Sustainable, safe and economically feasible energy concepts and technologies for European Inland Shipping

Inland Waterway Transport

Reader

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At the beginning of this reader, the European transport modes and transport strategies are presented. Then, the trans-European Transport Network (TEN-T) including the main transport routes are discussed. Afterwards, the importance of inland navigation as well as its advantages and disadvantges are presented. In the last section of the reader, a comparison of inland navigation in Europe with inland navigiaton in China and Brazil is made. At the end links and sources for further information are provided.

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European Transport Modes and Transport Strategy

"There are several transport modes and means of transport. A transport mode provides the necessary infrastructure for using a certain means of transport. Without this infrastructure, no transport would be possible. The transport modes are situated on land, on the water and in the air. Land transport comprises of road, rail and pipeline transport; waterborne modes are inland waterway, deep sea and short sea shipping; the air mode comprises of air traffic. Means of transport are technical facilities and equipment for the transport of people or goods. Transport means in freight transport are, for example, the inland vessel, the truck or the plane. Due to the fact that transport cannot usually be handled using a single mode or means of transport (e.g. because of geographic conditions), varying forms of transport have been developed, which are described as "transport processes"."[1]

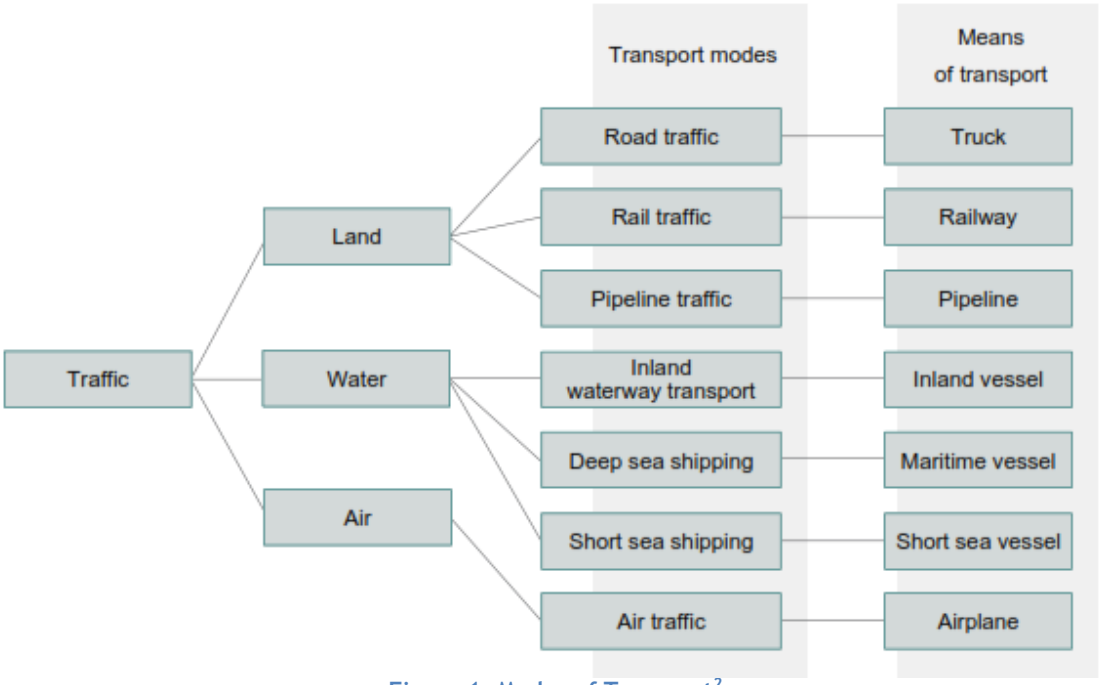

Figure 1: Modes of Transport[2]

"Transport can be processed in several forms (e.g. either directly or by making use of several modes of transport) and it is therefore necessary to specify these processes more clearly. Transport processes can be initially classified into direct and non-direct transport. In the case of a non-direct transport process, the transhipment of goods takes place, whereas in direct transport no such transhipment is needed. In direct transport, goods are transported directly from a point of departure to the destination. For this reason, it is also called door-to-door transport. In this case, the means of transport (e.g. vessel, truck or railway) is not changed and there is also no change of transport mode (e.g. rail or inland waterway). In short, direct transport can always be classified as unimodal (goods are transferred from the starting point to the end point by one means of

[1] via donau, 2013, p. 170 f.
[2] via donau, 2013, p. 171, on the basis Gronalt et. al, 2010.

transport). An example is port-port transport by inland vessel (e.g. transport of mineral oil from storage facility A to storage facility B)."[3]

Figure 2: Direct transport by inland vessel[4]

"Multimodal transport is characterized by the transport of goods using two or more different transport modes (e.g. change from waterway to rail). In order to change the means of transport, transhipment of the goods is required. In doing this, the strengths of the several individual transport modes can be used and the cheapest and most environmentally friendly combination can be chosen. Since each transhipment involves additional time and causes additional cost, multimodal transport is often used for long-distance transport where delivery time is not an important factor."[5]

Figure 1: Multimodal transport by inland vessel[6]

"The first part in a transport chain is called pre-haulage and constitutes the delivery of a cargo to the first point of transhipment (such as a port). Pre-haulage is mostly carried out by trucks. Nevertheless, if companies have access to the railway network, they are also able to use the railway for pre-haulage. Transhipment signifies the switching of the cargo or intermodal loading unit from one means of transport to another. A shift of transport modes, e.g. from road to inland waterway (multimodal transport) can also take place. The term main leg describes the transport of goods or loading units from the consignor's transhipment point to the consignee's transhipment point. The word "main" results from the fact that the longest part of the transport is performed between these points. Vessels or railway are mostly used in this case. The end-haulage signifies the delivery of the cargo from the consignee's point of transhipment to the consignee's location. Usually, the end-haulage is carried out by trucks. Pre- and end-haulage activities should be kept to a minimum, due to the fact that their costs are especially high. Additionally, the transhipment process itself should be optimized in order to save on time and costs."[7]

[3] via donau, 2013, p. 171.
[4] via donau, 2013, p. 172.
[5] via donau, 2013, p. 172.
[6] via donau, 2013, p. 172.
[7] via donau, 2013, p. 172 f.

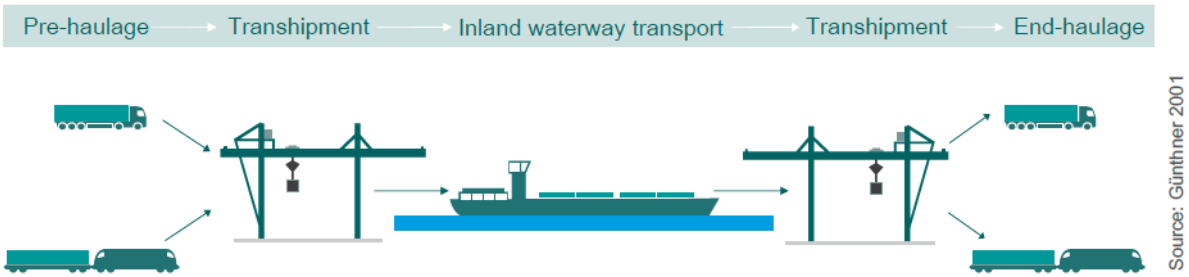

Figure 2: Intermodal or combined transport[8]

Its flexibility, speed and ability to deliver door-to-door make road transport virtually unbeatable over distances of up to 300 km. This is unlikely to change. Technology, research and innovation, and better logistics will make road transport on short routes even more efficient and more environment-friendly. For longer distances, there is a strong environmental case for intermodal transport where the main part of the route is by rail, sea or inland waterway with a short road journey at one or both ends. Successful examples of getting freight off the roads are, for instance, motorways of the sea where lorries or their trailers make part of their north-south or east-west journey across Europe by specialised ferries. Another intermodal match is taking shape for north-south road freight over the Alps where lorries will cross the mountains through tunnels on specially constructed trains and railcars.[9]

Modal Split and EU-Targets on Transport

The relationship between the different transport modes is referred to as the modal split (see fig. 1). Within the European Union, the share of road transport is constantly at a level of approximately 50 %, whereas inland waterways represent less than 5 % of the total transport volume.

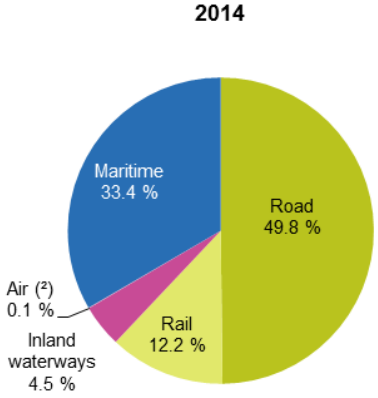

Figure 3: Modal Split in the EU in 2014[10]

The negative consequences of transport such as pollution, climate change, noise, congestion and accidents pose problems to the economy, health and well-being of European citizens. Freight

[8] via donau, 2013, p. 174.
[9] European Union, 2012, p. 12.
[10] Eurostat, 2016.

transport continues to grow and road freight transport, in particular, is projected to increase by around 40% by 2030 and by little over 80% by 2050. The EU transport policy aims therefore at reducing road transport towards less polluting and more energy efficient modes of transport.
Four types of actions support greater use of multimodal solutions.

- The internalisation of external costs in all modes of transport, with a view to send appropriate pricing signals to users, operators and investors. The social and environmental costs of transport should be paid in line with the polluter pays principle.
- More targeted investments into physical infrastructure, aimed at better interconnections between the single modal networks.
- Better used of information (on traffic, capacities, availability of infrastructure, cargo and vehicle positioning).
- Direct support for intermodal transport, which aims to increase the competitiveness of the combined transport (defined as intermodal transport with a strictly limited road leg). The EU also provides financial support to multimodal/intermodal transport.

The European Commission adopted a roadmap of 40 concrete initiatives for the next decade to build a competitive transport system that will increase mobility, remove major barriers in key areas and fuel growth and employment. At the same time, the proposals will dramatically reduce Europe's dependence on imported oil and cut carbon emissions in transport by 60 % by 2050.
By 2050, key goals will include:

- No more conventionally-fuelled cars in cities.
- 40% use of sustainable low carbon fuels in aviation; at least 40% cut in shipping emissions.
- A 50% shift of medium distance intercity passenger and freight journeys from road to rail and waterborne transport.
- All of which will contribute to a 60% cut in transport emissions by the middle of the century.[11]

The trans-European Transport Network (TEN-T)

The trans-European transport network is a network which comprises roads, railway lines, inland waterways, inland and maritime ports, airports and rail-road terminals throughout the 28 Member States. The TEN-T consists of two planning layers: The "comprehensive network" and the "core network".
The "**comprehensive network**": a multi-modal network of relatively high density which provides all European regions (including peripheral and outermost regions) with an accessibility that supports their further economic, social and territorial development as well as the mobility of their citizens. Its planning has been based on a number of common criteria (e.g. volume thresholds for terminals or accessibility needs). The total length of the comprehensive network amounts to 138,072 km of railway lines, 136,706 km of roads and 23,506 km of inland waterways.
The "**core network**": a part of the comprehensive network, distinguished by its strategic importance for major European and global transport flows. It results from a single European planning methodology. Developed by the European Commission and subjected to broad consultation among Member States and other stakeholders, it is the first method of its kind. The total length of the core

[11] European Commission, 2016.

network amounts to 50,762 km of railway lines, 34,401 km of roads and 12,880 km of inland waterways.
Each Core Network Corridor will embrace all the transport modes (road, rail, inland waterways, maritime and air transport), and in particular the connection platforms between the different transport modes (seaports, inland ports, airports, rail-road terminals), thus facilitating deployment of efficient and sustainable freight transport services. The Corridors will focus on modal integration, interoperability and on the coordinated development of infrastructure, in particular in cross border sections, across transport modes and for bottlenecks. The Corridors will further develop traffic management systems and promote the uptake of sustainable freight services and of innovation and new technologies, for instance in terms of provision of the infrastructure for alternative fuels. Wherever appropriate, the Corridors will use Motorways of the Sea as the maritime dimension of the Core Network Corridors and the Rail Freight Corridors as the rail freight dimension of the Core Network Corridor.[12] The following nine core network corridors have been identified and will function along the lines described:

1. The Scandinavian-Mediterranean Corridor is a crucial north-south axis for the European economy. Crossing the Baltic Sea from Finland to Sweden and passing through Germany, the Alps and Italy, it links the major urban centres and ports of Scandinavia and Northern Germany to continue to the industrialised high production centres of Southern Germany, Austria and Northern Italy further to the Italian ports and Valletta. The most important projects in this corridor are the fixed Fehmarnbelt crossing and Brenner base tunnel, including their access routes. It extends, across the sea, from Southern Italy and Sicily to Malta.

2. The North Sea-Baltic Corridor connects the ports of the Eastern shore of the Baltic Sea with the ports of the North Sea. The corridor will connect Finland with Estonia by ferry, provide modern road and rail transport links between the three Baltic States on the one hand and Poland, Germany, the Netherlands and Belgium on the other. Between the Odra River and German, Dutch and Flemish ports, it also includes inland waterways, such as the "Mittelland-Kanal". The most important project is "Rail Baltic", a European standard gauge railway between Tallinn, Riga, Kaunas and North-Eastern Poland.

3. The North Sea-Mediterranean Corridor stretches from Ireland and the north of UK through the Netherlands, Belgium and Luxembourg to the Mediterranean Sea in the south of France. This multimodal corridor, comprising inland waterways in Benelux and France, aims not only at offering better multimodal services between the North Sea ports, the Maas, Rhine, Scheldt, Seine, Saone and Rhone river basins and the ports of Fos-sur-Mer and Marseille, but also better interconnecting the British Isles with continental Europe.

4. The Baltic-Adriatic Corridor is one of the most important trans-European road and railway axes. It connects the Baltic with the Adriatic Sea, through industrialized areas between Southern Poland (Upper Silesia), Vienna and Bratislava, the Eastern Alpine region and Northern Italy. It comprises important railway projects such as Semmering base tunnel and Koralm railway in Austria and cross-border sections between PL, CZ and SK.

[12] European Commission, 2014, p. 3f.

5. The Orient/East-Med Corridor connects the maritime interfaces of the North, Baltic, Black and Mediterranean Seas, allowing optimising the use of the ports concerned and the related Motorways of the Sea. Including Elbe as inland waterway, it will improve the multimodal connections between Northern Germany, the Czech Republic, the Pannonian region and Southeast Europe. It extends, across the sea, from Greece to Cyprus.

6. The Rhine-Alpine Corridor constitutes one of the busiest freight routes of Europe, connecting the North Sea ports of Rotterdam and Antwerp to the Mediterranean basin in Genoa, via Switzerland and some of the major economic centres in the Rhein-Ruhr, the Rhein-Main-Neckar, regions and the agglomeration of Milan in Northern Italy. This multimodal corridor includes the Rhine as inland waterway. Key projects are the base tunnels, partly already completed, in Switzerland and their access routes in Germany and Italy.

7. The Atlantic Corridor links the Western part of the Iberian Peninsula and the ports of Le Havre and Rouen to Paris and further to Mannheim/Strasbourg, with high speed rail lines and parallel conventional ones, including also the Seine as inland waterway. The maritime dimension plays a crucial role in this corridor.

8. The Rhine-Danube Corridor, with the Main and Danube waterway as its backbone, connects the central regions around Strasbourg and Frankfurt via Southern Germany to Vienna, Bratislava, Budapest and finally the Black Sea, with an important branch from Munich to Prague, Zilina, Kosice and the Ukrainian border.

9. The Mediterranean Corridor links the Iberian Peninsula with the Hungarian-Ukrainian border. It follows the Mediterranean coastlines of Spain and France, crosses the Alps towards the east through Northern Italy, leaving the Adriatic coast in Slovenia and Croatia towards Hungary. Apart from the Po River and some other canals in Northern Italy, it consists of road and rail. Key railway projects along this corridor are the links Lyon – Turin and the section Venice – Ljubljana.[13]

[13] European Union, 2012, p. 14.

Figure 6: The Core Corridors Trans-European Transport Network (TEN-T)

Inland Waterway Transport

"Inland waterway transport plays an important role for the transport of goods in Europe. More than 37,000 kilometres of waterways connect hundreds of cities and industrial regions. Some 21 out of 28 Member States have inland waterways, 13 of which have an interconnected waterway networks. The potential for increasing the modal share of inland waterway transport is significant. Compared to other modes of transport which are often confronted with congestion and capacity problems, inland waterway transport is characterised by its reliability, energy efficiency and major capacity for increased exploitation. The European Commission aims to promote and strengthen the competitive position of inland waterways in the transport system, and to facilitate its integration into the intermodal logistics chain.
Inland waterway transport is a competitive alternative to road and rail transport. In particular, it offers an environment-friendly alternative in terms of both energy consumption and noise emissions. Its energy consumption per km/ton of transported goods is approximately 17 % of that of road transport and 50 % of rail transport. In addition, inland waterway transport ensures a high degree of safety, in particular when it comes to the transportation of dangerous goods. Finally, it contributes to decongesting overloaded road networks in densely populated regions."[14]

"With regard to specific energy use, inland navigation can be described as the most effective and most environmentally friendly mode of transport. An inland vessel is able to transport one ton of cargo almost four times further than a truck using the same consumption of energy."[15]

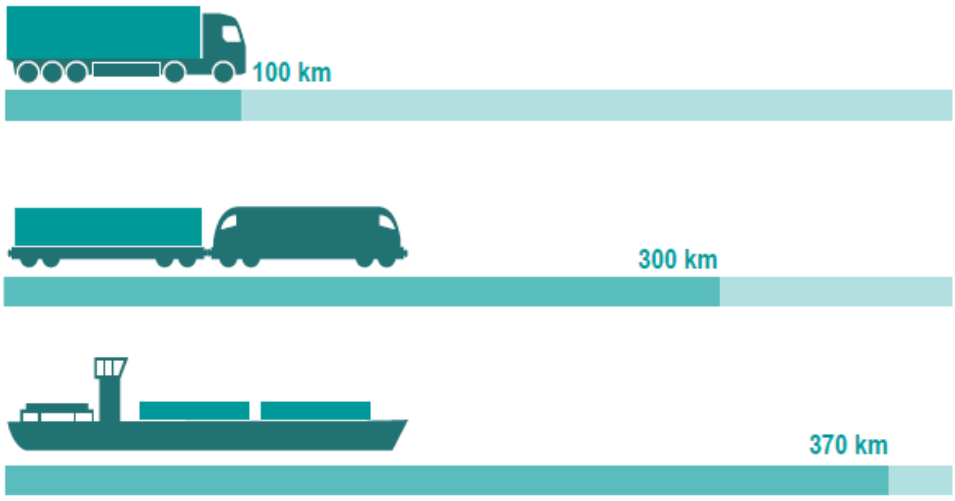

Figure 4: Transport distances for one ton of cargo requiring the same amount of energy[16]

[14] European Commission, 2016.
[15] via donau, 2013, p. 18.
[16] via donau, 2013, p. 18.

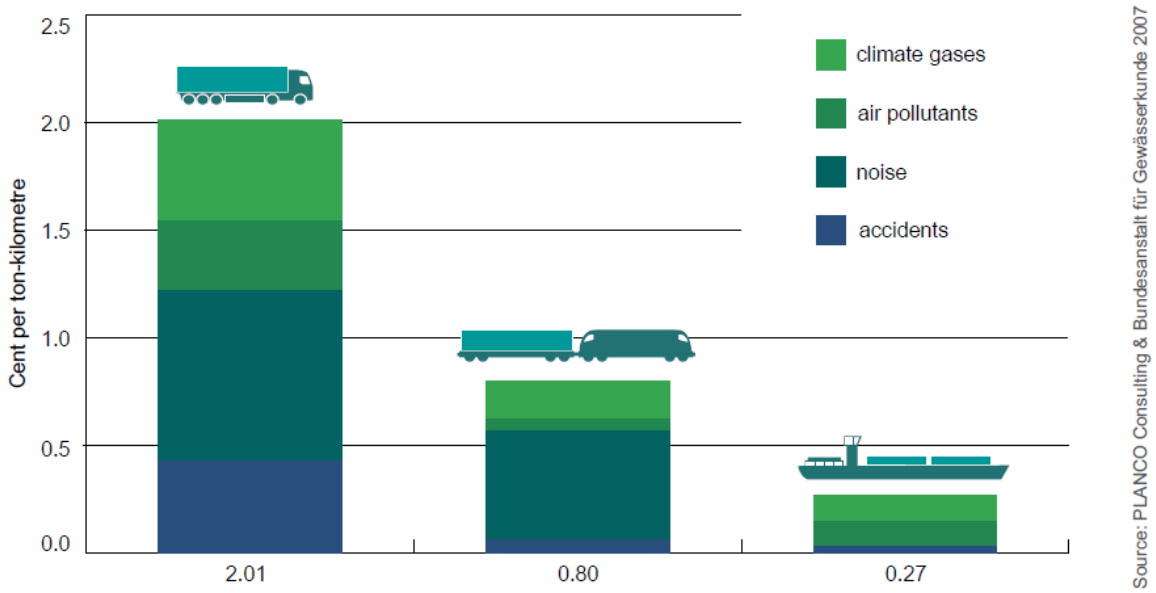

Figure 5: Sum of external cost per transport mode (average values for selected tranpsorts of buld goods)[17]

"External costs for inland navigation, i.e. costs deriving from climate gases, air pollutants, accidents and noise, are the lowest when compared to other transport modes. CO2 emissions are, in comparison to other modes of transport, especially low and this enables inland navigation to contribute to the achievement of climate goals set by the European Union."[18]

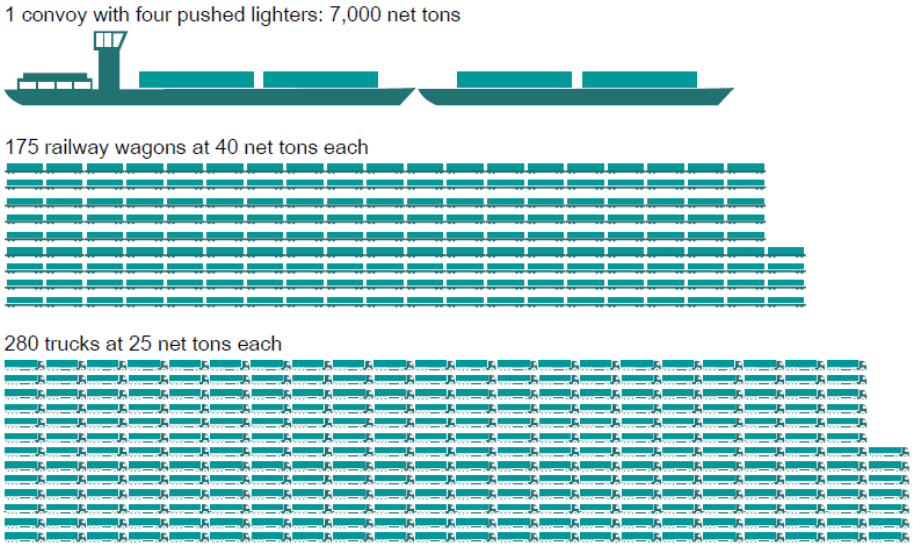

Figure 6: Transport capacity per transport mode[19]

[17] via donau, 2013, p. 19.
[18] via donau, 2013, p. 18.
[19] via donau, 2013, p. 19.

"Infrastructure costs consist of costs for constructing and maintaining transport routes. In the case of inland navigation, natural infrastructure is usually available, resulting in comparably low infrastructure costs. Detailed comparisons of aspects regarding inland transport modes are available for Germany: infrastructure costs per ton-kilometre are roughly four times higher"[20]

"Compared with other land transport modes, Danube navigation offers significantly higher transport capacity per transport unit. A single convoy with four pushed lighters can move 7,000 tons of goods, which corresponds to a load of 175 railway wagons each containing 40 net tons or 280 trucks each containing 25 net tons. Raising the amount of goods transported on the Danube will consequently result in a reduction of traffic jams, noise, pollution and accidents on roads and relieve strain on the railway system."[21]

Comparison of European and international waterways

Due to geographical prerequisites, countries may have a lot or little available waterways. At a global level, China and Russia have the most available navigable waterways.22 Therefore, the prerequisites for inland navigation differ at continental and country level due to available navigable waterways.
Another factor that influences the use of inland waterways as a transport mode is their political importance. In Europe, inland waterways are important for freight transport. The European Commission aims to strengthen inland navigation through a variety of measures such as promotion programs and cost benefits.23 In China, water transport can also be seen as a very important part of freight transport. Inland waterways have been the most important transport mode for many years and consequently of economic importance.24 In contrast, in Brazil, inland waterways are not an important transport mode and waterway management is very inefficient.[25]
The political importance is also reflected by investments in transport infrastructure: In the period 1992-2011 China spent 8.5 % of its gross domestic product (GDP) on infrastructure investments (high percentage invested in road, power, rail and water infrastructure). In comparison, Europe spent 2.6 % of the GDP on infrastructure investments. In Brazil, investments in waterway infrastructure have a low priority. In general, Latin America only spent 1.8 % of its GDP on infrastructure investments. [26]

Inland Navigation in Europe

"The most important inland waterway axis on the European mainland is the Rhine-Main-Danube-Corridor. The Rhine and Danube river basins, which are connected by the Main-Danube Canal, are the backbone of this axis. The Main-Danube Corridor was opened to navigation in 1992 and created and international waterway between the North Sea and the Black Sea. This waterway has a total

[20] via donau, 2013, p. 18.
[21] via donau, 2013, p. 18.
[22] URL: http://www.indexmundi.com/map/?t=10&v=116&r=xx&l=en [29.07.2016]
[23] URL: http://ec.europa.eu/transport/modes/inland/index_en.htm [29.07.2016]
[24] URL: https://www.britannica.com/place/China/Waterways [29.07.2016]
[25] Brazilian Ministry of Transport, 2013, p. 30.
[26] URL: http://www.mckinsey.com/global-themes/winning-in-emerging-markets/chinese-infrastructure-the-big-picture [29.07.2016]

length of 3504 km and provides a waterway connection between 15 European countries. The navigable length of the Danube available to international waterway freight transport is 2415 km, starting from Sulina at the end of the middle Danube distributaries into the Black Sea in Romania (river-km 0) to the end of the Danube as German federal waterway at Kelheim (river-km 2415). The Kelheim-Sulina main route is subject to the Convention Regarding the Regime of Navigation on the Danube of the April 18th, 1948, which ensures free navigation on the Danube for all commercial vessels sailing under the flags of all nations." [27]

In 2010, 43 million tons of cargo were transported on an average distance of 600 kilometres.[28] The most important market for freight transport on the Danube is the transport of iron and ferrous ores. Thus, the product category of ores and metal wastes can be identified as the most frequently transported goods on the Danube in 2014, followed by petroleum and agricultural products. Concerning the connection to other transport modes, there are different inland ports along the Danube as well as the maritime port in Constanta, where the highest volume of goods is transhipped.[29]
The route of the Rhine runs from Rotterdam (Netherlands) to Basel (Switzerland) and has a length of 885 km.30 Two third of all goods transported on inland waterways in Europe pass through the Rhine. This fact points out the importance of this inland waterway for the European economy and transport sector. The predominant transported goods in 2014 were solid mineral fuels, petroleum products and ores. The highest amount of goods is transhipped at the port of Duisburg (inland port) and at the port of Rotterdam (maritime port). The most important goods for transport on the Rhine are containers, weight-intensive goods and chemicals.[31]
Even though the Danube is 2.7 times longer than the Rhine, almost seven times more goods were transported on the Rhine in 2010. This is due to different infrastructural preconditions of these two inland waterways: The limited ramification of the Danube waterway enables only a spatially concentrated use, confining the Danube to a limited form of transport, requiring longer pre- and end-haulage by road or rail. For this reason, inland navigation in the Danube region usually has a lower share of national modal split figures. In addition, a total of 130 bridges span the international Danube waterway. [32] This leads to restrictions concerning the possible transport volume of inland vessels. The economic activity and the high density of population along the Rhine also support an increased use of this inland waterway as a transport mode. [33]

Inland navigation in China

Due to the longest waterway network with a total length of 123,495 kilometres, China has the largest network of inland waterways in the world. It consists of more than 5,000 rivers on which 1,180 million tons of cargo were transported in 2007.[34] Besides big maritime ports such as Shanghai, there are about 2,000 inland ports connecting inland waterways with other modes of transport.[35] In the South there are larger rivers with stable fairway conditions which are not affected by the appearance of ice. In contrast, rivers located in the North are smaller and show unstable fairway

[27] via donau, 2013, p. 46.
[28] via donau, 2013, p. 22 f.
[29] URL: http://www.inland-navigation.org/river/maindanube/ [29.07.2016]
[30] via donau, 2013, p. 23.
[31] URL: http://www.inland-navigation.org/river/rhine/ [29.07.2016]
[32] via donau, 2013, p. 22f and via donau, 2013, p. 59.
[33] URL: http://www.inland-navigation.org/river/rhine/ [29.07.2016]
[34] Urandaline Investments, no date, p. 237
[35] ESCAP, 2014, p. 125

conditions. In addition, during winter, the appearance of ice can affect inland waterway transport in this region.[36]

Compared to other countries around the globe, China, in particular the port of Shanghai, has the highest container transhipment. In fact, in 2012, 32.6 million TEUs were handled in Shanghai (see Figure 10).[37]

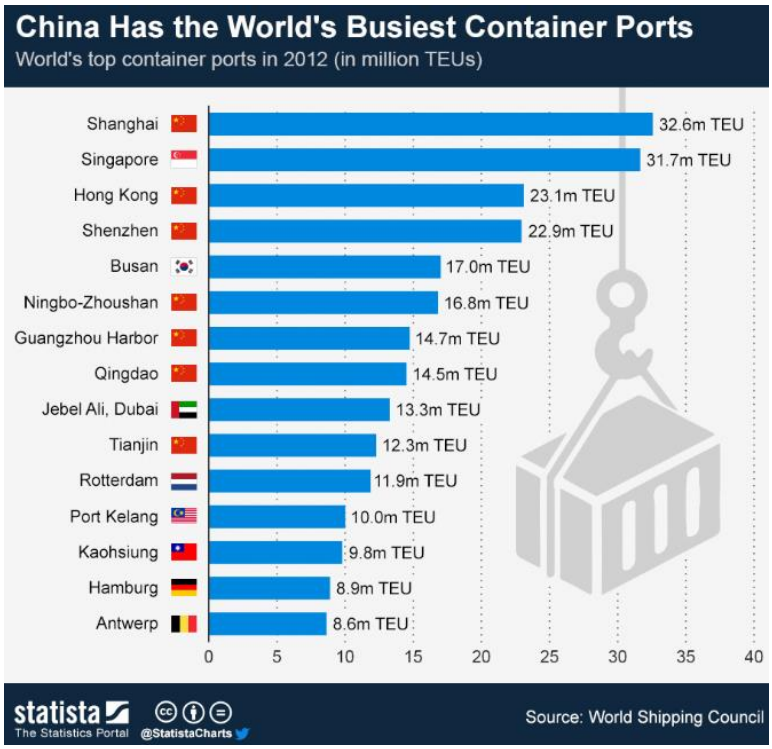

Figure 10: Transhipment in ports around the world (in million TEU)[38]

In 2007, more than three quarter of China‘s inland waterway transport volume of cargo was transported on three main waterways (Yangtze River, the Grand Canal and the Pearl River). Compared to the other two rivers, on the Yangtze River the highest volume (534 million tons) was transported and also the average transport distance in kilometres (378 km) was the highest.39 The Yangtze River runs from the Himalaya to Shanghai and has a total length of more than 6,300 km of which 3,000 km are navigable.40 Therefore, it is also the 3rd longest river, after the Nile and the Amazon, and largest river in the world. The Yangtze represents the main connection between rail, road and high-sea in China, enabling a wide intermodal transport network in China. Thus, also hinterland regions where an increasing number of industries are located are connected to maritime ports via the Yangtze River. The importance of this inland waterway is also pointed out by its contribution to China‘s gross domestic product (DGP) which was 35 % in 2010. 80% of China’s total inland cargo shipping is related to the Yangtze river. The most important ports are located at Chongqing, Wuhan, Shanghai and Nanjing.[41]

[36] URL: http://www.wwinn.org/china-inland-waterways [29.07.2016]
[37] URL: https://www.statista.com/chart/1488/china-has-the-worlds-busiest-container-ports/ [29.07.2016]
[38] URL: https://www.statista.com/chart/1488/china-has-the-worlds-busiest-container-ports/ [29.07.2016]
[39] Urandaline Investments, no date, p. 239.
[40] URL: http://www.wwinn.org/china-inland-waterways [29.07.2016]
[41] Rivers of the World, 2010, p.55ff and PIANC, 2009, p. 23.

The port of Chongqing is the biggest inland port of the Yangtze River with 1.1 billion tons of cargo handled in 2012. In addition, three million TEUs are passing the Chongqing annually. In Chongqing, inland navigation is very important which is also shown by the annual growth rate of waterway transport (+ 16.8%). Due to its strategic location, Chongqing serves as a logistical gateway to connect Western China with the rest of the country as well as international destinations. In fact, 90 % of the products manufactured in Chongqing and destined for export are transported via the Yangtze River. The main advantage of this port is that it provides a multimodal infrastructure. Cargo can be transhipped in the port and can be further transported by the transport modes rail, road or air. To stay competitive, Chongqing continues to invest in the development of the infrastructure.[42]

Inland navigation in Brazil

Brazil has the most available inland waterways in South America (50,000 km).[43] Compared to other transport modes, the broad Brazilian river system covers almost all territorial extensions. This leads to lower transport costs compared to rail and road on short transport distances. Nevertheless, only 22% of Brazilian inland waterways are used for freight transport. This is partly due to the fact that the main rivers are not located at the centres of production and consumption. In addition, compared to China and Europe, few investments are made in the inland waterway infrastructure. As a consequence, inland navigation makes a small contribution to the Brazilian economy.[44] Goods, which are mainly transported on the inland waterways in Brazil, are agricultural and mineral goods. Currently about 45 million tons of goods are transported on inland waterways in Brazil. Nevertheless, the potential transport volume of inland waterways in Brazil could reach 180 million tons per year.[45] There are three main inland waterway traffic routes: the Amazonas, the Sao Francisco and the Tocantins-Araguaia.[46] Even though inland waterways are not frequently used as transport modes in Brazil, ports are of international importance - ports participated in about 90 % of the country's export and import trade in 2010.[47]

The Amazonas has a length of 6,280 km and is the longest river in the world.[48] The route runs from Peru through northern Brazil to the Atlantic Ocean.[49] The banks of the Amazonas mostly consist of a tropical rainforest. This leads to the threat of theft – in fact, 27 million dollars were lost in the Amazonas region in 2015 due to thefts.[50]

The port of Manaus is the main transport hub for transports on the upper part of the Amazon Basin. The cargo volume per year is 11.8 million tons. In 2007, the total trade volume of the port of Manaus was 4.92 billion US dollar, whereas exports accounted for 1.15 billion US dollars.[51]

Fruits, seeds, machinery, wood and fuels are products which were mainly loaded in the port of Manaus. Machinery and electrical goods are mainly imported due to the Manaus' industrial tax free

[42] Consulate General of the Kingdom of the Netherlands in Chongqing/ Netherlands Business Support Office in Chengdu, Sichuan, 2014, p 3f and Rivers of the World, 2010, p 55 ff.
[43] URL: http://www.indexmundi.com/map/?t=10&v=116&r=as&l=en [29.07.2016]
[44] Rivers of the World, 2010, p. 47.
[45] URL: http://www.wwinn.org/brazil-inland-waterways [29.07.2016]
[46] Rivers of the World, 2010, p. 45.
[47] Martins, et al., 2013, p. 1.
[48] URL: http://www.wwinn.org/brazil-inland-waterways[29.07.2016] and Rivers of the World, 2010, p. 41.
[49] URL: http://www.thefreedictionary.com/Transport+on+the+Amazon [29.07.2016]
[50] URL: http://www.joc.com/trucking-logistics/cargo-thefts-rise-brazil-economy-shrinks_20150903.html [16.07.2016]
[51] Ministry of External Relations, 2008,p. 11.

zone. In this zone companies, in particular in the electrical and electronic sector, enjoy federal tax breaks. [52]

Comparison

As can be seen in the table below, the numbers significantly differ for Europe, China and Brazil: China has the most available waterways, the highest transported volume on waterways and the highest volume handled in ports compared to Europe and Brazil. Even though Brazil has more available waterways than Europe, around 12 times more volume is transported on European inland waterways.

These differences can be seen in context with the importance of inland navigation in the different countries/regions. In Europe and China, inland waterways are seen as important transport modes and various measures are used to increase the use of inland waterways. Besides financial support, promotional actions can be named as examples of such measures. In this context, investments in the waterway infrastructure can be seen as a main measure to guarantee the competitiveness of inland navigation.

	Europe	China	Brazil
Available waterways	40,000 km	123,495 km	50,000 km
Important waterway in region	Rhine-Main-Danube Corridor	Yangtze-River	Amazon
Transported volume on waterways in total	551 million tons	1,180 million tons	45 million tons
Transported goods	dry & bulk cargo, construction material	dry & bulk cargo, construction material	mainly agricultural and mineral goods
Important inland ports in region	Duisport	Chongqing	Manaus
Volume handled in ports	131 million tons	1.1 billion tons	11.8 million tons
Importance of inland navigation in region (political/economical)	High	High	Low
Share of inland navigation in Modal Split	7 % (2013)	24 % (2012)	14 % (2008)

Table 1- Comparison of inland navigation in Europe, China and Brazil

[52] URL: http://www.worldportsource.com/ports/review/BRA_Port_of_Manaus_3506.php [29.07.2016] and http://www.joc.com/port-news/south-american-ports/container-terminals-jungle-city-manaus-face-growing-pains_20150702.html [16.07.2016]

Further Links

The following links can be used as additional sources:

Manual on Danube Naviation:
Free Download at
http://www.viadonau.org/en/newsroom/news/detail/?tx_news_pi1%5Bnews%5D=582&cHash=5f5e546491ad1525e4d057ff40250a01

European Commission: Transport
http://ec.europa.eu/transport/index_en.htm

Trans-European Network TENtec
http://ec.europa.eu/transport/infrastructure/tentec/tentec-portal/site/index_en.htm

White Paper: Illustrated Brochure
http://ec.europa.eu/transport/themes/strategies/doc/2011_white_paper/white-paper-illustrated-brochure_en.pdf

EU Transport Scoreboard
http://ec.europa.eu/transport/facts-fundings/scoreboard/index_en.htm

Masterplan for Danube region
http://ec.europa.eu/transport/modes/inland/news/2014-12-04-danube-ministrial-meeting/masterplan.pdf

European Railway Agency
http://www.era.europa.eu/Pages/Home.aspx

Connecting Europe – Mobility is the Key
https://www.youtube.com/watch?feature=player_embedded&v=Q2LnkjyYcMA

The Future of Rail in Europe
https://www.youtube.com/watch?feature=player_embedded&v=8GHz-stzCso

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Rivers of the World: Rivers of the world Atlas, 2010, online available at URL: http://www.google.at/url?sa=t&rct=j&q=&esrc=s&source=web&cd=17&ved=0ahUKEwiFxZrsobPLAhWiCpoKHZbFAcw4ChAWCFYwBg&url=http%3A%2F%2Fwww.riversoftheworld.nl%2Fcomponent%2Fdocman%2Fdoc_download%2F28-atlas-on-inland-waterways-transport&usg=AFQjCNH2NAfbb6XXi6xRAH, last accessed on 29.07.2016.

Urandaline Investments: Chapter VI: Inland ports and waterways, online available at URL: http://www.urandaline.com.au/mcr/inland%20water%20transport.pdf, last accessed on 29.07.2016.

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