx% p.a. 2014-2019), the Czech Republic xx% p.a. 2014-2019) and Poland (xx% p.a. 2014 - 2019), the latter being the largest market in Eastern Europe. The recent growth of the passenger rail performance in Eastern Europe has influenced the overall development of the market in Continental Europe.

xx……

Forecast 2030

SCI Verkehr expects transport performance in Continental Europe to return to pre-crisis levels by 2023. Many countries have eased their Covid-19 restrictions with the beginning of 2022. Although the Omicron mutation of the virus is spreading faster than previous mutations, the high vaccination rates and milder courses allow an easing of the restrictions and curfews. Not all measures are eased, but a pre-Covid-19 routine is slowly coming back. …….

Continental Europe: Development and forecast of passenger rail performance
(pkm, Index 100 = 2019)



Source: Eurostat, Prognosis: SCI Verkehr © SCI Verkehr

Figure 4: Continental Europe – Prognosis of passenger rail transport performance

Transport performance Continental Europe (billion pkm)	
Year	
Forecast	
y-o-y (%)	

After the Covid-19 pandemic, people might generally return to their old mobility behaviour. However, there is a slight migration to motorised private transport and, on shorter distances in the metropolitan areas, to the bicycle. The recovery of long-distance transport services is being slowed down by the fact that companies are dispensing with business trips, as they now hold more meetings digitally.

The European states basically maintain their investments in rail transport. Especially the “European Year of Rail” 2021, that promotes trains as safe and sustainable …….

SCI Verkehr assumes that competition on the railways remains viable and no major insolvencies are expected. The states and Public Transportation Authorities (PTA) will support private transport companies. For example, in Austria the state concluded a PSO contract with the private open-access operator Westbahn to support the company and maintain limited operations.

In the long-term, a stable growth in passenger transport is expected. More investments are going to be made to support the passenger rail industry against the backdrop of combating climate change. Since the airline ……..

Main drivers of transport performance

Drivers	Brief description	Relevance	Trend
Contact / travel restrictions	– Because of the Covid-19 pandemic, contact and travel restrictions of the curfews drastically led to reducing travel activities. From spring 2022 on, there will no longer be a larger impact of restrictions, so contacts will get back to its pre-Covid-19 level.	◕	↗

Drivers	Brief description	Relevance	Trend
Mobility behaviour	–	●	↗
Infrastructure	–	◕	↗
Competition	–	◕	↗
Rolling stock fleet	–	◕	↗
Income	–	◑	→
Politics	–	◑	↗
Demographic development	–	◔	→

Drivers	Brief description	Relevance	Trend

Relevance for procurement: ● = very high, ◕ = high, ◑ = medium, ◔ = low, ○ = none
5-year trend: ↑ = strongly increasing, ↗ = increasing, → = constant, ↘ = decreasing, ↓ =strongly decreasing

2.2.2 Development on main intercity corridors

A lot of international connections have been reduced since the 1990s as many European countries were focused on air and road transport. When it came to rail transport, the focus mainly laid on domestic rail transport. However, at the end of 2020 Germany launched its plans to revive the TransEuropExpress concept, a network of European intercity cross-border trains by cooperating railway companies, in order to combat climate change.

– …….

Source: BMVI

Figure 5: Overview of first step TEE 2.0 routes focusing on Central and Western Europe

In a second step, with a short and medium-term implementation, the focus of the routes lies mostly on Southern and Eastern European country connections:

– TEE 21/22: Venice - Ljubljana - Graz -Vienna - Prague (end-2020s)
– TEE 23/24: Vienna - Ostrava - Krakow -Warsaw - Gdynia/Brest (near future)
– ……..

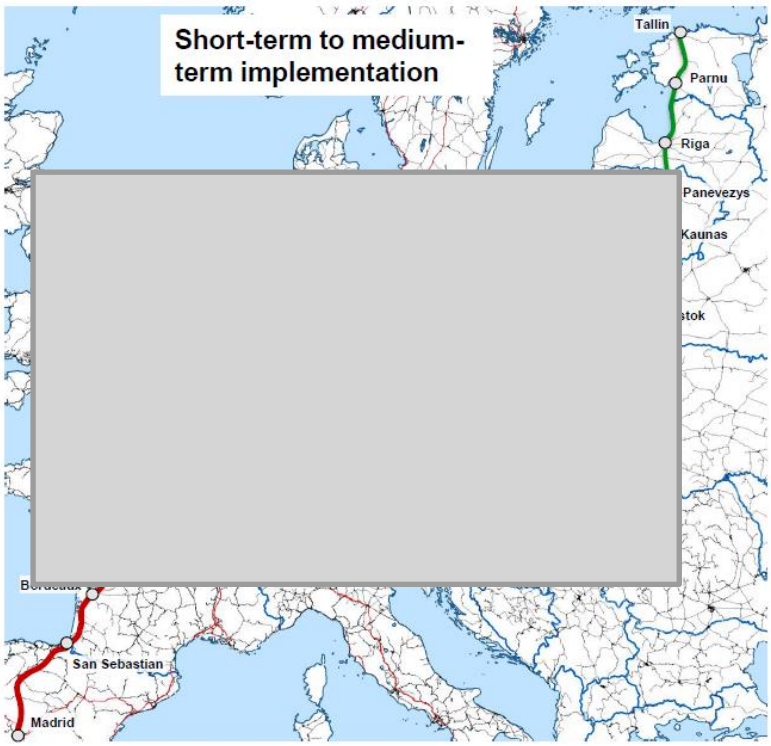
Source: BMVI

Figure 6: Overview of second step of TEE 2.0 routes focusing on Southern and Eastern Europe

In a third step of the concept TEE 2.0 additional routes as part of the signed Letter of Intent or routes directly demanded by countries are in focus:

– TEE 41/42: Budapest - Bratislava - Warsaw (near future)
– TEE 43/44: Tallinn - Riga - Kaunas - Warsaw (end-2020s)

……



Source: BMVI

Figure 7: Overview of third step of TEE 2.0 routes focusing on additional routes

In addition, a complementary network for night services is planned to be installed (see chapter 9).

2.3 Competitive landscape / Transport operators

2.3.1 European market regulation

Structure of the passenger rail market

National states are responsible for regulating passenger rail markets in Continental Europe. However, the EU provides a general legal framework, from which the most important aspects are presented below.

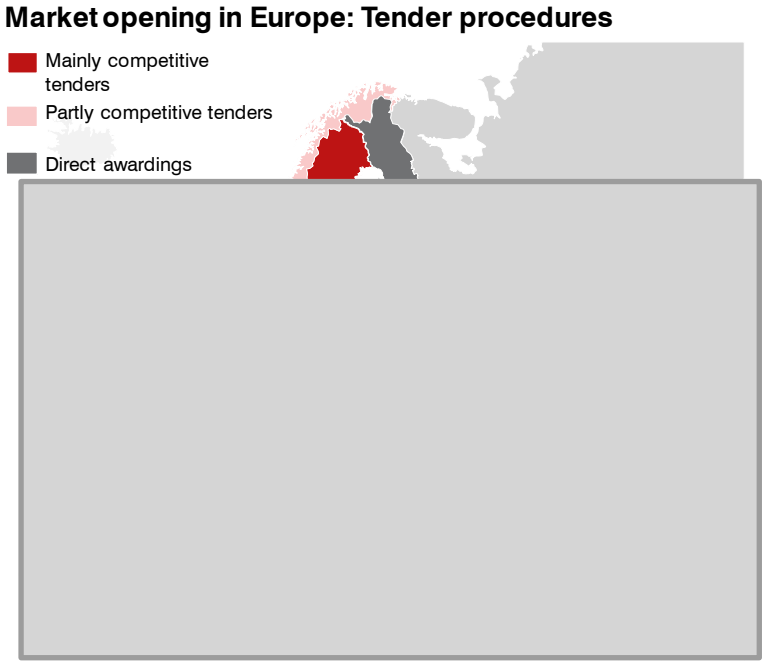
– …

Due to the different framework parameters, SCI Verkehr distinguishes in the following between the markets for Public Service Obligations (PSO) and open-access. For PSOs, the states conclude contracts with railway companies which regulate the scope of services, quality and usually also compensation payments (PSO contracts). By contrast, transport services that are operated on a commercial basis and at the financial risk of the transport operators are grouped under open-access. Approximately two thirds of transport performance in Europe is provided under a PSO contract, one third is in the open-access market.

Public Service Obligation (PSO)

In the EU, public services for passenger rail transport are concluded as PSO contracts between public bodies and transport companies. The individual states are responsible for awarding and financing these services. Within the states, the responsibilities are regulated differently. While some states organise transport contracts exclusively at state level, in other markets the regions are responsible for ordering transport services:

…



Source: EU Market monitoring

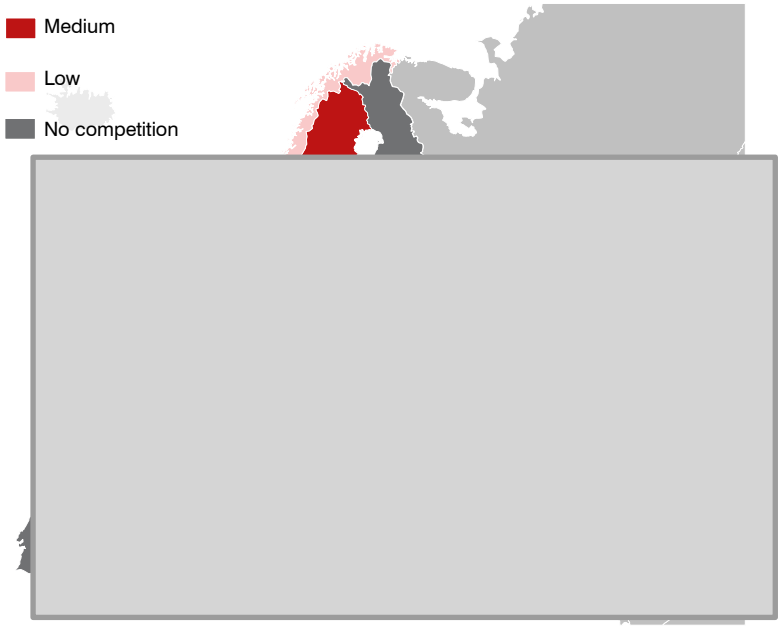
Figure 8: Continental Europe – tender procedures

The degree of market opening strongly differs within the different markets in Continental Europe. Only two states in Europe (Sweden and the UK) have fully opened their commercial services and those under public service obligations. In the EU, several member states tender their rail services. …..

2.3.2 Intercity transport operators

In a few markets in Europe, competition in intercity transport has so far been established. Intercity transport is usually offered as both PSO as well as on open-access basis. …

Market opening in Europe: Competition intensity Open Access intercity



Source: SCI; Number and market share of competitors

Figure 9: Continental Europe – Competition intensity open-access

In some European markets, competition in open-access has already been established. Although some state railways also provide part of their long-distance transport services in open-access on a commercial basis, third party transport companies in the open-access market are often in focus in this segment.

State railways

The incumbents of the largest markets, Germany (DB) and France (SNCF), dominate the European railway market. Both are also successful outside their domestic markets. Together, the two companies have a market share of xx% of the total transport performance in Continental Europe. They are followed by Trenitalia (~xx%), ÖBB and SBB.

– …..

The most significant competitors to the incumbent operators are mostly companies allied to the incumbents of other country markets.

Continental Europe: Market share by operator in long-distance transport in 2020
(%, pkm)

Source: Company information, SCI estimation

Figure 10: Continental Europe – Market share by operator

The largest operators in Continental Europe are linked to the countries with the highest transport volume. …

The largest operators in intercity transport are presented in the table below:

Operator	Brief description

Operator	Brief description
	Czechia and Hungary. Besides its Railjet services, ÖBB also employs conventional intercity services, which have additional stops and more regionalised itineraries.

Private Open-access operators

There are only five markets in Europe where there is significant competition in open-access: Sweden, Italy, Austria, Czech Republic, and Slovakia. In the following, the most important competitors in European Open-access are briefly presented:

Flixtrain	
Brief description	
Fleet structure	
Expansion plans	

RegioJet	
Brief description	
Fleet structure	
Expansion plans	

Leo Express	
Brief description	
Fleet structure	
Expansion plans	

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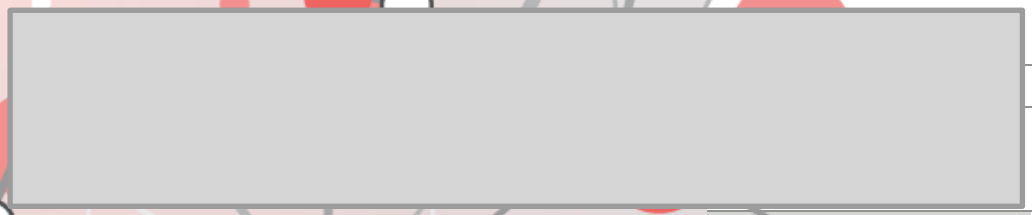

Verkehr

Since 2011, it operates one
n state railway ÖBB. The line

es to Munich from the end of

RC, which are planned to
lungary.

3 Push-pull train industry market

3 Push-pull train industry market in Continental Europe

3.1 Fleet structure

3.1.1 Rolling stock in intercity transport

The demand for passenger transport service in Continental Europe is covered by several rolling stock types. In intercity transport services, SCI Verkehr defines the following relevant rolling stock types:

– **Interregional/intercity multiple units**: self-driven (motorised) units, which normally consist of one or several permanently-coupled individual cars and which are operated in ……..

The rolling stock **fleet operated in intercity passenger services** in Continental Europe comprises a total of around **xx vehicles**, including passenger coaches (with maximum speed of 160 km/h or above), locomotives, multiple units, and high-speed trains. Almost xx% of this fleet accounts for vehicles operated in push-pull transport services, i.e., locomotives (with electric and diesel traction) and passenger coaches (of several types used in a trainset configuration).

Intercity passenger rolling stock installed base per segment in Continental Europe in 2021

Figure 11: Continental Europe – Intercity passenger rolling stock

In general, a trend of substituting passenger coaches with multiple units can be observed. Multiple units are mainly operated in and around major cities, ……..

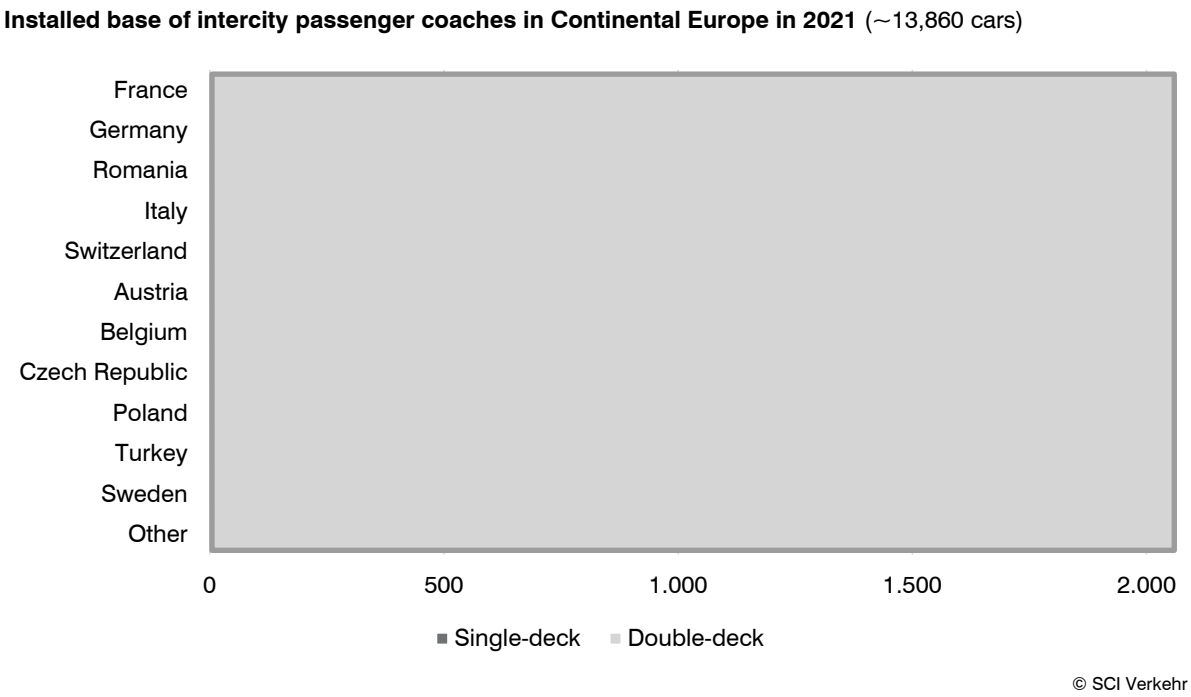

Figure 12: Continental Europe – Installed base of intercity passenger coaches

Large intercity passenger coach fleets of over 1,000 cars are operated in Belgium, Italy, Switzerland and Austria. The countries responsible for another one-third of the total fleet in Continental Europe. In terms of the fleet size, the Eastern European countries are clearly behind the Western European countries with only Romania being among the top countries. Manufacturers and products

3.1.2 Intercity passenger coaches

In the last five-year period, between 2017 and 2021, around **420 intercity passenger coaches** were delivered to operators in Continental Europe. Almost 65% of these deliveries were double-deck coaches built by Alstom/Bombardier, while the rest were single-deck coaches from various manufacturers, mostly from Eastern Europe.

Market shares per manufacturer of intercity passenger coaches in Continental Europe 2017-2021

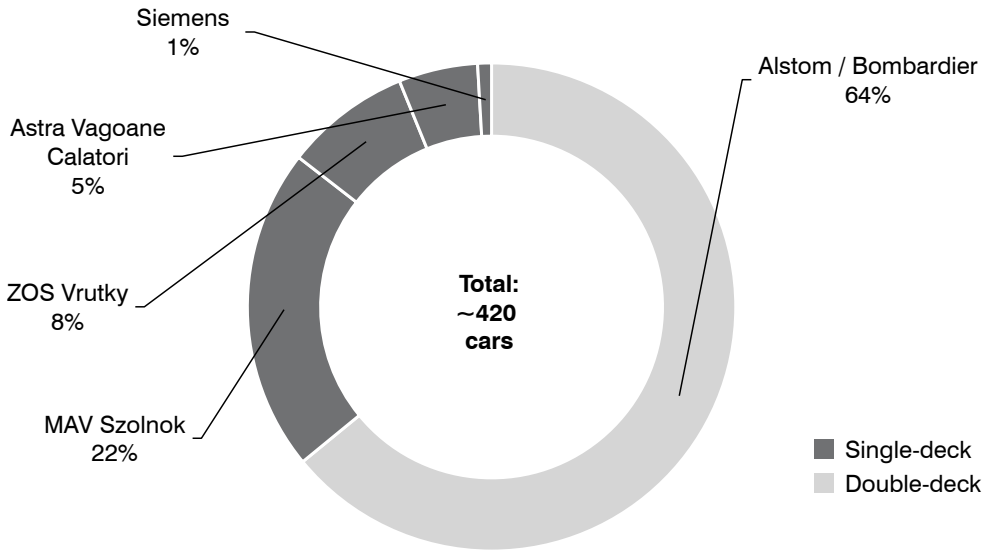

Figure 13: Continental Europe – Intercity passenger coach manufacturer shares 2017-21

Manufacturer	Recent activity overview	2017-2021 cars delivered
Alstom / Bombardier	With the takeover of Bombardier in 2021, Alstom became the passenger coach market leader in Continental Europe. Most recent delivery activities are related exclusively to double-deck coach deliveries in Germany (by Bombardier, prior to the merge) and in Belgium where Alstom/Bombardier signed a large framework contract for more than 1,300 cars with national passenger operator SNCB in 2015 and delivery started in 2021.	270
MAV Szolnok	MAV Szolnok, a production site of the Hungarian national railway passenger operator MAV, was very active recently, restarting rolling stock production in the country after it ended in 1990's. The series production of the modern single-deck passenger coaches for domestic and international services started in 2018, while ambitious plans for 2024 are announced for driving trailer coach production as well.	90
ZOS Vrutky	Slovak rolling stock manufacturer ZOS Vrutky plays a role in plans of national passenger operator ZSSK for upgrade long-distance coach fleet. This cooperation recently included new single-deck 1st and 2nd class passenger coach deliveries, as well as refurbishment agreement for part of the existing coach fleet. The new procurements are often realised from the EU funds. Unlike the other modern single-deck intercity passenger coaches, ZOS Vrutky's cars are designed for lower maximum speed of 160 km/h.	35
Astra Vagoane Calatori	In the passenger coach segment, Romanian rolling stock manufacturer Astra Vagoane Calatori was recently active outside its domestic market by delivering modern passenger coaches to the Czech open-access operator RegioJet. The company also provides coach maintenance services to Romanian state railway CFR Calatori.	22
Siemens	Following strong activity in Austria, Siemens is putting in efforts to further expand its business in Eastern Europe as well. In a consortium with Skoda, Siemens has been recently awarded with important intercity single-deck coach orders for the national incumbent CD, with first deliveries starting at the end of 2021. With coaches of its proven Viaggio platform, Siemens plays an important part in reshaping the Czech long-distance passenger transport offer with trains branded as InterJet and ComfortJet.	~5
		© SCI Verkehr GmbH

Intercity passenger coaches benchmark products overview

For the benchmarking purposes, single-deck intercity passenger coaches capable for operation at 200 km/h or higher are presented, as these are the most relevant products segment for the intercity and long-distance, i.e., night train, transport services, impacting the future market development the most. There are several passenger coaches currently available in the Continental European market which can be differentiated by maximum speed, namely 230 km/h and 200 km/h.
Among coaches for operation at **230 km/h**, two relevant products type are present in Continental Europe – Siemens **Viaggio Comfort** and **Talgo 230** coaches. A detailed overview is presented in the following table.

Asset type	**Viaggio Comfort**	**Viaggio Comfort**	**Talgo coaches (Talgo 230 – ICE-L)**
			
	High Floor Coaches	New coach types for ÖBB's Day and Night concept	ICE-L coaches for DB Fernverkehr
Main supplier	Siemens/Skoda	Siemens	Talgo
Track gauge (mm)	1,435	1,435	1,435
Operator(s)	CD	ÖBB	DB
Number of coaches (delivered/ordered)	50 / 182	0 / 303 (700 frame-contract)	0 / 391 (2)
Length (mm)	26,400 -26,8500	26,400 -26,8500	13,800
Width (mm)	2,825	2,825	2,942
Height (mm)	4,050	4,050	3,600
Weight (t)	48.6-53.3	48.-54.4	18-19
Axle arrangement	2'2'	2'2'	2'2'
Bogie type	SF400	SF100L	n/a
Vmax (km/h)	230	230	230
Brake system	3 discs per axle + magnetic track brake	3 discs per axle + magnetic track brake	Pneumatic with ABS
Number of seats (2nd class standard)	80*	67*	54*
Toilet system	Vacuum type	Vacuum type	Enclosed
			© SCI Verkehr GmbH

*subject to chosen layout and arrangement

The **Viaggio Comfort** coaches are part of the proven **Siemens** Viaggio family, ordered, branded and operated by different operators throughout the world. Due to the clear and standardised design, the model offers a quick and easy scaling of the train capacity as required by route or season. With a maximum speed of 230 km/h, this train set meets requirements for intercity transport. By design as single-deck coaches and as a complete trainset as well, a wide range of potential uses are possible, allowing flexible configuration of trains according to requirements and line planning. Different train configurations allow capacities of over 800 seats and, depending on requirements, the Viaggio Comfort can combine two complete trainsets using double traction. The recent order intake include:

– The Czech national rail incumbent **České dráhy** (CD) ordered 182 intercity Viaggio Comfort passenger coaches from the Siemens/Skoda consortium in 2019. Nine 20-car trainsets will be operated by CD, while national infrastructure manager Správa železnice (SZDC) will receive two

[2] Additional 1,309 cars in framework contract

coaches for testing purposes. The coaches are of six different configuration types, out of which five different coach configurations are deployed once in every train set. Featuring state-of-the-art interior, these trainsets are of a higher service level compared to 2018 ordered Viaggio Comfort coaches, which is well depicted also in given brand name of **ComfortJet**.

- In 2018, **České dráhy** (CD) ordered 50 Viaggio Comfort passenger coaches from a Siemens/Skoda consortium for national long-distance services under the **InterJet** brand. The value of the contract was EUR 115 million. Starting from December 2021, they are delivered are as semi-permanently coupled five-car sets. Siemens is responsible for the engineering, production of the car bodies, delivery of the bogies and the dynamic commissioning as well as authorisation, while Skoda handles the electric and mechanic final assembly and as well as delivery of auxiliary converters and control cabinets.
- Under the brand of **Railjet**, Austrian incumbent **ÖBB** has been the largest customer and operator for Viaggio Comfort trainsets. After the first coaches from a 2006 order for 469 cars were introduced in 2008 and proved in everyday services, more coaches followed in 2018. ÖBB and Siemens signed a framework agreement for the delivery of day (Railjet) and night trains with a total of up to 700 passenger coaches over the next five years. Night train is branded as **Nightjet**. The agreement has a total volume of more than EUR 1.5 billion when all of the agreement's services have been called up. At the signing of the agreement, ÖBB placed its first call for eight nine-car Railjet and 13 seven-car Nightjet trains, while further order for 20 seven-car Nightjets followed in 2021. The Viaggio coaches will be operated with ÖBB's current fleet of Siemens Taurus locomotives. Commissioning of the first trains is planned for 2022, while the framework agreement can also be extended beyond 2023 by ÖBB.

Founded in 1942, **Talgo** is a Spanish manufacturer of intercity, standard, and high-speed passenger trains. The core business of Talgo is manufacturing and maintenance of (very) high-speed trains and passenger coaches. For its passenger coaches, Talgo is using an extruded aluminium structure that is making train-sets lighter. Consequently, that results in greater speeds (up to 250 km/h), lower energy consumption and lower operational costs. Talgo trains can be fitted with a variable gauge system that allows them to run on different networks without losing significant time at gauge-changing stations. One another specificity of the Talgo passenger coaches differing them form conventional coach type in Europe is a one-axle system making them comparatively shorter. This configuration features a lighter weight of the coaches, however, the coaches can only operate as entire set as coupling procedures are time-consuming and technically complex.

The Talgo coaches operate in different configurations on different networks throughout the world. In 2019, **Deutsche Bahn** (DB) announced the awarding of a framework contract of up to 100 **Talgo 230** push-pull trainsets to operate long-distance inter-city and international services branded as **ECx**. A first order was for the delivery of 23 train sets comprising 17 passenger coaches and an electric locomotive. In 2020, Danske Statsbaner (DSB) announced a firm order of eight trainsets comprising 13 passenger coaches which was later expanded to 14 passenger coaches per train set. Unlike for the ECx, the Talgo coaches of DSB will only operate at speeds up to 200 km/h hauled by Siemens Vectron locomotives. The train sets will be employed on international routes to Germany.

The following table gives an overview of the three additional passenger coach types that are operational at speeds up to 200 km/h.

Asset type	Cegielski FPS 175A	Bpmz 20-90 type (AVA 200)	MAV IC+
			
Main supplier	Cegielski FPS	Astra Vagoane Calatori	MAV
Track gauge (mm)	1,435	1,435	1,435
Operator(s)	PKP Intercity	RegioJet	MAV-Start
Number of coaches (delivered/ordered)	76 / 81	22 / 0	90 / 0
Length (mm)	26,400	26,400	26,400
Width (mm)	2,824	2,825	2,825
Height (mm)	4,050	4,050	4,050
Weight (t)	50-52	42	47.5
Axle arrangement	2'2'	2'2'	2'2'
Bogie type	25ANa	Y32R	SF400 MAV
Vmax (km/h)	200	200	200
Brake system	Disc brake	n/a	Disc and magnetic, Knorr KE-PR-Mg (D) based
Number of seats	72	80	80
Toilet system	Enclosed	Vacuum	Enclosed
			© SCI Verkehr GmbH

Cegielski FPS (H. Cegielski – Fabryka Pojazdów Szynowych Sp. z o.o.) is a Polish manufacturing company from the city of Poznan. It is one of the oldest rolling stock manufacturers in Poland. The company was founded on the grounds of the former Locomotive and Rail Car Factory, continuing rolling stock production and repair operations. Its only customer so far is Polish state-owned passenger transport operator PKP Intercity, where cooperation also included refurbishment and modernisation projects. The latest order for PKP Intercity comprised the delivery of 55 passenger coaches worth EUR 113 million. The contract included an option for an additional 26 coaches that was realised in 2019.

Astra Vagoane Calatori is the only manufacturer of passenger coaches in Romania and one of the most important manufacturers in Eastern Europe. Astra produces different types of passenger coaches for regional and long-distance transport. The main type is the AVA 200 series, two other series were developed for the Italian and the Czech market. From the AVA 200 series, Astra produces different versions, such as sleeping and restaurant coaches.

MAV (Hungarian State Railways) is the Hungarian national railway company, with divisions MAV-Start Zrt. for passenger transport and MAV-Guessed Zrt. for maintenance services. MAV-Start initiated a project to produce a 70 IC+ passenger coaches for long-distance operations at its Szolnok workshops. The project is being financed by the state budget. Plans for additional 62 IC+ driving trailer coaches for 2024 are announced.

3.1.3 Intercity passenger locomotives

A total of around **140 locomotives** intended for operation in intercity passenger transport services, were delivered between 2017 and 2021. A majority of around 95% were electric locomotives, while diesel locomotives were delivered only in small numbers by Alstom/Bombardier and of a type that is not produced anymore. The manufacturer landscape in time span is less segmented than it is the case with manufacturers of intercity passenger coaches.

Market shares per manufacturer of intercity passenger locomotives in Continental Europe 2017-2021

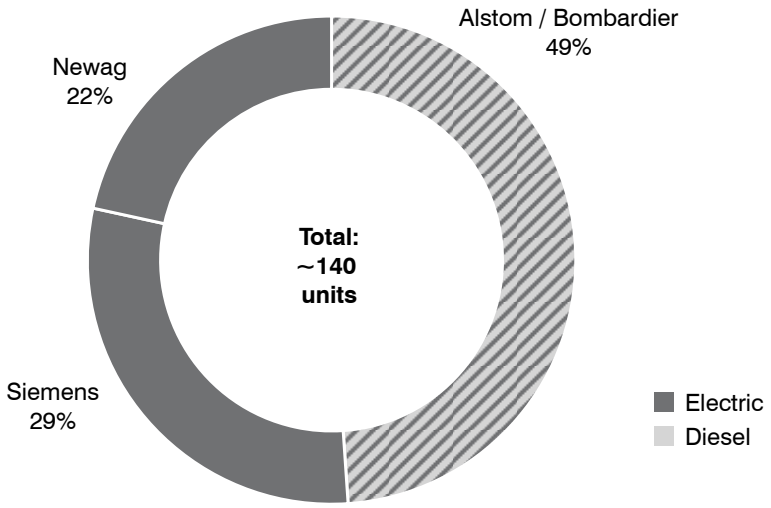

Figure 14: Continental Europe – Intercity passenger locomotive manufacturer shares 2017-21

Manufacturer	Recent activity overview	2017-2021 units delivered
Alstom / Bombardier	In the last years, Alstom/Bombardier has been trying to recapture market shares with its new products Traxx DC3 and MS3. The production of the Traxx 2 locomotive variants was ceased at the end of 2020. In early 2022, Belgian SNCB ordered Traxx MS3 locomotives for 200 km/h for domestic and international passenger transport services with recently ordered coaches. First deliveries are scheduled for 2026.	~70
Siemens	Siemens significantly strengthened its market position by winning large orders in recent years. From 2017 on, large framework contracts were signed, e.g., with ÖBB, DB Cargo or leasing company Railpool. Except for France, Siemens is offering country homologations for each important Continental European railway market with the Vectron platform. Authorisations for commercial service in Belgium (MS version) and Denmark (AC version) were received in 2020, France is expected at the earliest in 2026. In 2022, the company secured large orders in Eastern Europe, namely in Hungary and the Czech Republic.	~40
Newag	Polish rolling stock manufacturer Newag recently put efforts in the development of its multi-system locomotives of the Griffin type, capable of operating cross-border transport. The company is delivering new units to the national incumbent PKP Intercity.	30

Passenger locomotives benchmark products overview

The relevant products for the benchmarking purposes of this study are passenger locomotives with maximum speed range from 160-230 km/h built by leading locomotive manufacturers in Continental Europe – **Siemens** and **Alstom**/**Bombardier**.

Product Data	Vectron AC	Vectron MS	Traxx AC3
			
Main supplier	Siemens	Siemens	Alstom/Bombardier
Series	AC	MS	AC3
Years of delivery	2012-	2014-	2013-
Total number of deliveries	~160 in freight services ~90 in passenger services	~610 in freight services ~50 in passenger services	~220 in freight services ~60 in passenger services
Axle arrangement	Bo'Bo'	Bo'Bo'	Bo'Bo
Operational area	Mainline transport services	Mainline transport services	Mainline transport services
Traction-system (AC)	15 kV 16.7 Hz 25 kV 50 Hz	15 kV 16.7 Hz 25 kV 50 Hz	15 kV 16.7 Hz 25 kV 50 Hz
Traction-system (DC)	-	1.5 kV 3 kV	-
Length (m)	18.98	18.98	18.90
Width (m)	3.01	3.01	2.98
Power (kW)	6,400	6,400	5,600
Vmax (km/h)	160-200 (230[3])	160-200 (230[4])	160
Starting tractive effort (kN)	300 (320/350[5])	300 (320/350[5])	300
Service weight (t)	82-88	90	87
Axle load (t)	21.75	21.75	22.00
Equipment	ETCS, country safety systems, last-mile engine	ETCS, country safety systems	ETCS, country safety systems, last-mile engine
Homologations	AT, BG, CZ, CH, DE, DK, HU, HR, NO, RO, SE, SK, TK, IL, FI[6]	DE, AT, BE, BG, CH, CZ, FI, HR, HU, IT, NL, NO, PL, RO, RS, SE, SK, SI, TK, (FR, LU)	DE, AT, CH, CZ, RO, BG, NO, SE, SK, HU, HR, RS, TK, IL

The **Vectron** is a reconfigurable, modular Bo'Bo' multipurpose locomotive design by Siemens, intended to be the successor to the successful EuroSprinter family of locomotives. The Vectron family was officially introduced at the 2010 InnoTrans trade fair and started regular service in 2012. The Vectron AC locomotives are also available with an additional 180 kW last-mile diesel engine.

[3] Planned version for high-speed routes in Germany and Austria

[4] Planned version for high-speed routes in Germany and Austria

[5] 320 kN tractive effort with software upgrade; an upgrade to 350 kN is possible for the Austrian market as of 2021

[6] A broad-gauge version

The **Vectron AC** is a dual-system locomotive with a maximum power output of 6,400 kW used for cross-border services on European standard-gauge tracks. The high maximum speed and extended functions enable the locomotive to be utilised in freight as well in passenger transport services. The largest passenger operators in Continental Europe with this locomotive type in fleet are incumbents DSB (Denmark), DB Regio (Germany) and open-access operators Transdev (via its Swedish subsidiary Snälltaget) and Flixtrain (Germany).

The **Vectron MS** locomotives were developed as multi-system locomotives with a maximum output of 6,400 kW for cross-border freight and passenger transport services on European standard-gauge tracks. The Vectron MS locomotives offer a large number of different country approvals and are therefore suitable for use in international traffic, especially in Central and Eastern and Southern Europe. Moreover, Siemens offers a continuous optimisation of maintenance and locomotive operational characteristics by recording the vehicle data of the entire Vectron fleet as well as full-service maintenance contracts. Thus, there is a good basis to perform the maintenance at a high level. The largest passenger operators in Continental Europe with this locomotive type in fleet are Ceske Dráhy (Czech Republic), ZSSK (Slovakia) and open-access operator RegioJet (Czech Republic). In addition, various leasing companies also lease Vectron locomotives for passenger transport.

The **Traxx** locomotive platform built by Alstom/Bombardier is one of the most widespread mainline locomotive types in Continental Europe operated in freight and passenger mainline services. The Traxx name was introduced in 2003 and presents acronym that stands for **T**ransnational **R**ailway **A**pplications with e**X**treme fle**X**ibility. The locomotive type-labelling already reveals important key information, for example: the Traxx P160 AC2 is an **a**lternating **c**urrent locomotive of the **2**nd generation, designed as **p**assenger locomotive and capable of running at a top speed of **160** km/h.

The **Traxx AC3** is a Bo'Bo' dual-system locomotive of Alstom/Bombardier's third Traxx generation with a maximum power output of 5,600 kW and mainly used for cross-border services on European standard-gauge tracks. Like its preceding products, Traxx AC1/AC2, the Traxx AC3 is designed for operation under 15 kV at 16.7 Hz, and under 25 kV at 50 Hz alternating current, but can be optionally equipped with last-mile diesel engine. The largest passenger operator in Continental Europe with this locomotive type in fleet is German incumbent's passenger divisions, DB Fernverkehr and DB Regio.

3.2 Market volume and development

3.2.1 Intercity passenger coaches

Intercity passenger coaches OEM market volume in Continental Europe (in EUR million)

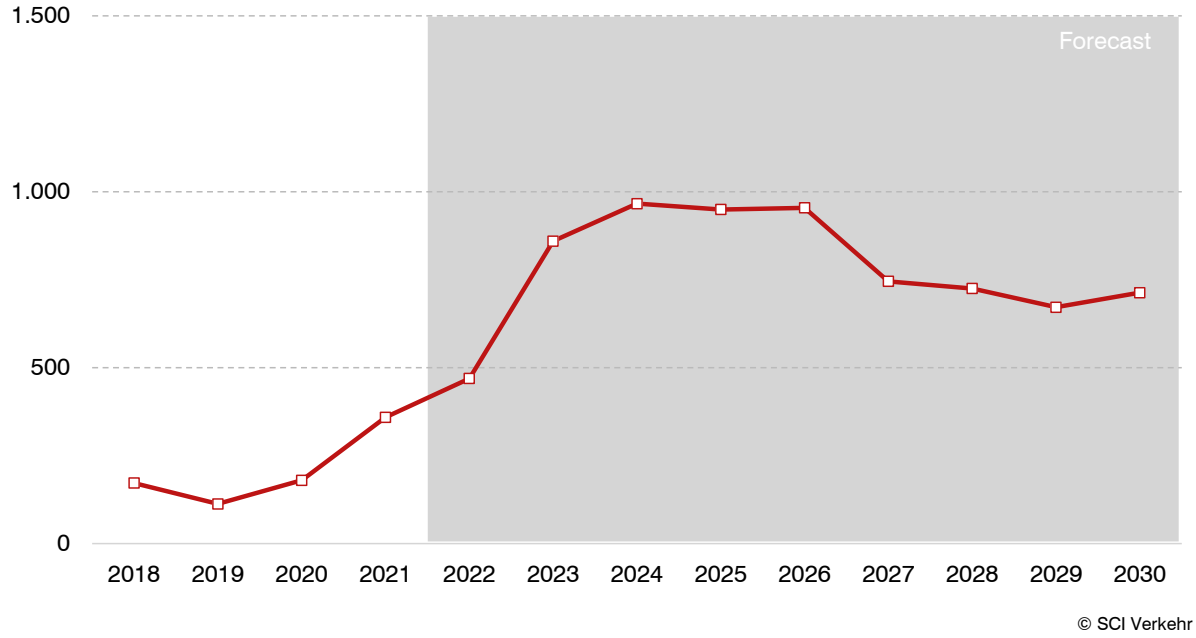

Figure 15: Continental Europe – Intercity passenger coaches OEM market volume forecast

In 2021, the OEM market volume for new intercity passenger coaches accounted for EUR 360 million, a continuation of increasing trend that started in 2019. The OEM market is expected to increase significantly within the next five years, driven by several large orders made by incumbents in Austria, Belgium, the Czech Republic, and Denmark from Siemens and Alstom/Bombardier. Additionally, large framework contracts like the one between German DB and manufacturer Talgo for up to 400 coaches are expected to be started or realised in the upcoming years.

At the same time, SCI Verkehr has recently observed increased interest and a positive market outlook for push-pull trains depicted in plans for future passenger coach procurements in various country markets such as Germany, Hungary, Italy, and Poland. This is taken into consideration as well in the future market forecast. From 2022 to 2026, the intercity coaches OEM market is expected to grow at a CAGR of nearly 20% reaching a level of nearly EUR 1 billion per year. The main drivers are the expansion of infrastructure in terms of capacity and, particularly in Eastern Europe, line speeds which will enable additional transport services. The political framework for a shift of transport to rail continues to be considered positive. In the second half of the 2020s, SCI Verkehr expects high market volumes for new passenger coaches of around EUR 700 million per year. With infrastructure projects and shift from flights to rail coming into effect at the end of the decade, volumes could increase again.

In addition, the expected positive outlook for cross-border rail transport in Europe is a key driver for the procurement of push-pull trains. The EU's goal is a significant expansion of international traffic on various corridors (e.g. TEE2.0). The deployment of push-pull trains in international transport offers advantages due to their higher flexibility, simpler homologation (compared to high-speed trains) as well as the infrastructural framework conditions (<250 km/h).

Another important driver for future intercity rail transport development is the development of short-distance flight markets in Europe. The short-distance flight became increasingly popular over the last decades, characterised by low-cost and quick offer from regional carriers such as EasyJet or Ryanair. However, this trend started to change recently, already setting a path for a further modal shift in future. In efforts to minimise the carbon footprint in the scope of the EU's decarbonisation plans for climate neutrality by 2050, governments are imposing bans or other measurements on short-haul flights. France is the country leading such measures as in April 2021, it enacted a short-distance national flights ban on routes where comparable train connections of up to 2.5 hours exist. Flights set to be eliminated from spring 2022 include routes from Paris to popular tourist cities such as Bordeaux, Lyon, and Nantes. Similar measures considering bans and short-distance flight restrictions are being considered in Spain, Germany, and Scandinavian countries.

Drivers of new procurements

Driver	Brief description	Relevance	Trend
Mobility demand	– In aftermath of the Covid-19 crisis, demand for passenger transport services is increasing again. – Passenger coaches can be very well utilised for expanding transport capacities, also over international corridors and especially when operator already has locomotive available. Moreover, push-pull trainsets can be adapted relatively fast to a fluctuating demand by changing the number of coaches. – In intercity passenger transport, competitiveness of railway to air transport is expected to strengthen further, considering the ongoing environmental debate and the EU's decarbonisation agenda.	●	↗
Infrastructure development	– Generally, intercity coaches are predominantly operated on long-distance, intercity routes and are, subsequently, benefitting from the construction or upgrade (especially upgrade of maximum speeds in Eastern Europe) of new lines. – Additionally, modern passenger coaches are able tom operate at speed of 200 km/h and above, so the segment can benefit from the building and upgrading of high-speed routes as well. – Ongoing and planned electrification projects in Continental Europe are also seen as a driver for the push-pull segment development. Efficient electric locomotives equipped with safety systems necessary for cross-border (corridor) passenger transport are available in the market and already proven in everyday operation.	●	↗
Fleet structure	– Large passenger coach installed base as traditional backbone of passenger rail transport in many countries in Continental Europe in general require replacement procurements. Substitution by other vehicle types (multiple units) is also present, but predominantly in regional and commuter transport. – Due to the technical progress, double-deck coaches became increasingly suitable for long-distance services (e.g., in Germany and Belgium) and took the largest share in recent intercity passenger coach procurements. However, single-deck coaches with a maximum speed of 200 km/h and above will remain the primary coach segment for intercity transport which is confirmed by recent and future procurements plans.	◕	↗
Political environment	– The TransEuropExpress 2.0 (TEE 2.0) concept is an initiative from 2020 that re-address international high-speed and overnight passenger rail services in scope of promotion of climate change mitigation and, as such, presents strong driver for intercity, cross-border passenger transport. – Various players in Europe are campaigning for an expansion of the night train network as an alternative to air travel. New services in this segment are driving demand for sleeper and couchette cars.	◕	→

Driver	Brief description	Relevance	Trend
Financial resources	– Financial resources for new passenger coach procurements are generally not observed as a critical point in Continental Europe. In the price sensitive markets of Eastern Europe, EU funds are often used for new procurements. – For intercity transport services, passenger coaches are becoming increasingly an option, as they are less expensive compared to high-speed trains. As a consequence, some operators in Western Europe have adapted their fleet strategy and contracted some new intercity passenger coach orders (e.g., Germany, Denmark). – Due to their higher flexibility compared to multiple units, passenger coaches are also interesting as an investment for private investors and leasing companies.	◑	↗
Operational requirements	– New high-capacity intercity trains composed of locomotive-hauled coaches with speeds of up to 200 km/h and above are a cost-efficient possibility for long-distance services between major agglomerations (e.g., in Central/Central-East Europe). – The advantage of passenger coaches is that the train length (number of coaches) is variable and can be adapted to the respective capacity requirements of the operator. The necessary locomotives can be either operated in passenger or in freight transport services. In countries with relatively large and young locomotive fleets, transport capacities can easily be extended cost-effectively by new passenger coaches.	◑	↑
Maintenance and refurbishment	– Passenger coaches can be refurbished relatively easy at low costs (no traction unit is part of the system), which can extend the standard service lifetime. – With systematic maintenance, coaches can be kept in operation for longer than their originally planned service life, which can be very well observed in some Continental European country markets, such as France, Italy, or Poland. – Ongoing and planned modernisation programmes in Continental Europe (Switzerland, Austria, Poland, Czech Republic, to name a few examples) are rather part of a constant trend in the passenger coach segment than development that would significantly impact on new procurements.	◑	→

Relevance for procurement: ● = very high, ◕ = high, ◑ = medium, ◔ = low, ○ = none

5-year trend: strongly increasing ↑, increasing ↗, constant →, decreasing ↘, strongly decreasing ↓

Important current and planned procurement projects

Aside from the procurements shown in detail in the following chapters for the focus markets, important intercity passenger coach delivery projects in other markets of Continental Europe are presented below.

Operator country	Manufacturer	Coach type	Level	Cars	Delivery	Remarks
Austria	Siemens	Viaggio (Nightjet)	SD	231	2022-2025	In 2018, Austrian Federal Railways (ÖBB) and Siemens have signed a framework agreement for the delivery of day and night trains with a total of up to 700 passenger coaches. So far, slightly more than 300 cars were called-off with first deliveries to start late 2022.
		Viaggio (Railjet)	SD	82	2023	
Belgium	Alstom/ Bombardier	M7	DD	477	2020-2025	In 2015, Alstom/Bombardier signed a large framework agreement for supply up to 1,362 M7 double-deck coaches to the Belgian National Railways (SNCB). As of the end of 2021, a total of 477 cars were ordered, with the last call-off in December 2021 for 98 cars, while around 70 cars were already delivered.
Denmark	Talgo	Talgo coaches	SD	112	2024-2026	In early 2020, the Danish state railway DSB selected the Spanish rail vehicle manufacturer Talgo as supplier for eight 14-cars trainsets.
France	n/a	Night train coaches	SD	300	2026-2030	In 2021, the French Transport Ministry announced its intention to invest EUR 800 million for night train services between 2026 and 2030, while SNCF is preparing a tender for 300 new night train coaches.
Hungary	MAV Szolnok	IC+	SD	90	2019-2021	Following two prototype vehicles produced in 2014/15, the Hungarian national railway holding MAV produced 90 IC+ single-deck intercity passenger coaches. 20 coaches are certified for international services, while the rest are intended for national transport only. Plans for additional 62 IC+ driving trailer coaches from 2024 are announced.
Slovakia	ZOS Vrutky	2nd class coaches	SD	17	2022-2023	In 2021, a contract for 17 intercity passenger coaches was signed between ZSSK and ZOS Vrutky. The purchase is financed by the EU funds.

After-sales

Market	After Sales
Average volume 2020-22 (EUR)	920
CAGR 2022-2026	-3.9%

The after-sales market accounted for EUR 950 million in 2021, which was also the average yearly level that has been present in the last five years. Generally, the after-sales market is expected to keep decreasing due to decrease of general passenger coach fleet in Continental Europe, as the oldest cars have gradually been taken out of service. At the same time, new procurement volumes are not sufficient to quantitatively compensate this down-trend, but they will answer growing demand in terms of quality and efficiency. Newly procured passenger coach fleets will positively influence the after-sales market in the longer-term after 2030.

3.2.2 Intercity passenger locomotives

Intercity passenger locomotives OEM market volume in Continental Europe (in EUR million)

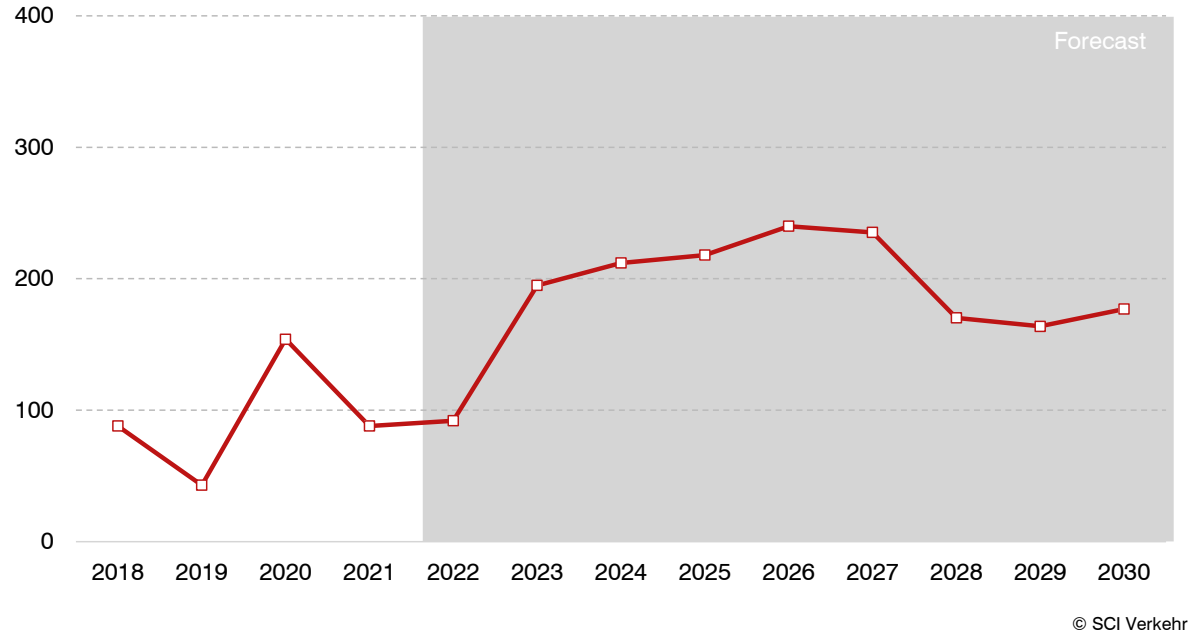

Figure 16: Continental Europe – passenger locomotives OEM market volume forecast

The OEM market level for intercity passenger locomotives was recently on a lower level of EUR 90 million in 2021, with Denmark, the Czech Republic, Bulgaria, and Germany as the only countries where new locomotives deliveries took place. However, for the next five-year period, between 2022 and 2026, CAGR is forecasted to take grow strongly by 27% reaching the yearly volumes of EUR 240 million with the main drivers being:

– Large Siemens intercity passenger locomotive orders made in 2022 in East Europe (Hungary and Czech Republic).
– Deliveries that are scheduled to take place in next 5 years on the base of previously made orders (Germany, Czech Republic, Poland, Sweden, and Denmark).
– Lower starting 2021/22 levels caused by the Covid-19 crisis which had a more pronounced impact on the passenger market in general than it was the case with rail freight market.

Between 2026 and 2030, OEM market volumes are generally expected to be at high level of EUR 170-180 million per year. The procurement development of locomotives follows the demand of new passenger coaches. SCI Verkehr expect no new diesel locomotive to be procured for passenger transport services anymore, backed up by increased environmental awareness of operators and the EU's decarbonisation plans for climate neutrality by 2050.

Important current and planned procurement projects

Aside from the procurements shown in detail in the following chapters for the focus markets, important passenger locomotive delivery projects in other markets of Continental Europe are presented below.

Operator country	Manufacturer	Locomotive type	Traction	Units	Delivery	Remarks
Hungary	Siemens	Vectron AC/MS	Electric	up to 115	From 2023	In 2022, MÁV-Start, the state-owned passenger operator of Hungary, announced the successful completion of the tender procedure to supply up to 115 electric locomotives. Reportedly, the company is ready to sign a framework contract with the joint bidder Siemens Mobility Kft. and Siemens Mobility Austria GmbH. The future order, which would consist of 90 Vectron AC and 25 Vectron MS locomotives, is set to renew MÁV-Start's fleet.
Denmark	Siemens	Vectron AC	Electric	16	2021-2023	After the initial order for 26 Vectron AC locomotives for regional/commuter transport services, Danish state railways (DSB) exercised option for an additional 16 units which will be used in cross-border passenger transport services between Germany-Denmark with DSB's Talgo coaches on order.

After-sales

Market	After Sales
Average volume 2020-22 (EUR)	760
CAGR 2022-2026	-0.6%

The after-sales market level was EUR 770 million in 2021. This market benefits mostly from old diesel passenger locomotive fleets that are still in operation, predominantly in Eastern Europe which are in need for maintenance and refurbishments. However, the oldest units are generally being put out of service and replaced with new, more efficient, ones. Therefore, the overall after-sales market is expected slightly to decrease at a CAGR of -0.6% between 2022 and 2026 and at CAGR of -2.1% in the long-term between 2026 and 2030. However, stable delivery levels of electric passenger locomotives will contribute correspondingly to the after-sales market in the long-term.

4 The push-pull train market in Germany

3.3 Table of figures