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## Danube navigation at a glance

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The following introductory chapter provides an overview of the system of Danube navigation, its characteristics and its relevance to the European transport system. The aspects outlined in this chapter are presented in greater detail in the subsequent chapters of this manual.

## System elements of Danube navigation

Danube navigation needs to be understood as a system of strongly interrelated single elements. These elements are the Danube **waterway**, the **vessels** and their cargoes (types of goods), the **ports** as hubs that link inland navigation with the **transport modes** of road and rail, **River Information Services (RIS)** together with the **legal and policy framework**. The potential of navigation on the Danube can only be fully realised when interaction of all of these elements is achieved.

### The Danube waterway

The Danube rises in the Black Forest in Germany and empties into the Black Sea in Romania and the Ukraine. The river is **2,845 km long** – 2,415 km of which are navigable – and connects ten riparian countries. Since early history, the Danube has been a main trading route in Europe. It is an important source of energy and drinking water as well as being a unique habitat for wildlife and a recreational area.

The capacity of the Danube waterway is a key factor of the inland navigation system and is determined mainly by prevailing **nautical conditions** (i.e. the



Source: Hafen Straubing-Sand GmbH

Aerial view of the Bavarian Danube port Straubing-Sand

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navigability of the Danube with a cost-effective vessel draught loaded over the course of the year). This has a direct influence on the potential capacity utilisation of vessels navigating the river. Good nautical conditions and continuous maintenance of the waterway's infrastructure enable the sector to offer reliable and competitive transport services. This is a crucial precondition for the sustainable integration of inland navigation as an environmentally friendly mode of transport within the logistical concepts of a modern economy.

### Danube ports

Inland ports facilitate the **combination of the transport modes waterway, road and rail**. Working in **multimodal** logistical chains, rail and road act as partners to waterway transport by enabling **pre- and end-haulage** operations with ports fulfilling their role as an essential interface.

Over the last few decades, ports on the Danube have undergone a substantial transformation from conventional inland ports to modern **logistical hubs**. In addition to their basic function as transshipment hubs and storage sites, ports today provide a broad range of logistical services including **commissioning, distribution** and **project logistics**. Due to the fact that they serve as production sites as well as centres for cargo collection and distribution, they are extremely well integrated into regional economies and contribute substantially to economic growth and the creation of employment.

The three **most important port locations in terms of transshipment volumes on the Danube** are Izmail (Ukraine), Linz (Austria) and Galați (Romania). The seaport of Constanța in Romania occupies a special place. It is connected to the Danube via the Danube-Black Sea **Canal** and plays an important role as a transshipment gateway to the Black Sea, thereby facilitating trade with Asia, the Middle East and the Black Sea region.

### Inland vessels

There are two fundamental types of inland vessels and these are classed as: **motor cargo vessels**, which are equipped with a motor and a cargo hold, and **convoys** comprising of a motor cargo vessel or pusher and one or more non-motorised pushed lighters which are connected to the pusher vessel. On the Danube, the predominant share of cargo traffic is carried out by such convoys.

The most common **types of cargo** transported on the Danube and its navigable tributaries are ores, scrap metal, **mineral raw materials**, solid fuels, construction materials and agricultural goods.

In addition to cargo transport, **passenger transport** also plays an important role with day trips and river cruises becoming more and more popular.

## River Information Services

A cornerstone of the technological modernisation of inland navigation has been the implementation of River Information Services (RIS). RIS are tailor-made **information and management services** for inland navigation that raise transport safety and help improve the cost-effectiveness, reliability and predictability of transport. It comprises of electronic navigational charts, the **tracking and tracing** of vessels and current online information on water levels.

## Transport policy framework

In addition to the goal of ensuring a high level of accessibility, **European and national transport policies** are increasingly striving to create preconditions for **sustainable** and **energy-efficient** transport. Inland navigation can contribute substantially to this due to the fact that it is environmentally friendly, safe and offers spare capacity.

In order to strengthen the share of inland navigation in an integrated transport system, the European Union has published an **Action Programme for the Promotion of Inland Waterway Transport – “NAIADES”** (European Commission 2006). In the Danube region, the Strategy for the Danube Region of the European Union will provide an important framework for development activities until 2020 (European Commission 2010b).

On a national scale, transport policy targets have been defined in specific **action programmes** for inland navigation or in **national transport master plans**, which refer to the above-mentioned political programmes at a European level.

One of the most important goals for the coming years will be to utilise the national and European programmes and strategies in order to enhance and modernise navigation on the Danube.

## Strengths and weaknesses of Danube navigation

The **strengths** of Danube navigation lie mainly with its ability to convey large quantities of goods per vessel unit, its low transport costs and its environmental friendliness. Furthermore, it is available around the clock, with no prohibition on driving at weekends or during the night. In addition, it has a high level of safety and low infrastructure costs.

The **weaknesses** of this mode of transport are its dependence on current fairway conditions and the associated variable **load factor** of the vessels, its low transportation speed and **network density** which means that pre- and end-haulage by road or rail are often necessary.

## Danube navigation at a glance

The main **opportunities** for Danube navigation are the enormous amount of spare capacities that the waterway has to offer, international development initiatives such as the Strategy for the Danube Region, the **internalisation of external costs** on a European scale, cooperation activities with road and rail, as well as the application of modern and harmonised River Information Services (RIS).

The key **threats** to Danube navigation are its variable weighting on the political agenda, and consequently in the budget debates of the various Danube countries, as well as the need for modernisation of many Danube ports and parts of the Danube fleet.

STRENGTHS	WEAKNESSES
<ul style="list-style-type: none"><li>• low transport costs</li><li>• ability to convey large quantities of goods per unit</li><li>• environmental friendliness</li><li>• safety</li><li>• availability around the clock</li><li>• low infrastructure costs</li></ul>	<ul style="list-style-type: none"><li>• dependence on variable fairway conditions</li><li>• low transport velocity</li><li>• low network connectivity, often requiring pre- and end-haulage</li></ul>
OPPORTUNITIES	THREATS
<ul style="list-style-type: none"><li>• spare capacity of the waterway</li><li>• rising demand for environmentally friendly transport modes</li><li>• modern and harmonised cross-border information services (RIS)</li><li>• cooperation activities with road and rail</li><li>• international development initiatives (e.g. NAIADES, Strategy for the Danube Region)</li></ul>	<ul style="list-style-type: none"><li>• inadequate maintenance of the waterway in some Danube riparian countries</li><li>• high requirement for modernisation of ports and fleet</li></ul>

SWOT analysis of Danube navigation

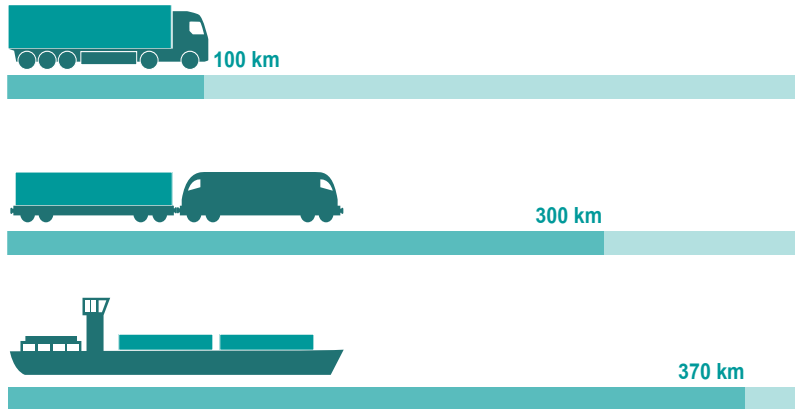
Source: via donau

## Danube navigation compared to other modes of transport

In comparison to other modes of transport, several factors demonstrate the advantages of inland navigation. For example, it features the lowest **specific energy consumption** and the lowest **external costs** of any **land transport mode**. Furthermore, it has the ability to transport large quantities of goods per unit (**bulk freight capacity**) and requires comparably low investment in maintaining and expanding its infrastructure.

## Specific energy use

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.



Source: via donau

Transport distances for one ton of cargo requiring the same amount of energy

## External costs

**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. CO<sub>2</sub> 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.

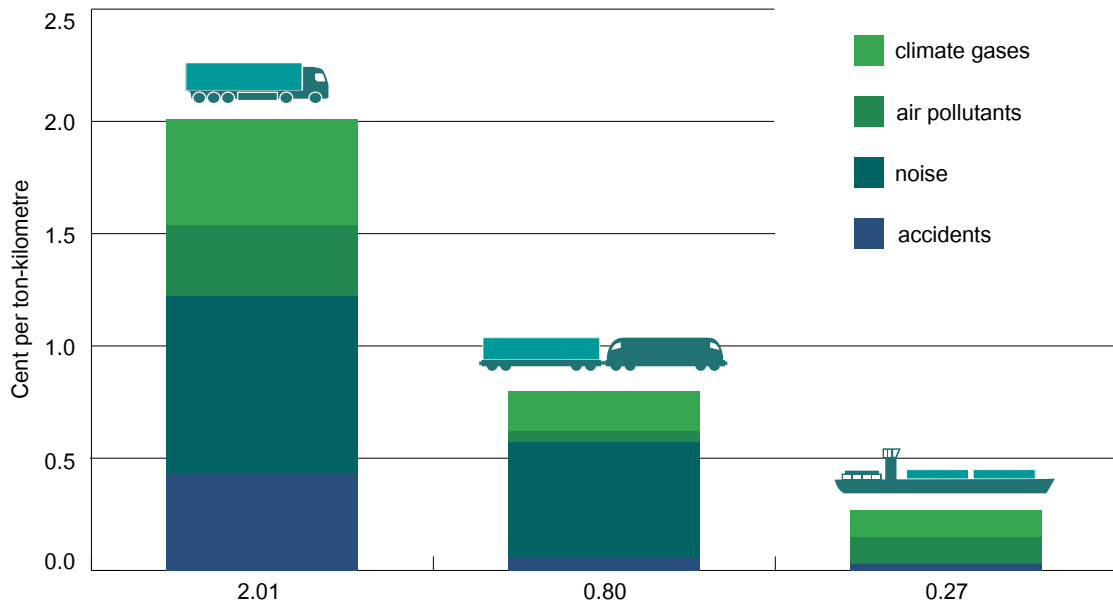
## Bulk freight capacity

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.

## Infrastructure costs

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

## Danube navigation at a glance



The sum of external costs for inland vessels is by far the lowest (average values for selected transports of bulk goods)

1 convoy with four pushed lighters: 7,000 net tons



175 railway wagons at 40 net tons each



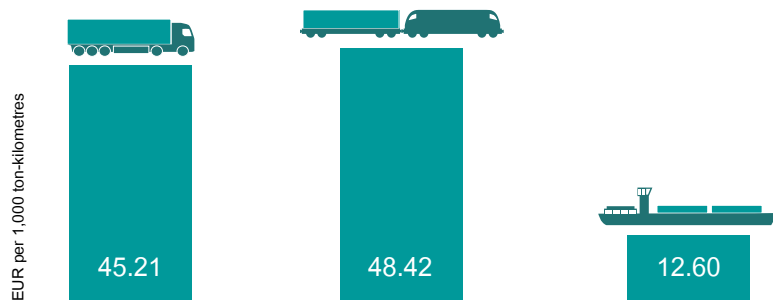
280 trucks at 25 net tons each



Inland vessels beat road and rail in terms of transport capacity

Source: PLANCO Consulting & Bundesanstalt für Gewässerkunde 2007

Source: via donau



Comparison of infrastructure costs (example of German inland transport modes)

Source: PLANCO Consulting & Bundesanstalt für Gewässerkunde 2007

for road or rail than for waterways (PLANCO Consulting & Bundesanstalt für Gewässerkunde 2007).

Improving the complete infrastructure of the 2,415 km long Danube waterway would require an investment of 1.2 billion EUR according to current cost estimations for infrastructure projects in the Danube riparian states. This corresponds roughly with the cost of constructing 50 km of road or rail infrastructure. The costs for current railway tunnel projects in Europe amount to between 10 and 20 billion EUR.

## Relevance of Danube navigation

### Danube waterway transport in comparison to Europe

In 2010, 485 million tons of goods were transported on the **inland waterways of the European Union**. Transport performance accounted for 148 billion ton-kilometres. Accordingly, the mean average distance of freight transport on European inland waterways amounted to 305 kilometres.

The **Main-Danube Canal** forms an important part of the Rhine-Main-Danube inland waterway which extends, with a length of 3,500 kilometres, through the European mainland from the Port of Rotterdam on the North Sea to the Port of Constanța on the Black Sea. With a transport volume of 300 million tons, the **Rhine** clearly has a more intense utilisation of transport than the **Danube**, on which about 43 million tons were transported in 2010. Nevertheless, Danube traffic is characterised by longer distances, and this becomes obvious when comparing the transport performance of these two main European waterways: 26 billion ton-kilometres on the Danube (average transport distance of about 600 kilometres) compared to 90 billion ton-kilometres on the Rhine (average transport distance of about 300 kilometres).



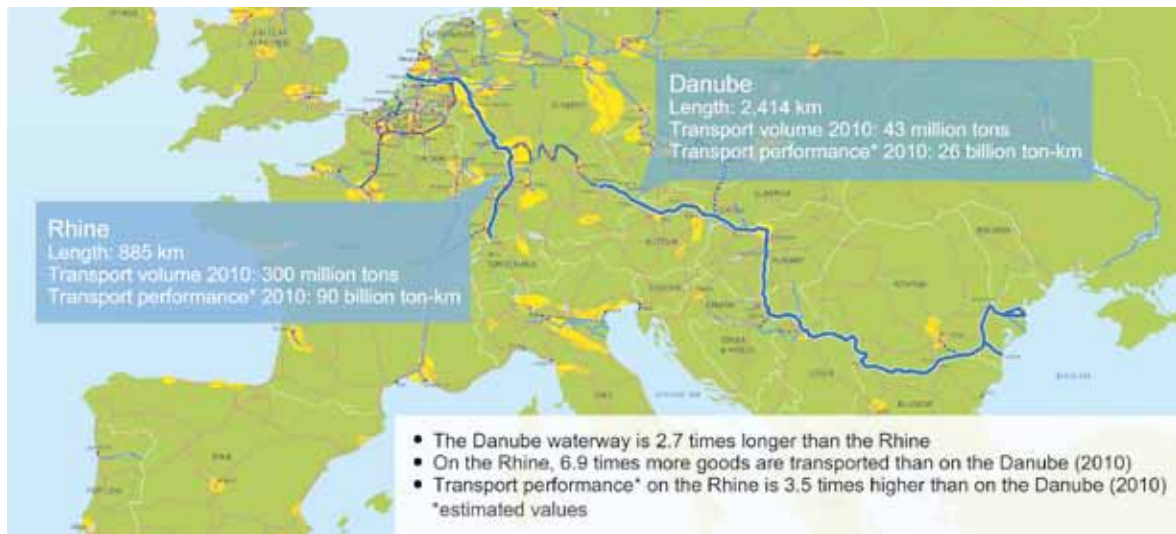
Statistical data for the EU-27 countries were taken from the online database of Eurostat, the Statistical Office of the European Union: [ec.europa.eu/eurostat](http://ec.europa.eu/eurostat); this comprises of estimated and preliminary values. Values for the Danube region are based on enquiries by via donau, which were conducted on the basis of national statistics.



## Danube navigation at a glance

Regarding the **transport volume of single Danube riparian states** achieved on the Danube waterway and its navigable tributaries in 2010, Romania was by far the largest transporter of goods (21.6 million tons), followed by Serbia with 14.3 million tons and Austria with 11.3 million tons.

**Maritime transport on the Danube**, i.e. transport on river-sea or sea-going vessels on the **Lower Danube** (Romania and Ukraine), accounted for 4.8 million tons in 2010, the majority being handled via the Sulina Canal.



Source: via donau, Inland Navigation Europe

The European inland waterways Rhine and Danube in comparison

### Modal split

For the **27 countries of the European Union**, the share of inland waterways in the **modal split** in 2010 was around 6.5% – meaning that 6.5% of all freight ton-kilometres were handled on waterways. This share differs sharply throughout individual EU countries. The Netherlands, for example, have important seaports and a highly integrated inland waterway network which is divided into small sections. This results in the highest inland navigation share of the EU-27 (32.9% in 2010).

In the **Danube region**, however, different infrastructural preconditions exist: waterway cargo transport is mainly concentrated on a principal river, on which very large amounts of cargo can be handled. However, the limited ramification of the 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.



Detailed statistics on transport in the European Union:  
[epp.eurostat.ec.europa.eu](http://epp.eurostat.ec.europa.eu)



Statistics on Danube navigation from the Danube Commission:  
[www.danubecommission.org](http://www.danubecommission.org)



Annual reports on Danube navigation in Austria are published by via donau and are available for download on [www.donauschiffahrt.info/en](http://www.donauschiffahrt.info/en).

### Danube waterway transport in Austria

In Austria, between 9 and 12 million tons of goods are transported on the Danube annually. About one third of these goods are ores and scrap metal; about one fifth accounts for petroleum products as well as agricultural and forestry products.

The waterway share in the modal split in the Austrian Danube corridor is about 14%. The Danube plays an important role mainly in upstream transport, especially in imports via the eastern border and in transit. In these transport segments, the Danube is approximately neck and neck with rail. With regard to the entire territory of Austria, the Danube has a share of approximately 5% of the modal split.

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**Inland vessels**

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## Types of vessels on the Danube

Basically, inland cargo vessels operating on the river Danube and its navigable tributaries can be divided into three types according to the **combination of their propulsion systems and cargo holds**:

- **Motor cargo vessels** (or self-propelled vessels) are equipped with a motor drive and cargo hold. Motor cargo vessels can be subdivided into dry cargo vessels, motor tankers, container and Ro-Ro vessels (see below under “Main types of vessels according to cargo type”)
- **Pushed convoys** consist of a pusher (motorised vessel used for pushing) and one or more non-motorised **pushed lighters** or **pushed barges** that are firmly attached to the pushing unit. We talk about a coupled formation or pushed-coupled convoy if a motor cargo vessel is used for propelling the formation or convoy instead of a pusher. A **coupled formation** consists of one motor cargo vessel with one to two lighters or barges coupled on its sides, whereas a **pushed-coupled convoy** has one to two lighters or barges coupled to the motor cargo vessel on its sides with additional lighters or barges placed in front of it.
- **Tugs** are used to tow non-motorised vessel units, so-called barges (vessels for carriage of goods with a helm for steering). Towed convoys are rarely used on the Danube any more because they are less cost-effective than pushed convoys.

Cargo shipping on the Danube is predominantly carried out by means of convoys (pushed convoys, coupled formations as well as pushed-coupled convoys), and only a small share by individual motor cargo vessels. On the Rhine, the ratio of convoys to motor cargo vessels is approximately the reverse.



Source: via donau

A 4-unit pushed convoy on the Austrian section of the Danube east of Vienna

## Inland vessels

### Pushed navigation on the Danube

When comparing all types of vessels operating on the Danube, the **bulk freight capacity of pushed convoys** is clearly the most impressive. The term “bulk freight capacity” indicates the possibility of transporting a large amount of goods on a vessel at the same time. A pushed convoy comprising of one pusher and four non-motorised pushed lighters of the type Europe IIb, for example, can transport around 7,000 tons of goods - the equivalent to the cargo carried by 280 trucks (with 25 net tons each) or 175 rail wagons (with 40 net tons each). The 4-unit convoy mentioned above can navigate the whole stretch of the Danube between the German port of Passau and the Black Sea. Even more impressive is the transport capacity of a 9-unit convoy like those used on the [Central](#) and [Lower Danube](#). Such a convoy can carry remarkable 15,750 tons of cargo and can therefore replace 630 trucks or 394 rail wagons (which is the equivalent of about 20 fully loaded [block trains](#)). Convoys comprising of up to 16 pushed lighters are possible on the lower reaches of the Danube due to the width of the waterway and the fact there are no limitations caused by locks.

The basic rule for the **formation of convoys** is: vessel units in pushed convoys are grouped so as to reduce water resistance when in motion as much as possible or so that sufficient stop and manoeuvre characteristics can be ensured (e.g. when navigating downstream). In order to lessen the resistance, the lighters are placed in a staggered arrangement towards the rear.

If the appropriate technical features of the units used in a convoy allow it, vessel units are not attached to one another rigidly, but rather coupled with

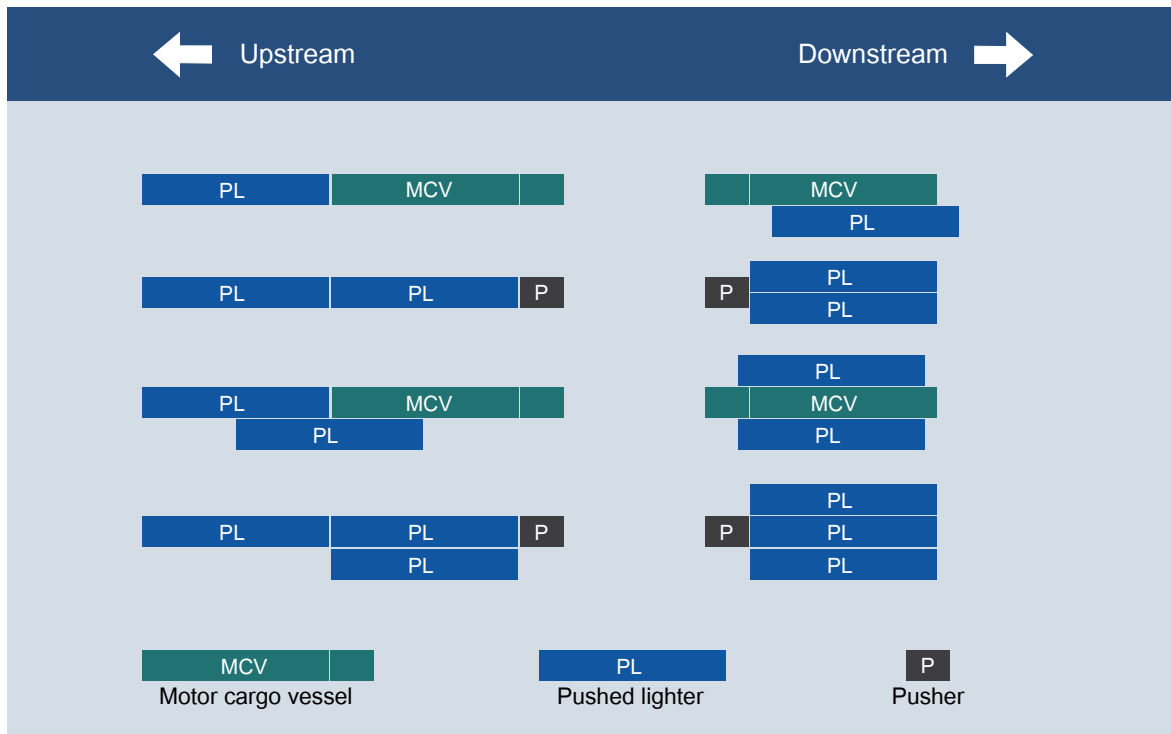


A Europe IIb type pushed lighter, which is typically used on the Danube, has the following dimensions: length 76.5 m, width 11.0 m, maximum draught 2.7 m with a load capacity of 1.700 tons.



Source: via donau/Andi Bruckner

Pusher belonging to the TTS Line shipping company



Source: via donau

Arrangement of vessel formations on the Danube

**flexible connectors** to enable the convoy to negotiate curves in areas with particularly narrow curve radii.

For **upstream** travel, the convoy should have as small a cross-sectional area as possible and thus the lowest possible resistance, which is why the lighters are arranged behind one another in a so-called cigar or asparagus formation. In contrast, the lighters are arranged next to each other together when travelling **downstream**, to facilitate the manoeuvrability of the convoy and most especially its ability to stop in the direction of the current.

### Main types of vessels according to cargo type

**Dry cargo vessels** are used for transporting a wide variety of goods including log wood, steel coils, grain and ore. These vessels can be used for almost anything and therefore reduce the number of empty runs (journeys with no return cargo). This class of vessel can generally carry between 1,000 and 2,000 tons of goods and is often used on the Danube in coupled formations or pushed-coupled convoys. Dry cargo vessels can be divided into the three main classes that are shown in the figure below.

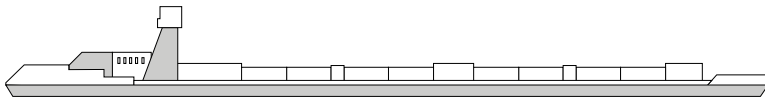
## Inland vessels



Gustav Koenigs	
Length:	67 m
Width:	8.2 m
Max. draught:	2.5 m
Deadweight (dwt):	900 t



Europaschiff	
Length:	85 m
Width:	9.5 m
Max. draught:	2.5 m
Deadweight (dwt):	1,350 t



Large motor vessel	
Length:	95 m / 110 m
Width:	11.4 m / 11.4 m
Max. draught:	2.7 m / 3.5 m
Deadweight (dwt):	2,000 t / 3,000 t



Main types of dry cargo vessels

Source: Voies navigables de France



Motor cargo vessel of the Europaschiff class

Source: via donau



ADN = European Agreement Concerning the International Carriage of Dangerous Goods by Inland Waterways (United Nations Economic Commission for Europe 2008)

ADN-D = Standards Concerning the Transport of Dangerous Goods on the Danube (Donaukommission 2007)

**Tankers** transport various types of liquid goods, such as mineral oil and derivatives (petrol, diesel, heating oil), chemical products (acids, bases, benzene, styrene, methanol) or liquid gas. The majority of the liquid goods mentioned above are **hazardous goods** which are transported using special tanker vessel units equipped with the appropriate safety devices. European regulations and recommendations, such as the ADN and ADN-D, as well as national legislation governing the transport of hazardous goods have particular relevance in this context.

Tankers used on the Danube have an average loading capacity of around 2,000 tons. As is the case with the navigation of dry cargoes, the transport of liquid goods on the Danube is carried out primarily by pushed convoys.

Modern tankers have a **double hull** which prevents the cargo from leaking in the event that the outer hull is damaged. Stainless steel tanks or cargo holds with a **special coating** are used in order to prevent the cargo from reacting with the surface of the tank. The use of heaters and valves enable the transport of goods that freeze easily even in winter, and sprinkler systems on deck protect the tanks from the summer heat. Liquid gases are transported under



Tanker	
Length:	110 m
Width:	11.4 m
Max. draught:	2.8 m
Deadweight (dwt):	2,300 t



Main characteristics of a tanker

Source: via donau



Source: helmut1972, www.binnenschifferforum.de

Tanker on the Danube



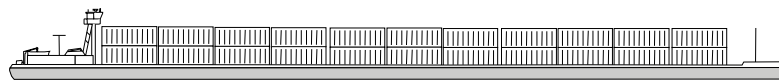
## Inland vessels

pressure and in a cooled state using special containers. Most tankers have pumps on board which can load and unload the goods directly into the tanks in ports not equipped with such special loading systems.

**Container vessels** are ships constructed specifically for the transport of containers and are currently used primarily in the Rhine region. In the Danube region container convoys with four pushed lighters are regarded as the best way to increase capacity. Such a pushed convoy has a total loading capacity of up to 576 TEU – each pushed lighter can therefore carry 144 TEU, i.e. three layers of containers with 48 TEU each.



TEU = Twenty-Foot Equivalent Unit. TEU is the measurement used for containerised goods and is equivalent to a container with the standard dimensions of 20 feet x 8.5 feet x 8.5 feet (around 33 m<sup>3</sup>).



Container vessel	
Length:	135 m
Width:	17.0 m
Max. draught:	3.7 m
Deadweight (dwt):	470 TEU



JOWI class Rhine container vessel

Source: Voies navigables de France

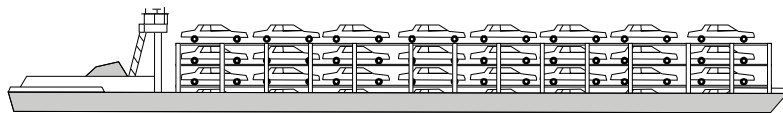


Container convoy entering the Austrian Port of Linz

Source: via donau

**Ro-Ro vessels:** Roll-on-Roll-off means that the goods being transported can be loaded and unloaded using their own motive power via port or vessel ramps. The most important types of goods transported in this way include passenger cars, construction and agricultural machinery, articulated vehicles and **semi-trailers** (“floating road”) as well as heavy cargo and oversized goods.

The majority of Ro-Ro transport operations are carried out with specially constructed vessels such as catamarans. **Catamarans** are vessels with a double



Ro-Ro vessel	
Length:	105 m
Width:	9.5 m
Max. draught:	1.4 m

270 x 

Type parameters of a Ro-Ro vessel

Source: Voies navigables de France



Ro-Ro catamaran on the Danube

Source: helmut1972, www.bimmenschifferforum.de



Information on passenger navigation is provided by the Danube Tourist Commission: [www.danube-river.org](http://www.danube-river.org)

hull in which the two hulls are connected by the deck, which forms a large loading surface for the rolling goods.

### Passenger vessels

The Danube has become significantly more attractive in recent years, even for longer river cruises along its whole stretch between the Main-Danube Canal and its Black Sea estuary. As a logical consequence of this trend, the number of orders for new passenger vessels is also rising. New **cruise or cabin vessels** for navigation on the large waterways of Europe set top standards as far as comfort, safety and nautical properties are concerned. Large river cruise vessels that are 125 metres long offer space for around 200 passengers who are usually accommodated in 2-bed cabins. Thanks to their dimensions, these vessels can pass through locks 12 metres in width and can therefore be used along the whole stretch of the river between the North Sea and the Black Sea.

A low draught of on average 1.5 metres, plus ingeniously constructed super-

## Inland vessels



Source: via donau/Andi Bruckner

Cabin vessel on the Danube

structures and deckhouses ensure smooth operation in very low water depths and safe passage under bridges in periods with higher water levels. The recent use of diesel-electric propulsion systems with gondola propellers now guarantees virtually silent operation as well as enabling relatively high speeds of up to 24 km/h in shallow waters.

In addition to the cabin vessels used for long-haul navigation, there are also **day-trip vessels** that usually only operate local liner services. These passenger vessels are used mainly for day trips, round trips and charter trips on the more attractive stretches of the Danube or for round trips in or to larger cities located along the Danube.

### The Danube fleet

Due to the economic model that prevailed in the eastern area of the Danube region until the political reforms of the 1980s, **large shipping companies** are still dominant on the Danube. Starting in the early 1990s, these shipping companies have been successively privatised. This is quite the opposite to the situation on the Rhine where small “one-ship companies”, i.e. private vessel owner-operators, are predominant.

With very few exceptions these large Danube shipping companies use large **pushed convoys** (occasionally still **towed convoys**) for transporting bulk cargo due to the relatively low gradient of the Danube in its middle and lower stretches. The share of cargo space of non-self-propelled units in the Danube fleet stood, for example, at around 71% at the end of 2010 according to statistics published by the [Danube Commission](#). In absolute figures, this amounted



The figures quoted here for the Danube fleet do not include the vessel units of Western European countries such as Germany or the Netherlands that operate for the main part with self-propelled vessels in exchange traffic with the Main and the Rhine.

## The market for Danube navigation

## The Danube region as an economic area

### The Danube as an axis of economic development

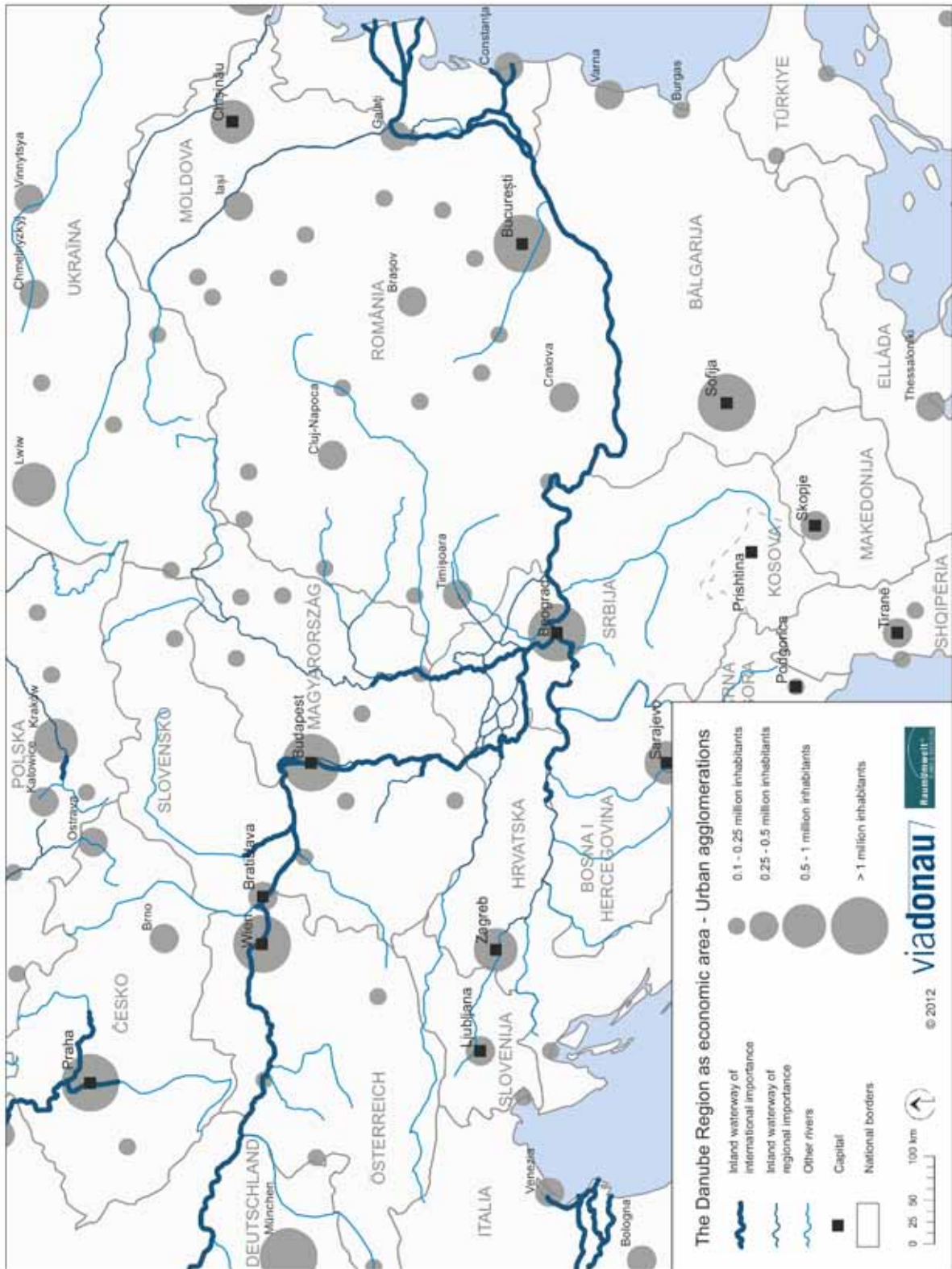
In its function as a transport axis the Danube connects key procurement, production and sales markets that have significant European importance. The **gradual integration of the Danube riparian states into the European Union** has led to the establishment of dynamic economic areas and trading links along the waterway. Slovakia's and Hungary's accession to the EU in the year 2004 followed by Bulgaria and Romania in 2007 saw the start of a new phase of economic development in the Danube region. Accession negotiations got underway with Croatia in October 2005 and Serbia received accession candidate status in March 2012.

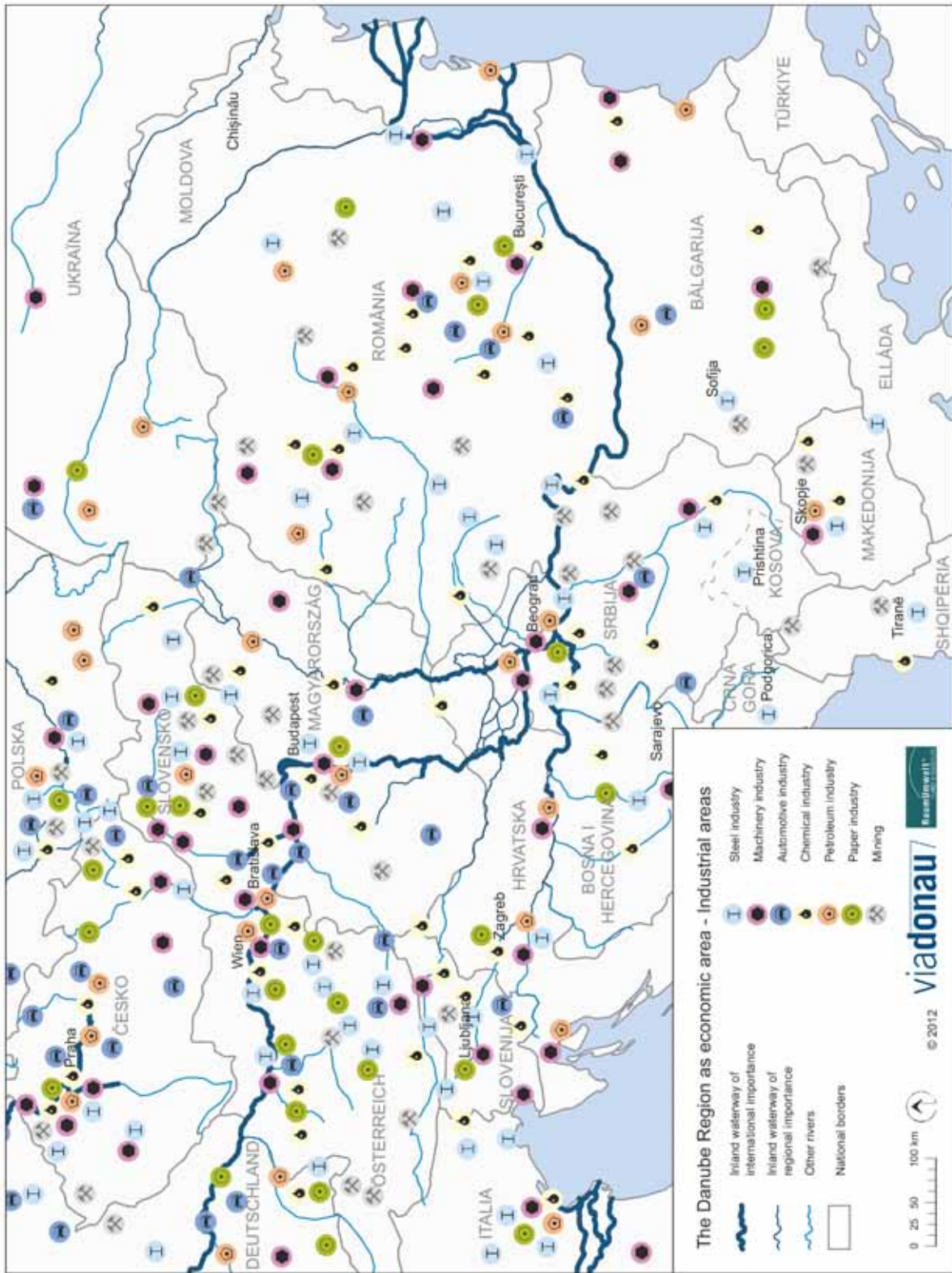
With approximately **90 million inhabitants**, the Danube region is of great economic interest. The economic and political heterogeneity that distinguishes the region is coupled with a dynamic development that is unparalleled anywhere else in Europe. The focus of this economic development lies in the capital cities of the Danube countries. Other urban areas are also playing an ever increasing role, in particular as consumer and sales markets. The Danube waterway as a **transport mode** can make a major contribution here with the provision of these centres with raw materials, semi-finished and finished products as well as the disposal of used materials and waste.

The Danube is of particular importance as a transport mode for the **industrial sites** that are located along the Danube corridor. **Bulk freight capacity**, the proximity to raw material markets, large free transport capacities and low transport costs all add up to make inland navigation the logical partner for resource-intensive industries. Many production facilities for the steel, paper, petroleum and chemical industries along with the mechanical engineering and automotive industry are to be found within the catchment area of the Danube. Project cargo and high-quality **general cargo** are now being transported on the Danube in ever increasing numbers in addition to traditional **bulk cargo**.

Due to its fertile soil, the Danube region is an important area for the cultivation of **agricultural raw materials**. These not only serve to ensure the sustainable provision of the conurbations in the vicinity of the Danube, but are also transported along the logistical axis of the Danube to be further processed. The ports and transshipment sites along the Danube play an important role here as locations for storage and processing and as goods collection points and **distribution centres**. A not inconsiderable part of these agricultural goods are exported overseas via the Rhine-Main-Danube axis and the respective seaports (North Sea and Black Sea).

# The market for Danube navigation





The Danube Region as economic area - Industrial areas

- Inland waterway of international importance
- Inland waterway of regional importance
- Other rivers
- National borders
- Steel industry
- Machinery industry
- Automotive industry
- Chemical industry
- Petroleum industry
- Paper industry
- Mining

0 25 50 100 km

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## The market for Danube navigation



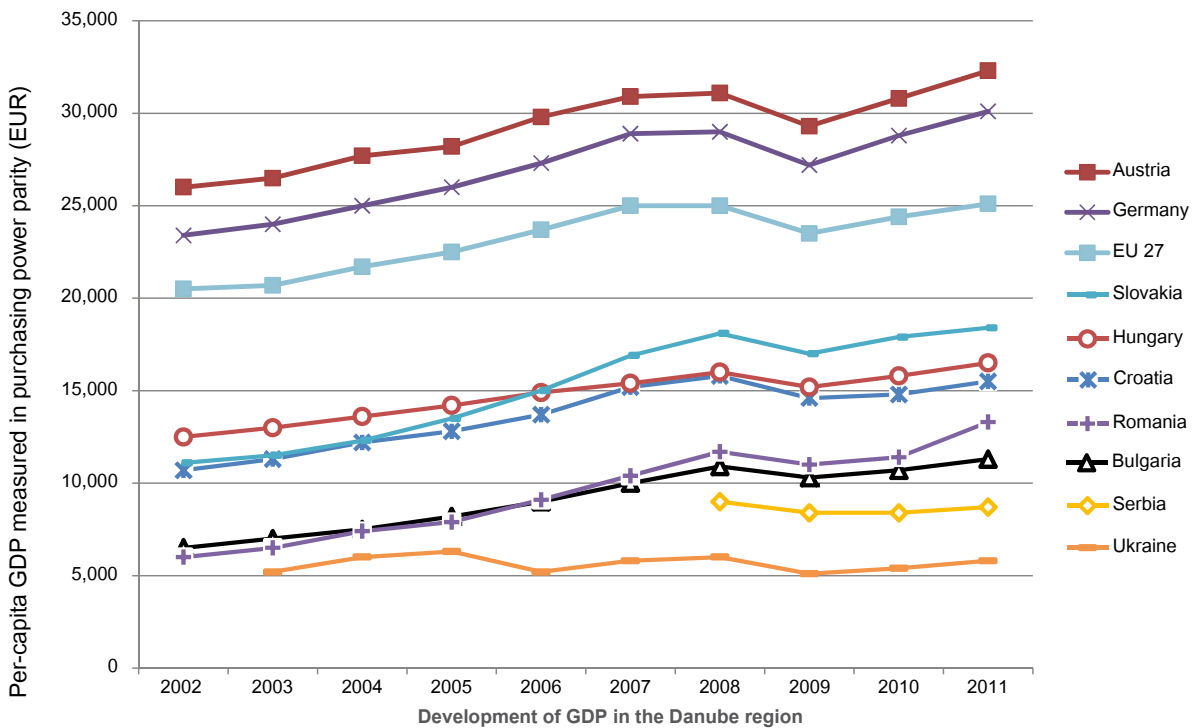


The current trend towards replacing fossil fuels with biogenic raw materials for the generation of energy and in the chemical industry has opened up new potential for Danube navigation specialised in **biomass logistics** and for the establishment of new value-added chains in the field of **renewable raw materials** (e.g. starch and oilseeds).

### Competitiveness and growth

One of the most striking characteristics of the Danube region is the substantial discrepancy in national income and macro-economic productivity. The **income and productivity levels** – measured in **purchasing power parity** of per-capita **gross domestic product** (GDP) – ranged from approximately EUR 32,300 in Austria to EUR 5,800 in the Ukraine in the year 2011, thus constituting a ratio of almost 6:1.

A clear picture emerges if you take a detailed look at the development of GDP in the individual Danube riparian states in recent years: For the most part, the economic crisis has been overcome in the EU member states and the road to continuous growth resumed. The latest EU member states Romania and Bulgaria, for example, managed to double their GDP in the period between 2002 and 2011. In 2011 the GDP in the Danube region again increased on average by more than 5% compared to the previous year. In contrast, the 27 EU countries in total only achieved an increase of barely 3%. This trend reflects



Source: Eurostat, Wiener Institut für Internationale Wirtschaftsvergleiche

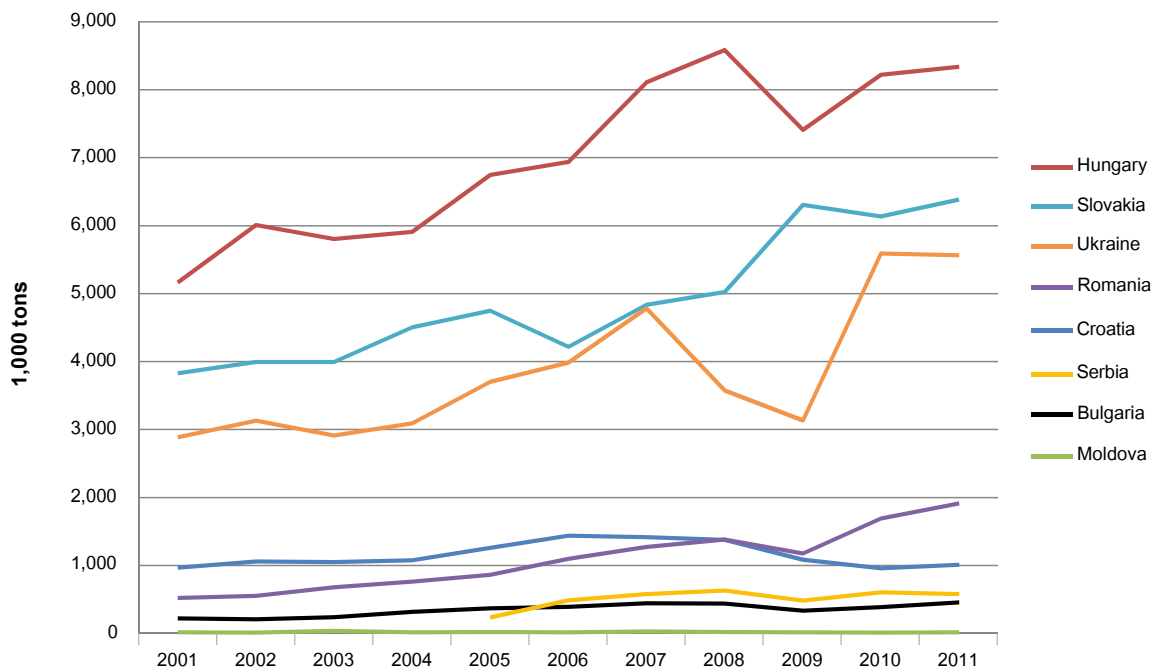
## The market for Danube navigation

the high dynamic growth of the Danube region and the increasing economic integration of the Danube riparian states.

### Austria's foreign trade links in the Danube region

Increasing deregulation of the European internal market and the integration of the Central and South-Eastern European states into the European Union has led to a fundamental restructuring of the flow of foreign trade in recent years. The Danube riparian states, Austria in particular, have reaped great benefits from this development.

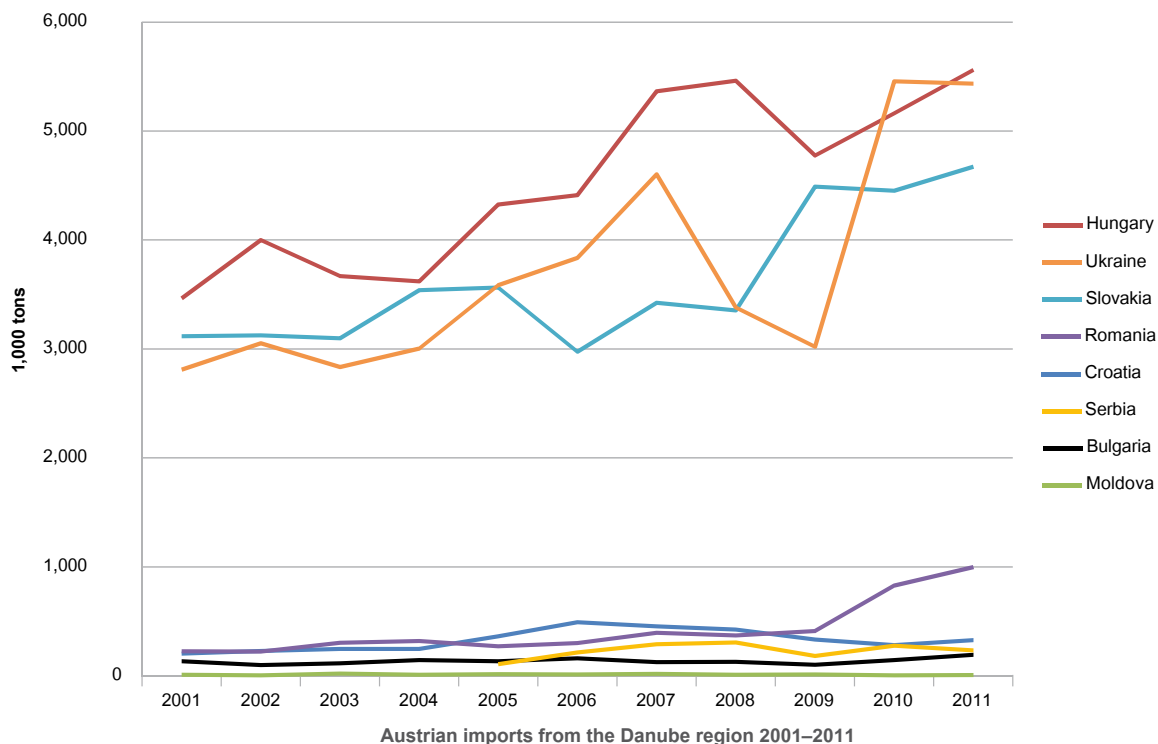
With an annual trade volume of almost 44 million tons (imports and exports together), Germany is by far Austria's most important trade partner. However, the data for Germany has been purposely omitted from the diagram below in order to focus more on Austria's trading relationships with Central and Eastern Europe.



Source: Statistics Austria

Austria's foreign trade links in the Danube region 2001–2011

In 2011 the **total volume of Austrian foreign trade in the Danube region** had already regained its level from the pre-crisis year of 2007 or had even exceeded it. With an increase from 13.6 million tons in the year 2001 to 24.3 million tons in 2011 (excluding Germany), the total volumes traded in the Danube region almost doubled during the period. Hungary



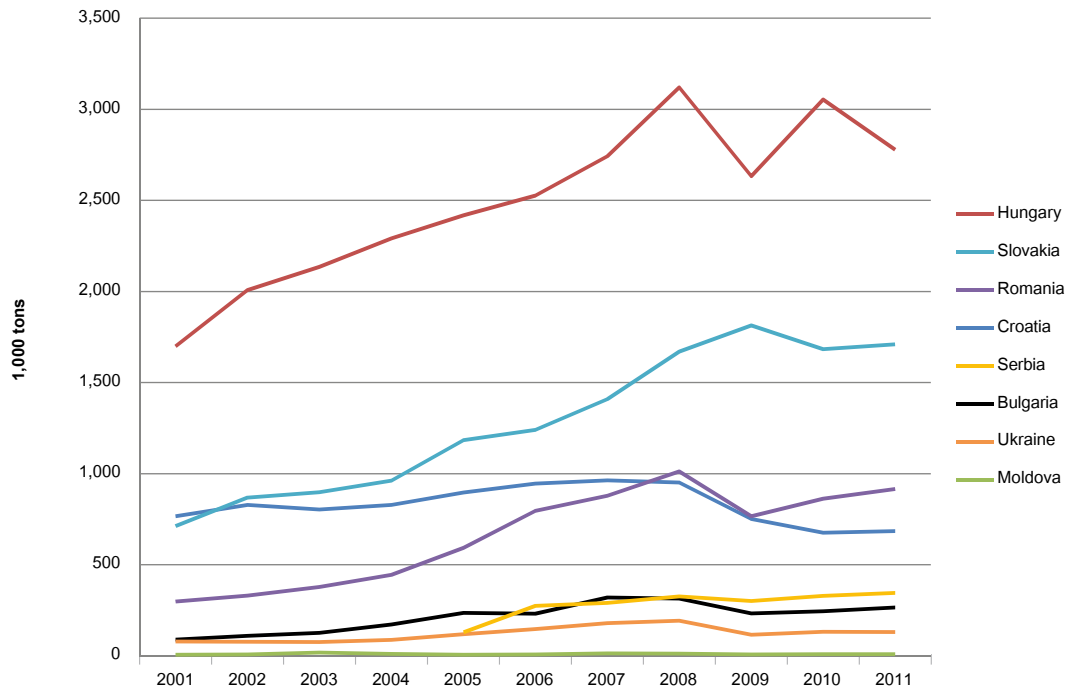
Source: Statistics Austria

is Austria's most important trade partner in Central and Eastern Europe, followed by Slovakia and the Ukraine. The rate of growth in the trade volume with Romania is remarkable: a total of 1.9 million tons of goods were traded between the two countries in 2011, the equivalent of a fourfold increase since the year 2001.

Hungary, the Ukraine and Slovakia respectively rank highest as far as **imports** to Austria are concerned. However, Romania has also gained significantly in importance here over the last few years. In the year 2011, a total of 17.4 million tons of goods were imported to Austria from the Danube riparian states (excluding Germany). This is equivalent to a rate of growth of 75% since 2001.

If **exports** to the Danube countries are considered individually, Hungary takes first place well ahead of Slovakia and Romania who take 2nd and 3rd places respectively. A total of 6.8 million tons of goods were exported from Austria to the Danube riparian states (excluding Germany) in the year 2011. This is equivalent to a rate of growth of almost 88% since 2001.

## The market for Danube navigation



Source: Statistics Austria

Austrian exports to the Danube region 2001–2011

### The Danube as a link to the Black Sea region

Because the European Union has managed to intensify its utilisation of the economic potential of Eastern and South-Eastern Europe in recent years, the next logical step is to focus more strongly on the countries of the Black Sea region. With more than **140 million inhabitants** the Black Sea region is a market with considerable development potential.



Source: via donau

The Black Sea region as a future market



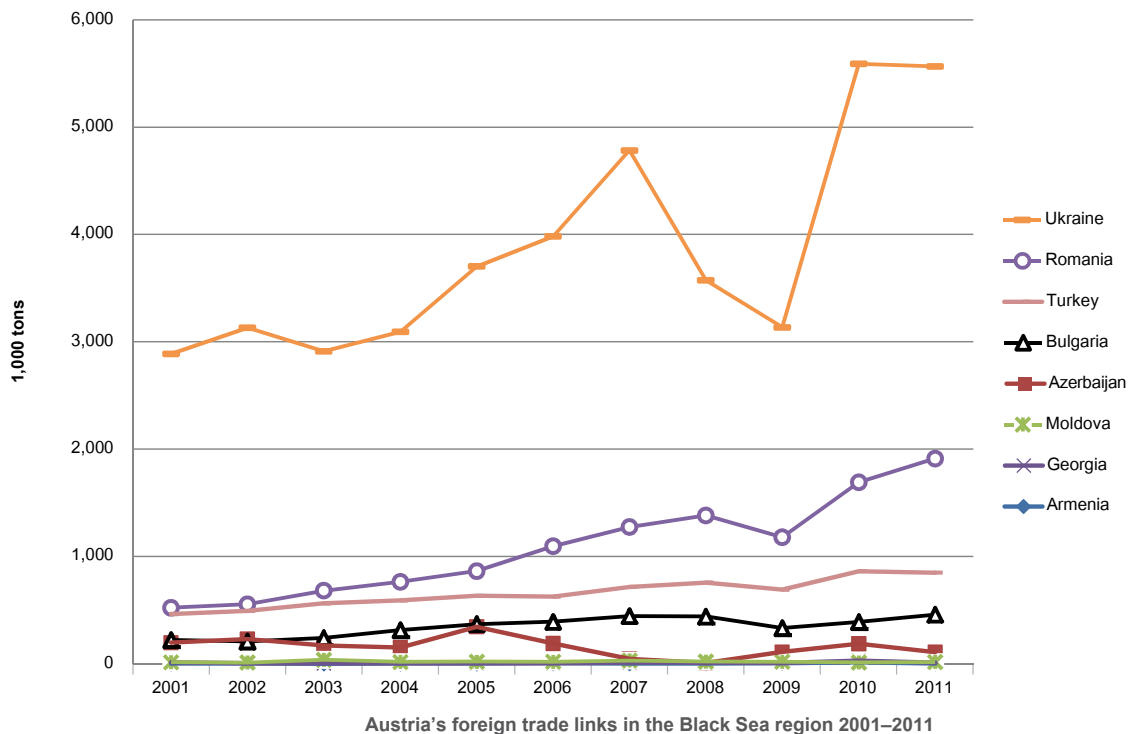
More information on the Danube Strategy can be found in the chapter “Targets and Strategies”.

According to the final report of the “Integrated Regional Program for the Black Sea Region” (Federal Ministry of Economy, Family and Youth 2010), this region encompasses Armenia, Azerbaijan, Georgia, the Republic of Moldova, the Russian Region Krasnodar (Sochi), Turkey and the Ukraine. The two EU member states Romania and Bulgaria must also be included here due to the fact that their national economies are becoming increasingly linked with the Black Sea riparian states via the seaports (e.g. Constanța, Varna).

For the European Union, the Danube represents an important link to this region. The EU Strategy for the Danube Region could open up further opportunities for cooperation with the Black Sea region. There has been a dynamic development in trade with Turkey in particular over the last few years. This country has become an important economic partner for the European Union both with respect to imports as well as exports.

### Austria's foreign trade links with the Black Sea region

With an annual trade volume of almost 7.3 million tons (imports and exports combined), the Russian Federation is by far Austria's most important trade partner among the Black Sea riparian states. However, as there is no data material that is clearly attributable to the Krasnodar




Source: Statistics Austria

## The market for Danube navigation

region, which borders the Black Sea, Russia has been purposely left out of the following diagram in order to maintain the regional focus.


As the diagram indicates, the Ukraine clearly took 1st place in 2011 with 5.6 million tons. With approximately 850,000 tons Turkey took 3rd place after the EU member state Romania (1.9 million tons). With an increase from 4.3 million tons in the year 2001 to 8.9 million tons in 2011 (excluding Russia), the total volumes handled in the Black Sea region more than doubled during the period.

Machines and vehicles, chemical products and processed goods constitute the largest proportion of Austrian **exports**, while raw materials (ores and steel from the Ukraine), foodstuffs (Georgia, the Republic of Moldova) and consumer-related finished goods (clothing) make up the lion's share of **imports**

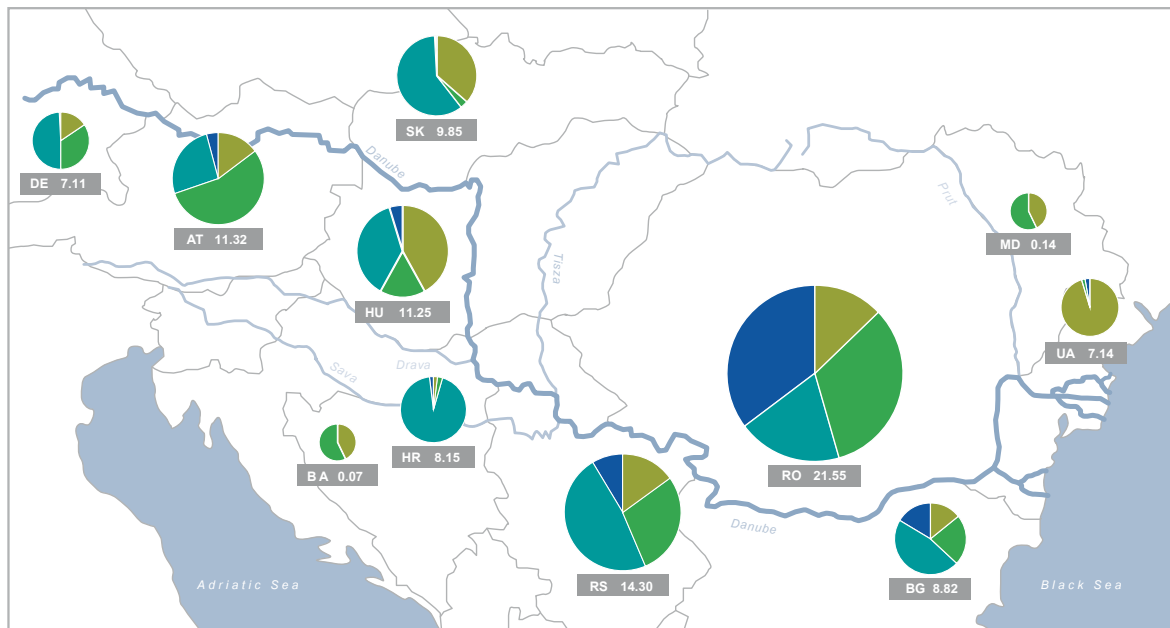
( Federal Ministry of Economy, Family and Youth 2010).

Almost a fifth of the total export volume to the Black Sea region involves the non-EU member state Turkey (2011: 480,000 million tons). Over the last few years, the country on the Bosphorus has become an important sales market for Austrian goods. This is of great relevance for Danube navigation in that the large volumes of imported raw materials (e.g. ores and coal) which are transported upstream the Danube could be evened out by exports in order to avoid empty runs of vessels. Goods transported by vessels on the Danube to the Black Sea port of Constanța and then on to Turkey by sea/short sea vessels could in fact ensure a higher **parity** of traffic on the Danube and in turn boost the overall competitiveness of Danube navigation.

### Transport volume

The latest figures available for the overall volume of goods transported on inland waterways within the Danube region date from the year 2010 ( via donau 2012). These provide a good overview of the volumes transported, major **transport relations** and the importance of Danube navigation in the riparian states.

In total, more than **43 million tons of goods** were transported on the Danube waterway and its tributaries in the year 2010. These and all the following figures include both transport by inland vessels and river-sea transport on the maritime Danube (Sulina and Kilia arm) up to the Romanian port of Brăila (river-km 170) as well as goods transported on the Romanian Danube-Black Sea Canal.



Million tons	DE	AT	SK	HU	HR	BA	RS	BG	RO	MD	UA
Export	1.12	1.67	3.60	4.73	0.16	0.03	2.17	1.27	2.78	0.06	6.82
Import	2.44	6.25	0.31	1.83	0.20	0.04	4.08	2.00	7.09	0.08	0.13
Transit	3.49	2.94	5.87	4.17	7.64	0.00	6.84	4.12	4.12	0.00	0.00
Domestic	0.06	0.46	0.07	0.52	0.15	0.00	1.21	1.43	7.56	0.00	0.19
<b>Total</b>	<b>7.11</b>	<b>11.32</b>	<b>9.85</b>	<b>11.25</b>	<b>8.15</b>	<b>0.07</b>	<b>14.30</b>	<b>8.82</b>	<b>21.55</b>	<b>0.14</b>	<b>7.14</b>

Source: via donau

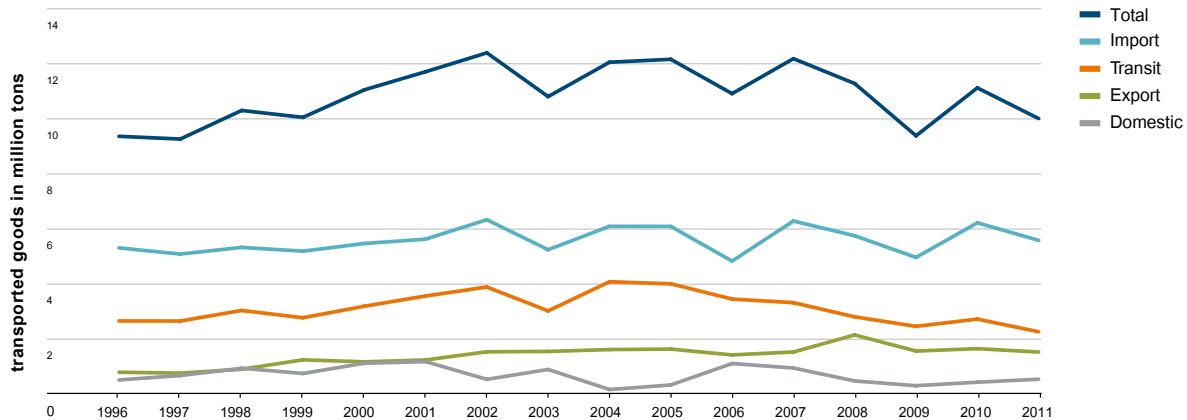
Transport volume on the Danube and its navigable tributaries in 2010

By far the largest transport volume for 2010 was chalked up by Romania with 21.6 million tons, followed by Serbia with 14.3 million tons and Austria with 11.3 million tons. The Ukraine was again the **largest exporter** on the Danube in the year 2010, which saw a total of 6.8 million tons being shipped out. Of all the Danube riparian states, Romania had the **biggest volume of imports** in the year 2010 – standing at 7.1 million tons. As far as **transit traffic** on the Danube was concerned, the largest transport volume of 7.6 million tons was registered in Croatia. Romania was again by far the most important country for **domestic transport**, with 7.6 million tons.

### Transport volume in Austria

As the following diagram shows, there has also been an upward trend in goods transport on the Austrian section of the Danube over the long term. The key contributing factor here is the **intensification of trade with the Central and South-Eastern Danube region and the Black Sea region** resulting from the gradual implementation of the EU eastern enlargement.

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Source: via donau

Transport volume on the Austrian Danube 1996–2011

Economic and financial crises have, of course, also had an impact on the transport volume on the Danube (most especially in the year 2009). Several severe periods of low water levels in the second half of the year 2011 also encumbered economic development, even bringing navigation on the **Lower Danube** to a standstill. The development of transport volume on the Danube had already been impacted by similar unfavourable water conditions in the year 2003. These pronounced periods of low water levels clearly indicate the urgent need to take action in transport policy in order to remedy the nautical bottlenecks along the Danube as quickly as possible.

Traditional **bulk cargo** (coal, ore and grain) and **liquid cargo** (predominantly mineral oil) currently account for the largest share of goods transported. It is the resource-intensive industries located in Austria that reap particular benefit from the utilisation of this bulk freight capacity and, at the same time, economical form of transport. One example of this is the voestalpine steel plant in Linz, whose supply of raw material is transported for the most part by inland vessels.

On the westbound route to the North Sea ports of Amsterdam, Rotterdam and Antwerp **semi-finished and finished products** are transported to a large extent. As far as transit traffic is concerned it is mainly the transport of **agricultural products** from Hungary, Bulgaria and Romania to Western Europe that plays a major role.

However, there is also an upward trend in the transport of **high-quality general cargo** by inland vessels on the Austrian Danube. The Danube is



also used for the repositioning of empty containers in addition to [Ro-Ro cargo](#) (new vehicles, agricultural and construction machinery etc.) and project cargo (heavy and oversized cargo).

## Market characteristics

Liberalisation and deregulation of the transport markets have made great headway within the European Union. In the Danube region, however, the political and legal framework conditions remain relatively heterogeneous due to the recent, or rather not yet concluded, accession of individual Danube riparian states to the European Union. In this respect, **greater harmonisation** is expected over the coming years and this will favour the entry of additional buyers and sellers in the market and in turn promote the opening up of new transport potential.

To date, the largest portion of goods transported on the Danube waterway originate from a few **major shippers** who deal with only a relatively small number of service providers. The **large shipping companies** are, for the most part, derived from former state-owned enterprises mainly and provide cargo space for the transport of traditional bulk goods based on long-term open policies. Smaller shipping companies and **independent ship owners** ([private vessel owner-operators](#)) often have to be more flexible in finding cargoes and for the most part serve economic niches and short-term requirements for transport services.

Transport operations are carried out on the basis of a **freight contract** (or contract of carriage) which is concluded between the consignor and the [freight carrier](#) either directly or indirectly. In the case of direct conclusion, the contract is concluded directly between the shipper and the shipping company. In contrast, there is at least one other party involved who acts as an intermediary if a contract is concluded indirectly (e.g. a [forwarder](#) or [freighting company](#)). The freight contract is concluded consensually between the parties. There is no special form required (freedom from any formal requirements).

A [consignment note](#) that serves as documentation for the transport operation is drawn up for each individual freight order. A [bill of lading](#) often regulates the legal relationship between the freight carrier and the consignee in inland navigation. The bill of lading provides the consignee with evidence of the right to receive the consignment and obliges the freight carrier to hand over the goods only on submission of the bill of lading. This transport document is customary in inland navigation and constitutes a [document of title](#), the submission of which leads to a transfer of ownership of the goods. In other words, the bill of lading functions as a certificate of receipt for the goods, as a carriage promise

## The market for Danube navigation

for the transport of the goods and a promise to hand over the goods to the legitimate owner of the bill.

The parties involved in the inland waterway transport market will be dealt with in detail in the following. The different forms of contract used in Danube navigation and the transport solutions upon which these are based will also be explained in this section.

### Supply side of Danube navigation

Logistics providers on the Danube navigation market include primarily transport companies, port and terminal operators and companies that act as intermediaries (freighting companies, forwarders).

#### Transport companies

**Shipping companies** are commercial ship transport companies that professionally organise and implement the transport of goods using their own vessels or those from other companies. They always operate several vessels. Shipping companies are distinguished by the fact that they prepare and direct transport from land (in contrast to independent ship owners who usually do not have such a “land-based organisation”).

In addition to such shipping companies, the independent ship owners – **private vessel owner-operators** – mentioned above are also active on the market. Most of these operate a single motor cargo vessel, some own up to three vessels. As a rule, independent shippers also act as captains of their own ships and do not normally run any land-based commercial offices. In many cases they are organised into co-operatives.



Further information on ports and terminals can be found in the chapter “Ports and Terminals”)



Source: via donau

Motor cargo vessel

## The market for Danube navigation

### Port and terminal operators

Ports and terminals can be operated privately or as public facilities. However, provision of the logistic services at one port or transshipment site often comprises of co-operation between private and public parties.

The transshipment and storage of goods are among the basic functions of ports and terminals. As a rule, ports also offer a whole series of logistical value added services for customers such as packing, stuffing and stripping of containers, sanitation and quality checks.

### Companies acting as intermediaries

Companies without their own fleet of vessels can also act as intermediaries for the provision of cargo space. In such cases, contracts of carriage are concluded directly.

In order to market their services, both shipping companies as well as independent shippers often use **freighting companies**. The freighter is the contract partner of the company placing the order for transport and functions as a broker for rented cargo space. As a rule, the relationship between the owner of the vessel and the freighting company is regulated by means of a subcharter. In other words, the freighter acts as both freight carrier and consignor.

**Forwarders** specialised in inland waterway transport or forwarders' specialised business units also play an important role in Danube navigation. Here too, the freight contract is concluded indirectly. The forwarding company, in its function as a service provider, concludes a forwarding contract with the shipper. The forwarding contract differs from the freight contract in that it obliges to provide the transport of the goods. The shipping company or the independent ship owner is obliged to transport the cargo. A freight contract, which is concluded with a shipping company or an independent ship owner in the name of the forwarder, but at the cost of its customer, regulates the relationship between these two parties.

**(Shipping) agencies** mostly represent several shipping companies (one for each area or freight type) and carry out all the tasks of a commercial agent on another company's behalf but for their own account. These tasks include freight acquisition, preparation of documents, invoicing, collection of charges or complaints processing. Freight contracts are in turn concluded indirectly between agents and consignors.

In practice, it is often the case in Danube navigation that the parties involved carry out several of the above-mentioned roles at the same time. A typical example would be freighting companies that sometimes also own their own cargo space.

## Demand side of Danube navigation

The demand side of the inland waterway transport market includes, for the most part, shippers, i.e. industrial companies that receive or convey goods. Although forwarders and logistics service providers are also active in carrying out transport for third parties as well.

### Traditional markets of Danube navigation

Due to the large volume of goods that can be transported on a vessel unit, inland navigation vessels are ideally suited to the transport of bulk cargo. If planned and carried out correctly, transport costs can be reduced in comparison to road and rail and this in turn compensates for longer transport times. The inland vessel is especially suitable for the transport of large quantities of cargo of low-value goods.

However the system requires the availability of high-quality logistics services along the waterway (transshipment, storage, processing, collection and/or distribution). Many companies use Danube navigation as a fixed part of their logistics chain. Currently, the great bulk freight capacity of inland vessels is utilised predominantly by the metal industry, agriculture and forestry and the petroleum industry.

Inland navigation is an extremely important mode of transport for the **steel industry**. Approximately 25-30% of the total amount of the raw material ore, for example, is transported on the Austrian stretch of the Danube. Due to their heavy weight, semi-finished and finished goods such as steel coils can also be transported economically using inland navigation.



Source: Mierka Donauhafen Krems

Transshipment of steel coils

The most important steelworks in Austria is voestalpine, which is located in Linz. This company operates a factory port on its own premises that has an

## The market for Danube navigation

annual waterside transshipment of 3–4 million tons. This is also Austria's most important port in that it has handled almost half of all waterside transshipment in Austria in recent years.

Other major steel plants in the Danube region are located in Dunaújváros/ Hungary (ISD Dunafer Group) and Galați/Romania (ArcelorMittal).

The demand and, therefore, also the flow of goods from the **agriculture and forestry sector** can fluctuate greatly from one year to the next. Agriculture is dependent to a great extent on weather conditions (precipitation, temperature, days of sunshine per year). Crop failures in a region due to bad weather conditions can lead to a fluctuation in the volume of transported goods required to cover the needs of the affected region. Grain and oilseed are the main products transported on the Danube. Although the transport of wood is also growing in importance due to the increasing demand from the processing industry and biomass plants.



Log wood

Source: via donau

Agricultural and forestry products together account for around 20% of the total volume of goods transported annually on the Austrian stretch of the Danube. Many Austrian companies trading in agricultural products or involved in the processing of such goods (i.e. starch, foodstuffs and animal fodder, biogenic fuel, log wood) have settled directly on the waterway. Many companies have already set up factory transshipment sites or have settled in a port where they operate their silos or processing facilities. This enables transport on inland vessels with no pre- or end-haulage, thereby enabling companies to benefit from particularly low transport costs.



Source: via donau

Tanker

**Petroleum products** from the mineral oil industry account for another 20% of the total transport volume on the Austrian stretch of the Danube and therefore constitute a major market. In the Danube region there are many refineries located either on or near the Danube.

Due to their great bulk freight capacity, low transport costs and high level of safety, inland vessels are predestined as a significant means of transport for petroleum products in addition to pipelines. The fuel tanks of around 20,000 cars can be filled up with the cargo of a single tanker.

Petroleum products and their derivatives are classed as hazardous goods and for this reason are transported in special vessel units equipped with the



Source: via donau

High & heavy goods transport

## The market for Danube navigation

respective safety equipment. European regulations and national hazardous goods legislation have particular relevance for tanker shipping.

### Other branch-specific potential for Danube navigation

In addition to traditional bulk cargo transport, there are numerous sectors involved in the transport of high-value goods, which, due to their specific requirements, represent a great challenge but at the same time a substantial potential for the development of logistics services along the waterway.

Due to their size and the available infrastructure, inland vessels are ideally suited for special transport such as **heavy goods or oversized loads** (“high & heavy”), e.g. construction machinery, generators, turbines or wind power plants. The greatest advantage here compared to conventional road transport is that no special modifications need to be made along route, e.g. the dismantling of traffic lights and traffic signs or protective covers for plants. Another benefit is the fact that there is no inconvenience to the general public due to street closures, restrictions on overtaking or noise when such goods are transported by inland vessel.

The Danube has also developed today to become a logistics axis of pan-European importance for the bundling, storage and processing of **biogenic**



Rapeseed

Source: via donau

(renewable) raw materials (e.g. grain, oilseed, log wood). The increasing shortage of non-renewable resources and the creation of cross-sector value-added chains that result from this (e.g. the food and fodder industry, chemical industry and energy generation sector) enable the development of new types of cargo on the Danube. Transport costs can be reduced and the negative impact on the environment minimised thanks to targeted improvement in logistic



Source: via donau

Construction material

services available on the Danube (port infrastructure, special transhipment equipment) and the operation of inland vessels along the resource-intensive value-added chains. This entails the necessity of logistics chains that meet the high requirements of the respective goods.

A favourable development can also be expected in Central and South-Eastern Europe as far as the **construction material industry** is concerned. This is due mainly to the high requirements of renovating and expanding the infrastructure, although structural and civil engineering as well as residential construction also play a significant role. The resulting transport volumes and growing exchange of goods with South-Eastern Europe suggest a high potential for inland navigation. Inland vessels could be used here for both bulk



Source: EHG Ennshafen GmbH

Transhipment of waste paper



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Source: via donau

New cars on board an inland vessel

cargo (e.g. [mineral raw materials](#)) as well as general cargo (e.g. construction materials, construction machinery).

Inland vessels come up trumps where the **paper industry** is concerned, thanks to their low transportation costs over long distances and the fact that it can be integrated so easily in [multimodal](#) logistics chains. Finished and semi-finished products (paper, carton, cardboard) as well as raw, additional and auxiliary materials (log wood, waste paper, bulking agents and pigments) are among the goods transported for the paper industry. Paper products, in contrast to many other bulk cargo, are sensitive logistics goods which place high demands on transport, storage and transshipment.

Strategies such as [just-in-time](#) or [just-in-sequence](#) are among the determin-



Source: via donau

Storage of chemical products

ing factors for success or failure in the **automotive industry**. Due to their long transport times inland vessels only play a role in the logistics chain here where the transport of less time-critical components is concerned. However, specific carrier potential can be exploited (high transport capacity, low transport costs) with the use of Ro-Ro vessels for the transport of new vehicles due to the high concentration of production plants in the Danube region (e.g. in Slovakia and Romania).

Another major sector is **fertilisers**, which are currently being transported in large quantities on the Danube. These account for approximately 10% of the total transport volume on the Austrian stretch of the Danube. Plants from the **petrochemical industry** are often found in the immediate vicinity of refineries; these plants manufacture plastics and other oil-based products from the oil derivatives. Due to its great bulk freight capacity Danube navigation is also the ideal solution for this market segment. However, economical concepts for **pre- and end-haulage** are required here. **Combined transport** represents an attractive alternative for integrating the inland vessel into the logistics chain of the chemical industry in addition to the construction of warehouses for bulk cargo.

**Used materials and waste** are bulk goods of relatively low value and are therefore not usually associated with time-critical transport. Because of these characteristics, inland navigation is an interesting alternative to road and rail for waste management. In principle, all waste material can be transported by inland vessels, regardless of whether it is in the form of bulk cargo or containers. The major urban areas located directly on the Danube (e.g. Vienna, Bratislava, Budapest and Belgrade) are reliable suppliers of waste metal, household refuse and other waste materials. Energetic utilisation by waste power plants is leading to an additional demand for the transport of waste.



Source: via donau

Scrap

## The market for Danube navigation

### Types of contract and transport solutions

Transport companies offer cargo space either in its entirety (full load) or as part of the available cargo hold (part load). However, the freight contract concluded with the client can also apply to the transport of individual “packages”. This is known as general cargo transport. The transport of heavy and oversized goods (project cargo) differs from traditional shipping of general cargo primarily due to the need for special vessel and transshipment equipment and long-term transport planning.

Conventional bulk cargo transport on the Danube usually takes the form of **contract trips**, i.e. several trips on the basis of a contract for a specific period of time. Contract trips are often agreed for a longer period in the form of an annual contract. Such types of transport have the following features:

- An agreed annual total quantity, whereby the time of the transport operations involved as well as the size of the part deliveries is not specified (this allows for the prevention of goods being transported during low-water periods)
- Transport of full loads by motor cargo vessels or pushed convoys
- More generous timeframes regarding arrivals and departures
- Transport of the goods between one port of loading and one port of **discharge**
- Involvement of just one consignor and one consignee

In addition to contract trips, inland waterway transport is also carried out on the **spot market** (days' trading), i.e. on the basis of a freight contract concluded for individual trips or cargoes in compliance with current prices. **Spot transport** has the following features:

- Conclusion of a freight contract (contract of carriage) applicable to a full, part or package good load
- Specification of fixed delivery times (in part involving contractually agreed payment of penalties)
- Fiercer competition before conclusion of the contract, because several quotes from different transport companies are generally obtained at short notice
- Regular involvement of several parties (e.g. forwarders, agencies)

Decreasing shipment sizes and an increasing number of suppliers and customers means that a high degree of punctuality and reliability with regard to departure and arrival times is expected. **Multimodal liner services** offer a solution in this case. Like passenger ships or regular-service buses, the cargo vessels of a liner service travel according to a fixed timetable to specific ports in which the cargo is generally transhipped for further transport by road or rail.



Sample calculations can be retrieved in the section “Market and Organisation” at [www.ines-danube.info](http://www.ines-danube.info).

The flexibility in the formation of pushed convoys enables the simultaneous transport of different types of goods (e.g. rolling goods, containers or bulk cargo) and helps to counterbalance disparity of traffic, i.e. different transport volumes on the route travelled.

Liner services on a waterway are distinguished by the following features:

- Regular departure and arrival times according to a fixed timetable
- Accessibility for all players in the market
- Possibility of shipping part loads (e.g. 10 containers)
- Concept for adhering to the timetables even in the event of nautical restraints (replacement services by rail or road could be necessary)

## Business management and legal aspects

Shippers and [logistics service providers](#) always select the mode of transport based on the **price-performance ratio** for each individual consignment. Planning ability, reliability, transport duration and the handling of transport damage are regarded as the primary components of such performance.

This section provides an overview of the individual parts of the **transport cost calculation** for the inland vessel and includes a detailed description of the most important legal regulations pertaining to inland waterway transport. It is intended to offer a brief overview of the latest legal framework conditions applicable for Danube navigation.

### Basic principles of an inland navigation calculation

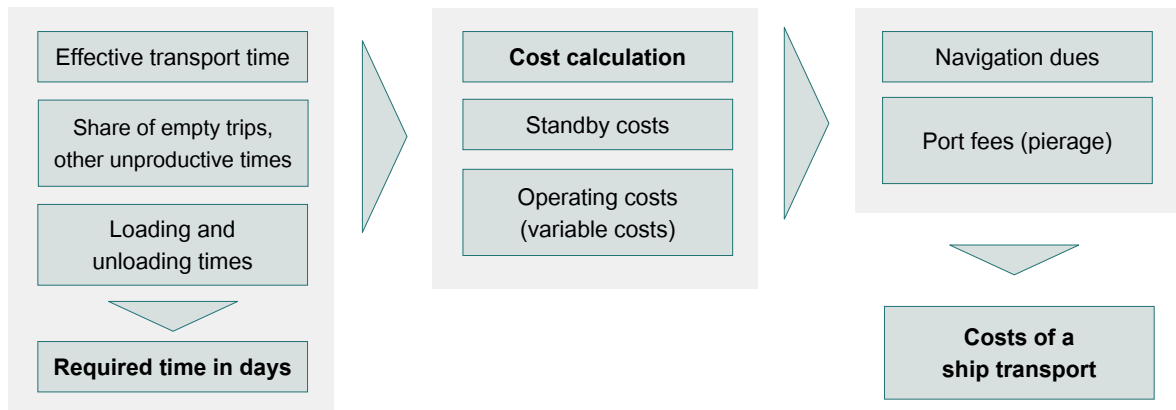
A difference is generally made between two types of costs for a transport by inland vessel, depending on whether the costs are fixed or variable: **Standby costs** and **operating costs** are both types of costs which are dependent to a large extent on individual factors and framework conditions such as the [bunker costs](#) or maximum [draught loaded](#), and therefore need to be calculated, as far as possible, on the basis of current values. The composition of the fleet and the organisation behind it also play a key role here.

The following chart illustrates the cost structure of an inland waterway transport from the port of departure to the port of discharge excluding the costs for transshipment, pre- and end-haulage.

As limiting factors, both the draught loaded and the maximum available cargo space volume play a key role when planning a transport.

Where inland waterway cargo transport is concerned, the available [fairway](#) depth and, therefore, the **possible draught loaded** of a cargo vessel is a decisive economic criterion in shipping operations. A fairway depth of 10 cm,

## The market for Danube navigation



Schematic overview of the cost calculation

Source: via donau

for example, corresponds to a load of between 50 and 120 tons, depending on the size of the cargo vessel used. Higher draughts loaded, and therefore better **load factors** of the vessels used, reduce transport costs per ton drastically. For this reason, the continuous availability of suitable fairway depths is a decisive factor for the competitiveness of inland navigation. In the case of long-haul traffic, critical fairway locations are not reached for five to ten days. As it is difficult to predict water levels, the possible draught loaded during loading (departure) of the vessel cannot be determined exactly and a safety margin is therefore usually necessary. The safety margin is based on the empirical values of the shipping company.

In addition to the actual possible **immersion depth**, the shipping company must also determine whether the **maximum available cargo hold volume** is sufficient to take the planned size of the cargo. The **specific weight** of the cargo indicates the ratio of the weight force to volumes and therefore also the utilisation of the available space in the cargo hold.

### Calculation of transport times

The **effective transport time** is determined by the speed of the vessel, the flow velocity of the body of water as well as the number of locks and time spent for lockage. Lockage from Vienna westwards generally takes approximately 40 minutes or downstream from Vienna eastwards approximately 1.5 hours.

The following **table of travel times**, which takes the Austrian Danube port of Linz as the start and end point, has been calculated for typical types of vessel or convoy using the travel times for the most important routes in the Danube Corridor. The calculated durations include times for lockage but exclude intermediate stops at ports, delays caused by unfavourable nautical conditions and waiting times at borders. The mode of operation for all types of vessel

	Travel time in hours				Distance in km	Port	Number of locks	Travel time in hours			
	4-unit pushed convoy	2-unit pushed convoy	Motor cargo vessel 2,000 tons	Motor cargo vessel 1,350 tons				Motor cargo vessel 1,350 tons	Motor cargo vessel 2,000 tons	2-unit pushed convoy	4-unit pushed convoy
		174	161	172	1454	Ghent	62	159	149	165	
		170	157	168	1419	Antwerp	61	155	145	161	
		163	151	160	1325	Amsterdam	61	149	140	154	
		163	151	161	1336	Rotterdam	58	147	138	152	
		145	135	142	1119	Duisburg	58	135	127	141	
		119	113	113	835	Mainz	58	119	111	125	
		115	109	109	808	Frankfurt	56	116	108	122	
		43	41	41	380	Nürnberg	17	55	47	55	
		26	25	25	280	Kelheim	8	39	31	39	
		23	22	22	242	Regensburg	6	33	26	34	
		14	13	13	153	Deggendorf	4	21	17	21	
					0	Linz	0				
	2	2	2	2	19	Enns	1	3	2	3	3
	7	6	6	6	73	Ybbs	3	10	8	10	11
	13	10	10	10	133	Krems	4	17	14	17	19
	20	17	17	17	211	Vienna	7	27	22	27	30
	26	22	22	22	263	Bratislava	7	36	30	37	41
	42	37	37	37	491	Budapest	8	60	51	61	70
	51	45	45	45	652	Baja	8	75	63	76	88
	61	54	54	54	798	Vukovar	8	90	76	91	106
	67	60	60	60	878	Novi Sad	8	99	85	100	117
	73	65	65	65	978	Belgrade	8	109	93	110	128
	98	88	88	88	1340	Vidin	10	142	120	140	164
	115	103	103	103	1639	Giurgiu	10	167	140	163	191
	135	121	121	121	2007	Reni	10	197	164	192	224
	142	128	128	128	2131	Sulina	10	208	173	201	236
	133	120	119	120	1891	Constanța	12	190	159	185	216
	139	125	125	125	2074	Izmail	10	203	169	197	231
	141	127	127	127	2120	Kilia	10	207	172	200	235

Direction

Direction

Source: via donau

Table of travel times from/to Linz

## The market for Danube navigation

and convoy is considered as continuous navigation for 24 hours a day with the exception of the 1,350 ton motor cargo vessel, which is usually operated for 14 hours a day.

**Empty trips** occur primarily due to disparate traffic, i.e. transport of goods that takes place in only one direction – upstream or downstream. However, they may also occur due to different transport flows between two areas. Another key reason for empty trips is the fact that the loading and unloading ports for subsequent transports are often far apart. Empty trips can vary according to the different sections of the route or the different companies and are incorporated into the transport time as surcharge rates.

**Other unproductive times** occur due to unplanned waiting caused by lightening (i.e. when the cargo of a ship has to be divided among several vessels due to shallow water) or due to suspensions of navigation in the case of ice or high water levels.

**Loading and unloading times** vary greatly from one case to another. They depend on the transshipment facilities and their availability at the respective ports.

### Cost categories

The following **ship parameters** should be taken into account and calculated on the basis of current values when working out the cost of a ship transport.

- Size and capacity of the vessel as well as draught and possible draught loaded (maximum dimensions in accordance with the waterway class)
- Age and condition of the ship to be used
- Flag under which the ship is registered
- Operator structure (independent ship owner, shipping company)
- Mode of operation (operating time 14, 18 or 24 hours a day)
- Crew (number, qualification, kind of contract)

**Standby costs** are the costs for maintaining a vessel ready for use not taking operating costs into account and that fall due even while the vessel is standing still. These include, for example, crew wages, maintenance and repairs, amortisation of the vessel or interest and insurance.

**Operating costs** are costs incurred during operation of the vessel, i.e. dependent on the number of kilometres or hours travelled. These include, for example, bunker and lubricant costs, commission for brokering the contract or dues and fees.

Inland vessels are normally driven by combustion engines and use gasoil as fuel. Average **fuel consumption** is dependent on three factors: the utilisation



More information concerning the Danube Commission and the Belgrade Convention can be found in the chapter “Targets and Strategies”.

of the vessel (due to loading limitations), the parity of traffic (empty trips) and the prevailing fairway depths ([shallow water resistance](#)). Nautical conditions ([impounded sections](#), free-flowing sections, characteristic current velocities) also have a great impact on fuel consumption in each individual case. Fuel prices are linked to the price of oil and can therefore fluctuate considerably.

As the section of the Danube from Kelheim to Sulina is defined as an international waterway, in compliance with the “Convention Regarding the Regime of Navigation on the Danube” dated 18th August 1948 (“Belgrade Convention”), and can therefore be used free of charge by navigation, it is not subject to any **navigation dues**.

The 63-km-long Sulina Canal used almost exclusively by sea-river or seagoing vessels is an exception. The Romanian River Administration of the Lower Danube charges dues calculated per ton deadweight of a vessel for maintenance purposes.

The authorities charge dues for infrastructure maintenance on national waterways that do not fall under the Belgrade Convention. Such waterways include the Ukrainian Bystroe arm (maritime stretch of the Danube), the Romanian Danube-Black Sea Canal (links the Danube to the Black Sea and the seaport of Constanța at Cernavodă) and the German Main-Danube Canal.

**Port fees** are charged for the use of the port basin and also frequently for waste disposal, power connections or drinking water supply, and are calculated according to the volume of transhipped cargo.

### Operative cost management

Full-costing systems for calculating the daily rates for keeping a vessel on standby are traditionally widespread in inland navigation. This entails registering and adding up of all periodic individual and overhead costs – e.g. costs for the crew, amortisation and insurance – and dividing the total by the number of operating days in the given period. Costs calculated in this way are called daily standby costs and are average values or **fixed costs** incurred independent of the contract.

In addition, operating costs per travelled hour are charged for specific routes and types of vessel. These are **variable costs** that can be added to each individual contract. Variable vessel costs include:

- Fuel and lubricant costs
- Costs for non-permanently employed crew members, e.g. temporary workers
- Costs that vary depending on the route, e.g. pilot costs
- Commissions for brokering the contract



## The market for Danube navigation

- Levies and dues, e.g. navigation dues or port fees
- Costs for cleaning the vessel

A contract is not accepted on principle unless the standby and operating costs, i.e. the fixed and variable costs, are covered and a profit over and above this amount can be generated. If no such contract can be found for a vessel, a transport price can also be accepted if it is higher than the variable costs but lower than the fixed costs. This means that at least a sum can be achieved that will cover the fixed costs, the so-called **contribution margin**. Any commercial activity will only increase losses if the transport price is lower than the variable costs.

### Legal regulations and agreements

As the majority of transport on the Danube waterway involves cross-border transport, international agreements play a vital role in the structuring of concluded transport contracts and the contractual and liability aspects involved. The following section looks in detail at three international agreements that have a great impact on inland waterway transport.

The **Budapest Convention on the Contract for the Carriage of Goods by Inland Waterway (CMNI)** is an international convention that harmonised the legal provisions governing contracts for the cross-border transport of cargo on inland waterways for the very first time. The convention was concluded on 22nd June 2001 under the patronage of the Central Commission for the Navigation of the Rhine, the Danube Commission and the United Nations Economic Commission for Europe and came into force on 1st April 2005 (Central Commission for the Navigation of the Rhine et al. 2000). The convention applies to all contracts of carriage for transporting cargo by inland waterway where the port of loading or the port of discharge is located in a state that is party to the convention. It regulates the general rights and obligations of the contractual parties, primarily those of the freight carrier, the consignor and the consignee. In general, the convention includes regulations pertaining to

- the type and content of the transport documents,
- the liability in the event that the cargo is lost or damaged during transport as well as
- the circumstances and situations that allow exemption from liability.

All Rhine and Danube riparian states, with the exception of Austria and the Ukraine, have ratified the Budapest Convention. From a purely legal point of view, only transport operations between these two states as well as domestic transport in these states do not fall under the regulations of the convention. In all other cases, either the loading port or the discharge port is located within

the CMNI area in which the regulation applies.

The **Bratislava Agreements** are a collection of contracts under private law whose purpose is to regulate the cooperation among [shipping companies](#) operating on the Danube. Among these, the **Agreement on General Conditions for the International Carriage of Goods on the River Danube** is of particular importance. This regulates the rights and obligations of shippers and shipping companies in connection with the carriage of goods. Although the formally prescribed customer order sheet for transport is still provided for in the agreement, this no longer has any bearing on day-to-day practice. The most important regulations of the agreement pertain to the drawing up of transport documents, the accepting and handing over of the cargo to be transported, loading and unloading of vessels, calculating freight charges, liability, impediments to contract performance, the exercise of rights of lien and dealing with complaints. In recent years the regulations of the Bratislava Agreements have increasingly receded into the background giving way to the CMNI.

The transport of hazardous goods by inland vessel is regulated by the **European Agreement Concerning the International Carriage of Dangerous Goods by Inland Waterways (ADN)** ( United Nations Economic Commission for Europe 2008). This agreement encompasses all hazardous goods and specifies whether or not these can be transported by inland vessel. There are special regulations for the approved hazardous goods concerning the following points:

- The classification of the goods, including allocation criteria and review procedures
- The use of packaging, tanks and containers for bulk cargo
- Shipping procedures (e.g. marking and labelling)
- Regulations concerning the loading, transport, unloading and other handling of goods
- Regulations concerning a ship's crew, equipment, operation and documentation
- Regulations for shipbuilding

## The market for Danube navigation



Source: via donau

Transshipment of concrete sections in Bad Deutsch-Altenburg

### Success stories in Austria

#### Wind power plants on board of vessels – environmental friendly transport for clean energy

A special project launched at the transshipment site of Bad Deutsch-Altenburg in the year 2011 now ensures the supply of parts and components to a neighbouring wind park. The companies Mierka Donauhafen Krems and Prangl organize the transshipment of turbine components on the transshipment site belonging to via donau east of Vienna.

Concrete sections of the towers for the wind turbines are unloaded along a 100-metre transshipment point. One to two inland vessels arrive every week. Ideally, each vessel can transport a complete 135-metre high tower comprising of around 50 concrete sections with a total weight of 1,600 tons.

Transshipment is effected by a mobile 400-ton caterpillar crane. The parts each weigh between 20 and 52 tons and are either loaded directly onto special trucks or held temporarily in special storage areas. Delivery by ship and unloading is generally carried out step-by-step taking around two days to completely discharge each vessel.

Utilisation of the transshipment site in Bad Deutsch-Altenburg means that the parts can be transported almost to their final destination by means of environmentally-friendly inland vessels. In doing so, the use of road to transport the parts to the wind farm – around 100 special transport operations per wind turbine – has been reduced to a minimum.



Source: LINZER AGRO TRADE GmbH

Location of LINZER AGRO TRADE GmbH

### LINZER AGRO TRADE utilises the advantages of Danube navigation

LINZER AGRO TRADE GmbH is one of Europe's leading wholesalers for fertilizers. Around 1.2 million tons of fertilizers a year are produced at its headquarters in Linz. The main focus of the company's business is the Danube region. Inland waterway transport is the best option for transporting the granulated fertilizers economically as bulk cargo. Its distribution network is also governed by this principle with almost all storage locations to be found along the Danube.

Around 700,000 tons of fertilizers a year are currently transported on the Danube waterway: about half of this is shipped via the Main-Danube Canal to Germany and France and the other half goes to the Central and South-Eastern European market.

The demand for fertilizers fluctuates greatly according to the season and is at its highest between the months of February and May. Transport must be carried out in advance and storage locations filled in order to cover demand.

Growth potential for the fertilizer industry is to be found primarily in the South-Eastern European states with their extensive areas of agricultural land. The demand for fertilizers is expected to rise hand-in-hand with the increasing of efficiency in the agricultural sector. This in turn will result in the need for new storage facilities along the Danube.

## The market for Danube navigation



Source: via donau

Conveyor in Pischelsdorf

### From ship to power plant on the conveyor

A conveyor was put into operation in 2010 that connects the transshipment site in Pischelsdorf to the Dürnrrohr power plant. The companies Donau Chemie AG (as the operator of the transshipment site), EVN AG and VERBUND-ATP formed a cooperation to finance the sustainable project. The new conveyor ensures the environmentally-friendly supply of coal to the power plant.

The coal is first unloaded from the inland vessel at the site with a crane, then dumped into a loading hopper which in turn discharges it to a feeding conveyer. Separated from metal and impurities, the coal is loaded onto the conveyer where it sets off on its 3.2-kilometre route to the power plant.

Around 2 million tons of coal per year can now be transported with a maximum conveyor capacity of 660 m<sup>3</sup> an hour. In order to minimise dust and prevent the loss of material the conveyer is designed in such a way that it is transformed into a tube at its feeding point and does not open up again until shortly before the open storage site at the power plant. It is planned that around half of the coal required by the Dürnrrohr power plant will be delivered in the long term by inland vessels. This means that the end haulage from the transshipment site to the coal storage location directly at the power plant is virtually CO<sub>2</sub> and NO<sub>x</sub> neutral.

Regular transport operations have been carried out from the transshipment site to the power plant since April 2010. Donau Chemie, as the operator of the port, has expanded the unloading capacity of the transshipment site and also procured Austria's largest mobile excavator to handle the transshipment of the coal. EVN and ATP were responsible for the installation of the pipe conveyor from the transshipment site to their location.

### Automotive logistics with inland vessels

New vehicles/cars have been transported regularly on the Danube since 1997. As one of Europe's largest providers of automotive logistics, BLG LOGISTICS utilises the advantages of Danube navigation for its multi-modal transport.

New Mitsubishi, Ford und Renault vehicles are transported from Kelheim to Budapest on two motor cargo vessels. On the way back, Suzuki cars are transported from Budapest to Kelheim. The Suzuki vehicles constitute the framework of Danube transport, as the downstream trips avoid empty runs which in turn increases the cost efficiency of waterway transport. There is a regular timetable with two departures a week. Runs may be added or cancelled at short notice in order to respond quickly and flexibly to sector-specific fluctuations in demand. Intermediate stops at other ports are arranged on request.

The motor cargo vessels used have three decks and can load 200 to 260 cars depending on the type of vehicle. The vehicles are loaded on and unloaded from the vessel via a bow ramp lowered onto the Ro-Ro ramp of the port.

BLG LOGISTICS uses Danube navigation due to the low transport costs, the environmental-friendliness of this mode of transport ("green logistics") and the high quality of the transport. Around 250,000 new vehicles had already been transported on the Danube by the beginning of 2012.



Source: via donau

The motor cargo vessel Kelheim in Ro-Ro operation

## The market for Danube navigation

### Logistical utilisation of RIS by Industrie-Logistik-Linz

The company Industrie-Logistik-Linz (ILL) has taken on a pioneering role in the utilisation of **River Information Services (RIS)** for the planning and handling of inland waterway transport. River Information Services were conceived with the aid of European funding, and in close cooperation with *via donau*, with the aim of networking all companies in the logistics chain of transport electronically (e.g. shipping companies, port/terminal operators) thus making data exchange simpler.

With the aid of the so-called TES service (Transport Execution Status), ILL can access the current transport status of the inland waterway transport of an order. This also includes cargo-related information (type and quantity), the estimated arrival time at the port of destination as well as position and vessel data.

In addition, ILL uses the DoRIS value-added services which it links with its in-house system “i-logistics”. In doing so, the latest water levels and operating status of locks for the Austrian stretch of the Danube provided by *via donau* can be displayed both in table form and graphically on a chart.

Combined with the position and cargo data, this allows ILL to optimise and enhance the management of the transshipment including all the resources and infrastructure this requires. It also enables the calculation of the stock levels for a specific period of time.



The i-logistics system of Industrie-Logistik-Linz