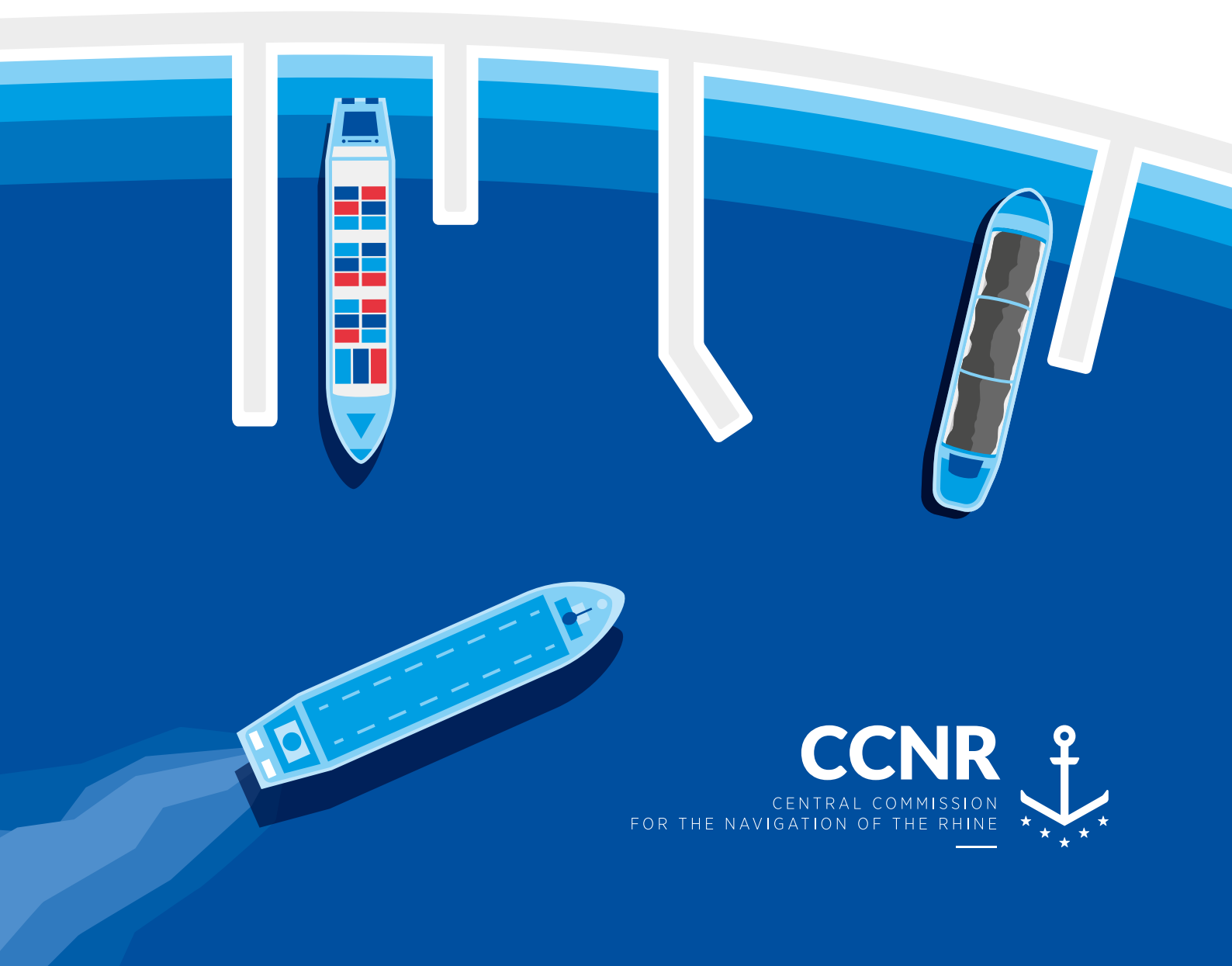


ANNUAL REPORT

2017

INLAND NAVIGATION
IN EUROPE

MARKET OBSERVATION



CCNR

CENTRAL COMMISSION
FOR THE NAVIGATION OF THE RHINE



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September 2017

FOREWORD

Building on a long tradition of several years, the 2017 European Inland Navigation Market Observation report is the result of close collaboration between the Central Commission for the Navigation of the Rhine (CCNR) and the European Commission. This well-established collaboration aims at providing yearly an exhaustive view of the inland navigation market situation as well as an analysis of its evolution and developments. In this report, policy makers, industry stakeholders, administrative authorities, academic researchers and the broader public will find useful statistics, insights and analysis covering all aspects of the inland navigation market, from freight traffic to fleet evolution and port transshipment. Three smaller 'market insights' publications complete the annual report during the year.



A key feature of the report lies in its ever growing European dimension, as several European inland navigation partners, including River Commissions and sector representatives, have taken a very active part in its preparation. The CCNR has been promoting relentlessly collaboration between all inland navigation actors and stakeholders and is delighted to present the Market Observation as one major concrete outcome of this collaboration, among many others.

The report also addresses inland navigation as part of the broader transport multimodal environment. It is clear indeed that inland navigation's sustainable development must be considered jointly with the development of other transport modes. This is also one of the reasons why the CCNR keeps contributing to the activities of the Trans-European Transport Networks and in particular of the TEN-T Core Rhine Alpine Corridor.

I wish to thank the European Commission and all organisations and individuals who contributed to the present publication. And would like to encourage them to pursue their vitally important engagement in the years ahead to enable an ever greater understanding and better awareness of European inland navigation and its important achievements, challenges and possibilities for further development. It is my conviction that the present report will provide readers with most useful reference material for their activities and I wish them both a pleasant and stimulating read.

Bruno Georges

CCNR Secretary General

Inland navigation has linked people and economies across Europe for centuries, enabling communication and creating prosperity along rivers, canals and lakes. The EU Transport policy builds on that heritage, looking after the specific role of inland navigation in today's advanced multimodal logistics.



The positive development and impressive socio-economic returns of inland navigation need to be better documented and more widely known by the general public, industry stakeholders and policy makers. Inland navigation still holds huge potentials which we must use to make our transport system more efficient, resilient and sustainable. Market observation, analysis of trends and identification of best practices and business dynamics are critical to achieving this, because it gives visibility to market opportunities and the many positive externalities inland navigation has.

This is why the European Commission supports – and commends – the European Inland Navigation Market Observation exercise undertaken by the Secretariat of the Central Commission for the Navigation of the Rhine, in cooperation with the other River Commissions and the sector at large.

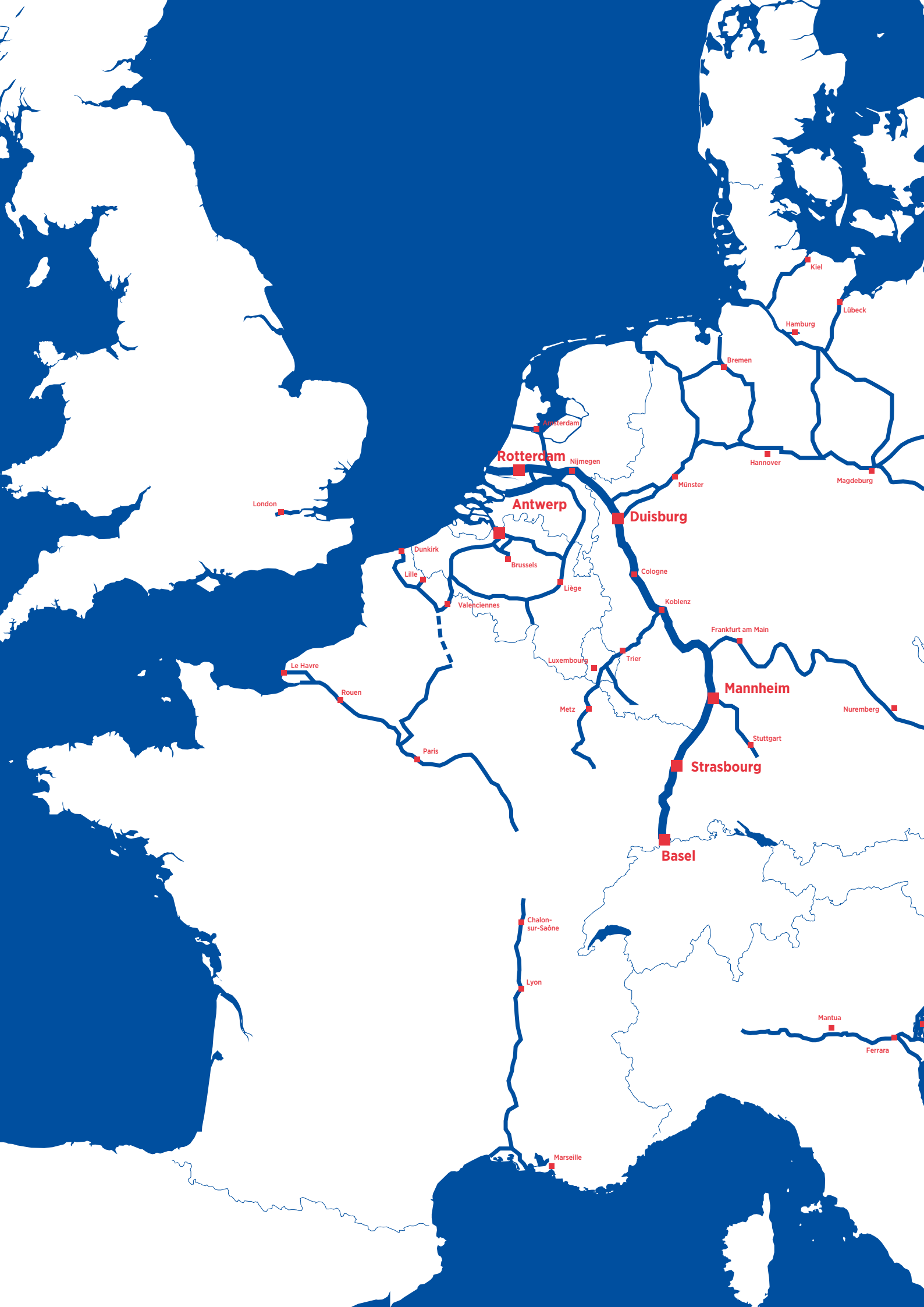
I welcome the 2017 Annual Report, which puts into perspective not only the evolution of the sector over the past months, but also the potential for growth and the contribution that inland navigation can make to sustainable development in the Union, for the benefit of its people and businesses.

The Report is the fruit of excellent cooperation between the CCNR and the European Commission. It demonstrates the role inland navigation can play in an integrated multimodal transport system of the future and will certainly be a source of information and inspiration for our 'Year of Multimodality 2018'.

Violeta Bulc

European Commissioner for Mobility and Transport





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Ferrara

Nuremberg



Szczecin

Berlin

Dresden

Prag

Regensburg

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Venice



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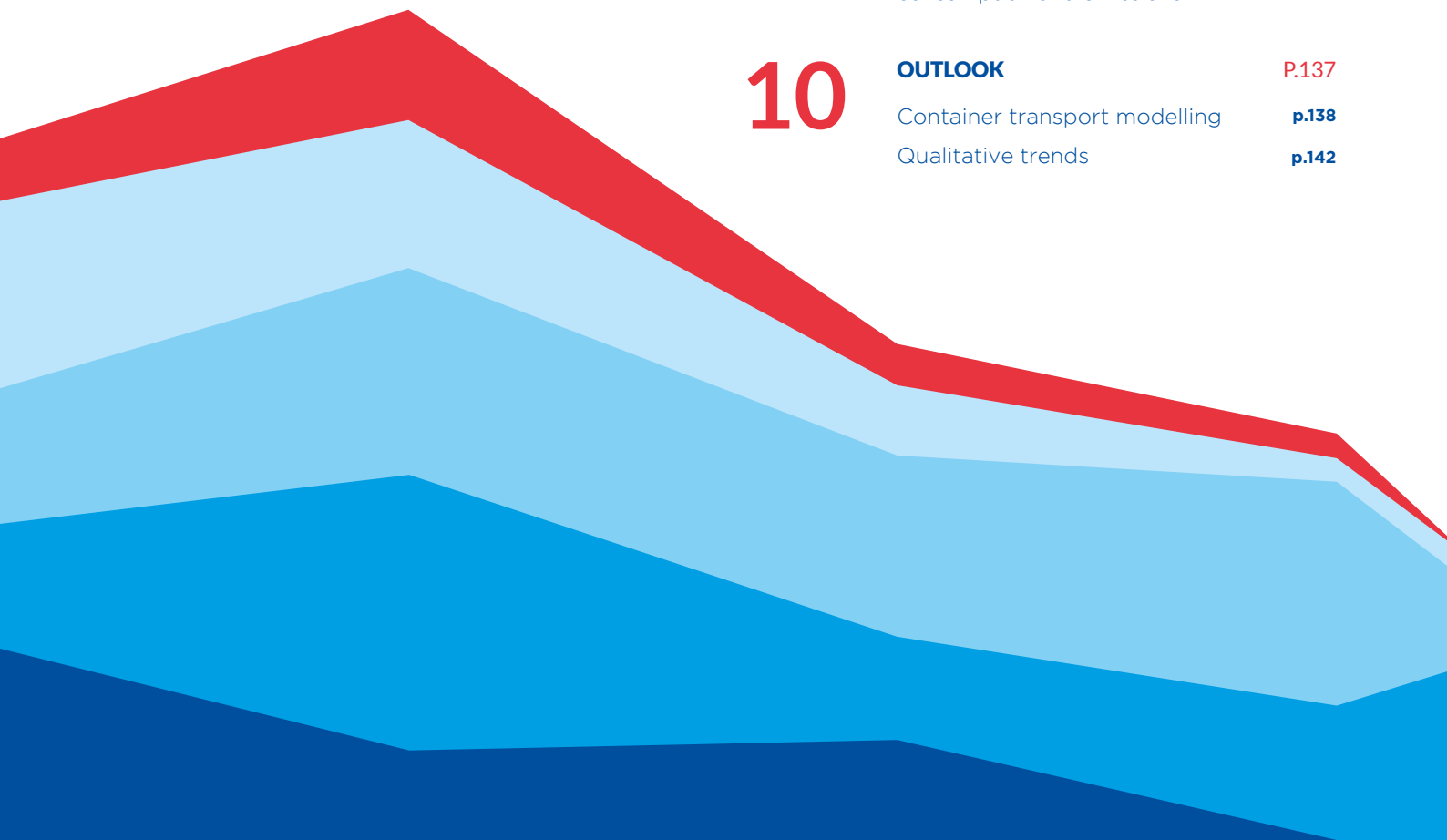
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EXECUTIVE SUMMARY

Since 2013 the European Union has been enjoying rather limited but steady economic growth and, in 2016, the GDP growth in the Eurozone indeed increased by 1.7%. These economic conditions, together with industrial production and trade growth, are expected to keep on evolving positively in the near future and will boost the transport industry activity as a whole and inland navigation activity in particular.

But 2016 also showed that inland navigation activity is not only dependent on the overall economic context. Sectorial conjectural evolution can have significant impact; French inland waterway transport was, for example, negatively impacted by the bad harvests during summer 2016. Navigation conditions also play an important role, and Rhine traffic was indeed impacted by low water conditions both at the end of 2015 and at the end of 2016.

On the other hand, inland navigation goods transport benefits from the dynamism of several transport segments. Container transport, waste transport and chemical transport on inland waterways are all segments that experienced growth of between 3% and 5% in 2016 compared to 2015 on the Rhine. Likewise, the dynamic steel industry activity in the Upper Danube area significantly boosted the transport of ores and metal products on the Danube.

Inland ports are of vital importance for the development of inland shipping, as they are, just like seaports, the places where inland shipping connects to other modes of transport. Good quality of the port infrastructure and the promotion of inland waterway traffic by the port can have an important positive influence on the development of this transport mode. A detailed focus on inland ports activity enables one to identify individual ports trends and specializations and to highlight ports initiatives to promote inland navigation.

As a matter of fact, this report does not only present an overview of the global situation of the inland navigation market in Europe; specific developments taking into account goods segments and geographical details are put into perspective in order to have a better understanding of the inland navigation market.

The inland navigation fleet structure is slowly evolving in Europe; the fleet size has decreased by 2.8% at the European level. While both tanker cargo fleet and dry cargo fleet saw their total number and their total tonnage decrease in 2016, the average tonnage per vessel is still increasing for these two types of vessels. But the overall fleet remains rather old; dry cargo and tanker cargo vessels have respectively an average age of 50 and 39 years. The utilization rate of the fleet remains between 55% and 85% depending on the vessel types, below levels that were experienced before the economic crisis. Sector turnover is therefore very much dependent on freight rate fluctuations.

Many innovative projects emerge locally and new buildings show that this sector is undergoing an upswing; this is particularly true in the passenger transport segment, where

approximately one quarter of new vessels entering into service in 2016 were powered by diesel-electric engines. But even though innovation exists, one of the main challenges of inland navigation in the coming years will be to spread it at a larger scale in the market while it remains today limited to specific examples. This is, for example, the case for all innovative measures aiming at reducing emissions from inland navigation transport.

Inland waterways goods transport is maintaining a modal share of 6% of all transport goods (inland navigation, road, rail and pipeline) in the European Union and this modal share goes up to nearly 40% in countries with dense networks of waterways such as the Netherlands. Inland navigation transport belongs to a multimodal environment in which innovation enables one to be more efficiently connected to other modes of transport, more competitive and more environmental-friendly.

→ www.inland-navigation-market.org





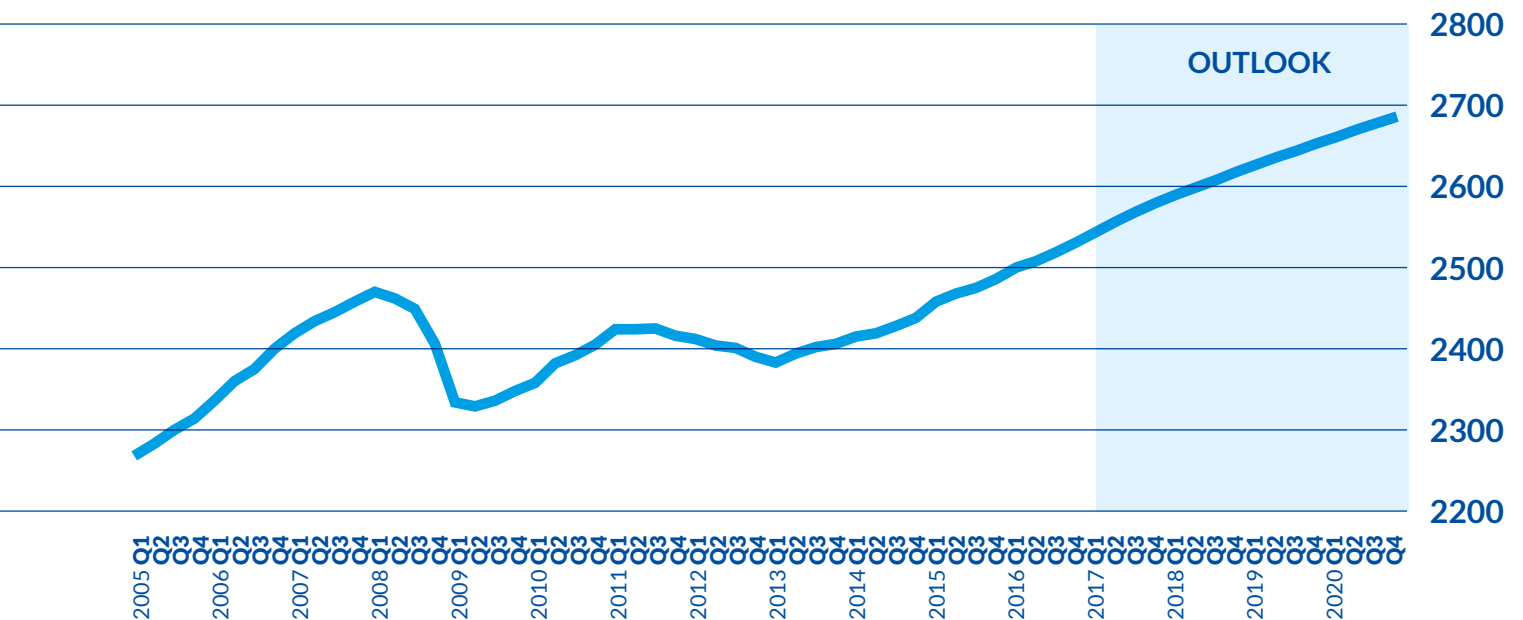
01

ECONOMIC CONTEXT

- Since 2013, the Eurozone has experienced steady GDP growth of between 1% and 2%.
- Eurozone world trade increased by 2% in 2016 and is expected to keep increasing until 2020, triggering an increase in sea ports hinterland traffic.
- The building industry is one of the industries that contributes highly to inland navigation transport in the European Union and is currently enjoying positive growth rates (+1.3% in 2016).

GENERAL ECONOMIC CONDITIONS IN EUROPE

GDP EVOLUTION IN THE EUROZONE - PAST EVOLUTION AND OUTLOOK
(GDP IN BILLION EUROS)



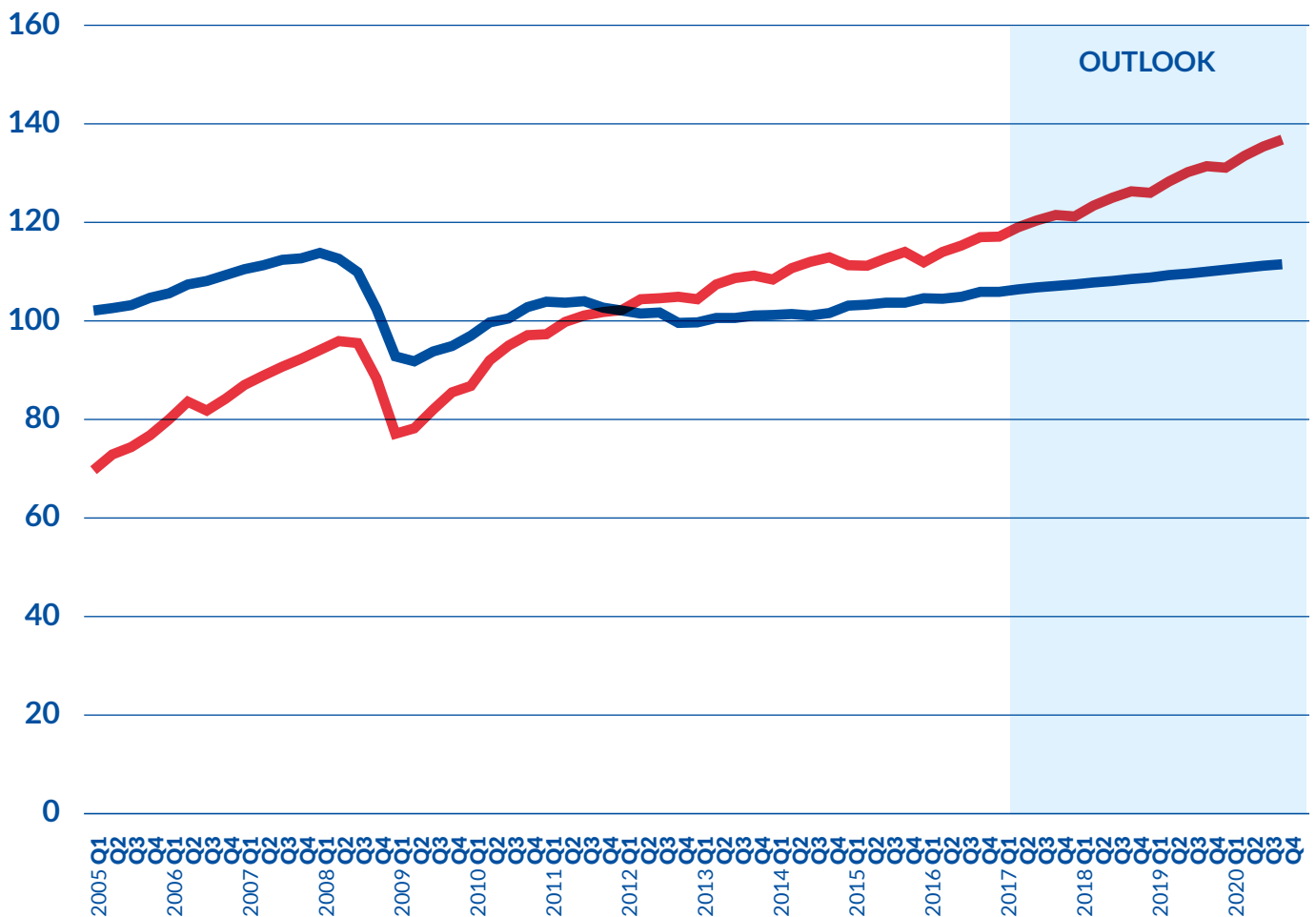
Source: Oxford Economics

Since 2013, GDP evolution in the Eurozone is characterized by a rather limited but stable growth trend with a yearly GDP growth between 1% and 2%. It is assumed that this evolution will continue until 2020. Deviations from this growth trend would arise in the case of major financial crises in the Eurozone.

1.7%

GDP growth in the Eurozone in 2016

INDUSTRIAL PRODUCTION AND WORLD TRADE IN THE EUROZONE – PAST EVOLUTION AND OUTLOOK (INDEX)



Eurozone industrial production (Index 2010=100)

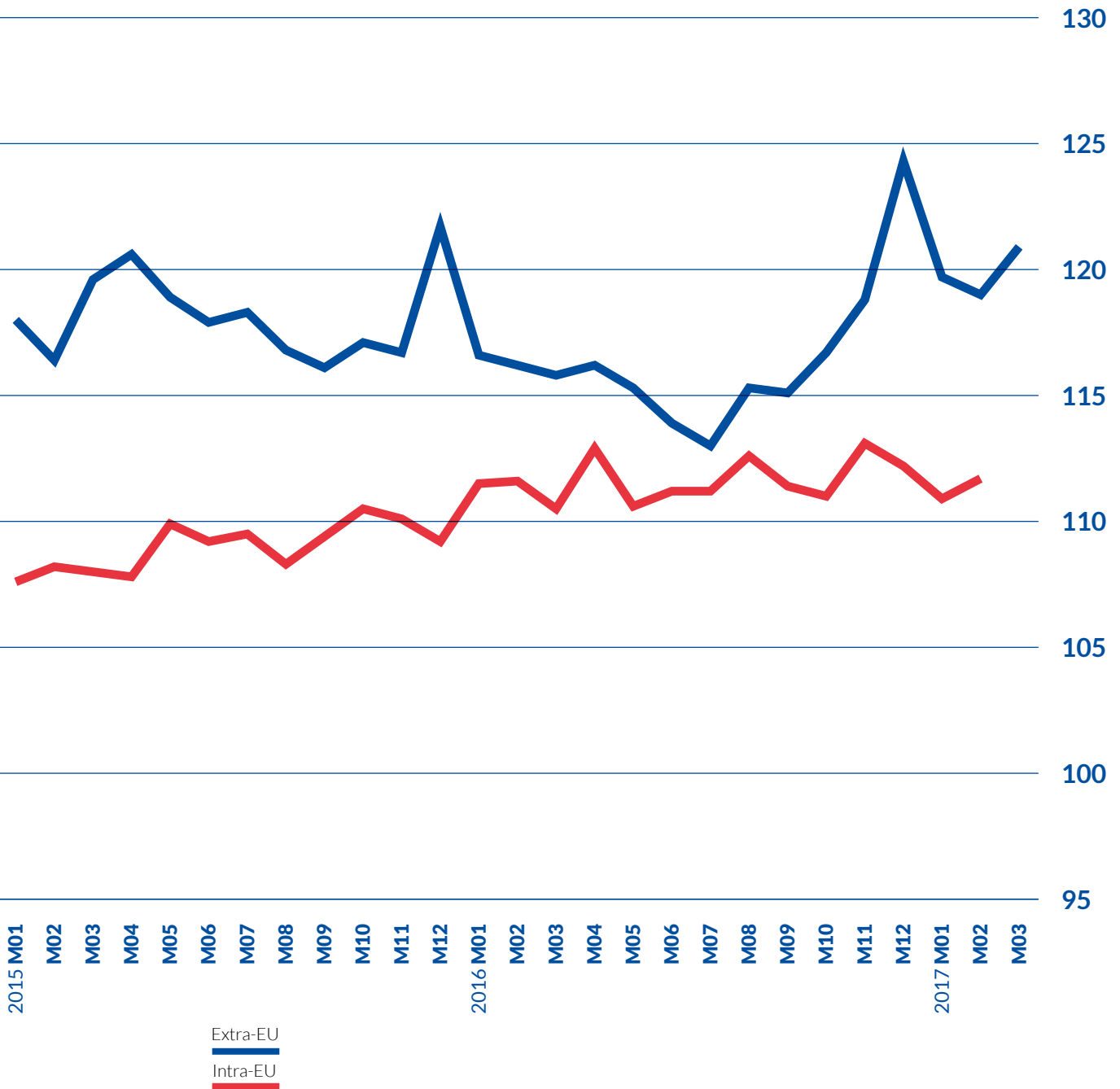
Eurozone world trade (Index 2011=100)

Source: Oxford Economics

World trade is progressing with a higher growth rate than industrial production in the Eurozone. And this trend is expected to proceed further in the near future. Between 2016 and 2020, the expected annual growth rate is 1.4% for industrial production and 4.0% for world trade. European world trade will indeed benefit from worldwide growth, and this rather positive economic outlook should have a positive impact on the transport industry as a whole.

As world trade is mainly transported by maritime traffic, rising trade figures have a positive impact on maritime container traffic, and therefore also container traffic on inland waterways - especially in the hinterland of big seaports.

EVOLUTION OF EXPORTS FROM THE EUROPEAN UNION COUNTRIES (INTRA-EU AND EXTRA-EU TRADE - INDEX 100 IN 2010)



Source: Eurostat

Exports from EU countries towards extra-EU destinations experienced significant growth during the second semester of 2016. This growth was promoted by a recovery of commodity prices, which enabled developing countries to import more goods from Europe. Still, since the beginning of 2017, exports towards extra-EU countries have decreased, remaining nonetheless higher than one year ago, at the beginning of 2016.

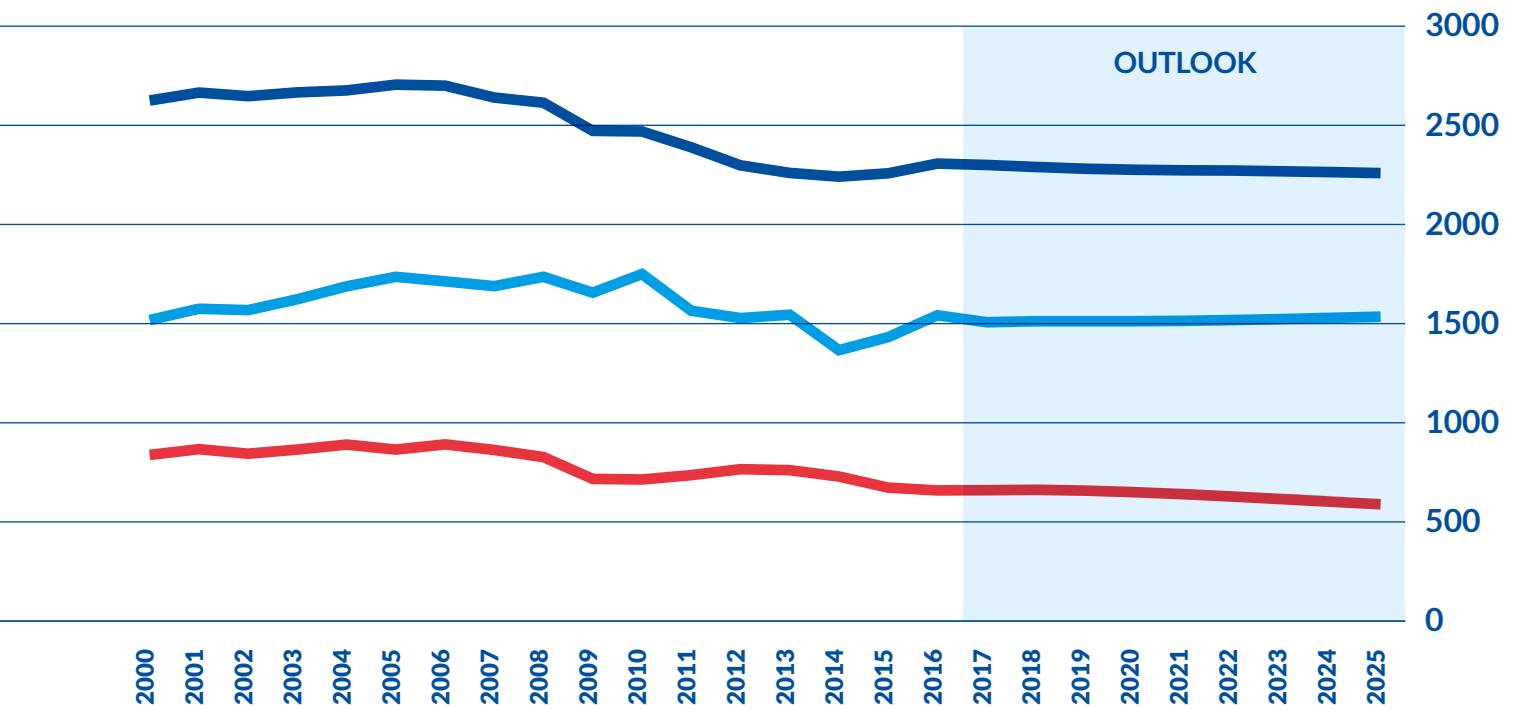
The growth of exports from EU countries to EU countries increased as well in 2016. Even though the growth was more limited, intra-EU exports increased by 2.5% in 2016.



ECONOMIC CONDITIONS OF IWT-RELATED SECTORS

COAL, GAS AND OIL DOMESTIC DEMAND EVOLUTION IN THE EUROPEAN UNION - PAST EVOLUTION AND OUTLOOK

(YEARLY DOMESTIC DEMAND IN MTOE - MILLION TONNE EQUIVALENT OIL)



Oil
Gas
Coal

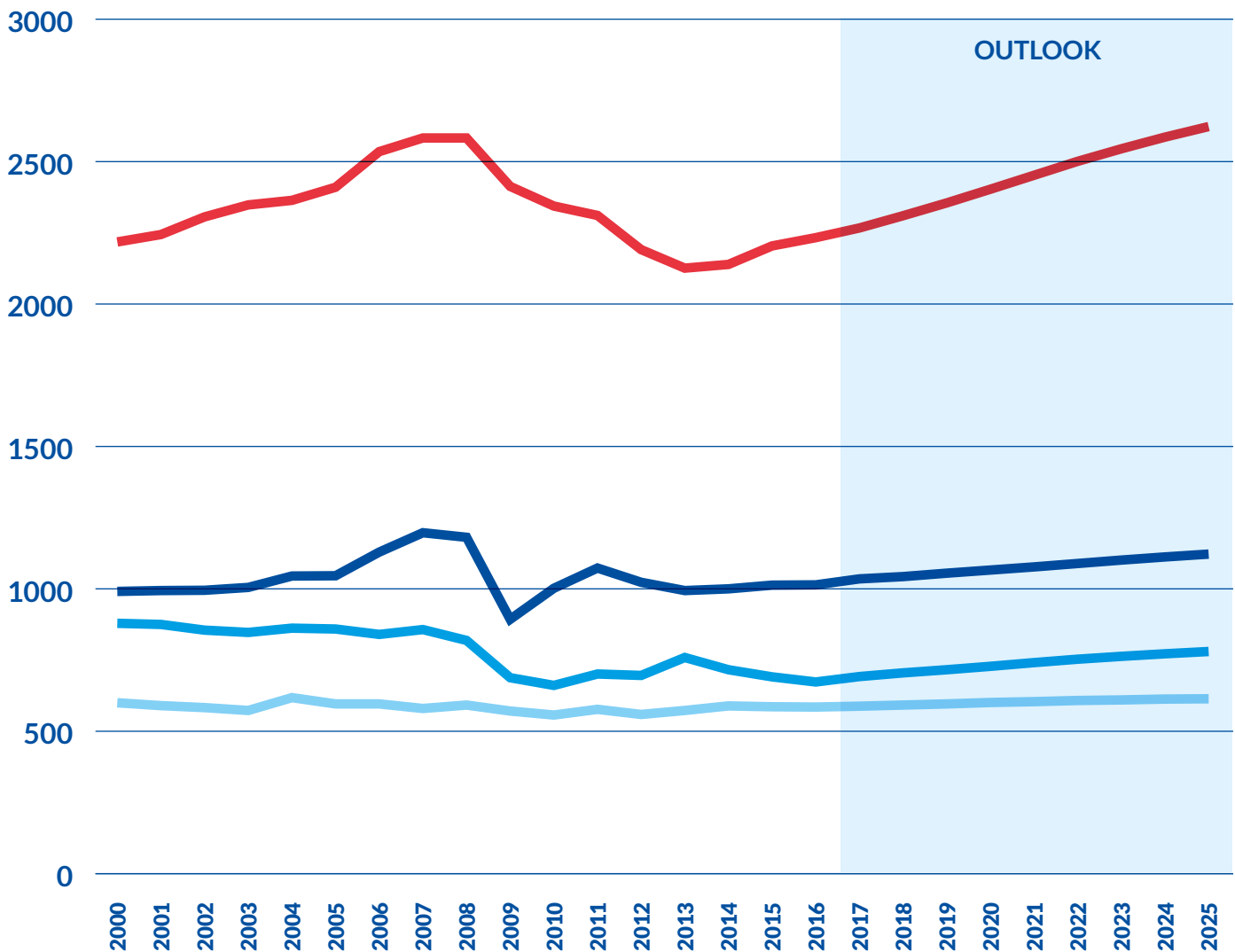
Source: Oxford Economics

The demand for coal is expected to go down in Europe, due to the phasing out of coal fired power plants and the political aim of increasing the share of renewable energy production.

The demand for oil should rather stagnate or decrease very slightly until 2025, as a substitution for mineral oil-based fuels in the transport sector is not realistic until 2025, even though this is expected in the long-term.

Gas consumption should however increase slightly over the next years, benefitting from an energy shift from coal and oil towards gas and renewables. Focusing only on coal, gas and oil, the share of gas consumption is indeed expected to increase from 32% in 2015 to 35% in 2025.

EU GROSS OUTPUT OF ACTIVITIES CONTRIBUTING TO INLAND WATERWAYS GOODS TRANSPORT (EU GROSS OUTPUT IN BILLION REAL US\$ - 2010 US\$)



Construction

Basic metals and metal products

Coke and refined petroleum products

Agriculture, forestry and fisheries

Source: Oxford Economics, CCNR analysis

The construction sector is assumed to expand its activity in Europe, fostered by important trends like urbanisation, strong demographic growth in certain regions and cities, and immigration.

For metals and metal products, limited growth is foreseen. Steel is needed in the construction sector, but also in other branches of the economy where growth prospects are less optimistic. And in contrast to the construction sector, the steel demand can be met by a worldwide supply that will impact growth prospects in the European Union.

Agricultural products are promoted by important trends, such as the greening of the energy sector, which increases the demand for biomass, and should therefore maintain a significant share of IWT in the long term even though conjectural negative impacts can occur due to bad harvests, for example.



02

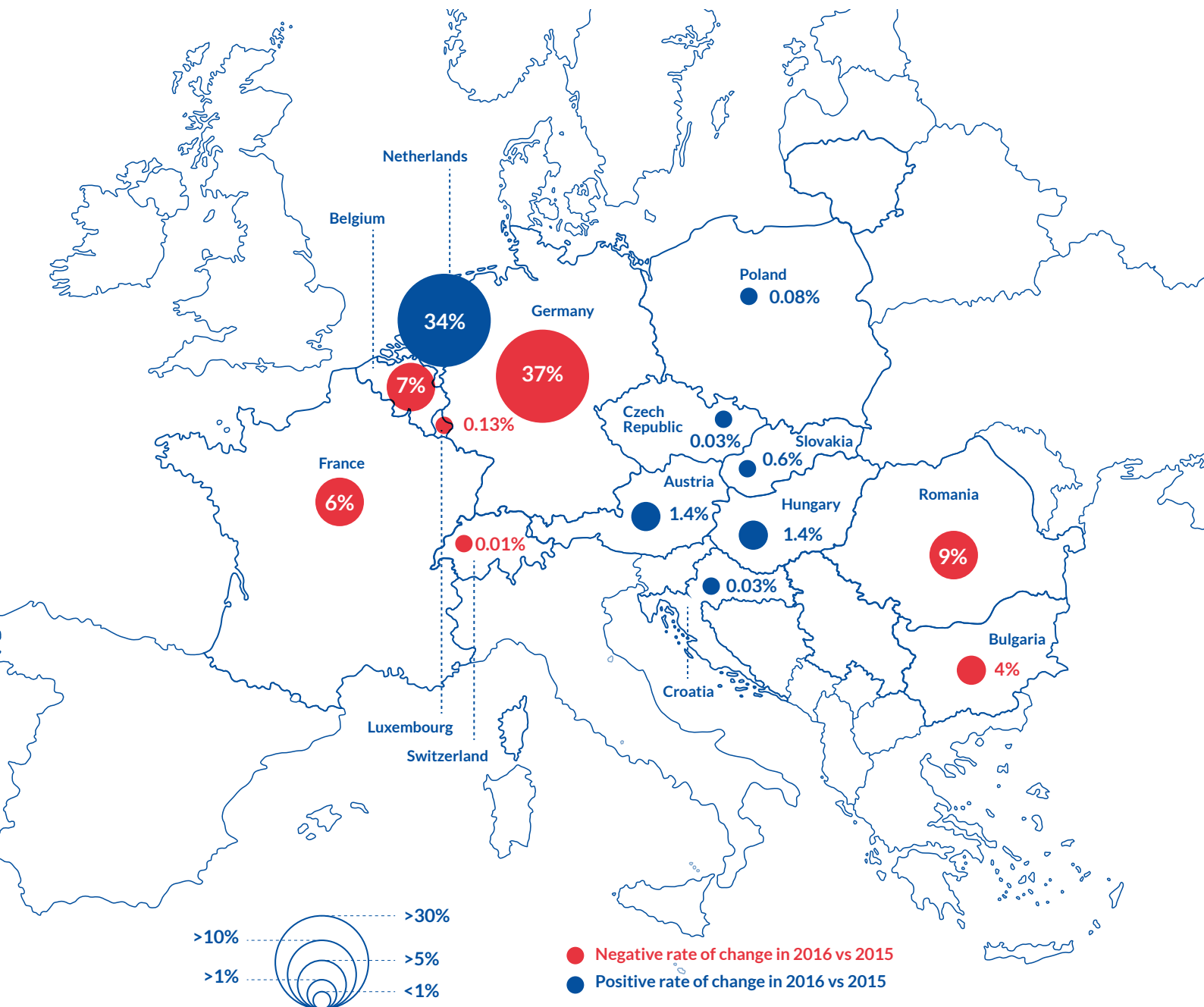
FREIGHT TRAFFIC ON INLAND WATERWAYS

- Germany and the Netherlands represent 72% of total EU transport performance on inland waterways.
- Total inland waterway transport performance was close to 145 billion tonne-kilometers in 2016 (1% decrease compared to 2015).
- Container transport on inland waterways increased by 4.6% in the European Union in 2016 and accounts for more than 15 billion tonne-kilometers.

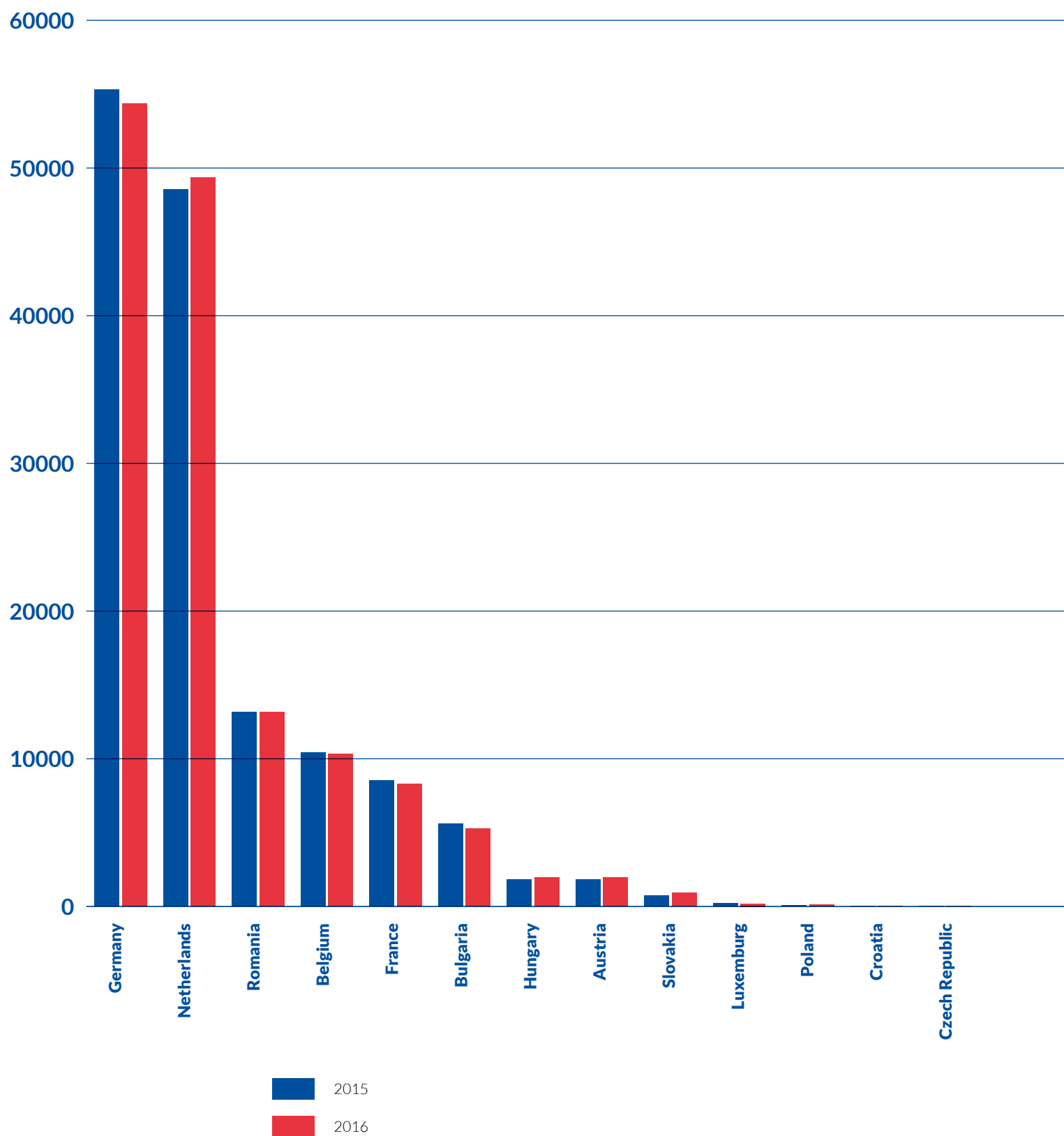
INLAND NAVIGATION

GOODS TRANSPORT IN EUROPE

SHARE OF THE COUNTRIES' TKM IN TOTAL TRANSPORT PERFORMANCE IN EUROPE
(SHARE IN %)

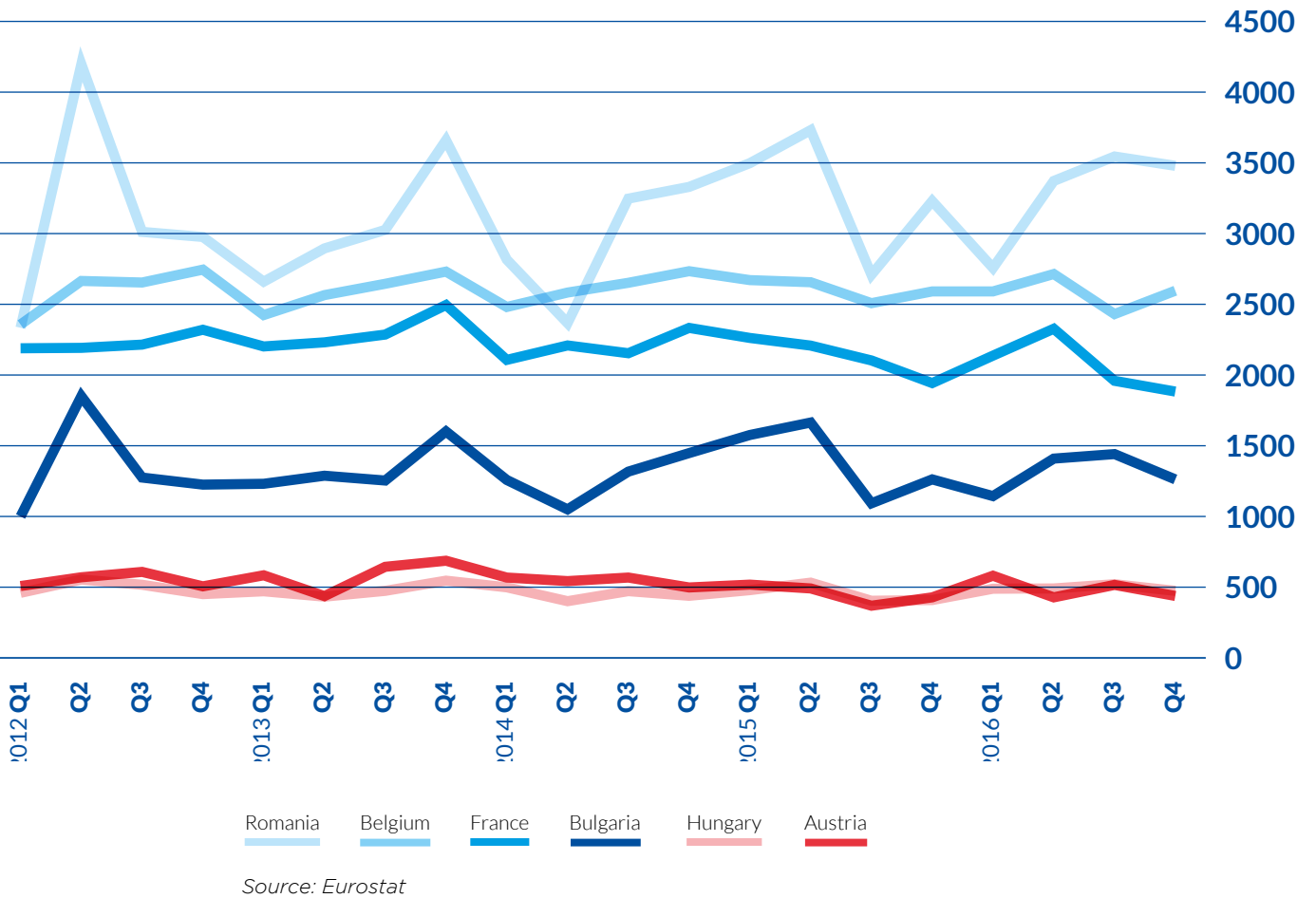
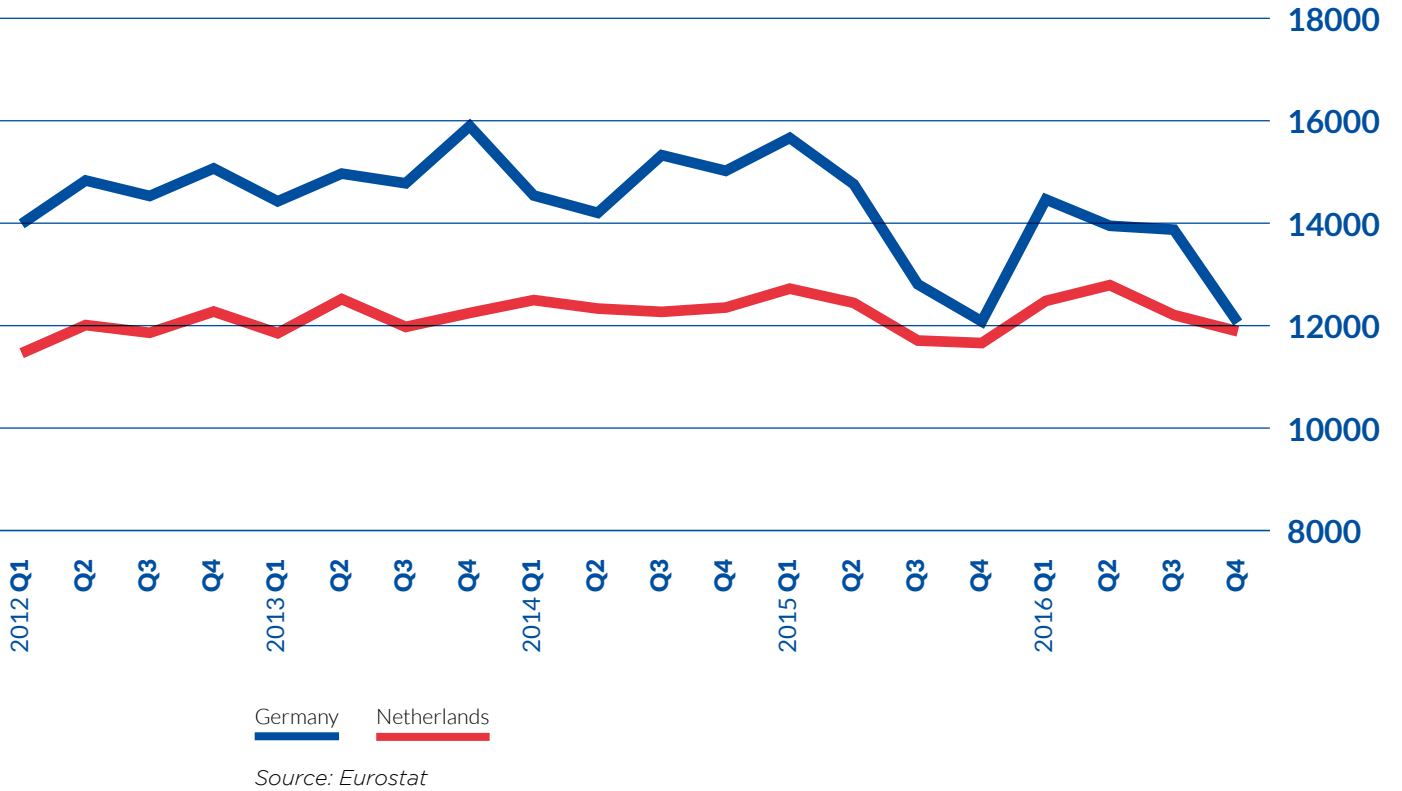


Source: Eurostat

IWT TRANSPORT PERFORMANCE IN 2015 AND IN 2016 IN MAIN EU IWT COUNTRIES
(TRANSPORT PERFORMANCE IN MILLION TKM)

Source: Eurostat

IWT TRANSPORT PERFORMANCE IN 2015 AND IN 2016 IN MAIN EU IWT COUNTRIES
 (TRANSPORT PERFORMANCE IN MILLION TKM)



Inland navigation activity is very concentrated in Europe with two countries, the Netherlands and Germany, representing 71% of total European transport performance on European inland waterways.

More generally, European Union Rhine countries (Belgium, the Netherlands, France and Germany) represent 85% of total inland navigation goods transport performance; European Union Danube countries (Bulgaria, Croatia, Hungary, Austria, Romania and Slovakia) represent 15% of goods transport performance on European inland waterways. And other countries represent today less than 0.5% of European goods transport by inland navigation.

The total IWT transport performance in the European Union reached nearly 145 billion TKM in 2016 and decreased by 1% compared to 2015, with the most important decrease from eight main IWT European countries being observed in Luxemburg, France and Germany, with respectively 19%, 2.5% and 1.7% decrease in transport performance in 2016 compared to 2015. Luxemburg and France in particular are two countries where inland navigation activity strongly relies on transport of agriculture products, and the bad harvests in 2016 therefore significantly impacted the inland navigation traffic in these two countries. Agricultural products transport represents 25% of inland waterways transport performance in France, and this transport decreased by more than 20% in 2016 compared to 2015 (Source: VNF data).

The evolution of transport performance in Germany and the Netherlands also highlights the effect of the two periods of low water in the Rhine region at the end of 2015 and at the end of 2016. A difficult recovery of volume transported in 2016, especially on dry cargo segments, explains the transport performance decrease in Germany in 2016.

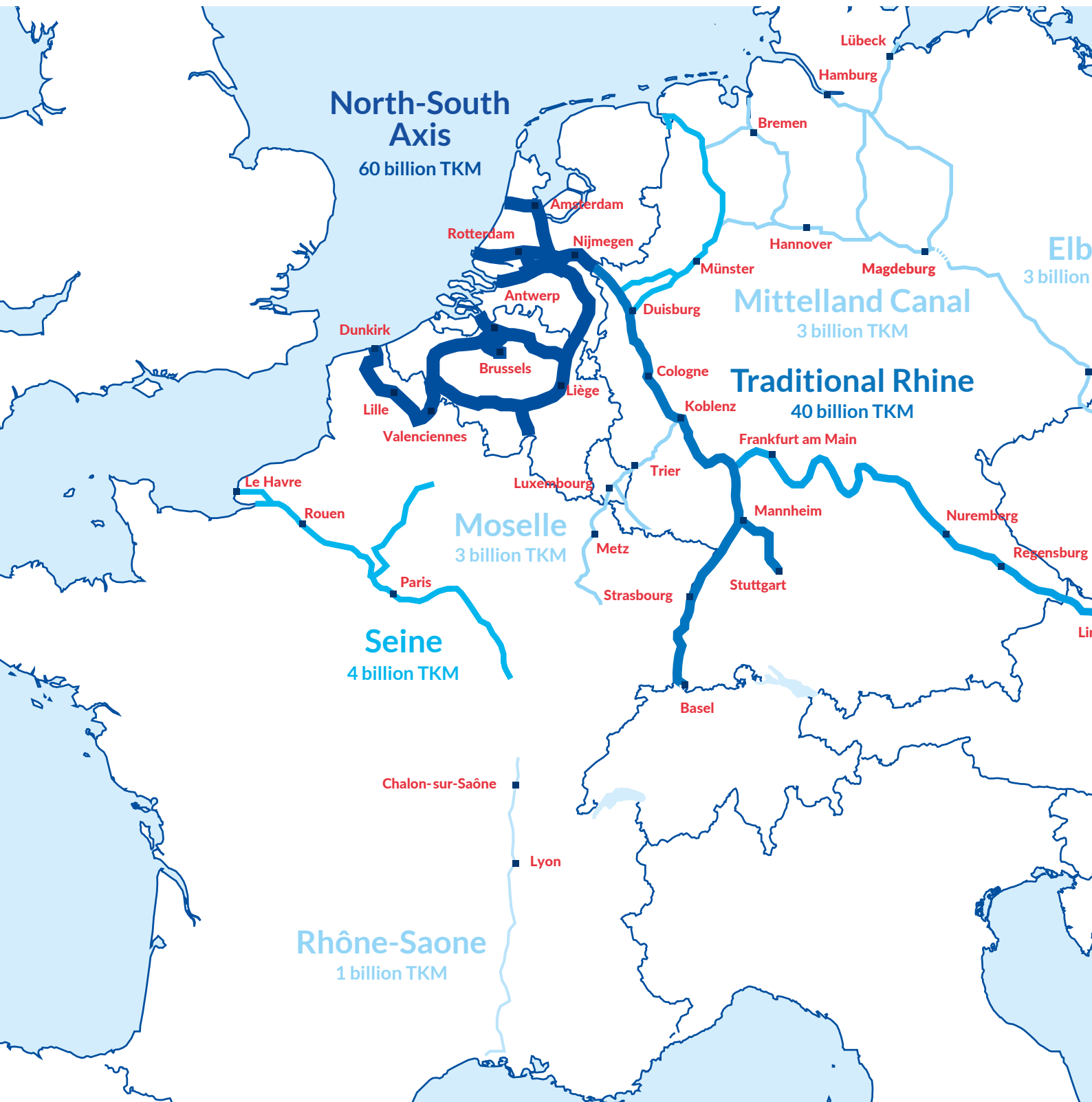
In Danube countries, despite bad harvest results in 2015 that impacted the transport performance at the beginning of 2016, especially in Romania, the steel industry maintained the level of transport performance in the region.

European Union countries with smaller weight in European inland navigation transport performance nonetheless experienced two-digit growth in 2016, showing the development of inland navigation in these countries. The IWT transport performance growth rate in Czech Republic, Croatia, Poland and Slovakia was indeed between 12% and 24% in 2016.

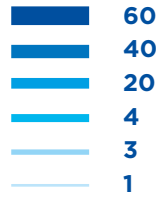


INLAND NAVIGATION

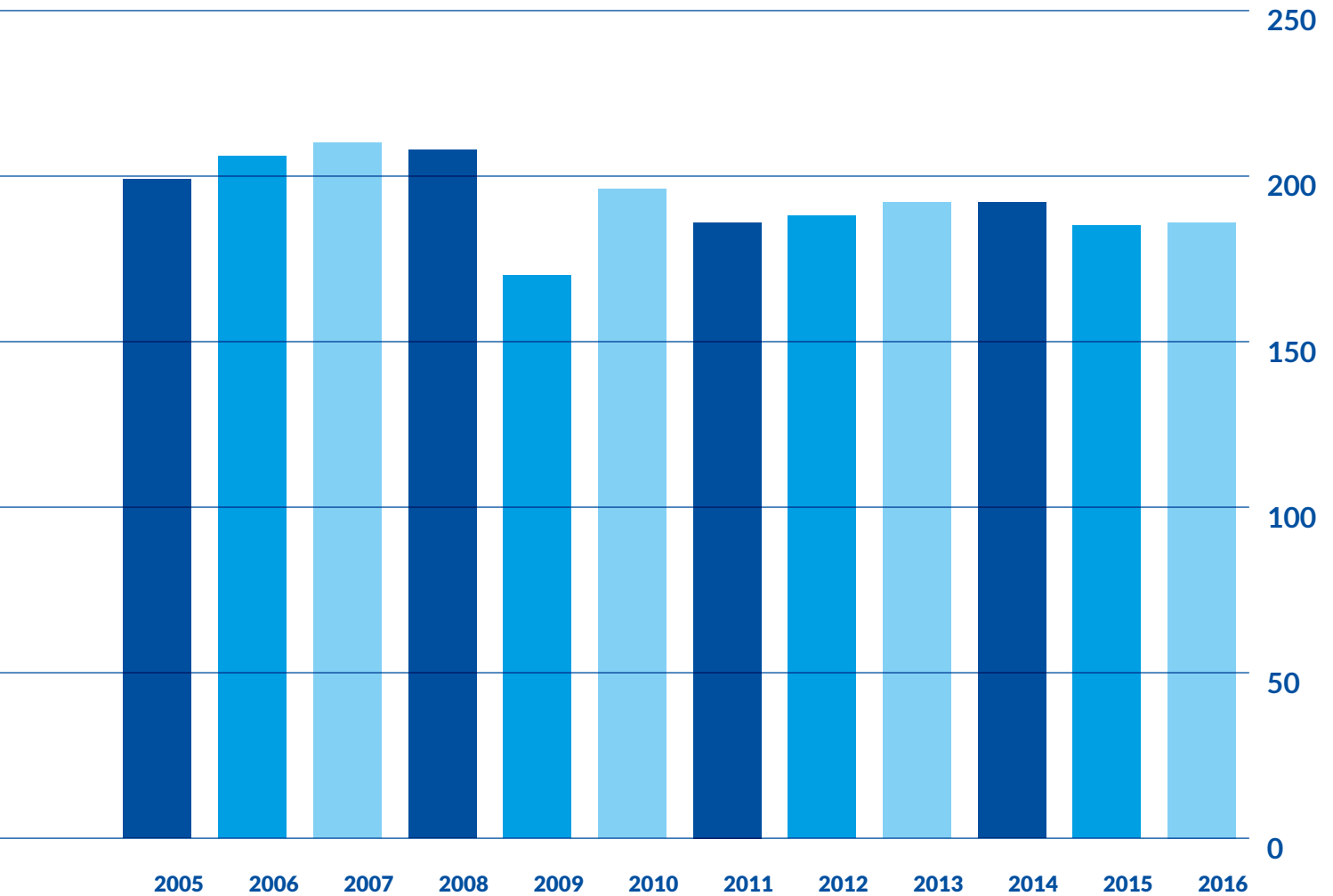
GOODS TRANSPORT IN MAIN EUROPEAN RIVER BASINS



TRANSPORT PERFORMANCE IN MAIN EUROPEAN RIVER BASINS (IN BILLION TKM)



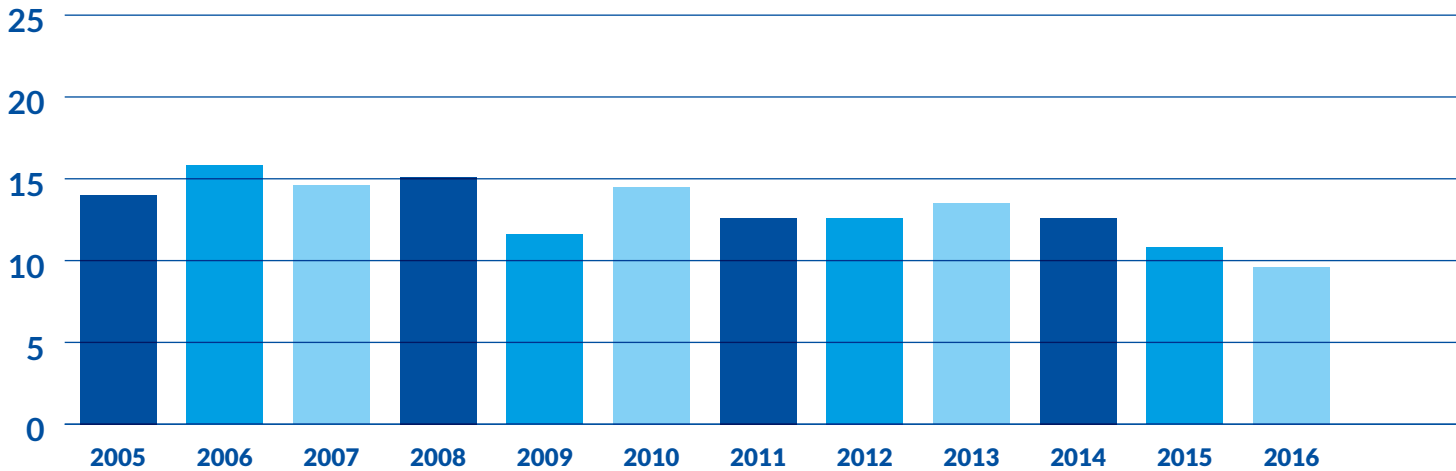
YEARLY VOLUME OF GOODS TRANSPORTED ON THE TRADITIONAL RHINE (TOTAL VOLUME IN MILLIONS OF TONNES)



Source: Destatis, CCNR

Despite better economic conditions, water conditions have recently not enabled the translation of economic activity catch-up into traffic volume increase. The volume transported on the Rhine remained stable in 2016 and the Rhine remains still by far the most important European basin per volume of goods transported, maintaining a share of 2/3 of European volumes transported by IWT on this river. And focusing on the “Traditional Rhine” (the Rhine between Basel and the Dutch-German border), transported volume already accounts for not far from 50% of the volume transported on European inland waterways.

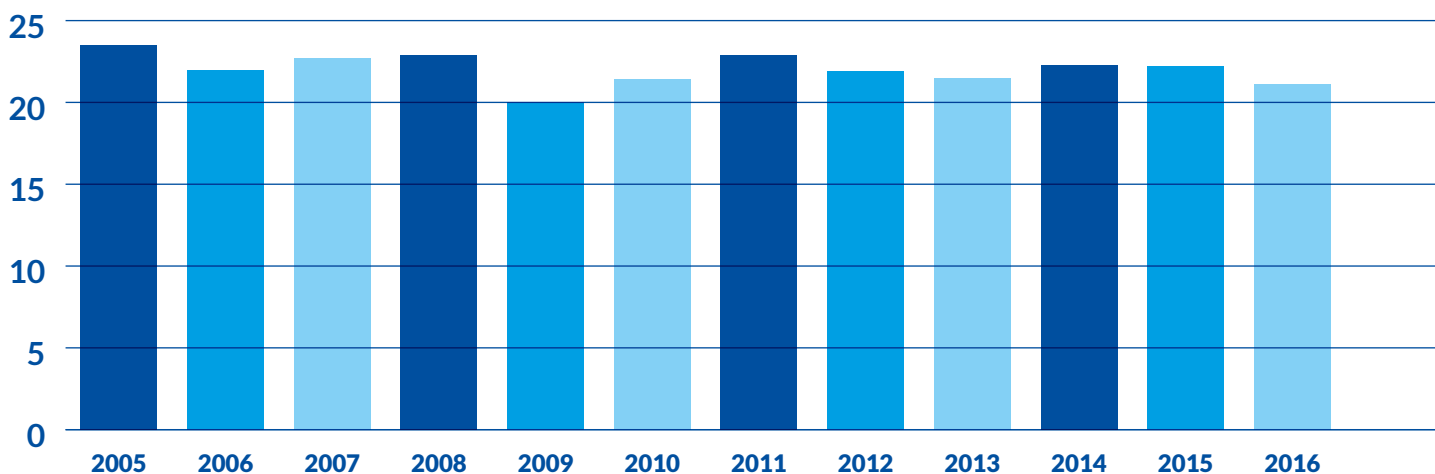
YEARLY VOLUME OF GOODS TRANSPORTED ON THE MOSELLE (TOTAL VOLUME IN MILLIONS OF TONNES)



Source: Destatis, CCNR

The Moselle runs from Eastern France to Germany, through Luxemburg, and inland navigation transport mainly relies on agricultural products, raw materials for the steel industry and more and more on container transport. The decrease of 24% of agricultural products volume transported on the Moselle in 2016 (due to bad harvest results in 2016) had a significant negative impact on the Moselle goods transport. Even though volumes are today more limited, Moselle traffic can however still count on dynamic container traffic. While it had doubled between 2014 and 2015, container traffic increased by 12% between 2015 and 2016.

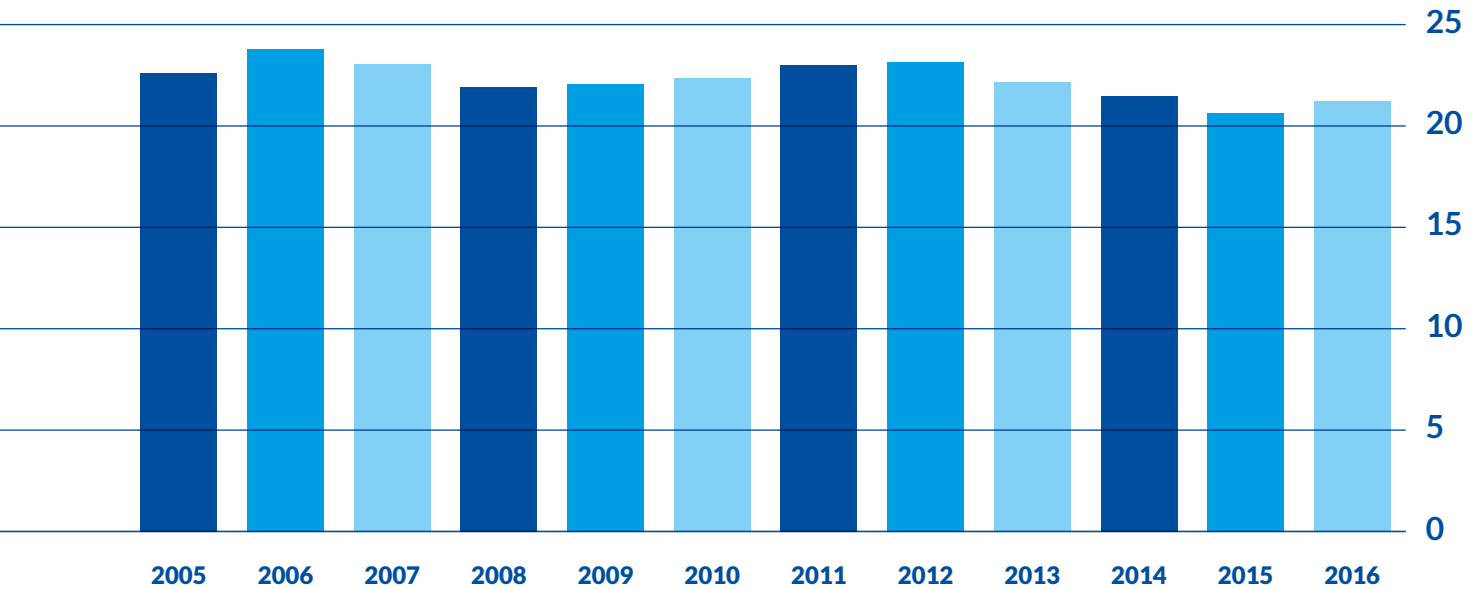
YEARLY VOLUME OF GOODS TRANSPORTED ON THE MITTELLAND CANAL (TOTAL VOLUME IN MILLIONS OF TONNES)



Source: Destatis, CCNR

The Mittelland canal is a link between East and West in Northern Germany, going from the Rhine region to the Oder region. Its construction started in 1906 and was aimed at providing a low-cost transportation mode for agricultural products from the surplus production region East of Berlin to very populated regions of West Germany. Since then the utility has diversified, linking industrial regions and main Northern Europe sea ports. Volumes transported have been stable for 10 years with between 20 and 25 million goods passing every year through the canal.

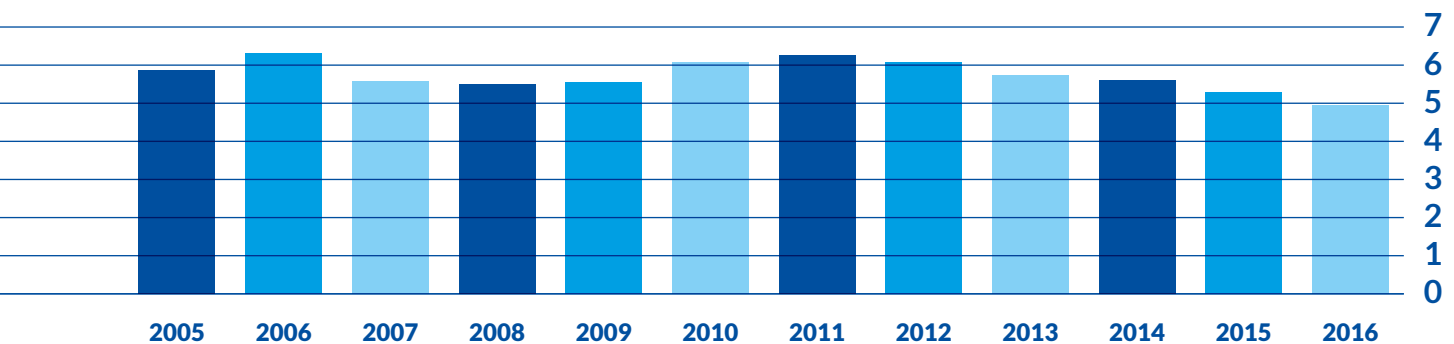
YEARLY VOLUME OF GOODS TRANSPORTED ON THE SEINE BASIN (TOTAL VOLUME IN MILLIONS OF TONNES)



Source: VNF

With more than 20 million goods transported every year, the Seine river basin is the main river basin in France in terms of freight transport. The growth of the segment of container transport and of the segment of building materials transport compensated for the difficult year for agricultural products transport. Indeed, the total transport on the Seine increased by nearly 3% in 2016 compared to 2015. And this 2016 growth calls for positive expectations in 2017 with a recovery of the agricultural products transport segment and further dynamism on other segments.

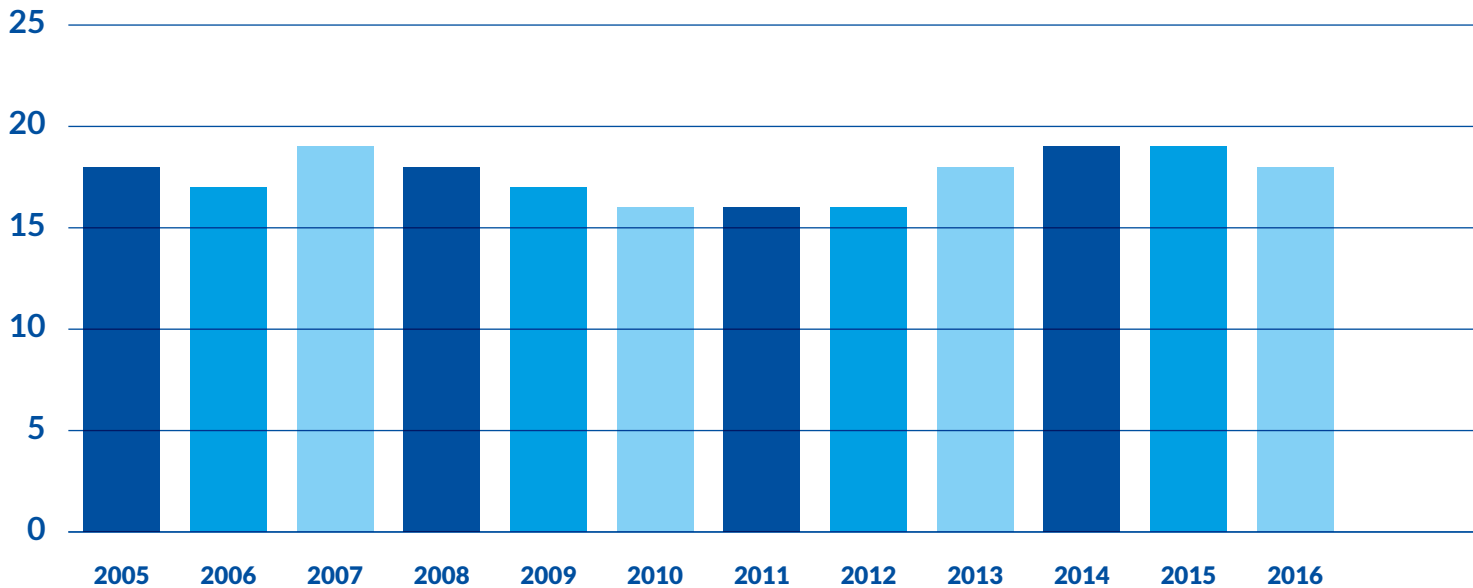
YEARLY VOLUME OF GOODS TRANSPORTED ON THE RHÔNE-SAÔNE RIVER BASIN (TOTAL VOLUME IN MILLIONS OF TONNES)



Source: VNF

The Rhône-Saône basin connects the East of France to the South of France, reaching the Seaport of Marseille. It was strongly impacted in 2016 by the decrease concerning the transport of agricultural products. The volume of agricultural products transported decreased by 25% in 2016 and was not compensated by the largest segment on the Rhône-Saône which is the transport of building materials. This segment indeed also experienced a decrease in 2016 compared to 2015.

YEARLY VOLUME OF GOODS TRANSPORTED ON THE ELBE RIVER BASIN (TOTAL VOLUME IN MILLIONS OF TONNES)



Source: VNF

The river Elbe connects different German regions and the Czech Republic with the Port of Hamburg. Via the Havel river, the Elbe is also linked to Berlin. By far the largest part of transport volumes are currently observed on the Lower Elbe, which is the stretch of the Elbe in the vicinity of the Port of Hamburg. This hinterland traffic showed an upward trend from 2012, but the year 2016 saw a decrease compared to 2015 (decrease also observed for the total traffic in the Port of Hamburg in 2016). Detailed figures from the Statistical Office for Hamburg and Schleswig-Holstein show that this decrease was mainly due to less agricultural products and foodstuff transport while liquid cargo (especially chemicals) registered an increase.

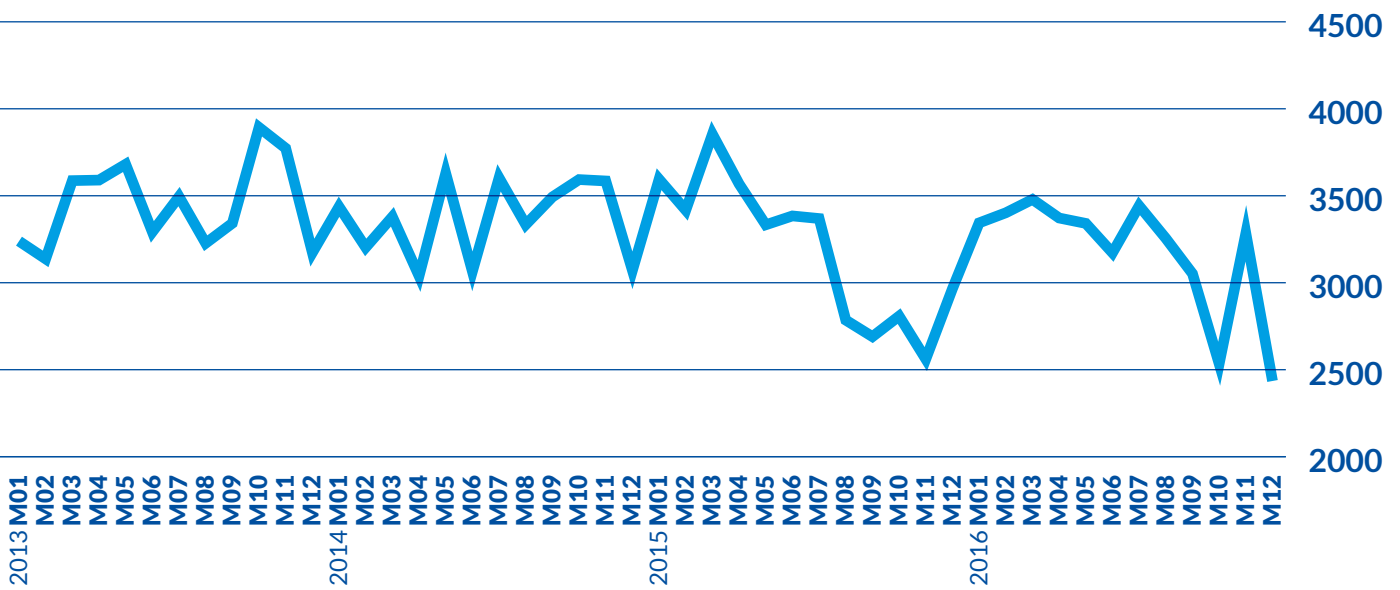
The container transport on the Elbe grew by only 1% in 2016, compared to 16.7% in 2015. It is expected that an upward tendency will evolve due to the willingness of the Port of Hamburg to shift an increasing amount of goods traffic in its hinterland from road to rail and IWT.



IWW TRANSPORT

PER TYPE OF GOODS IN THE RHINE AREA

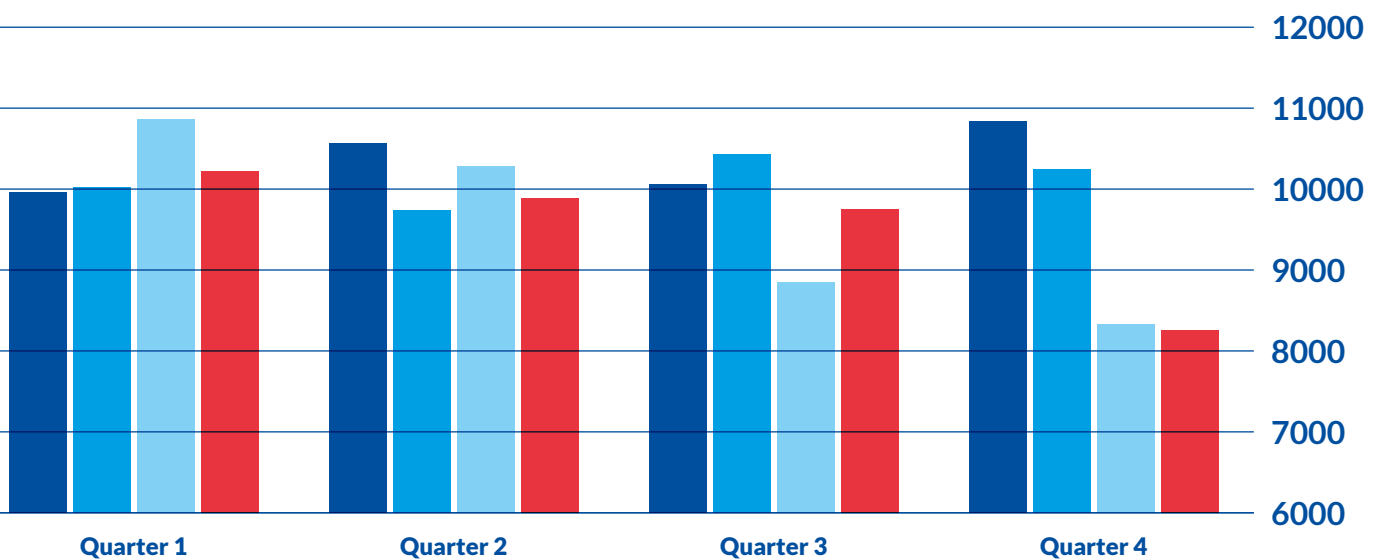
MONTHLY IWT TRANSPORT PERFORMANCE ON THE TRADITIONAL RHINE BETWEEN 2013 AND 2016 (TRANSPORT PERFORMANCE IN MILLION TKM)



Source: Destatis, CCNR

COMPARISON OF QUARTERLY IWT TRANSPORT PERFORMANCE ON THE TRADITIONAL RHINE (TRANSPORT PERFORMANCE IN MILLION TKM)

2013 2014 2015 2016

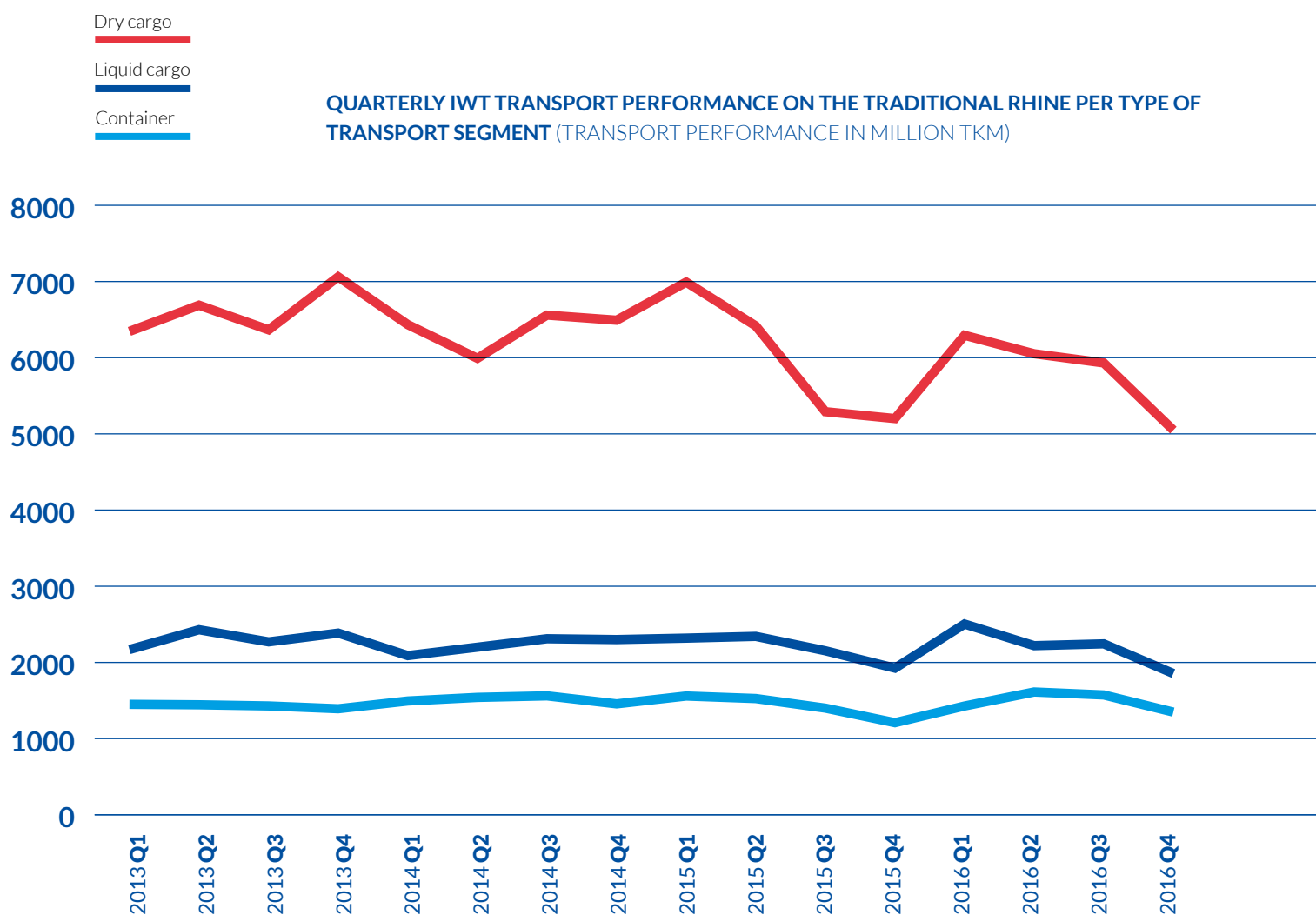


Source: Destatis, CCNR

The volume of goods transported on the Rhine was strongly impacted by the water levels in 2016. A low water period occurred at the end of 2015 between August and October, negatively impacting transport performance during the second semester of 2015. The first semester of 2016 witnessed a traffic catch-up, not reaching the levels of the first semester 2015. Comparing the first semester of 2016 to the first semester of 2015, a decrease in total transport performance of 4.9% can indeed be observed on the Traditional Rhine (and a decrease of 2.2% for the volume of goods transported). The second semester of 2016 also experienced a low water period on the Rhine, starting however later than in 2015. The impact on Rhine traffic can be observed only from October. These water conditions, more favorable than in 2015, enabled a transport performance increase of 4.8% during the second semesters of 2015 and 2016 (and an increase of 3.9% for the volume of goods transported).

Nevertheless, it is important to note that the transport performance measured on the Traditional Rhine during the second semester of 2016 is respectively 13% and 14% smaller than in 2014 and in 2013, showing the relative impact of low water periods at the end of 2016.

2016 also showed how the sector is able to react to increase the volume of goods transported when the water conditions return to suitable conditions for inland navigation. November 2016 is an example with a monthly transport performance back to the average level of the four previous years while October 2016 had experienced a 25% decrease compared to that average level.



Source: CCNR analysis based on national statistic offices data

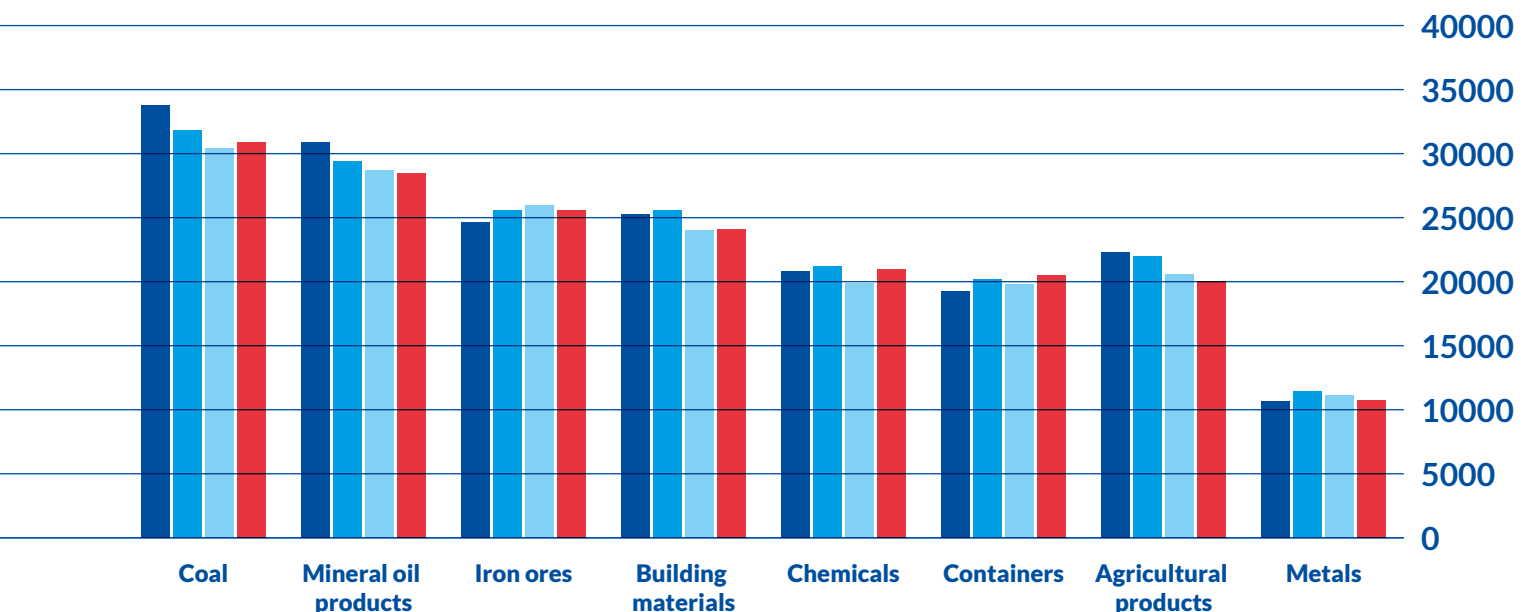
All segments suffer from the low water periods but the evolution is different from one segment to another. Liquid cargo and container segments, for example, enjoyed a more dynamic catch-up in 2016, reaching greater levels of transport performance than in 2015. Both liquid cargo transport and container transport on the Rhine experienced their higher levels of quarterly transport performance over the last years in 2016, respectively during the first and second quarters of 2016. However, all segments were impacted to the same extent during the last quarter of 2016, with a decrease in transport performance ranging from 15 to 20% compared to the previous quarter.

YEARLY EVOLUTION OF VOLUME OF GOODS TRANSPORTED BY IWT BY TYPE OF GOODS IN THE RHINE AREA

(YEARLY VOLUME IN THOUSAND TONNES ON THE TRADITIONAL RHINE)

	2015 (1000 t)	2016 (1000 t)	Variation 2016 vs 2015
Coal	30 453	30 923	2%
Mineral oil products	28 681	28 466	-1%
Ores	25 993	25 600	-2%
Building materials	23 994	24 107	0%
Chemicals	19 883	20 942	5%
Containers	19 758	20 475	4%
Agricultural products	20 603	20 057	-3%
Metals	11 138	10 727	-4%
Other	5 132	5 642	
Total	185 635	186 939	1%

2013 2014 2015 2016



Source: CCNR analysis based on national statistic offices data

The transport of coal, mineral oil products and building materials has undergone similar development over the past four years. While the volume transported in 2016 was in the same order of magnitude compared to 2015 (between +2% and -1% for the evolution between 2015 and 2016), the volume transported in 2016 was significantly lower than in 2013 and in 2014. This is due to the fact that the low water periods, even if they were limited in time in 2016, were not compensated by dynamic activity during the rest of the year. Still, the long-term evolution appears to be quite different for these three segments. The volume of building materials transported on the Rhine has nearly been divided by two over the last 20 years, but an expected increase in the house building industry over the next years, especially in the Netherlands and in France, could support the transport of building materials. The decrease has not been as great for the mineral oil products segments but it also decreased from approximately 35 million tonnes transported 20 years ago to 28 million tonnes transported in 2016. This structural trend is due to a reduction in fuel consumption in the automotive sector and in house heating activities and is expected to be pursued. Coal transport on the Rhine has been pushed by the increasing coal import from Germany. But a shift in German energy public policies towards renewable energies has started to trigger a decrease in coal transport that is expected to continue over the next years.

Transport of chemical products and containers are two segments that have experienced a significant increase over the last 20 years. The volumes transported on the Rhine have almost doubled for chemical products and tripled for containers. The volumes are not even impacted so much during years experiencing low water periods; the volumes transported remained the same for chemical products in 2016 compared to years 2013 and 2014 and even increased for containers.

The situation of the transport of agricultural products is particular because it was strongly and negatively impacted by the bad harvest in 2016. This explains the decrease of close to 10% in 2016 compared to years 2013 and 2014. Apart from this conjectural event that impacted the agricultural product segment in 2016, the long-term evolution of transport of this type of goods is rather positive, being one of the most dynamic segments of the cargo segment over the last 10 years.

The comparison of the evolution of metals and ores transport is interesting because the transport activity for these two types of goods is mainly driven by the steel industry. Looking at the long-term past evolution, it appears that ores transport has decreased while metals transport has remained stable; this can be explained by the fact that the steel industry has increased the efficiency of use of raw materials.¹ But looking at the evolution since 2013, the ores transport evolution is positive while that of metals transport is not so positive (it should be noted that the evolution has a limited order of magnitude, +4% for ores transport between 2013 and 2016 vs +1% for metals transport). An explanation could be that the metals transport segment is more sensitive to modal shift towards road transport, in particular in periods of low water. Storage capability increase can be used more easily for ores than for metals because of quality issues.²

¹ Source: German Steel Industry association - Report "Ways of efficiency in the steel industry" (2010)

² Source: Market Observation - Report "German Federal Office of Goods Transport"

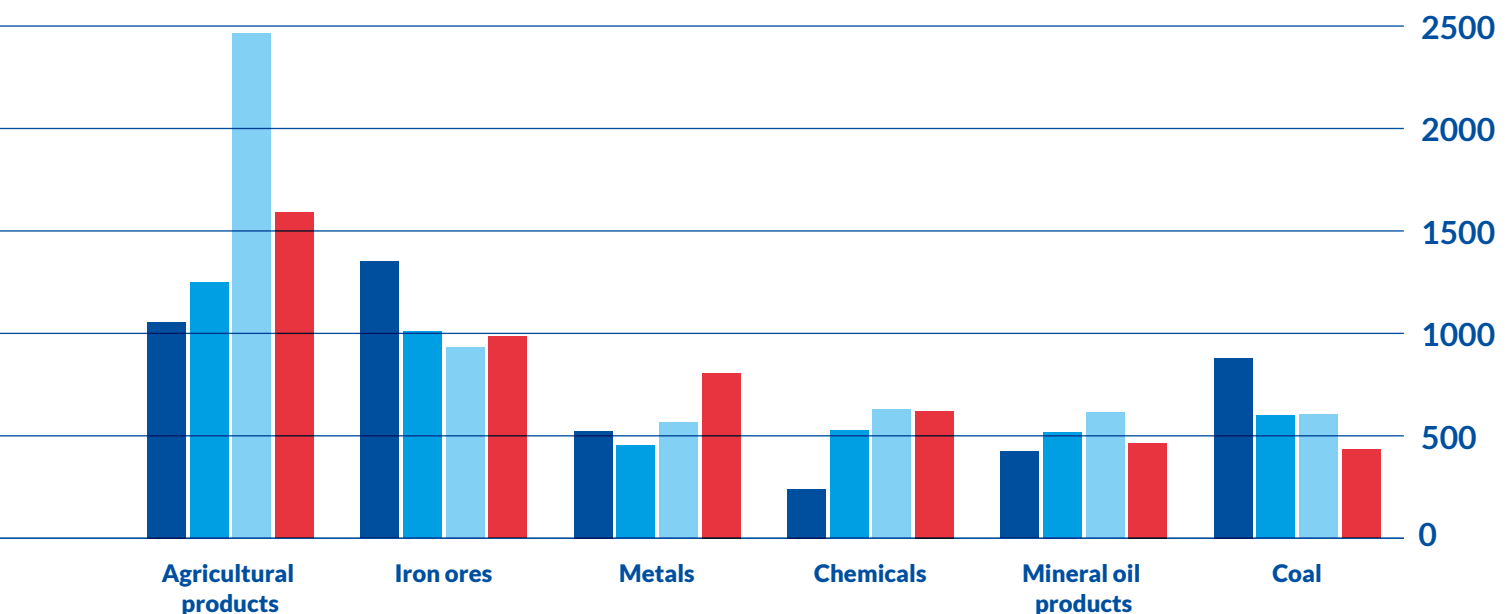
IWW TRANSPORT

PER TYPE OF GOODS IN THE DANUBE AREA

YEARLY EVOLUTION OF VOLUME OF GOODS TRANSPORTED BY IWT BY TYPE OF GOODS IN THE DANUBE AREA (YEARLY VOLUME IN 1000 TONNES ON MIDDLE DANUBE - HUNGARY/CROATIA/SERBIA TRANSBORDER AREA)

	2015 (1000 t)	2016 (1000 t)	Variation 2016 vs 2015
Agricultural products	2463	1591	-35%
Iron ores	933	985	6%
Metals	564	807	43%
Chemicals	629	620	-1%
Mineral oil products	613	465	-24%
Coal	605	433	-28%
Total	5807	4901	-16%

2013 2014 2015 2016

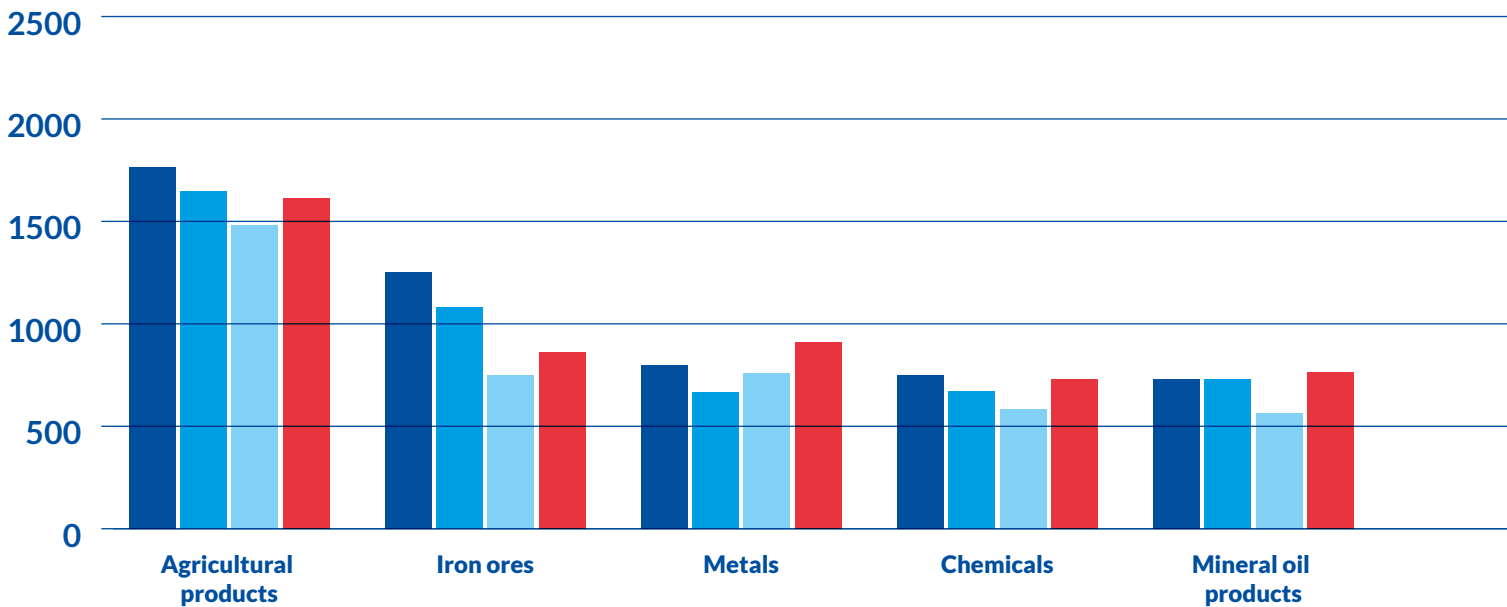


Source : CCNR analysis based on Danube Commission data and market observation report

**YEARLY EVOLUTION OF VOLUME OF GOODS TRANSPORTED BY IWT BY TYPE
OF GOODS IN THE DANUBE AREA (YEARLY VOLUME IN 1000 TONNES ON UPPER DANUBE –
SLOVAKIA / HUNGARY TRANSBORDER AREA)**

	2015 (1000 t)	2016 (1000 t)	Variation 2016 vs 2015
Agricultural products	1483	1614	+9%
Metals	757	910	+20%
Iron ores	749	862	+15%
Mineral oil products	564	763	+35%
Chemicals	585	730	+25%
Total	4138	4879	+18%

2013 2014 2015 2016



Source : CCNR analysis based on Danube Commission data and market observation report

The transport of agricultural products constitutes the most important segment on the Danube, and is especially important for the Middle Danube region, from which cereals are exported via the seaports at the Black Sea (Constanța) to countries in the Mediterranean Sea. It experienced difficulties during the first semester of 2016 because of bad harvests in 2015. The agricultural products transport therefore decreased by 35% in the Middle Danube area in 2016 compared to 2015. This decrease concerning the segment of agricultural products is mainly due to the traffic levels during the first semester of 2016. The second semester of 2016 indeed experienced a catch-up of transport of agricultural products with better harvest results in 2016.

The steel industry is also a strong driver of inland waterways transport in the Danube region and this sector was particularly active in 2016. Giving some examples of the steel industry activity along the Danube, Voestalpine in Austria, Dunafer in Hungary, Zelezara in Serbia, Arcelor Mittal in Romania and US Steel Kosice in Slovakia all use inland waterways transport to transport raw materials and final products.

The transport of metals, for instance, is mainly downstream on the Danube and enjoyed a 43% increase in the Middle Danube and a 20% increase in the Upper Danube area in 2016 compared to 2015. Also, the iron ores traffic, which is mainly upstream on the Danube, recovered strongly after the low water restrictions of 2015.

Container transport remains very limited in the Danube region. It represents only 0.5% of the total Danube traffic and it represents less than 0.2% of total container transport in the European Union on inland waterways.

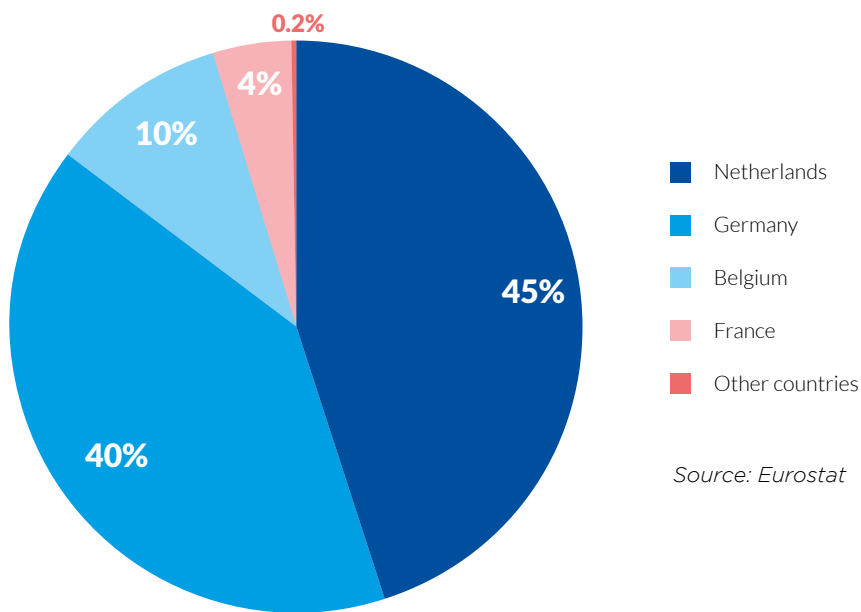
The total volume of goods transported in the Middle Danube decreased in 2016 compared to 2015. But the decrease was mainly due to the agricultural products transport segment. The Upper Danube area (Austria, Slovakia) goods transport is more driven by the steel industry, with a weight of transport of agricultural products which is not as sizeable. And on this part of the Danube, there was an increase of the volume transported in 2016, an 18% increase in 2016 compared to 2015 for the volume of goods transported by IWT through Gabčíkovo, at the border between Hungary and Slovakia.



INLAND NAVIGATION

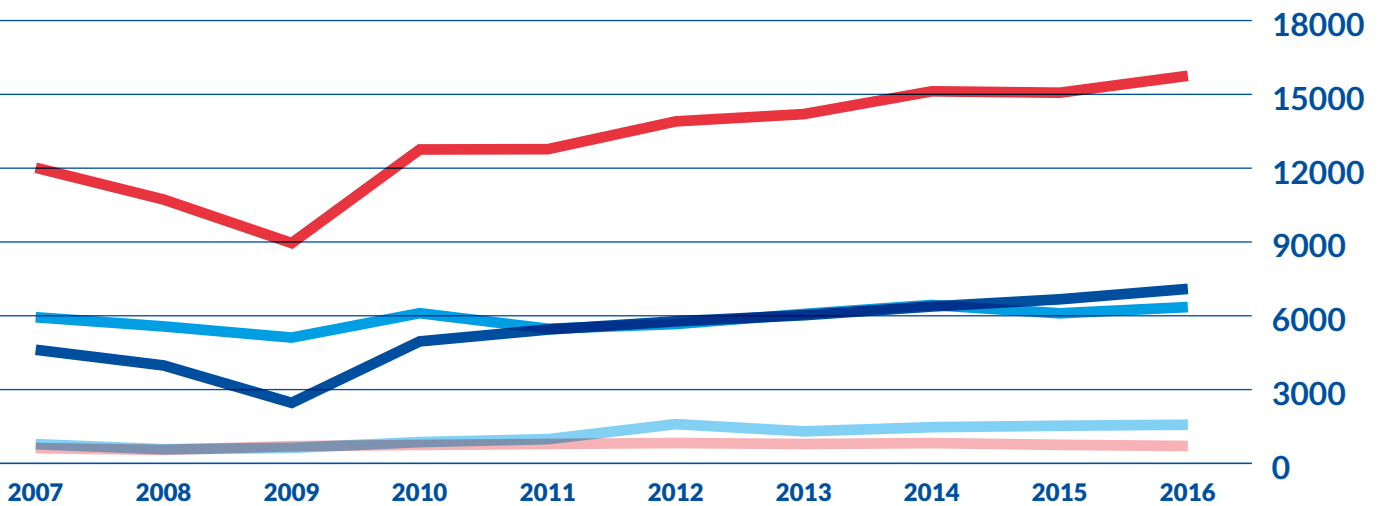
CONTAINER TRANSPORT IN EUROPE

DISTRIBUTION OF CONTAINER TRANSPORT PERFORMANCE ON INLAND WATERWAYS IN 2016 IN THE EUROPEAN UNION



CONTAINER TRANSPORT PERFORMANCE ON INLAND WATERWAYS IN EUROPE
 (TRANSPORT PERFORMANCE IN MILLION TKM)

Belgium Germany Netherlands France European Union



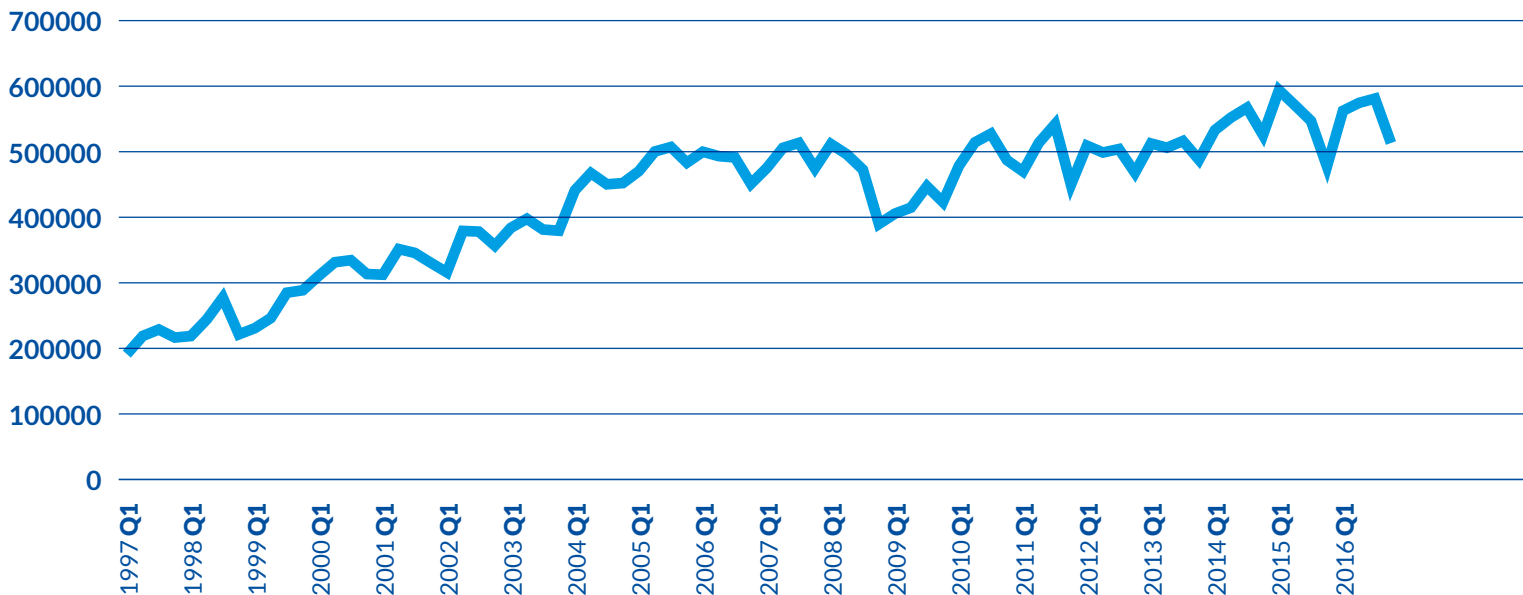
Container transport on inland waterways is almost exclusively present in the Netherlands, Belgium, Germany and France with a share of European Union transport performance higher than 99%.

Rhine area infrastructures and good connections with the two major European sea ports for container traffic, Rotterdam and Antwerp, partly explain dynamic container transport on inland waterways in the Rhine area.

Container traffic occupies a major place in the economy of inland navigation. On a European scale, over 15 billion TKM were transported by inland waterways in 2016, an increase of 31% over 10 years. Compared to 2015, the transport of containerized goods increased by 4.6%.

In 2016, the main containerized goods conveying countries in Europe saw their numbers increase by 6.4%, 4.2% and 2.7% respectively for the Netherlands, Germany and Belgium. France, on the other hand, was down by 6.1%.

VOLUME OF CONTAINERS TRANSPORTED ON THE TRADITIONAL RHINE OVER THE LAST 20 YEARS (VOLUME IN TEU)



Source: Destatis, CCNR analysis

16%

of the total transport performance on the Traditional Rhine was container transport in 2016.

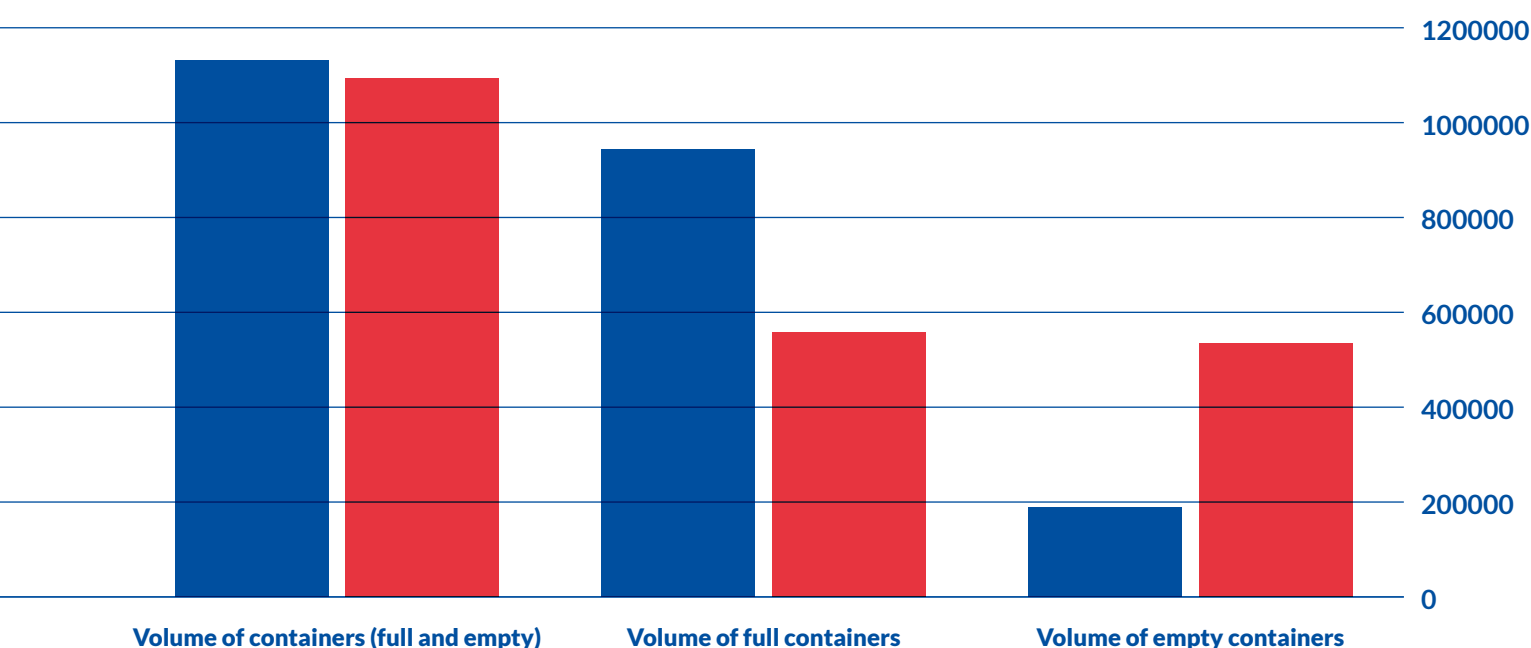
On the Traditional Rhine, the traffic of goods is mainly represented by trade between Belgium, Switzerland, Germany, France and the Netherlands, which accounted for more than 97% of freight transport on the Traditional Rhine in 2016. Only 3% of the freight transport on the Traditional Rhine is either fluviomaritime transport heading to overseas destinations such as the United Kingdom or freight transport going through the Rhine-Main-Danube canal towards Danube countries. The share of the container in the transport of goods on the Traditional Rhine in 2016 was 16%.

Container transport on the Traditional Rhine has almost tripled in 20 years. This significant increase can be explained by the recovery in world trade, but also by the modernization of structures to facilitate the transport, loading and unloading of goods.

In 2016, more than 2.2 million TEU were transported on the Traditional Rhine, an increase of 2% compared to 2015.

DISTINCTION BETWEEN FULL AND EMPTY CONTAINERS CARRIED ON THE TRADITIONAL RHINE IN 2016 (VOLUME IN TEU)

■ Downstream ■ Upstream

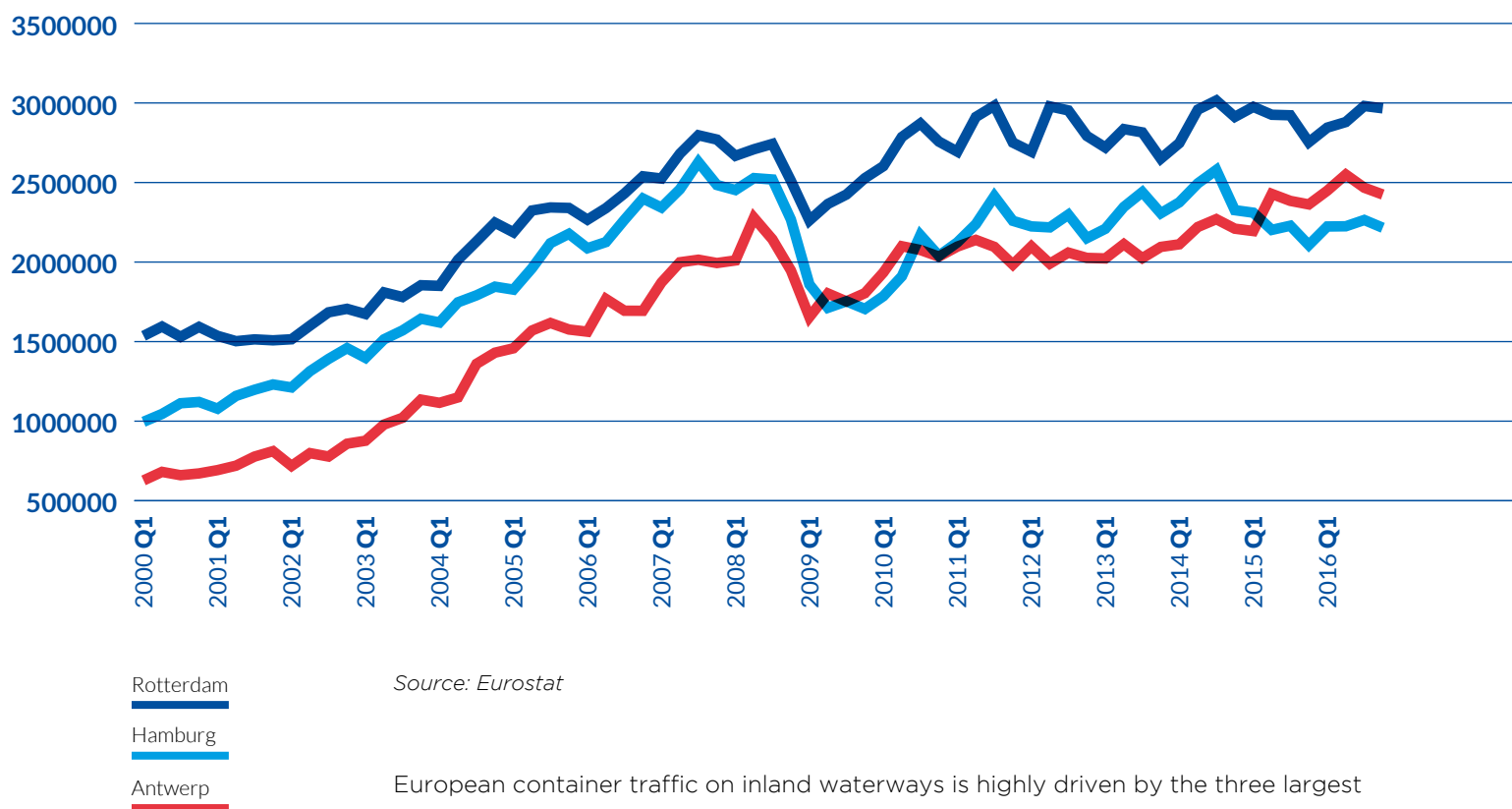


Source: CCNR

1,131,549 TEU were transported downstream, while 1,093,717 TEU were transported upstream. Subtlety is revealed by the distinction between full and empty containers.

Almost as many containers were transported downstream and upstream, but more than 943,000 full TEU were transported downstream, or 83% of the total containers carried downstream. This imbalance between full and empty containers can be explained by the overall nature of trade in goods on the Traditional Rhine. Raw materials are generally imported into Europe and more particularly into Germany for the production and exportation of manufactured products in the rest of the world.

CONTAINER MARITIME TRAFFIC IN THE MAIN EUROPEAN SEAPORTS (TEU)

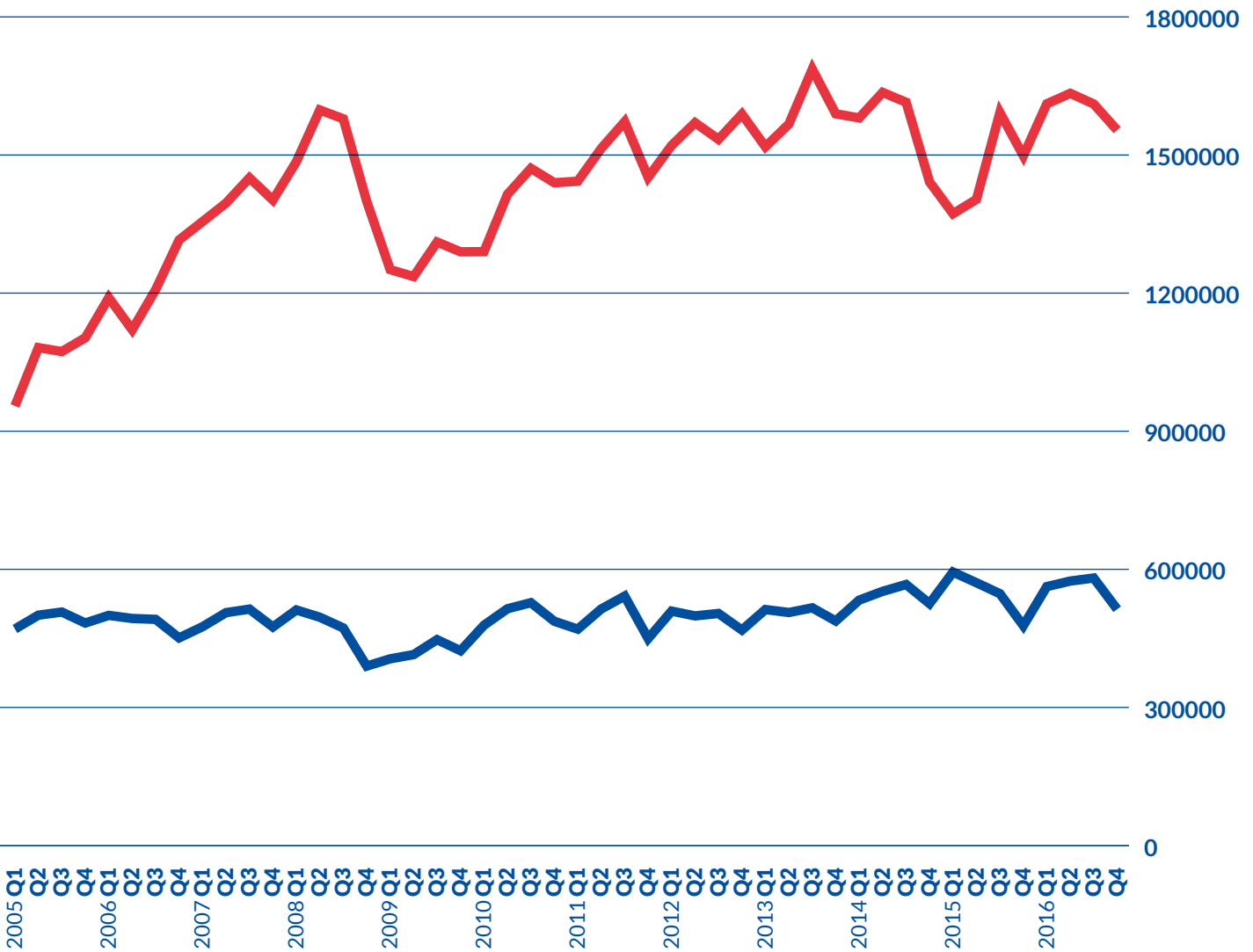


MARITIME CONTAINER TRAFFIC IN THE MAIN EUROPEAN SEAPORTS IN 2016

	Mio tonnes in 2016	Rate of change	Mio TEU in 2016	Rate of change
Rotterdam	127.1	+0.7%	11.7	+0.8%
Antwerp	118	+4%	9.9	+5.6%
Hamburg	91.7	+1.2%	8.9	+1.0%

Source: Port of Rotterdam, Port of Antwerp, Statistical Office for Hamburg/Port of Hamburg

VOLUME OF CONTAINERS TRANSPORTED ON GERMAN RAILWAYS AND ON THE TRADITIONAL RHINE (TEU)



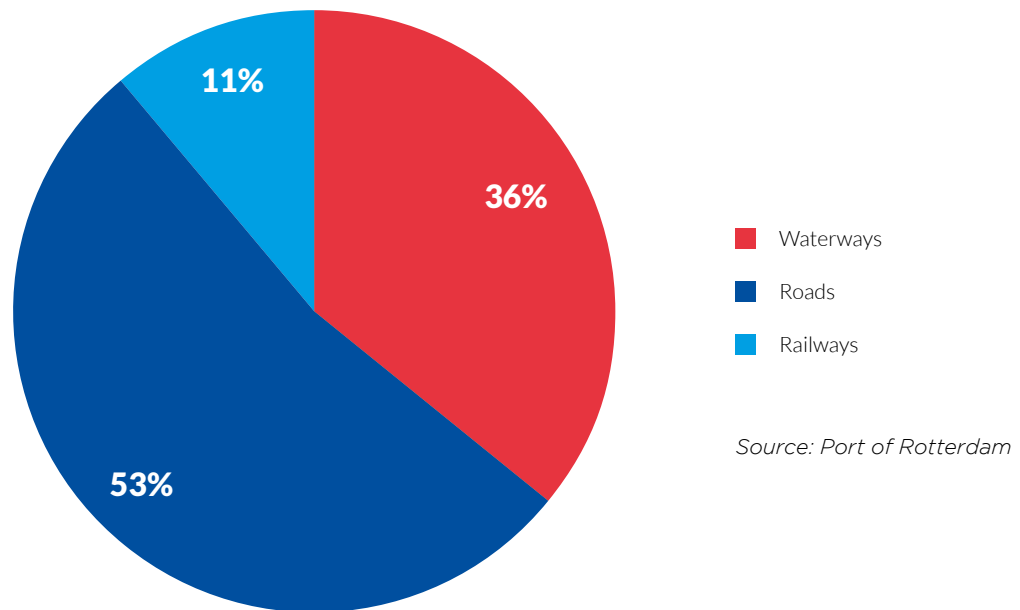
German railways

Traditional Rhine

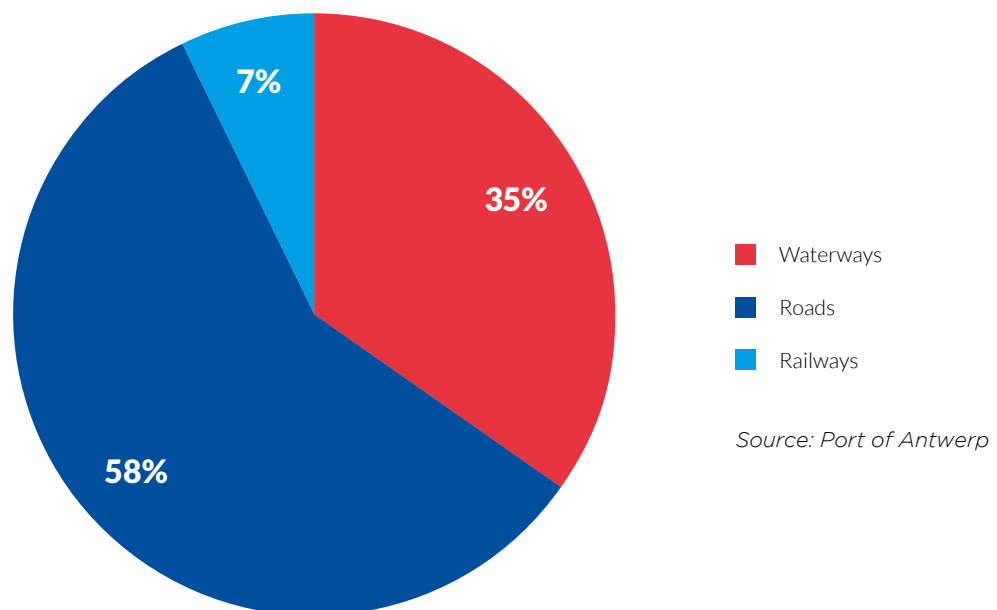
Source: Eurostat, Destatis, CCNR

Since 2005, yearly German railways container traffic has increased by 52% to 6.4 million TEU while hinterland traffic on the Traditional Rhine has increased by 13.7% to 2.2 million TEU. In the period 2005-2008, a strong increase was observed for the railways, while the fluvial remained constant. After the 2008 economic crisis, the traffic revival was faster for the fluvial sector, whereas it took three years for the German railways to regain pre-crisis traffic levels. In the period 2014-2015, container traffic experienced significant growth in the Port of Antwerp that benefitted to a greater extent the container traffic on the Rhine than on German railways. In 2016, German railways container traffic increased by 9.3%, while hinterland traffic on the Traditional Rhine increased by only 1.9%.

MODAL SPLIT OF CONTAINER HINTERLAND TRANSPORT IN THE PORT OF ROTTERDAM IN 2016



MODAL SPLIT OF CONTAINER HINTERLAND TRANSPORT IN THE PORT OF ANTWERP IN 2016



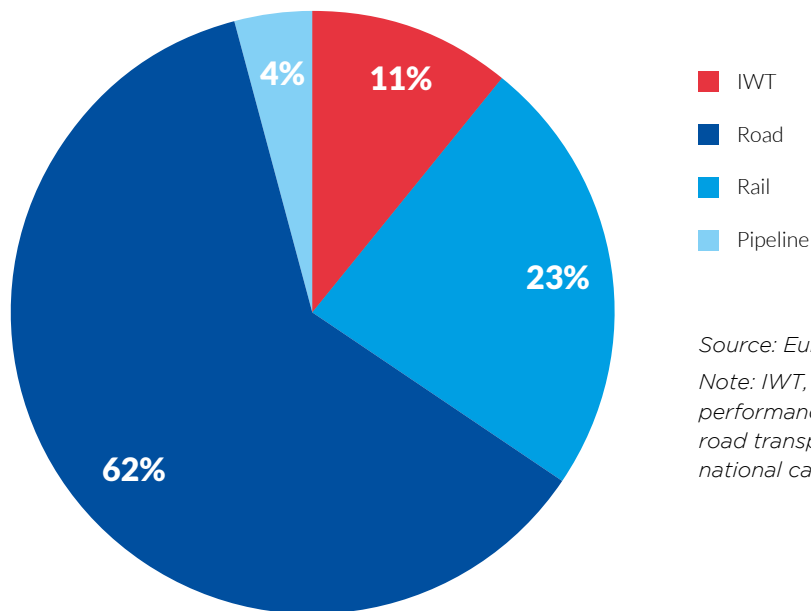
In Hamburg, container inland shipping had a modal split share of only 2.1%, which is a rather low share compared to the ports of Antwerp and Rotterdam. At least container inland shipping increased by 2.8% in Hamburg in 2016 in terms of TEU (Source: Statistical Office for Hamburg/Port of Hamburg).

When a large network of waterways is accessible from the sea port, as is the case in the Netherlands and Belgium, inland waterways remain one of the most widely used modes of transport. This is the case of the Lower Rhine basin, which absorbs more than one-third of the containerized cargo from the ports of Rotterdam and Antwerp, while rail modal share lies around 10%.

INLAND NAVIGATION AND OTHER MODES OF TRANSPORT

IN GERMANY

SHARE OF TRANSPORT PERFORMANCE FOR TRANSPORT OF ALL GOODS BY MODE OF TRANSPORT IN GERMANY (MODAL SHARE IN % OF 2015 ANNUAL TRANSPORT PERFORMANCE)



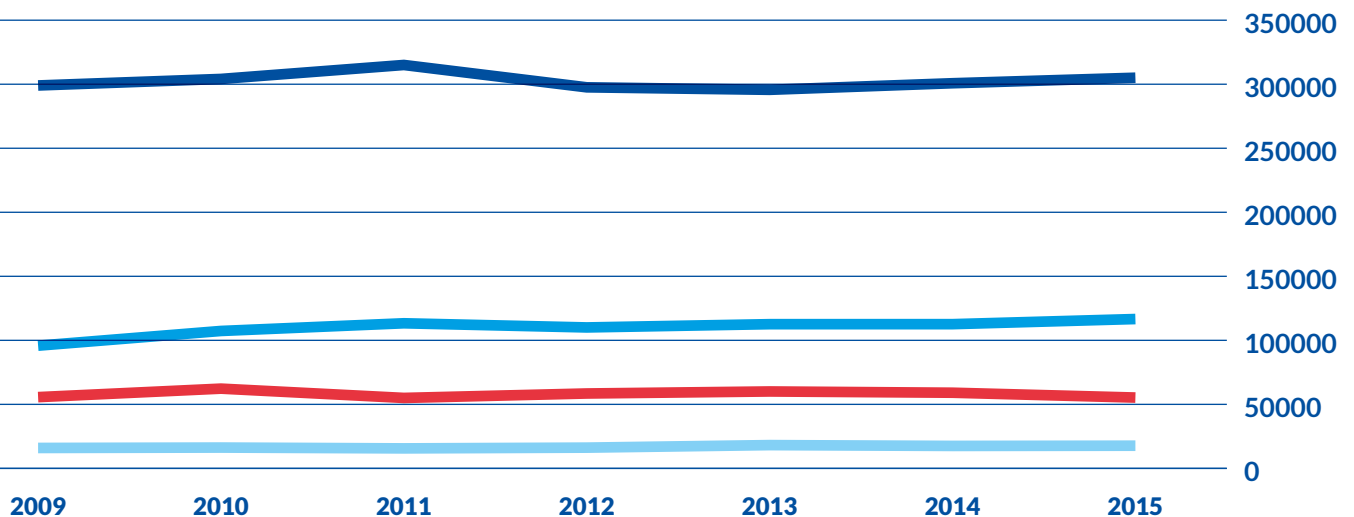
Source: Eurostat

Note: IWT, rail and pipeline transport performance on national territory/ road transport performance by national carriers

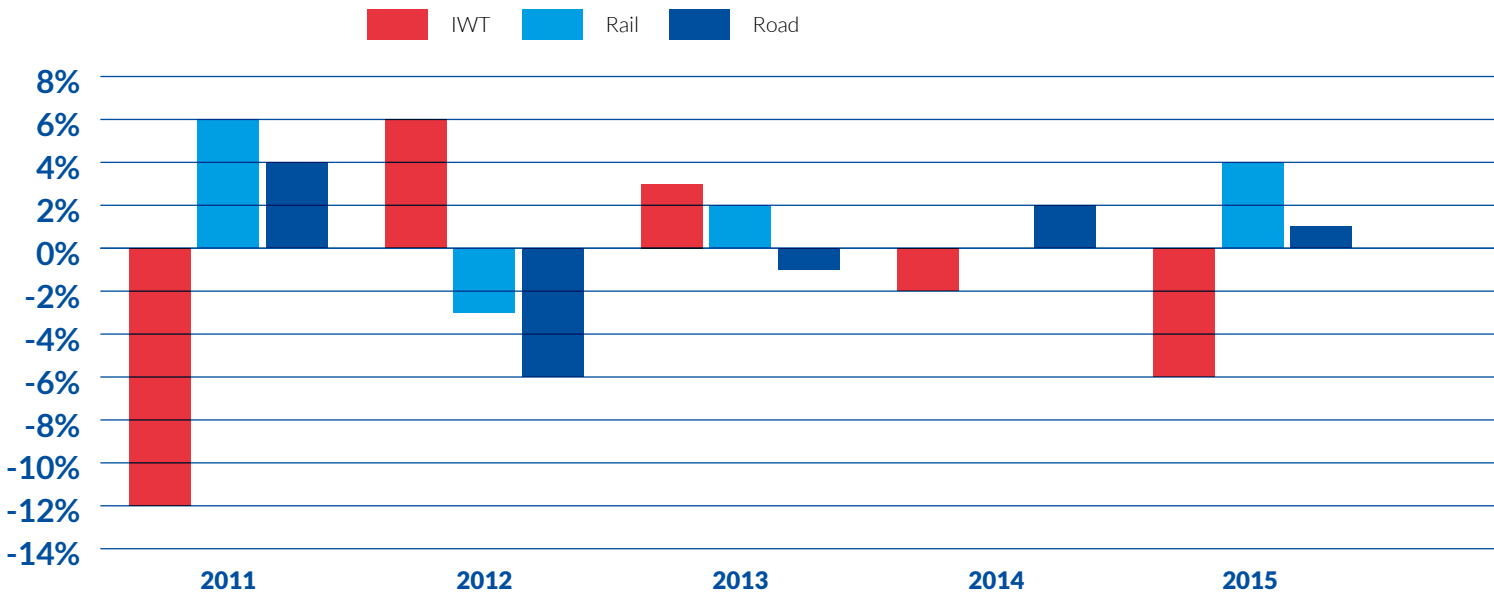
EVOLUTION OF TRANSPORT PERFORMANCE FOR ALL MODES OF TRANSPORT IN GERMANY (YEARLY TOTAL TRANSPORT PERFORMANCE IN MILLION TKM)

Road Rail IWT Pipeline

Source: Eurostat

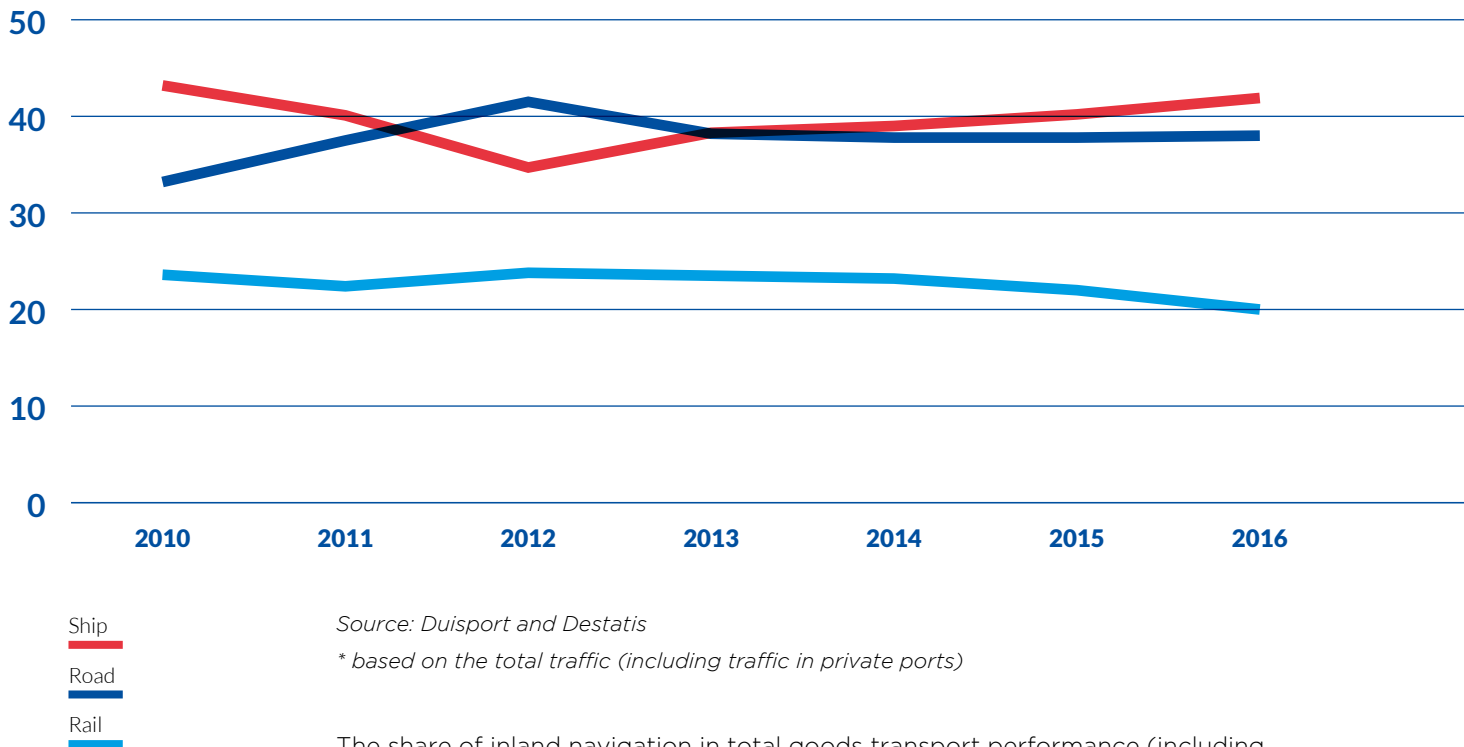


YEARLY RATE OF CHANGE OF TOTAL TRANSPORT PERFORMANCE PER MODE OF TRANSPORT IN GERMANY (RATE OF CHANGE IN %)



Source: Eurostat, CCNR analysis

MODAL SPLIT IN THE MAIN INLAND NAVIGATION PORT IN EUROPE, THE PORT OF DUISBURG* (MODAL SHARE IN %)



Source: Duisport and Destatis

* based on the total traffic (including traffic in private ports)

The share of inland navigation in total goods transport performance (including pipeline transport) is 11% in Germany. It is higher than the average throughout the European Union; Germany indeed enjoys a network of large waterways enabling a high level of inland navigation transport performance from the Elbe to the Rhine. Only two countries in Europe have greater weight of inland navigation in the share of total transport, the Netherlands and Belgium, with inland navigation shares reaching respectively 39% and 17% compared to rail and road transport.

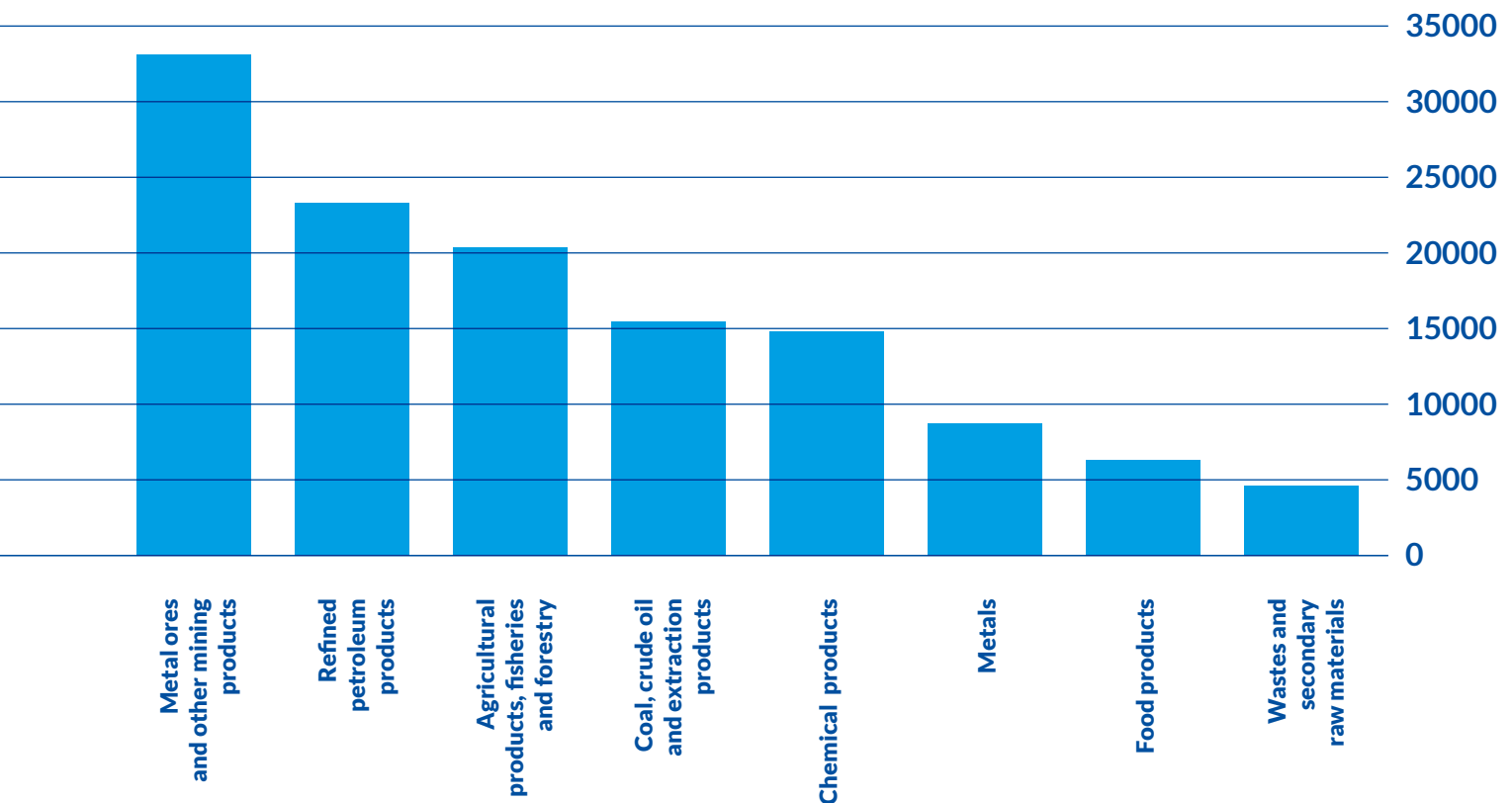
Inland navigation has maintained its modal share in Germany since 2009 at the same level, oscillating between 11% and 13%. The modal share of inland navigation was actually almost the same in 2009 as in 2015. The main change compared to the situation in 2009 concerns the rail and road transportation modes. Between 2009 and 2015, the modal share of rail increased by three percentage points while the modal share of road decreased by almost three percentage points at the same time.

The slight changes concerning inland navigation modal share in Germany seem to be caused by the low water period. Indeed, the modal share of inland navigation remains above 12% except in 2011 and in 2015 when it went down to 11%, and these two years experienced periods of low water conditions that impacted the loading degree of inland navigation vessels. It seems that rail and road benefited from a modal shift during these periods because the growth rates of these two transportation modes were positive during these two years while volumes transported by inland navigation decreased. On the contrary, in 2012, inland navigation enjoyed a positive growth rate because of a catch-up phenomenon and, at the same time, the volume of goods transported by road and rail decreased, highlighting the fact that inland navigation could gain back its modal share.

The recent modal share evolution in the Port of Duisburg (biggest inland port in terms of volumes of goods transhipped in Germany and in Europe) also highlights the current relative dynamism of inland navigation in ports. The modal share in the Port of Duisburg increased in 2016 to nearly 42%.

■ IN THE EUROPEAN UNION

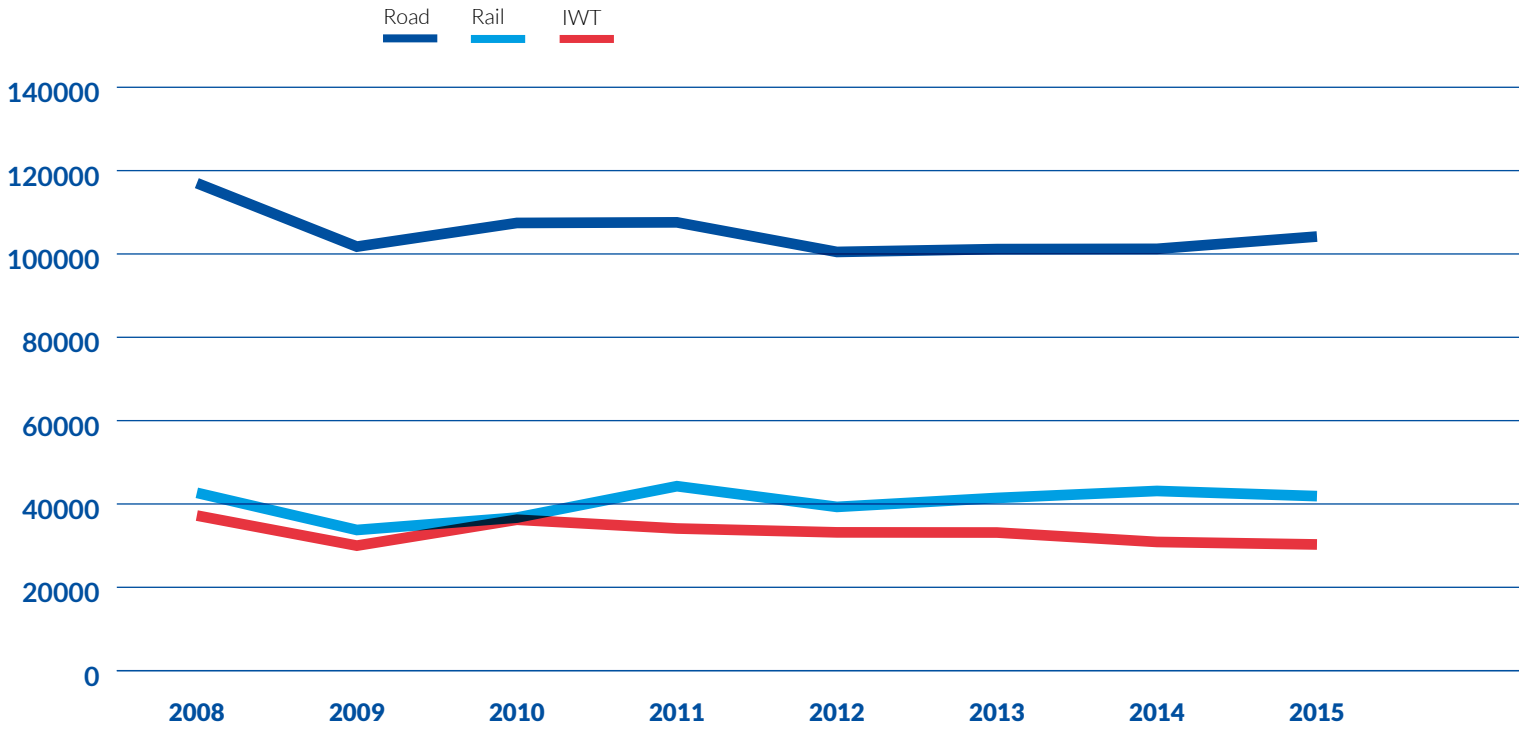
TOTAL INLAND NAVIGATION TRANSPORT PERFORMANCE IN THE EUROPEAN UNION PER TYPE OF GOODS (TRANSPORT PERFORMANCE IN MILLION TKM)



Source: Eurostat

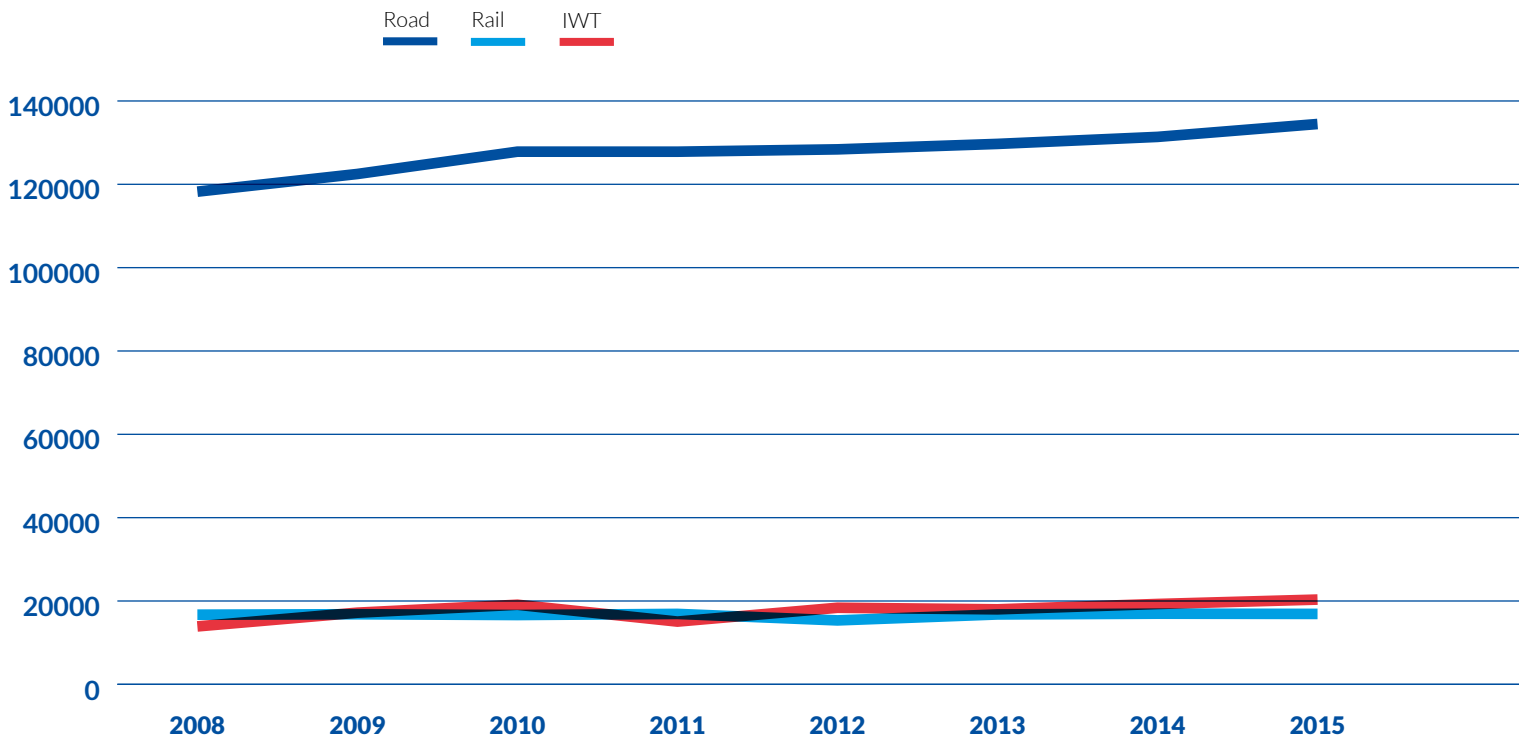
Note: NST 2007 goods categories are used.

IRON ORES TRANSPORT PERFORMANCE EVOLUTION IN THE EUROPEAN UNION
 (TRANSPORT PERFORMANCE IN MILLION TKM)



Source: Eurostat, CCNR analysis

AGRICULTURAL PRODUCTS TRANSPORT PERFORMANCE EVOLUTION IN THE EUROPEAN UNION
 (TRANSPORT PERFORMANCE IN MILLION TKM)



Source: Eurostat, CCNR analysis

The eight types of goods highlighted on the previous graph (iron ores, petroleum products, agricultural products, crude oil, chemical products, metals, foodstuffs and wastes) represent 97% of the total transport performance of inland navigation in the European Union.

The modal share of inland navigation can be very high for these types of goods, and inland waterways can almost be the exclusive mode of transport in some regions of Europe. The modal share (compared to rail and truck) can, for example, reach 90% for refined petroleum products in the Netherlands. And even at the European level, inland navigation maintains a significant market share for these types of goods despite constraints related to the availability of suitable waterways.

Taking a closer look at the two main dry cargo products transported by inland navigation in Europe, IWT has a modal share of approximately 20% for iron ores and approximately 10% for agricultural products at the European level (taking into account 15 EU countries with inland navigation activity).

The transport of iron ores is impacted by the worldwide competition faced by the European steel industry, and the volume of iron ores transported by all modes of transport in Europe has decreased since 2008. The decrease is particularly true for inland navigation because this mode of transport also experienced a decrease of the modal share from 19% to 17% between 2008 and 2015. The main beneficiary of the decrease was rail transport while road transport maintained a modal share right below 60%.

The transport of agricultural products is a more dynamic segment with continuous growth since 2008 for the total volume transported by all transportation modes. The modal share of IWT is smaller for agricultural products than for iron ores transport but the tendency in terms of modal share is more positive. Since 2008, the modal share of inland navigation has increased from 9.3% to 11.8% while both the modal shares of rail and road decreased over the same period.





03

GOODS TRANSSHIPMENT IN INLAND PORTS

- Volume of goods transported in 10 main Rhine ports increased by 2% and container volume transported in 10 main Rhine container ports increased by 3% in 2016.
- Seven out of nine main inland Danube ports experienced positive growth in goods transshipment in 2016, mainly boosted by steel industry activity.
- Most of the European inland ports specialized in goods based on the steel industry and building industry enjoyed positive growth rates in 2016.

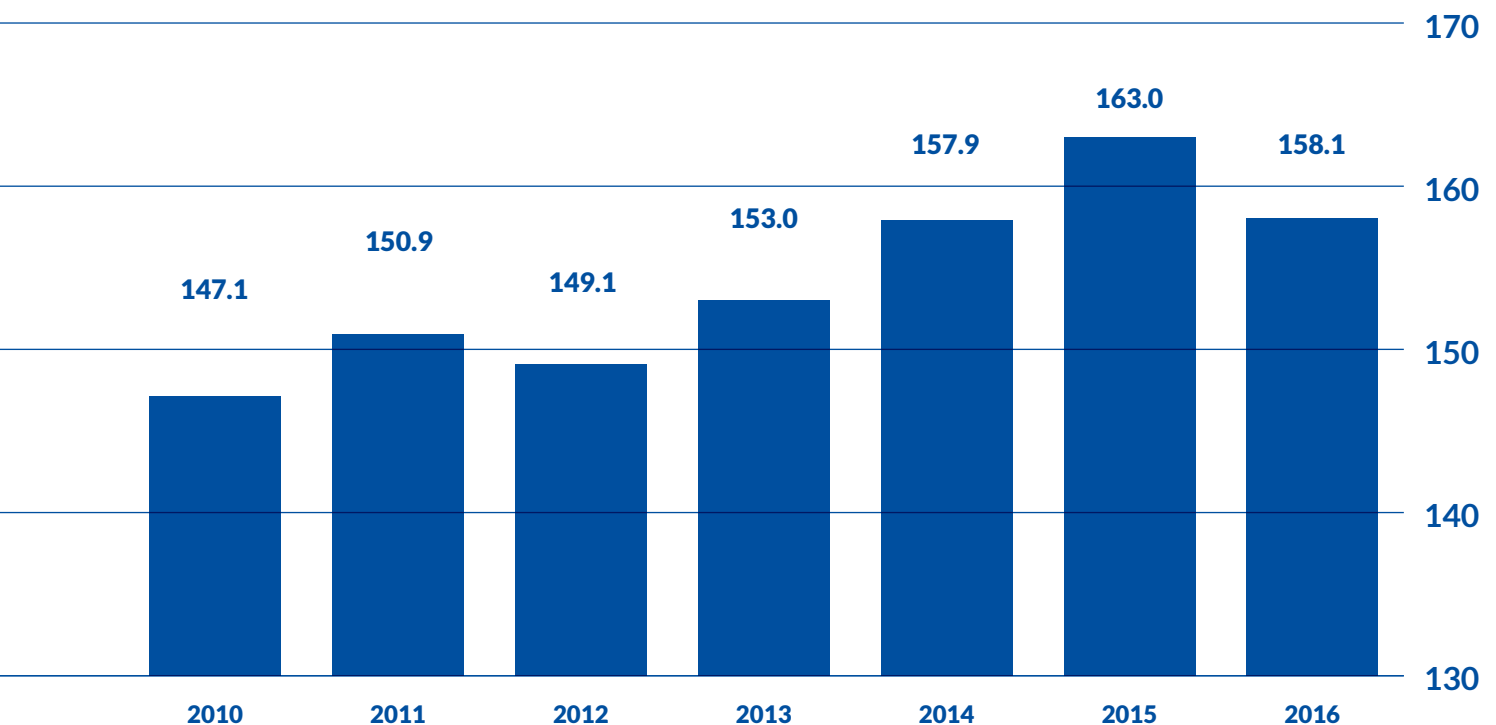


INLAND WATERWAY TRAFFIC

IN THREE MAIN EUROPEAN SEAPORTS

In **Rotterdam**, around 100,000 inland vessels frequented the port in 2016, compared to 110,000 vessels in 2015.³ Also, the volume of goods traffic by IWT decreased (-3%) in 2016. IWT has very high shares in the hinterland traffic: 86% for dry cargo, 40% for liquid cargo and 36% for containers. The port has the objective to increase this last share above the 40% level.

INLAND WATERWAY TRAFFIC IN THE SEAPORT OF ROTTERDAM (MILLION TONNES)

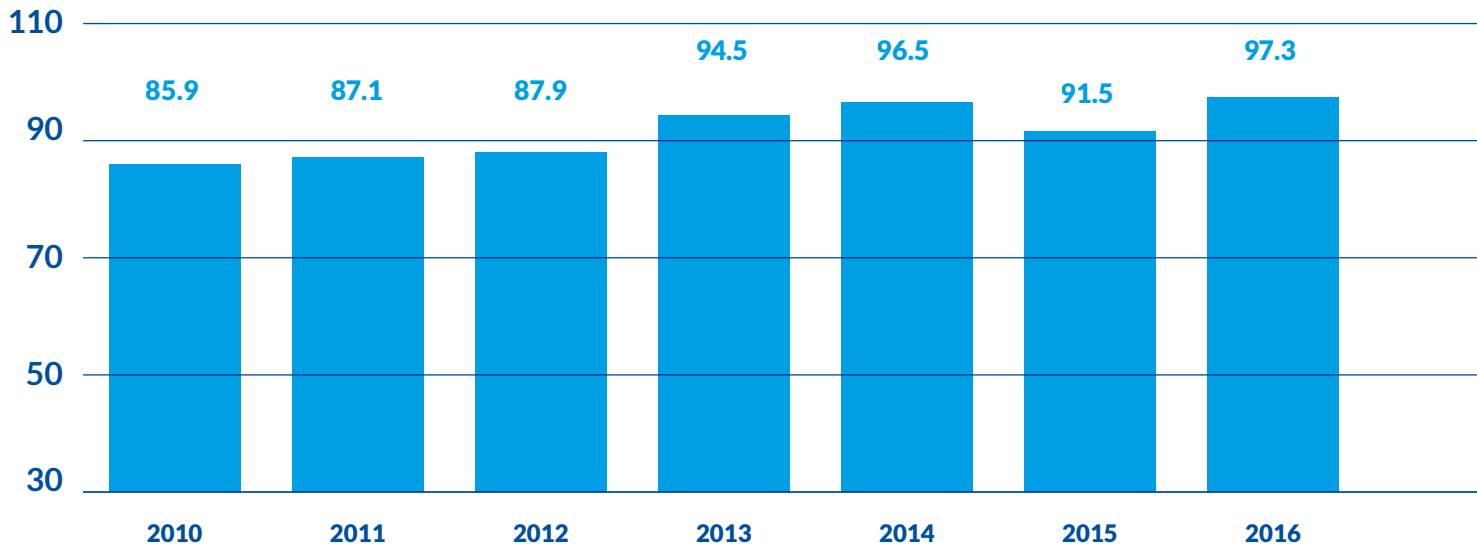


Source: Port of Rotterdam

³Source: Port of Rotterdam website

In **Antwerp**, 58,006 inland vessels frequented the port in 2016, with goods traffic of 97.3 million tonnes (+6.3%). Important IWT goods segments are liquid cargo (55%) and machines and containerized goods (25%). IWT traffic grew strongly in Antwerp over the past years: the level in 2016 was 13% higher than in 2010. The overall modal share of IWT is almost 40%.

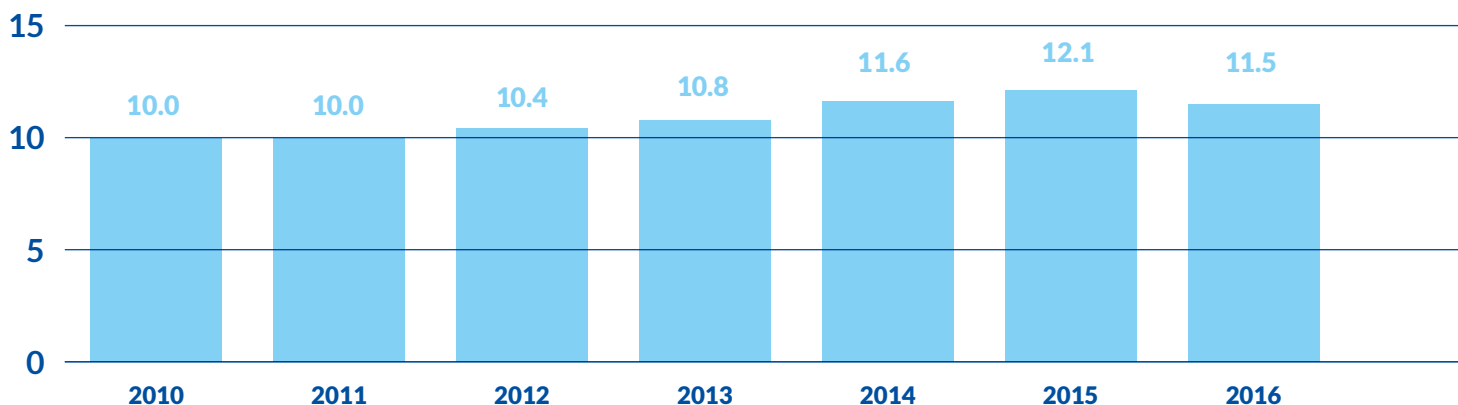
INLAND WATERWAY TRAFFIC IN THE SEAPORT OF ANTWERP (MILLION TONNES)



Source: Port of Antwerp

In **Hamburg**, 20,382 inland vessels frequented the port in 2016, transporting 11.5 million tonnes of cargo. Dry cargo (55%) and liquid cargo (33%) account for the majority, and containers for 10%. The overall modal share of IWT stands at 11.5%, which is clearly lower than in Rotterdam and Antwerp. This is due to the weak position of IWT in container traffic (2%), while IWT has a high modal share in liquid cargo traffic (40%), and also in dry mass cargo traffic (20%).

INLAND WATERWAY TRAFFIC IN THE SEAPORT OF HAMBURG (MILLION TONNES)



Source: Statistical Office of Hamburg

The differences in the modal split between the western seaports (Rotterdam, Antwerp) and the Port of Hamburg explain to a certain extent the differences in the inland shipping transport volumes in the respective hinterland regions: the Rhine region with its high volume of IWT traffic on the one hand, and the Elbe region with a relatively limited IWT transport level on the other hand.

EVOLUTION OF GOODS TRAFFIC IN 2016 IN EUROPEAN INLAND PORTS

RHINE PORTS

The following table and figure show the evolution of waterside goods traffic in the year 2016 compared to 2015 for the ten Rhine ports with the highest goods traffic. The rate of change for the total waterside traffic in these ports was around 2% in 2016 compared to 2015.

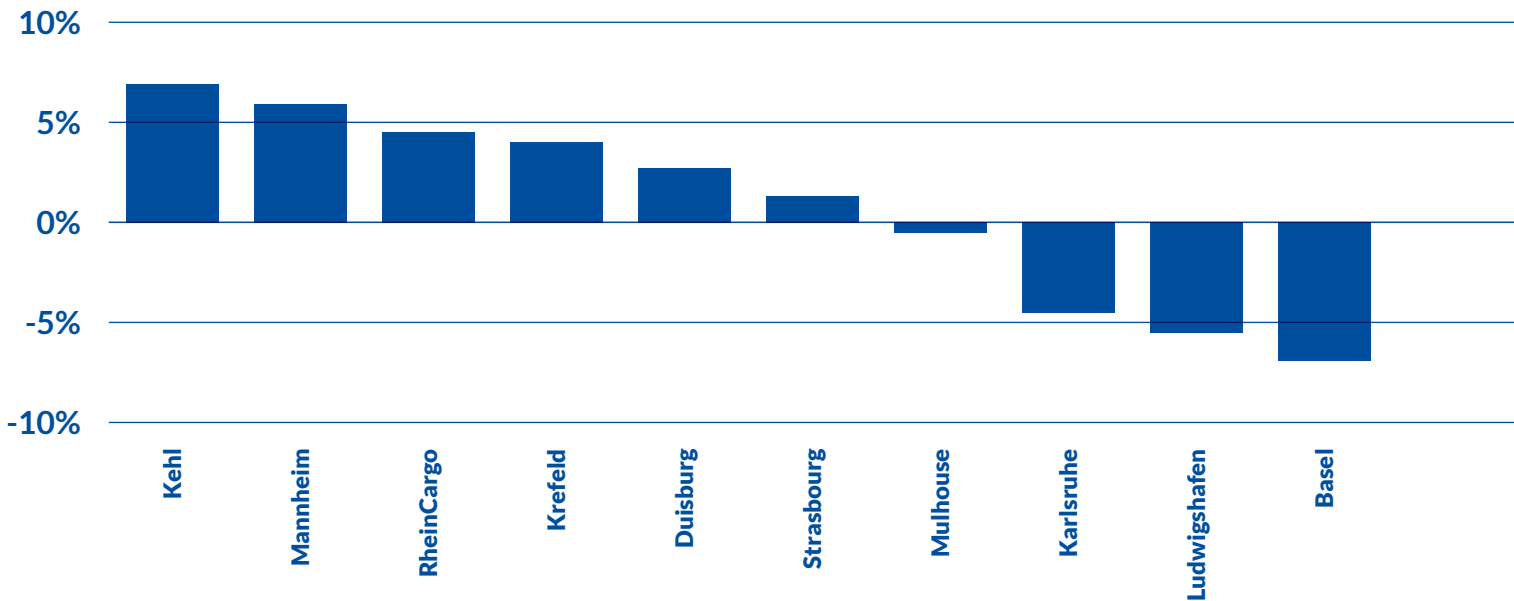
WATERSIDE GOODS TRAFFIC IN TEN MAJOR RHINE PORTS (MILLION TONNES)

	2015	2016	2016/2015
Duisburg	54.1	55.6	+3%
RheinCargo*	17.4	18.1	+5%
Mannheim	8.2	8.7	+6%
Strasbourg	7.4	7.5	+1%
Ludwigshafen	7.4	6.9	-7%
Karlsruhe	6.5	6.2	-4%
Basel	6.3	5.9	-7%
Mulhouse	4.9	4.9	-1%
Kehl	3.2	3.5	+7%
Krefeld	3.0	3.2	+4%
Total	118.4	120.5	+2%

Source: Destatis and ports mentioned

*RheinCargo is a multimodal port and logistics company that operates seven ports in Cologne, Neuss and Düsseldorf.

YEARLY RATE OF CHANGE OF WATERSIDE GOODS TRAFFIC IN MAJOR RHINE PORTS IN 2016 (RATE OF CHANGE IN %)



Source: Destatis and ports mentioned

Duisburg: waterside goods traffic in the largest European inland port increased by almost 3% in 2016, reaching a volume of 55.6 million tonnes. Within the modal split, inland shipping gained further market shares, reaching 42%, while rail transport lost market shares down to 20% and road transport maintained a market share of 38% between 2015 and 2016. This high market share of IWT in goods traffic is due to the activity of the steel industry in Duisburg, which receives large amounts of raw materials (iron ore, coal) by ship.

Cologne-Neuss-Düsseldorf: the port and logistics group RheinCargo operates seven ports in Cologne, Neuss and Düsseldorf, with waterside traffic of 18.1 million tonnes and total traffic (all modes) of 28 million tonnes in 2016. The modal split share of IWT was 65% both in 2015 and in 2016. While river traffic increased in 2016, rail traffic lost 4%. According to Rhein Cargo⁴, railway transport is faced with fierce competition from road transport, due to low fuel prices in the road transport sector since the end of 2014.

Mannheim: traffic was promoted by growth in mineral oil products and coal. In Kehl on the Upper Rhine, scrap steel for the local steelwork had a strong recovery, after the low water levels of the year 2015 which had hindered those transport flows.

In the largest European inland port,
the Port of Duisburg, inland waterside traffic
has a share of

42%
of total traffic activities

⁴ Press release of RheinCargo from March 10th 2017

CONTAINER TRAFFIC IN RHINE PORTS

For the container segment, the rate of change of the total waterside container traffic in the ten largest container Rhine ports was 3% in 2016 compared to 2015.

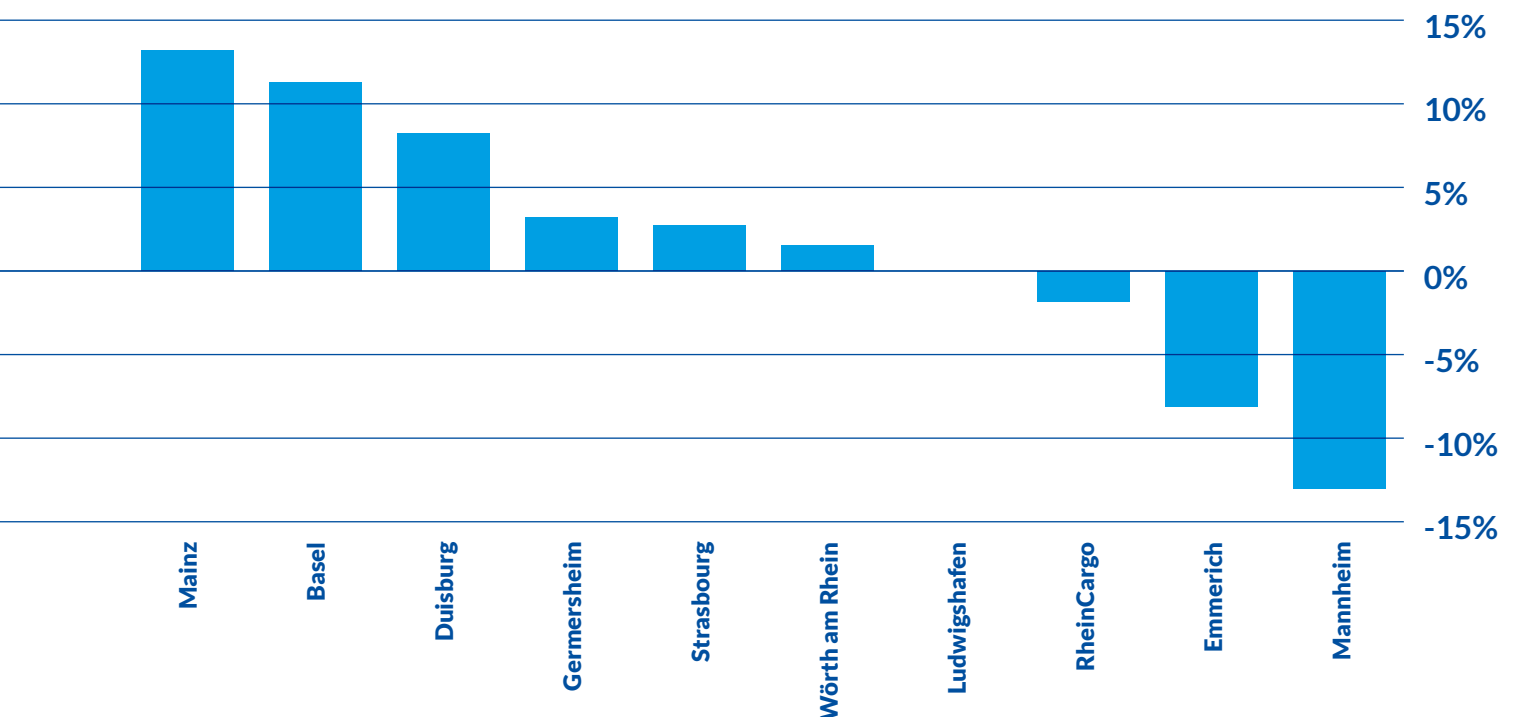
WATERSIDE CONTAINER TRAFFIC IN TEN MAJOR RHINE PORTS FOR CONTAINERS

Port	TEU 2015	TEU 2016	TEU 2016/2015
Duisburg	475 461	514 649	+8%
RheinCargo*	303 955	298 373	-2%
Germersheim	152 574	157 531	+3%
Wörth am Rhein	125 817	127 729	+2%
Mainz	111 522	126 206	+13%
Mannheim	134 311	116 891	-13%
Basel	102 916	114 498	+11%
Emmerich	117 114	107 582	-8%
Strasbourg	102 432	105 168	+3%
Ludwigshafen	97 488	97 221	+/-0%
Total	1 723 590	1 765 848	+3%

Source: Destatis and ports mentioned

*RheinCargo is a multimodal port and logistics company that operates seven ports in Cologne, Neuss and Düsseldorf.

YEARLY RATE OF CHANGE OF WATERSIDE CONTAINER TRAFFIC (TEU) IN THE TEN LARGEST CONTAINER PORTS ON THE RHINE IN 2016

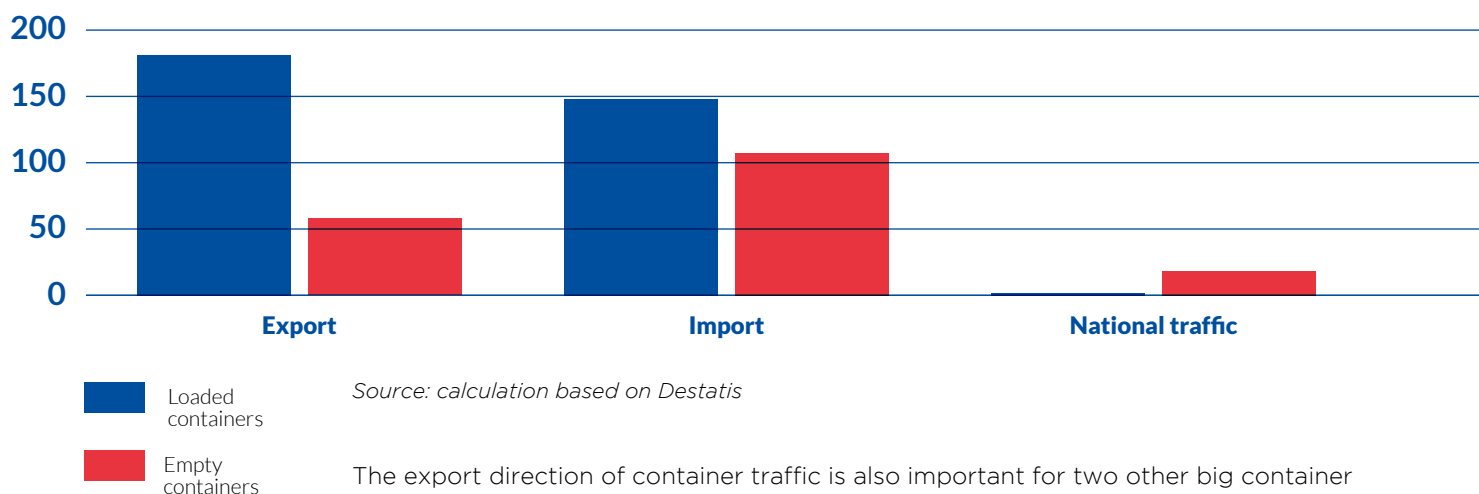


Source: Destatis and ports mentioned

The biggest European inland port, Duisburg, holds this position also in container traffic. In 2016, container transport represented 10.4% of total waterside traffic in Duisburg, which amounted to 5.4 million tonnes⁵ and 514,649 TEU (+8%). 20 foot and 40 foot containers are the two most common types, with a share of 43% and 55% of all containers handled.

As container shipping is part of international logistical chains, it is only logical to observe that 96% of waterside container traffic in Duisburg is international traffic (50% is export, and 46% import). Export traffic goes mainly downstream on the Rhine to the ARA seaports (Amsterdam – Rotterdam – Antwerp), and 77% of these export containers were loaded in 2016, and only 23% were empty.⁶ This shows that inland waterway container traffic plays an important role for the exports of manufactured goods via the ARA seaports to overseas. Within the import traffic, the ratio of loaded to empty containers was 58% loaded versus 42% empty. This reflects that many empty containers are redirected by maritime container shipping companies to the terminals in the hinterland, in order to be refilled and used for exporting goods again. For the entire Traditional Rhine, a very similar structure to the one in the Port of Duisburg is observable (see chapter on containers in this report).

STRUCTURE OF WATERSIDE CONTAINER TRAFFIC IN THE PORT OF DUISBURG (THOUSANDS TEU)



The export direction of container traffic is also important for two other big container ports on the Rhine: Germersheim and Wörth/Rhein - both at the Upper Rhine near Karlsruhe, only 20 km in distance from each other. Their waterside traffic is largely influenced by the presence of a German automobile company. In Wörth there is the world's largest production site for trucks, and trucks are exported in components per container to overseas. In the Port of Germersheim, the same company has a large storage centre for truck spare parts, from which wholesalers all over the world are supplied - by ship, train and truck.⁷

In the Port of Mannheim, the decrease in 2016 was not caused by lower transport demand, but instead by the extension of the container terminal in order to absorb the increasing demand better in the future. Due to the extension work, the transshipment activity in 2016 was hindered.

77% of all export container traffic in the Port of Duisburg consists of loaded containers.

⁵ Weight transported by container shipping includes the weight of the container boxes.

⁶ Source: calculation CCNR based on Destatis data

⁷ www.media.daimler.com

FRENCH AND BELGIAN INLAND PORTS

The rate of change of the total waterside port traffic in the ten largest French and Belgian inland ports was slightly positive in 2016 (+2%).

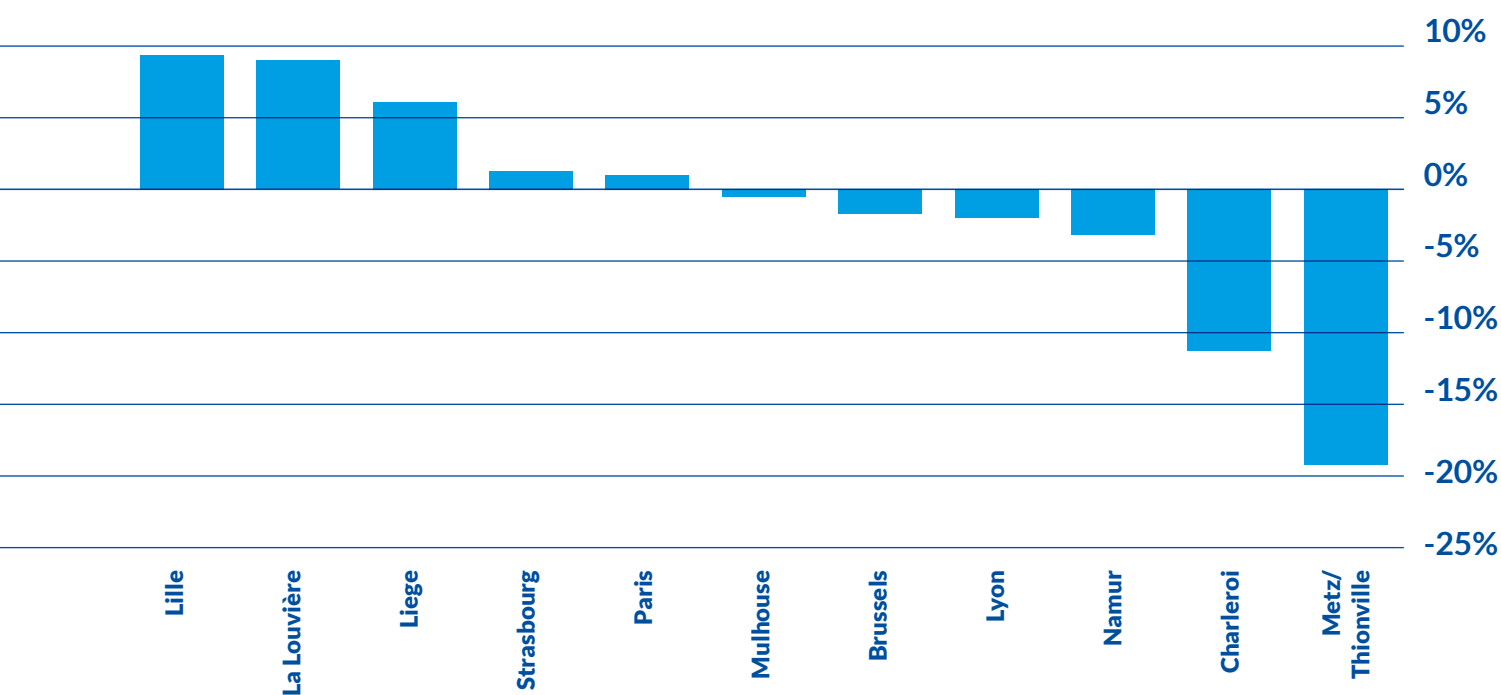
WATERSIDE TRAFFIC IN TEN MAJOR FRENCH AND BELGIAN INLAND PORTS (MILLION TONNES)

	2015	2016	2016/2015
Paris	20.3	20.3	+1%
Liège	14.6	15.5	+6%
Strasbourg	7.4	7.5	+1%
La Louvière *	5.9	6.5	+9%
Namur	5.1	5.2	-3%
Brussels	4.4	4.3	-2%
Metz/Thionville	2.5	2.0	-19%
Lille	1.5	1.7	+9%
Lyon	1.4	1.4	-2%
Charleroi	1.6	1.4	-10%
Total	64.7	65.8	+2%

Source: ports data.

*Port Autonome du Centre et de l'Ouest (PACO)

YEARLY RATE OF CHANGE OF WATERSIDE GOODS TRAFFIC IN THE TEN LARGEST FRENCH AND BELGIAN INLAND PORTS IN 2016



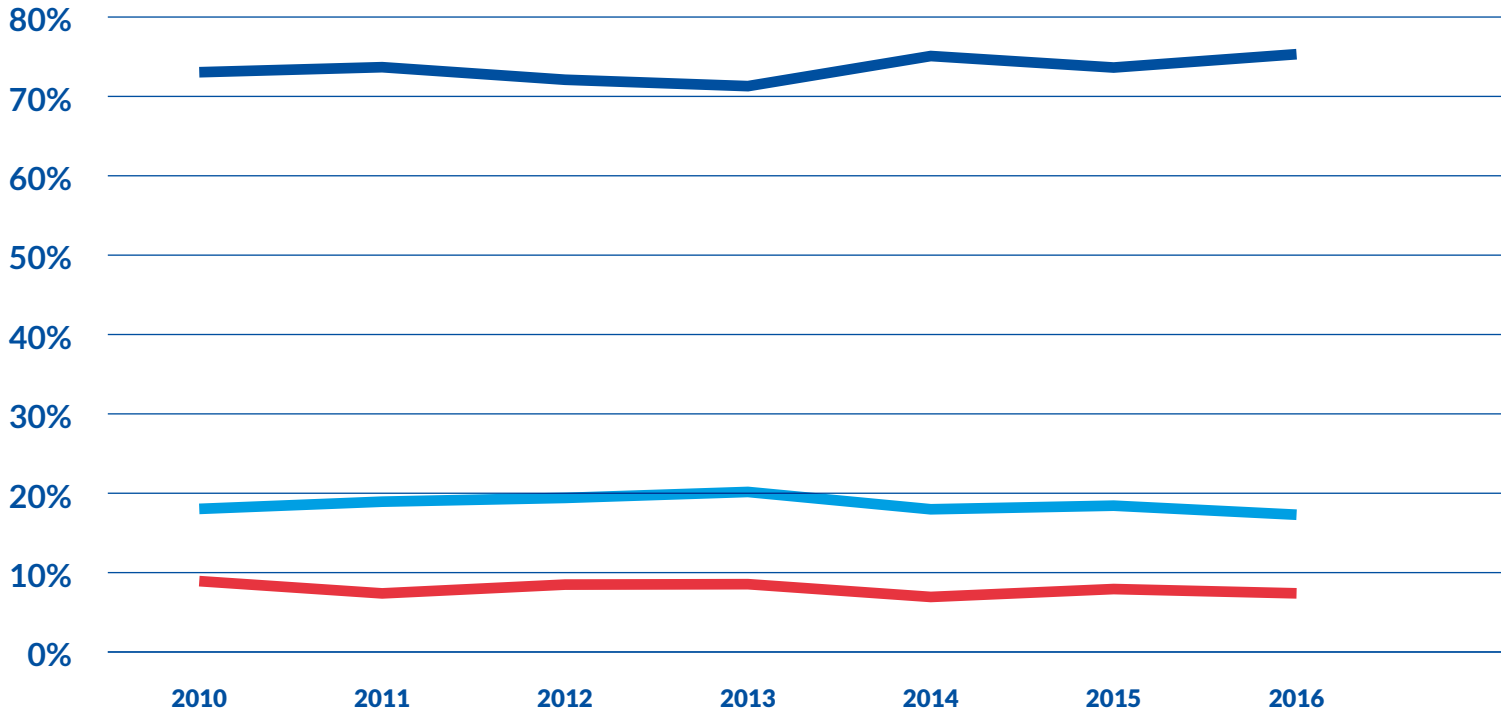
Source: ports data

The Port of Paris is, with a waterside traffic of more than 20 million tonnes per year, among the three biggest inland ports in Europe. In 2016, the two largest product segments (sands, stones and building materials; agricultural products) witnessed very different evolutions. While building materials increased strongly, promoted by large infrastructure work in Paris, grain traffic decreased due to bad harvest results. Another French port, the Port of Metz, where IWT has a modal share of 45%, suffered even more from bad harvest results in 2016. Grain represents 92% of total traffic in Metz, which explains the strong decline in 2016.

The Port of Liège is, after Duisburg, Paris and RheinCargo, the fourth largest European inland port. The increase of 6% in 2016 came mainly from sands, stones and building materials (+2%), metals (+10%), and wood pellets (+130%). These pellets, imported from the Netherlands, are used as raw material by a biomass electricity power plant on the river Meuse. This plant is one of only two electricity plants in Belgium producing with biomass. Another example of the “green diversification” in the port is a new bioethanol production site (BioWanze) on the river Meuse, which uses wheat and sugar beet (0.6 million tonnes, + 16% in 2016) as raw material for the production of alternative fuels.

According to data provided by the port, the modal split share of IWT in Liege had a positive trend in the last 20 years, and reached 75% in 2016. The last time that the IWT modal split share in Liege was higher than 75% was in the year 1990.

MODAL SPLIT IN THE PORT OF LIEGE



Ship
Road
Rail

Source: Port of Liege

In the Port of Lille, the strong traffic growth is explained by an increase in the segments of stones and building materials, metals and containers. This offsets the reduction in agricultural products.

CONTAINER TRAFFIC IN FRENCH AND BELGIAN INLAND PORTS

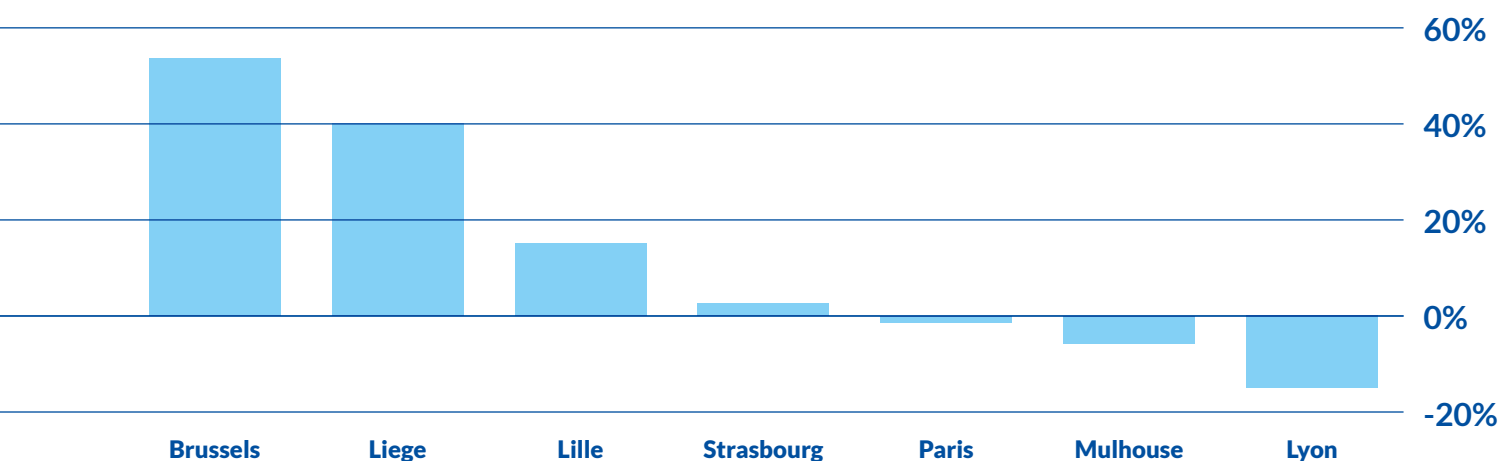
The evolution of the waterside port traffic in the largest French and Belgian inland ports for container traffic was very positive in 2016 (+8%). Examples are the dynamic growth in Brussels and Liege, where container traffic is growing thanks to active promotion by the port authorities. Positive evolutions are also the growing urban container transport in Paris, and the evolution of the Port of Lille to a container hinterland hub for western seaports.

WATERSIDE CONTAINER TRAFFIC IN MAJOR FRENCH AND BELGIAN INLAND PORTS

	TEU 2015	TEU 2016	2016 / 2015
Paris	163 916	161 261	-1%
Strasbourg	102 432	105 168	+3%
Liège	40 665	56 862	+40%
Lille	44 352	50 929	+15%
Brussels	19 465	29 895	+53%
Mulhouse	30 438	28 690	-5%
Total	401 268	432 805	+8%

Source: ports mentioned.

EVOLUTION OF WATERSIDE CONTAINER TRAFFIC (TEU) IN SEVEN MAJOR FRENCH AND BELGIAN CONTAINER INLAND PORTS IN 2016 COMPARED TO 2015



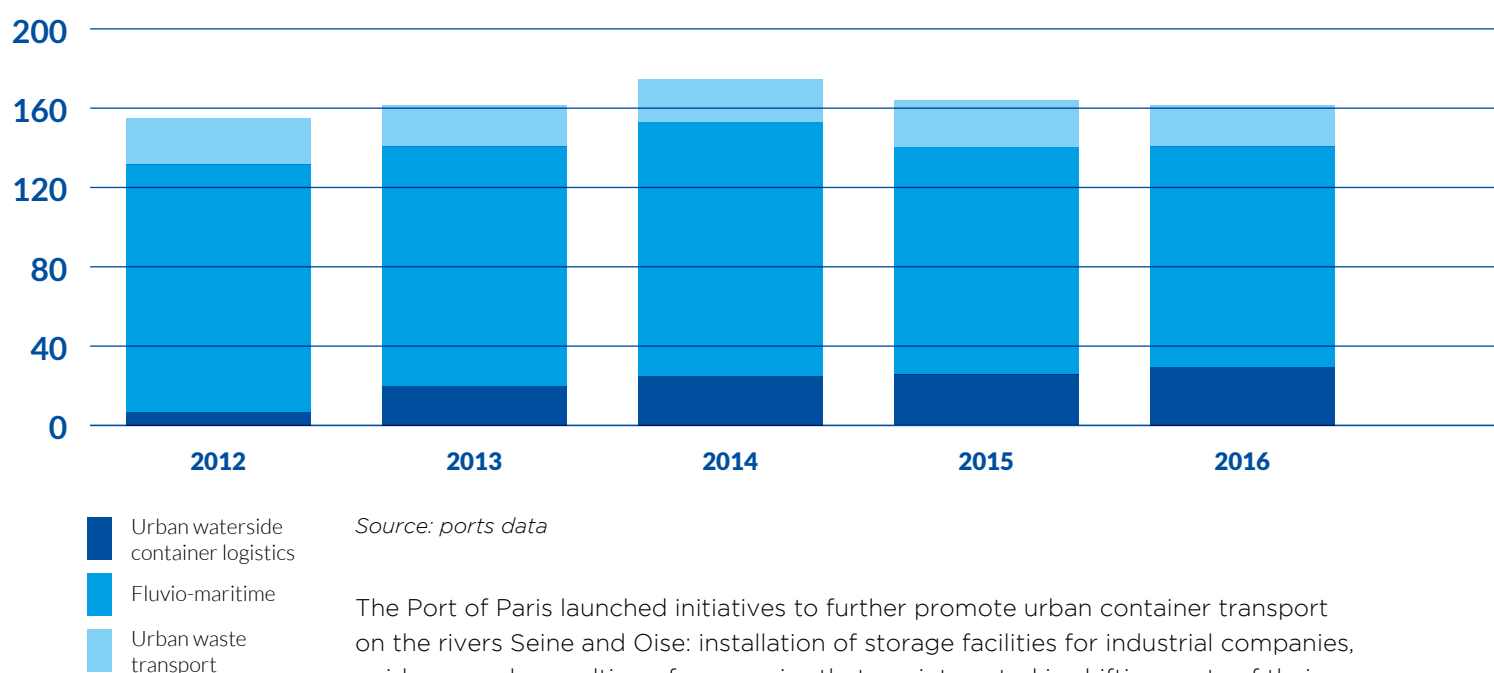
Source: ports mentioned

In the Port of Brussels, a very dynamic evolution of container traffic has been present since 2015. According to the port, this can be explained by the arrival of a new operating company for the container terminal, which significantly increased the waterway activity of the terminal. About 40% of goods transshipment per container in Brussels are metals. They are transported by container shuttle services between Brussels and the Seaport of Antwerp.

Waterside container traffic increased by 40-53% in 2016 in the inland ports of Liege and Brussels.

The Ports of Paris registered a waterside container traffic of 161,261 TEU in 2016. Although this represented a small decrease of 1.4%, the positive aspect was further strong growth in the segment of urban container traffic on the river Seine of 14.6%. Within this type of transport, food products for supermarkets are delivered by container barges on the rivers Seine and Oise in Paris. Container inland shipping had a modal split share of 33% in total container traffic in the Ports of Paris in 2016, which was also its average share during the time period 2010-2016.

STRUCTURE OF CONTAINER TRANSPORTS ON RIVERS IN PARIS (THOUSANDS TEU)



The Port of Paris launched initiatives to further promote urban container transport on the rivers Seine and Oise: installation of storage facilities for industrial companies, guidance and consulting of companies that are interested in shifting parts of their logistical activities from road to inland waterway traffic. The benefits for the city of Paris consist of a reduction of emissions, fewer traffic problems and fewer accidents and related social costs.

In Paris, urban waterside container traffic is on an upward trend, promoted by a modal shift from road to IWT.

The Port of Lille reached a new record level in waterside container traffic in 2016. IWT has a modal share of 39% in total container traffic. Lille is in a very favorable geographic position, as it is near to major seaports (Dunkerque, Calais, Antwerp), and can serve as a kind of hinterland hub for container traffic.

The Port of Lyon, in the hinterland of the Seaport of Marseille on the river Rhône, has two container terminals, depots for mineral oil products and also private port activities. In 2016, the overall waterside traffic decreased by 2%, and the container traffic by 15%. This was caused by too high water levels on the Rhône in the first half of the year, which prevented three-layer container transport between Marseille and Lyon. Besides, strikes in the Port of Marseille (against the "Loi Travail") had negative effects on the fluidity of the hinterland transport from Marseille and therefore on the port traffic in Lyon as well.⁸

⁸ Strikes against the new labour legislation in France were present in all French seaports (notably Le Havre, Marseille, Dunkerque) in 2016 and had a negative impact on the traffic not only in Lyon, but in Paris and Lille as well.

DANUBE PORTS

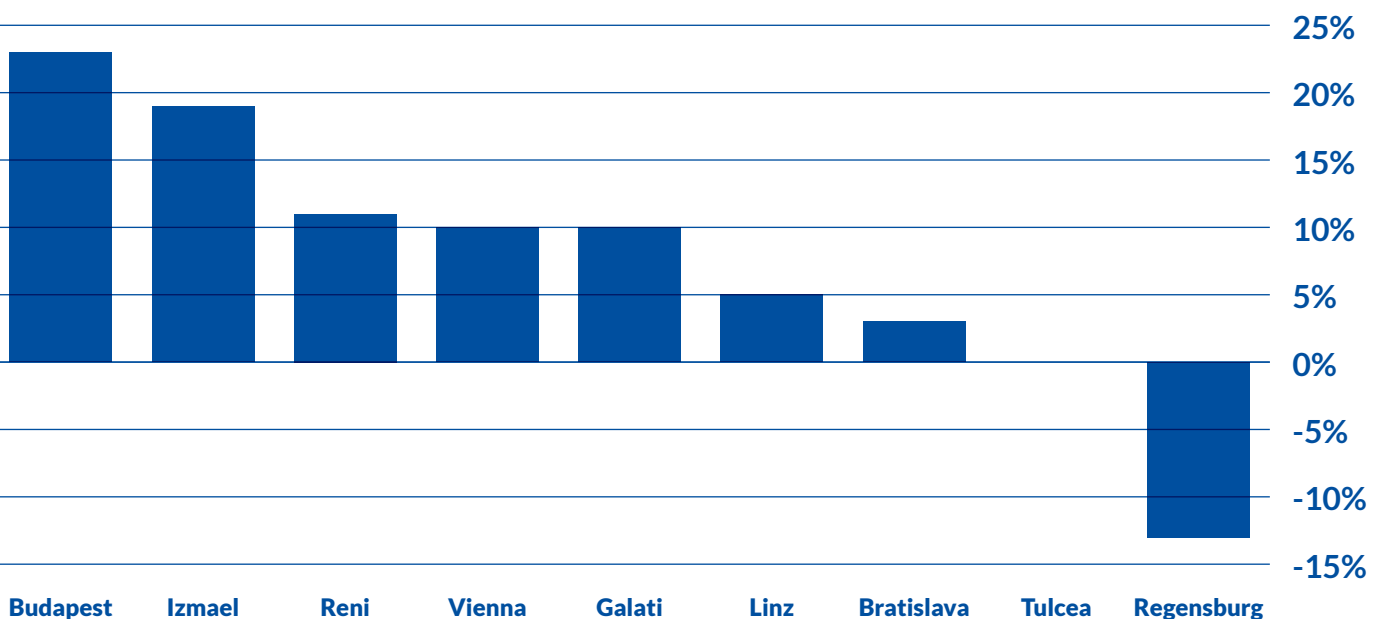
On the Danube, there are 20 ports with an annual goods traffic of more than 1 million tonnes per year. The following figures show the evolution in nine of the largest Danube ports between 2015 and 2016. The rate of increase of total waterside traffic in these ports was 9%, which is due to the recovery of mass goods transports in 2016 after the low water period of 2015.

WATERSIDE TRAFFIC IN NINE LARGE DANUBE PORTS (MILLION TONNES)

	2015	2016	2016 / 2015
Izmael	4.8	5.7	+ 18%
Linz	3.8	4.0	+ 5%
Galati	3.0	3.3	+10%
Bratislava	1.9	2.0	+3%
Tulcea	1.5	1.5	+/- 0%
Regensburg	1.5	1.3	-13%
Vienna	1.0	1.1	+10%
Budapest	0.8	1.0	+23%
Reni	0.9	1.0	+11%
Total	19.2	20.9	+9%

Source: Danube Commission - Market Observation 2016

EVOLUTION OF WATERSIDE GOODS TRAFFIC IN NINE LARGE DANUBE PORTS IN 2016 COMPARED TO 2015

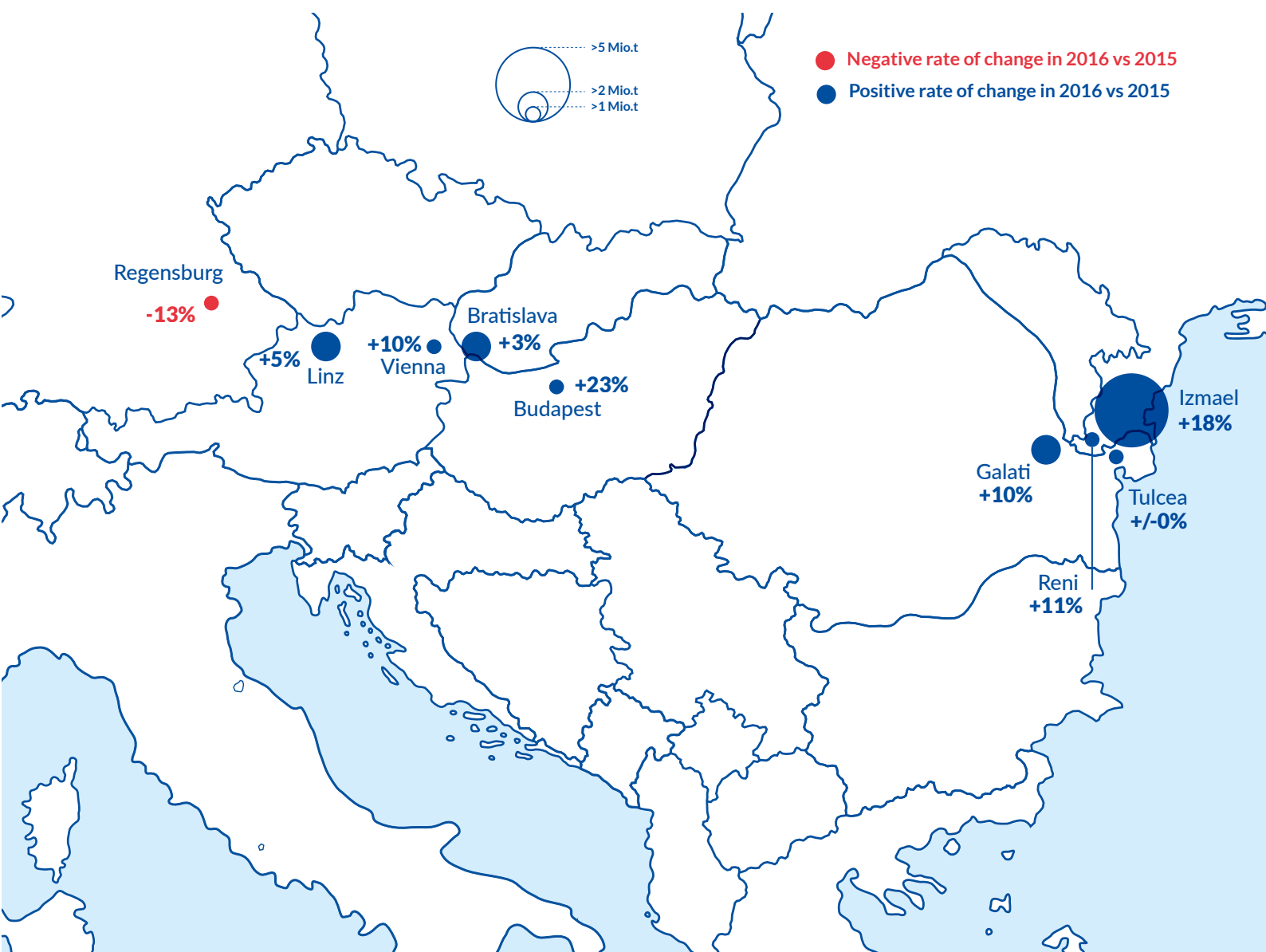


Source: Danube Commission - Market Observation 2016

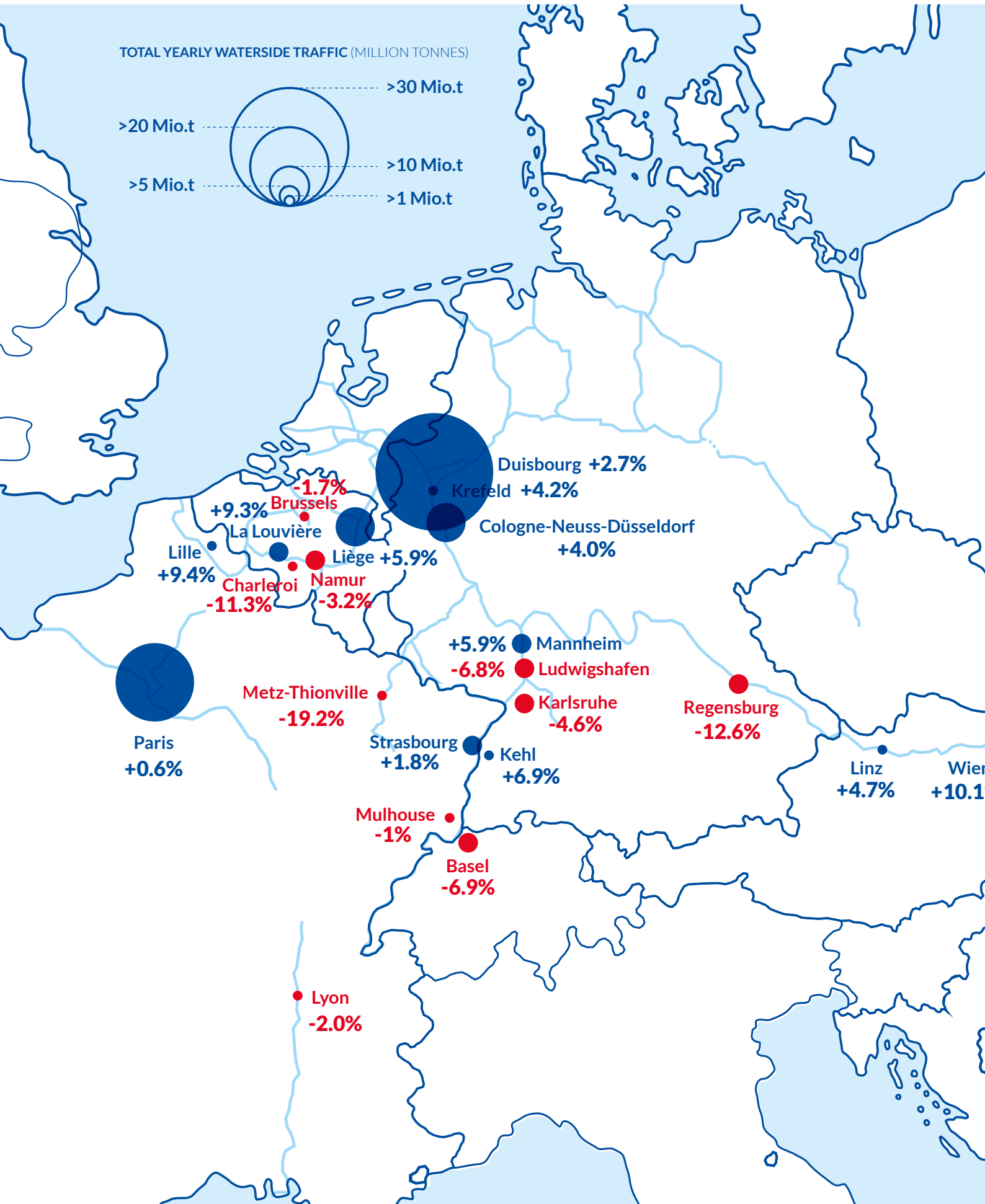
The very positive evolution in the Port of Budapest can be explained by strong growth of exports and imports of mineral oil products, to and from the Lower Danube in Romania. Also in the Port of Vienna, where mineral oil products make up 80% of total traffic, this segment showed an increase in 2016 (+8%) explaining the positive evolution in port traffic.

The Ukrainian sea-river port of Izmael on the Lower Danube is very active in exporting iron ore and coal towards other Danube ports with high activity of the steel industry: Linz (Austria), Smederovo (Serbia) and Galati (Romania). Iron ore traffic is also dominant in the Port of Bratislava (Slovakia), where these raw materials arrive by train and are transshipped to inland vessels, mainly to the Austrian Port of Linz for the provision of the steel industry.

A negative evolution was witnessed for the traffic in the German Danube Port of Regensburg. The cause was mainly the reduction in transshipments of foodstuff and agricultural products. In 2015, the port had received extra transshipment volumes for these products, as many vessels had to be made lighter in Regensburg, the reason being the low water levels on the German stretch of the Danube. In 2016 however, this extra transshipment was not present, as the water levels on the German Danube were higher.



EVOLUTION OF WATERSIDE TRAFFIC IN EUROPEAN INLAND PORTS





Note: 2016 data for Dutch ports was not available.

SPECIALIZATION

OF INLAND PORTS PER GOODS SEGMENT

The structure of the waterside traffic of most of the major European inland ports is characterized by a rather high degree of specialization on particular goods segment, for example on liquid cargo, building materials, the steel industry or agricultural products.

In many cases, this form of specialization is determined by regional industrial clusters, or the abundance of certain raw materials or agricultural products in the region surrounding the port. The following text gives an overview of these patterns, based on statistical data about waterside ports traffic in 2016 and 2015.

Two criteria were defined, for determining a high degree of specialization of a particular port for a certain goods segment: first of all, this goods segment should be the one with the highest share in total waterside traffic of the port. And secondly, the share of this goods segment should be at least 40% of total waterside traffic.



SEGMENT OF SANDS, STONES, GRAVEL & BUILDING MATERIALS

The segment of sands, stones, gravel and building materials is very important for the inland ports in France, Belgium and the Netherlands. This is mainly due to the natural abundance of these materials in these countries. Among the ports with a high share of these materials are the second and the fourth largest inland port in Europe (Ports of Paris; Liege Port Authority). Sands, stones and building materials can be transported between Belgium, the Netherlands and France via the waterways of the North-South axis. Unfortunately, for the inland ports in the Netherlands, no data for 2016 were available, but the ports were integrated in the map.

EUROPEAN INLAND PORTS WITH A SPECIALIZATION IN SAND, STONES AND BUILDING MATERIALS (2016 FIGURES)

	Sand, stones and building materials			Total waterside traffic	
	Traffic volume (Mio. t)	Share in waterside ports traffic	Evolution 2016/2015	Traffic volume (Mio. t)	Evolution 2016/2015
Paris (FRA)	15.0	74%	+9%	20.3	+1%
Liège (BEL)	6.7	43%	+2%	15.5	+6%
Namur (BEL)	4.8	93%	-3.5%	5.2	-3%
La Louvière (BEL)*	3.9	60%	+23%	6.5	+9%
Strasbourg (FRA)	3.4	46%	+14%	7.5	+1%
Brussels (BEL)	2.4	55%	+/- 0%	4.3	-2%
Charleroi (BEL)	0.8	59%	-5%	1.4	-11%
Lille (FRA)	0.7	42%	+3%	1.7	+10%
Total	37.7	-	+6.5%	62.4	+3%

Source: CCNR analysis based on ports data

*Port Autonome du Centre et de l'Ouest (PACO)

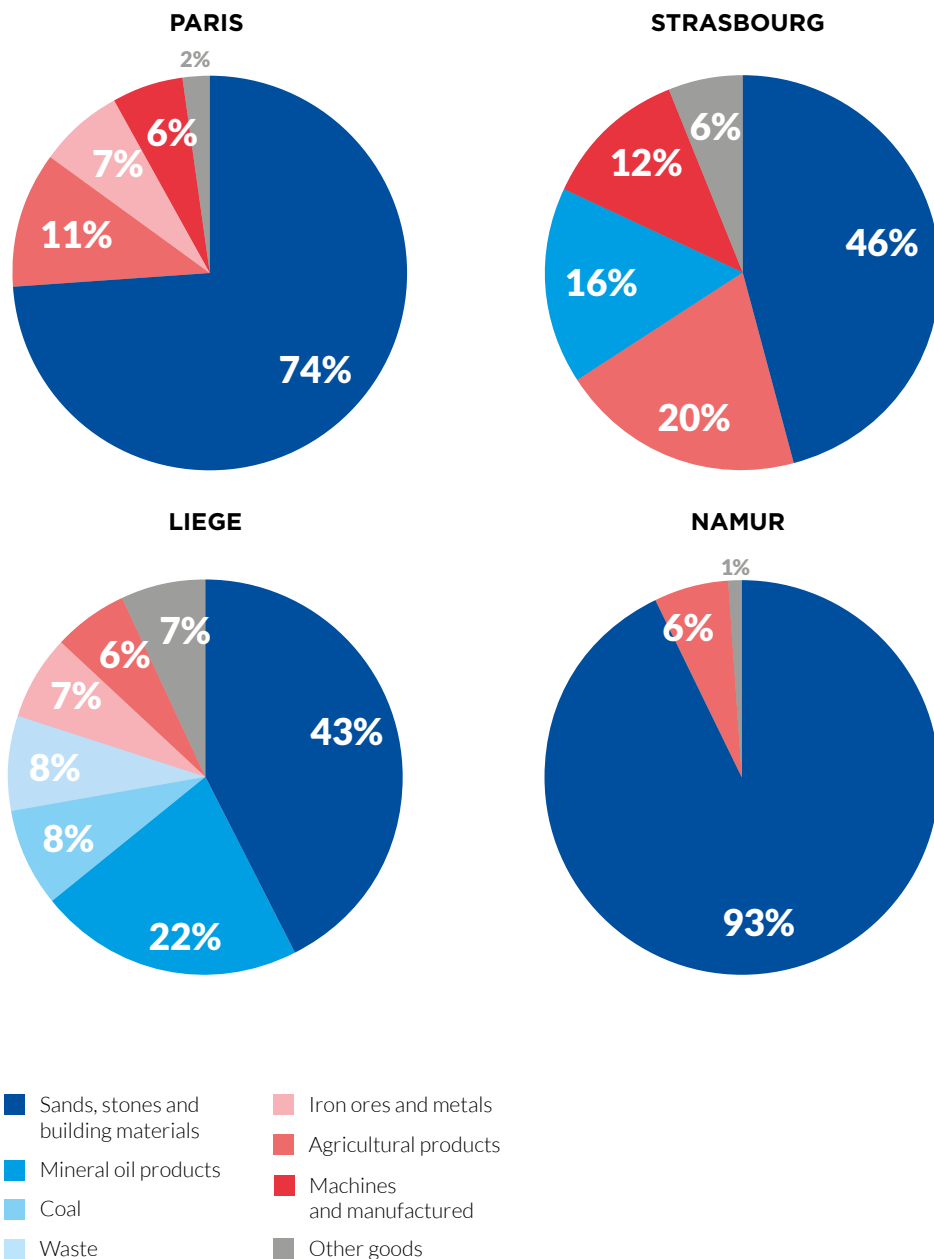
The traffic of sands, stones and building materials amounted to 37.7 million tonnes in these ports, which was an increase of 6.5% compared to 2015. This product segment acted as growth driver in 2016, as can be seen from the comparison with the total growth rate in these ports (+3%).

In Paris, dynamism is created by large infrastructure projects: the construction of new metrolines within the urban project "Grand Paris Express" is leading to an increasing transport demand for building materials, and inland shipping will be involved in the delivery of sand and building materials for this construction work. The Port of Paris has signed an agreement with the public organisation "Société du Grand Paris", which is in charge of carrying out the public transport work until the year 2030.

In many European inland ports, the traffic of sands, stones and building materials is promoted by large infrastructure projects, and by growing activity in the building industry.

The positive evolution in other ports can be explained by increasing building activity in the Netherlands and France, leading to more transport demand for sands, gravel and stones on the North-South axis. Most of the Belgian ports export large volumes of sand, gravel and building materials to the Netherlands and to France.

SHARE OF PRODUCTS IN WATERSIDE PORTS TRAFFIC (% BASED ON TONNES - 2016 FIGURES)



Source: Ports of Paris, Liege Port Authority, Port of Strasbourg, Namur Port Authority

LIQUID CARGO SEGMENT

Liquid cargo traffic is very important along the Rhine, with its clusters of refineries and chemical industries around Cologne and Ludwigshafen. Also the hinterland traffic from refineries in the ports of Rotterdam and Antwerp has to be considered, as the example of the Swiss Rhine Ports in Basel shows: 42% of the imports of mineral oil products of Switzerland are delivered on the Rhine to Basel (Source: Swiss Association for crude oil and petroleum products).

Cologne is the biggest European transshipment place for this market segment. The RheinCargo ports group, which unites seven ports in Cologne, Neuss and Düsseldorf, had a liquid cargo traffic of 7.7 million tonnes in 2016. In addition to this, there are 1.8 million tonnes of liquid cargo traffic in private ports in Cologne.

Ludwigshafen is a centre for chemical products, with a traffic volume of more than 3.3 million tonnes per year. In 2016, chemical products had an increase of 2%, but mineral oil products, accounting for another 1.5 million tonnes, registered a rather strong loss.

There are also inland ports on the Danube (Vienna), the Elbe (Magdeburg), and the Western German canal network (Gelsenkirchen, Marl) with a specialization on the liquid cargo segment.

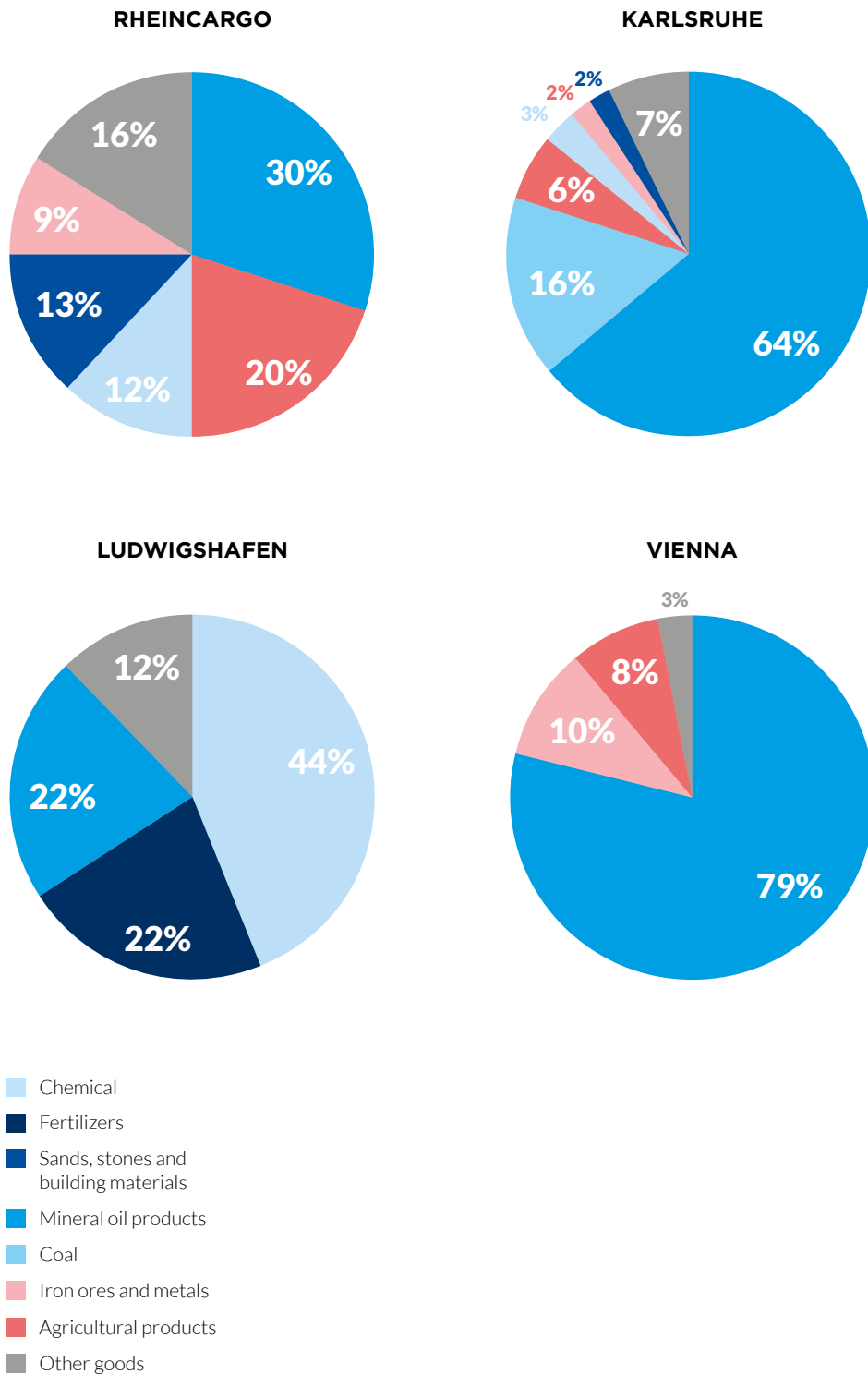
EUROPEAN INLAND PORTS WITH A SPECIALIZATION ON LIQUID CARGO (2016 FIGURES)

	Liquid cargo			Total waterside traffic	
	Traffic volume (Mio. t)	Share in waterside ports traffic	Evolution 2016/2015	Traffic volume (Mio. t)	Evolution 2016/2015
RheinCargo (GER)	7.7	43%	+/-0%	18.1	+3%
Ludwigshafen (GER)	4.8	70%	-7%	6.9	-7%
Karlsruhe (GER)	4.2	67%	+4%	6.2	-5%
Gelsenkirchen (GER)	3.9	91%	+14%	4.3	+12%
Basel (SUI)	3.0	51%	-12%	5.9	-7%
Marl (GER)	1.6	47%	+3%	3.4	+/-0%
Magdeburg (GER)	1.5	47%	-6%	3.1	-9%
Krefeld (GER)	1.4	44%	+2%	3.2	+4%
Vienna (AUT)	0.8	79%	+8%	1.1	+10%
Total	28.9	-	-0.3%	52.2	+0.2%

Source: CCNR analysis based on ports data

In 2016, the total traffic for this goods segment stagnated more or less in all of the specialized ports, which was also the case if we look at the total waterside goods traffic in those inland ports.

SHARE OF PRODUCTS IN WATERSIDE PORTS TRAFFIC (% BASED ON TONNES – 2016 FIGURES)



Source: RheinCargo, Port of Ludwigshafen, Port of Karlsruhe, Statistik Austria

■ STEEL INDUSTRY SEGMENT

The activity of the steel industry and its related waterside traffic is found alongside various rivers in Europe: the Rhine, Moselle, Saar, Danube, Belgian waterways. The public and private ports in Duisburg on the Lower Rhine are by far the biggest transshipment places in Europe. The traffic in the steel industry makes Duisburg also the biggest European inland port. The steel industry in Duisburg receives most of its iron ore and coal from the Port of Rotterdam - more than 33 million tonnes per year - by push convoys transported on the Rhine. The outgoing traffic (steel and steel products) accounts for another 8 million tonnes.

Large volumes of steel-related goods are also transshipped in many Danube ports (Izmael, Galati, Smederovo, Bratislava, Linz), in Saarlouis/Dillingen at the Saar and in Kehl on the Upper Rhine.

EUROPEAN INLAND PORTS WITH A SPECIALIZATION ON THE STEEL INDUSTRY (2016 FIGURES)*

	Iron ore, coal, steel, scrap steel metals and metal products			Total waterside traffic	
	Traffic volume (Mio. t)	Share in waterside ports traffic	Evolution 2016/2015	Traffic volume (Mio. t)	Evolution 2016/2015
Duisburg (GER)	40.7	73%	+2%	55.6	+3%
Izmael (UKR)	5.2	91%	+38%	5.7	+17%
Linz (AUT)	3.1	77%	+10%	4.0	+5%
Saarlouis (GER)	2.7	91%	-8%	3.0	-11%
Kehl (GER)	2.4	67%	+10%	3.7	+7%
Bratislava (SVK)	1.2	60%	+3%	2.0	+3%
Total	55.3	-	+4.8%	74.0	+4%

Source: CCNR calculation based on Destatis, Statistik Austria and Danube Commission

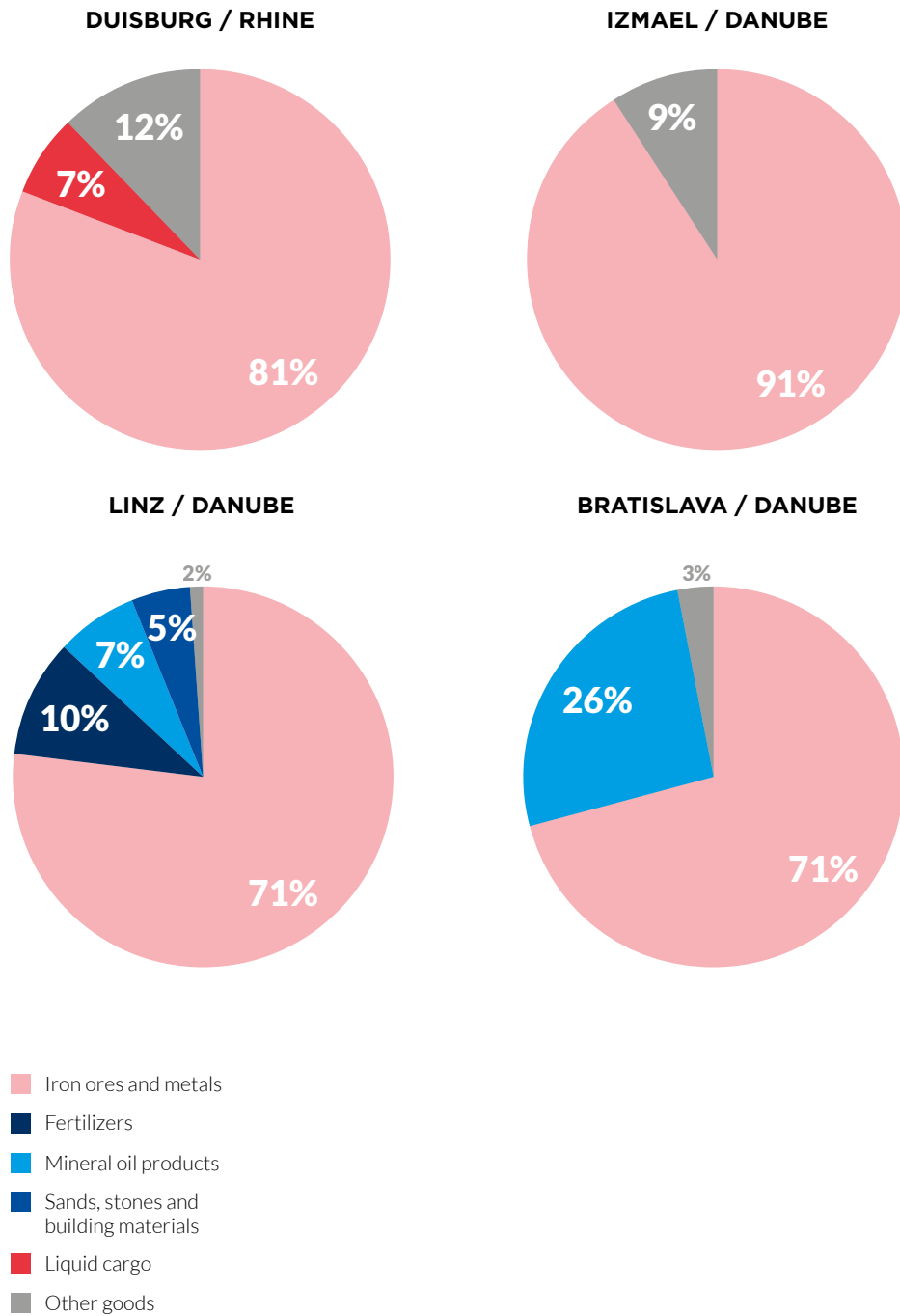
*For the Danube ports Galati and Smederovo with a high share of steel-related products, no detailed figures were available.

In 2016, this segment registered an overall growth of almost 5% in the specialized ports. This was slightly higher than the rate of increase for the total inland waterway traffic in these ports. The steel segment acted therefore as a growth driver for European ports traffic in 2016.

Almost 3/4 of the waterside traffic in the Port of Duisburg is due to raw materials and products related to the steel industry.

The Danube ports increased their waterside traffic in 2016 for iron ores and coal mainly due to better water level conditions in comparison to 2015. Similar effects were also present on the Upper Rhine, as this stretch of the Rhine had also suffered from low water levels in 2015.

SHARE OF PRODUCTS IN WATERSIDE PORTS TRAFFIC (% BASED ON TONNES - 2016 FIGURES)



Source : Destatis, Statistik Austria, Danube Commission

OTHER GOODS SEGMENTS – CONTAINER, AGRICULTURAL PRODUCTS, COAL

Container ports can mainly be found along the Rhine, and important examples are the Ports of Germersheim, Wörth am Rhein or Emmerich. In these ports, container traffic has a share of 80%, 67% and 60% of total traffic respectively. But other container ports exist outside the Rhine: in the Port of Lyon, container traffic has a share of around 60%. In northern Germany, the Port of Braunschweig at the Mittelland-Canal lies in the hinterland of the Seaport of Hamburg, to which it is connected via the Elbe-Seiten-Canal. In 2016, Braunschweig registered 53,359 TEU, which represents about 50% of total goods traffic.

Agricultural products are strongly present in the Danube region, and especially on the Middle Danube in Hungary. The Port of Budapest is the main example, and other smaller Hungarian Danube ports (e.g. Baja) follow. In Western Europe, the French Port of Metz is highly specialized on grain, with a traffic volume of 1.4 million tonnes in 2016, representing 92% of the traffic in Metz alone. A related segment is the traffic of foodstuff. A port with a high volume of foodstuff traffic is the RheinCargo Port of Neuss, with 3 million tonnes in 2016, and the Port of Mannheim with 1.5 million tonnes in 2016. However, in both ports, the share of this segment is nevertheless lower than 40%.

Coal is often related to the steel industry, but it can also be related to the energy sector. The number of ports with a specialization in the energy segment is in fact very limited. There are only two cases, namely in the German capital, Berlin, and in Hamm, at the Datteln-Hamm Canal in the Ruhr area. In Berlin, coal had a waterside traffic of 3.7 million tonnes in 2016 (57% of waterside traffic), which was related to the provision of a major power plant for heating energy by inland shipping. But this coal traffic is expected to vanish almost completely from 2017 onwards, due to the decision of the energy company to end the use of brown coal due to environmental concerns. In general, the future of coal as an energy resource and as a transport good is questioned by the transition towards renewable energies.

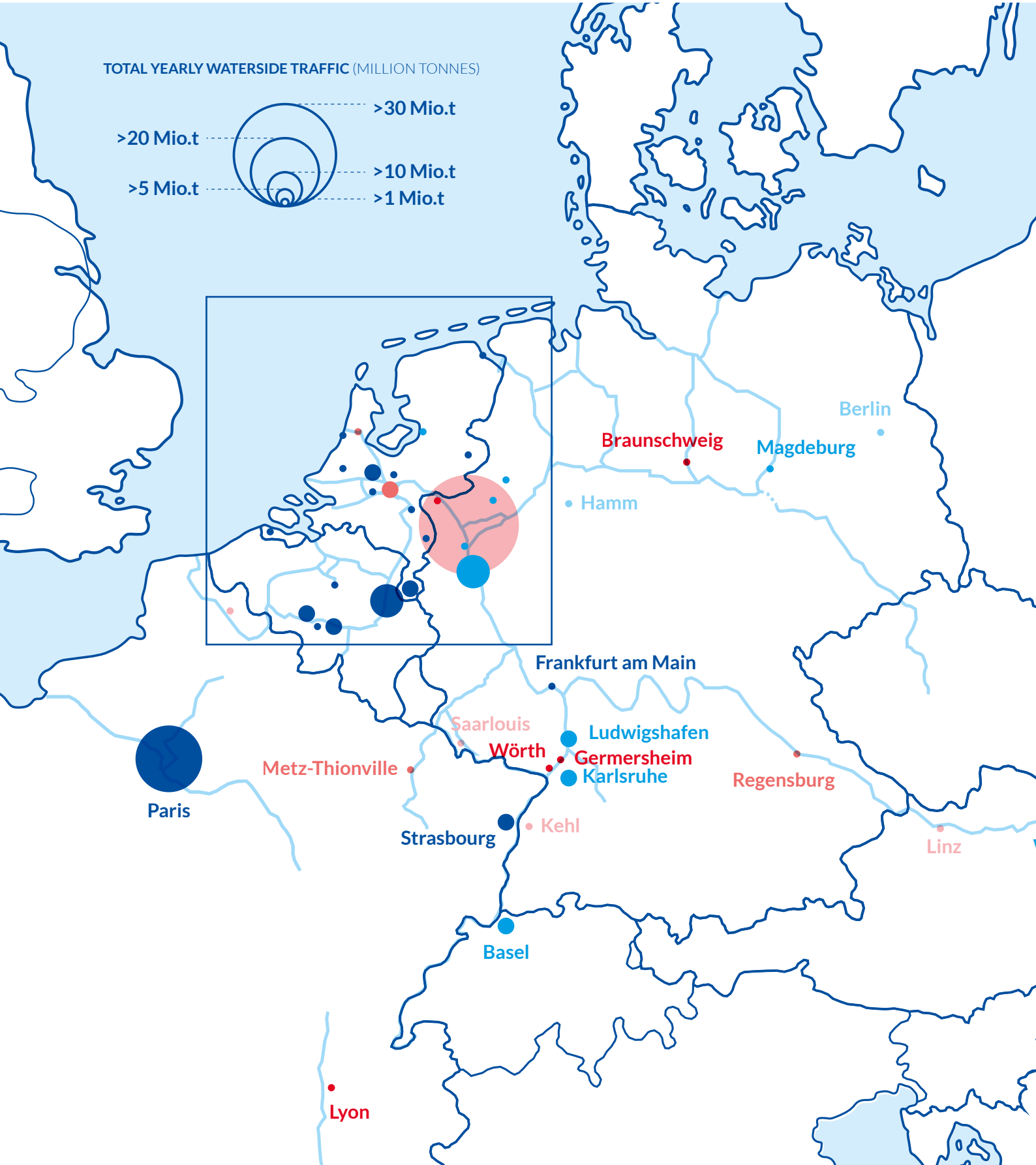
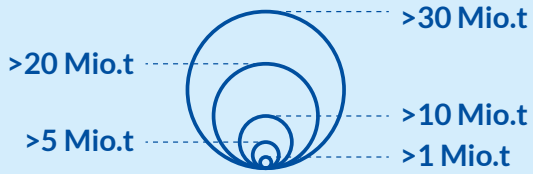


EUROPEAN INLAND PORTS AND THEIR SPECIALIZATION

Port specialization

- Sands, stones and building materials
- Liquid cargo
- Coal
- Machines and containers
- Agricultural products and foodstuff
- Iron ores and steel

TOTAL YEARLY WATERSIDE TRAFFIC (MILLION TONNES)









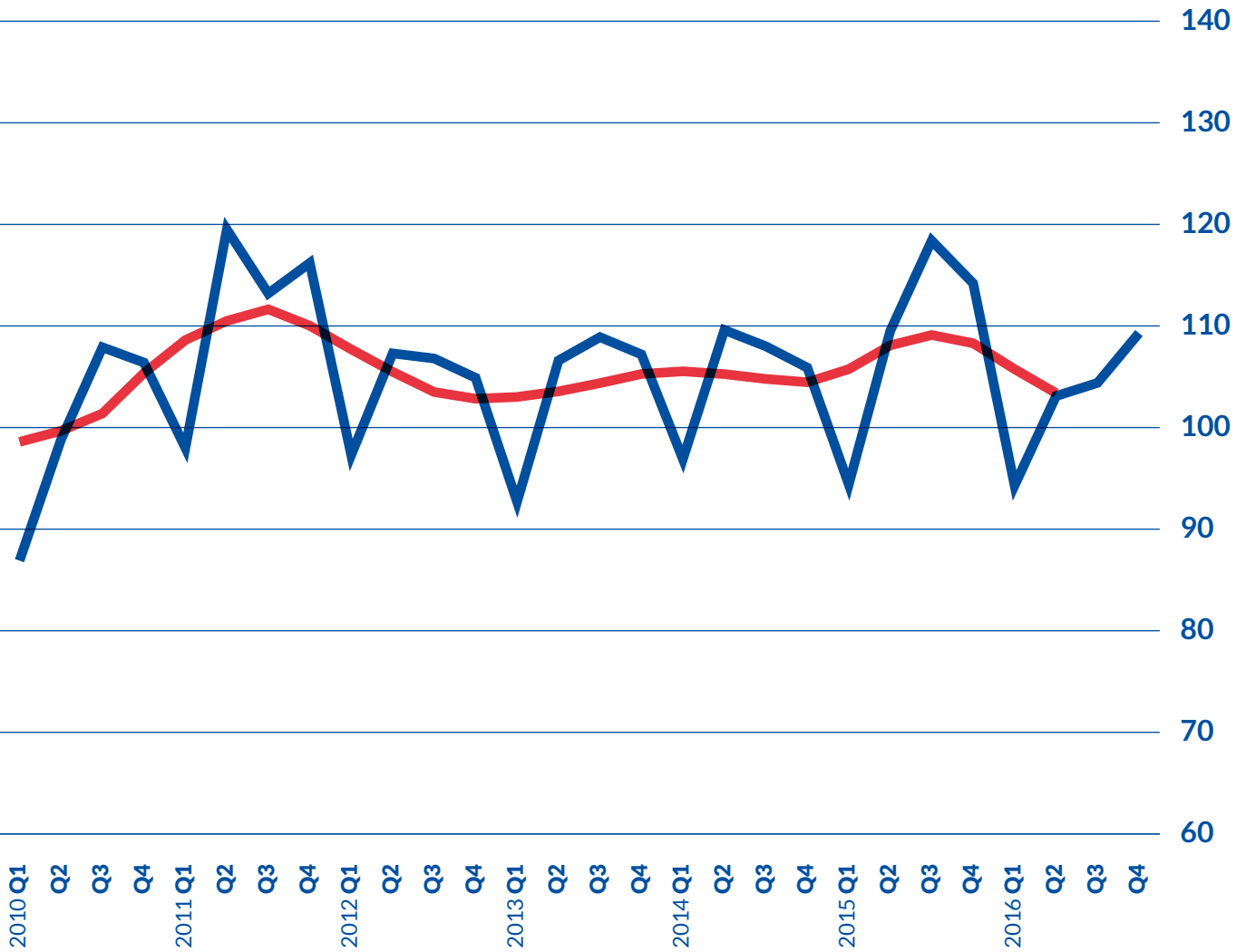
04

OPERATING CONDITIONS

- Total turnover decreased significantly in Germany and the Netherlands because of a decrease in freight rates and a limited increase in transport performance.
- Water levels impacted both transport performance and freight rates on the Danube and on the Rhine in 2015 and, to a lesser extent, in 2016.
- The share of goods transport within the total inland navigation sector turnover is 34% in Austria, 73% in Hungary, 80% in Germany and more than 90% in the Netherlands, but the share of passenger transport in European inland navigation sector turnover is increasing.

TURNOVER DEVELOPMENT IN EUROPE

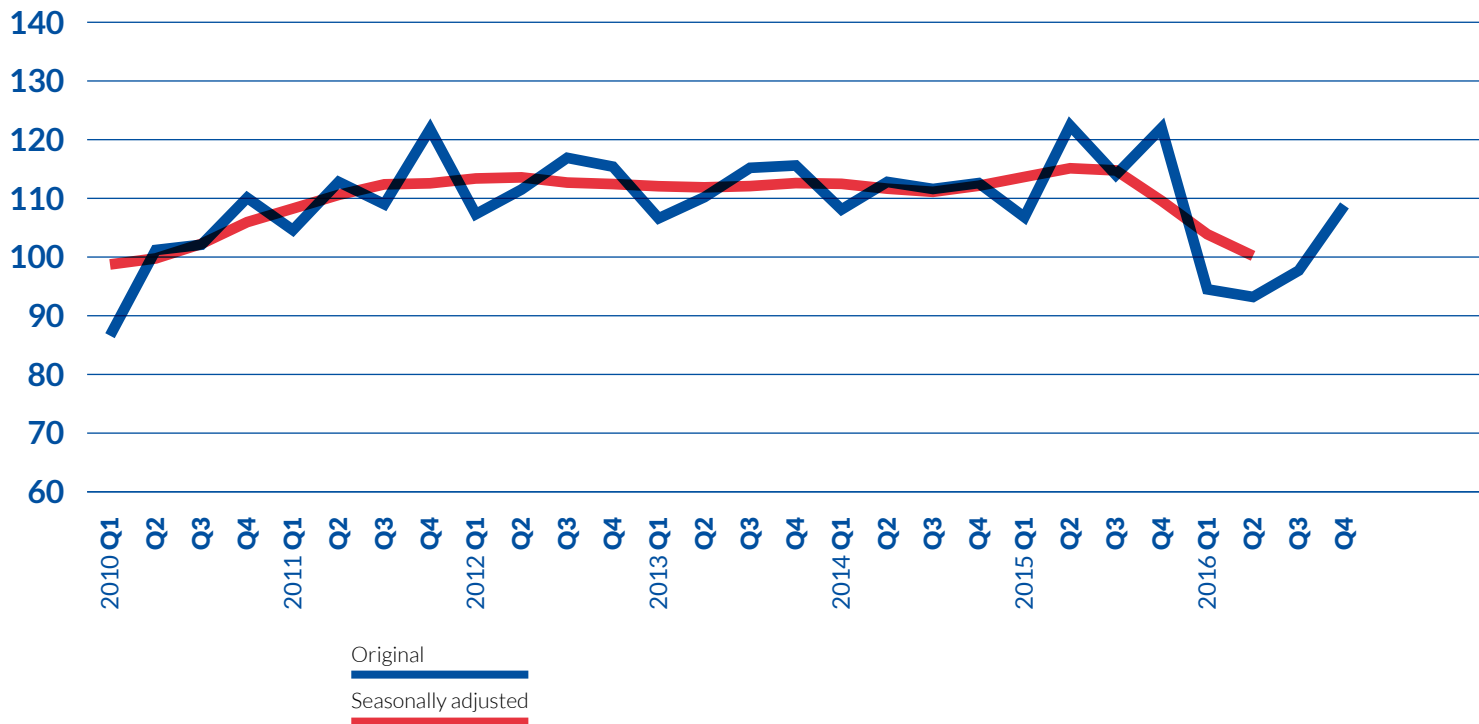
TURNOVER DEVELOPMENT IN THE NETHERLANDS (2010=100) – RHINE COUNTRY
WITH A HIGH SHARE OF GOODS TRANSPORT



Original
Seasonally adjusted

Source: CBS

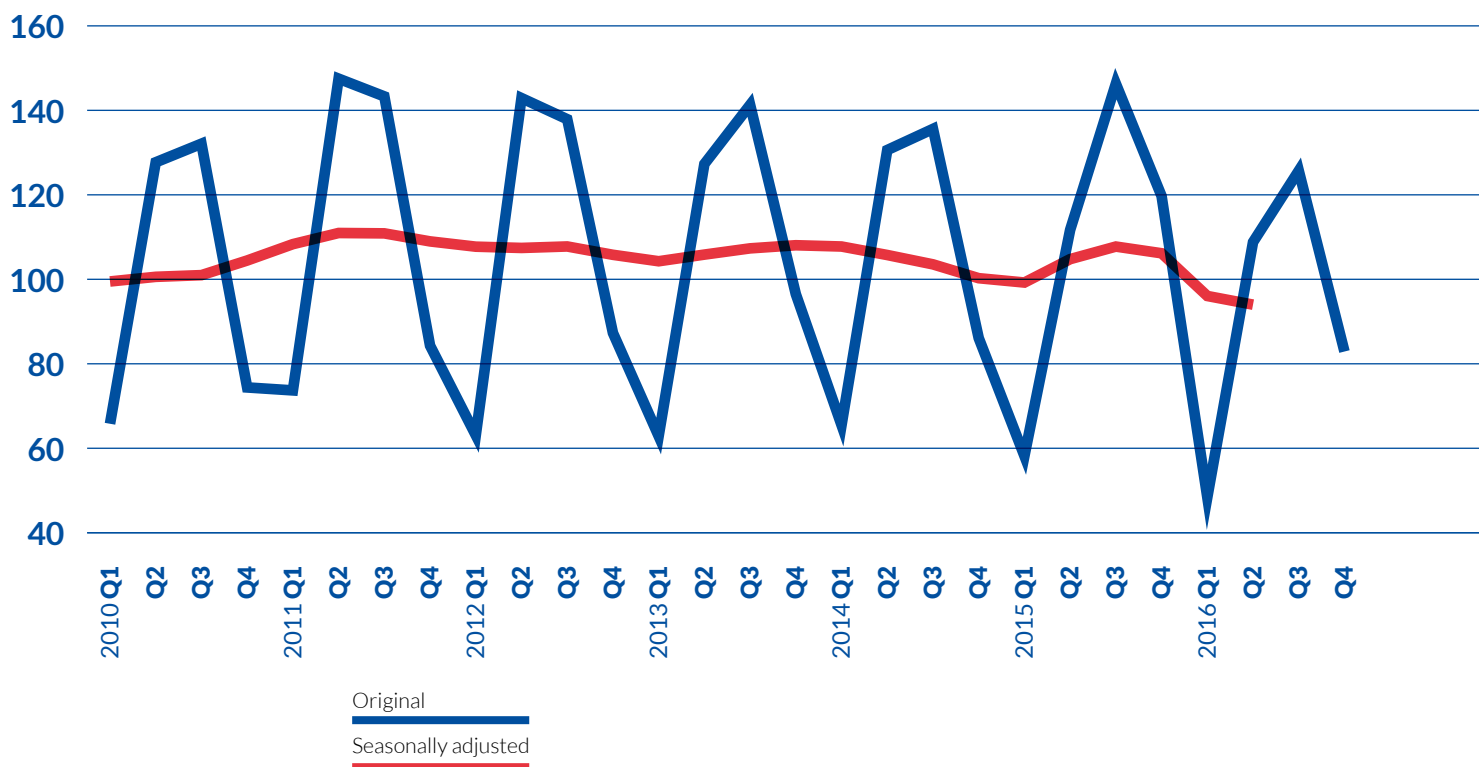
TURNOVER DEVELOPMENT IN GERMANY (INDEX 2010=100) - RHINE COUNTRY WITH A HIGH SHARE OF GOODS TRANSPORT *



Source: Destatis

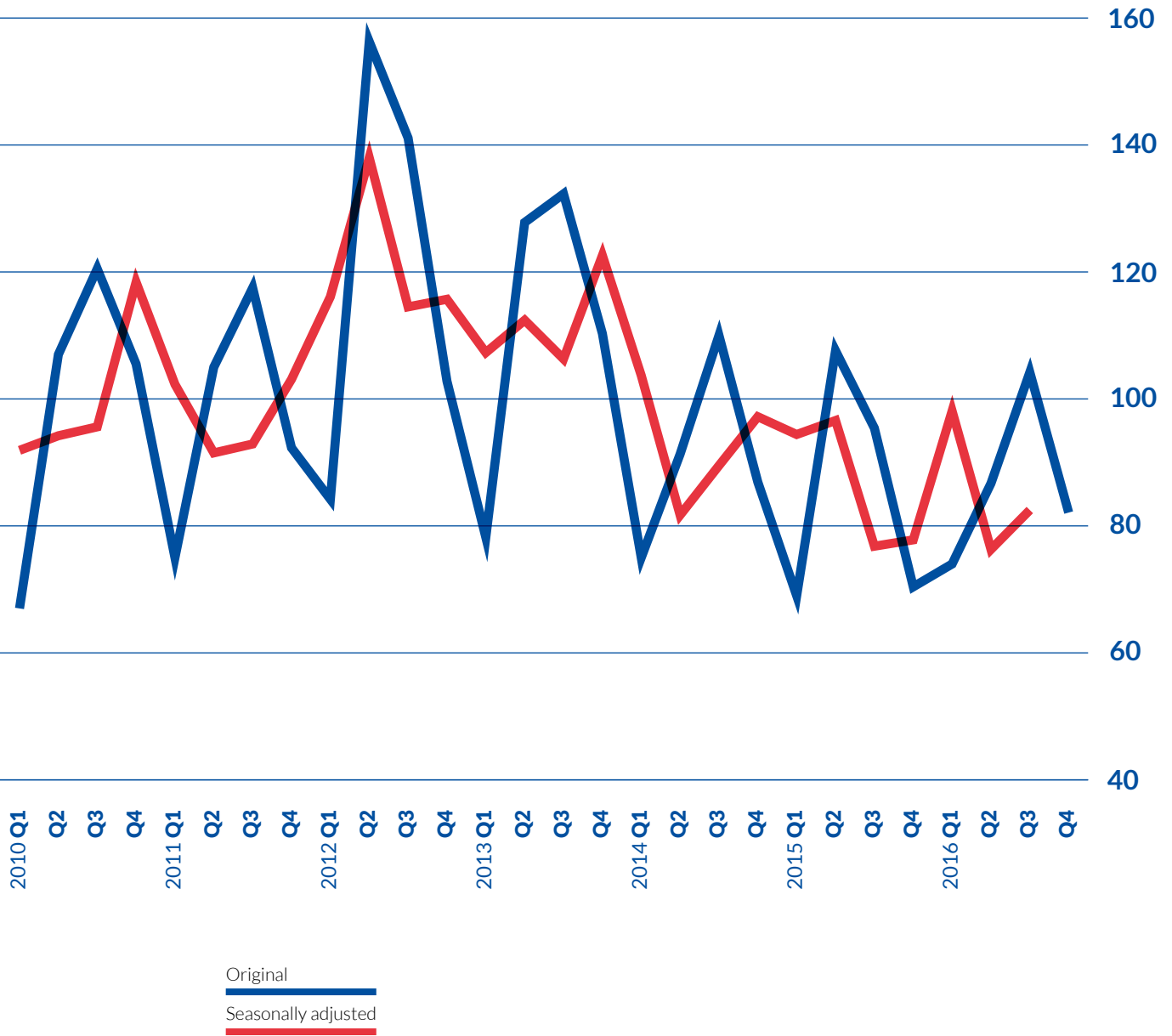
*The figure shows the turnover in goods transport only.

TURNOVER DEVELOPMENT IN AUSTRIA (INDEX 2010=100) - DANUBE COUNTRY WITH A HIGH SHARE OF PASSENGER TRANSPORT



Source: Eurostat

TURNOVER DEVELOPMENT IN HUNGARY (INDEX 2010=100) - DANUBE COUNTRY
WITH A HIGH SHARE OF GOODS TRANSPORT



Original
Seasonally adjusted

Source: Eurostat

In 2016, turnover in goods transport in Western Europe fell, above all due to the recovery of water levels, which lead to higher loading degrees of vessels. Therefore, the effectively available fleet capacity increased. This changed the supply-demand relation on the market, towards an extension of the supply side. The logical result was a decrease of prices and turnover.

In the Netherlands, goods transport has a share of 92 % of total turnover in inland shipping, and passenger transport only 8 %. In 2016, there was a decrease of 7.5 % in total turnover. Compared to the average turnover in the period from 2010 until 2015, the result was -3.7 % (Source: CBS). However, turnover per inland navigation freight transport company increased slightly due to a stronger decline in the number of companies during this period (Source: Eurostat).

In contrast to inland shipping, Dutch rail cargo transport increased turnover by 4.1 % compared to 2015 and even by 11.7 % compared to the average in the period 2010-2015. Road transport had an increase of 3 % with regard to 2015 and 9 % with regard to 2010-2015.

In Germany, goods transport has a turnover share of 81 %, and passenger transport 19 % (upward trend). In 2016, there was a year-on-year decrease of 15 % in goods transport turnover, and of 13 % compared to the average in the period 2010-2015. Regarding German passenger shipping, turnover increased by 5.4 % in 2016. In terms of turnover per employee, Germany has the highest productivity among Rhine countries with about 350 k€ turnover per employee (2014 figures, source Eurostat).

According to surveys conducted by the German Federal Office of Goods Transport (BAG), the turnover evolution within goods transport differs according to market segments. Within the dry cargo shipping segment, a decrease was predominant, especially on the Rhine market, where small companies operate under difficult market conditions, facing a high degree of competition. In container shipping, however, companies experienced rather stagnating turnover figures.

Austria is a country with a dominance of passenger shipping. This segment has a share of 66 % in turnover, and shows a further upward trend. In 2016, turnover was 2 % higher than in the previous year, but its level was still far below the values of the years 2013 and 2014.

In Austria, passenger shipping has a share of 2/3 of total turnover.

Hungary is a Danube country where goods transport has a higher share in IWT turnover (73%) than passenger transport (27%). Turnover in the Hungarian inland shipping industry was on the rise during the year 2016, but this was mainly due to the usual seasonal variations in goods transport. Over the whole year, the result was 1.3% higher than in 2015.

In Danube countries, Austria traditionally registered the highest turnover per passenger transport enterprise with about €650k on average during the period 2009-2014. The turnover in Hungary was about €250k per passenger transport entity over the same period.

TURNOVER EVOLUTION 2016/2015

	Share in total turnover of... *		Total turnover evolution 2016/2015
	goods transport	passenger transport	
Netherlands	92%	8%	-7.5%
Germany	81%	19%	- 11.1%
Austria	34%	66%	+2.0%
Hungary	73%	27%	+1.3%

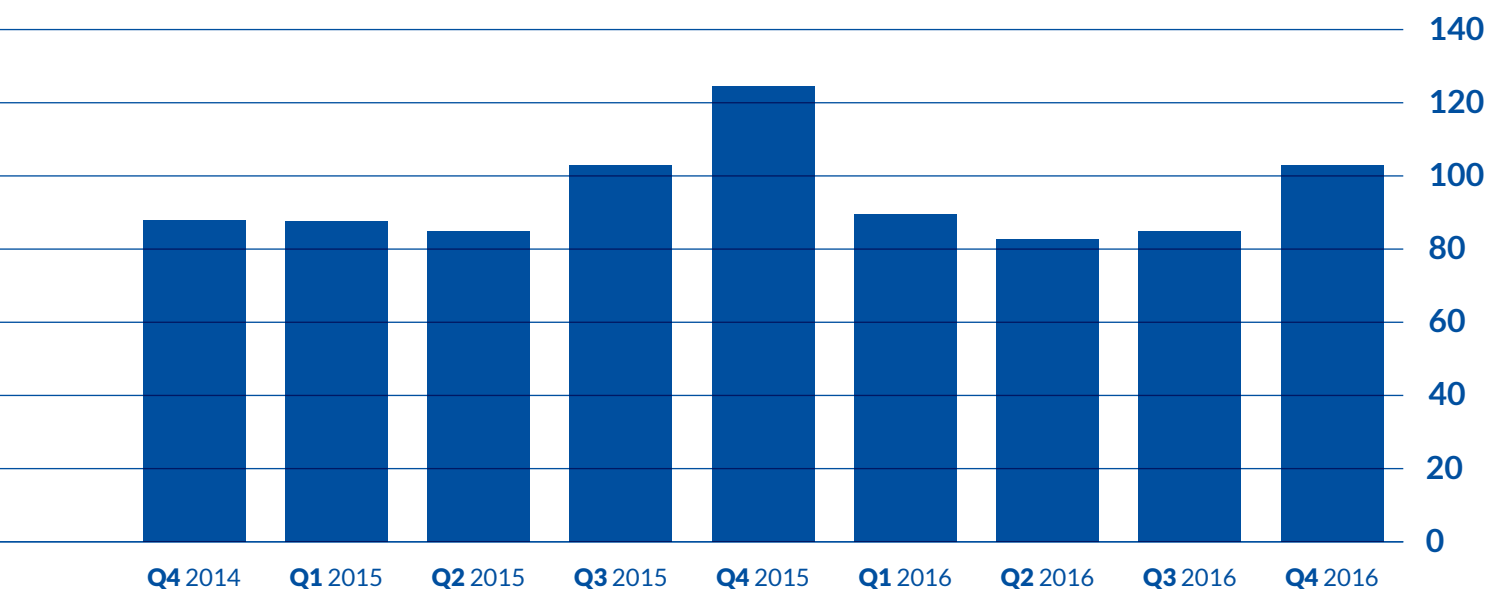
Source: CBS, destatis, Eurostat

* % shares are for 2015.

FREIGHT RATES, COSTS AND INVESTMENTS

FREIGHT RATES

DEVELOPMENT OF FREIGHT RATES IN THE NETHERLANDS (2015 AVERAGE=100)



Source: CBS - Centraal Bureau voor de Statistiek

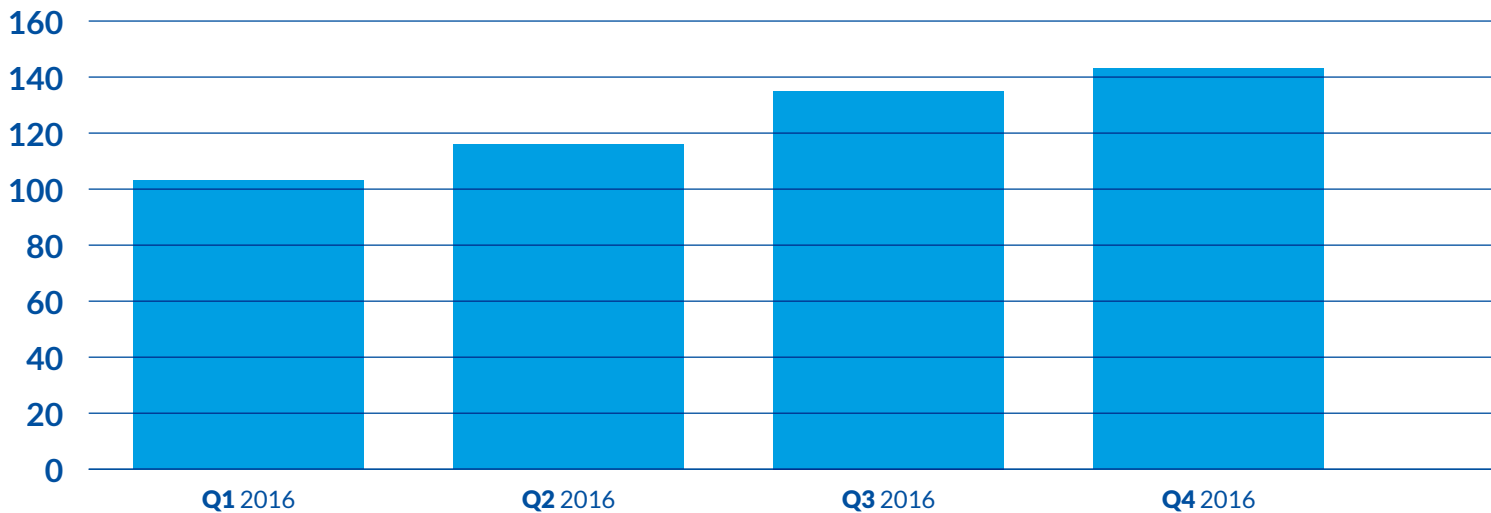
In 2016, the average level of transport prices in goods transport in the Netherlands (average of dry cargo, liquid cargo and containers) was 10% lower than in 2015. In the course of the year, prices picked up slightly, so that in the 4th quarter of 2016, prices were around 20% higher than in the 3rd quarter of 2016. However, when compared to the 4th quarter of 2015, prices in Q4 2016 were well below the values at the end of 2015 (-17%).

In the Netherlands, IWT transport prices were on average 10% lower in 2016 than in 2015. The main reason was the recovery in water levels which lead to a decrease in freight rates.

The overall evolution since the end of 2014 shows no inherent upward trend. Major upward movements are only induced by periods of low water levels, as the example of autumn 2015 and winter 2016 shows: the end of 2016 (November, December) experienced low water levels, which explains the slight upward movement in prices in that time.

Also, tanker shipping freight rates in the Rhine market were at a rather low level in the first half of 2016, despite a slightly rising transport demand for chemicals. In the chemical segment, where longer contracts are more common than in the mineral oil segment, the freight rate level increased only very moderately when new contracts had to be concluded. (Source: BAG)

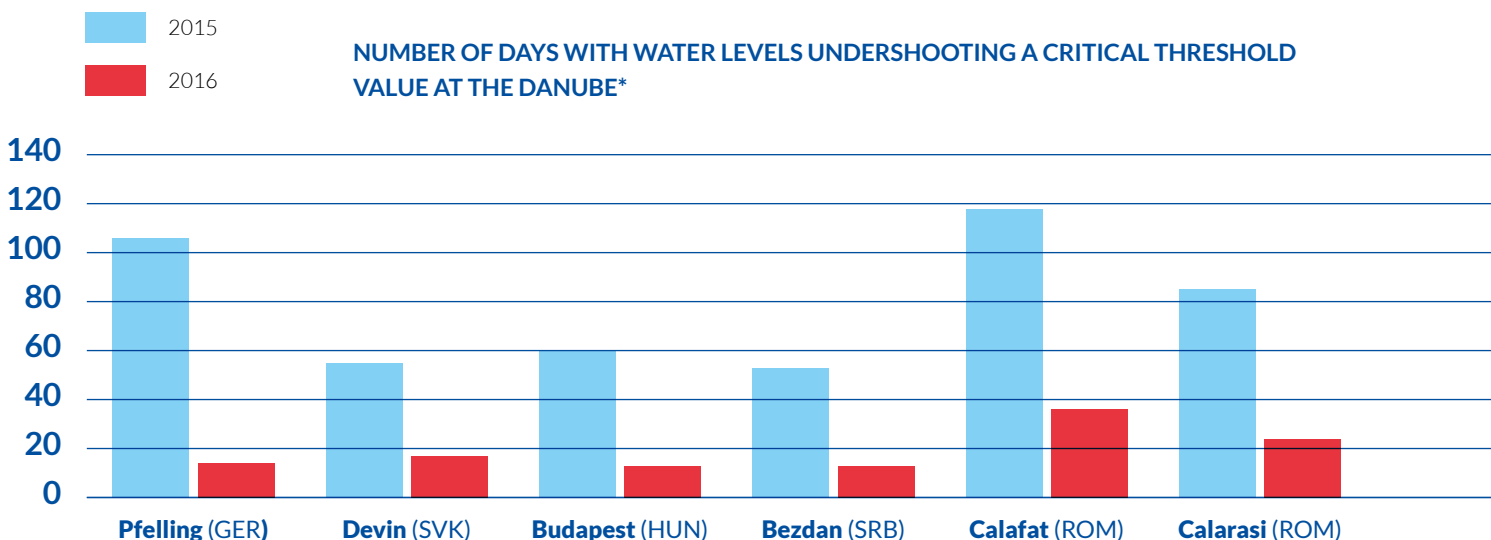
DEVELOPMENT OF FREIGHT RATES IN THE DANUBE REGION (JANUARY 2015=100)



Source: Danube Commission

On the Danube, freight rates are above all determined by bunker fuel costs. These bunker fuel costs were on a strong upward movement in 2016. According to the Danube Commission, freight rates increased sharply in the course of the year 2016 (freight rates based on transport of grain and chemical products from Middle Danube inland ports).

Hydraulicity conditions were much better on the Danube in 2016 than in 2015. In 2015, water conditions were especially unfavorable on the Upper Danube (Germany) and on the Lower Danube (Romania). In 2016, a recovery of water levels set in, allowing large volumes of mass cargo to be transported again.



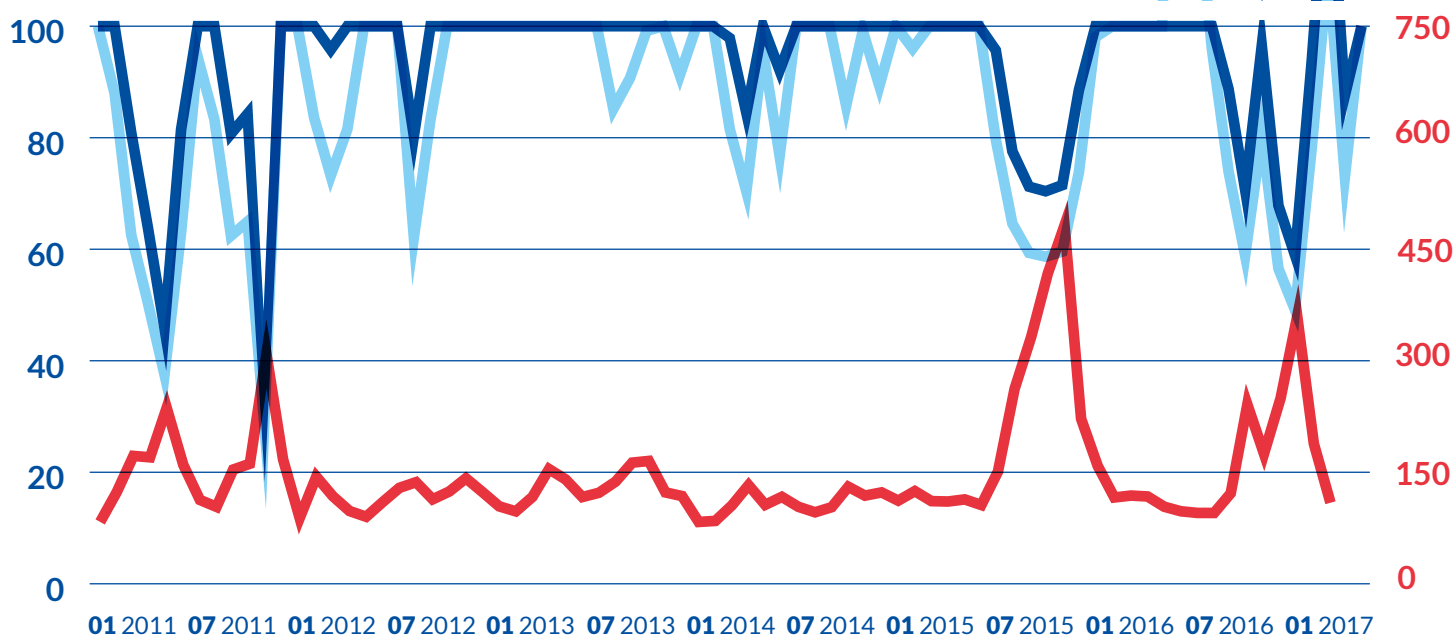
Source: Danube Commission, Via Donau

* This critical value is defined as the water level which is achieved on 94% of all days per year, over a period of 30 years.

Water levels recovered strongly on the Danube in 2016, which enabled an increase in goods transport along the Danube compared to 2015.

On the Rhine, water levels were also much better than in 2015, but at the end of the year (November, December), a new low water period set in, leading to a short but sharp increase in transport prices.

MAXIMUM LOADING DEGREES AT KAUB/MIDDLE RHINE FOR VESSELS WITH A DRAUGHT OF 2.5 AND 3 METERS, COMPARED WITH FREIGHT RATE INDEX*



Source: CCNR and PJK International

*Freight rates in tanker shipping

Loading Degree (2.5 Meter)

Freight Rate Index (2010 = 100)

Loading Degree (3.0 Meter)

■ COSTS

Fuel costs decreased further in 2016. But due to clauses in the contracts, IWT companies are often obliged to transfer the fuel costs savings to their clients (shippers).

Personnel costs rose modestly in 2016. The collective wage agreement for personnel in the German IWT sector included an increase in wages of 2.6% from September 2016 onwards. On January 1st 2017, wages increased further by 2.2%. In the Netherlands, the collective wage agreements increased wages during 2016 by only 0.3%.

The activity and also the costs of maintenance and repair work increased in 2016. Due to the relatively high level of freight rates and revenues in the autumn of 2015, many ship owners decided to use the extra revenue for financing delayed repair work and inspections in the first half of 2016. However, for many old vessels, spare parts were not available anymore, which lead to additional costs in this field. (Source: BAG)

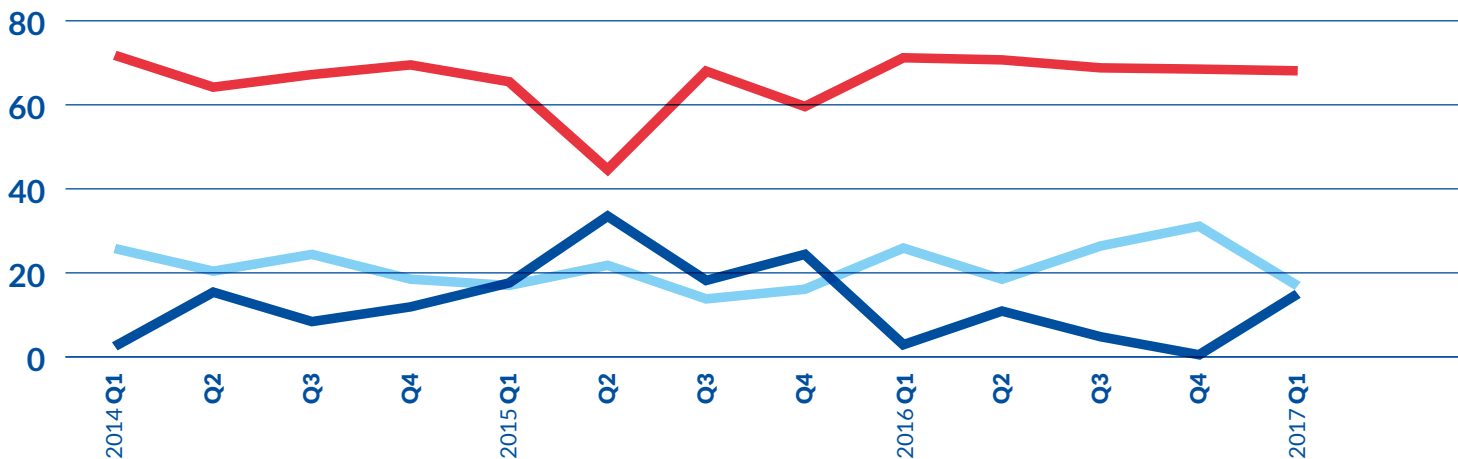
INVESTMENT

According to CBS data, investment in new ships accounts for about 80% of the total investment in tangible assets of the Dutch inland shipping companies. Investment in machinery and installations followed in second place with a share of 10%. Investment in new vessels – and also in tangible assets overall - decreased strongly from 2010 onwards, which is of course also confirmed by the decreasing new construction figures according to IVR.

Regarding the investment plans, the Dutch statistical office conducts regular quarterly surveys about the investment plans of IWT companies in the Netherlands. Within these surveys, companies are asked about their investment plans in tangible assets (e.g. new vessels, new machinery, etc.) in the current year.

The following figure shows the shares of companies (%) that want to keep their investment constant, decrease or increase their investment level. This is based on a survey where respondents are asked whether they want to keep constant, decrease or increase their investment level during the current year.

SURVEY RESULTS ABOUT INVESTMENT PLANS IN THE DUTCH IWT SECTOR



Investment level
remains the same

Decrease of investment

Increase of investment

Source: CBS

For the entire year 2016, on average 70% of the companies within the survey said that they wanted to keep their investment level constant in 2016 (compared to 2015). 5% wanted to increase, and 25% wanted to reduce investment.

More than 2/3 of Dutch inland shipping companies wanted to keep investment expenditures constant in 2016.

In Q1 2017, the share of companies that wanted to keep investment constant in 2017 was 68%. 15% planned to invest more and 17% planned to invest less. Overall, these results show that investment plans have picked up a bit at the beginning of 2017, at least concerning investment for 2017.

In Q1 2017, the survey asked also about the investment plans for the next year (2018). 77% of the companies answered that they want to keep investment in 2018 constant. 9% want to expand and 14% want to reduce investment.





05

FLEET

- 73% of the European fleet is composed of dry cargo barges and self-propelled dry cargo vessels.
- The European fleet is decreasing both in terms of total units and in terms of total gross tonnage, but the average vessel loading capacity is increasing.
- 15% of the dry cargo fleet and 37% of the tanker cargo fleet is less than 20 years old.

FLEET SIZE EVOLUTION

73% of the European fleet are dry cargo barges and self-propelled dry cargo vessels.

In Europe, there are more than 13,500 vessels offering inland freight transport services (dry cargo, tanker cargo and push & tug vessels) with a total loading capacity of 17 million tonnes. About 74% of the European fleet comes from Rhine countries. The main sector of activity is dry cargo; 73% of the European fleet operate in this segment.

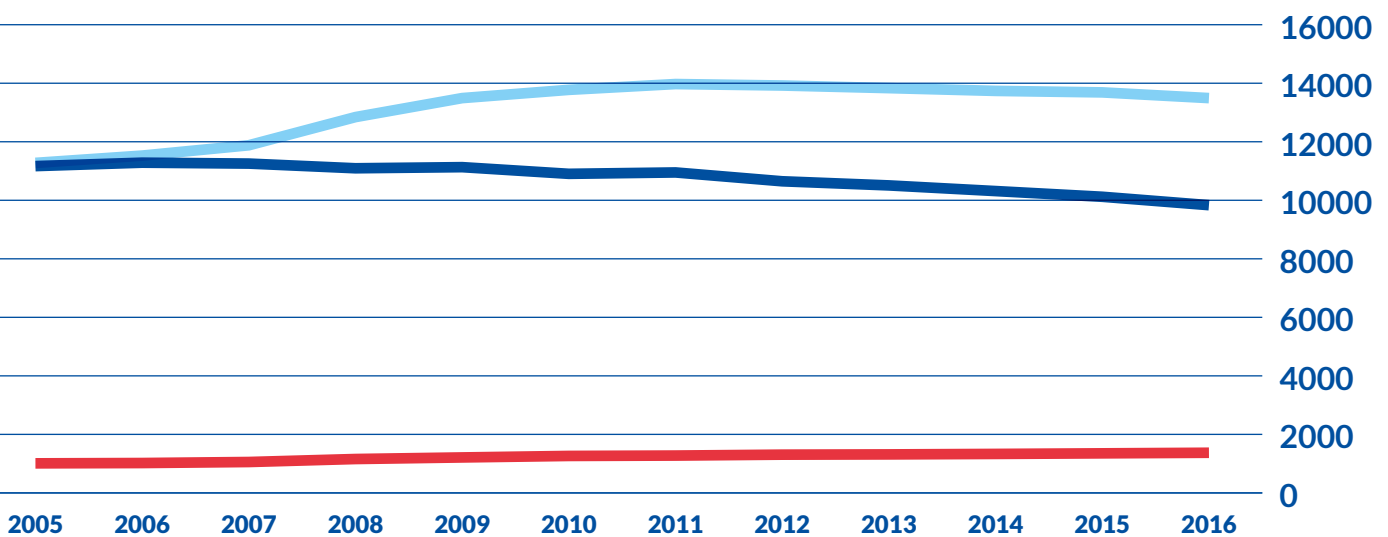
RHINE COUNTRIES

In 2016, more than half of the existing fleet was registered in the Netherlands. The German fleet amounted to 25%.

The majority of vessels operate in the dry cargo sector except in Switzerland and Luxembourg where respectively more tanker and passenger vessels operate.

EVOLUTION OF THE FLEET IN RHINE COUNTRIES (NUMBER OF DRY CARGO, TANKER CARGO AND PUSH & TUG VESSELS)

Gross tonnage (1000t) Number of vessels Average gross tonnage



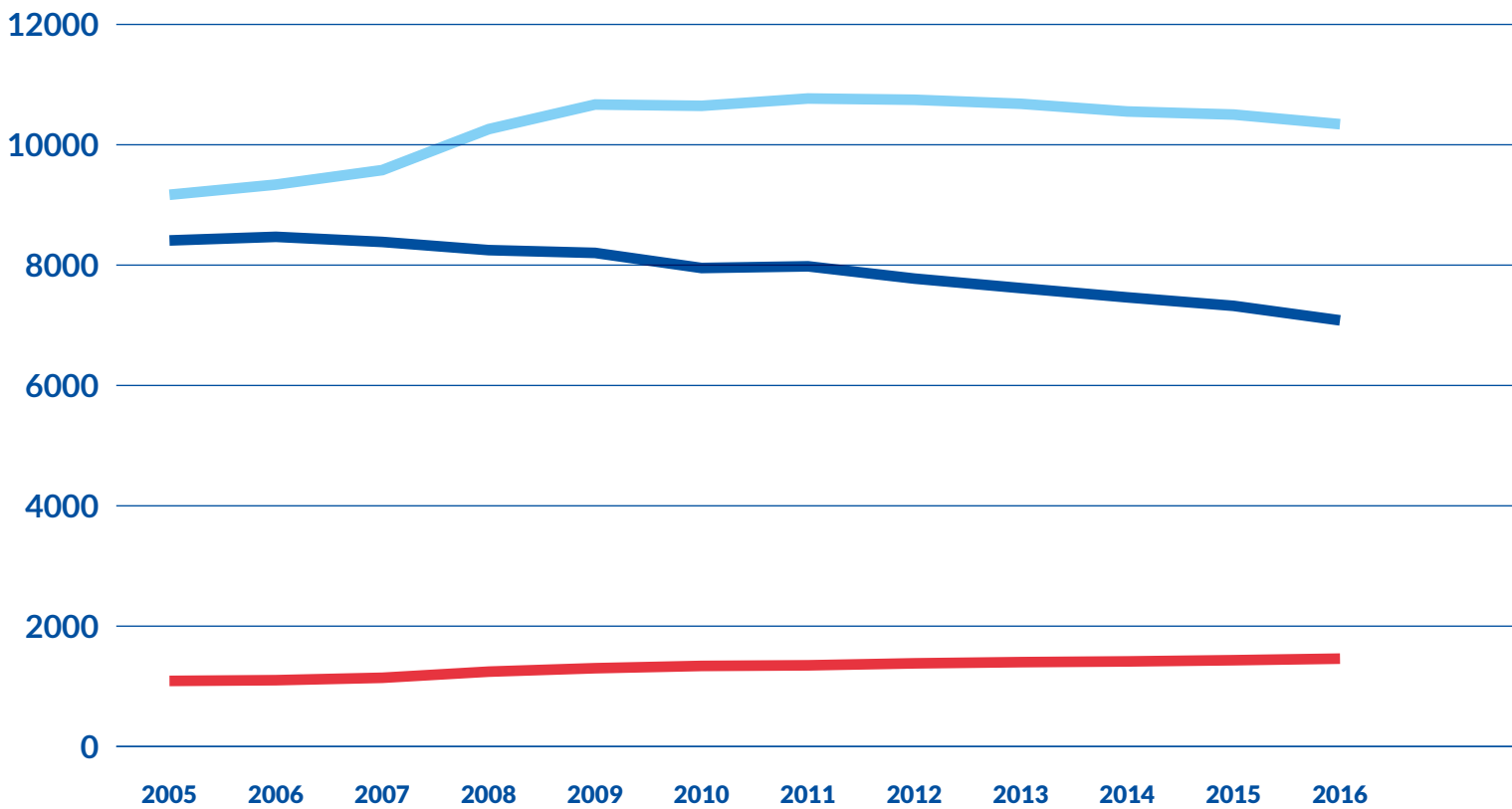
Source: National Offices, CCNR calculation

*Germany: data for 2015

In the last decade, the evolution of the Rhine fleet has been marked by a reduction in the total number of vessels operating in the market (-12%) but an increase in the available loading capacity (20%). This means that newly built vessels in the IWT sector, particularly between the years 2007 and 2009, were built with higher loading capacity.

From 2015 to 2016, there was also a decrease in the total Rhine fleet (-2.8%), mainly influenced by the reduction in the number of French vessels (-15%) and Dutch vessels (-1%) in the dry cargo sector. The available loading capacity fell (-1.4%) as small and medium size vessels left the market.

EVOLUTION OF THE DRY CARGO FLEET IN RHINE COUNTRIES



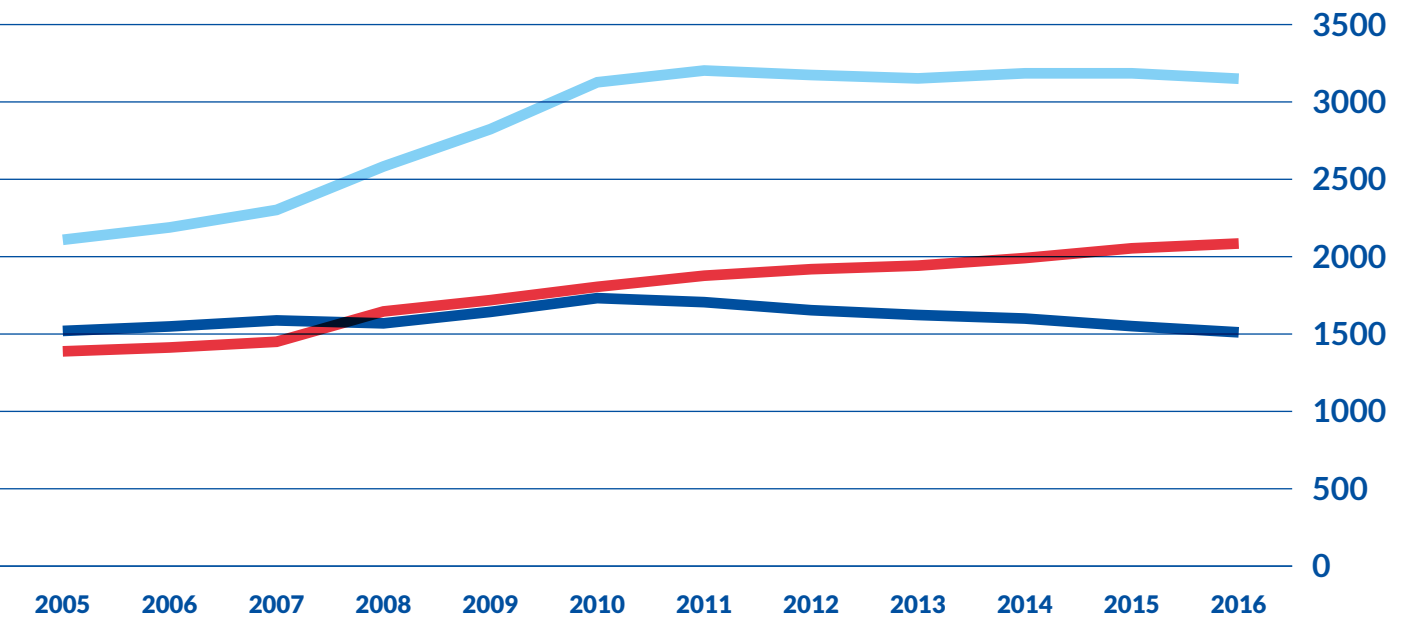
Gross tonnage (1000t)
Number of vessels
Average gross tonnage

Source: national offices, CCNR calculation

Note: 2015 data taken into account for Germany due to unavailability of 2016 data

In the **dry cargo** segment, the number of vessels decreased over the last decade (-16%) mainly due to smaller vessels leaving the market in Germany, France and Belgium. The available loading capacity increased (13%) over the period, reaching 10.3 million tonnes in 2016.

EVOLUTION OF THE TANKER CARGO FLEET IN RHINE COUNTRIES



Gross tonnage (1000t)

Number of vessels

Average gross tonnage

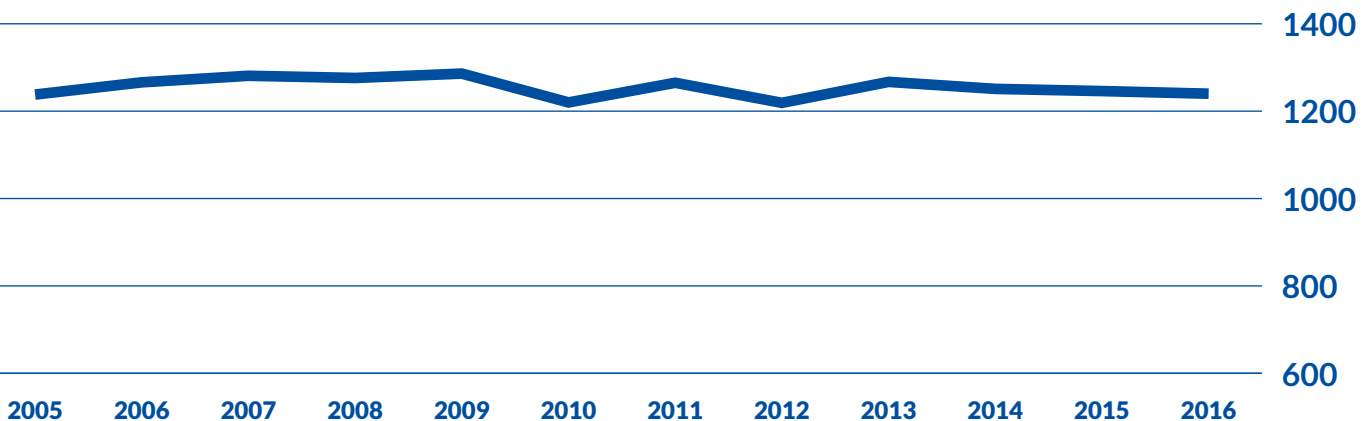
Source: national offices, CCNR calculation

*Germany: data for 2015

In **tanker shipping**, the total number of vessels decreased from 2010 onwards (-13%) in all countries. However, the loading capacity increased over the last decade (+49%), reaching 3 million tonnes in 2016. Larger vessels have been built during this period.

Due to new safety regulations along the Rhine, tanker vessels should have double hulls by the end of 2018. Thus, some of the existing single hull vessels left the market during the period, which is the main reason for the overall tanker fleet drop. In 2011, about 60% of the fleet were double hull vessels but, in 2017, this percentage has increased to 82%.

EVOLUTION OF THE PUSH & TUG FLEET IN RHINE COUNTRIES (NUMBER OF VESSELS)



Source: national offices, CCNR calculation

*Germany: data for 2015; France: data not included

The **push & tug** fleet remained almost stable at about 1,200 vessels over a decade, regarding all Rhine countries fleet except France. It particularly fell in Germany (-7%) and Belgium (-31%) from 2008 onwards.

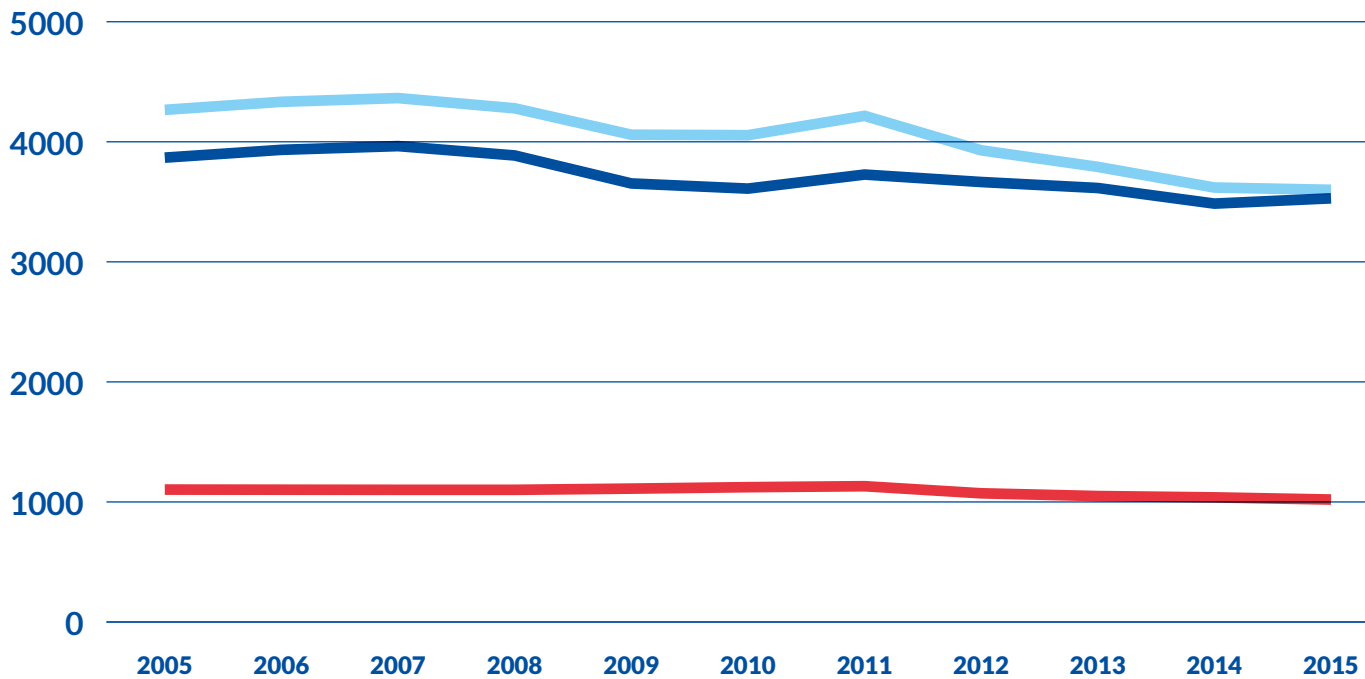
-2.8% decrease in the number of vessels operating in Western Europe 2016 vs 2015.

DANUBE COUNTRIES

Romania has the largest fleet of the Danube countries which amounts to 44% of the total Danube fleet.

EVOLUTION OF THE FLEET IN DANUBE COUNTRIES

(NUMBER OF DRY CARGO, TANKER CARGO AND PUSH & TUG VESSELS)



Gross tonnage (1000t)

Number of vessels

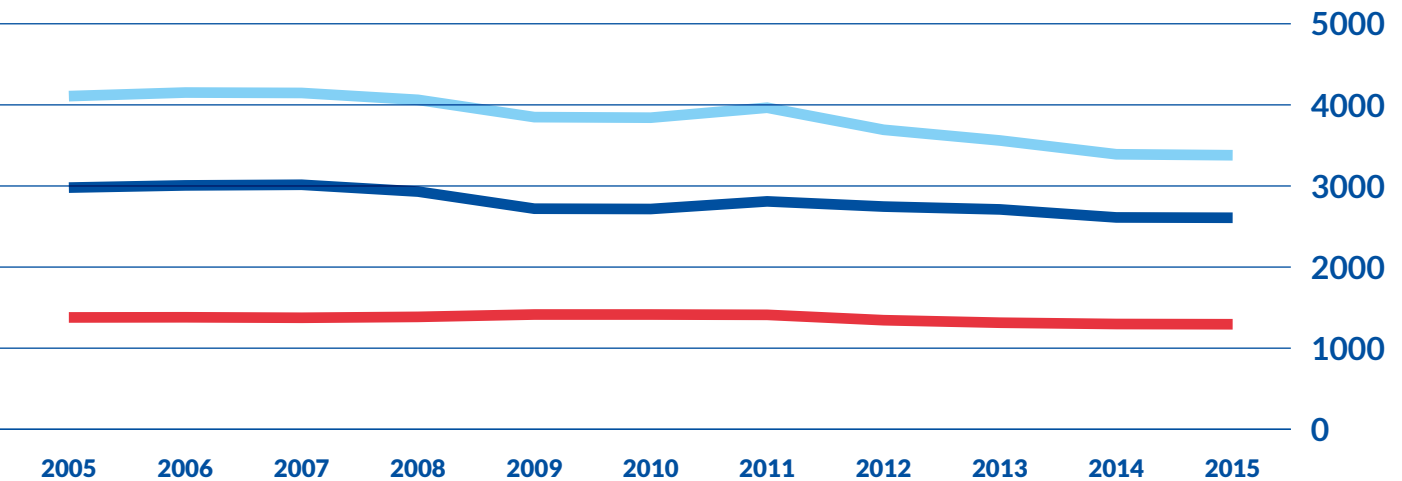
Average gross tonnage

Source: Danube Commission

In the last decade, the number of vessels operating in the Danube area decreased (-9%) but at a lower rate than in Rhine countries (-12%). The available loading capacity also fell (-16%) so that the average tonnage remained stable at about 1,000 tonnes per vessel.

From 2014 to 2015, there was a slight increase in the total Danube fleet (1.3%), mainly influenced by the new vessel construction in Romania (+5%) in all sectors of activity. The available loading capacity fell (-0.5%), mainly due to the Ukrainian vessels that left the market.

EVOLUTION OF THE DRY CARGO FLEET IN DANUBE COUNTRIES



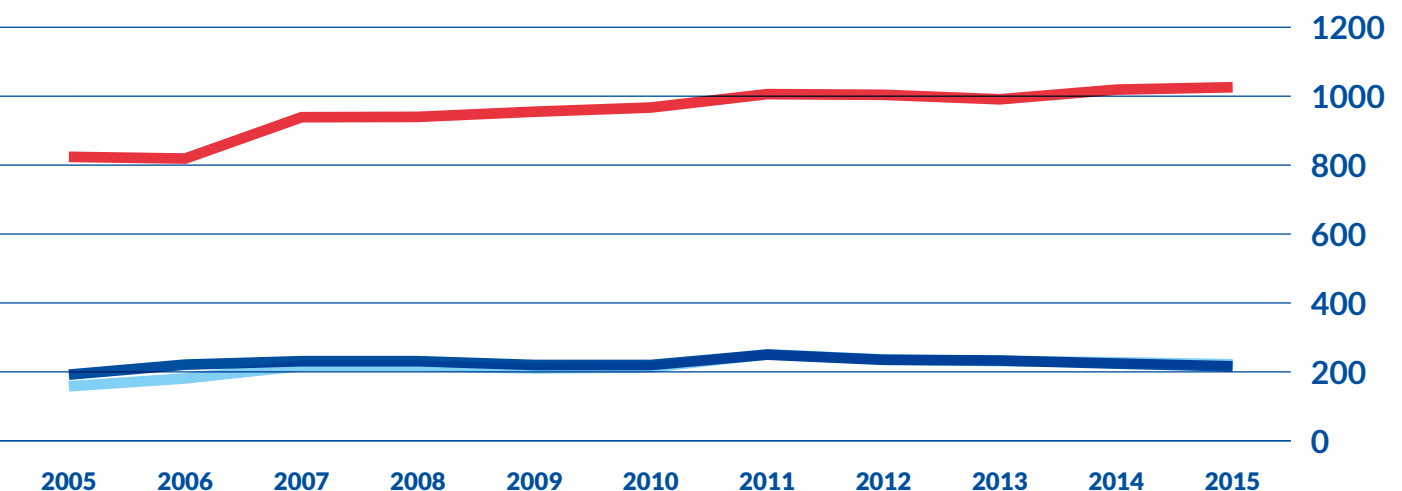
Source: Danube Commission

The transport of **dry goods** is the dominant market with about 74% of the fleet operating in this sector. However, in Hungary and Austria more than 70% of the companies operate in passenger transport.

Gross tonnage (1000t)
 Number of vessels
 Average gross tonnage

In the dry cargo sector, there was a (-13%) decrease in the total number of vessels in the last decade, especially remarkable from 2011 onwards. This fall was particularly relevant in Ukraine (-48%) and Hungary (-29%); however, the Romanian fleet grew (21%) over the period. The loading capacity available decreased about 730 thousand tonnes over the decade. In 2015, most of the existing dry cargo fleet were barges, representing from 73% to 90% of the total dry cargo fleet in each country.

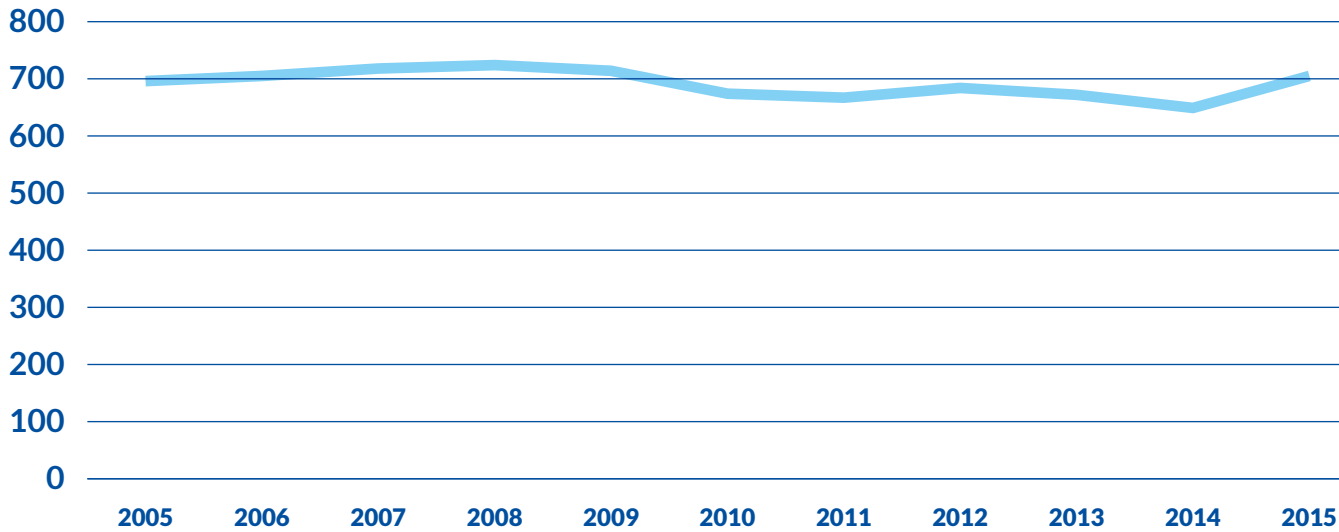
EVOLUTION OF THE TANKER CARGO FLEET IN DANUBE COUNTRIES



Source: Danube Commission

The **tanker sector** was dominated by the Romanian fleet which increased by 57% in a decade. In general, the evolution was positive for all countries except for Ukraine and Hungary, but the tanker cargo market continues to have a low market share. The total loading capacity gradually increased in a decade (+40%), reaching 222 thousand tonnes in 2015.

EVOLUTION OF THE PUSH & TUG FLEET IN DANUBE COUNTRIES (NUMBER OF VESSELS)



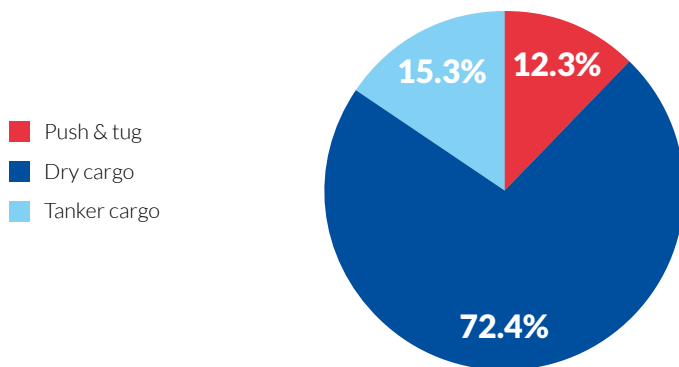
Source: Danube Commission

The number of **push & tug vessels** slightly decreased from 2010 onwards mainly due to the reduction in the Ukrainian (-25%) and Hungarian (-27%) fleet. From 2014 to 2015, the total number of vessels recovered because of the building of new vessels in Romania (+20%).

Comparison between Rhine and Danube structure of the fleet (2015)

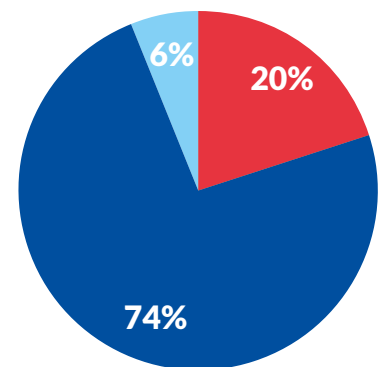
The structure of the fleet in Rhine and Danube countries is similar since most of the vessels transport dry cargo bulk. In 2015, a total of about 7,300 and 2,600 dry cargo vessels operated in the Rhine and Danube countries respectively. In tanker shipping, the structure differs slightly. As the sector has more activity in the Rhine region, more vessels operate in this area (15%). About 1,550 tanker vessels were active on the Rhine as compared to 216 vessels operating in the Danube area. The push & tug fleet represented a higher percentage than tanker vessels in the Danube fleet structure, showing that the dry cargo sector is still a predominant market.

RHINE STRUCTURE OF THE FLEET



Source: national offices

DANUBE STRUCTURE OF THE FLEET



Source: Danube Commission

FLEET STRUCTURE ANALYSIS

RHINE COUNTRIES

The Western European market is characterized by a relatively old fleet. In Belgium, Germany and the Netherlands, about half of the active IWT vessels were built more than 50 years ago. In France, these vessels represent approximately 80% of the total fleet. There are still some vessels (15% of the European fleet) which were built more than 75 years ago, particularly present in the Netherlands and Germany.

Switzerland is the country that has the newest fleet (87% of the vessels were built in the last 35 years) which is mainly due to a wave of new river cruise vessels in the years 2010-2016. The Luxembourg fleet is also quite modern (65% of the vessels were built in the last 35 years) but the new vessels are mainly active in tanker shipping.

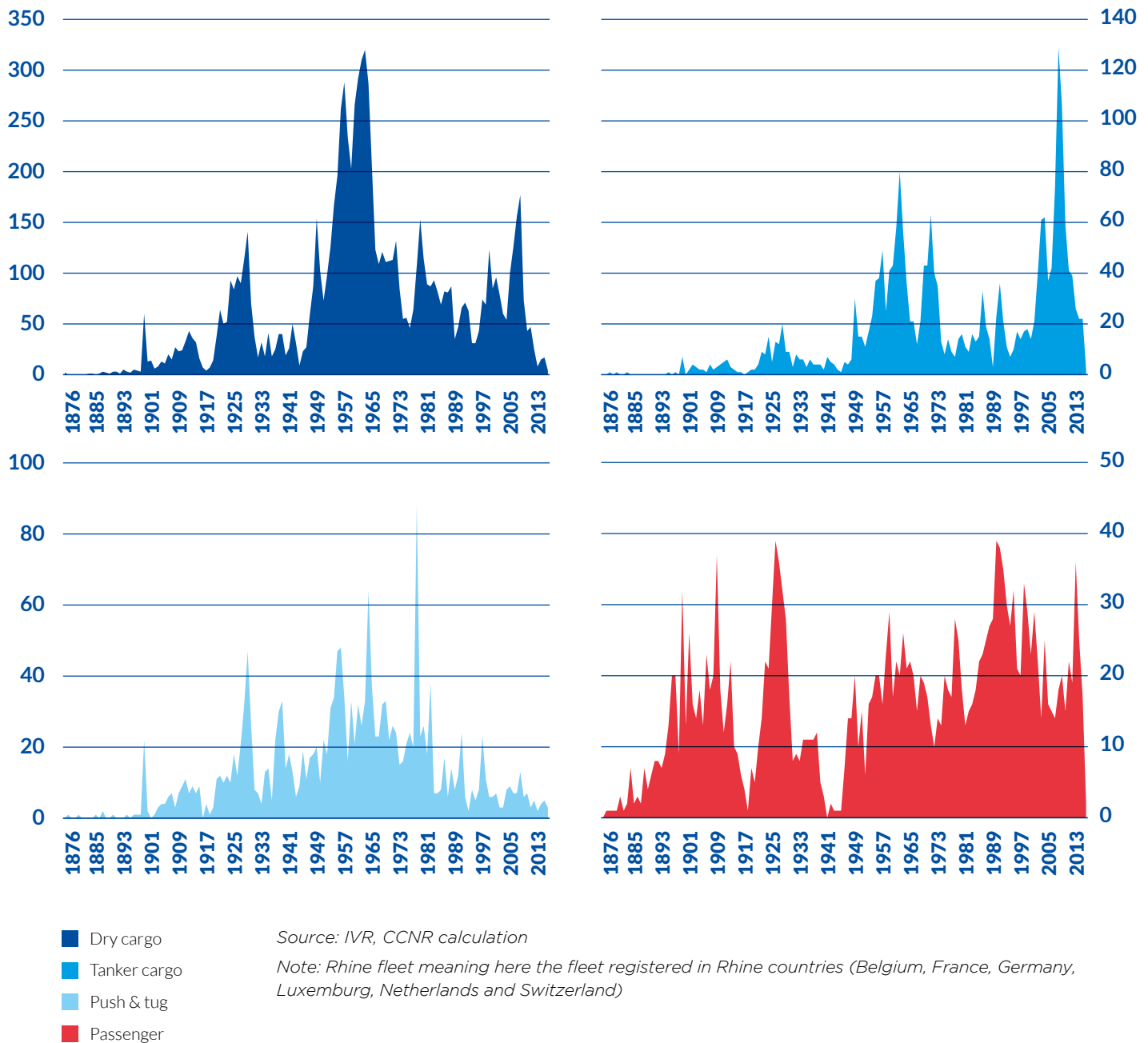
1965

Average year of construction for a dry cargo vessel in Rhine countries

1979

Average year of construction for a tanker cargo vessel in Rhine countries

THE RHINE FLEET BY SECTOR OF ACTIVITY AND YEAR OF CONSTRUCTION (NUMBER OF VESSELS)



The average year of construction is 1965 for a dry cargo vessel and 1979 for a tanker cargo vessel. In passenger shipping, although new vessels were built in the last years, the average year of construction is 1959. For push & tug vessels, the average year is also 1959.

In **tanker shipping**, a great number of new motor vessels came into the market in the last years and new construction is expected in the following years. The reason behind this is that most chemical companies, such as BP or Shell, only sign contracts with vessels that are less than 25 years old due to quality and safety reasons. This would explain why 37% of the tanker cargo fleet is less than 20 years old.

With respect to tanker cargo barges, the year structure differs. About 36% of them were built more than 70 years ago and only 7% of them are less than 20 years old.

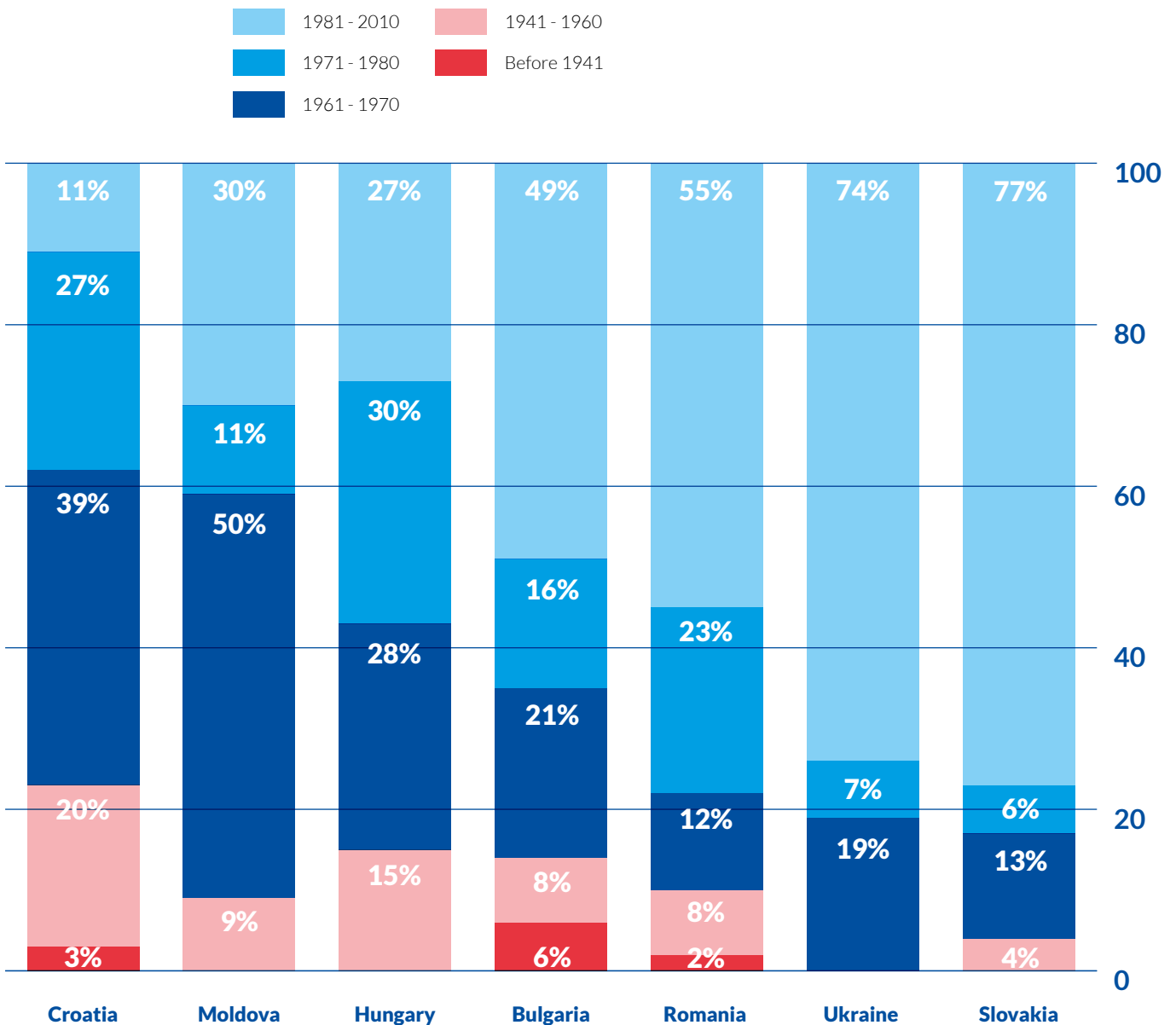
In the **dry cargo segment**, which is characterized by a large number of small family businesses, the number of newly built vessels is much lower than in the tanker cargo sector. About 43% of the fleet was built between 1940 and 1970 and only 15% of the vessels are less than 20 years old.

In **passenger shipping**, there is a large number of vessels, mainly river cruise vessels, which were built between 1876 and 1930 and represent about 31% of the fleet. However, new cruise vessels appeared in recent years; about 8% of them were built from 2009 onwards.

DANUBE COUNTRIES

In the Eastern European market, some differences can be found between countries characterized by an older fleet (Croatia, Moldova and Hungary) and countries with a newer fleet (Bulgaria, Romania, Ukraine and Slovakia).

THE DANUBE FLEET BY YEAR OF CONSTRUCTION (% BASED ON NUMBER OF VESSELS)



Source: Danube Commission

In Danube Countries, the percentage of the oldest vessels (those which were built more than 75 years ago) is much lower than in Rhine countries, representing only 2% of the total fleet.

In Croatia and Moldova, the structure of the fleet by year of construction is quite similar. The majority of vessels were built between 1941 and 1970.

In Hungary, half of the fleet is older than 45 years.

In Bulgaria and Romania, about half of the fleet was built in the last three decades. In these countries, most of the companies operate in freight transport, and their vessels are relatively newer compared to the dry cargo fleet in Rhine countries.

Ukraine and Slovakia have the newest fleet; most of the existing vessels are less than 30 years old.



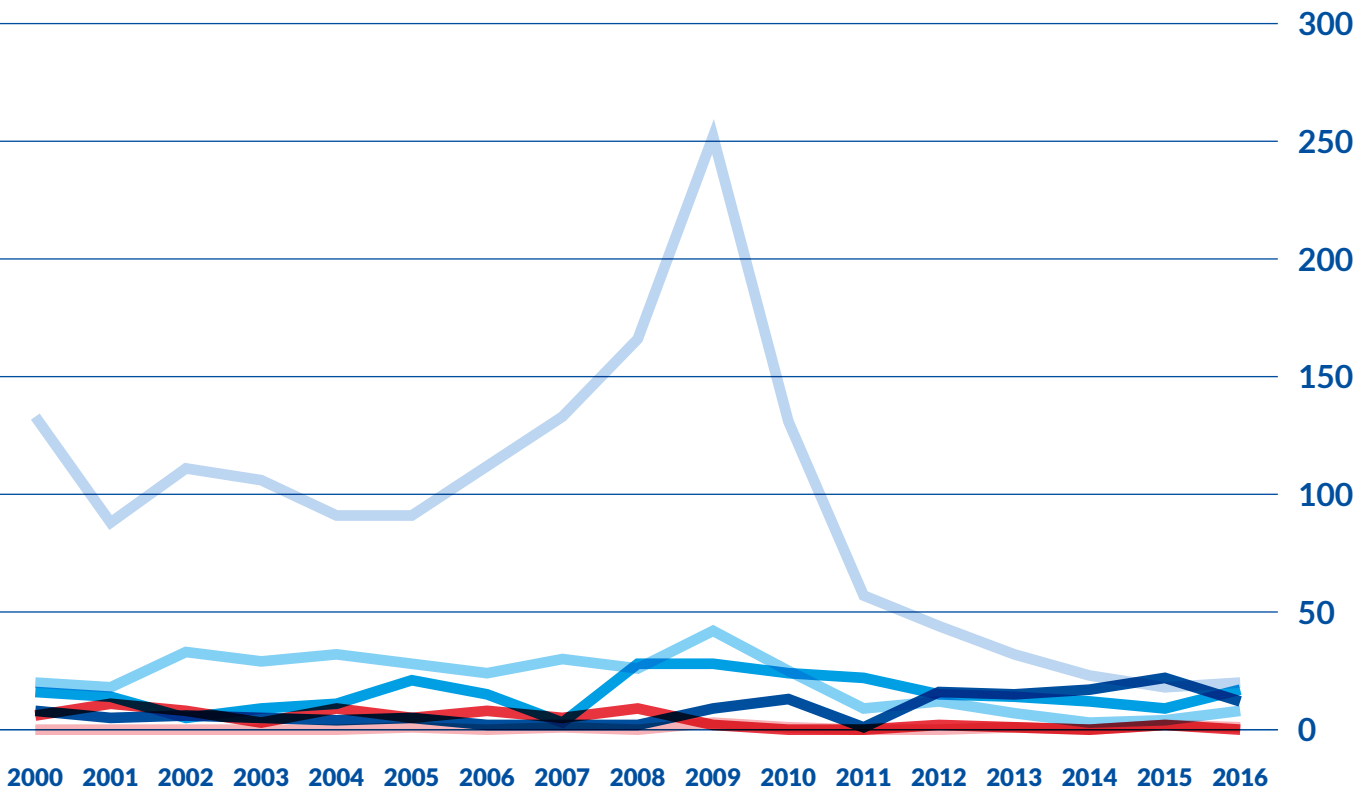
NEW VESSEL CONSTRUCTION

In 2016, the new tonnage added to the market was about **22%** higher than in 2015.

- Netherlands
- Belgium
- Germany
- Switzerland
- France
- Luxembourg

In the last years, a new construction wave caused an overcapacity of larger vessels which was clearly revealed when the economic crisis hit major parts of the IWT sector. During these years, freight flows significantly decreased whilst the fleet was still expanding.

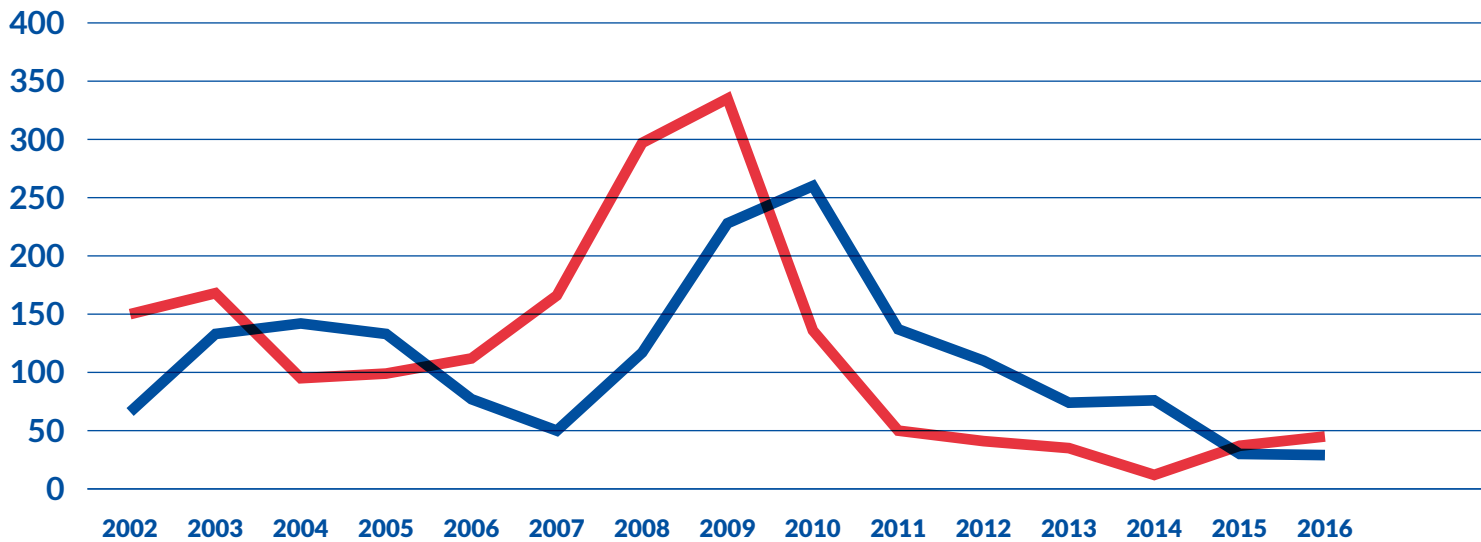
CONSTRUCTION OF NEW VESSELS IN RHINE COUNTRIES (NUMBER OF VESSELS)



Source: IVR

Most of the new construction occurred in the Netherlands (65%). The extension in the Port of Rotterdam and the good results of the container transport encouraged companies to order new vessels before the crisis. However, most of them came into the market in 2009.

NEWLY BUILT VESSELS IN DRY AND TANKER CARGO SECTORS (TONNAGE 1000 T)



Dry cargo
—
 Tanker cargo
—

Source: IVR

In relation with the wave of construction of new vessels in the Netherlands, the loading capacity of the dry cargo new vessels tripled from 2006 to 2009. In new tanker cargo vessels, the growth was even higher, as the loading capacity was five times higher in 2010 than in 2007. After the crisis started, less capacity was added to the IWT market.

In the dry cargo segment, 14 new vessels were introduced in Western Europe in 2016, with a total tonnage of 50,000 tonnes. Out of these 14, half of them were for container transport (two push convoys and five self-propelled vessels); the other new vessels were five self-propelled dry cargo vessels and two self-propelled vessels specialized for the transport of sand.

In 2015, there had been nine new dry cargo and container vessels, with a total tonnage of 31,517 tonnes. Therefore, the year 2016 brought a small net increase.

Twenty new tanker vessels for goods transport and three new bunkering vessels came into the market in 2016, with a total loading capacity of 51,000 tonnes (without the bunkering vessels). Included in those was the world's most environmentally friendly inland vessel (ECOLINER), and also the world's biggest tanker vessel for bitumen transport (LAPRESTA).

In 2016, five new push & tug boats were built. Most of them are active in the ARA region and on the Lower Rhine and only one is active in the Port of Basel on the Upper Rhine.

In addition, two new push boats were introduced by IMPERIAL for its activities in South America.





06

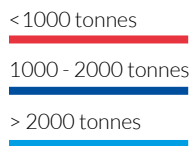
CAPACITY MONITORING

- Taking into account maximum loading degrees due to water conditions, the average fleet utilisation rate was 80% on the dry cargo segment and 61% on the liquid cargo segment in 2016.
- Fleet utilisation rate increased for smaller vessels and decreased for bigger vessels in 2016.

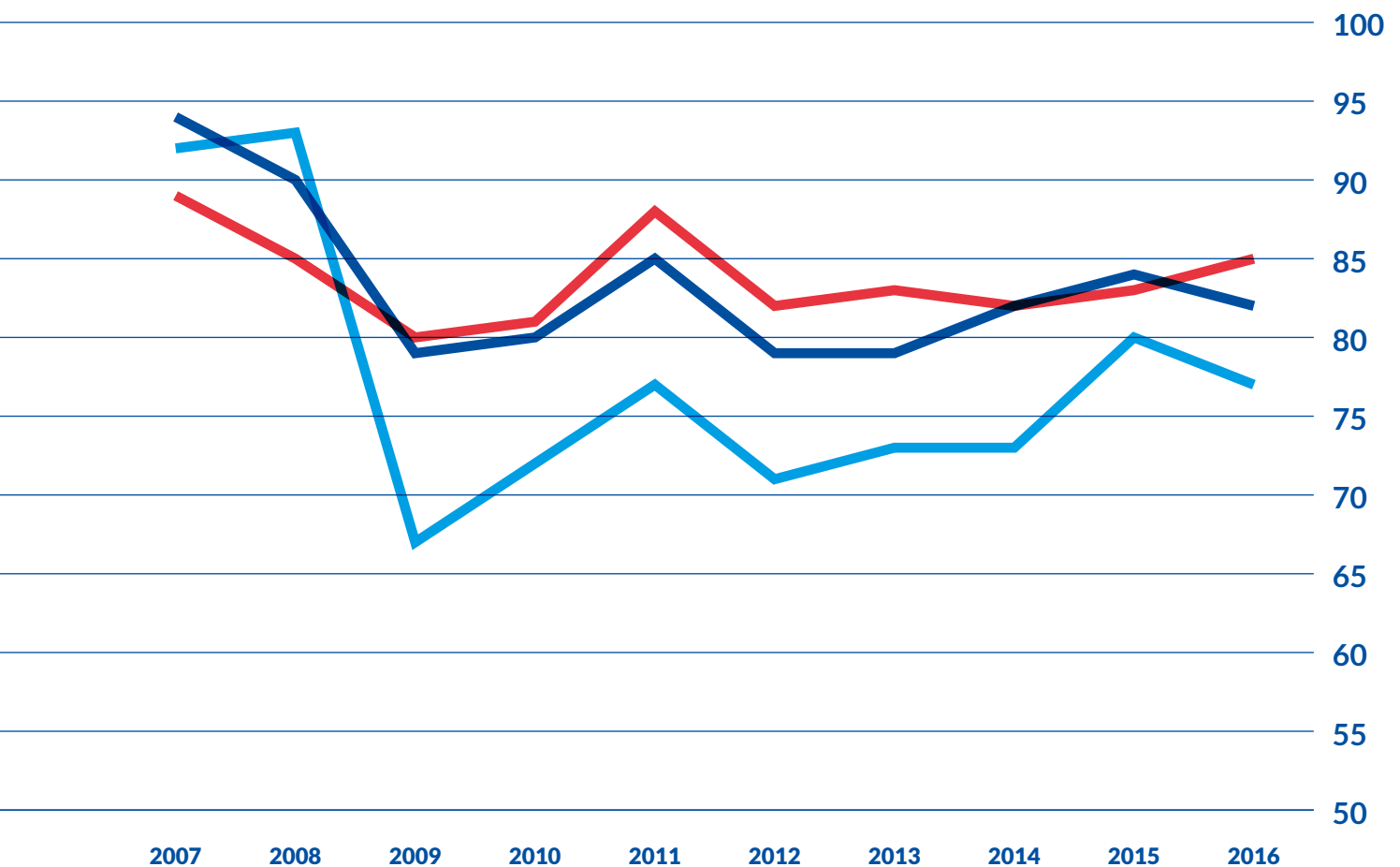
DRY CARGO VESSELS

In 2016, the average utilisation rate of the dry cargo fleet dropped slightly compared to 2015. In the corresponding graph and table, the evolution of the demand/supply ratio in inland navigation is plotted for the different fleet segments. It should be noted that the average fleet utilisation rates dropped overall, and in particular for the vessel size classes 1000-2000 t (84% → 82%) and > 2000 t (80% → 77%). Only for the small vessels (size class < 1000 t) was there an increase (82% → 85%).

The major reasons for the overall decline are, on the one hand, low growth rates for classical dry cargo segments (fewer agricultural products due to a bad harvest, closure of coal-fired power plants) and, on the other hand, better water conditions as compared to 2015. Vessels smaller than 1000 tonnes are taken off the market to a larger extent than the reduction of the freight volumes.



UTILISATION RATE OF THE DRY CARGO FLEET ACCORDING TO FLEET SEGMENTS (IN %)



Although the dry cargo fleet shows a structural recovery from the crisis, fleet utilisation levels did not reach the values of 2007 and 2008. A decrease in freight volumes in the agricultural sector, especially in France, has led to lower transport demand and therefore hampers the recovery of the inland navigation market. Energy transition has reduced the demand for coal transport.

These developments still show indications of overcapacity in the dry cargo fleet.

It should be noted that the fragmented structure in the inland navigation market hampers regulation of capacity.

COMPARISON BETWEEN NEEDED AND AVAILABLE FLEET CAPACITY IN THE DRY CARGO MARKET

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Needed tonnage										
Less than 1000 tonnes	1,98	1,86	1,72	1,69	1,83	1,65	1,60	1,51	1,49	1,47
1000 - 2000 tonnes	2,73	2,67	2,37	2,36	2,48	2,29	2,34	2,39	2,44	2,38
More than 2000 tonnes	3,93	4,11	3,38	3,72	4,02	3,71	3,96	3,93	4,37	4,16
TOTAL	8,64	8,63	7,47	7,77	8,33	7,65	7,89	7,83	8,31	8,01
Available tonnage										
Less than 1000 tonnes	2,24	2,18	2,14	2,09	2,07	2,02	1,92	1,85	1,81	1,73
1000 - 2000 tonnes	2,92	2,95	3,01	2,96	2,93	2,91	2,97	2,92	2,90	2,89
More than 2000 tonnes	4,27	4,40	5,03	5,19	5,23	5,24	5,40	5,39	5,44	5,39
TOTAL	9,42	9,52	10,18	10,24	10,23	10,17	10,29	10,17	10,14	10,02
Average utilisation rate										
	92%	91%	73%	76%	81%	75%	77%	77%	82%	80%

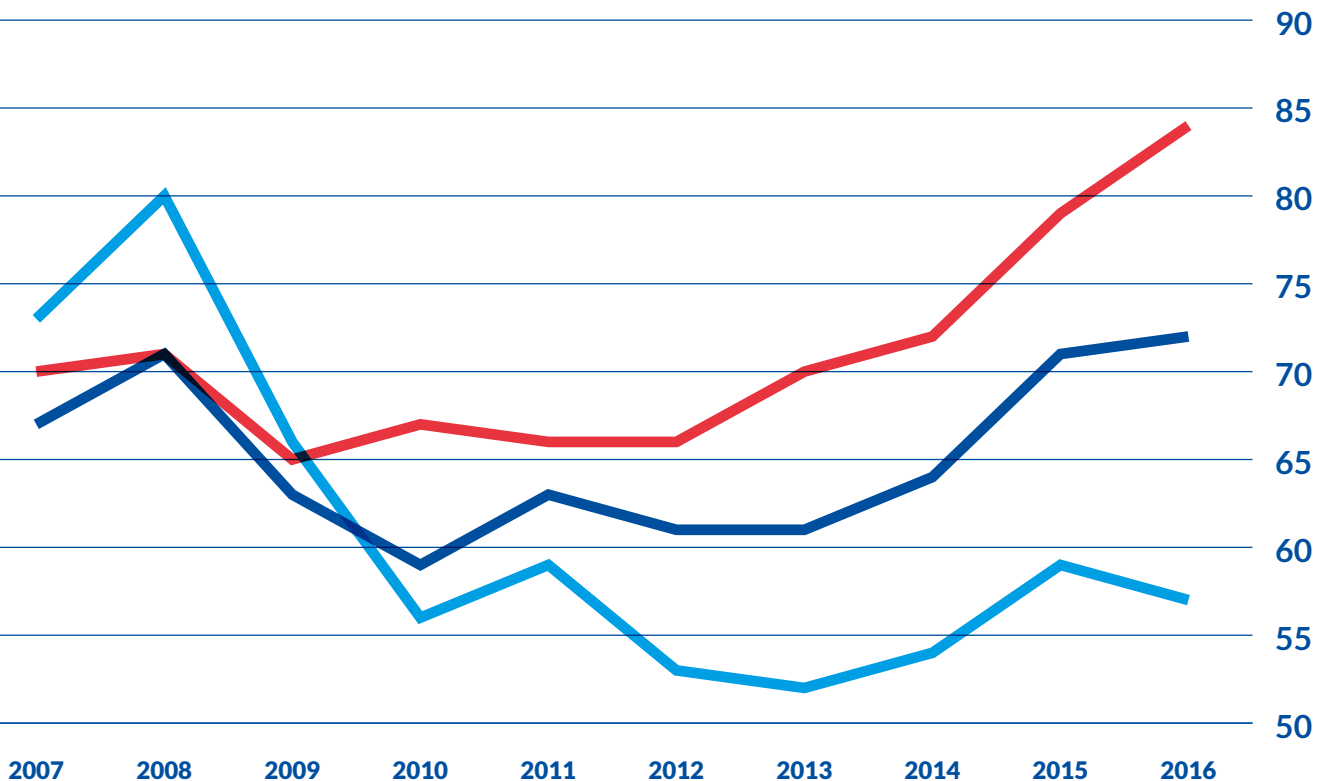
Source: Panteia

LIQUID CARGO VESSELS

In 2016, the average utilisation rate of the liquid cargo fleet dropped on average by 1% down to 61%. The main reason was the better water conditions in the autumn of 2016. The largest tankers in the fleet were mostly affected by the better water conditions, as these vessels have the largest draft - both when empty and laden. This fleet segment (> 2000 tonnes) has by far the highest share of the total liquid cargo and therefore this affected the overall result.

< 1000 tonnes
 1000 - 2000 tonnes
 > 2000 tonnes

UTILISATION RATE OF THE LIQUID CARGO FLEET ACCORDING TO FLEET SEGMENTS (IN %)



Source: Panteia

Due to the obligation to carry nearly all kind of liquid commodities in double hull vessels from 2019 onwards, a large number of single-hull tankers have been scrapped lately. This has mostly affected the tankers that are smaller than 2,000 tonnes. Thus, a large increase in capacity utilisation can be noticed for tankers with a loading capacity of less than 1,000 tonnes. In this segment, nearly no new vessels have entered the market.

For vessels with a cargo carrying capacity between 1,000 and 2,000 tonnes, it should be noted that a large part of the German and Dutch waterway network can only be accessed by tankers of this size. On a regular basis, new, double hull tankers enter this market. Therefore, the utilisation rate remained stable for this category.

COMPARISON BETWEEN NEEDED AND AVAILABLE FLEET CAPACITY IN THE LIQUID CARGO MARKET

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Needed tonnage										
Less than 1000 tonnes	0,13	0,13	0,11	0,11	0,10	0,10	0,10	0,09	0,09	0,09
1000 - 2000 tonnes	0,48	0,51	0,47	0,47	0,50	0,47	0,47	0,49	0,53	0,52
More than 2000 tonnes	1,04	1,15	1,08	1,07	1,21	1,11	1,12	1,20	1,30	1,27
TOTAL	1,64	1,79	1,66	1,65	1,82	1,68	1,68	1,78	1,93	1,88
Available tonnage										
Less than 1000 tonnes	0,18	0,18	0,17	0,17	0,16	0,15	0,14	0,13	0,12	0,11
1000 - 2000 tonnes	0,72	0,72	0,75	0,79	0,80	0,78	0,77	0,76	0,75	0,73
More than 2000 tonnes	1,42	1,44	1,63	1,93	2,04	2,09	2,15	2,22	2,23	2,24
TOTAL	2,32	2,34	2,55	2,89	3,00	3,02	3,06	3,11	3,09	3,07
Average utilisation rate	71%	76%	65%	57%	60%	56%	55%	57%	62%	61%

Source: Panteia





07

MARKET STRUCTURE

- The number of IWT companies has decreased by 1.2% in Rhine countries since 2008, while the number of IWT companies is increasing in Danube countries.
- 97% of IWT companies in France and in the Netherlands have fewer than 10 employees.

IWT COMPANIES

In Europe, there were about 10,000 inland waterway companies operating in the market in 2014 and 70% of them were located in Western Europe.

More than 22,000 people were employed in the IWT sector in the Netherlands, Germany, Belgium and France in 2014.

RHINE COUNTRIES

Western Europe inland shipping is characterized by a fragmented market with several small family businesses owning or operating one or two vessels.

DRY CARGO SECTOR

For the dry cargo sector, results show that the spot market is dominant (55-65%) for the negotiation of prices. This concerns transports of cereals and foodstuff, sand / gravel, ores and coal. Time or voyage charter contracts are also signed by 20% of companies. In this sector, about 70% of the shipping companies contact shippers via one or more intermediaries. In addition, online platforms are used in 15% of cases.

- In the steel market (iron ore transport), dedicated units also exist, in the form of push convoys travelling regularly from the ARA ports to the steel plants in the hinterland.
- In the foodstuff transport, customers are often large agribusiness companies or co-operations of farmers.
- Regarding the transport of sand and gravel: gravel transport, between mining locations and the building industry, is mostly done over the spot market. For sand, dedicated vessels operate on a project basis. Conditions and pricing are based on project-based contracts.

LIQUID CARGO AND CONTAINER SECTOR

In liquid cargo, as well as in container transport, time charter contracts are more often to be found. In the container sector, the share of time charter is around 45%, and around 40% in the liquid cargo sector. About 50% of all contracts in these segments are long-term contracts, with a duration of 2-3 years on average. But a great number of agreements are still made via the spot market. In the case of LNG vessels, longer agreements are possible due to the high investment needed for operating in the market. For instance, the 15 new LNG vessels entering the market by the end of 2018 have a 7-year contract with Shell.

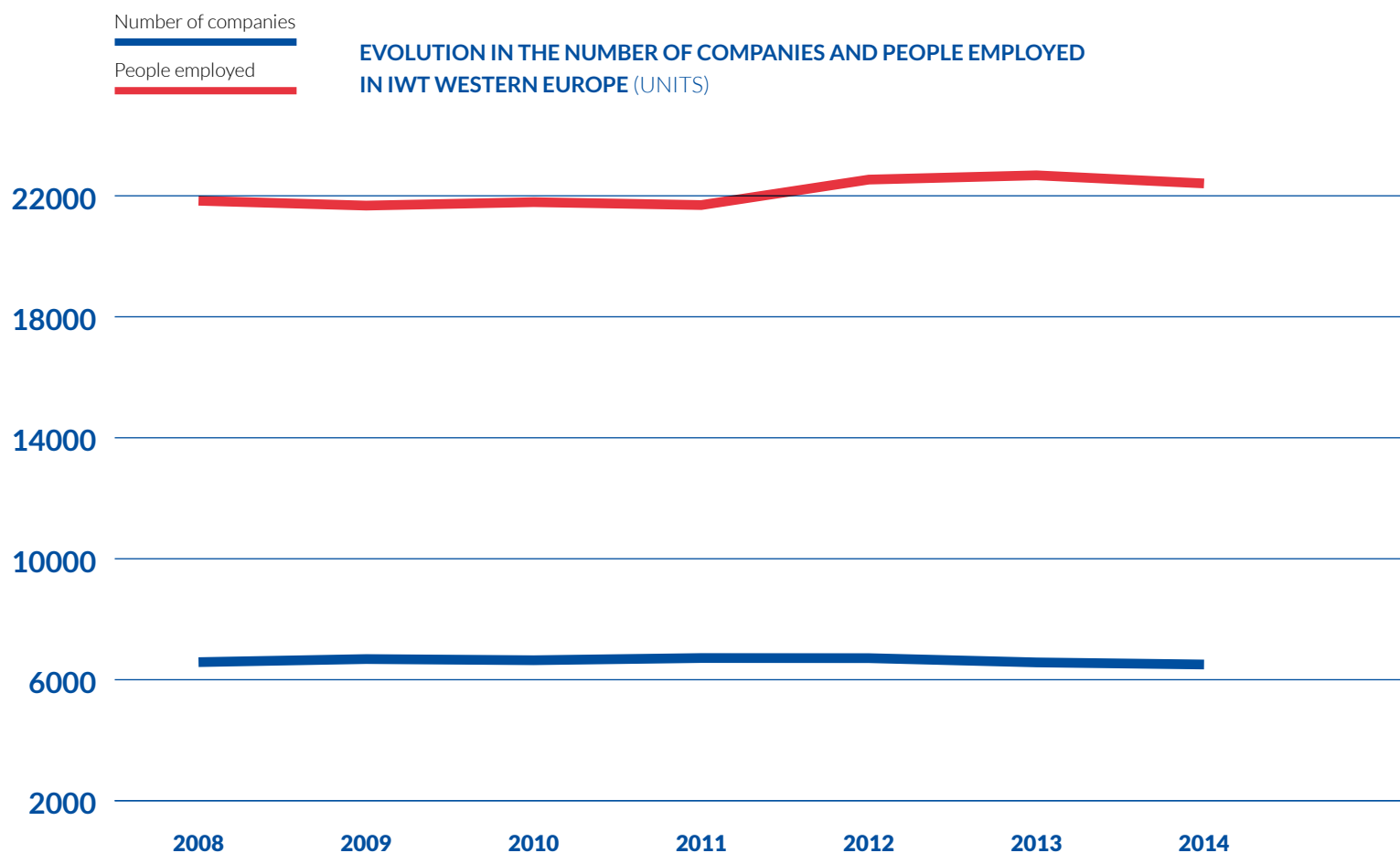
Suppliers of IWT services have solid and long relationships with one dedicated broker in 70% and 50% of cases respectively. In both sectors, an additional 15% contact more than one intermediary. Own marketing and own contacts account for 10%. Online platforms are not significant for liquid cargo, and only slightly so for container shipping.

For container shipping, large shipping lines have a stronger influence in the seaport hinterland than individual small companies. Large shipping lines usually sign long-term agreements and decide on what containers are shipped under carrier's haulage. This last concept means that the maritime shipping company organises also the transport in the hinterland of the seaport, and decides on the transport modes.

In the IWT sector, the presence of cooperatives is not widely spread yet. Through this type of cooperation is only done in 5%-10% of the cases, although some cooperatives are currently growing steadily.

In 2014, 63% of the existing IWT companies were registered in the Netherlands which employed about 45% of the total labour force in the sector. French and German enterprises represented 17% and 14% respectively.

The majority of enterprises operate in the freight transport sector (76%). In the case of Switzerland, 53% of the companies operate in passenger transport.



Source: national statistical offices, Eurostat, CCNR calculation

*People employed in the Netherlands, Germany, France and Belgium.

After the crisis in 2008, the total number of companies in Western Europe decreased slightly (-1.2%). This was mainly influenced by the decrease in the number of German companies (-13%), particularly relevant in freight transport enterprises. In the Netherlands, there was also a reduction of enterprises (-1.6%) over the period.

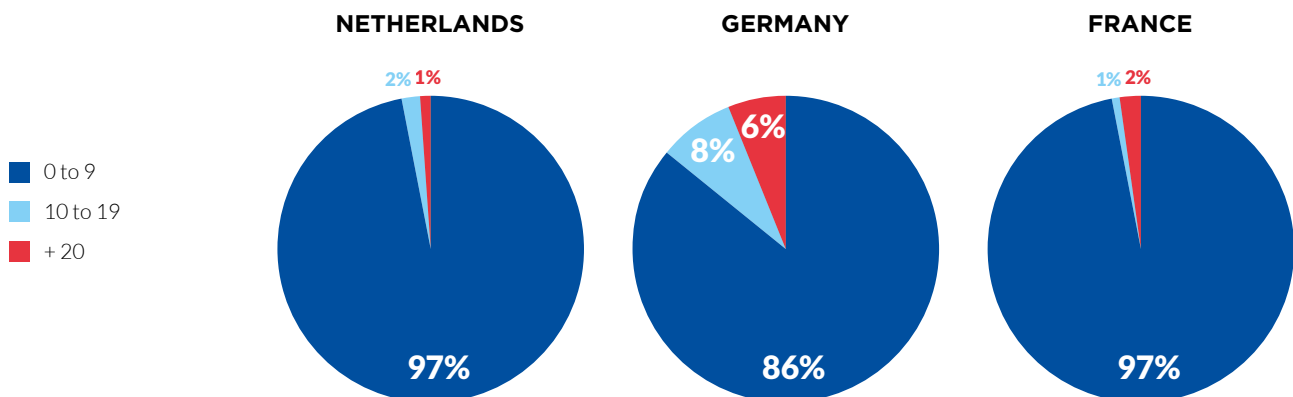
The evolution in the number of companies was different in other Rhine countries:

- In France, the number of passenger transport companies almost doubled. However, the evolution in the total number of IWT entities remained stable due to the decline in freight transport enterprises (-18%).
- In Switzerland, twelve new companies entered the market (21% growth) but only three of them operated in passenger transport.

The sector is very dense in the Netherlands where there were 65 entities per 100km navigable inland waterway in 2014.

The number of employees in the sector increased over the period (3%). This was influenced by new people hired in the Netherlands (+12%) and France (+20%), since German and Belgium companies reduced their labour force.

COMPANIES BY NUMBER OF EMPLOYEES IN 2014 (% OVER THE TOTAL)



Source: CBS, Destatis, INSEE

In the Rhine countries, the structure of the market is determined by a large number of small family businesses, which mainly operate in the dry cargo sector, except in Switzerland where larger companies operate in river cruises or tanker shipping.

In the Netherlands, Germany and France, the number of companies that have up to nine employees is significantly high. In Switzerland, these enterprises represent about 66% of the total number of IWT entities.

Regarding the sector of activity, freight transport companies had between two and six employees on average. In Switzerland, more people were hired between 2009 and 2014 since companies had about 12 employees in 2009 and five years later, 20 people were working in each entity.

In passenger transport companies, there were more employees per enterprise (between four and 12 people) on average. In Switzerland, there was a 56% increase, from 35 to 55 employees per company, in the period 2009-2014.

In the Netherlands and in France, **97%** of IWT companies have fewer than 10 employees.

DANUBE COUNTRIES

The structure of the IWT market in Danube countries is influenced by the communist past. The previous state owned enterprises became privately owned but the big size of the companies remained. About 14 large companies, with more than 20 vessels, dominate the market.

On the Upper Danube, smaller shipping companies from the Netherlands, Germany and Belgium are very active but their market share is about 15% of the total cargo transported in this area.

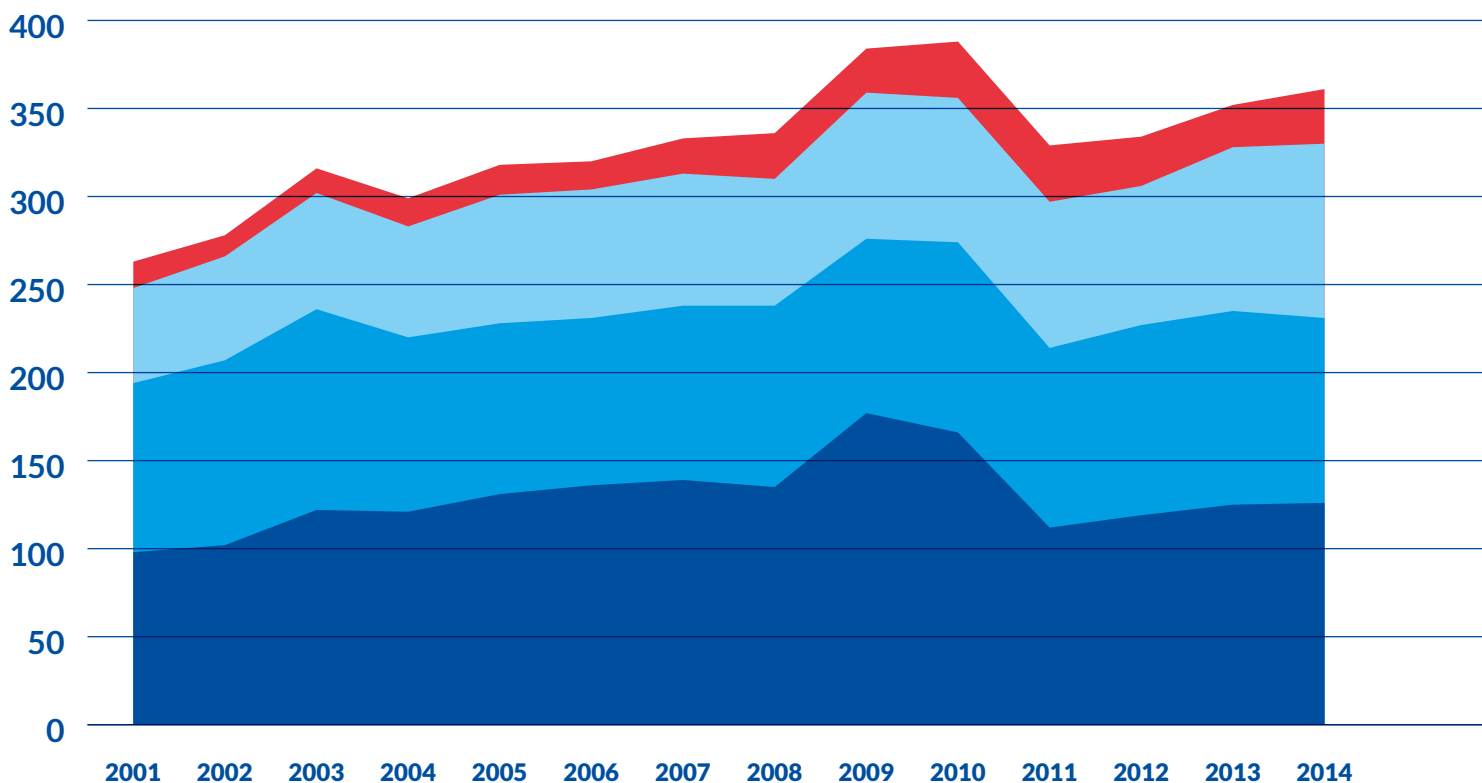
The largest enterprises operate in the freight transport sector with a fleet mainly formed by barges for the transport of bulk goods. In passenger shipping, there are smaller enterprises that offer day trip or river cruise transport services. 70% of these services are performed by vessels with the flag of the Netherlands, France, Switzerland or Malta.

The sector is dense in Austria where there were about 30 entities per 100 km navigable inland waterway in 2014.

On a regular basis, about 20-25 fleet operators work in the freight transport market in the Danube region.



EVOLUTION IN THE NUMBER OF IWT COMPANIES IN THE DANUBE REGION



The number of IWT entities operating in the Danube area increased (+37%) over the period. Particularly after 2008, the trend was influenced by new passenger transport entities entering the market. The drop in 2011 was due to a decrease (-55%) in the number of Romanian passenger shipping companies as compared to 2010.

The evolution in the number of companies was different in each Danube country.

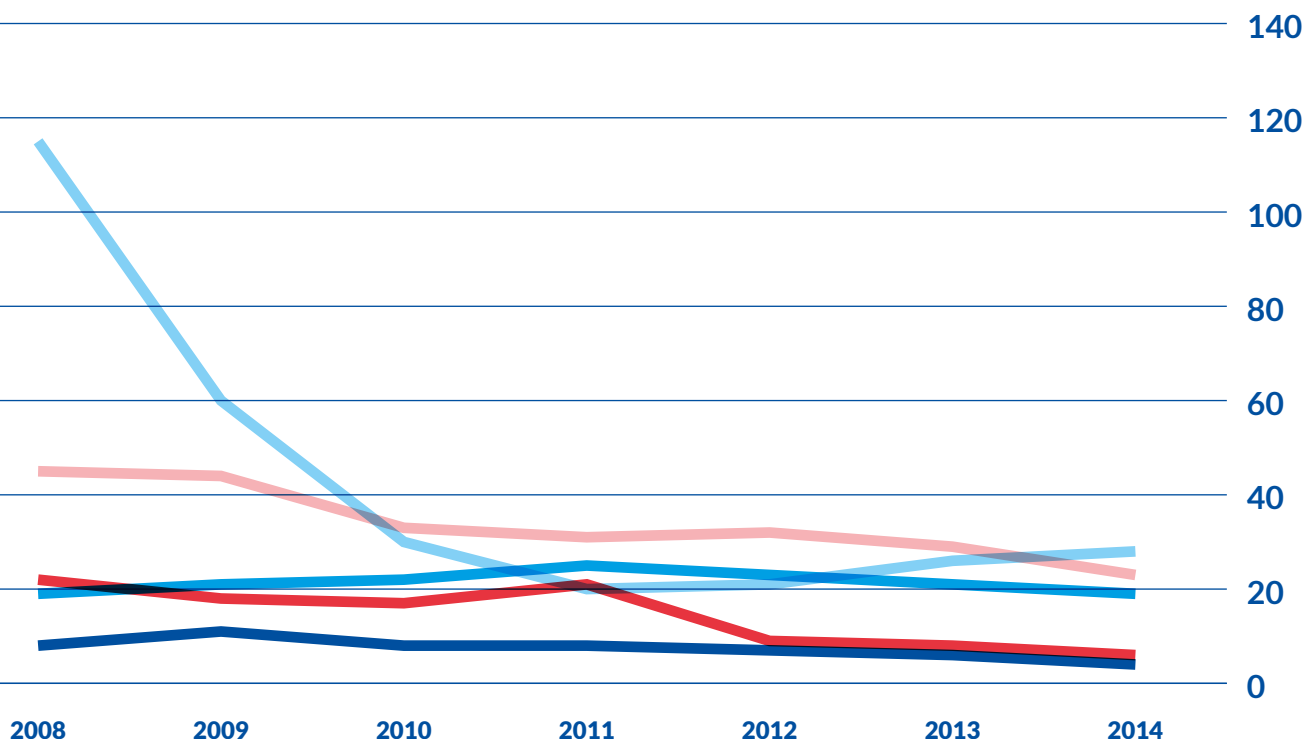
- In Romania, there was an upward trend (+80%) until 2009 when the number of both freight and passenger companies started to decrease. In 2014, 126 IWT enterprises were Romanian which was the largest number among Danube countries. 71% of them operated in the freight market.
- In Hungary, the number of IWT companies increased (+9%) over the period, especially in passenger transport (32%) from 2008 onwards. In 2014, there were 78 passenger and 27 freight transport companies; however, the total annual turnover was €17.8Mio and €58.1Mio, respectively. This means that most passenger transport companies are small and offer day trip or commuting services along the Danube in Budapest.
- Austria registered a gradual increase in the total number of IWT entities (+83%) mainly due to the passenger transport growth.

Passenger transport in the Danube countries includes day trip shipping, river cruises and also commuter traffic.

Slovakia
Bulgaria
Romania
Austria
Hungary

In most countries, the majority of enterprises operate in the transport of dry bulk, except in Hungary and Austria where passenger transport companies represented about 74% and 86%, respectively, in 2014.

NUMBER OF EMPLOYEES PER COMPANY IN FREIGHT TRANSPORT



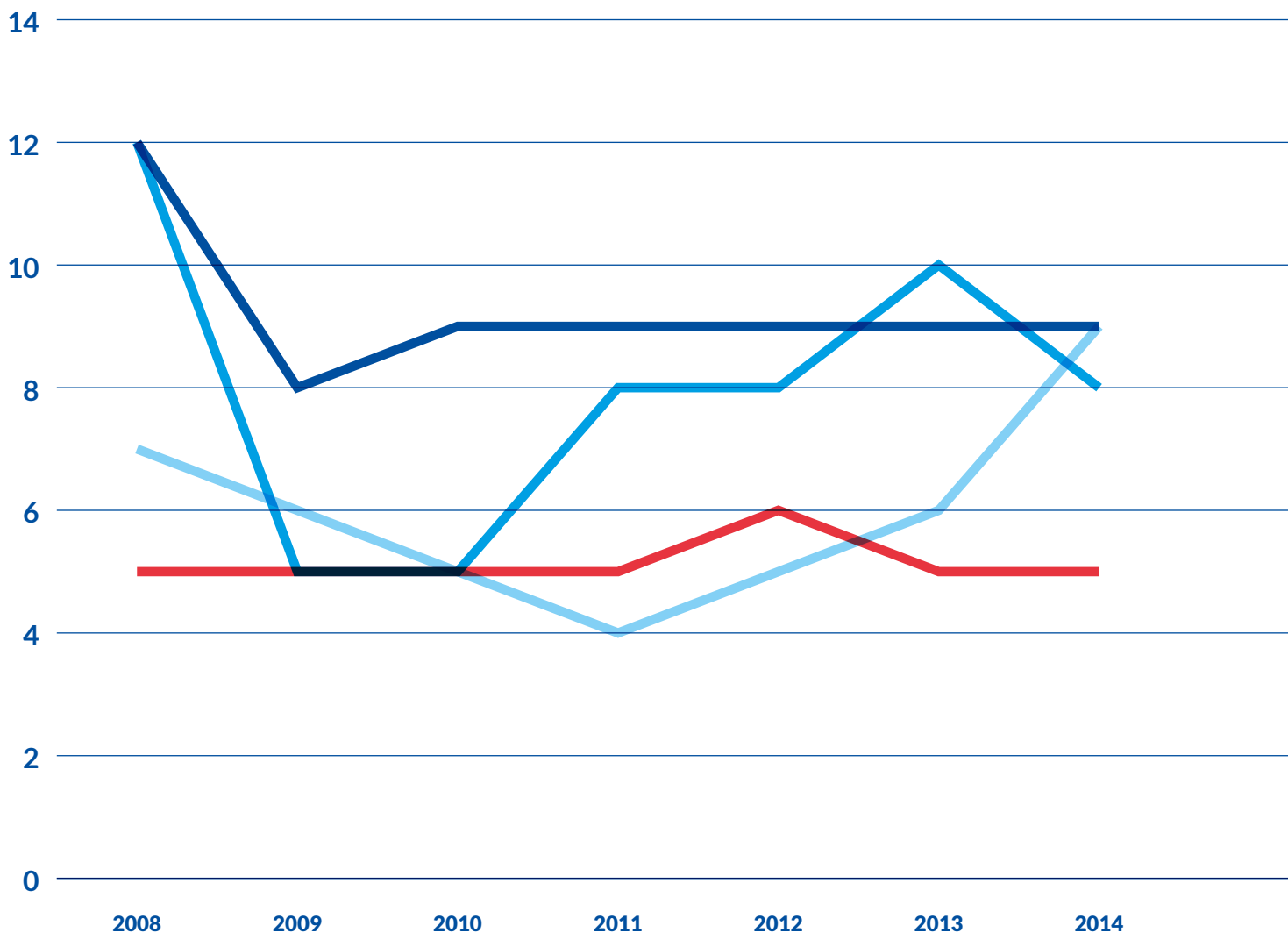
Source: Eurostat, CCNR calculation

In freight IWT, there was a decrease in the number of employees per company in all Danube countries, except in Romania where there was a 3% increase. The economic crisis and the restructuration of companies might have led to this situation.

Bulgarian and Hungarian freight entities reduced the number of employees by half during the period. This reduction was even stronger in Austria and Slovakia where companies' labour force was diminished by about 74%.

Hungary
Romania
Slovakia
Austria

NUMBER OF EMPLOYEES PER COMPANY IN PASSENGER TRANSPORT



Source: Eurostat, CCNR calculation

In passenger transport, most of the companies have less than 10 employees on average which is the same structure as in most Rhine countries.

Bulgaria is an exception. Five new large companies entered the market in 2014, hiring more than 60 employees per entity on average.





08

PASSENGER TRANSPORT

- With 335 active vessels, the European Union represents 39% of the worldwide river cruise fleet.
- A rising trend can be observed on Portuguese and French rivers while the Rhine, Danube and Elbe still account for the main share of the active European fleet.
- Out of 31 new vessels worldwide, 20 new river cruise vessels were put into service in Europe in 2016.

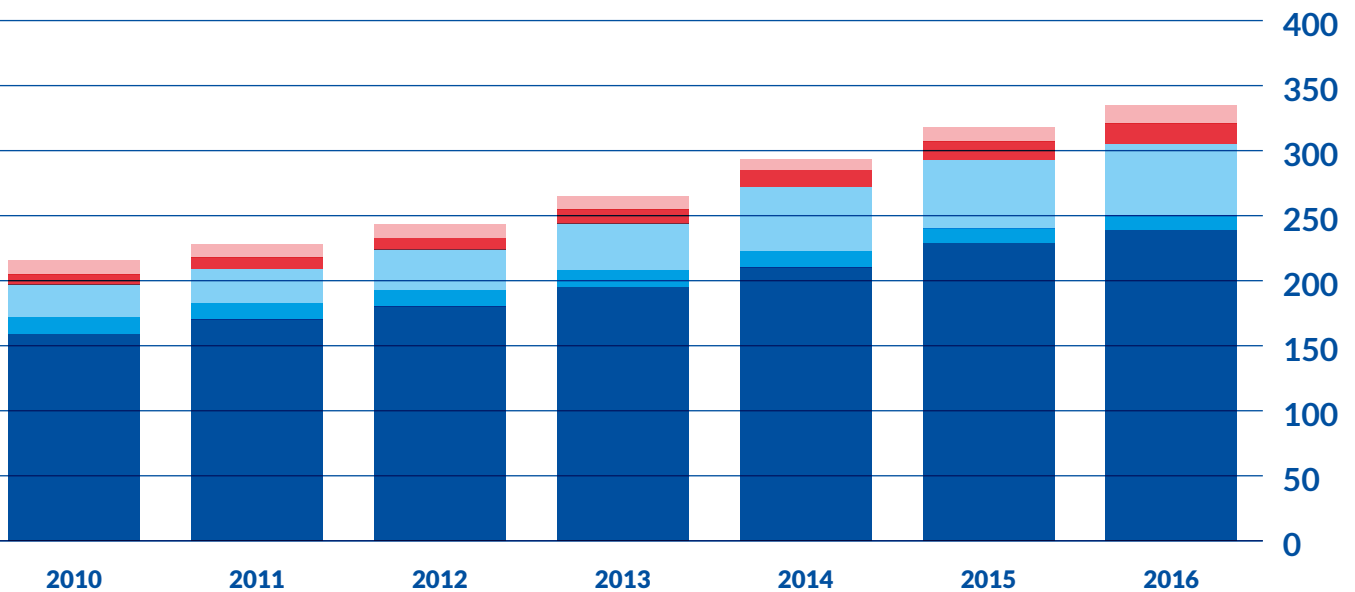
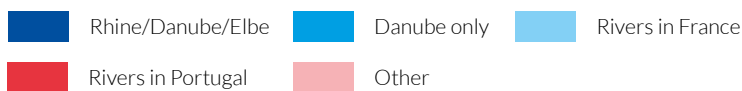
PASSENGER TRANSPORT FLEET

75% of active cruise vessels in Europe are navigating on the Rhine, Danube and Elbe.

The EU has increased its fleet capacities tremendously over the last 11 years. In 2016, the fleet of the EU region numbered 335 active cruise vessels which represent 39% of the worldwide river cruise fleet, compared to 24% in 2005.

River cruise vessels active on the Rhine (including tributaries), Danube and Elbe represent 75% of active vessels in Europe. Vessels active on rivers in France account for 16%, with a rising trend. Vessels on Portuguese rivers (Douro) have a share of almost 5%.

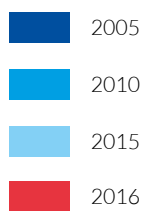
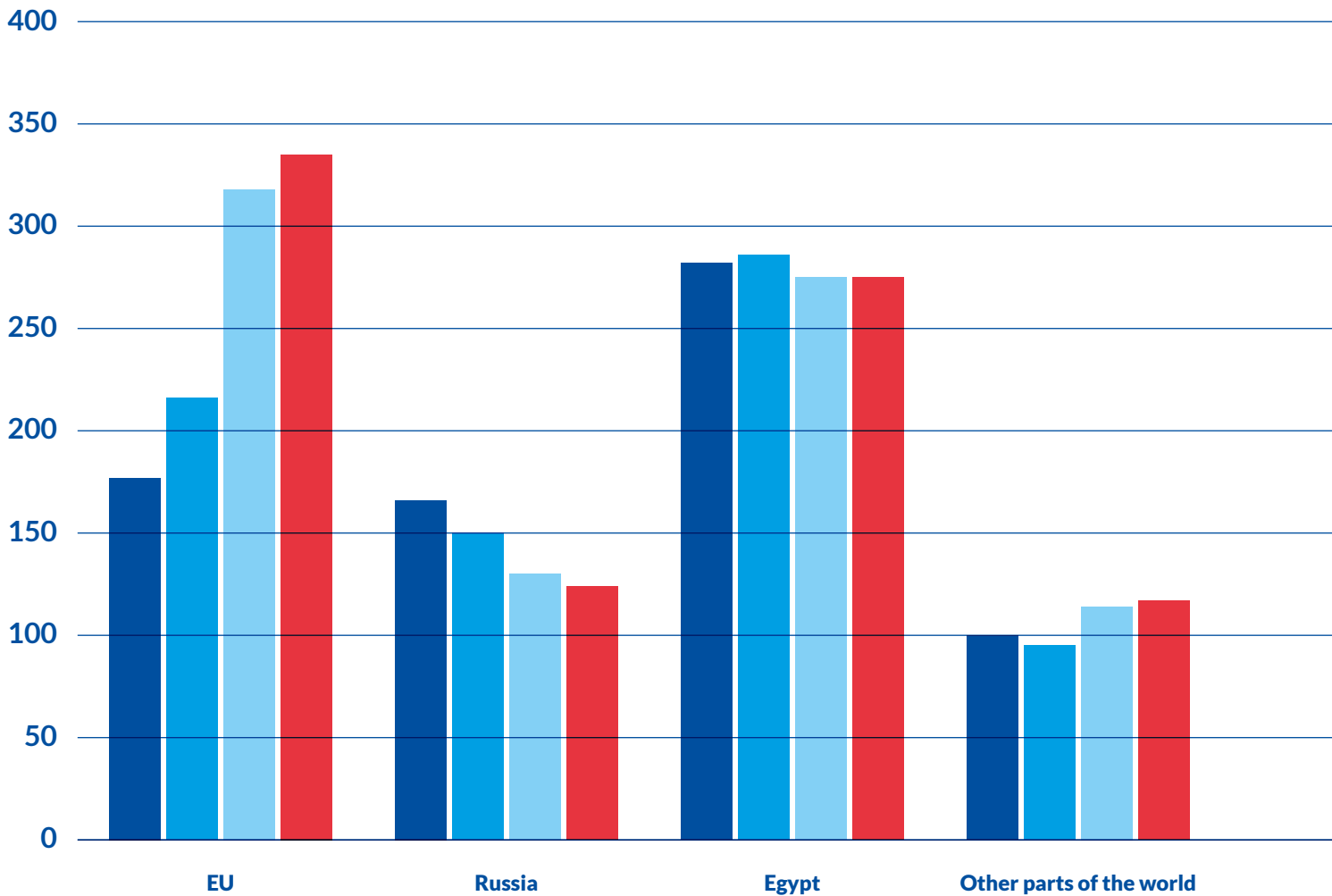
NUMBER OF RIVER CRUISE VESSELS IN EUROPE BY REGION OF OPERATION (2010 - 2016)



Source: CCNR

From a technical point of view, these vessels are foreseen to only operate in these regions.

DISTRIBUTION OF RIVER CRUISE VESSELS PER REGION WORLDWIDE



Source: Hader & Hader 2016

In two other important regions, the evolution is less positive: the Russian River Cruise fleet has a very high average age and is reduced from year to year. The Nile fleet in Egypt is stagnating, due to the negative impact of political developments on the number of tourists visiting Egypt.

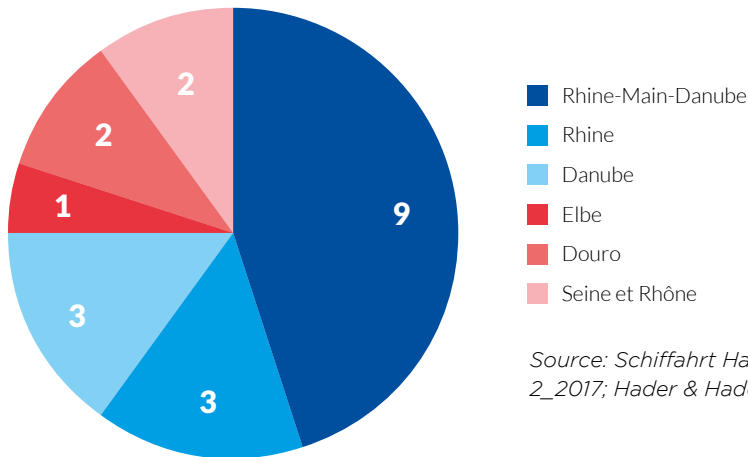
The building of new cruise vessels in Europe continues in 2016, albeit at a slower tempo than in the years before.

In Europe, 20 new river cruise vessels were put into service in 2016, out of 31 worldwide – that represents a significant

share of 70%.

The chart below shows the newly built vessels and their regional distribution of operation as intended by the ordering company. The Rhine (including tributaries) and the Danube still account for the largest proportion of the new vessels. In terms of occupancy, the share is the same with the largest number of beds for Central European waterways Rhine-Main-Danube (1,591 beds), Rhine (440 beds), followed by Danube (434 beds) and Douro (202 beds).

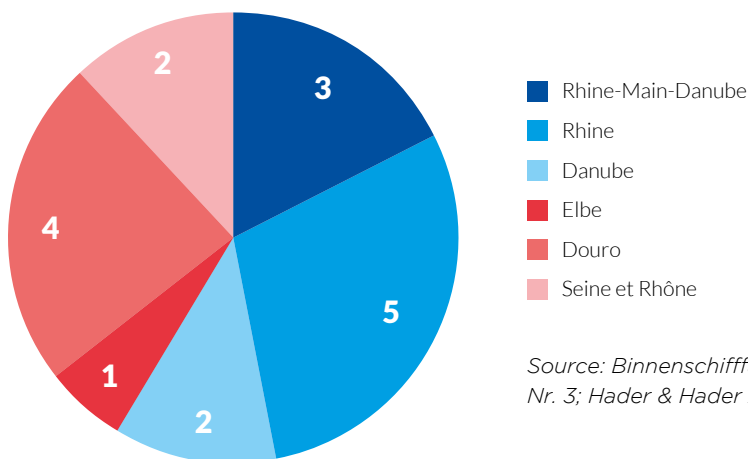
NEWLY BUILT PASSENGER CRUISE VESSELS IN 2016 BY REGION OF OPERATION



Source: *Schifffahrt Hafen Bahn und Technik*, 2_2017; *Hader & Hader* 2016

For the years 2017 and 2018, the number of new vessels entering the European market continues to decrease slowly: 17 new vessels are foreseen for 2017, and only 10 are scheduled for 2018. Overall, the wave of new vessels that had started in 2010, and reached its peak in 2014, is now coming to an end.

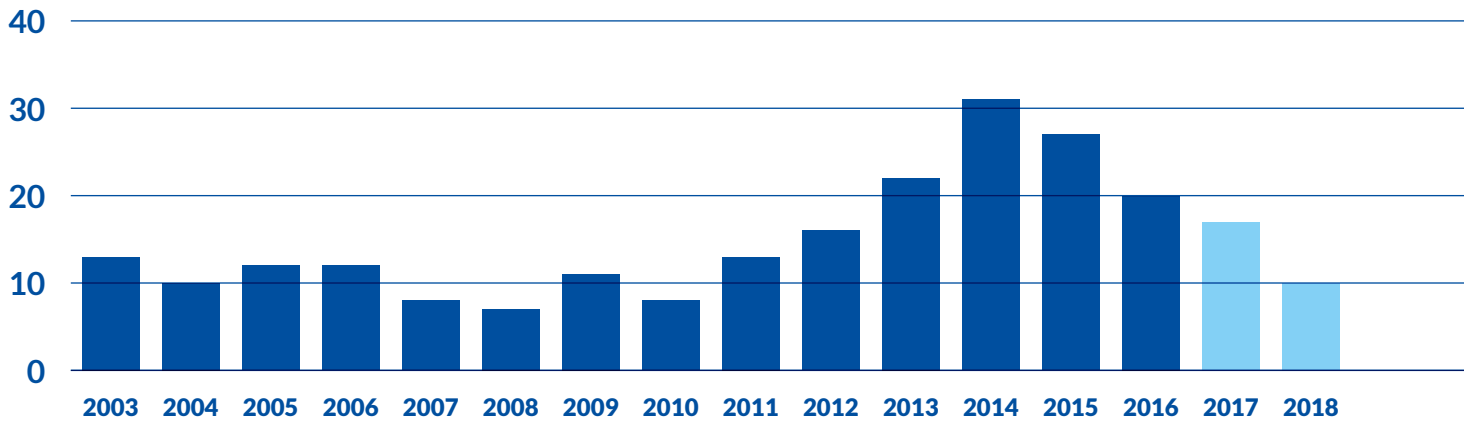
NEWLY BUILT PASSENGER CRUISE VESSELS IN 2017 BY REGION OF OPERATION



Source: *Binnenschifffahrt - ZfB - 2017*, Nr. 3; *Hader & Hader* 2016

A possible new wave could only be triggered by an increase of new vessel orders for the English-speaking market. It should be emphasised that travellers from Great Britain not only consult the offers of British tour operators but also those of the rapidly growing US market. Furthermore, British tour operators recently opened up new target groups by chartering high-quality newly built vessels.

NEW RIVER CRUISE VESSELS FOR THE EUROPEAN MARKET (2003-2018)*



Source: Hader & Hader 2016

*values for 2017 and 2018: forecast based on order books

For the German market, as far as the capacity of the fleet is concerned, it remains almost constant. Higher charter rates result in less shipbuilding directly for the German market. The Dutch fleet, on the other hand, hardly grows, as new ships are often made available to foreign markets.

The year 2017 will be characterised by a regional diversification: for the first time, almost half of the new ships (47%) will not be employed on the Rhine-Main-Danube system, but on the Douro, Rhône and Seine.

This diversification also takes place within the Rhine itself: travel routes for river cruises were extended from the Rhine to its tributaries (for example the Main). From the viewpoint of the operators, this diversification makes economic sense, as concentrating on only one river can be risky. This applies especially to the new vessels.

Not only does the geographical scope change, but also the thematic spectrum is broadened, in order to reach a younger audience: more and more theme tours are offered, e.g. River cruises to the most beautiful Christmas markets along the Rhine or culinary cruises on the Rhône, where regional specialties can be discovered.

Besides, the operators have also noticed the growing environmental awareness among their target groups, hand in hand with an increasing interest and demand for so-called "green cruising". Therefore, they have successfully introduced several greening technologies in their new vessels, like Dual-Fuel-engines, Diesel-electric engines and post-combustion filters. These new propulsion systems lead to a gradual green modernisation of the river cruise fleet. Apart from the benefits for the environment, these new technologies also improve the comfort of the passengers on board, in terms of a reduction of noise and local pollutant emissions.

In the wake of the overall goal of increasing its sustainability, certain operators are creating new concepts for expanding their offer for different waterway profiles. For example, on the river Elbe, one of the leading European companies (with a fleet of 45 ships) introduced a vessel with a single paddlewheel propulsion. This allows navigation in shallow waters and, thus, navigation becomes possible with only 5 to 10 centimetres of water under the hull and allows ongoing operation on the river Elbe despite frequent periods of low water conditions. Moreover, this system ejects less water, which results in a much more sustainable cleaner flow. (Source: Mer et Marine - Toute l'actualité marine)

PASSENGER TRANSPORT DEMAND

In 2016, a total of 1.36 million river cruise trips were taken on inland waterways in the EU, which corresponds to an increase of 2.7% compared to the previous year. In 2015, however, an increase of 17% had taken place within only one year.

Despite a sluggish start to the season, influenced by the attacks in Europe in Paris (November 2015) and Brussels (March 2016), the wave of cancellations and lack of bookings feared by the river cruise industry, in particular for the French regions, did not materialise. All in all, they were even able to post a slight increase at the end of the booking season.

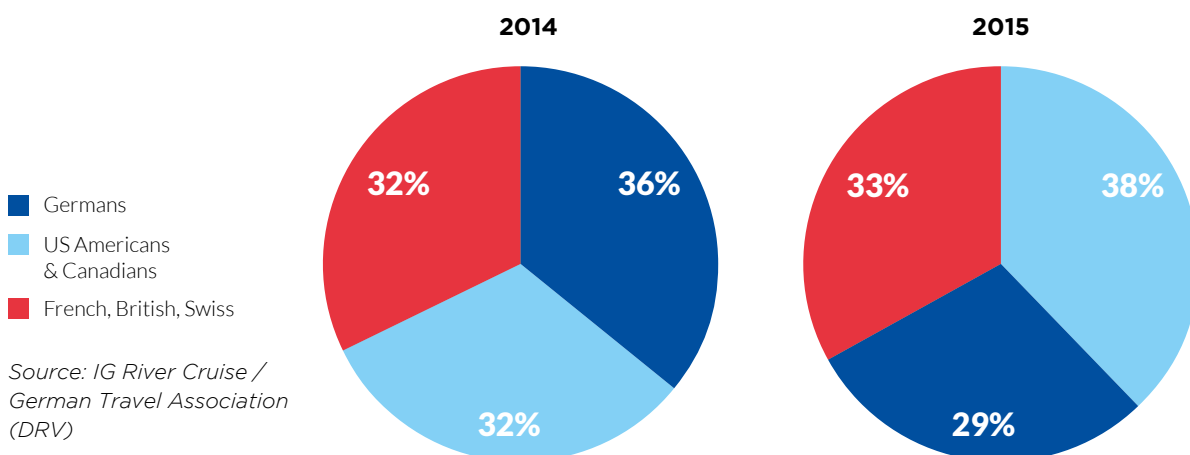
Contributing 39% of cruise passengers, the USA and Canada were again the most important source markets in 2016, almost the same as in 2015 (38%).

However, it can be assumed that their rate of growth was negatively affected particularly by the threat of terrorism and the official travel warning. It is undeniable that a change in security habits has taken place: a lot of American customers prefer so-called "home cruising", avoiding flights overseas.

The German source market ranked in second place at 29%. The German passenger volume had again grown by 2.8% to more than 435,000 passengers.⁹

The number of British passengers in Europe rose from 131,400 in 2015 to 166,700 (Source: CLIA) in 2016. Therefore, it can be assumed that the shift in passenger split from German-speaking customers to English-speaking customers keeps on progressing.

SPLIT OF PASSENGERS BY NATIONALITY (%)



⁹Source : Deutscher Reiseverband DRV ; press release dated 09.03.2017 „Fluss-Kreuzfahrt in Europa behauptetsich“ (River cruise in Europe is asserting itself)

For the German passengers, the Rhine (35.5%) was once again the most popular destination, followed by the Danube (34.4%). However, a slight shift in the market share from the Rhine and Danube to less travelled rivers could be observed. It was noticeable that this shift was at the expense of the Danube (-3.6 percentage points) and the Rhine (-2.7 percentage points).¹⁰

DISTRIBUTION OF PASSENGERS FROM THE GERMAN SOURCE MARKET TO TRAVEL DESTINATIONS WORLDWIDE

Travel destinations	2015	2016
Rhine & Tributaries	38.2%	35.5%
Danube & Tributaries	38.0%	34.4%
Seine, Rhône, Saône, Garonne, Loire	8.6%	10.5%
Elbe, Oder, Havel	3.0%	4.3%
Other European destinations	2.8%	4.1%
Other Non-European destinations	9.4%	11.2%

Source: IG River Cruise / German Travel Association (DRV)

Considering the evolution in global demand, the market for river cruises is independent of other shipping markets, as it is less exposed to fluctuations in industrial production. However, travel intensity is strongly influenced by the effects of temporary and regional influences such as weather conditions (i.e. icing in the winter season). Nevertheless, thanks to the use of modern cruise vessels and new technologies, for example propulsion with a single paddlewheel, it is possible to extend the service period considerably, so that the season break lasts only from January to March/April.

There is only a very general connection between the demand for river cruising and global economic development. In principle, the dependencies linked to the purchasing power are usually influenced or even replaced by regional political events, intra-industry trends such as an expansion or constriction of the supply chain (i.e. cancellation of cruises due to closures) and marketing measures.

Furthermore, the Rhine, thanks to its navigable tributaries, offers several different travel itineraries, which makes it attractive for repeaters, tourists that travel repeatedly to the same destination.

Another positive aspect of the Rhine is its geographical proximity to important global airports such as Amsterdam, Basel, Frankfurt and Cologne. This geographical situation offers a considerable advantage for foreign passengers (especially from overseas) arriving by plane. Thus, distant source markets can also easily be operated.

¹⁰ Source : DeutscherReiseverband DRV ; press release dated 09.03.2017 „Fluss-Kreuzfahrt in Europa behauptetsich“ (River cruise in Europe is asserting itself)

From the point of view of navigation, the Rhine offers the best conditions for three-floor passenger vessels up to a length of 135 m, not least because the water level for cruise ships is rarely too low and locks can only be found on the Upper Rhine.

Another aspect to be taken into consideration, not only for the construction of new vessels, is the number and size of locks. Especially on the river Elbe and Moldau, newly constructed vessels can gain in length but cannot exceed a width of more than 10 meters in order to respect the constraints of navigation.

The Danube, together with the Rhine, is the most important European river for the cruise sector. On the Danube, there is a cluster of ports that play a significant role in river cruising. These main ports are Passau (Germany), Vienna (Austria), Bratislava (Slovakia), Budapest (Hungary) and Belgrade (Serbia). River cruises on the Danube can be split into two major types of journeys:

- **Short distance cruises** from Passau to Vienna, Bratislava and Budapest, lasting 5 to 8 days. They represent the most common type of Danube river cruises in terms of number of passengers transported (565,000 passengers in 2016 compared to 534,000 in 2015 (+5.7%).
- **Long distance cruises** from Passau to the Danube delta region lasting 14 to 16 days. For these cruises, 87,000 passengers were counted in 2016, compared to 83,000 in 2015 (+ 4.7%).

Concerning the nationality of the vessels, Switzerland has by far the highest share of all states. Together with Malta, France and the Netherlands, the Swiss flag accounted for 70% of the total number of river cruise vessels that were active in the short distance trip segment between Passau, Vienna, Bratislava and Budapest. In 2015, this share had been 74%, and 72% in 2014. River cruise vessels flying the German flag had a share of 15% in 2016, compared to 17% in 2015 and 16.5% in 2014. Vessels flying the Bulgarian flag accounted for 7% in 2016. Overall, this means that vessels with a nationality outside the Danube region account for the large majority of river cruise trips on the Danube.

The European river cruise industry continues to contribute significantly to the added value of inland shipping in 2016. It guarantees 13,971 jobs directly on the ships and a further 3,540 jobs within shipping companies operating on the land side. In addition, more than 11,000 jobs are linked to the river cruise industry, i.e. suppliers, ports, excursion agencies and other service providers on land.







09

EMISSIONS IN INLAND NAVIGATION

- Although inland waterway transport benefits from economies of scale, greenhouse gas emissions and pollutant emissions are raising increasing concern and attention.
- Technical, operational and transport management measures exist to limit emissions, but implementation costs limit their market penetration.
- Operational measures have the highest cost-benefit ratio, and stricter emission standards will apply for new engines from 2019 onwards.

DEFINITIONS AND CONTEXT

The transport sector is generating different effects on the environment. Transport infrastructure (roads, railway lines, locks, dams, etc.) represents and intervention on nature and landscape. Based on this infrastructure, and in strong interaction with it, the transport of goods and passengers causes external effects like noise, emissions and accidents. The present report aims to give a short overview of the ecological profile of inland shipping compared to the two land transport modes, road and rail. Based on this comparison, different possibilities for reducing energy consumption and emissions are presented. The report ends with some conclusions.

GREENHOUSE GAS EMISSIONS AND POLLUTANT EMISSIONS

Certain emissions contribute to global warming and are therefore called greenhouse gas emissions (GHG). Other emissions do not – at least not directly – affect the climate, but are harmful to air quality and human health. These emissions are called pollutant emissions. The relevance of emissions in the IWT sector reflects the fact that, until today, almost 100% of the fuel used by inland vessels is gasoil, which is very similar to diesel. Therefore, the most relevant emissions in IWT are:

1. Pollutant emissions - mainly nitrogen oxides (NO_x), particulate matter (PM), hydrocarbons (HC) and carbon monoxide (CO)
2. Greenhouse gas emissions (GHG) -mainly CO₂

Most measures for the reduction of emissions in IWT at the same time also reduce fuel consumption, and therefore have both ecological and economic benefits. This does not apply to all measures: important exceptions are exhaust gas reduction techniques that can reduce pollutant emissions (PM and NO_x) by up to 80-90%, but do not lead to less fuel consumption.

WELL-TO-WHEEL AND TANK-TO-WHEEL EMISSIONS

The well-to-wheel (or well-to-propeller) approach comprises all emissions caused by a transport mode: emissions during fuel extraction, fuel production, fuel transport, and finally the emissions caused by the combustion of fuel in the engines.

The tank-to-wheel (or tank-to-propeller) approach contains only those emissions that occur from the combustion of fuel in the engines (of a vessel, a truck or a train).

Within this report, the well-to-wheel (or well-to-propeller) approach is followed, as it gives a more comprehensive picture of the ecological profile of a mode of transport. This is especially relevant for electric rail transport. About 80% of European rail traffic uses electric traction today (UIC / CER (2015)). Therefore, the emissions of rail traffic, based on a tank-to-wheel approach, would be almost zero.

But for the generation of electricity, significant emissions can be produced. If electricity is produced by a coal fired power plant for example, the well-to-wheel emissions would be quite high. This is taken into account only by the well-to-wheel approach. For electric rail transport, the well-to-wheel emission factors presented in this report are based on the average mix of electricity produced in the Netherlands.

Comparisons of emissions between different transport modes should follow the well-to-wheel approach.



EMISSIONS IN IWT

COMPARED TO OTHER TRANSPORT MODES

Comparisons of emissions between different modes of transport are challenging, due to the large influence of the vehicle or vessel size, the infrastructure and operational factors.

Within this report, this intermodal comparison follows a study by the Dutch research institute CE Delft. This institute has developed long standing expertise in studying the ecological profile of different transport modes, including inland navigation. The study¹¹ was published in 2016 and represents an actualization of a previous study published in 2011. For the calculation of emissions in IWT, practical data for 100 inland waterway vessels were provided by BLN-Schuttevaer, with data according to these parameters:

- Vessel parameters (length, width, draught, capacity)
- Annual tonnage transported
- Annual distance travelled, loaded and empty
- Description of sailing area
- Annual diesel consumption

These data enabled energy consumption per ton-kilometer and CO₂ emissions for different vessel types to be determined. Pollutant emissions per ton-kilometer are calculated using reported emission factors for engines of different construction years.¹²

In Western Europe, two vessel types are representative of the majority of transports: the Large Rhine vessel (110 m length), and the Rhine-Herne canal vessel (85 m length). The Rhine-Herne canal vessel has a loading capacity of around 1,500 tonnes, which is equal to the current average loading capacity of the Western European dry cargo fleet (based on national administration data). But on smaller inland waterways in Belgium, the Netherlands and France, the type Kempenaar (55 m length) is also relevant. On the Lower Rhine and Danube there are pushed convoys carrying more than 10,000 tonnes of cargo.

VESSEL TYPES CHOSEN FOR THE INTERMODAL EMISSION COMPARISON

Vessel type	Transported goods	Loading capacity (tonnes)
Kempenaar	Heavy bulk	616 t
Rhine-Herne canal vessel	Heavy bulk	1,537 t
Large Rhine vessel	Heavy bulk	3,013 t
Coupled convoy	Heavy bulk	5,046 t
4-barge pushed convoy	Heavy bulk	11,181 t

Source: CE Delft (2016)

¹¹ CE Delft (2016), *STREAM Freight Transport 2016 - Emissions of Freight Transport modes*

¹² For the detailed methodology, see CE Delft (2016), page 51

For rail freight traffic, the most common type of vehicle is the medium-length electric train, as around 80% of rail freight traffic in Europe is achieved with electric trains today.

Decarbonisation of fuels is already much in progress in the rail sector: 80% of European goods traffic by rail is carried out by electric traction today.

TRAIN TYPES CHOSEN FOR THE INTERMODAL EMISSION COMPARISON

Train types	Transported goods	Loading capacity (tonnes)
Diesel, medium length train	Heavy bulk	1,914 t
Electric, medium length train	Heavy bulk	1,914 t

Source: CE Delft (2016)

Within road transport, the average type of freight carried is medium weight cargo. Heavy tractor-semitrailers combinations account for over 75% of ton-kilometers. In transport with lighter trucks (load capacity < 20 t), medium weight trucks play an important, and in terms of emissions, representative role.

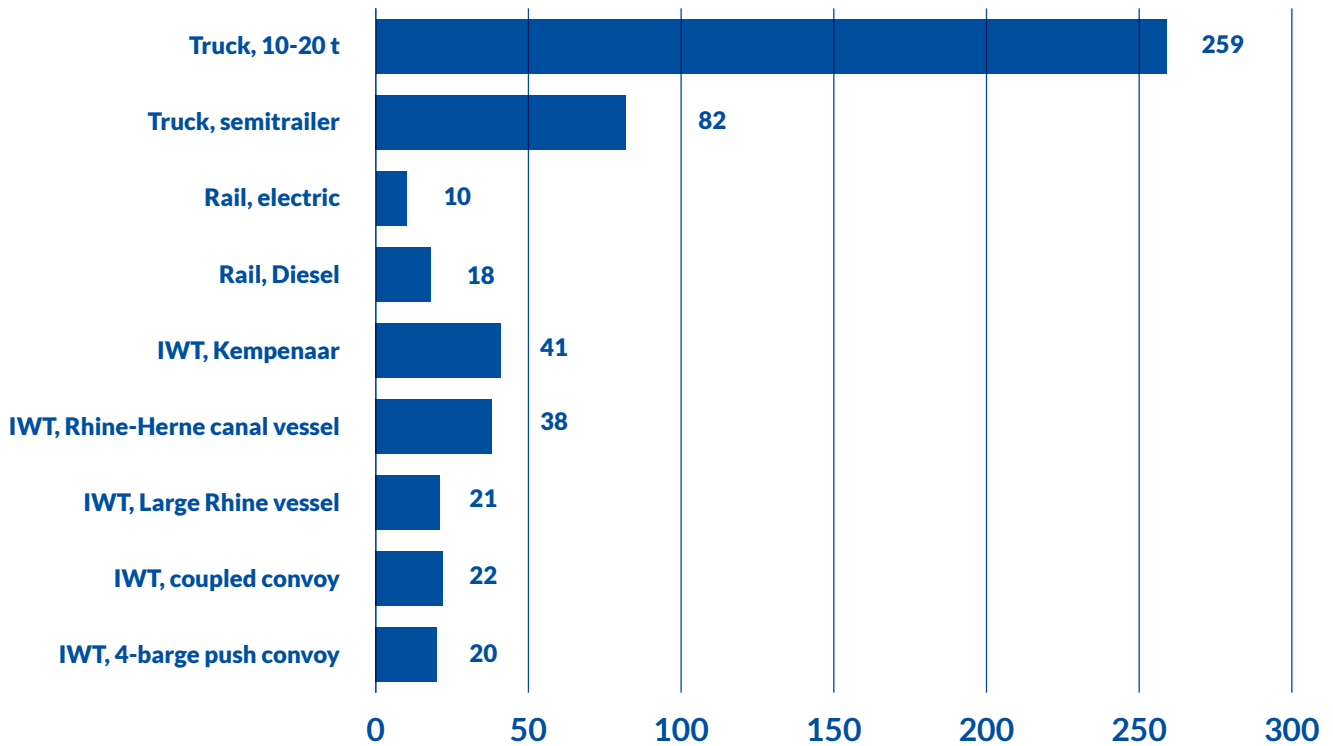
TRUCK TYPES CHOSEN FOR THE INTERMODAL EMISSION COMPARISON

Truck types	Transported goods	Loading capacity (tonnes)
Truck, 10-20 tonnes	Medium-weight-bulk	7.5 t
Truck, semitrailer heavy	Medium-weight-bulk	29.2 t

Source: CE Delft (2016)

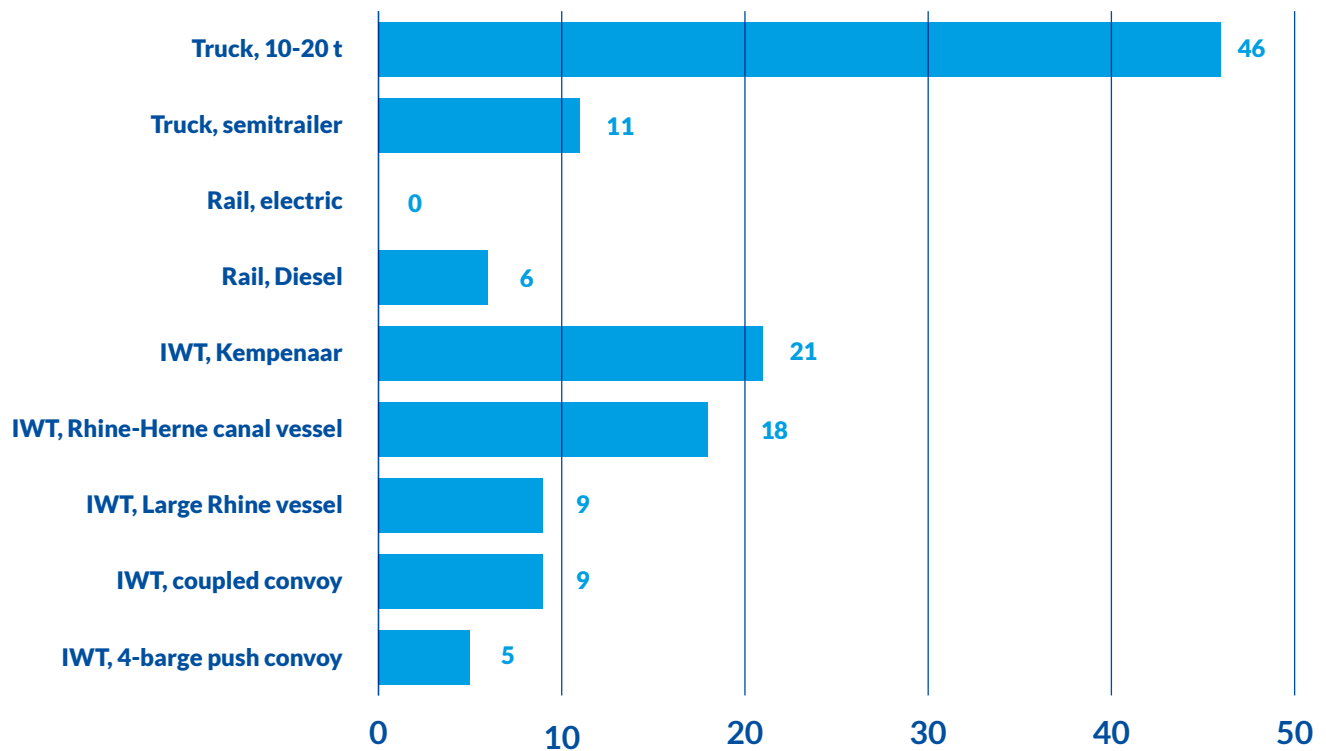
For PM, the emissions due to wear-and-tear were also taken into account. These emissions are caused by abrasion from tyres, brake linings and road surface. They are relevant for trucks, where they can be in the same magnitude as the PM emissions from engines.

The following figures show the emission factors according to CE Delft for the different vessel, train and truck types. Within IWT, it is straightforward to see the influence of the vessel size: larger vessels have lower fuel consumption values per ton-kilometer and therefore lower emissions per ton-kilometer than smaller ones. Four-barge pushed convoys have the lowest values of the vessel types presented here.

REPRESENTATIVE EMISSION FACTORS FOR CO₂, BULK TRANSPORT (G/TKM)

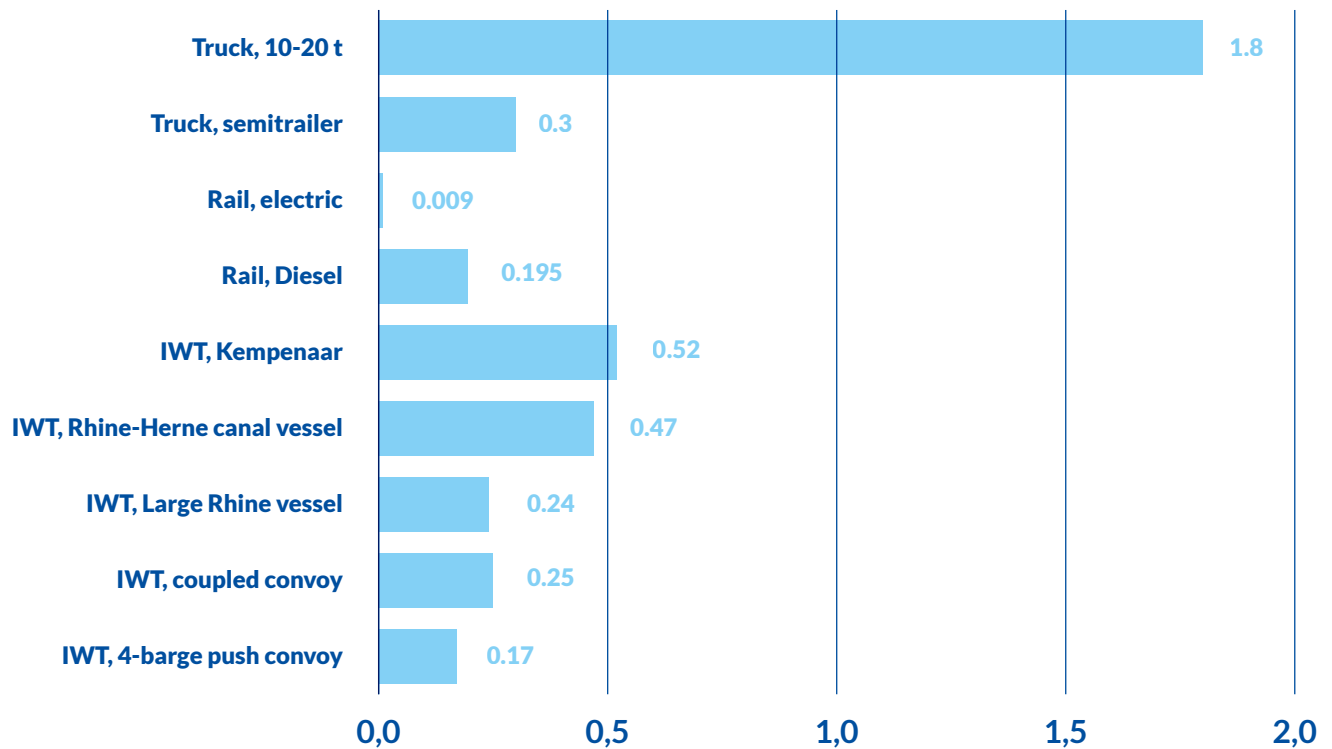
Source: CE Delft (2016), STREAM Freight transport 2016. Well-to-wheel emissions approach

REPRESENTATIVE EMISSIONS FACTORS FOR PARTICULATE MATTER (PM), BULK TRANSPORT (1000 G/TKM)



Source: CE Delft (2016), STREAM Freight transport 2016. Well-to-wheel emissions approach

REPRESENTATIVE EMISSIONS FACTORS FOR NITROGEN OXIDES (NO_x), BULK TRANSPORT (G/TKM)



Source: CE Delft (2016), STREAM Freight transport 2016. Well-to-wheel emissions approach

The following conclusions can be drawn:

- For CO₂ emissions, all IWT vessel types have lower emissions than the most common truck type (semitrailer), but higher emissions than the most common railway type (electric railway).
- For pollutant emissions PM and NO_x, IWT vessels have higher emissions than electric railways, the most common railway type.
- If we compare pollutant emissions between IWT and road traffic, we see that one of the most common vessel types (the Large Rhine vessel) as well as the larger vessel types have lower emissions than truck semitrailers. The second very common vessel type, Rhine-Herne-Canal, has higher emissions than the truck semitrailers.

From the figures, the overall conclusion seems to be that IWT vessels emit relatively few greenhouse gases, but can have rather high values for pollutant emissions, when compared to railways and trucks. Therefore, it is worth thinking about emission reduction measures specifically for the IWT sector. The next chapter will analyse these measures.

MEASURES

FOR REDUCING FUEL CONSUMPTION AND EMISSIONS IN IWT

Emission reduction measures in inland shipping can be categorized into three main groups:

- Technical measures: measures related to the propulsion system, vessel design and vessel equipment, exhaust after treatment, engine internal measures, use of alternative fuel/energy (LNG, electricity, hydrogen, biofuel)
- Operational measures: measures related to speed reduction, smart steaming, journey planning, on board information systems, optimal maintenance
- Traffic and transport management: measures related to the organisation of the logistical chain, to the interface between inland waterway vessels and other transport modes, to the interface of inland waterway vessels and infrastructure (locks, terminals in inland and seaports, etc.)

Based on a literature review, for most of the above-mentioned options, the reduction potential (in terms of reduced energy consumption compared to a conventional diesel engine without any greening measures), the applicability (new construction/retrofit), the approximate costs, and the approximate payback time were investigated.

A synoptic overview of the investigation results can be found in the following table. It has to be said that the indicated costs and payback times are only a broad indication, and can differ, depending on particular technical and economic circumstances. The payback times are of course influenced by fuel price evolutions.

TECHNICAL, OPERATIONAL AND TRAFFIC MANAGEMENT MEASURES FOR REDUCING ENERGY CONSUMPTION IN IWT

Area	Measures	Applicability	Decrease of energy consumption	Additional costs (€)	Payback time (years)
Technical	Father-and-son engine ¹³	New and retrofit	10%	150,000	7-8
	Diesel-electric propulsion	Only new vessels	10%	200,000	10
	Electric propulsion	Only new vessels	10%	300,000	15
	Liquefied natural gas (LNG)	New and retrofit	No	new: 1,000,000 retro: 1,400,000	16-20
	Particulate matter filter (PMF)	New and retrofit	No	500,000	-
	Selective catalytic reduction (SCR)	New and retrofit	No	500,000	-
	Flexible tunnel	New and retrofit	10%	60,000	1.5-3
	Optimized hull form	New and retrofit	10%	150,000	3-4
	Weight reduction by composite materials	Only new vessels	5-15%	Increase in hull costs by 30%	10-15
Operational	Speed reduction/ Smart steaming	All vessels	10-30%	250€ for a training course	0.1-0.2
	On-board information systems/Journey planning		10%	Low costs	< 1
	Optimal maintenance		5%	Low costs	< 1
Traffic and transport management	Reduction of empty trips	All vessels	high	No general quantification possible	
	Improving interface in seaports		high		
	AIS/RIS/Inland ECDIS		high		

Source: own compilation based on DNV GL (2015), Pauli (2016), Development Centre for Ship Technology and Transport Systems (DST), Hazeldine, Pridmore et al. (2009)

¹³ This system consists of a combination of a smaller and a larger engine, which are deployed depending on the navigation situation and according to their optimal power range. For the energy demanding upstream transport, only the larger engine can be active, while the smaller one can be inactive. For downstream transport, when less power is needed, only the smaller engine could be deployed. Overall, this system leads to savings in fuel consumption.

Operational measures have a very positive cost-benefit ratio, as they are cheap, easy to implement and have very short payback times. Speed reduction and journey planning are important examples.

Selective catalytic reduction (SCR) and particulate matter filters (PMF) are exhaust after treatment systems. SCR reduces nitrogen oxides NO_x by 85-90%, and PMF reduces particulate matter by 90-95%. Therefore, these systems are very efficient at reducing pollutant emissions. But for a single engine of some 1,000 kW, which is a common engine size for a self-propelled vessel in Europe, the price for exhaust after treatment systems is almost as high as the price for a new engine (Pauli 2016). Besides, PMF can lead to slightly higher fuel consumption levels by 2-3% (European Commission 2013).

LNG's main advantages are a significant reduction of pollutant emissions (80% for NO_x, 75% for PM). The effects on greenhouse gas emissions are not as positive, as methane slip occurs when the combustion process is not perfect. Methane slip is very harmful for global warming - its global warming potential is about 28 to 34 times higher than that of CO₂ (Pauli 2016). Further technological evolution is needed in order to reduce methane slip.

LNG has high investment costs. Therefore, LNG as a fuel should be much cheaper than gasoil in order to come to acceptable payback times. However, actual low oil prices limit the profitability of LNG.

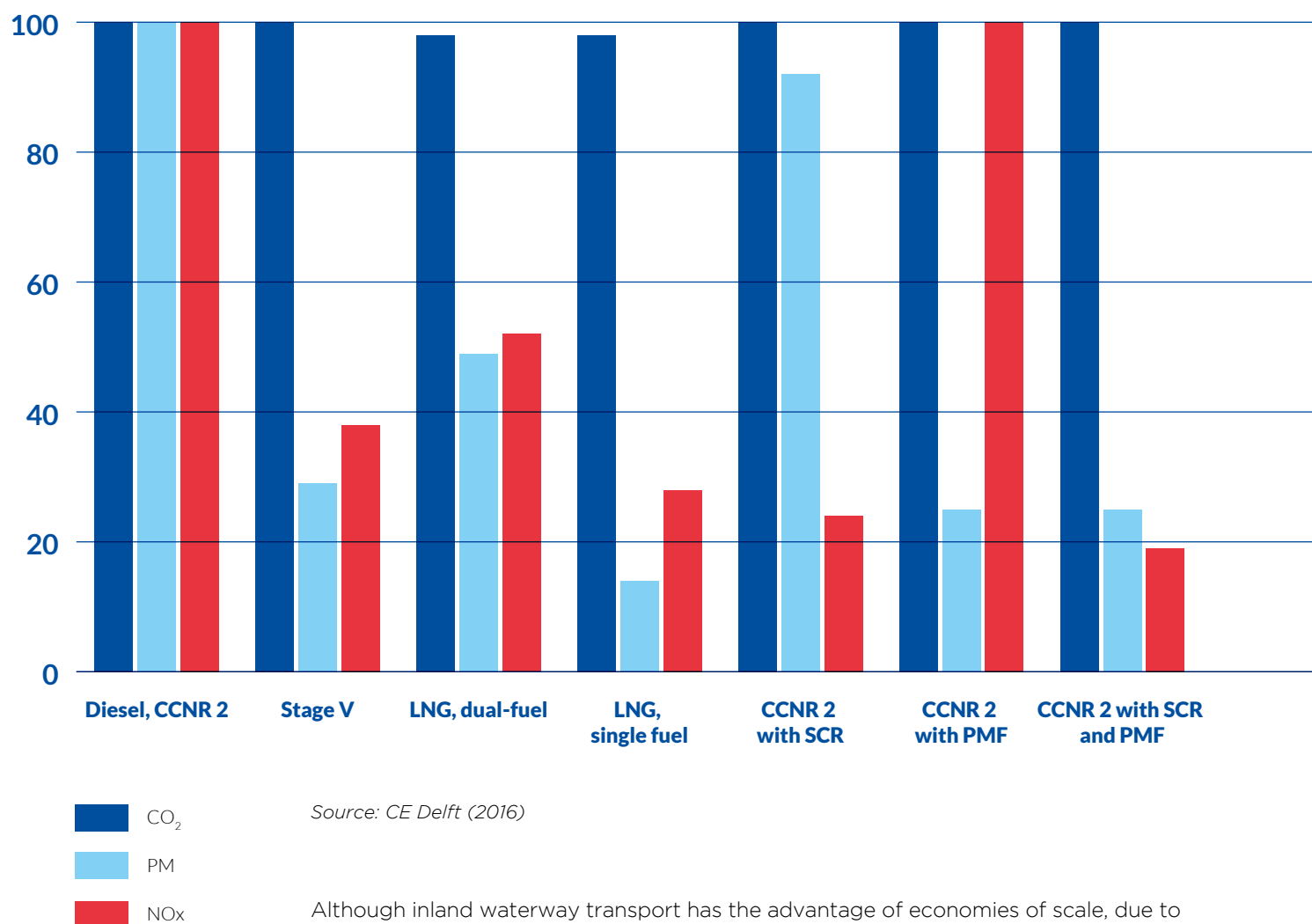
Currently, most projects for LNG vessels are partly publicly funded, for example by the LNG Masterplan Rhine-Main-Danube, a large research project that has received 40 million Euros of EU funding. Its vision is that LNG will be transported by IWT from LNG terminals in seaports to LNG hubs (serving as bunkering stations) in the hinterland. Economically, it can be expected that investment costs for LNG will go down with more vessels using LNG, and the provision of LNG will develop as more bunkering stations become available.

New stringent emission standards (NRMM) will be in place for new inland vessels from 2019 onwards.

The new emission limits (Stage V) that will apply for new engines from 2019 onwards¹⁴ can only be met with single LNG fuel propulsion or with the installation of both exhaust after treatment systems. This is shown in the following figure, where the reference emission level is the CCNR Stage II level, which was applied for new engines in 2007.

¹⁴ Regulation (EU) 2016/1628 of the European Parliament and of the Council of 14 September 2016 on requirements relating to gaseous and particulate pollutant emission limits and type-approval for internal combustion engines for non-road mobile machinery

COMPARISON OF EMISSION LIMITS ACCORDING TO STAGE V AND CCNR 2 WITH DIFFERENT GREENING OPTIONS (DIESEL CCNR 2 = 100)



Source: CE Delft (2016)

Although inland waterway transport has the advantage of economies of scale, due to the large capacities of ships compared to trains and even more so compared to trucks, the emissions of inland vessels are attracting more and more concern and attention. This is less the case for greenhouse gas emissions, but much more the case for pollutant emissions. These emissions are harmful to nature and human beings, which is relevant both for the personnel working in IWT as well as for populations in densely populated areas, living alongside inland waterways (in port areas or cities).

In theory, many emission reduction measures for IWT exist, but their application is often very costly, and therefore difficult to implement in a market structure with a high share of family businesses. Perhaps the measure with the highest and quickest return on investment (both in economic and in ecological meaning) are operational measures, such as the reduction and optimization of speed, on board information systems, journey planning and automatic cruise control systems.

In addition to these measures, from 2019 onwards, new and much stricter emission standards will apply for new engines. Pollutant emissions should decrease with the gradual integration of new engines into the fleet. A fact that supports this process is the shorter life time of new engines, which applies in general to engines built after 1990. The introduction of LNG vessels contributes further to the reduction of pollutant emissions.





10

OUTLOOK

- Container inland waterway transport volume is highly dependent on macroeconomic indicators, sea ports activity, environmental conditions and other modes of transport activity.
- Container and building materials transport are the two segments expected to register the highest growth in the coming years.
- Because of a decrease in the European Union energy mix, coal transport is expected to decrease in the coming years while other traditional industries boosting inland navigation activity should maintain their level of activity.

CONTAINER TRANSPORT MODELLING

This section aims at describing a model explaining the demand for container transport on the Traditional Rhine. Container transport evolution can be explained both by macroeconomic reasons and by environmental parameters. The objective is to identify key indicators that can explain this evolution.

Several macroeconomic indicators (GDP, exchange rate) and sectoral indicators (rail traffic, port transshipment) will be used and statistical tests will enable us to identify the combination of indicators that are most appropriate to explain the evolution of container traffic on the Traditional Rhine.

Both macroeconomic and sectoral variables are taken into account in order to identify the best way to explain the transport of containers on the Rhine, to see which variables have the best explanatory contribution and how we can interpret the relationship between the transport of containers on the Rhine and these explanatory variables. The variable to be explained (dependant variable) is the volume of container transported on the Traditional Rhine from 1997 to 2016 (quarterly), with twenty-foot equivalents (TEU) being the unit. The model is of the log-log type for a better interpretation of the coefficients as elasticities allocated to each explanatory variable, coefficients that are obtained from a regression by the ordinary least squares method (OLS). These variables were statistically tested for their significance and for their multi-collinearity.

TESTED VARIABLES

	Sources	Included in the model?
European Gross Domestic Product (GDP)	Eurostat	Yes
Container transshipment in the Port of Rotterdam	Eurostat	Yes
Transport of containers by German railways	Destatis	Yes
Effective exchange rates of the United States	Eurostat	Yes
Effective exchange rates of China	Eurostat	Yes
Oil price	OCDE	Yes
European population	Eurostat	No
Industrial Production Index (IPI)	OCDE	No
Producer Price Indices (PPI)	OCDE	No
Inflation (CPI)	OCDE	No
RWI/ISL Container Throughput Index	ISL	No
Container transshipment in the Port of Antwerp	Eurostat	No

Source: CCNR

MODEL REGRESSION EQUATION

$$\log(teu) = \alpha + \beta \log(gdp) + \gamma \log(oil) + \delta \log(rot) + \varepsilon \log(rail) + \zeta \log(usa) + \eta \log(chi)$$

EXPLANATORY VARIABLES OF THE MODEL AND COEFFICIENTS OBTAINED (OLS)

Variables	Coefficients	Significances (*)
Constant	-9.77350	***
European Gross Domestic Product (gdp)	1.05036	***
Oil price (oil)	0.07110	**
Container transshipment in the Port of Rotterdam (rot)	0.74760	***
Transport of containers by German railways (rail)	-0.48218	***
Exchange rate with United States USD/EUR (usa)	0.78180	***
Exchange rate with China CNY/EUR (chi)	-0.59955	***

*evaluated with the level of threshold: *** = 0.1%, ** = 1%, * = 5%

The coefficient of determination (R^2) is a measure of the quality of the prediction of a linear regression, evaluated between 0 and 1. The closer the coefficient is to 1, the better the prediction will be. Here, the R-squared equals 0.9586 which, added to the significances of the variables at the 1% threshold, attests to the quality of prediction of the regression.

INTERPRETATION**Macroeconomic indicators**

GDP is a strong macroeconomic indicator to represent the overall economy of European countries. It is strongly correlated with the transport of containers on the Rhine. The oil price is an indicator that represents the business stance of the economy. High oil prices are often an indicator for a strong business cycle and can indicate high container traffic both in maritime and in inland shipping.

World trade indicator

Container transshipment in the Port of Rotterdam serves as an indicator of world trade. The situation of the Port of Rotterdam, the largest European port, at the mouth of the Rhine allows the exchange of goods between Europe and other countries in the world.

Market competition indicator

The transport of containers by German railways acts as an indicator of market competition. Its negative coefficient attests to the modal shift that can occur between the two modes of transport, namely the river and the railways.

Macroeconomic competition indicators

The effective exchange rates USD/EUR and CNY/EUR serve as indicators of macroeconomic competition and have an influence on global trade flows. The United States and China are the two main commercial partners of the European Union but their relationships with the EU are different. The USA-EU trade relationship is mainly composed of EU exports while the weight of EU imports is more important in the China-EU relationship. And this explains the different signs for the coefficients of

exchange rates for USA and China. The appreciation or depreciation of each currency influences trade and, logically, container traffic. If the US Dollar gets stronger compared to the Euro, EU exports to USA are expected to increase and EU imports from USA are expected to decrease.

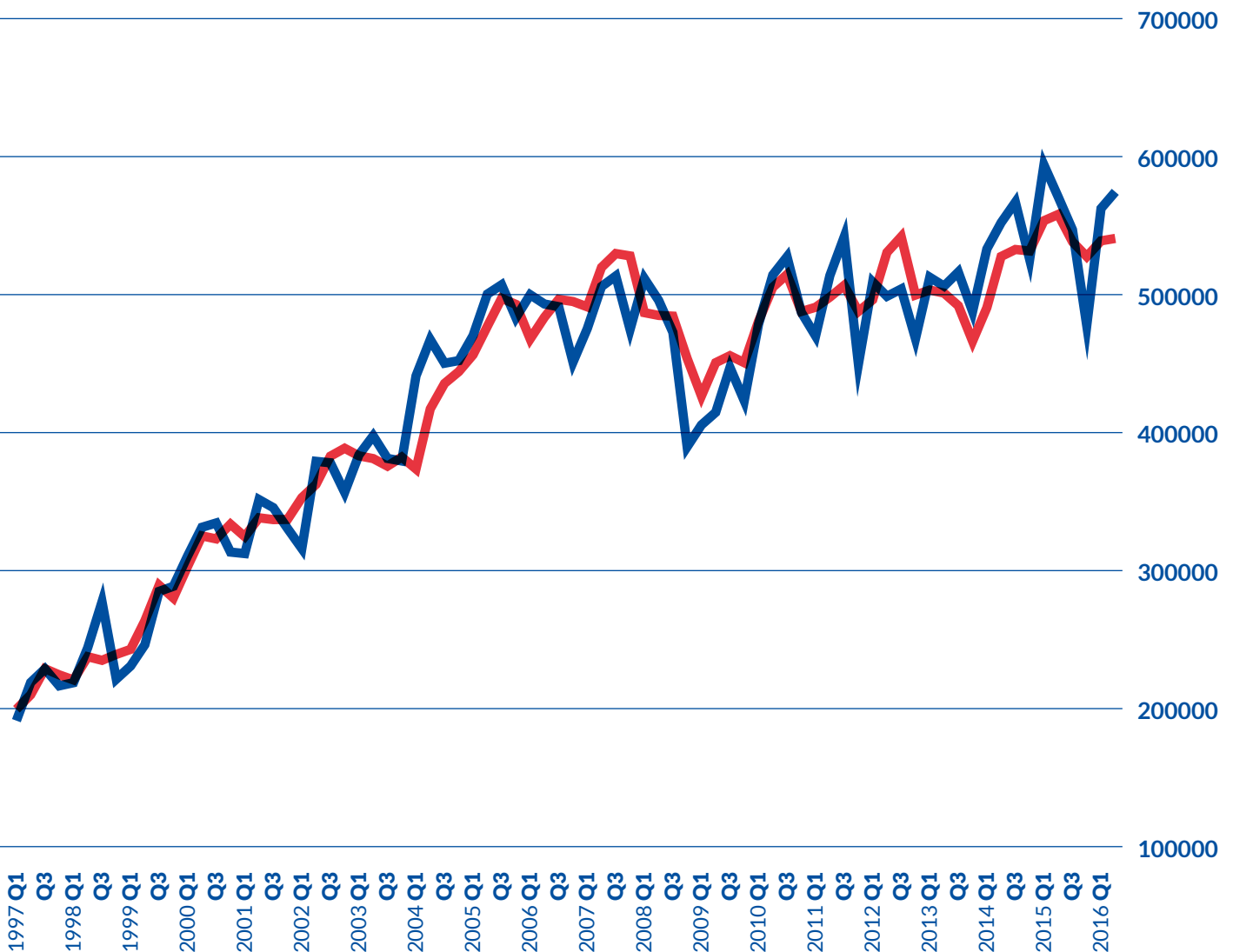
The positive coefficient means that this has a positive impact on container transport which is consistent with the EU trade flow between USA and EU that gives more weight to EU exports. The opposite mechanism is at stake with China, which explains in this case the negative coefficient.

MODEL EQUATION

$$teu = e^{-9.7735} \cdot .gdp^{1.05036} \cdot .oil^{0.0711} \cdot .rot^{0.7476} \cdot .rail^{-0.48218} \cdot .usa^{0.7818} \cdot .chi^{-0.59955}$$

Container transport
 Model

VOLUME OF CONTAINERS TRANSPORTED ON THE TRADITIONAL RHINE (IN TEU) AND ECONOMETRIC MODEL

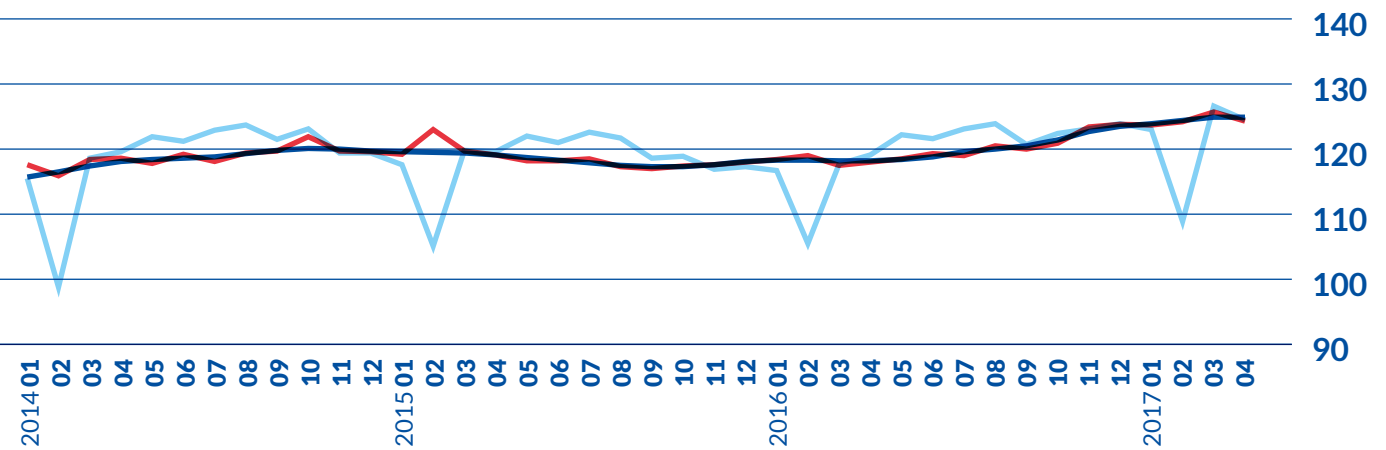


Source: CCNR



QUALITATIVE TRENDS

RWI/ISL CONTAINER THROUGHPUT INDEX



Original
 Seasonally and working day adjusted
 Trend-cycle component

Source: ILS

The RWI/ISL Container Throughput Index is based on data from 82 international ports covering more than 60% of global container management in the world. It is a monthly index for the global container flow to provide reliable conclusions on short-term trends in global economic activity. It is an early indicator for world trade and container shipping.

Calculated since 2007, the index is very closely linked to world trade. It offers similar results and provided reliable data for the 2008 financial crisis for example. The index has been steadily growing since 2009 and the recovery of the global economy.

In 2016, the trend-cycle component of the index showed an upward trend in response to the 2015 decline, giving credit to the positive outlook for container transport. The first figures for the year 2017 are encouraging regarding the continuation of this trend.

TRENDS IN DEMAND FOR INLAND WATERWAYS TRANSPORT IN 2017 & 2018 IN EUROPE

	Main driver(s)	Trends in demand for transport in 2017 and 2018
Agricultural products	Harvest results	Stable after catch-up
Iron ores	Steel production	Stable
Metals	Steel production	Stable
Coal	Weather and energy policy, partly steel production	Decrease
Sand, soil and building materials	Construction activity	Increase
Containers	World trade	Increase
Mineral oil products	Oil prices and refinery output	Stable
Chemicals	Chemical production	Stable

Source: CCNR analysis based on macroeconomic and sectorial data

After the catch-up process for agricultural products transport that will occur during the year 2017, a stable evolution is expected for the end of 2017 and in 2018, assuming that harvest results will be on a multi-annual average. This outlook is aligned with the EU agricultural products output which is expected to increase by 0.5% in 2017 and 0.7% in 2018.

Steel production in Germany increased only slightly (+2%) during the first six months of 2017 compared to the same period in 2016. But the number of new orders has decreased a bit compared to the previous year. Therefore, the slight increase observed during the first semester of 2017 is not expected to announce further steel production increase in 2017 and 2018. And the outlook for the steel segment is rather oriented towards a stable evolution or a slight increase due to the reinforcement of the competitive position of the EU.

Coal is faced with declining demand in the energy sector. In Germany, the consumption of coal decreased by 5% in 2016 compared to 2015. Strongly rising prices for steam coal in the second half of 2016 also contributed to this decline. The present trends are supposed to continue. The outlook for coal remains on a decreasing trend.

The transport of sands, stones and building materials is promoted by rising construction activity in Western Europe, especially in the Netherlands and in France. Large new infrastructure projects contribute to this evolution that will benefit the inland navigation sector in the next two years.

The world trade indicator (RWI/ISL index) followed a stable upward trend during 2016 and the 1st quarter of 2017, reaching a growth rate of 5% between the first four months of 2017 and 2016. Consequently, maritime container traffic growth is robust, which lays the basis for a continuation of further growth for container transport on inland waterways. As analysed in the forecasting models, container waterways transport might nonetheless be impacted by environmental conditions and in particular by water level conditions.

The oil price has shown rather strong fluctuations in 2017, but has been on a downward trend overall, reflecting the growing oil supply from non-OPEC countries. Although a declining oil price can stimulate the transport demand for mineral oil products, the long run trend in this segment is rather downward orientated. The long-term domestic oil demand in the EU is expected to decrease and this demand is expected to decrease respectively by 0.3% and 0.4% already in 2017 and in 2018 (Source: Oxford Economics). The impact should be limited for inland navigation transport in 2017, and in 2018 and a stable evolution is foreseen.

It is expected that chemical production will remain overall stable in 2017, or grow only very modestly (+1% forecast in Germany). Therefore, the outlook for chemical transport is stable as well, with the possibility of a slight increase.

The transport of waste, boosted by the emergence and growth of the recycling and circular economy can be a chance for inland navigation in general and inland ports in particular. Concerned goods could for example be scrap metals, household waste and regenerated building materials, meaning that several inland navigation transport segments could benefit from new economic opportunities offered by current trends.

■ GLOSSARY

ARA: Amsterdam - Rotterdam - Antwerp

bn: Billion

EU: European Union

Europe: European inland navigation in this report includes two countries that do not belong to the European Union - Switzerland and Serbia

Freight rate: Price at which a cargo is delivered from one point to another

GDP: Gross Domestic Product

IWW: Inland Waterways

IWT: Inland Waterways Transport

Loading degree: Percentage of maximum vessel loading

MTOE: Million Tonnes of Oil Equivalent

Mio: Million

NOx: Collective term for nitrogen oxides

OECD: Organisation for Economic Co-operation and Development

PM: Particular Matter Emissions arising due to combustion or wear and tear

Q1: First Quarter

Rhine countries: Belgium, France, Germany, Luxemburg, Netherlands, Switzerland

RWI/ISL Container Throughput Index: Index of worldwide container throughput in ports

Tank-to-wheel emissions: Emissions arising from fuel combustion during vehicle use

TEU: Twenty-foot Equivalent Unit (unit for container volume)

TKM: Tonne-Kilometer (unit for transport performance which represents volume of goods transported multiplied by transport distance)

Turnover: Sales volume net of sales taxes

Waterside goods traffic: Loading or unloading activity in ports, which includes inland vessels

Well-to-tank emissions: emissions arising during extraction, transport and refinery of fuels or during electric power generation and transmission

Well-to-wheel emissions: The sum of well-to-tank and tank-to wheel emissions

■ NATIONAL STATISTICS OFFICES

Sources	Original Name	English Name	Country
Statistik	Statistik Austria	Statistics Austria	Austria
VNF	Voies Navigables de France	Navigable Waterways of France	France
INSEE	Institut national de la statistique et des études économiques	National Institute of Statistics and Economic Studies	France
Destatis	Statistisches Bundesamt	Federal Statistical Office of Germany	Germany
CBS	Centraal Bureau voor de Statistiek	Central Statistical Office	Netherlands

■ PORTS

Original Name	English Name	Country
Duisport	Duisport	Germany
Hafen Hamburg	Port of Hamburg	Germany
Haven Antwerpen	Port of Antwerp	Belgium
Haven Rotterdam	Port of Rotterdam	Netherlands
Hafen Mannheim	Port of Mannheim	Germany
Hafen Kehl	Port of Kehl	Germany
Ports de Paris	Ports of Paris	France
Port autonome de Strasbourg	Port of Strasbourg	France
Port autonome de Liège	Port of Liège	Belgium
Port autonome de Namur	Port of Namur	Belgium
Port autonome de Charleroi	Port of Charleroi	Belgium
Port de Bruxelles	Port of Brussels	Belgium
Port de Lille	Port of Lille	France
Port de Lyon	Port of Lyon	France
Ports de Moselle	Ports of Moselle	France
Port de Mulhouse-Rhin	Port of Mulhouse	France
RheinCargo	RheinCargo	Germany
SchweizerischeRheinhäfen	Port of Switzerland	Switzerland

BOOKS, JOURNAL ARTICLES & STUDIES

Source	Original Name	English Name	Country
Binnenschifffahrt - ZfB - 2017, Nr. 3	„Viele Neubauten für die Flusskreuzfahrt“, in: Zeitschrift für Binnenschifffahrt (ZfB) - 2017, Nr. 3	„ Many new vessels being built for the cruise sector“, in: ZfB – 2017, No. 3	Germany
CE Delft	CE Delft (2016), STREAM Freight Transport 2016 – Emissions from Freight Transport Modes	CE Delft (2016), STREAM Freight Transport 2016 – Emissions from Freight Transport Modes	Netherlands
DNV GL (2016)	Det Norske Veritas / Germanischer Lloyd (2016), „Energieberatung in der deutschen Binnenschifffahrt“	Det Norske Veritas / GermanischerLloyd (2016), „Energy advice in the German inland shipping sector“	Norway/ Germany
Hader 2016	Hader, A. (2016), The River Cruise Fleet Handbook 2016/2017	Hader, A. (2016), The River Cruise Fleet Handbook 2016/2017	Germany
Hazeldine, Pridmore et al. (2009)	Hazeldine,T. / Pridmore, A./ Nelissen, D. / Hulskotte, J. (2009),„Technical Options to reduce GHG for non-RoadTransport Modes“, paper produced for the European Commission	Hazeldine, T. / Pridmore, A. / Nelissen, D. / Hulskotte, J. (2009), „Technical Options to reduce GHG for non-RoadTransport Modes“, paper produced for the European Commission	EU
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OTHER SOURCES

Original Name	English Name	Country
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Oxford Economics	Oxford Economics	World
World Steel Association	World Steel Association	World
European Commission	European Commission	EU
EUROSTAT	EUROSTAT	EU
IG River Cruise	IG River Cruise	Europe
IVR	IVR	Europe
Institut pour le transport par batellerie (ITB)	Institute for transport by skippers	Belgium
FranceAgrimer	France Agrimer	France
Mer et Marine – Toute l'actualite marine	Mer et Marine – Maritime News (www.meretmarine.com)	France
AG Energiebilanzen	Working Group on Energy Balances	Germany
Bundesamt für Güterverkehr (BAG)	German Federal Office of Goods Transport	Germany
Daimler Global Media Site (www.media.daimler.com)	Daimler Global Media Site (www.media.daimler.com)	Germany
Deutscher Reiseverband (DRV)	German Travel Association	Germany
DST – Entwicklungszentrum für Schiffstechnik und Transportsysteme	Development Centre for Ship Technology and Transport Systems	Germany
Institut für Seeverkehrswirtschaft und Logistik (ISL)	Institute of Shipping Economics and Logistics (ISL)	Germany
Statistisches Amt für Hamburg und Schleswig-Holstein	Statistical Office of Hamburg and Schleswig-Holstein	Germany
Wasserstraßen-und Schifffahrtsverwaltung des Bundes (WSV)	German Inland waterway administration	Germany
Wirtschaftsvereinigung Stahl	German Steel Industry Association	Germany
Centraal Bureau voor de Rijn- en Binnenvaart	Central Bureau for Inland Barging	Netherlands
Panteia	Panteia	Netherlands
PJK International	PJK International	Netherlands
SchweizerischeErdöl-Vereingung	Swiss Association for Crude Oil and Petroleum Products	Switzerland

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