READER – DANUBE NAVIGATION – MARKET AND STRENGTHENING OF THE WATERWAY

Extract of relevant passages from the „Manual of Danube Navigation", viadonau (2019) and the „Annual Report 2018" from viadonau

Pictures: viadonau in Manual on Danube Navigation (2019), p. 79, 106

The following introductory chapter provides an overview of the system of Danube navigation, its characteristic features and its relevance for the European transportation system. The aspects outlined here will be described in detail in the individual chapters of this manual.

Transport policy framework

In addition to the goal of ensuring a high quality of accessibility, **the European and national transport policies** are increasingly striving to create preconditions for sustainable and energy-efficient transport. Inland navigation can make an important contribution in this regard: because it is environmentally friendly, safe and has plenty of spare capacity.

In order to strengthen the role of inland navigation in an integrated transport system, the European Union has therefore published a second **Action Programme for the promotion of Inland Waterway Transport (NAIADES II)** for the period 2014–2020 (European Commission, 2013a). Accompanying the programme is the **Staff Working Document Greening the Fleet**, which sets out a framework to reduce pollutant emissions caused by inland navigation (European Commission, 2013b).

Moreover, work is under way to define the **Good Navigation Status**, which is intended to provide a uniform definition for good navigation status and its measurability for European waterways in class IV and above (European Commission, 2018a).

The European Union **Strategy for the Danube Region** provides an important framework for development activities (European Commission, 2010b).

At national level, the transport policies are set out in **integrated transport strategies** or in specific **action plans**, which refer to the above-mentioned political programmes at a European level. **The Action Programme for the Danube** by the Austrian Ministry for Transport, Innovation and Technology creates a framework for developments in the areas of inland navigation, ecology and flood protection until 2022 (BMVIT, 2015).

One of the primary objectives of the coming years will be to use the national and European programmes and strategies in order to enhance and modernise navigation on the Danube.

System elements of Danube navigation

Inland navigation needs to be understood as a system of strongly interrelated individual elements. The system elements of Danube navigation are the Danube **waterway**, the **ports** as hubs to connect with the transport modes road and rail, as well as the **vessels** and their cargo (types of cargo). The potential of inland navigation will only be fully utilisable if all elements within the system interact smoothly.

Danube waterway

The Danube rises in the Black Forest in Germany and empties into the Black Sea in Romania and the Ukraine. The river has a **length of 2,845 km** – just under 2,415 km of which are navigable – and connects ten riparian states. The Danube has been a significant European trading route since early history. It is also an important source of energy and drinking water, as well as a precious and unique recreational space and habitat.

Strengths and weaknesses of Danube navigation

The principal **strengths** of Danube navigation are the ability to transport 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 and can provide a high degree of safety and low infrastructure costs.

The **weaknesses** lie in its dependence on fluctuating fairway conditions and the consequent, varying degree of the vessel load factor, the low transport speed and network density, which often necessitate pre- and end-haulage by road or rail.

The **opportunities** of Danube navigation are the high free capacities of the waterway, international development initiatives such as the Strategy for the Danube Region, the internalisation of external costs at European level, cooperation with road and rail, as well as the use of modern and harmonised River Information Services (RIS).

The **threats** to Danube navigation are found in the different political and hence budgetary importance assigned to this transport mode in the individual Danube states, as well as in the need to modernise many Danube ports and parts of the Danube fleet.

STRENGTHS	WEAKNESSES
• Low transport costs • Bulk freight capacity • Environmental friendliness • Safety • Availability around the clock • Low infrastructure costs	• Dependence on variable fairway conditions • Low transport speed • Low network density, often requiring pre-/end-haulage
OPPORTUNITIES	**THREATS**
• Free capacities of the waterway • Rising demand for green transport modes • Modern and internationally harmonised information services (RIS) • Cooperation with road and rail • International development initiatives (e.g. Strategy for the Danube Region)	• Inadequate maintenance of the waterway in some Danube riparian countries • Administrative barriers lead to competitive disadvantages (e.g. time-consuming/expensive checks) • High requirement to modernise the ports and fleets

Source: viadonau

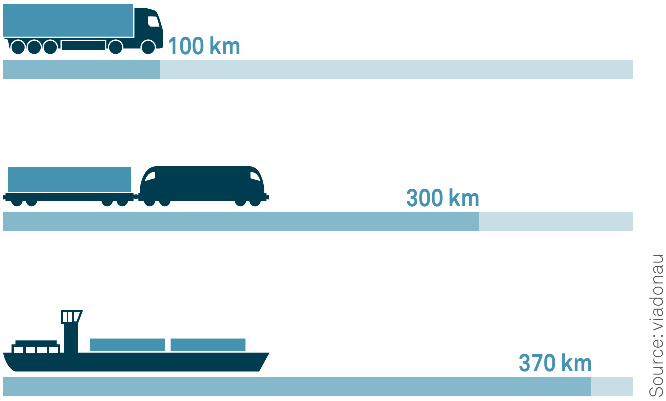
SWOT analysis of Danube navigation

Danube navigation compared to other transport modes

Some facts speak clearly in favour of inland navigation in comparison with other transport modes: For instance, it has the lowest specific energy consumption and the lowest external costs of all inland transport modes. In addition, it has a high bulk freight capacity and low investment requirements for maintaining and expanding the infrastructure.

Specific energy consumption

In regard **to specific energy consumption**, inland navigation can be described as the most efficient and hence environmentally friendly transport mode. Inland vessels can transport one ton of cargo almost four times as far as a truck with the same energy consumption.



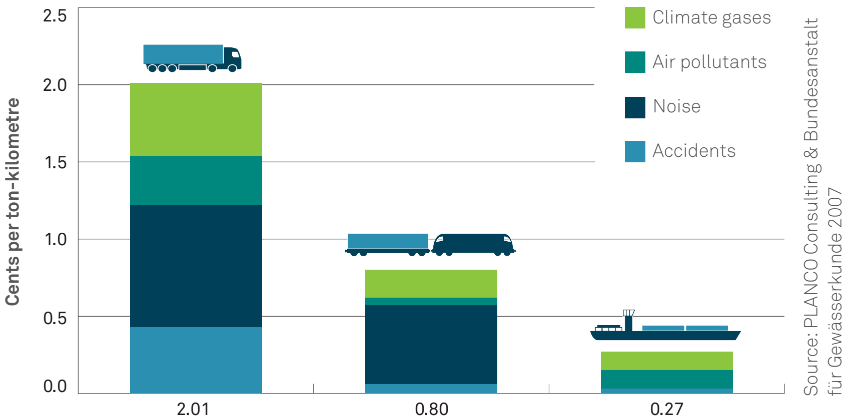
Transport distances for one ton of cargo requiring the same amount of energy

External costs

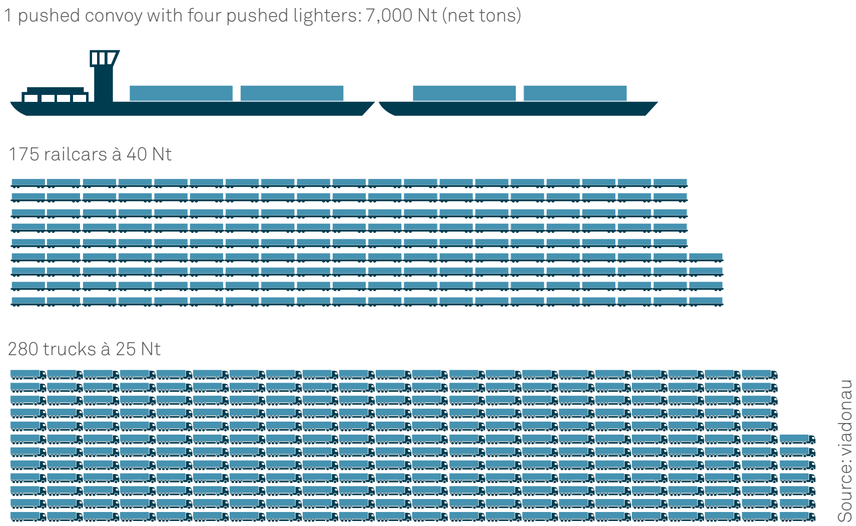
Inland navigation also accounts for the lowest **external costs**, so those costs associated with climate gases, air pollutants, accidents and noise. CO_2 emissions are comparatively low in particular, which means that inland navigation can contribute to achieving the European Union climate targets.

Bulk freight capacity

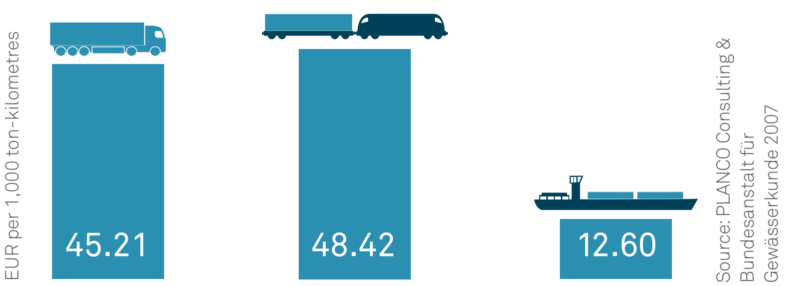
Compared to other land transport modes, Danube navigation offers a significantly higher **transport capacity per transport unit**. For instance, a single convoy with four pushed lighters can transport around 7,000 tons of goods – equivalent to the cargo carried by 175 railcars (with 40 net tons each) or 280 trucks (with 25 net tons each). Hence, increasing cargo transport on the Danube means a significant reduction in congestion, noise emissions, environmental pollutions, road accidents and the burden on the rail system.



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



Inland vessels beat rail and trucks for transport capacity



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

Infrastructure costs

Infrastructure costs are comprised of the **costs for building and maintaining transport routes**. As in most cases it is possible to make use of the inland waterways as natural infrastructure, the infrastructure costs are low for inland navigation. Detailed comparisons with land transport modes in Germany are available: They indicate that the infrastructure costs per tonne-kilometre for road and rail are four times higher than for waterways (PLANCO Consulting & Bundesanstalt für Gewässerkunde, 2007).

Current cost estimates of infrastructure projects in the riparian states suggest that improving the complete infrastructure of the 2,415 km Danube waterway would cost 1.2 billion Euros in total. This is more or less equivalent to the costs of constructing around 50 km of road or rail infrastructure. Current European rail tunnel projects each cost 10 to 20 billion Euros.

Relevance of Danube navigation

Danube waterway transport in a European comparison

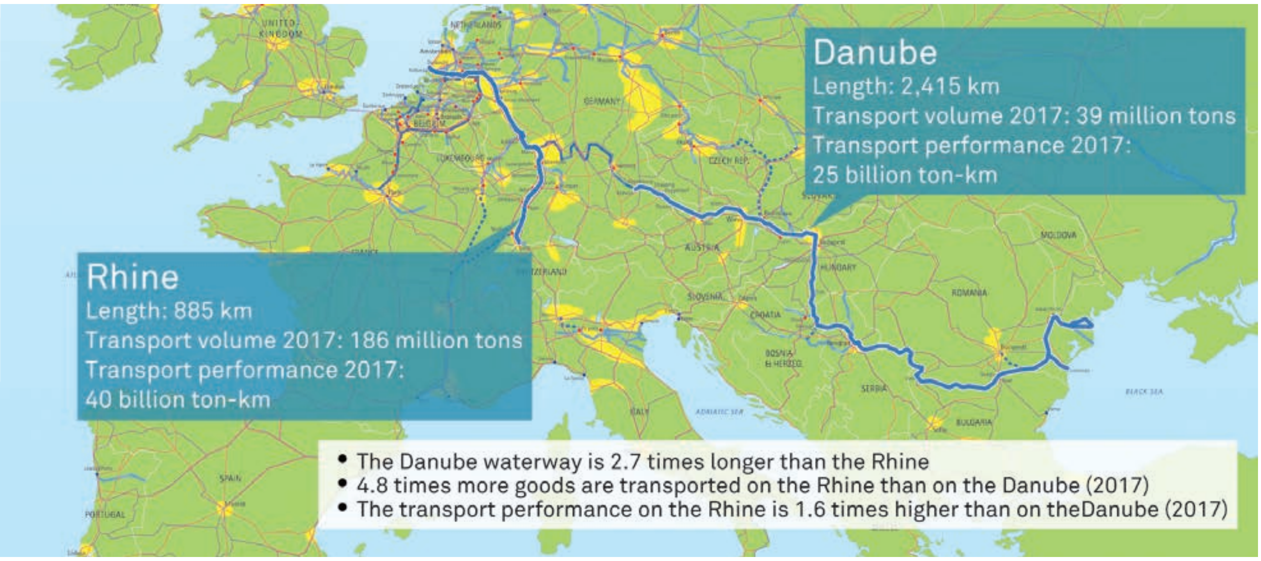
Statistical data for the EU-28 countries were taken from the online database of Eurostat, the statistical office of the European Union: ec.europa.eu/eurostat; this comprises of estimated and preliminary values. Values for the Danube region are based on enquiries by viadonau, which were conducted on the basis of national statistics.

In total, 558 million tons of goods were transported on **the inland waterways of the European Union** in 2017. The transport performance was 147 billion ton-kilometres. Accordingly, the average distance of waterway freight transport was 263 km.

The **Main-Danube Canal** creates an important basis for the 3,500 km, central Rhine-Main-Danube inland waterway, which extends through all of European mainland from the Port of Rotterdam on the North Sea to the Seaport of Constanţa on the Black Sea. With a transport volume of 186 million tons, the **Rhine** has significantly higher utilisation than the **Danube**, which was used to transport 39 million tons in 2017. Nonetheless, goods are transported for longer distances on the Danube, as shown by the transport performance for these two key European waterways: 25 billion ton-kilometres on the Danube (mean transport distance approx. 600 km) compared to 40 billion ton-kilometres on the Rhine (mean transport distance approx. 200 km).

If one considers the **transport volumes** along the Danube waterway and its navigable tributaries **in the individual Danube riparian states**, by far the largest transport volume for 2017 was recorded by Romania with 19.1 million tons, followed by Serbia with 12.5 million tons and Austria with 9.5 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 5.8 million tons in 2017, whereby the majority was transported via the Sulina Canal.



Source: viadonau, Central Commission for the Navigation of the Rhine

The European inland waterways Rhine and Danube in comparison

Modal split

In the **28 countries of the European Union**, waterways made up a 6.0% share of the modal split in 2017 – which means that 6.0% of all freight ton-kilometres were handled on waterways. This share differs sharply in the individual EU states. The Netherlands, for instance, 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 28 EU countries (44.7% in 2017).

The infrastructural circumstances in the **Danube region** are different: Goods transport by waterway is concentrated on one main river. While it is able to transport very large quantities of freight to some extent, the small number of branches also means that it can only be used in focused regional areas. The Danube is therefore confined to a limited form of transport requiring longer pre- and end-haulage by road and rail. This is why the waterways tend to account for a smaller share of the national modal split in the countries of the Danube region.

Danube freight transport in Austria

In a longtime average, around 10 million tons of goods are transported on the Austrian Danube each year. Around a third of these goods are ores and scrap metals, while petroleum products, agricultural products and forestry products each account for around one eighth of the transported goods.

The waterway share in the modal split in the Austrian Danube corridor is roughly 10%. The Danube plays an important role mainly in upstream transport, especially in imports via the eastern border. In this area, the Danube is approximately neck and neck with rail transports.

@ Detailed statistics on the topic of transportation in the European Union: epp.eurostat.ec.europa.eu

@ Statistics on Danube navigation from the Danube Commission: www.danubecommission.org

@ Annual reports on Danube navigation in Austria are published by viadonau and are available to download at www.viadonau.org

The future of mobility

The future development of the mobility system is defined by national and European transport policies. This is achieved by determining basic objectives and strategies as well as by their implementation in important infrastructure and innovation projects. Based on this, the co-functioning of transport modes is promoted and negative consequences of mobility are reduced.

In addition to the target of safeguarding a high level of accessibility, the focus in Europe is clearly oriented toward sustainable and energy-efficient **transport**. Inland waterway transport can substantially contribute to this purpose because it is environmentally friendly, safe and has plenty of spare capacity. Due to these facts, inland waterway transport has, in recent years, become more and more perceived as an attractive transport option by politicians and economists. This is supported by European and national action programmes.

Detailed information on the European transport policy together with strategies and regulations are available on the web portal of the European Union: europa.eu/european-union/topics/transport_en

This chapter describes the **core objectives and strategies of European and national transport policies** which are of relevance to inland navigation. These objectives and strategies are predominantly of a basic, recommendatory character. Their further specifications are achieved by means of various action programmes and regulations at both European and national level. The main **sectoral provisions** (e.g. fairway parameters, environment, River Information Services) are dealt with in more detail in the respective chapters of this manual.

European funding database for inland waterway transport: https://eibip.eu/funding/

The implementation of transport-related strategies is supported by funds of the European Union as well as by national budgets and funding schemes. In addition, the EU is striving to better integrate private stakeholders into the financing of projects.

The digital waterway

Detailed information on the EU Digital Single Market Strategy: ec.europa.eu/digital-single-market

As a cross-sectoral issue, digitalisation is among the most significant challenges currently facing Danube navigation. Digitalisation in this regard is defined as **digital transformation**, the adaptation of business models and supply chains as a continuous change process precipitated by the increasingly widespread use of digital technologies and their connectivity.

Working document by the Commission services on digital inland navigation: ec.europa.eu/transport/sites/transport/files/legislation/swd20180427-digital-inland-navigation.pdf

Besides progressive digitalisation in a broader sense, the activities of the European Union are focused in particular on international connectivity. At European level, digitalisation is assigned a high priority within the **Digital Single Market Strategy** (DSM), which includes inland navigation within the transport sector.

The **Digital Inland Waterway Area** (DINA) initiative by the European Commission addresses specific issues of inland navigation within the Digital Single Market Strategy, while the European Commission's **Digital Transport and Logistics Forum** (DTLF) supports matters of digitalisation in the transport and logistics sectors that affect the various transport modes.

Website of the Digital Transport and Logistics Forum: www.dtlf.eu

This handbook contains examples of many relevant activities that are currently contributing to improvements in the economic efficiency, safety and environmental performance of Danube navigation:

- **Waterway activities** (e.g. waterway asset management systems, lock management, signing of waterway, riverbed surveys, water level management)

- **Landside activities** (digitalisation of processes and services at ports and terminals)

- **On-board activities** (e.g. digital monitoring of the vessel's operating data, automatic course tracking, collective measurement of fairway data on board vessels)

- **River Information Services** (e.g. fairway information services, transport information and management, notices to skippers, electronic reporting)

In addition, **potential future developments** are being analysed and shaped at European level by means of cooperation between infrastructure operators, shipping companies, logistics service providers and scientific institutions. The development of automated vessels (connected & automated transport) is among the ongoing efforts in collaboration with maritime navigation. The potential of new organisational forms (synchro-modality) and the possible influence of current trends (IoT – Internet of Things, physical internet, blockchain) on Danube navigation are being analysed in cooperation with the logistics sector in order to include inland navigation within multimodal logistics chains.

Besides continued development of the River Information Services, a variety of organisations in the Danube states are active in these fields and are preparing further steps in the area of digitalisation.

Source: viadonau/Christian Wurzer

State-of-the-art buoys in use

Transport policy framework at European level

Overarching objectives and strategies

The EU strategy **Europe 2020**, which was adopted in 2010, describes the essential overarching (transport) policy objectives and strategies of the European Union for the year 2020. Accordingly, the strategy also provides the policy framework for the further development of inland navigation (European Commission, 2010a).
In a rapidly changing world, the EU is aiming for growth which is:

- **smart** (through effective investments in education, research and innovation),
- **sustainable** (thanks to a decisive move towards a low-carbon economy and competitive industry) and
- **inclusive** (with a strong emphasis on job creation and poverty reduction).

Further information on the Europe 2020 strategy is available on the website of the European Commission: https://bit.ly/2gEXPR2

The process will be steered on the basis of five policy objectives, which will enable the measurement of its implementation. The fields of **climate change and energy** together with **research and development** are of particular relevance to inland navigation. In the field of climate change and energy, objectives have been set to cut greenhouse gas emissions in the range of 20 to 30% in comparison to 1990, to raise the share of renewable energy to 20% and to boost energy efficiency by 20%. For research and development in Europe, 3% of the gross domestic product of the EU will be made available. The European Commission publishes ongoing monitoring reports on the indicators, which are accessible online (refer to the link in the margin).

The European Commission's 2011 **White Paper on Transport** titled 'Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system' (European Commission, 2011) sets ambitious objectives for reducing oil dependency and CO_2 emissions. The latter should be reduced by 60% by 2050 in comparison to 1990.

The White Paper recognises inland navigation as an energy-efficient transport mode and encourages the raising of its share in the modal split.

The following **goals of the White Paper** are specifically relevant for inland navigation:

- 30% of road freight over 300 kilometres should shift to other transport modes such as waterway transport by 2030, and more than 50% by 2050. This shall be facilitated by efficient and green multimodal transport corridors. The Danube is part of such a corridor within the scope of the EU's trans-European transport network (TEN-T), i.e. core network corridor No. 10 'Strasbourg – Danube'.
- A fully functional and EU-wide multimodal TEN-T core network shall exist by 2030, with an extended network of high quality and high capacity by 2050 with a corresponding set of information services. Special relevance is given to the European ports in their function as interfaces between the transport modes.
- Equivalent management systems for land and waterway transport (River Information Services – RIS) shall be deployed.

• The principles of 'user pays' and 'polluter pays' shall be fully applied in the transport sector and a higher level of engagement by the private sector should be encouraged. This shall contribute to the elimination of distortion, generate revenue and ensure financing for future transport investment.

The objectives of the White Paper shall be achieved by means of a **roadmap of 40 project activities**. For Danube navigation, relevant project activities include the creation of a multimodal core network, the establishment of a suitable framework for inland navigation and the development of multimodal freight transport backed by telematics systems ('e-freight').

The European Commission published an implementation report on the White Paper in 2016 (European Commission, 2016).

Further information on the 2011 White Paper on Transport is available on the website of the European Commission: https://ec.europa.eu/transport/themes/strategies/2011_white_paper_en

Source: viadonau/Johannes Scherzer

Objectives and strategies relating to inland navigation

The second **Action Programme for the Promotion of Inland Waterway Transport of the European Commission** (towards quality inland waterway transport – NAIADES II) (European Commission, 2013a) defines the strategic inland navigation policy of the European Union until 2020 in the five thematic areas of infrastructure, markets, fleet, jobs and skills as well as River Information Services. The programme continues the efforts of the first Action Programme (NAIADES).

Website of the NAIADES II Action Programme https://ec.europa.eu/transport/modes/inland/promotion/naiades2_en

NAIADES II is designed to augment the capacity utilisation of inland waterways along with the sustainability of inland navigation in Europe. The European Commission published the NAIADES II Mid-term Progress Report in 2018, setting out the progress in the five areas until 2017 (European Commission, 2018b). It provides a positive assessment and describes the next necessary steps.

PLATINA II (Platform for the Implementation of NAIADES II) was installed as a platform for the coordinated implementation of the strategies and measures of the NAIADES II Action Programme in 2013-2016. The initiative was implemented by numerous organisations from several European countries and by the European

Commission, resulting in key milestones such as an analysis of external costs of inland navigation or standards for ship simulators in the training of captains, as well as promoting the dissemination of good practices in the area of waterway management.

Website of the NAIADES II implementation platform PLATINA II: https://www.danube-navigation.eu/projects/platina-ii-platform-for-the-implementation-of-naiades

The NAIADES II Action Programme, as well as the results of the implementation platform PLATINA II, have **positively influenced the perception of inland navigation** not only at a European and national political level but also in the European navigation sector. Crucial preconditions for promoting this sustainable transport mode have been developed and will serve as an essential basis for work in the coming years.

In 2018, the European Commission published an analysis of the term '**good navigation status**' in relation to waterways. This involved agreeing on a common definition of a 'good navigation status' and its implications for Europe's waterways in a process of dialogue with important representatives of inland navigation, as well as with the environmental sector (European Commission, 2018a).

Transport policy framework in the Danube region

EU Strategy for the Danube Region

Danube countries participating in the Strategy for the Danube Region are: Germany, Austria, Czech Republic, Slovakia, Slovenia, Hungary, Romania, Bulgaria, Croatia, Serbia, Montenegro, Bosnia and Herzegovina, Ukraine and Moldova.

Web platform of the Strategy for the Danube Region: www.danube-region.eu

Web platform of Priority Area 1a – To improve mobility and multimodality: Inland waterways: https://www.danube-navigation.eu

The **Strategy of the European Union for the Danube Region (EUSDR)** has been in force since 2011 (European Commission, 2010b). It is a macro-regional strategy comprising the 14 Danube countries, among them EU Member States, accession candidates and third countries. Additionally, a large number of stakeholders are involved in the process of the strategy's implementation.

The strategy is intended to be implemented until 2020 on the basis of an action plan which rests on four pillars: Connecting the Danube Region, Protecting the Environment in the Danube Region, Building Prosperity in the Danube Region and Strengthening the Danube Region. For each pillar, distinct objectives and actions have been specified by the EU and the Danube countries.

The four pillars are further divided into eleven priority areas. Austria and Romania are jointly coordinating **Priority Area 1a – To improve mobility and multimodality: Inland waterways**.

Six thematic working groups were set up for the systematic and coordinated implementation of objectives within Priority Area 1a and in order to discuss implementation initiatives and projects with the relevant stakeholders in the Danube region:

- WG 1 – Waterway Infrastructure & Management
- WG 2 – Ports & Sustainable Cargo Transport
- WG 3 – Fleet Modernisation
- WG 4 – River Information Services
- WG 5 – Education & Jobs
- WG 6 – Administrative Procedures

Based on periodic evaluation, target achievement will be measured and roadmaps for implementing specific measures will be adapted accordingly.

Belgrade Convention

The **Convention Regarding the Regime of Navigation on the Danube** was signed by all Danube riparian states ('Belgrade Convention' of 1948). Its main objectives are to safeguard the freedom of navigation on the Danube for all states as well as to oblige the Danube states to maintain their sections of the Danube waterway to a navigable condition.

The signatory states of the Belgrade Convention are Bulgaria, Germany, Croatia, Moldova, Austria, Romania, Russia, Serbia, Slovakia, Ukraine and Hungary.

Source: INTERACT

Area of application of the Danube Strategy

The implementation of the Belgrade Convention, together with adherence to its provisions, is supervised by the **Danube Commission** which is based in Budapest. The Commission is made up of the signatory states of the Belgrade Convention.

Further information about the Danube Commission, including the text of the Belgrade Convention: www.danubecommission.org

Danube River Protection Convention

The International Commission for the Protection of the Danube River (ICPDR) was founded in 1998 and is located in Vienna. The dedicated aim of the ‚Danube River Protection Commission' is the implementation of the **Convention on Cooperation for the Protection and Sustainable Use of the Danube River** ('Danube River Protection Convention') as well as that of the Water Framework Directive (WFD) of the European Union in the Danube region. The signatories of this convention – along with members of the commission – are 14 Danube states and the European Union.

Further information about the Danube River Protection Commission and the Danube River Protection Convention: www.icpdr.org

Information about the EU Water Framework Directive:
ec.europa.eu/environment/water/water-framework

The Danube River Protection Convention is of relevance to inland navigation, because river engineering measures have an effect on the hydromorphological situation and/or the natural composition of ecological communities. Besides its impact on hydromorphology, navigation can influence riverine landscapes in other ways, for instance through pollution or wave-slap.

Source: viadonau/Robert Tögel

Win-win for navigation and ecology by integrative waterway infrastructure projects on the Danube

Framework Agreement on the Sava River Basin

Further information on the Sava River Basin Commission, including the text of the Framework Agreement on the Sava River Basin:
www.savacommission.org

The Sava river is one of the most important navigable tributaries of the Danube. The International Sava River Basin Commission (ISRBC) was founded in 2005 in order to implement the **Framework Agreement on the Sava River Basin (FASRB)**, which was signed by the four Sava riparian states Serbia, Bosnia and Herzegovina, Croatia and Slovenia in 2002. The commission pursues the following goals:

- Establishment of an international regime of navigation on the Sava river and its navigable tributaries
- Establishment of sustainable waterway management, including the integrated management of surface and ground water resources
- Implementation of measures to prevent or limit hazards such as floods, ice, droughts and accidents involving substances hazardous to water

Transport policy framework in Austria

BMVIT Action Programme for the Danube 2022

The 'Overall Transport Plan for Austria' sets out the objectives and policies of Austrian transport planning until 2025 for all transport modes.

The detailed basis for the Austrian navigation policy is defined until 2022 in the **Action Programme Danube** (APD) (Federal Ministry for Transport, Innovation and Technology, 2015), whose objectives, for the first time, apply equally to ecology and flood protection in addition to navigation itself. By proceeding in this way, the programme reflects the multifunctional character of the Danube and uses synergies between these three fields of action. The programme is being implemented by viadonau – Österreichische Wasserstraßen-Gesellschaft mbH, together with the Federal Ministry for Transport, Innovation and Technology, as well as in close cooperation with the relevant stakeholders.

The action programme's six impact objectives (as shown in the diagram below) will be implemented in 23 measures, each of which contributes to one, two or all three fields of action. Underlying the efforts is the intention to continue strengthening inland navigation within the overall system of Austrian transport – also based on the European guidelines. The measures included in the action field of inland navigation refer to the areas of waterway infrastructure, lock operations, provision of user information (River Information Services), transport development, fleet modernisation and knowledge management. These thematic areas are discussed in more detail in the individual chapters of this manual.

Scheduled to run until 2022, numerous projects and initiatives will contribute to achieving these objectives or have already been implemented successfully. Annual progress reports provide information on the Action Programme's current implementation status.

@ For more information about the Action Programme Danube and its progress reports: www.bmvit.gv.at/verkehr/schifffahrt/binnen/aut/apd.html

@ For more information about the individual implementation activities within the Action Programme Danube: www.viadonau.org/unternehmen/aktionsprogramm-donau/massnahmen/

Sustainable and safe development of the living and economic environment of the Danube					
Navigation			Ecology		Flood Protection
Customer-oriented waterway management and improvement of the Danube fairway	Increase competitiveness of Danube navigation in logistics networks	Increase traffic safety and safe lock operations	Reduce greenhouse gas emissions and increase environmental performance of Danube navigation	Preserve and improve the Danube as natural habitat	Ensure flood protection and damage minimisation in case of a flood disaster

Source: viadonau

The objectives of the Action Programme Danube until 2022

European funding database for inland waterway transport:
https://eibip.eu/funding/

For more information about the legal framework in regard to inland navigation in Austria, visit the website of the Federal Ministry for Transport, Innovation and Technology:
https://www.bmvit.gv.at/verkehr/schifffahrt/recht/index.html

National funding schemes

In addition to the strategic and legal framework, Austria is also initiating **funding pools for specific topics** at national level that are designed to complement the European funding programmes to drive the development of inland navigation in Austria. The **current Austrian funding schemes** are accessible in the **European funding database for inland navigation**.

Legal framework for inland navigation in Austria

The legal provisions for inland navigation in Austria are defined by European regulations and their transposition into national law on the one hand and by the specific national legislation on the other.

Waterways Act (Federal Law Gazette I 177/2004)

The Waterways Act sets out the tasks and organisation of the Federal waterway administration in Austria, viadonau – Österreichische Wasserstraßen-Gesellschaft mbH, a subsidiary of the Federal Ministry for Transport, Innovation and Technology. The strategic planning, control and monitoring of the administration of federal waterways rests with the Federal Ministry for Transport, Innovation and Technology itself.

By law, all measures carried out on expanses of water must be implemented with the greatest possible care for the environment. Waterways must be planned, constructed and maintained in such a way that they can be used safely by all stakeholders with due consideration of and according to all laws pertaining to navigation.

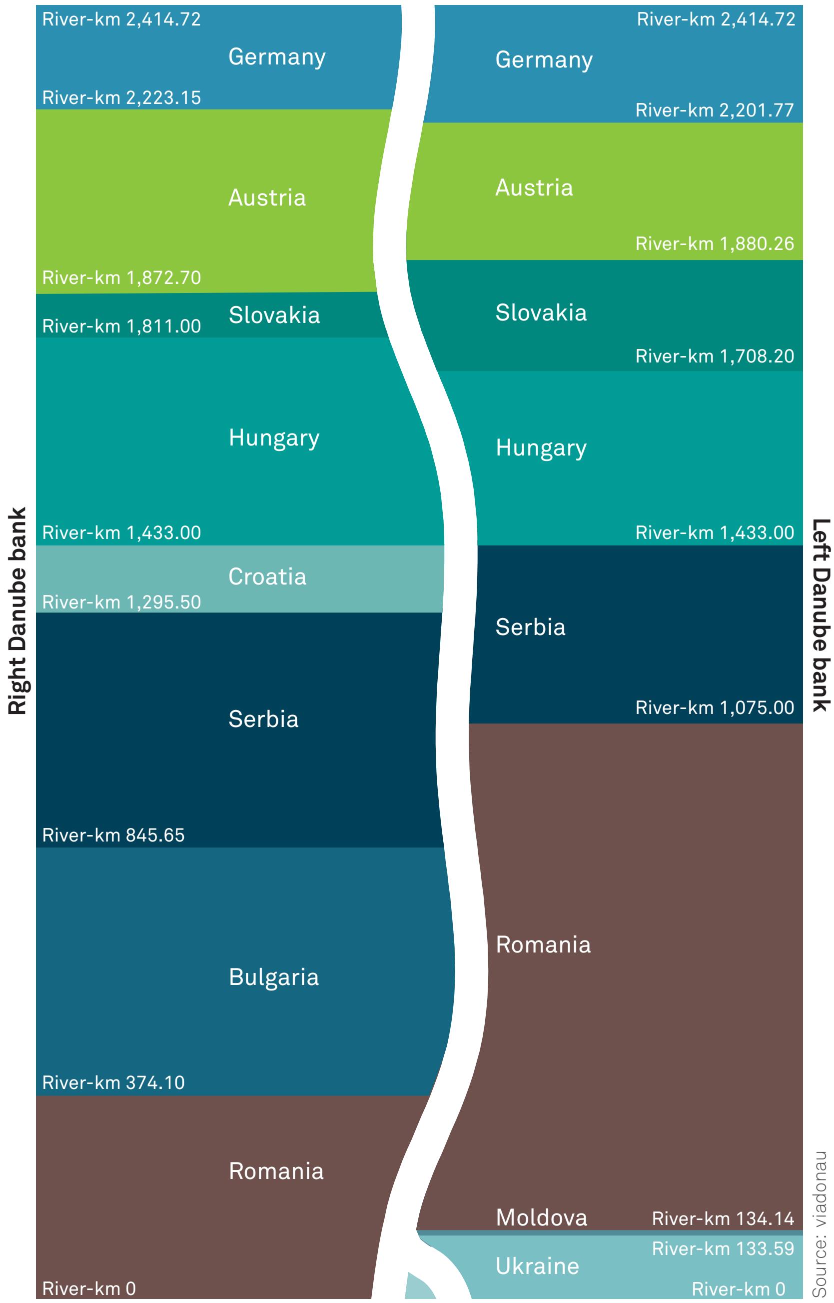
Navigation Act (Federal Law Gazette I 62/1997)

The Navigation Act sets out the framework for navigation on Austrian waters and contains regulations concerning waterways, shipping facilities, commercial navigation laws, ship authorisation, ship command and schools for skippers.

The Danube and its tributaries

Geopolitical dimensions

On its way from the Black Forest, in Germany, to its mouth in the Black Sea in Romania and the Ukraine, the Danube passes through **ten riparian states**, which makes it the most international river in the world.



Danube riparian states and common border stretches on the navigable Danube waterway

With a total length of 1,075 kilometres, Romania has the **largest share of the Danube**, representing almost a third of the entire length of the river. Thereof, some 470 kilometres make up the common state border with Bulgaria. Moldova has the **smallest share of the Danube** with only 550 metres. Four countries, i.e. Croatia, Bulgaria, Moldova and Ukraine, are situated on only one bank of the river.

The Danube marks a **state border** along 1,025 km of its length, which corresponds to 36% of its entire length (calculated from the confluence of the Breg and Brigach headstreams in Germany to Sulina at the end of the Danube's middle delta distributary in Romania) or to 42% of its navigable length (Danube waterway from Kelheim to Sulina).

Source: viadonau/Pilo Pichler

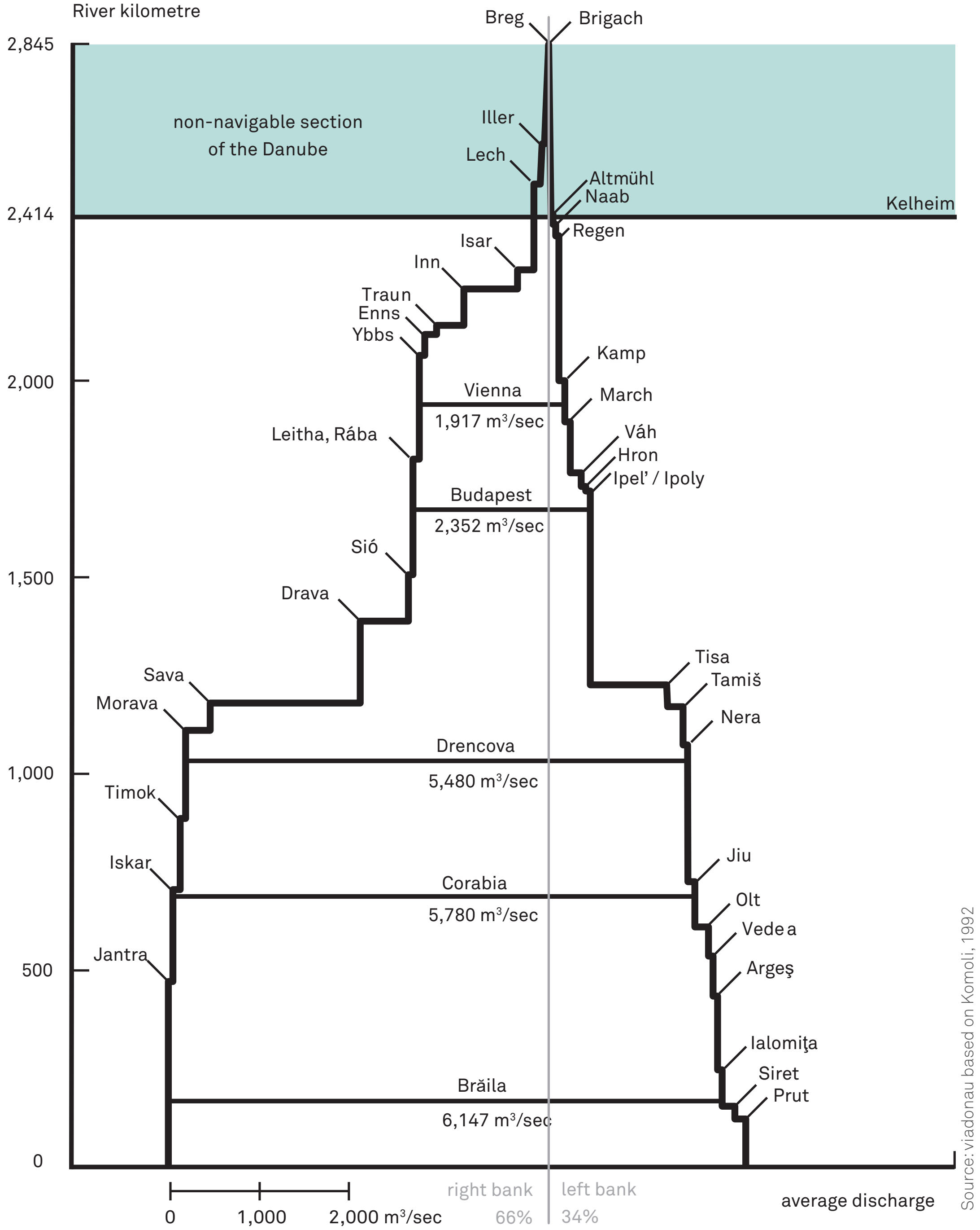
River basin district and discharge

The **river basin district** is the catchment area where all water from land surfaces, streams and ground water sources drains into the respective river. The river basin of the Danube covers **801,463 km²**. It lies to the west of the Black Sea in Central and South-Eastern Europe.

The diagram on the following page shows the structure of the **average discharge** for the entire length of the Danube, depicting the water distribution of the Danube's main tributaries and their geographical position (right bank, left bank). The term 'discharge' refers to the amount of water which passes by at a certain spot of the watercourse over a specific unit of time. Generally, discharge is indicated in cubic metres per second (m³/sec). At its mouth, the Danube has an average discharge of about 6,550 m³/sec, which makes the Danube the **river with the highest runoff in Europe.**

In terms of average inflow, the **five major tributaries** of the Danube are the Sava (1,564 m³/sec), Tisa/Tisza/Tysa (794 m³/sec), Inn (735 m³/sec), Drava/Drau (577m³/sec) and Siret (240 m³/sec).

The **longest tributary of the Danube** is the Tisa/Tisza/Tysa with a length of 966 kilometres, followed by the Prut (950 kilometres), Drava/Drau (893 kilometres), Sava (861 kilometres) and Olt (615 kilometres).



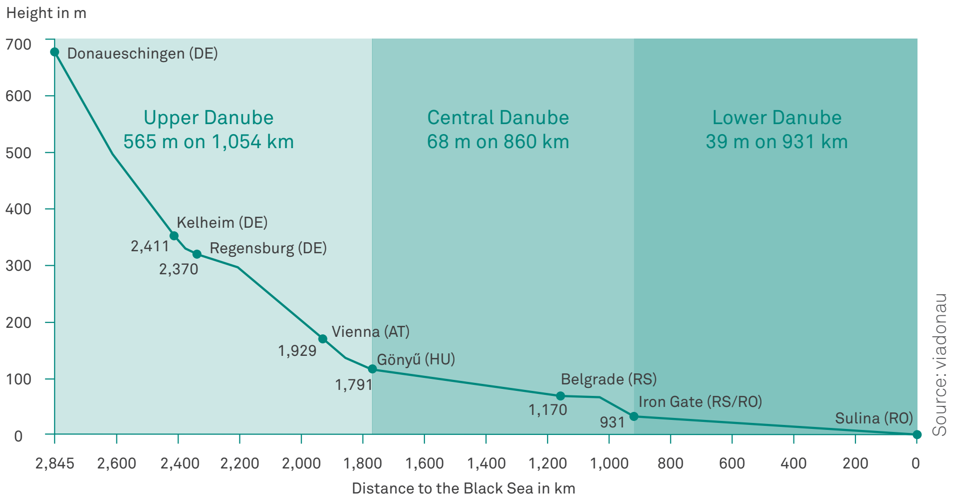
Average discharge of the Danube from its source to its mouth, based on data for the years 1941–2001

Length and gradient

With a **length of 2,845 kilometres**, the Danube is Europe's second-longest river after the Volga. In one of its first hydrographic publications, the European Danube Commission, which was established in 1856, stated that the Danube originates at the confluence of its two large **headstreams, the Breg and the Brigach**, at Donaueschingen in the **Black Forest** in Germany and that from this confluence the river has a length of 2,845 kilometres (measured to its mouth in the Black Sea at river-km 0 in Sulina at the middle distributary of the Danube delta). When measuring the distance from the origin of the **longer of the two headstreams, the Breg**, at Furtwangen to the Black Sea at Sulina, the overall length amounts to **2,888 kilometres**.

Due to the high gradient in the **first third** of its course (over a length of 1,055 kilometres), the upper part of the Danube has the characteristics of a **mountain river**. For this reason, nearly all river power plants, taking advantage of the gradient of a watercourse, are located on this part of the Danube. Only after the change of gradient at Gönyű in the north of Hungary (river-km 1,791) does the river gradually change into a lowland river.

While the **Upper Danube** has an average height difference of slightly more than 0.5 metres per kilometre, the average height difference on the **Lower Danube** is only slightly more than 4 centimetres per kilometre. The following illustration shows the **gradient curve of the Danube** from its source at Donaueschingen to its mouth in the Black Sea.



Gradient curve of the Upper, Central and Lower Danube

Classification of inland waterways

Working Party on Inland Water Transport of the UNECE's Inland Transport Committee: www.unece.org/trans/main/sc3/sc3.html

A **waterway** is a body of surface water serving as a route of transport for goods and/or passengers by means of vessels. Navigable inland transport routes are called inland waterways. Natural inland waterways are provided by **rivers** and **lakes**, whereas **canals** are artificial waterways.

In order to create the most uniform conditions possible for the development, maintenance and commercial use of Europe's inland waterways, in 1996 the Inland Transport Committee of the United Nations Economic Commission for Europe (UNECE) adopted the **European Agreement on Main Inland Waterways of International Importance** (AGN) (United Nations Economic Commission for Europe, 2010). The Agreement, which came into force in 1999, constitutes an international legal framework for the planning of the development and maintenance of the European inland waterway network and for ports of international importance, and is based on technical and operational parameters.

By ratifying the Agreement, the contracting parties express their intention to implement the coordinated plan for the development and construction of the so-called E waterway network. The **E waterway network** consists of European inland waterways and coastal routes which are of importance for international freight transport, including the ports situated on these waterways.

E waterways are designated by the letter 'E' followed by a number or a combination of numbers, whereby main inland waterways are identified by two-digit numbers and branches by four- or six-digit numbers (for branches of branches). The **international waterway of the Danube** is designated as **E 80**, and its navigable tributary the **Sava**, for example, as **E 80-12**.

Waterway classes are identified by Roman numbers from I to VII. **Waterways of class IV or higher** are of economic importance to international freight transport. Classes I to III identify waterways of regional or national importance.

The class of an inland waterway is determined by the **maximum dimensions of the vessels** which are able to operate on this waterway. Decisive factors in this respect are the **width** and **length** of inland vessels and convoys, as they constitute fixed reference parameters. Restrictions regarding the **minimum draught loaded** of vessels, which is set at 2.50 metres for an international waterway, as well as the **minimum height under bridges** (5.25 metres in relation to the highest navigable water level) can be made only as an exception for existing waterways.

The following table shows the parameters of international **waterway classes based on type of vessels and convoys** which can navigate the waterway of the respective class.

Motor cargo vessels						
Type of vessel: general characteristics						
Water-way class	Designation	Max. length L (m)	Max. width B (m)	Draught d (m)	Deadweight T (t)	Min. height under bridges H (m)
IV	Johann Welker	80-85	9.5	2.5	1,000-1,500	5.25 / 7.00
Va	Large Rhine vessel	95-110	11.4	2.5-2.8	1,500-3,000	5.25 / 7.00 / 9.10
Vb	Large Rhine vessel	95-110	11.4	2.5-2.8	1,500-3,000	5.25 / 7.00 / 9.10
VIa	Large Rhine vessel	95-110	11.4	2.5-2.8	1,500-3,000	7.00 / 9.10
VIb	Large Rhine vessel	140	15.0	3.9	1,500-3,000	7.00 / 9.10
VIc	Large Rhine vessel	140	15.0	3.9	1,500-3,000	9.10
VII	Large Rhine vessel	140	15.0	3.9	1,500-3,000	9.10

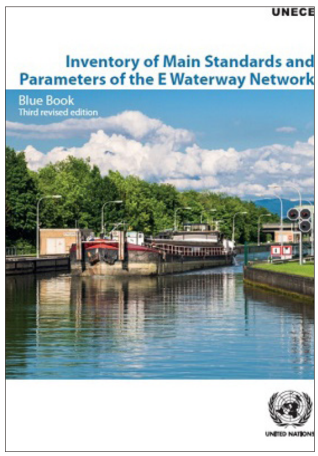
Pushed convoys						
Type of convoy: general characteristics						
Water-way class	Formation	Length L (m)	Width B (m)	Draught d (m)	Deadweight T (t)	Min. height under bridges H (m)
IV		85	9.5	2.5-2.8	1,250-1,450	5.25 / 7.00
Va		95-110	11.4	2.5-4.5	1,600-3,000	5.25 / 7.00 / 9.10
Vb		172-185	11.4	2.5-4.5	3,200-6,000	5.25 / 7.00 / 9.10
VIa		95-110	22.8	2.5-4.5	3,200-6,000	7.00 / 9.10
VIb		185-195	22.8	2.5-4.5	6,400-12,000	7.00 / 9.10
VIc		270-280	22.8	2.5-4.5	9,600-18,000	9.10
		195-200	33.0–34.2	2.5-4.5	9,600-18,000	9.10
VII		275-285	33.0–34.2	2.5-4.5	14,500-27,000	9.10

Source: United Nations Economic Commission for Europe, 2010

Waterway classes according to the AGN

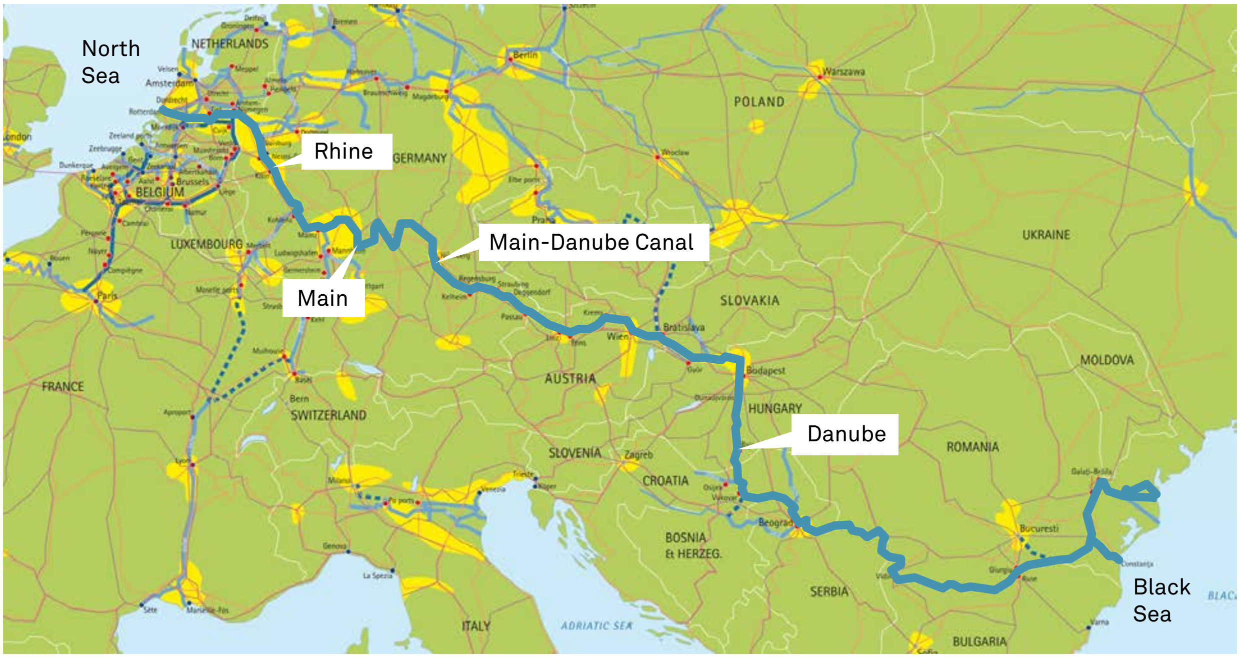
In 1998, the UNECE Inland Transport Committee first published an **Inventory of Main Standards and Parameters of the E Waterway Network**, the so-called 'Blue Book', as a supplement to the AGN (United Nations Economic Commission for Europe, 2012). The 'Blue Book' contains a list of the current and planned standards and parameters of the E waterway network (including ports and locks) as well as an overview of the existing infrastructural bottlenecks and missing links. This publication, which supplements the AGN, allows for the monitoring of the current state of implementation of the agreement on an international basis.

@ 'Blue Book' database: www.unece.org/trans/main/sc3/bluebook_database.html



The international Danube waterway

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 Canal** was opened to navigation in 1992 and created an international waterway between the North Sea in the West and the Black Sea in the East. This waterway has a total length of 3,504 kilometres and provides a direct waterway connection between 15 European countries.



Source: viadonau, Inland Navigation Europe

The inland waterway axis Rhine-Main-Danube

Danube Commission: www.danubecommission.org

The **navigable length of the Danube** available to international waterway freight transport is just under **2,415 kilometres**, starting from Sulina at the end of the middle Danube distributary into the Black Sea in Romania (river-km 0) to the end of the Danube as a German federal waterway at Kelheim (river-km 2,414.72). The Kelheim–Sulina main route is subject to the **Convention Regarding the Regime of Navigation on the Danube** of 18 August 1948 ('Belgrade Convention'), which ensures free navigation on the Danube for all commercial vessels sailing under the flags of all nations.

For more information concerning the Danube Commission and the Belgrade Convention, refer to the chapter 'Objectives and Strategies'.

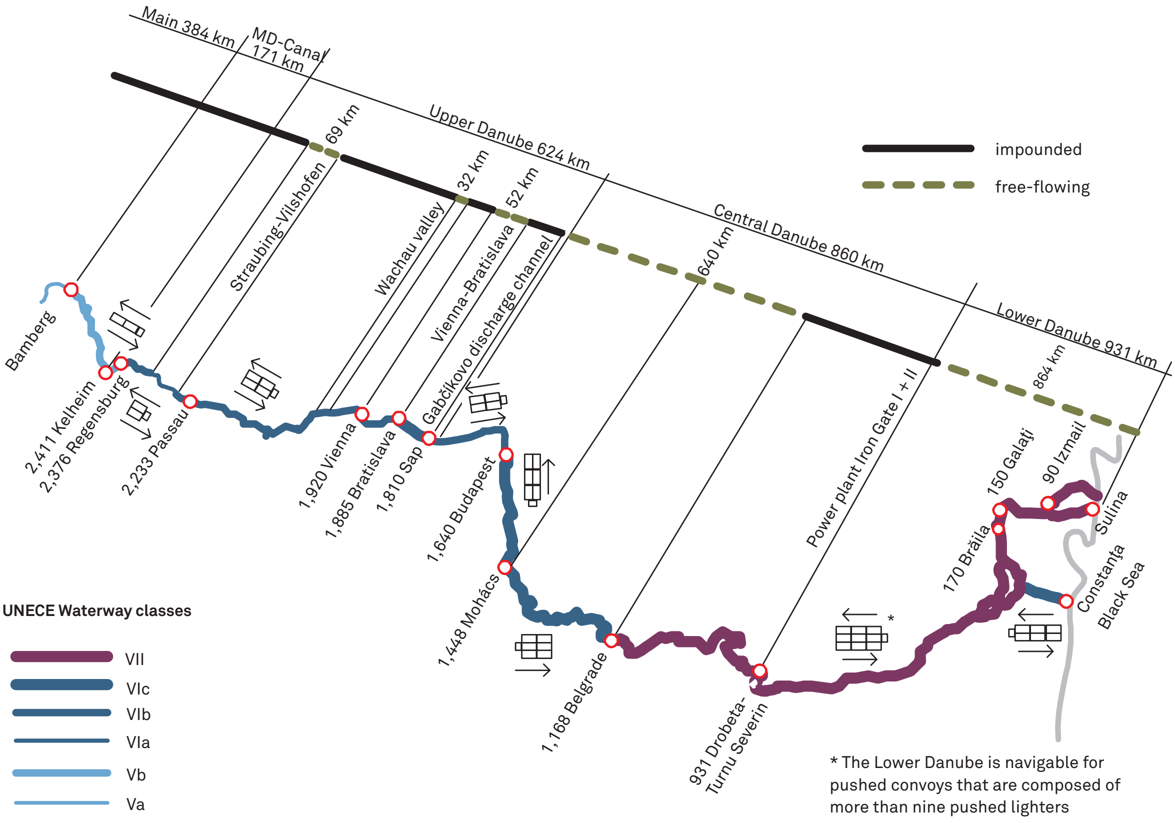
According to the definition of the Danube Commission, the international Danube waterway can be subdivided into three main sections for which the nautical characteristics are provided in the following table. This division into **three main sections** is based on the physical-geographical characteristics of the Danube river.

	Upper Danube Kelheim – Gönyű	Central Danube Gönyű – Turnu-Severin	Lower Danube Turnu-Severin – Sulina
Length of section	624 km	860 km	931 km
River-km	2,414.72–1,791.33	1,791.33–931.00	931.00–0.00
Ø gradient per km	~ 37 cm	~ 8 cm	~ 4 cm
Height of fall	~ 232 m	~ 68 m	~ 39 m
Upstream travel speed of vessels	9–13 km/h	9–13 km/h	11–15 km/h
Downstream travel speed of vessels	16–18 km/h	18–20 km/h	18–20 km/h

Source: viadonau, Danube Commission

Nautical characteristics of the different Danube sections

The **waterway classes** of the various sections of the Danube and the **largest possible vessel units** (convoys) which are able to operate on these sections are shown in the following diagram. This diagram also includes the differences in the possible combinations of vessels in convoys for upstream and downstream travel as well as the impounded and free-flowing sections of the Danube waterway.



Source: viadonau

Maximum possible dimensions of convoys on the Danube waterway according to waterway classes

From **Regensburg to Budapest** (except for the Straubing–Vilshofen section in Bavaria) the Danube is classified as waterway class VIb and is navigable by 4-unit pushed convoys. The 69-km nautical bottleneck between Straubing and Vilshofen on the Bavarian section of the Danube is classified as waterway class VIa and is navigable by 2-lane 2-unit convoys.

Between **Budapest and Belgrade** the Danube is basically navigable by 2-lane and 3-lane 6-unit convoys. Here, the Danube is classified as waterway class VIc.

On the section downstream from **Belgrade to the Danube delta** (Belgrade–Tulcea) the Danube is classified as waterway class VII (highest class according to the UNECE classification). This entire section is navigable by 9-unit convoys while some subsections are suitable for even larger convoys.

Apart from the Kelheim–Sulina main route, several **navigable distributaries and side arms, canals** and **tributaries** form an integral part of the Danube waterway system. Apart from the Kelheim–Sulina section, all other transport routes are **national waterways** which are each subject to different regulations. The table on the following page provides an overview of these waterways.

The **length of navigable waterways in the Danube basin** (Danube including all navigable distributaries and side arms, canals and tributaries) comes to approximately 6,300 kilometres. 58% or **3,600 kilometres** of these are **waterways of international importance**, i.e. waterways of UNECE class IV or higher.

Source: viadonau

Overview of the waterways in the Danube region

Name of waterway	Riparian countries	Navigable length	UNECE Waterway class	Number of locks
Distributaries of the Danube:				
Kilia arm / Bystroe arm	Romania + Ukraine	116.60 km	VII / VIa	0
Sulina arm	Romania	62.97 km	VII	0
Sfântul Gheorghe arm	Romania	108.50 km	VIb + Vb	0
Side arms of the Danube:				
Bala / Borcea	Romania	116.60 km	VII	0
Măcin	Romania	98.00 km	III	0
Szentendre	Hungary	32.00 km	III	0
Canals:				
Danube-Black Sea Canal	Romania	64.41 km	VIc	2
Poarta Albă-Midia Năvodari Canal	Romania	27.50 km	Vb	2
Hidrosistem Dunav-Tisa-Dunav	Serbia	657.50 km	I - III	15
Main-Danube Canal	Germany	170.78 km	Vb	16
Tributatries of the Danube:				
Prut	Moldova + Romania	407.00 km	II	0
Sava	Serbia + Croatia + Bosnia and Herzegovina	586.00 km	III + IV	0
Tisa/Tisza	Serbia + Hungary	685.00 km	I - IV	3
Drava/Dráva	Croatia + Hungary	198.60 km	I - IV	0
Váh	Slovakia	78.85 km	VIa	2

Source: viadonau

Important waterways in the Danube region

System elements of waterway infrastructure

The size of inland vessels or convoys suitable for specific inland waterways depends mainly on the current **infrastructure parameters of the waterway** in question. The following factors of waterway infrastructure influence navigation:

- Waterway and fairway (depth and width, curve radii)
- Lock chambers (available length and width of lock chambers, depth at pointing sill)
- Bridges and overhead lines (clearance and available passage width under bridges and overhead lines)

In context with these determinants there are **further framework conditions** which may influence navigation on a certain waterway section:

- Waterway police regulations (e.g. maximum permissible dimensions of vessel units, limitations on the formation of convoys)
- Traffic regulations (e.g. one-way traffic only, maximum permissible speed on canals or in danger areas)

- Navigation restrictions and suspensions due to adverse weather conditions (floods, ice formation), maintenance and construction works at locks, accidents, events etc.

Water levels and gauges of reference

A **water gauge** measures the gauge height which corresponds to the height of water at a certain point in the reference profile of a body of water, i.e. the **water level**. In general, gauge heights are measured several times a day. Nowadays, they are also published on the Internet by the national hydrographic services.

Source: viadonau/Andi Bruckner

Gauge staff at a gauging site; sample water level at gauge: 95 cm

It has to be kept in mind that the water level measured at a water gauge does not allow for any conclusions about the actual water depth of a river to be made and hence about current fairway depths. This is due to the fact that the **gauge zero**, i.e. the lower end of a gauge staff or altitude of a gauge, does not correspond with the location of the riverbed. The gauge zero can lie above or below the medium riverbed level of a river section. In rivers, the flow of the current and the riverbed change fairly often and hence the gauge zero of a water gauge cannot be constantly realigned.

When assessing the currently available water depths within the fairway, boat masters refer to **gauges of reference**, which are relevant for certain sections of inland waterways. The water levels at the water gauge of reference are decisive for the draught loaded of vessels, for the passage heights under bridges and overhead lines as well as for restrictions on or suspension of navigation in periods of floods.

Reference water levels

The mean sea level measured at a gauging site of the nearest ocean coast serves as the reference for determining the absolute or geographic level of a gauge zero on the earth's surface, the so-called **absolute zero point.** Hence, the water gauges along the river Danube have different reference points: the North Sea (Germany), the Adriatic Sea (Austria, Croatia, Serbia), the Baltic Sea (Slovakia, Hungary) and the Black Sea (Bulgaria, Rumania, Moldova, Ukraine).

As the water level at a gauge changes continually, **reference water levels** or **characteristic water levels** have been defined in order to gain reference values, e.g. on the maintained depth of the fairway. Characteristic water levels are **statistical reference values for average water levels** which have been registered at a certain gauge over a longer period of time. The most important reference water levels for inland waterway transport are:

- **Low navigable water level** (LNWL)
- **Highest navigable water level** (HNWL)

If the highest navigable water level (HNWL) is reached or exceeded by over a certain degree, the authority responsible for the waterway section concerned may impose a temporary suspension of navigation for reasons of traffic safety.

Fairway and fairway channel

The term **fairway** refers to the part of an inland waterway that is navigable for shipping at a particular water level and that is marked by **fairway signs**. The **fairway channel** is the area of a body of inland water for which the waterway administration seeks adherence to certain fairway depths and fairway widths for navigation purposes. The fairway channel is therefore part of the fairway. A 'minimal' cross section is assumed on rivers in determining the cross-section of the channel, so its depth and width. It is derived from the 'most shallow' and 'narrowest' points of a certain river section at low water. For the Danube, the **fairway channel depth** determined for a 'minimal' cross section refers to the low navigable water level (LNWL). The **current fairway channel depth** can be calculated with the following formula:

Current water level at gauge of reference
\+ Minimum fairway channel depth at LNWL
\- LNWL value for gauge of reference
= Current minimum fairway channel depth

In order to provide navigation with sufficient fairways channel depths of natural waterways during periods of low water levels and enable cost-effective transport on a river even during such adverse water levels, **river engineering measures** may be taken. This usually involves the installation of **groynes** that keep the river's water yield in the fairway channel during low water levels. Groynes are structures which are normally made up of armour stones which are dumped into a certain area of the riverbed at a right angle or with a certain inclination. River engineering structures which are constructed parallel to a river's flow are called **training walls** and have the purpose of influencing the flow direction of a body of water and stabilising its cross section.

Source: viadonau

Declining groyne, i.e. adjusted to the river's flow direction, for river regulation at low water levels

Low navigable water level (LNWL) = the water level reached or exceeded at a Danube water gauge on an average of 94% of days in a year (i.e. on 343 days) over a reference period of several decades (excluding periods with ice).

Highest navigable water level (HNWL) = the water level reached or exceeded at a Danube water gauge on an average of 1% of days in a year (i.e. on 3.65 days) over a reference period of several years (excluding periods with ice).

The authorities and organisations responsible for maintaining a waterway aim to keep fairways at a constant minimum depth, e.g. by conservational dredging measures in the fairway. These so-called **minimum fairway channel depths** are geared to low navigable water level (LNWL) as a statistical reference value for the water level.

For more information on the interdependency of available fairway channel depths and the cost-effectiveness of Danube navigation, refer to the section 'Business management and legal aspects' in the chapter 'Logistics solutions: The market for Danube navigation'.

As there are **no guaranteed minimum fairway channel depths** at LNWL on the Danube (with the exception of the Bavarian section of the Danube in Germany), boat masters and shipping operators have to plan their journeys according to the fairway channel depths which are currently available at the most shallow stretches of the waterway or according to the admissible maximum draught loaded (= draught of a vessel when stationary) as foreseen by waterway police regulations.

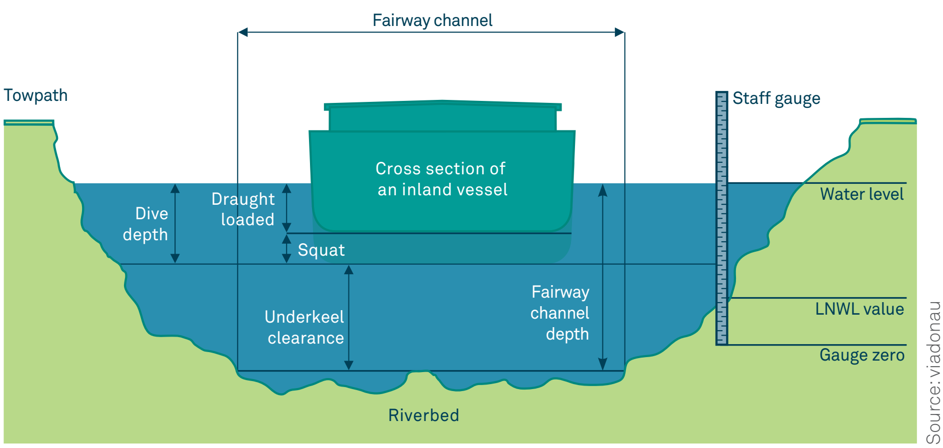
The Romanian section of the Danube between Brăila and Sulina is also termed the **maritime Danube** as this section is also navigable by river-sea vessels and sea-going vessels. 170 kilometres long, this river section is maintained by the Romanian River Administration of the Lower Danube for vessels with a maximum draught of 7.32 metres. Beyond this, the **Kilia/Bystroe arm**, which is not subject to the Belgrade Convention and which falls under the Ukrainian waterway administration, is navigable by river-sea vessels and sea-going vessels.

Draught loaded, squat and underkeel clearance

Fairway depths available in the fairway channel determine how many tons of goods may be carried on an inland cargo vessel. The more cargo loaded on board of a vessel, the higher is its **draught loaded**, i.e. the **draught** of a ship when stationary and when carrying a certain load. The draughts loaded usable for navigation companies have a decisive influence on the cost-effectiveness of inland waterway transport.

Immersion depth = draught loaded ($v_{vessel} = 0$) + squat ($v_{vessel} > 0$)

In calculating the potential draught loaded of a vessel on the basis of current fairway or fairway channel depths, the **dynamic squat** as well as an appropriate safety clearance to the riverbed, the so-called **underkeel clearance**, have to be considered in order to prevent groundings of cargo vessels in motion. The **immersion depth** of a ship equals the sum of its draught loaded (loaded vessel in stasis; velocity v = 0) and its squat (loaded vessel in motion; velocity v > 0).



Parameters of fairway channel (schematic presentation)

Squat refers to the level to which a ship sinks while it is in motion compared to its stationary condition on waterways with a limited cross section (i.e. rivers and canals). A loaded vessel has a squat within a range of about 20 to 40 centimetres. As the squat of a vessel is continually changing according to the different cross sections of a river and the different velocities of a vessel, the boatmaster should not calculate the safety clearance between the riverbed and the bottom of the vessel too tightly when determining the draught loaded of his vessel.

This safety clearance is termed **underkeel clearance** and is defined as the distance between the bottom of a vessel in motion and the highest point of the riverbed. Underkeel clearance should not be less than 20 centimetres for a riverbed made of gravel or 30 centimetres for a rocky bed in order to prevent damage to the ship's propeller and/or its bottom.

Underkeel clearance = fairway channel depth – (draught loaded + squat)

Fairway signs

The width and the course of the fairway are marked by internationally standardised **fairway signs** such as buoys or traffic signs ashore.

In 1985, the Inland Transport Committee of the United Nations Economic Commission for Europe (UNECE) adopted the **European Code for Inland Waterways** (CEVNI) in Resolution No 24 (United Nations Economic Commission for Europe, 2015). Among other things, CEVNI specifies standardisation of the fairway signs at European level and is fleshed out by the **Guidelines for Waterway Signs and Marking** (United Nations Economic Commission for Europe, 2016a).

Resolutions of the Working Group on Inland Water Transport of the UNECE's Inland Transport Committee: www.unece.org/trans/main/sc3/sc3res.html

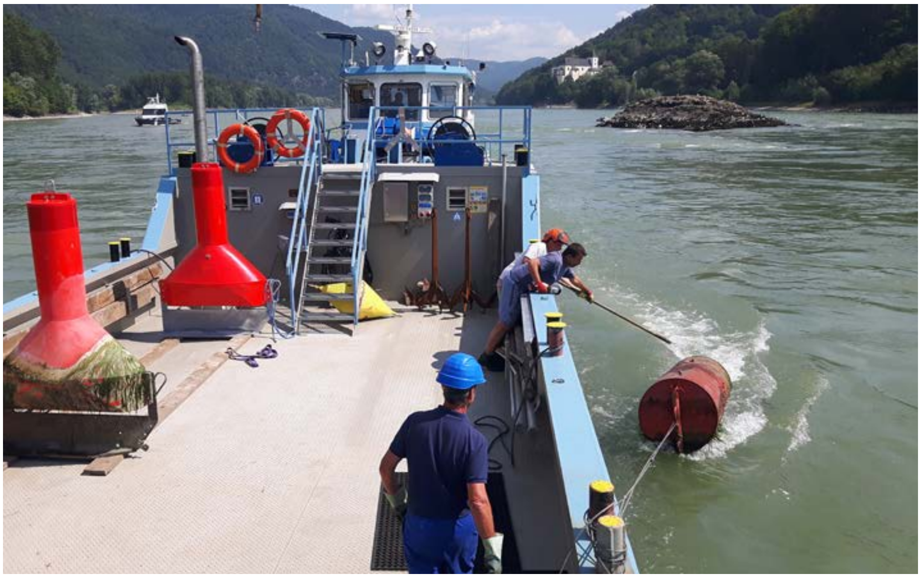
In regard to the marking of fairway limits in the waterway, the right side of the fairway is indicated by red, cylindrical fairway signs, while the left side is delimited by green, cone-shaped signs. The terms 'right side' and 'left side' of the waterway or fairway or the fairway channel, apply to an observer looking downstream, i.e. in the direction in which the water is flowing. Buoys (with or without red or green lights), floats or floating rods can be used as **floating fairway signs**. They must be fitted with a cylindrical or conical top mark if their own shape is not cylindrical or conical.

Floating fairway signs must be equipped with **radar reflectors** to ensure that they show up on the ship radar. They may be the aforementioned top marks or separate signs that are attached on or in the fairway signs.

Together with the floating signs on the waterway, fixed **fairway signs on land** indicate the course of the fairway relative to the banks and show the points at which the fairway comes closer to either of the banks. Square boards, either with or without a red or green light, are used as land-side fairway signs.

Red and green **rhythmic lights** on the fairway signs help to improve transport safety during poor visibility and at night. Rhythmic lights emit light of constant intensity and colour with a certain, recurring succession of light signals and interruptions.

The Danube Commission adopted the UNECE provisions for the Danube waterway in its **Basic Rules of Navigation on the Danube (DFND)** (Danube Commission, 2010) and in the accompanying **Instruction for installation of fairway signs on the Danube** (Danube Commission, 2015).



Source: viadonau/Thomas Hartl

Manipulation of a red buoy to indicate the right-hand limit of the fairway on the Austrian section of the Danube

Landing sites

Landing sites are specially marked areas on the banks of a waterway at which vessels or floating bodies can berth. There may be many reasons why a ship would have to interrupt its travel and berth at a landing site. Loading and unloading of cargo, embarking or disembarking of passengers, bunkering of fuel, adherence to rest periods, crew changes, provisioning, visits to doctors or the authorities, repairs, health and technical emergencies etc. However, landing sites are often reserved for certain vehicles only (e.g. landings for small vessels, fuel landings, fire brigade landings) or are used for a special function (transhipment sites, waiting berths, emergency berths). A distinction can also be made between public and non-public landing sites.

Landing sites are marked by **navigation signs** that indicate the direction of the landing site (relative to the navigation sign), its length, berthing rules and possibly the maximum berthing period or vehicles that are exclusively permitted to use the landing site, among other things.

The banks of a landing site are structurally designed either in **slanted shoring** (riprap) or **vertical shoring** (wall or sheet piling). Vertical shoring enables direct berthing close to the bank and increases safety when departing or boarding the vessel. Established alternatives to vertical shoring include dolphins or pontoons that are equipped with additional walkways that enable the crew to board or disembark safely.

Some landings are equipped with **additional facilities** for navigation, including the supply of shore-side power and drinking water, waste disposal, places to deposit a car or lighting.

Source: viadonau

Cargo vessel at a Danube landing site

River power plants and lock facilities

Barrages, i.e. facilities which impound a river with the aim of regulating its water levels, are often created in the form of **river power plants**, which convert the power of the flowing water into electrical energy. In this process they make use of the incline created by impounding the water between the water upstream and downstream of the power plant (headwater and tailwater).

A river power plant usually comprises of one or several **powerhouses**, the **weir** and the **lock** with one or more lock chambers. Locks enable inland vessels to negotiate the differences in height between the impounded river upstream of a power plant and the flowing river downstream of a power plant.

The most common type of lock on European rivers and canals is the **chamber lock** whereby the headwater and the tailwater are connected via a lock chamber which can be sealed off at both ends. When the lock gates are closed, the water level in the lock chamber is either raised to the headwater level (admission of water from the reservoir) or lowered to the tailwater level (release of water into the section downstream of the power plant). No pumps are required for the admission and release of the water.

Depending on the direction in which a vessel passes through a lock, the terms used are **upstream locking** (from tailwater to headwater) or **downstream locking** (from headwater to tailwater). Once a vessel which needs to pass through a lock has been announced via radio, the locking is carried out by the **lock manager**. A locking operation takes approximately 40 minutes, about half of which is required to navigate the vessel into and out of a lock chamber.

Source: viadonau

Lock facility at the river power plant at Vienna-Freudenau (river-km 1,921.05)

The fairway depth in a lock chamber is determined by the **depth at the pointing sill** – the distance between the surface of the water and the pointing sill, i.e. the threshold of a lock gate which forms a watertight seal with the gate to avoid drainage of the lock chamber.

Special protective devices protect the lock gates from damage caused by vessels.

Stop logs serve to seal off lock chambers from headwater and tailwater in order to drain lock chambers. They are used mainly for reasons of **lock overhaul**, i.e. for maintenance work or for the replacement of lock components.

There are a total of **18 river power plants** on the Danube, with 16 of these power plants located on the Upper Danube due to the high gradient of the river between Kelheim and Gönyű. 14 of the 18 lock facilities on the Danube have **two lock chambers**, thus enabling the simultaneous locking of vessels sailing upstream and downstream.

The lock facilities downstream of Regensburg all feature a minimum **utilisable length** of 226 metres and a **width** of 24 metres which enables locking of convoys made up of at least two pushed lighters which are coupled in parallel.

No.	Lock/power plant	Country	River-km	Lock chambers		
				Length (m)	Width (m)	Number
1	Bad Abbach	DE	2,397.17	190.00	12.00	1
2	Regensburg	DE	2,379.68	190.00	12.00	1
3	Geisling	DE	2,354.29	230.00	24.00	1
4	Straubing	DE	2,327.72	230.00	24.00	1
5	Kachlet	DE	2,230.60	226.50	24.00	2
6	Jochenstein	DE/AT	2,203.20	227.00	24.00	2
7	Aschach	AT	2,162.80	230.00	24.00	2
8	Ottensheim-Wilhering	AT	2,147.04	230.00	24.00	2
9	Abwinden-Asten	AT	2,119.75	230.00	24.00	2
10	Wallsee-Mitterkirchen	AT	2,095.74	230.00	24.00	2
11	Ybbs-Persenbeug	AT	2,060.29	230.00	24.00	2
12	Melk	AT	2,038.10	230.00	24.00	2
13	Altenwörth	AT	1,980.53	230.00	24.00	2
14	Greifenstein	AT	1,949.37	230.00	24.00	2
15	Freudenau	AT	1,921.20	275.00	24.00	2
16	Gabčíkovo	SK	1,819.42	275.00	34.00	2
17	Đerdap/Porțile de Fier I	RS/RO	942.90	310.00*	34.00	2
18	Đerdap/Porțile de Fier II	RS/RO	863.70 862.85	310.00	34.00	2

*The lock Đerdap / Porțile de Fier I consists of two consecutive lock chambers which require two-stage lockage

Source: viadonau

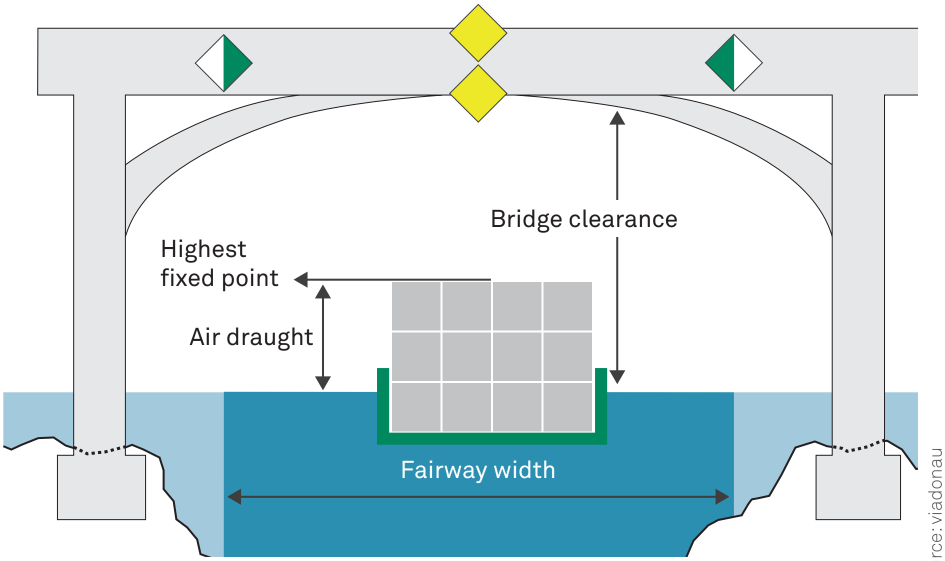
Lock facilities along the Danube

Bridges

Bridges can span a waterway, a port entrance or a river power plant and hence a lock facility. On free-flowing, i.e. unimpounded river sections, water levels can be subject to considerable fluctuations which influence the potential passage under bridges at high water levels.

Depending on the distances between the individual bridge pillars there will be one or more – in most cases two – **openings for passage** of vessels. If a bridge has two openings for passage which are dedicated for navigation purposes, one is generally used for upstream traffic and the other for downstream traffic. Suitable **navigation signs** that are mounted directly on the bridge indicate whether the passage through a bridge opening is permitted or forbidden.

Whether a vessel can pass under a bridge depends on the **vertical bridge clearance** above the water level and on the **air draught of the vessel**. The air draught of a vessel is the vertical distance between the waterline and the highest fixed point of a vessel once movable parts such as masts, radar devices or the steering house have been removed or lowered. The air draught of a vessel can be reduced by **ballasting** the vessel. For this purpose, ballast water is pumped into the ballast tanks or solid ballast is loaded.



Air draught of a vessel and vertical bridge clearance as determining parameters for passages under bridges

Apart from the height of the bridge openings and a vessel's air draught, the **bridge profile** is another factor which determines whether a vessel is able to pass under a bridge. For sloped or arch-shaped bridges, not only a vertical but also a sufficiently dimensioned **horizontal safety clearance** must be ensured. As the figures indicating the height and width of an opening for passage below a bridge always refer to the entire width of the fairway, the clearance below the crest of arch-shaped bridges, i.e. below the centre of the bridge, is higher than at the limits of the fairway.

On free-flowing sections of rivers, **vertical bridge clearance** is indicated in relation to the **highest navigable water level** (HNWL), whereby the indicated passage height corresponds to the distance in metres between the lowest point of the lower edge of the bridge over the entire fairway width and the highest navigable water level. The **width of the fairway** below a bridge is indicated in relation to **low navigable water level** (LNWL). In river sections regulated by dams, the maximum impounded water level serves as the reference value both for the vertical and the horizontal bridge clearance. The reference level on artificial canals is the upper operational water level.

Between **Kelheim** and **Sulina**, a total of **129 bridges** span the international Danube waterway. Of these 129 Danube bridges, 21 are bridges over locks and weirs.
By far the greatest frequency of bridges is found on the **Upper Danube** (89 bridges): 41 bridges span the German section of the Danube, 41 the Austrian and seven the Slovakian or Hungarian sections of the Danube. On the **Central Danube** there are a total of 33 bridges; on the **Lower Danube** there are only seven.

Fairway maintenance

The necessary works for the maintenance of the fairway on natural waterways such as rivers depend on the general characteristics of the respective river: In free-flowing sections the flow velocity of the river is higher than in impounded sections, in artificial canals or in sections flowing through lakes.

The **transport of sediments** (e.g. gravel or sand) is an important dynamic process in free-flowing sections of rivers, especially in periods with higher water levels and the corresponding higher flow velocities of the river. Along with the respective discharge of the river, this transportation of sediment leads to **continuous change in the morphology of the riverbed**, either in the form of sedimentation or erosion.

In shallow areas of the river this continuous change of the riverbed can lead to restrictions for navigation with regard to the minimum fairway parameters (depth and width) to be provided by waterway administrations, i.e. reduced depths and widths of the fairway.

Legal and strategic framework

The overriding aim with regard to the maintenance and optimisation of waterway infrastructure by the Danube riparian states is the **establishment and year-round provision of internationally harmonised fairway parameters**.

The recommended minimum fairway parameters for European waterways of international importance – including the Danube – are listed in the **European Agreement on Main Inland Waterways of International Importance** (AGN) (United Nations Economic Commission for Europe, 2010). With regard to the fairway depths to be provided by waterway administrations, the AGN makes the following provisions: On waterways with fluctuating water levels the value **of 2.5 metres minimum draught loaded of vessels** should be reached or exceeded on 240 days on average per year. However, for upstream sections of natural rivers characterised by frequently fluctuating water levels due to weather conditions (e.g. on the Upper Danube), it is recommended to refer to a period of at least 300 days on average per year.

Based on the **Convention Regarding the Regime of Navigation on the Danube**, which was signed in Belgrade on 18 August 1948 ('Belgrade Convention'), the Danube Commission recommended the following fairway parameters for the Danube waterway: **2.5 m minimum fairway depth** (1988), respectively **2.5 m minimum draught loaded of vessels** (2013) below low navigation water level (LNWL) (i.e. on 343 days on average per year) on free- flowing sections and a minimum fairway width of between 100 and 180 metres, dependent on the specific characteristics of the river section concerned (Commission du Danube, 1988 or Danube Commission, 2011).

On 7 June 2012, the transport ministers of the Danube riparian states met for the first time at the European Union's Council of Transport Ministers in Luxemburg to agree on a **Declaration on effective waterway infrastructure maintenance on the Danube and its navigable tributaries**. The riparian states are committed to maintaining adequate fairway parameters for good navigational status according to the provisions of the 'Belgrade Convention' and – for those countries who have ratified it – the AGN.

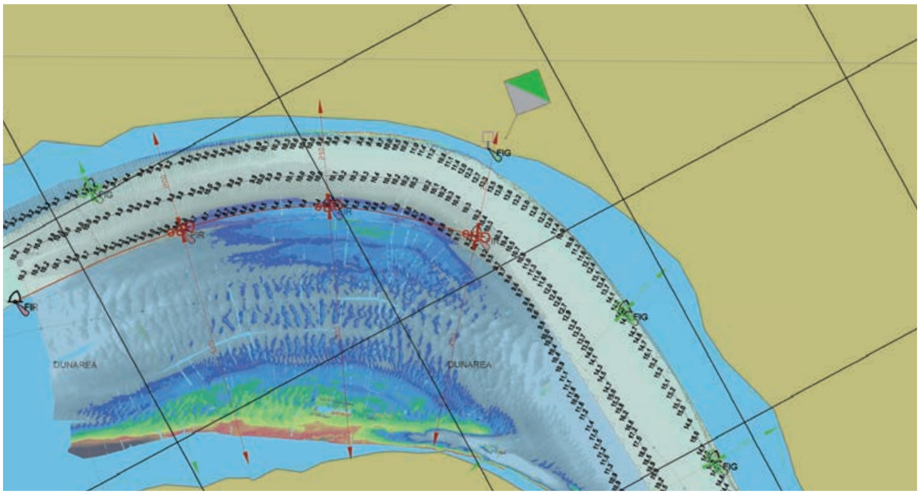
Information about the Master Plan and its monitoring: www.danube-navigation.eu/documents-for-download

FAIRway Danube project: www.fairwaydanube.eu

Further information on the EU Strategy for the Danube Region and on the EU's trans-European transport network is found in the chapter 'Objectives and Strategies' of this manual.

Clear guidelines to achieve the targets enshrined in the declaration were prepared in 2014 by Priority Area 1a – Inland Waterways – within the EU Strategy for the Danube Region in a central document, the **Fairway Rehabilitation and Maintenance Master Plan for the Danube and its Navigable Tributaries**. The Master Plan indicates the shallow sections along the Danube that are critical for navigation and describes the medium-term measures that are necessary in the area of waterway management in order to alleviate these shallow sections. The Master Plan was jointly adopted by the majority of the Danube transport ministers in 2014, providing significant political backing. The transport ministers confirmed once again in 2016 and 2018 that they would provide the necessary funding at national level. Implementation of the Master Plan is reviewed twice each year.

As a flanking measure, the transnational **FAIRway Danube** project, which is co-funded by the EU, will carry out key aspects of the Master Plan by 2021 and in doing so will make a significant contribution to its implementation.



Source: Administrația Fluvială a Dunării de Jos

Bathymetric survey of the maritime Danube stretch in Romania near Tulcea

Fairway maintenance cycle

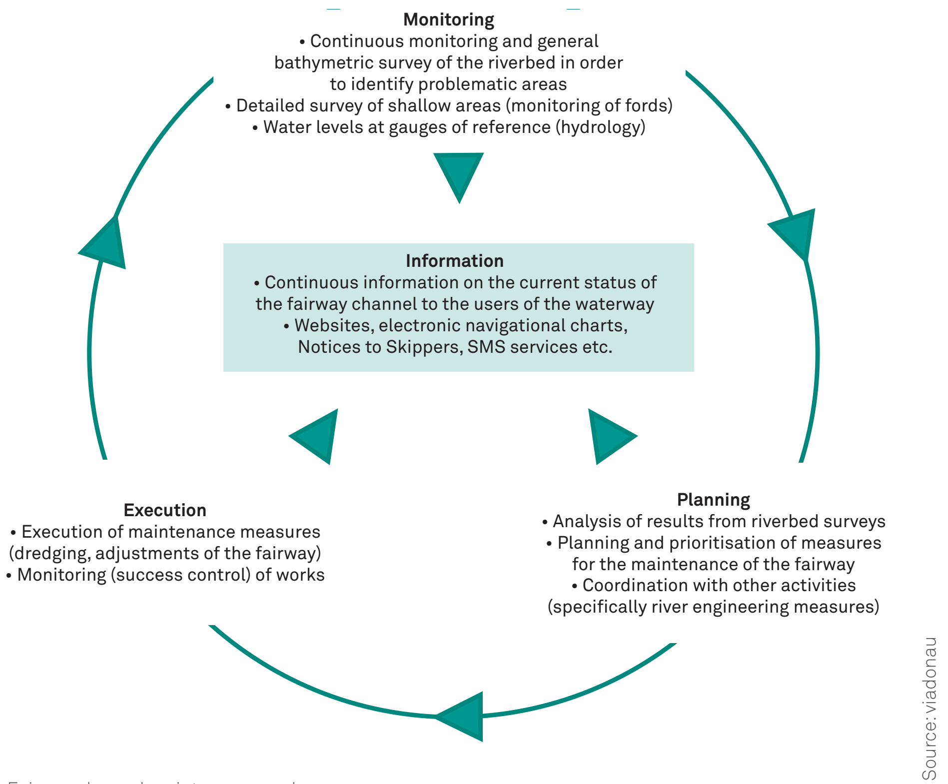
In the case that the minimum fairway parameters are not achieved, the responsible waterway administration is obliged to take suitable measures in order to re-establish them. This is generally accomplished by **dredging shallow areas** (fords) within the fairway. Dredging is an excavation operation with the purpose of removing bottom sediments (sand and gravel) and disposing of them at a different location in the river in due consideration of ecological aspects.

Where recurring dredging is necessary at certain fords, it is possible to implement **hydraulic engineering optimisation measures** in order to ensure adherence to the defined fairway parameters for navigation. Doing so significantly reduces ongoing dredging operations and improves availability of the fairway.

Dredging and hydraulic engineering measures require predictive planning based on the results of regular **bathymetric surveys** and a subsequent review (success monitoring) of the work by the competent waterway administration body.

Given that the **measures** to maintain the fairway are **recurring and interdependent**, it is reasonable to speak of a fairway channel maintenance cycle. Among the most important tasks of this cycle are:

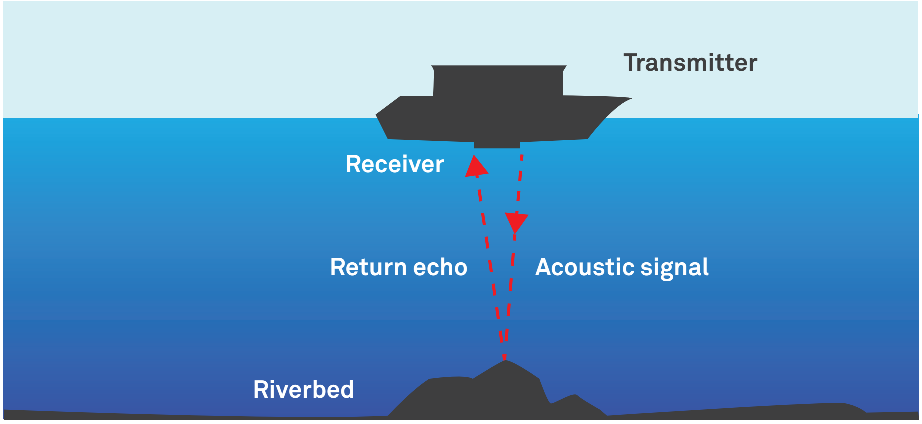
- Regular bathymetric surveys of the riverbed in order to identify problematic areas in the fairway channel (reduced depth and widths)
- Planning and prioritisation of necessary interventions (dredging measures, realignment of the fairway channel, traffic management) based on the analysis of up-to-date bathymetric surveys
- Execution of maintenance works (mainly dredging measures, including success monitoring)
- Provision of continuous and target group-specific information on the current state of the fairway channel to the users of the waterway



Fairway channel maintenance cycle

Surveying of the riverbed

The continuous bathymetric surveying of the riverbed is one of the basic tasks of a waterway administration in order to carry out fairway maintenance measures. Bathymetric survey is conducted on so-called **survey vessels** which are equipped with specific **survey equipment**.



Source: viadonau

Schematic mode of operation of an echo sounder

The most important device for bathymetric surveying of the riverbed is an **echo sounder** which uses sonar technology for the measurement of underwater physical and biological components. Sound pulses are directed from the water's surface vertically down to measure the distance to the riverbed by means of sound waves. The transmit-receive cycle is rapidly repeated at a rate of milliseconds. The continuous recording of water depths below the vessel yields high-resolution depth measurements along the survey track. The distance is measured by multiplying half the time from the signal's outgoing pulse to its return by the speed of sound in the water, which is approximately 1.5 km/sec.

The two main bathymetric systems for bathymetric surveying which are based on the technology of echo sounding are the single-beam and the multi-beam methods.

Single-beam bathymetric systems are generally configured with a transducer mounted to the hull or the side of a survey vessel. A sonar transducer turns an electrical signal into sound (transmitter) and converts sonar pulses back into electrical signals (receiver). Survey vessels using the single-beam technology can only measure water depths below their own survey track, i.e. directly beneath the vessel, thus creating cross or length profiles for the water depths of a river.

Accordingly, areas in between the recorded profiles are not surveyed, but in order to display survey results on a map, water depths for these areas are calculated on the basis of a mathematical interpolation method. Consequently, single-beam technology cannot ensure a full coverage of the current morphology of the riverbed. Waterway administrations generally use the single-beam technology to gain a quick overview on the general morphology of river stretches.

In order to obtain full coverage of a riverbed, **multi-beam bathymetric systems** are used. The multi-beam sonar system has a single transducer, or a pair of transducers, which continually transmits numerous sonar beams in a swathe or fan-shaped signal pattern to the riverbed. This makes multi-beam systems ideal for the rapid mapping of large areas. In addition, and in contrast to single-beam technology, multi-beam bathymetry yields 100% coverage of the morphology of a riverbed, i.e. there are no data gaps between cross or length profiles produced by single-beam bathymetry. Unfortunately, multi-beam surveys are more time-consuming and also more complex than single-beam surveys. Waterway administrations use the multi-beam technology as a basis for the planning and monitoring of dredging works as well as for other complex tasks such as searching for sunken objects or research activities.

Source: viadonau/Andi Bruckner

Multi-beam bathymetric survey on the free-flowing section of the Danube east of Vienna by via donau – Österreichische Wasserstraßen-Gesellschaft mbH

Maintenance dredging works

On the basis of the results of a bathymetric survey of the riverbed, **shallow areas within the fairway** which need to be dredged can be identified. Waterway administrations either carry out dredging works themselves or assign specialised hydraulic engineering to the task.

The essential questions in this respect are: How much material (measured in m^3) needs to be dredged at which location? At which location shall the dredged material be deposited in the river? The latter question has both an economic aspect (distance between dredging site and disposal area) as well as an ecologic aspect: Where is the best place to dispose of the dredged material in terms of environmental impact?

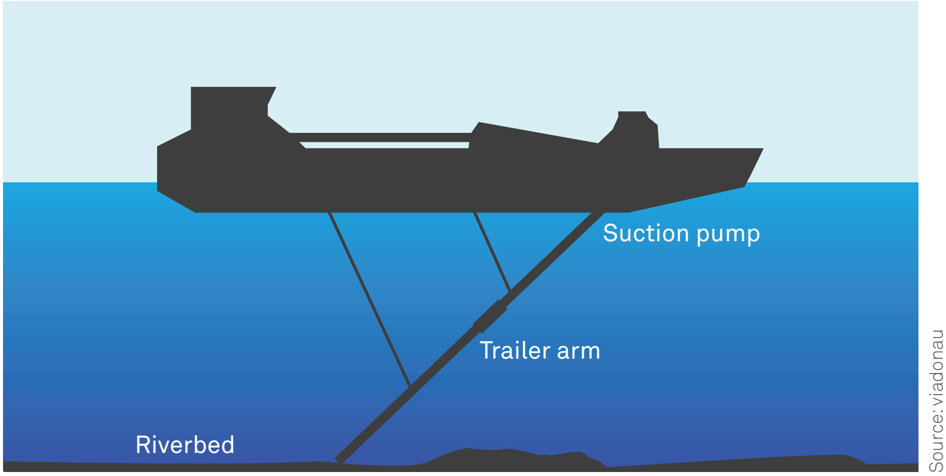
In general, the **selection of the dredging equipment** to be used for a specific measure is based on the characteristics of the dredging task. The equipment used on the Danube waterway is described in greater detail in the following.

On the Upper Danube from Germany to Hungary, where the riverbed generally consists of coarse material (gravel or rocky material), the dredging equipment usually used is **backhoe dredgers in combination with hopper barges**. A backhoe dredger consists of a hydraulic crane which is mounted on a spud pontoon. The crane excavates the material and loads it onto a hopper barge for transportation. Hopper barges have a bottom equipped with doors which can be opened to deposit the dredged material at the disposal point. These non-motorised vessels are moved forward by pushers and need minimum water depths of approximately two metres. Backhoe dredgers can dredge a wide range of different materials (from silt to soft rock), but their output level is limited. This dredger type is very convenient for accurate dredging such as the removal of local shallow areas.

Source: viadonau

Dredging works with backhoe dredger in combination with hopper barges on the free-flowing section between Vienna and Bratislava

Trailing suction hopper dredgers are well suited to dredging soft soil (silt or sand) but require sufficient water depths, i.e. a minimum of five metres. This dredging equipment is especially suitable for the Lower Danube on the Bulgarian and Romanian stretches of the river, where the riverbed consists mainly of silt or sand. Trailing suction hopper dredgers are vessels which are equipped with a suction pipe which acts like a huge 'vacuum cleaner' on the riverbed. The excavated material is sucked on board and collected in the hold of the vessel. Once it is fully loaded, the vessel travels to its destination. Arriving there, the doors in the base of the hold are opened and the excavated material is deposited on the riverbed. This type of dredger does not need anchors and is also very convenient for carrying out maintenance dredging works, provided that a disposal site can be found in the river at a reasonable distance.



Schematic view of a trailing suction hopper dredger

Hydraulic engineering optimisation of critical ford areas

It is advisable to use hydraulic engineering measures to optimise shallow areas and fords that require frequent dredging. Firstly this significantly reduces the regularity of necessary maintenance dredging and the associated, ongoing costs for the waterway operators, while secondly ensuring permanent adherence to the fairway parameters that are required for navigation.

These hydraulic engineering measures must consider the specific situation at the shallow section and make best possible use of existing water structures like **groynes and training walls** to keep the extent of intervention as low as possible. In addition, **ecological optimisation measures** should also be considered as early as the planning phase, for instance the construction of subsurface channels close to the banks. Besides classic elements within hydraulic engineering (groynes and training walls), alternative approaches such as **island landfills** can also produce the desired effects.

Source: viadonau

Hydraulic engineering optimisation on the Austrian Danube: Extension of current groynes near Bad Deutsch-Altenburg and Treuschütt on the free-flowing section between Vienna and Bratislava

Source: viadonau

Hydraulic engineering optimisation on the Austrian Danube: Island landfill in the Rote Werd ford of the free-flowing section between Vienna and Bratislava

Digitalisation and waterway infrastructure

In regard to the waterway infrastructure, a clear distinction can be made between digitalisation measures that are intended to optimise the physical waterway infrastructure (assets) and traffic management ('digital infrastructure'), and those measures that relate to information concerning the current availability (transport route) and current use of the infrastructure (ongoing transports) ('digital information services'):

Digital infrastructure (main users: infrastructure operators): infrastructure (asset) management systems (maintenance and expansion of the waterway infrastructure, bedload management), automation and remote control of lock and weir facilities, lock management (optimised chamber utilisation), marking of waterways (remote monitoring of shore-side and water-borne fairway signs), generation of basic data (bathymetric survey, gauges), compilation and visualisation of the data in geographic information systems.

Digital information services (main users: boatmasters, fleet operators, logistics specialists): Fairway information services as part of the River Information Services (water levels, information on shallow sections, route and lock availability, vertical clearance under bridges, Notices to Skippers), digital Aids to Navigation (virtual fairway signs in electronic navigational charts), berth occupation and berth booking systems (current availability).

River Information Services are described in their own chapter in this manual.

The following provides a more detailed description of the services and tools that are already in operation along the Danube waterway.

Digital asset management

Asset management systems for waterways enable an integrative view of waterway infrastructure management or its parts and sections (e.g. fairway/fairway channel, river structures such as groynes or training walls, landing sites, locks or bridges). The provisioning of **asset management software**, combined with a broad variety of basic data, can be used, through the application of big data methods, to obtain profound and visually processed decision-making support for maintenance and improvement measures on waterways at the push of a button. Basic data includes riverbed images, information on the location and dimensions of the fairway or the fairway channel, the positions of water-side marks and signs, the condition of structures (e.g. groynes, training walls, landing sites, locks), current and historical gauge data, transport flows etc. The matching processes can be digitally modelled within operative planning and implementation of specific constructional measures and hence optimise and provide an objective foundation for the budgeting, impact assessment, monitoring and documentation of individual measures.

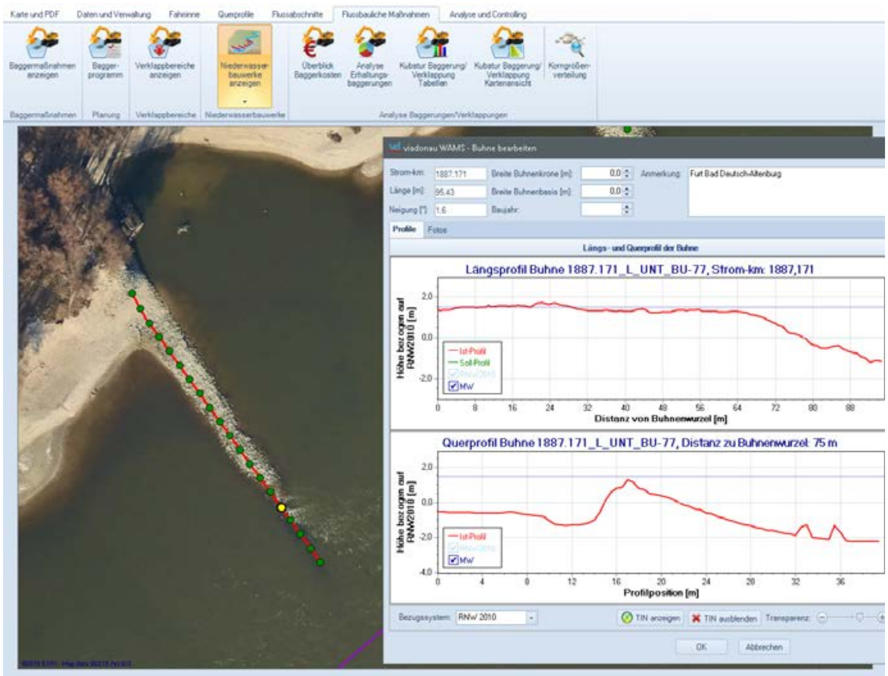
Holistic asset management systems for waterways remain in their nascent stages at European and global level. The feasibility of a cross-border asset management system and the underlying system elements was examined for the international Danube waterway within the framework of a study conducted as part of the EU-funded 'Network of Danube Waterway Administrations – data & user orientation' (NEWADA duo) project (Hoffmann et al., 2014).

The waterway monitoring system WAMOS is currently being established in several Danube states within the framework of the EU-funded 'FAIRway' project and on the basis of this study and the WAMS waterway asset management system (see below), which has already been implemented in Austria. This system aims to compile within a Danube-wide database a minimal set of waterway infrastructure data (bathymetric survey, water levels, infrastructure measures) originating from national waterway (asset) management systems.

Waterway asset management in Austria

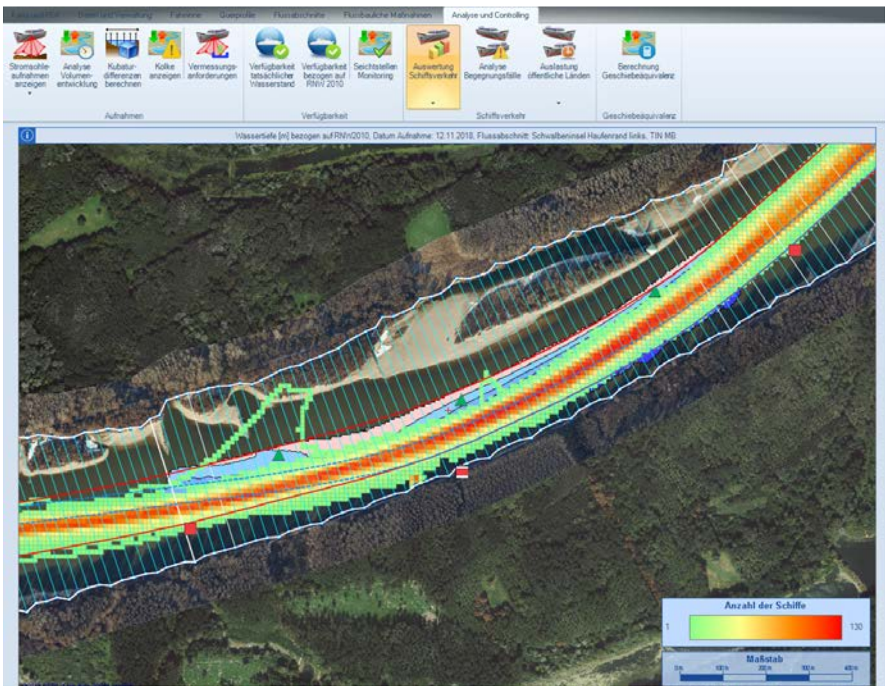
The waterway asset management system WAMS was created in a multi-year research project conducted in cooperation between viadonau as the waterway infrastructure operator and the Technical University Vienna; its purpose is to manage the infrastructure on the Austrian section of the Danube. In operation at viadonau since 2015, the software delivers improved decision-making assistance for efficient and ecologically optimised maintenance of the waterway. WAMS has a modular structure and includes the following functions and features, among others:

- Central waterway database for the management of big data, including a graphic user interface; the database brings together basic infrastructural data such as riverbed images and water levels and permits, among other things, the analysis of fairway channel availability or the evaluation of sedimentation and erosion in freely definable sections of the waterway.
- Process management for dredging works: Maintenance measures in the fairway channel can be planned and optimised systematically using the software; their implementation and results can then be monitored and visualised in a transparent and comprehensible form.
- Support for optimisation of the bedload cycle toward a holistic system of sediment management to reduce riverbed erosion and to optimise maintenance: Comprehensive documentation on dredging and dumping in the area of the free-flowing section east of Vienna; visualisation of the quantities and the ecological impact of dumping bedload further upstream.
- Analysis and functional assessment of the low water regulating structures over their life time: The precise location and condition of the individual structures are mapped precisely based on aerial images and multi-beam surveys and then visualised in the WAMS system; this can be used to derive any necessary maintenance work required on the structures.
- Consideration of the traffic flows on any definable sections for the optimisation of infrastructure based on fairway channel utilisation: Visualisation of the actual vessel tracks (by means of so-called 'heat maps') and combination with infrastructure data (bathymetric surveys) to enable optimisation of the fairway channel trajectory and possible dredging measures.



Presentation of the cross and length profiles of a groyne in WAMS; the elevation points are obtained from laser scanning flights

Source: viadonau



Heat map presentation of vessel tracks in WAMS, obtained from around Schwalbeninsel on the free-flowing section between Vienna and Bratislava

Source: viadonau

Remote monitoring of fairway signs

Digitally-assisted monitoring of water and shore-side fairway signs such as fairway buoys with or without a rhytmic light or rhytmic lights on land enable continuous tracking of the correct position and functions of these traffic signs. Common technologies used for remote monitoring on waterways are GPS (satellite positioning), satellite communication (e.g. 'Globalstar') or the Automatic Identification System (AIS) by River Information Services.

Positional changes of **floating fairway signs** are monitored. For instance, a notification is sent if a fairway buoy moves beyond a defined limit (e.g. due to deviation or collision with a vehicle). This notification allows the competent waterway authorities to respond in good time and restore the proper state of the sign.

For **water or shore-side rhythmic lights** remote monitoring can also be used to track the lamp functions (condition, rhythm/flashing frequency, light intensity), current power supply (battery voltage) and ambient temperature.

Virtual fairway signs – known as 'virtual AtoNs (Aids to Navigation)' – are already used in the maritime sector. This involves sending icons of digital fairway signs to the boatmaster by AIS; they are then displayed on an electronic navigation chart on board, without the signs being physically present. There are also potential uses for this technology within inland navigation, for instance to ensure timely designation of hazardous areas (e.g. new shallow sections due to sediment relocation) or temporary traffic bottlenecks (e.g. around accidents). Naturally, it will only be possible to use virtual fairway signs if suitable display devices and current charts are available on the vessels themselves.

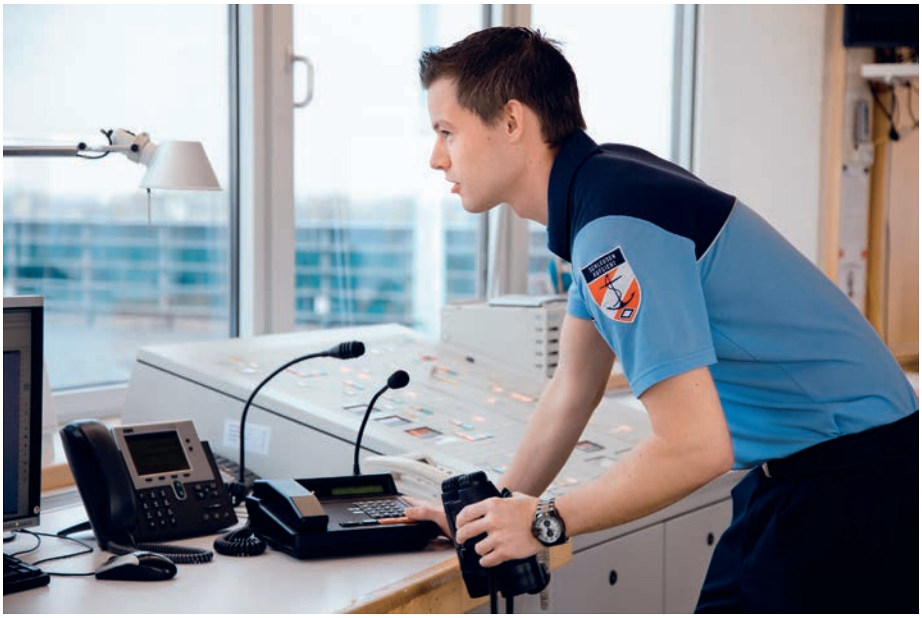
Source: viadonau/Raimund Appel, Thomas Hartl

Use of remote monitoring technologies on plastic buoys of the type B7 (without light) and LT B7 (with light); on the left: monitoring using Globalstar (satellite); on the right: monitoring using AIS

Digitally-assisted lock management

Locks constitute bottlenecks for inland navigation as the bundling of vessel traffic and the time-intensive process of locking delay the journey. Waiting times can be expected by vessels particularly before lock facilities, as currently no long-term advance notification of a vessel's arrival at a lock is possible. In the past, boatmasters have only been able to register for the locking process when they are already in the proximity of the lock facility due to the short radio range. Therefore, vessels arriving at the lock will be handled according to the principle of 'first come, first served' (the only exceptions are liner services, which are given priority in some countries).

The main purpose of a lock management system for inland navigation is to optimise traffic flows by making locking procedures more efficient and plannable. River Information Services (RIS) support navigation and lock operators in their daily tasks.



Source: viadonau/Pilo Pichler

Lock management at the lock Freudenau near Vienna

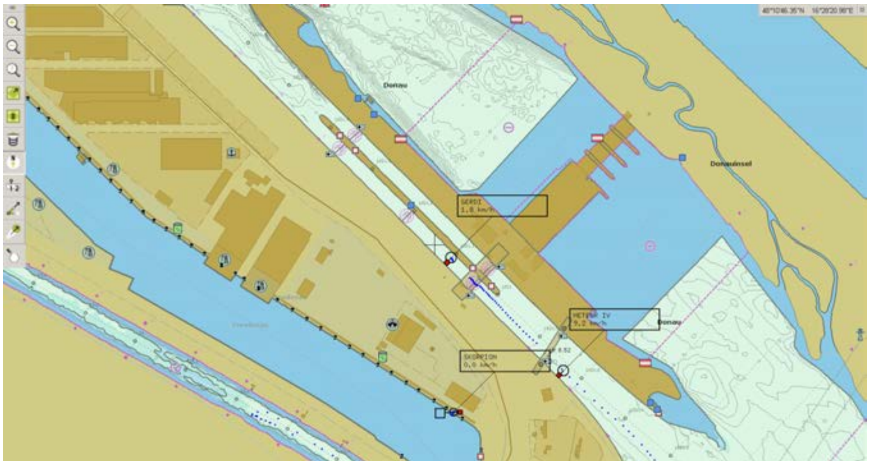
Before admission to European inland waterways, inland vessels have to undergo a technical inspection. The results of which are recorded in a central vessel database.

Lock management with RIS in Austria

The RIS systems to support lock management on the Austrian Danube consist of two main components:

- electronic traffic situation image from the DoRIS system
- electronic lock journal

There is also a connection to the European Hull Database and to the electronic reporting system for hazardous goods.

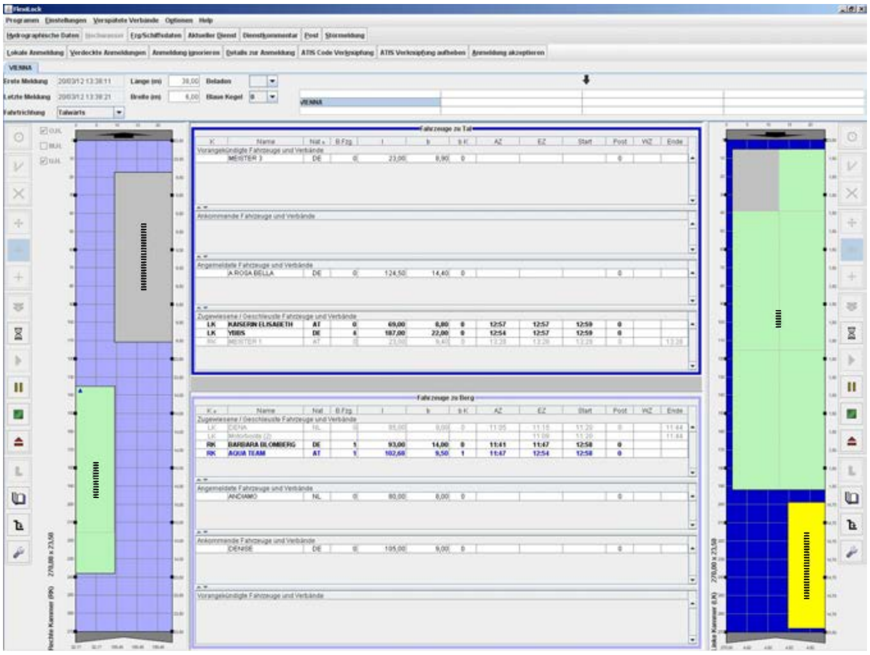


Source: viadonau

Visualisation of vessel traffic in the immediate proximity of a lock on the Electronic Navigational Chart

The **AIS (Automatic Identification System)**, which provides seamless geo-positioning of vessels, is used for the planning of locking and the identification of the optimum time to enter the lock. This enables optimised planning of locking cycles, the avoidance of waiting periods and a reduction in empty lock cycles. At the same time, vessels can send timely notification and can optimise their speed to reduce fuel consumption and costs where possible.

An **electronic lock journal** was introduced at the Austrian Danube locks. This system largely enables automated planning and documentation of all services at the lock.



Source: viadonau

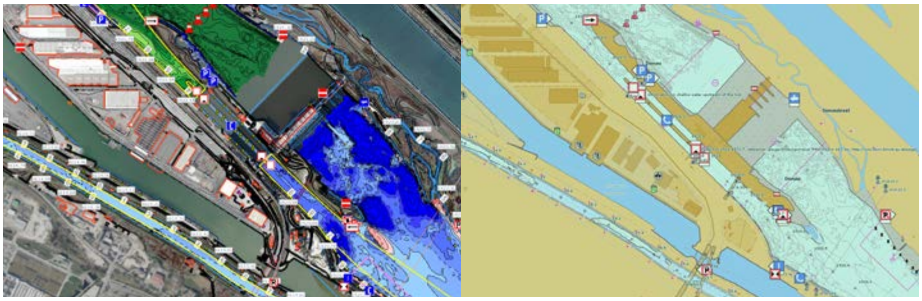
User interface for the electronic lock journal

Fairway Information Services

So-called **Fairway Information Services** (FIS) provide current information on the navigability of waterways and therefore support boatmasters, fleet operators and other waterway users in the planning, monitoring and execution of inland waterway transport.

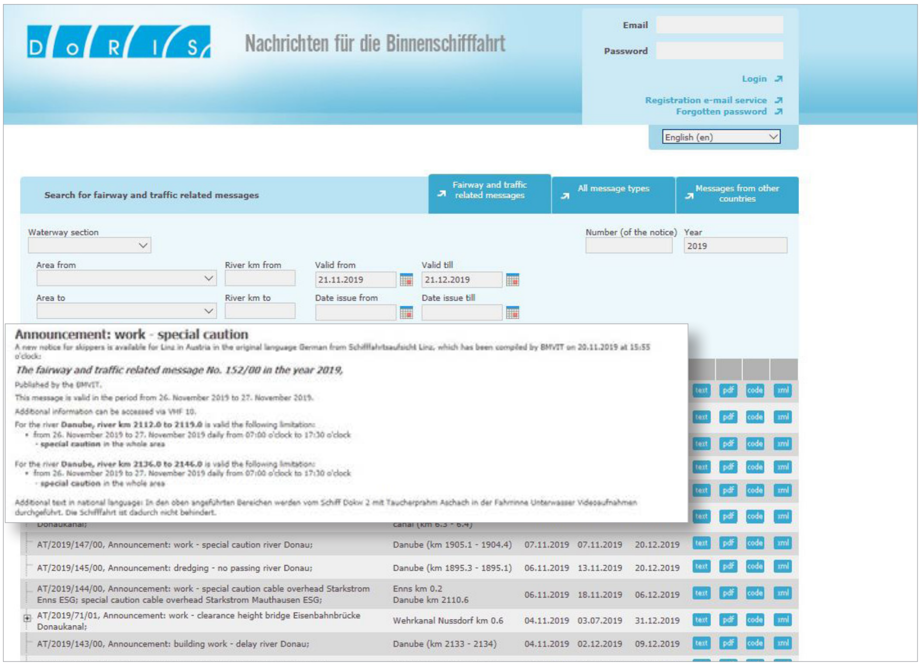
The most common way to publish fairway-related information is either through Electronic Navigational Charts (Inland ENCs) or online via Notices to Skippers (NtS).

More information on Electronic Navigational Charts and Notices to Skippers can be found in the chapter 'River Information Services'.



Source: viadonau

From basic data to the Electronic Navigational Chart; section of the Freudenau power plant in Vienna along the Austrian section of the Danube



Source: viadonau

Accessing a Notice for Skippers on the Austrian DoRIS portal

Static data such as bridge parameters, the dimensions and position of the fairway or results of bathymetric surveying activities are included in **Electronic Navigational Charts** which are updated on a regular basis.

Dynamic data such as water levels at gauges, prognoses of gauge heights or information on navigation restrictions and suspensions are provided via **Notices to Skippers** or can be directly accessed on the Internet.

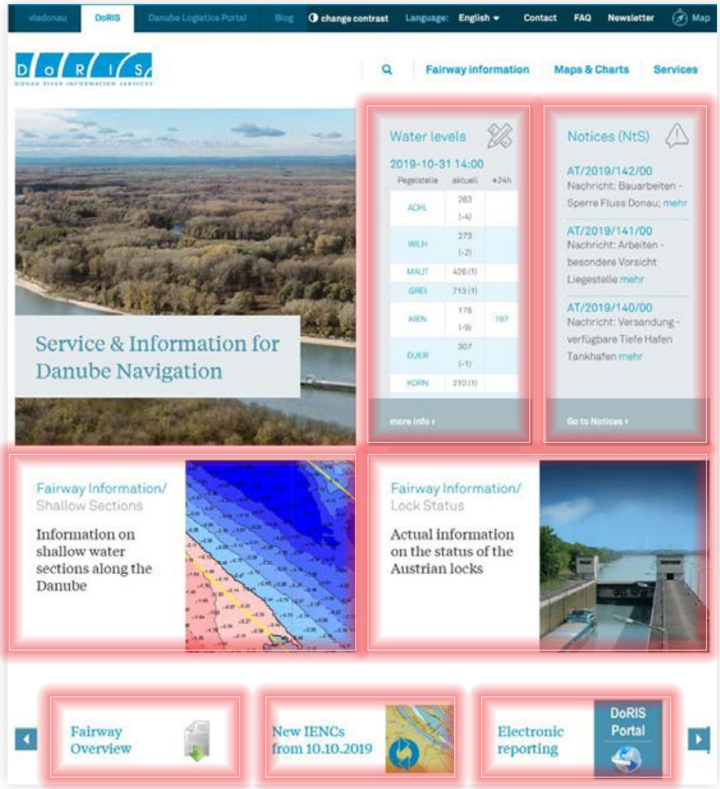
Digital fairway information in Austria

Donau River Information Services (DoRIS) provide extensive fairway information services in Austria, in particular:

- Water levels: Information about the current water levels and level forecasts at ten gauge stations
- Shallow sections: Current fairway depths at important shallow sections of the two free-flowing sections of the Danube in Austria; a depth layer plan is available for each published shallow section, which also visualises the useable deep channel; shallow sections that are currently being dredged are marked accordingly.
- Vertical bridge clearance: The currently available clearance relative to the momentary water level is published for the seven bridges on the Austrian Danube that have the lowest vertical clearance heights.

- Notices to Skippers: Contain information concerning the waterway and traffic as well ice reports.
- Current operational status of the lock chambers in the nine locks along the Austrian Danube.
- Blocked stretches in cases of flooding or ice.
- The 'Overview on the actual fairway information' presents the current water levels, shallow sections, lock status and Notices to Skippers, summarised in one single PDF file.
- Electronic navigational charts are available online for the entire Austrian Danube section and can also be downloaded as PDF files and printed out.

The public RIS information is free of charge and can be accessed on the DoRIS website or using the smartphone app 'DoRIS Mobile' (for iOS and Android).

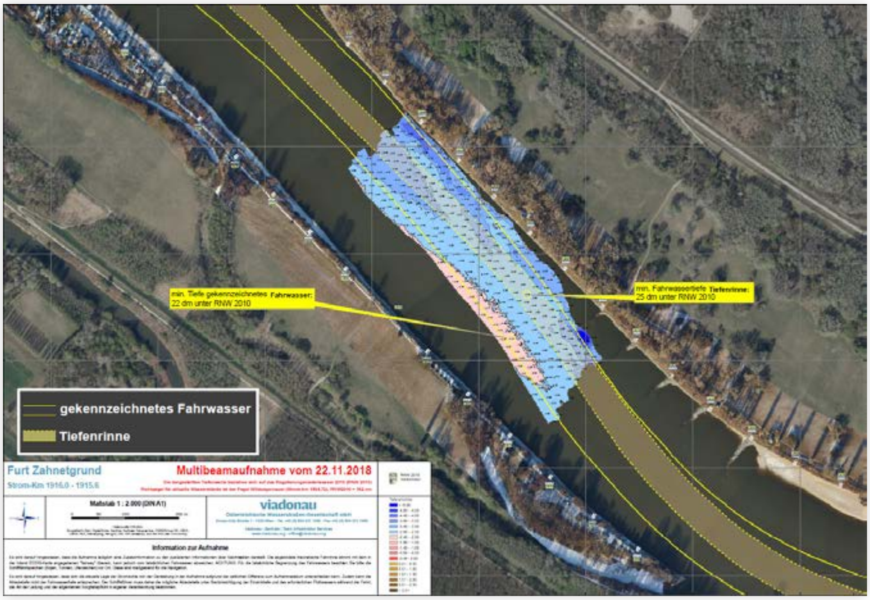


Source: viadonau

Online services on the DoRIS website

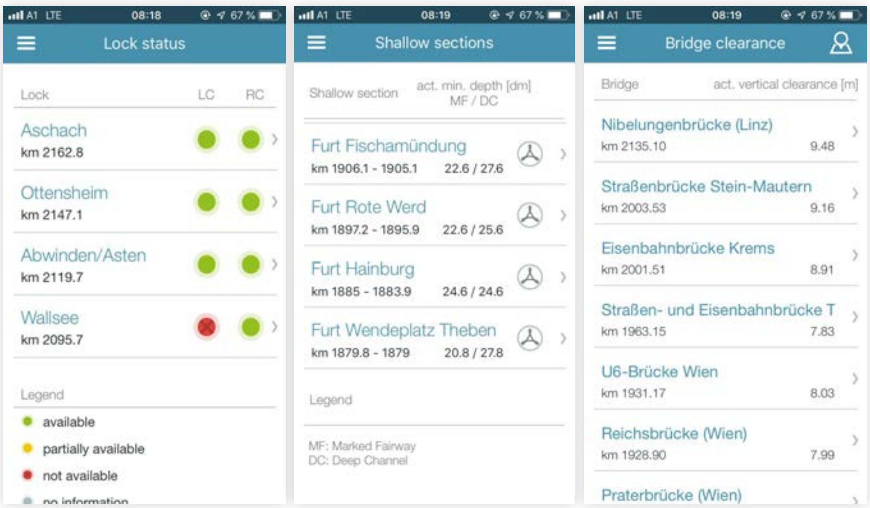
Current fairway information for the Austrian section of the Danube is available at the DoRIS website: www.doris.bmvit.gv.at/en,

as well as on the free smartphone app DoRIS Mobile:



Source: viadonau

Deep layer plan for a shallow section east of Vienna, with visualisation of the course of the marked fairway and the deep channel



Source: viadonau

Example of information from the DoRIS Mobile app

Improvement and extension of waterways

Apart from the maintenance of the fairway channel of inland waterways for the purpose of meeting the recommended fairway parameters, infrastructure work on waterways may also include the improvement or extension of the existing inland waterway network. The **improvement** of a waterway pertains to the upgrade of its UNECE waterway class or to the removal of so-called 'infrastructural bottlenecks'. The **extension** of the network can be the construction of new waterways which in some cases, according to the AGN, may be described as 'missing links'.

The maintenance, improvement and extension of inland waterways should always be accomplished by taking the following two main aspects of inland waterway infrastructure development into account:

- **Economics of inland navigation**, i.e. the connection between the existing waterway infrastructure and the efficiency of transport
- **Ecological effects of infrastructure works**, i.e. balancing environmental needs and the objectives of inland navigation (integrated planning)

Legal and political framework

The legal/political framework for the improvement and the extension of the inland waterway infrastructure network is set at the following different levels by the corresponding institutions as well as by strategic projects and documents:

- **Pan-European**: United Nations Economic Commission for Europe (UNECE) → international resolutions and agreements (AGN; Resolution No. 49 on the most important bottlenecks and missing links in the European inland water way network)
- **European**: European Union (mainly Directorates-General for Mobility and Transport, Regional and Urban Policy and Environment) → Danube waterway as part of Corridor 10 in the framework of the trans-European transport network; Priority Area 1a (To improve mobility and multimodality: Inland waterways) of the EU Strategy for the Danube region; Water Framework Directive, Natura 2000 network etc.
- **Regional (Danube region)**: Danube Commission, International Commission for the Protection of the Danube River, International Sava River Basin Commission → Belgrade Convention, Recommendations on the minimum requirements of fairway parameters as well as the improvement of the Danube by hydro-engineering and other measures, Plan for the principal works called for in the interests of navigation; Danube River Basin Management Plan, Joint Statement (cf. on the next page under 'Environmentally sustainable Danube navigation'); Framework Agreement on the Sava River Basin and accompanying strategy for its implementation
- **National**: national transport strategies and development plans of the ten Danube riparian states, as the maintenance and improvement of the infrastructure of inland waterways is a national competence of the countries concerned

@ Inland navigation at UNECE: www.unece.org/trans/main/sc3/sc3.html

@ Trans-European transport network: ec.europa.eu/transport/infrastructure

@ Priority area inland waterways in the Danube region strategy: www.danube-navigation.eu

@ Danube Commission: www.danubecommission.org

@ International Commission for the Protection of the Danube River: www.icpdr.org

@ International Sava River Basin Commission: www.savacommission.org

Infrastructural bottlenecks in the waterway network of the Danube region according to UNECE Resolution No 49

Environmentally sustainable Danube navigation

For more information on this topic, visit the website of the Commission for the Protection of the Danube River: www.icpdr.org/main/issues/navigation

Large river systems such as the Danube are highly complex, multi-dimensional, dynamic ecosystems and thus require comprehensive observation and management within their catchment area.

This kind of holistic approach is also required by the **Water Framework Directive** (WFD) of the European Union (European Commission, 2000). For international river basin district entities such as the Danube the WFD requires the coordination of international river basin management plans which also involve non-EU member states wherever possible. In the Danube river basin district, the **International Commission for the Protection of the Danube River** (ICPDR) is the platform for the coordination of the implementation of the WFD on the basin-wide scale between the Danube countries.

In 2008, the ICPDR, the Danube Commission and the International Sava River Basin Commission (ISRBC) endorsed a **Joint Statement on Guiding Principles for the Development of Inland Navigation and Environmental Protection in the Danube River Basin** (International Commission for the Protection of the Danube River, 2008). The statement provides guiding principles and criteria for the planning and implementation of waterway projects that establish consistency between the sometimes conflicting interests of navigation and the environment. It opts for an **interdisciplinary planning approach** and the establishment of a 'common language' across all disciplines involved in the process.

In order to facilitate and ensure the application of the Joint Statement, a **Manual on Good Practices in Sustainable Waterway Planning** has been developed by the ICPDR and relevant stakeholders in the Danube region within the framework of the EU project PLATINA in 2010 (Platform for the Implementation of NAIADES, 2010). It focuses on projects for a sustainable improvement and expansion of waterways. The basic philosophy is to integrate environmental objectives into the project design, thus preventing legal environmental barriers and significantly reducing the amount of potential compensation measures.

Source: viadonau/Zinner

Win-win for ecology and commerce: renatured banks and innovative form of groyne for regulation of low water levels on the free-flowing section of the Danube east of Vienna

The manual proposes the following **key characteristics for integrative planning**:

- Identification of integrated project objectives incorporating inland navigation aims, environmental needs and the objectives of other uses of the river reach such as nature protection, flood management and fishing
- Inclusion of important stakeholders in the early phase of a project
- Implementation of an integrated planning process to translate inland navigation and environmental objectives into concrete project measures thereby creating win-win results
- Performance of comprehensive environmental monitoring prior, during and after project works, thereby enabling an adaptive implementation of the project when necessary

While the focus of the 2010 **Manual on Good Practices in Sustainable Waterway Planning** is placed on future hydraulic engineering projects to optimise the infrastructure of inland waterways, the supplementary **Good Practice Manual on Inland Waterway Maintenance** addresses the eco-friendly and sustainable implementation of ongoing maintenance works on inland waterways by the waterway administration authorities.

@ Electronic versions of the good practice manuals: www.naiades.info/downloads

The manual was published in 2016 as part of the EU's PLATINA II project and concentrates on the proactive maintenance of fairway channels in free-flowing sections of natural waterways in Europe. Among others, the maintenance measures include dredging at problematic areas, the relocation or (temporary) narrowing of the fairway course or the optimisation of current river structures in regard to their regulating or ecological effects.

Catalogue of Measures for the Danube east of Vienna

via donau – Österreichische Wasserstraßen-Gesellschaft mbH, a subsidiary of the Austrian Federal Ministry for Transport, Innovation and Technology, adopts an integrative approach to stabilise the water level on the free-flowing section of the Danube east of Vienna, to preserve the unique habitat in the Danube-Auen National Park and to structure the waterway infrastructure in line with the requirements of safe and efficient Danube navigation. The corresponding Catalogue of Measures is the outcome of an interdisciplinary planning process.

Based on the insight acquired in the pilot project phase of the Integrated River Engineering Project, conservation activities will be combined with optimisation measures within hydraulic engineering:

- Integrative bedload management: In order to maintain safe and cost-effective navigable fairway conditions, gravel is excavated every year at the critical shallow sections. Gravel is also obtained from bedload traps specially set up for the purpose. This material is taken as far upstream as possible and dumped there in areas where the riverbed is deep. This counteracts the current-related removal of gravel (degradation) and thus secures the height of the riverbed. This bedload redistribution is enhanced by the external addition of gravel. Deep areas, in which the river has already largely washed out the gravel, are secured.

- Riverbank restoration: Natural riverbank structures are forming due to the local dismantling of the stone armour on the banks of the Danube. New habitats are being created for birds that breed on gravel banks and for typical riverine plant species. The river is reclaiming more space, which reduces the stress on the riverbed and lowers the water level in case of flooding.

- Sidearm reconnection: Branches bring life to the wetland forest and have become a rare type of habitat. They shape the landscape through erosion and sedimentation. Connections between the largest branch systems in the Danube-Auen National Park and the Danube will therefore be strengthened once again. The aim is to achieve the highest level of continuous flow so that the branch is active virtually all year round. This relieves pressure from the riverbed in the main channel and counteracts riverbed erosion. The resulting improved retention effect on the Danube wetlands also complements to constructive flood protection.

- Optimisation of the regulating structures: In order to ensure navigability also during low water periods and to reduce the operating costs of waterway infrastructure, low water regulation structures (groynes, training walls) are improved in critical ford areas (shallow sections). In areas of erosion, regulating measures can be moderately reduced by widening the channel to relieve pressure on the riverbed, thereby stabilising the water level.

Source: viadonau/Robert Tögel

Reconnected inlet opening for the Johler branch near Hainburg

Stakeholder participation: The involvement of the most diverse stakeholders and civil society is an important prerequisite for the development and implementation of socially and environmentally compatible solutions. Therefore, the implementation of the Catalogue of Measures is accompanied and supported by a participation model. At the centre of the model is an advisory board made up of representatives from industry, environmental NGOs, the ICPDR (International Commission for the Protection of the Danube River), the Donau-Auen National Park and viadonau. Further players who are affected or interested are involved in the course of ongoing information and discussion offerings.

A learning system: The Catalogue of Measures affords the flexibility required for new findings and current developments to be incorporated into the implementation. Ongoing preservation measures can be continually improved. The optimisation projects that are being implemented gradually according to their priority also enable constant further development from project to project. Continuous status evaluations and monitoring, or scientific support respectively are necessary for planning and success control ('learning from the river').

@ Project website: www.lebendige-wasserstrasse.at

Source: viadonau

Loading of gravel; Reconstruction of a groyne

Waterway management in Austria

Home to 350.50 kilometres of river, Austria accounts for 10% of the total Rhine-Main-Danube waterway. Besides the Danube itself, the Vienna Danube Canal (17.1 km) and short sections of the Danube tributaries Traun (1.8 km), Enns (2.7 km) and March (6.0 km) are classified as waterways.

via donau – Österreichische Wasserstraßen-Gesellschaft mbH is responsible for maintaining the Austrian section of the Danube waterway and its navigable tributaries and canals. The company was founded in 2005 by the Austrian Federal Ministry for Transport, Innovation and Technology (BMVIT) and is tasked with the conservation and development of the Danube waterway. The legal basis for all activities and services supplied by the company is provided by the **Waterways Act** (Federal Law Gazette I 177/2004). They include the establishment and provision of fairway parameters (waterway maintenance in accordance with the international provisions in force), the implementation of ecological hydraulic engineering and renaturation projects, the maintenance and restoration of river banks as well as the continuous provision of hydrographical and hydrological data. Regarding traffic management, viadonau operates an information and management system for navigation named DoRIS (Donau River Information Services) and is responsible for the management of the nine Austrian Danube locks. The headquarter of viadonau is located in Vienna; in order to carry out its tasks, the company also owns four branch offices along the Danube and March rivers.

viadonau website:
www.viadonau.org

via donau – Österreichische Wasserstraßen-Gesellschaft mbH

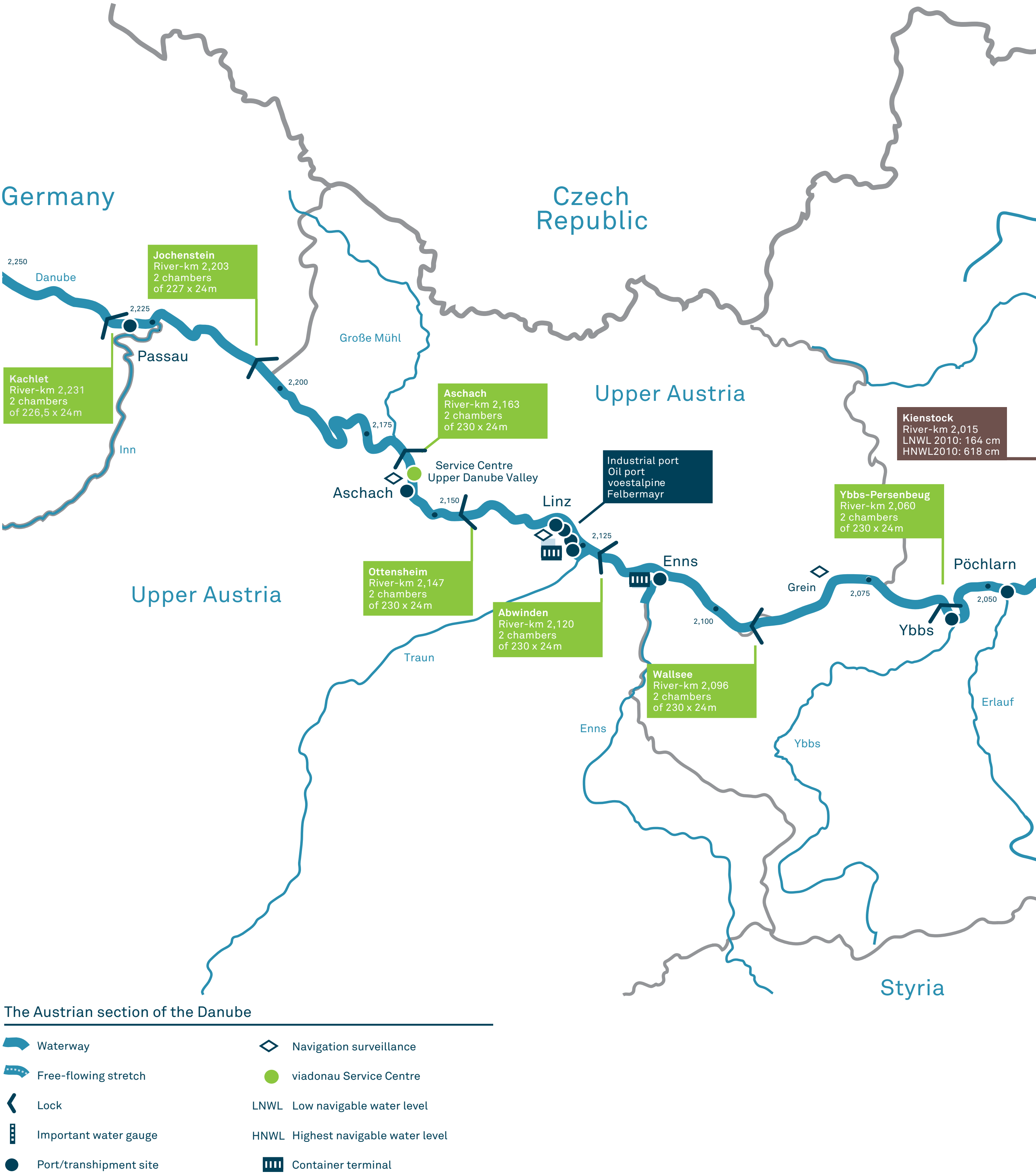
Adress: A-1220 Vienna, Donau-City-Strasse 1
Tel: +43 50 4321 1000 | Fax: +43 50 4321 1050

The strategic planning, control and monitoring of the administration of federal waterways rests with the **Federal Ministry for Transport, Innovation and Technology** (BMVIT). As a subordinate entity of the Supreme Navigation Authority (OSB) in the Ministry, navigation surveillance is carried out by nautically trained administration police who are responsible for ensuring the consistent administration of navigation on the Austrian section of the international Danube waterway within the framework of the 'Belgrade Convention'. Among the tasks of the navigation surveillance, which has six field offices along the Danube in Austria, are navigation control, the supervision of adherence to all administrative regulations pertaining to navigation, the issuing of directives to the users of the waterway and assistance for damaged vessels.

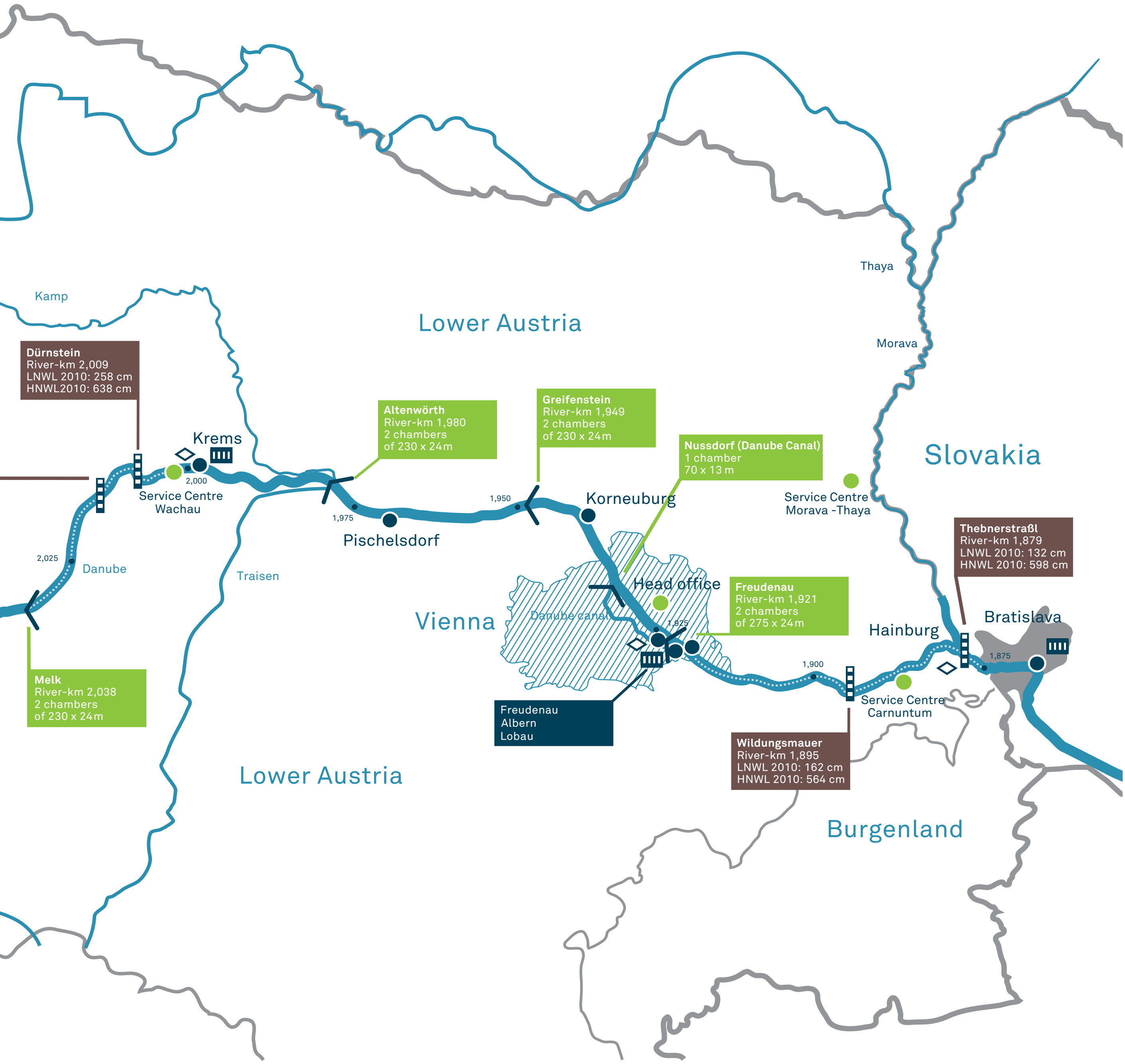
Supreme Navigation Authority
within the Federal Ministry for Transport, Innovation and Technology.

Adress: A-1030 Vienna, Radetzkystrasse 2
Tel: +43 1 71162 655903 | Fax: +43 1 71162 655999

BMVIT website:
www.bmvit.gv.at



The Austrian section of the Danube including offices and branch offices of viadonau and navigation surveillance



Source: viadonau

FIGURES DATA FACTS

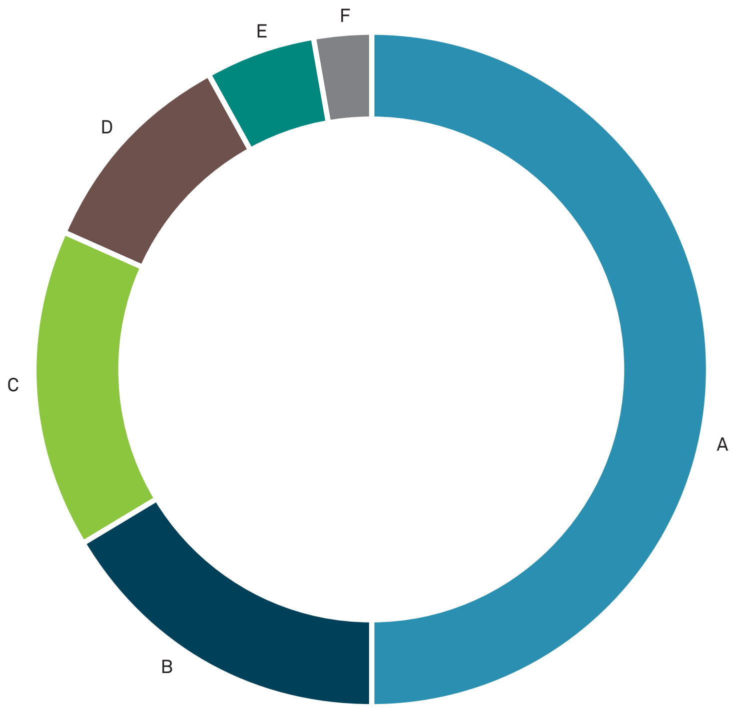
Costs per core tasks and impact scope viadonau 2018

Costs of core tasks

F
Other
2.6%
904,363 Euros

E
Real estate
5.3%
1,831,187 Euros

D
Development and innovation
10.4%
3,589,582 Euros

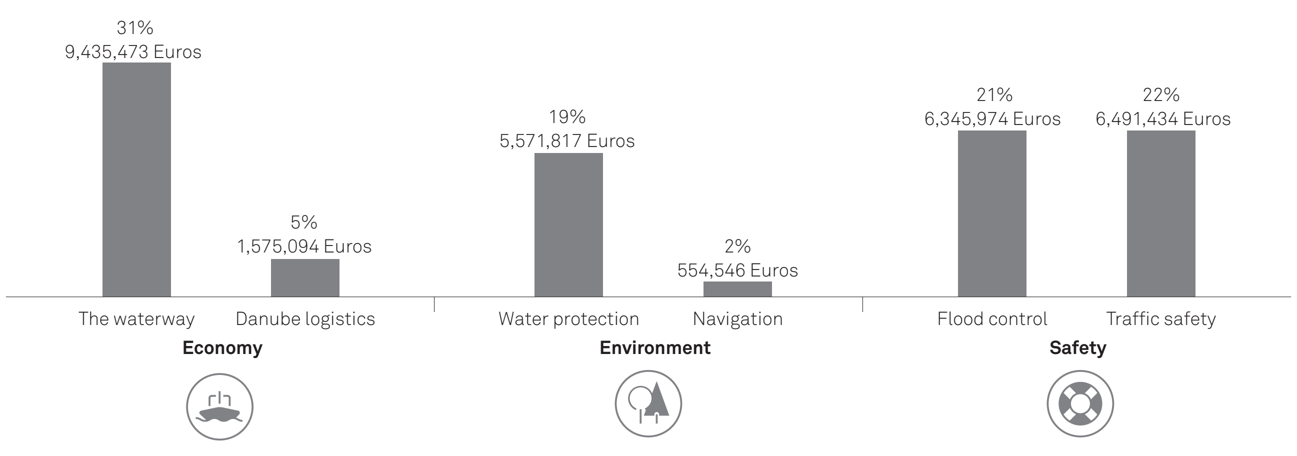


A
Infrastructure management
50.2%
17,268,598 Euros

B
Traffic management
16.3%
5,616,708 Euros

C
Flood control (excl. DHK)
15.2%
5,223,954 Euros

Costs per impact scope



BALANCE SHEET VIADONAU

Service creates trust
Consistent customer orientation

2018 – a year of opportunities and challenges: Austria's EU Council Presidency in 2018 provided a particularly prestigious opportunity to draw attention to the Danube's growing role within the European transport network. On the other hand, the historical low-water period as the determining factor during the year once again showed how important proactive waterway management is for the reliability of the Danube transport route.

Competitive through sustainability and predictive action. At viadonau, the year featured a number of important international events. The fact that the environment and economic interests are not mutually exclusive, but can – quite on the contrary – complement each other perfectly, was illustrated by the Danube Awareness Day, the inaugural event held as part of Austria's EU Council Presidency. The RIS Corridor Management Stakeholder Forum addressed innovative solutions for the further implementation of the telematics system RIS (River Information Services) in the European waterway network, while the Danube Business Talks formed the highlight of the series of events organised by viadonau. Here, new markets for inland navigation were explored together with representatives from politics, administration and the transport and logistics sector.

Internationalising quality. The events contributed to strengthening international contacts and networks as well as successfully advancing joint transnational projects. The international FAIRway Danube project in particular offered concrete progress in terms of service quality along the entire Danube. The construction and commissioning of several working and sounding vessels in Croatia, Slovakia, Bulgaria and Romania were a strong signal for the Danube as a sustainable mode of transport.

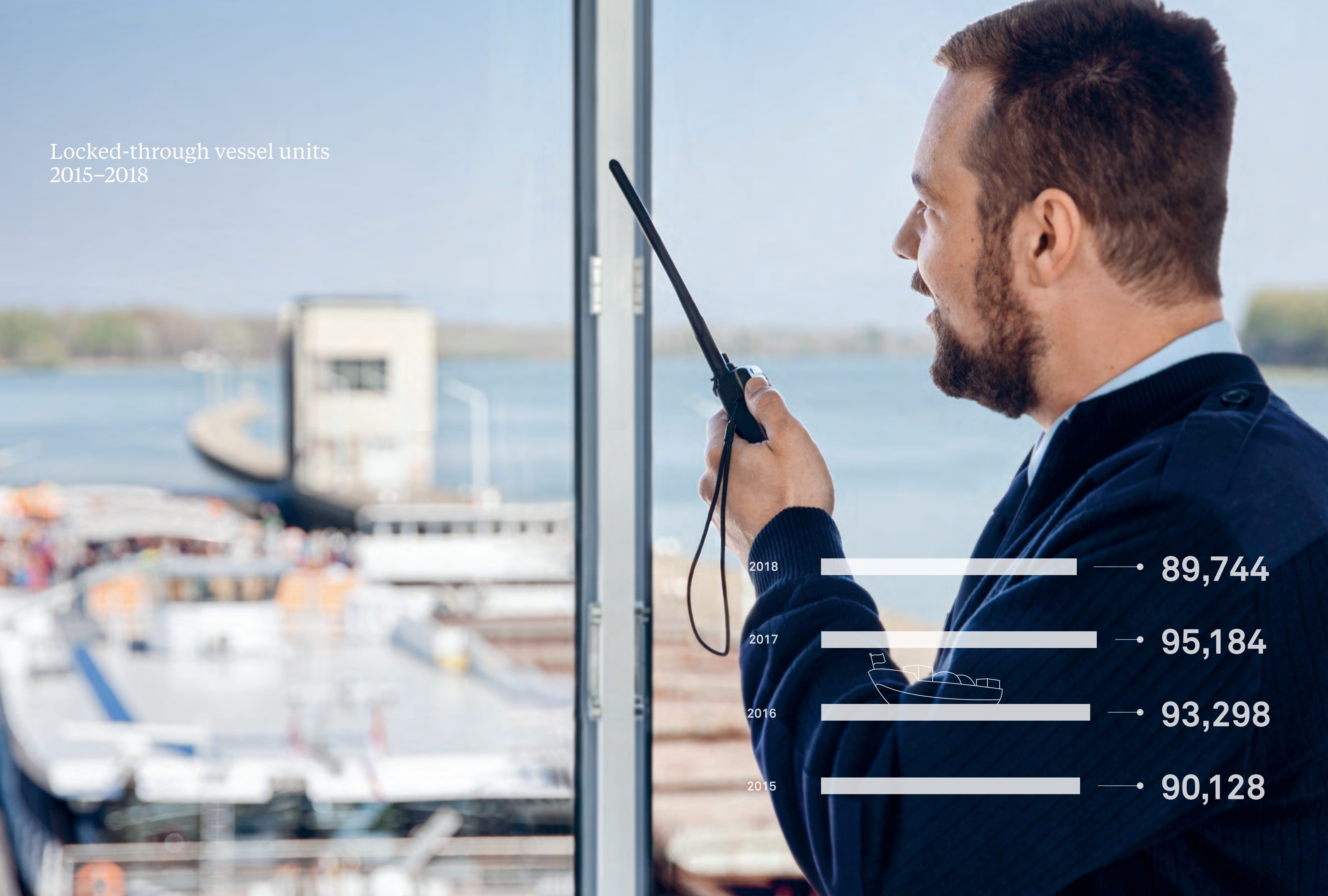
Once again: waterway management. Due to the pronounced low water level, the second half of 2018 in particular was an important test for integrative, proactive waterway management. A new island was created in the Rote Werd shallow section on the Danube east of Vienna in March with the intention of contributing to low water regulation by reducing the flow cross-section. In addition, other critical shallow sections were also improved in a sustainable manner. In order to be able to guarantee the shipping parameters at the Treuschütt ford, viadonau also optimised existing hydraulic structures there in summer – in a way that preserves nature.

An ecological first. In order to ensure sustainable protection of the Danube river banks on the Johlerarm near Hainburg, special measures with an emphasis on soil and water bioengineering aspects were implemented towards the end of 2018. In the inflow area of the side arm, a construction of tree trunks and willow branches was used to secure the bank in an innovative manner – a scientifically guided measure that was used for the first time in this form on the Danube.

"For us the future of the Danube has already begun. We want to know today what will be in demand tomorrow and thus provide modern and accurate services. About 95 percent of the Danube waterway customers questioned gave once again excellent grades to the quality of our services in a survey at the end of 2018. Such kind of satisfaction is our highest reward and shows us that we are on the right path."

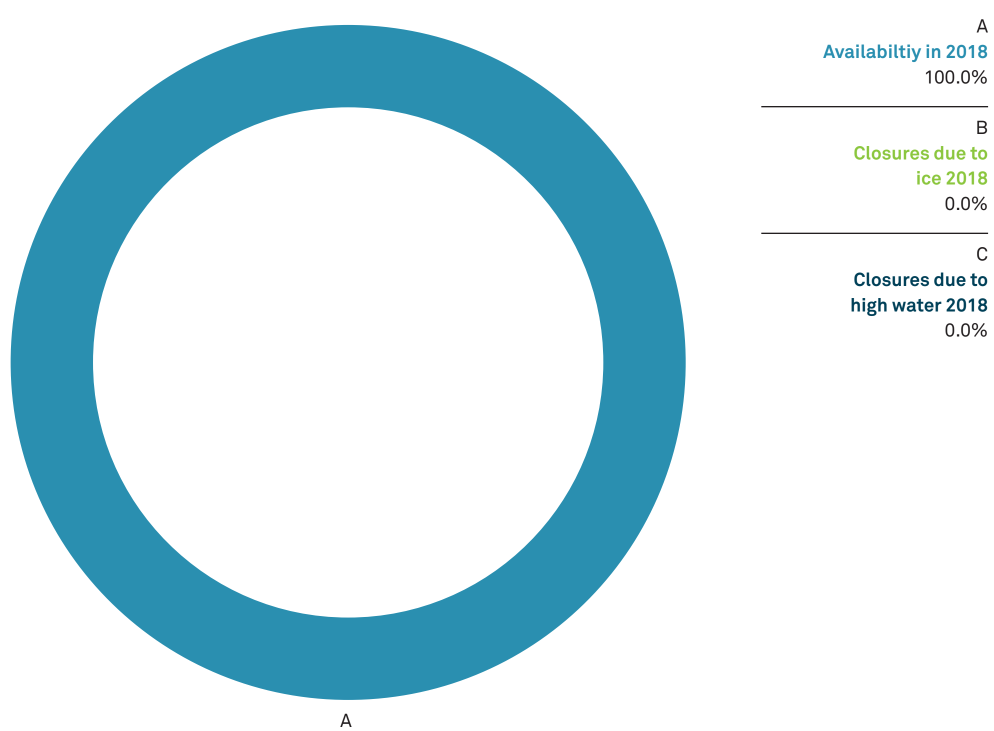
CHRISTOPH CASPAR
Head of Communication and Knowledge Management

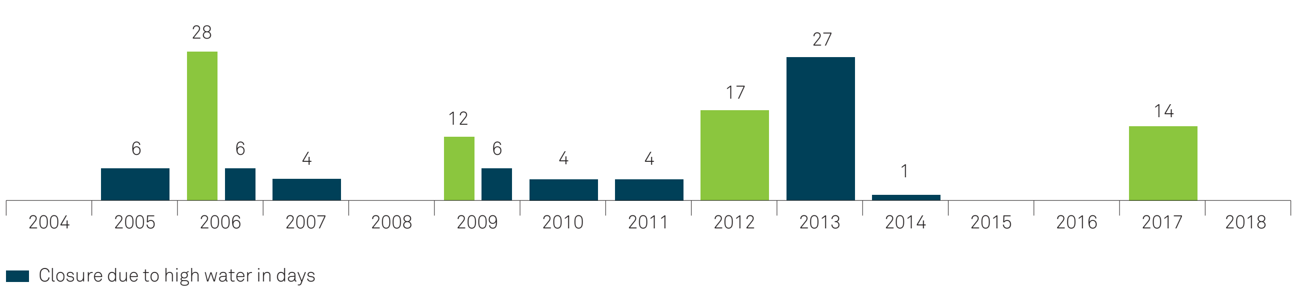
Locked-through vessel units
2015–2018



FIGURES DATA FACTS

Navigational closures due to high water and ice 2004 to 2018





Source: Supreme Navigation Authority at the Federal Ministry for Transport, Innovation and Technology; viadonau

AVAILABILITY OF WATERWAY

Danube navigable all year round in 2018
No closures due to high water or ice

Over a 15-year annual average from 2004 to 2018, the availability of the Austrian section of the Danube waterway was 97.7%, or 357 days per year. During this period, four closures due to ice were recorded with an average duration of just under 18 days, while the waterway had to be closed in eight of these years due to floods with an average duration of around seven days.

In 2018, the Austrian section of the Danube was not subject to official closures due to ice or high water. The availability of the waterway in 2018 was therefore 365 days or 100% of the year. In early January and around Christmas, the water levels at the Wildungsmauer gauge only reached the highest navigable water level for a few hours at a time, so that no official high-water closures had to be imposed. Even the extreme low water period in the second half of 2018 did not result in navigation being closed, so that the waterway was available all year round. However, the reduced loading depths of the cargo vessels due to the low water levels resulted in massive economic losses.

Weather-related closures can be implemented by the relevant authorities on the Austrian section of the Danube waterway in extreme situations, such as high water or ice. While closures due to ice are normally confined to the winter months of January and February, high waters and flooding generally tend to occur in the spring or summer months.

Apart from closures due to high water and ice, official closures of the waterway can also occur due to traffic accidents, water pollution, construction work or events. In 2018, such closures had a total duration of 20.6 hours and had to be arranged on a total of 13 days of the year. The average duration of a closure was just under 1.5 hours. Total lock closures (the parallel closure of both lock chambers) included in the above numbers accounted for a duration of 11.0 hours and affected four of the ten lock facilities on the Austrian Danube section.

"The 'low water year' 2018 was primarily a challenge for freight navigation. The fact that the Austrian Danube was still navigable all year round is thanks to the experience and know-how of our waterway management. With need-based dredgings – pro-actively and precisely – we kept the traffic flowing."

CHRISTIAN LAG
Captain Waterway Management

LOAD FACTOR

Unfavourable fairway conditions Load factor at only 56%

- Average daily mean value of the water level at the Wildungsmauer gauge 27 cm below that of the previous year
- 7,622 loaded vessel journeys
- Significant decline in loaded vessel journeys and load factor in the second half

Due to an unusually long and intensive drought period, the year 2018 brought unfavourable fairway conditions. At 236 cm, the average daily mean value of the Wildungsmauer gauge in 2018 was 27 cm lower than in the previous year. In addition, 92 days with water levels below the low navigable water level (LNWL) were counted in the second half of the year.

These hydrological conditions had a noticeable impact on both the number of loaded vessel journeys and the average load factor of the vessels. As a result, only 7,622 loaded vessel journeys were registered on the Austrian Danube in 2018, a decrease of 14.7% compared to the previous year. At the same time, an average load factor of the vessels of only 55.5% was achieved in 2018, compared with 61.4% in 2017.

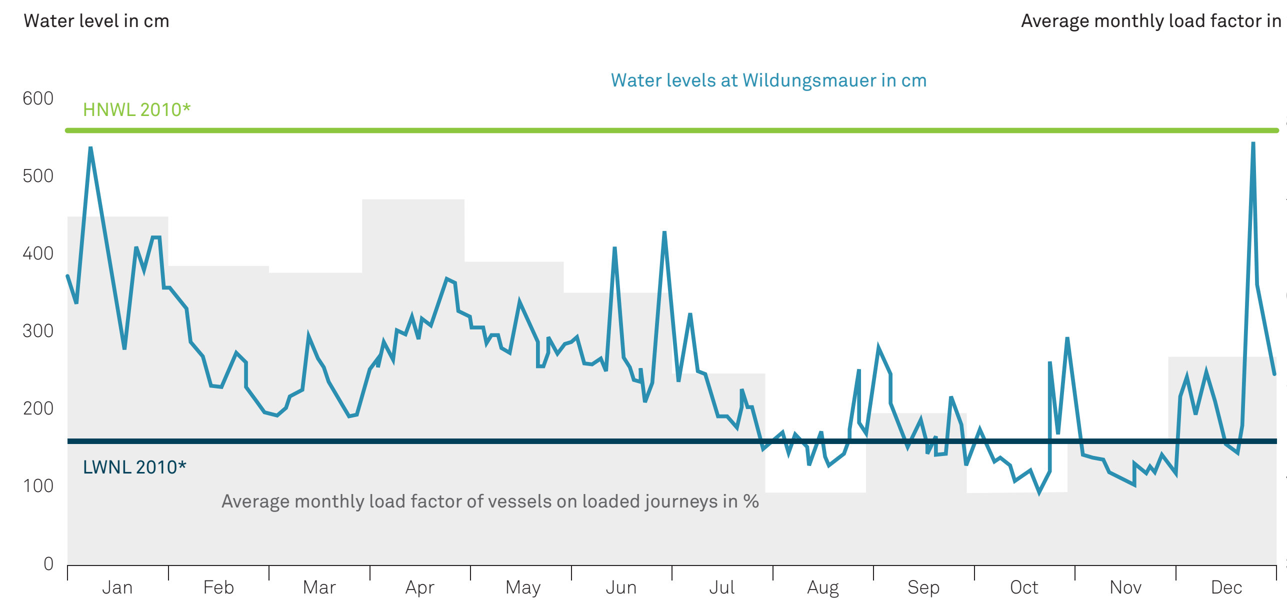
The relatively favourable fairway conditions in the first half of the year contributed to the fact that relatively high load factors of over 60% were achieved throughout the period from January to June. The sharp decline in water levels from July onwards, which remained at a very low level until the end of November, led to a reduction in the number of loaded vessels on the one hand and to a significant reduction in the average load factor to 38% (August and October) on the other.

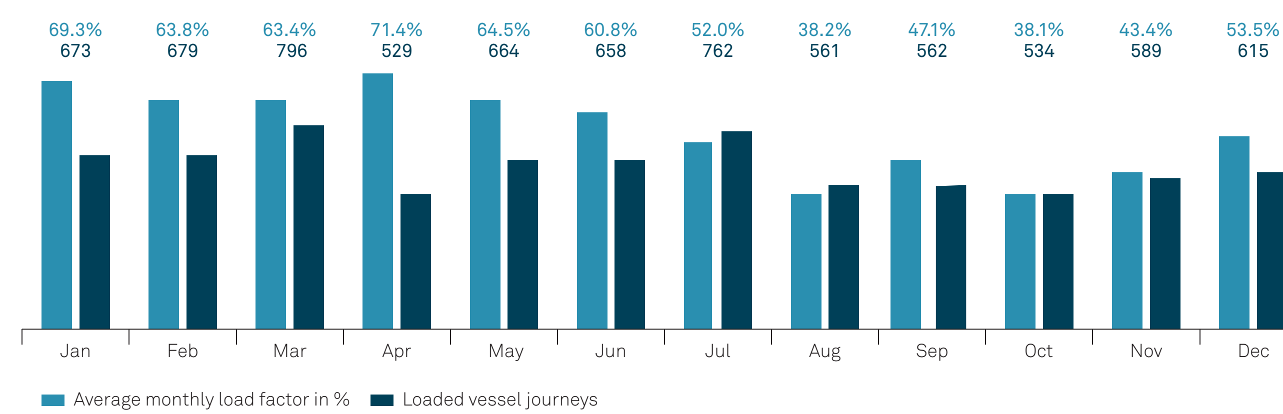
The months of June and July offer a particularly clear illustration of the link between fairway conditions and load factors: The volume of goods carried in the two months was approximately the same (750,661 and 747,754 tons respectively). Due to favourable fairway conditions – the average daily mean value of the water level at Wildungsmauer gauge was 282 cm – only 658 journeys were required in June with an average load factor of 60.8%. In July, however, the transport of almost the same volume already required 762 loaded trips, since an average daily mean value of only 220 cm at the Wildungsmauer gauge meant that an average load factor of only 52.0% could be achieved.

The figures for the month of April stand out. While on the one hand the lowest monthly figure was recorded with only 529 loaded vessel journeys, the load factor of 71.4% represented the peak for 2018. The high load factor in April was due to the relatively favourable fairway conditions. The sharp decline in the number of loaded trips, on the other hand, is due to the lock overhaul carried out from 10 to 30 April 2018 along the Bavarian Danube, the Main-Danube Canal and the Main, resulting in a closure within the section of the Rhine-Main-Danube axis west of Austria for almost three weeks.

FIGURES DATA FACTS

Water levels and resulting load factors of cargo vessels in 2018 using the Wildungsmauer gauge of reference



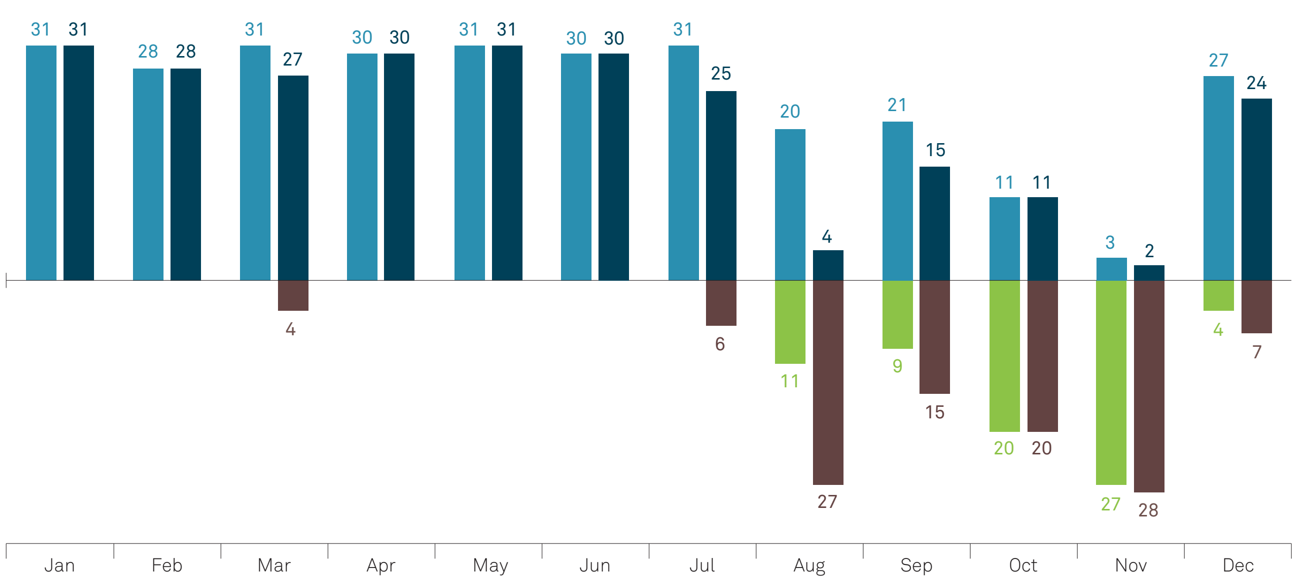


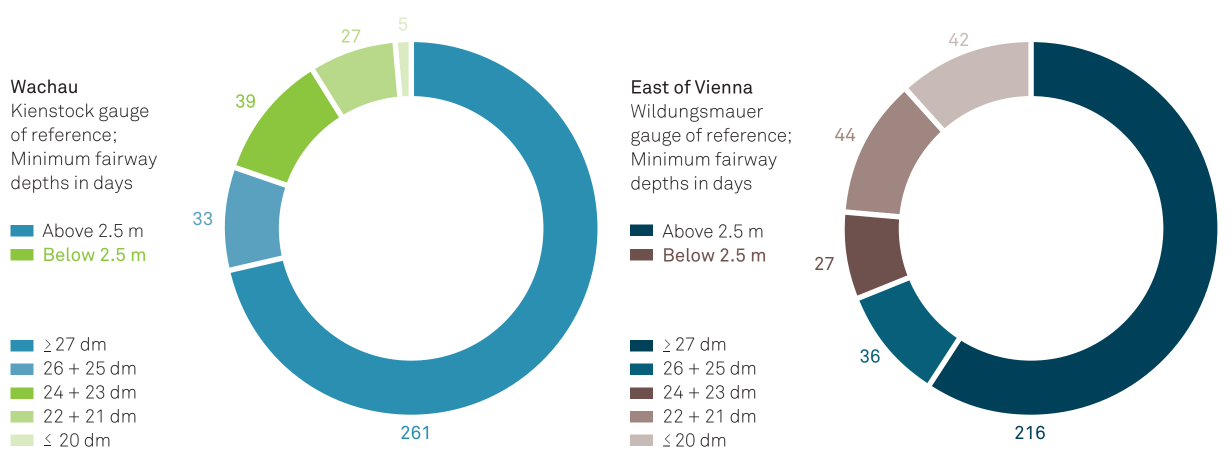
* LNWL 2010 (low navigable water level): This value represents the water level exceeded on 94.0% of days in a year during ice-free periods with reference to a 30-year observation period (1981–2010). The current LNWL value for the water gauge Wildungsmauer is 162 cm.
HNWL 2010 (highest navigable water level): This value represents the water level corresponding to the discharge exceeded on 1.0% of days in a year with reference to a 30-year observation period (1981–2010). At Wildungsmauer, the highest navigable water level is currently 564 cm.

Source: Statistics Austria, adapted by viadonau

FIGURES DATA FACTS

Minimum continuously* available fairway depths in days on the free-flowing stretches of the Danube 2018





* Based on the fairway width required for a four-unit pushed convoy travelling downstream without encountering other vessels. Fairway width depends on the river bend radii involved.

Source: viadonau

FAIRWAY DEPTHS

2.5 m only on 252 days
Record low water level as of August

From a hydrological point of view, the Danube had a good water level in the first half of 2018, whereas the drought in summer and autumn greatly reduced the discharge over almost the entire second half of the year. In a statistically "average" year, there are 22 days with water levels below the regulatory low navigable water level (LNWL); due to the record low water level in the second half of 2018, the water level in the free-flowing section east of Vienna was below the defined low navigable water level (Wildungsmauer gauge) on 92 days; in the Wachau 58 such days were recorded (Kienstock gauge). Therefore, low water prevailed on about 25% of the days in 2018. The last similarly poor low water year was 15 years ago (2003).

With the exception of ten days, water depths of more than 2.5 m in the fairway's deep channel were continuously available in the two free-flowing stretches of the Austrian Danube (Wachau and east of Vienna) during the first half of 2018 (January to July). With the onset of the extreme dry period in summer, a pronounced low-water period with historically low levels occurred between mid-July and early December. In two thirds of the month of October and almost throughout all of November, fairway depths of less than 2.5 m were available for navigation in the two free-flowing sections.

Overall, the Wachau recorded the availability of a minimum depth of 2.5 metres in the deep channel on 294 days or 80.6% of the year (–13.1% compared to 2017). In the free-flowing section east of Vienna, a minimum navigable depth of 2.5 metres was available on only 252 days or 69.0% of the year (–17.8%).

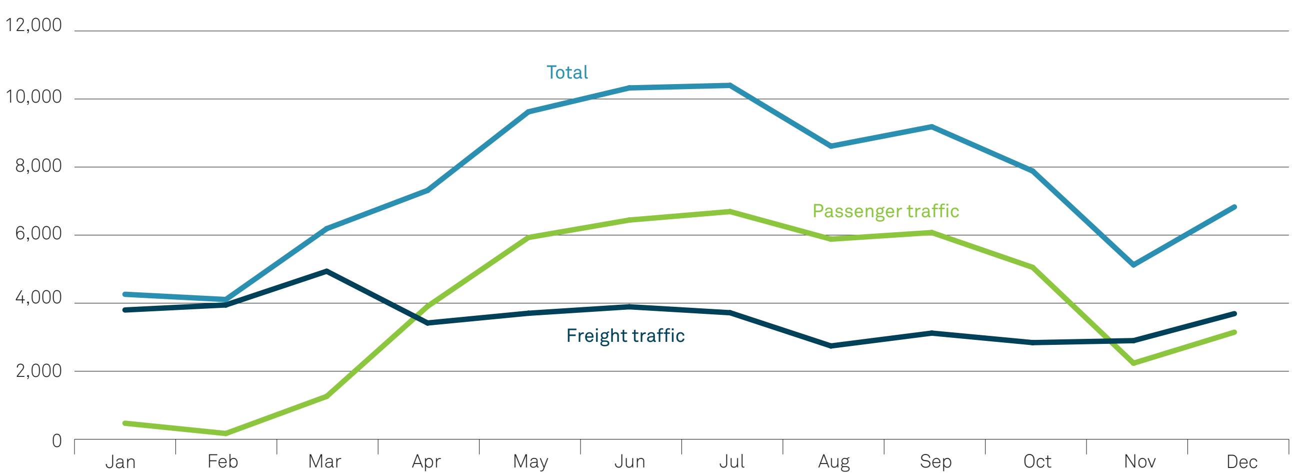
Despite the exceptionally low water levels in the second half of the year, navigation on the Austrian Danube never came to a complete standstill in 2018. In order to remove aggradation from the shallow sections of the river proactively, eight maintenance dredgings were carried out during the year, resulting in the removal of approximately 151,000 cubic metres of material. Almost all dredging operations (approximately 99%) had to be carried out on the section east of Vienna.

The lowest available navigable water depths for the two free-flowing stretches were calculated based on all hydrographical surveys of the riverbed published by viadonau in 2018. They were evaluated in combination with the respective gauge hydrographs (mean daily water levels at the Kienstock and Wildungsmauer gauges of reference). The reference was the continuous availability of a deep channel inside the fairway, representing the required fairway width for a four-unit pushed convoy travelling downstream without encountering other vessels.

- Water depths of 2.5 m in the deep channel east of Vienna available on 252 days or 69.0% of the year.
- Availability of 2.5 m in the Wachau available on 294 days or 80.6% of the year.

FIGURES DATA FACTS

Vessel units in freight and passenger transport locked through Austrian Danube locks in 2018*



	Freight traffic	% to previous year	Passenger traffic	% to previous year	Total	% to previous year
2018	42,597	–16.7	47,147	+7.1	89,744	–5.7
2017	51,164	–0.9	44,020	+5.6	95,184	+2.0
2016	51,603	+1.6	41,695	+6.0	93,298	+3.5
2015	50,781	–18.7	39,347	+1.6	90,128	–10.9
2014	62,449	–1.1	38,716	+19.8	101,165	+6.0

* Vessel units in freight transport include convoys (pushers, motor cargo vessels or motor tankers with cargo and tank lighters or barges) and individual vessels (motor cargo vessels and motor tankers or individual pushers and tugs). Passenger vessels include day-trip vessels and cabin vessels.

Source: viadonau

LOCKED-THROUGH VESSEL UNITS

90,000 units locked through
Decrease in freight transport

A total of 89,744 passenger and cargo vessel units, travelling both upstream and downstream, were locked through the nine Austrian lock facilities in 2018 (excluding the Jochenstein power station on the Austrian-German border). Included in this number were 26,919 motor cargo vessels and motor tankers (–15.9% compared to 2017), 15,678 pushers (–18.2%) and 47,147 passenger vessels (+7.1%). A total of 34,851 cargo and tank lighters or barges (–21.4%) were also locked through as part of coupled and pushed convoys. Taking all types of vessels and convoys into consideration, the total number of locked-through vessel units in freight and passenger transport showed a decline of 5.7% against 2017.

Freight transport on the Austrian Danube saw a significant decrease in locked-through vessel units (–16.7% or 8,567 units). In passenger transport, on the other hand, a substantial increase was recorded (+7.1% or 3,127 vessel units). In 2018, freight transport had a share of 47.5% of total shipping volumes (–6.3%) with passenger traffic accounting for the remaining 52.5% (+6.3%).

In relation to 2018 as a whole, the average number of vessels passing through an individual Austrian Danube lock facility amounted to 9,972 convoys and individual vessels (–604 vessel units). This is equivalent to 831 (–50) vessel movements per month and an average of 28 locked-through vessels per day. As in previous years, the highest volume of vessels was once again recorded at the Freudenau lock in Vienna with 11,972 vessels and convoys passing through the lock (–6.8%), followed by the Greifenstein lock with 10,729 units. Aschach lock recorded the smallest number of locked-through vessels with 8,551 units.

In addition to commercial freight and passenger vessel units, 11,071 (+7.8%) small sports and leisure crafts also passed through lock facilities on the Austrian Danube in 2018, together with a further 1,697 vessels, which included public authority and rescue crafts.

"Each of thousands of ships that pass the locks every year with passengers from all over the world shows us the significant importance of education and the high sense of responsibility in our job. To be close to the river and in the middle of Danube navigation and to ensure an optimal traffic regulation – these are parts of the most beautiful sites of my profession as a lock supervisor."

MARKUS SIEGER
Lock Supervision Freudenau

AVAILABILITY OF LOCKS AND WAITING TIMES

99.9% continuous availability Waiting times for only 6.7% of vessels

- 99.9% continuous availability of the Austrian locks in 2018
- Lock overhauls are carried out during the low-traffic period from November to March in order to avoid waiting times
- 37 minutes average waiting time for 6.7% of the vessels

As the nine Austrian Danube locks are large-scale technical installations, they need to be serviced and maintained at regular intervals to ensure operational functionality and safety and thus also the capacity of waterway traffic flow. These so-called lock overhauls, along with necessary large-scale repairs, accounted for approximately 83% of all closure days of the 18 lock chambers in 2018. The average duration of overhauls carried out in the winter half year 2017/18 and completed by the spring of 2018 was 127 days per chamber.

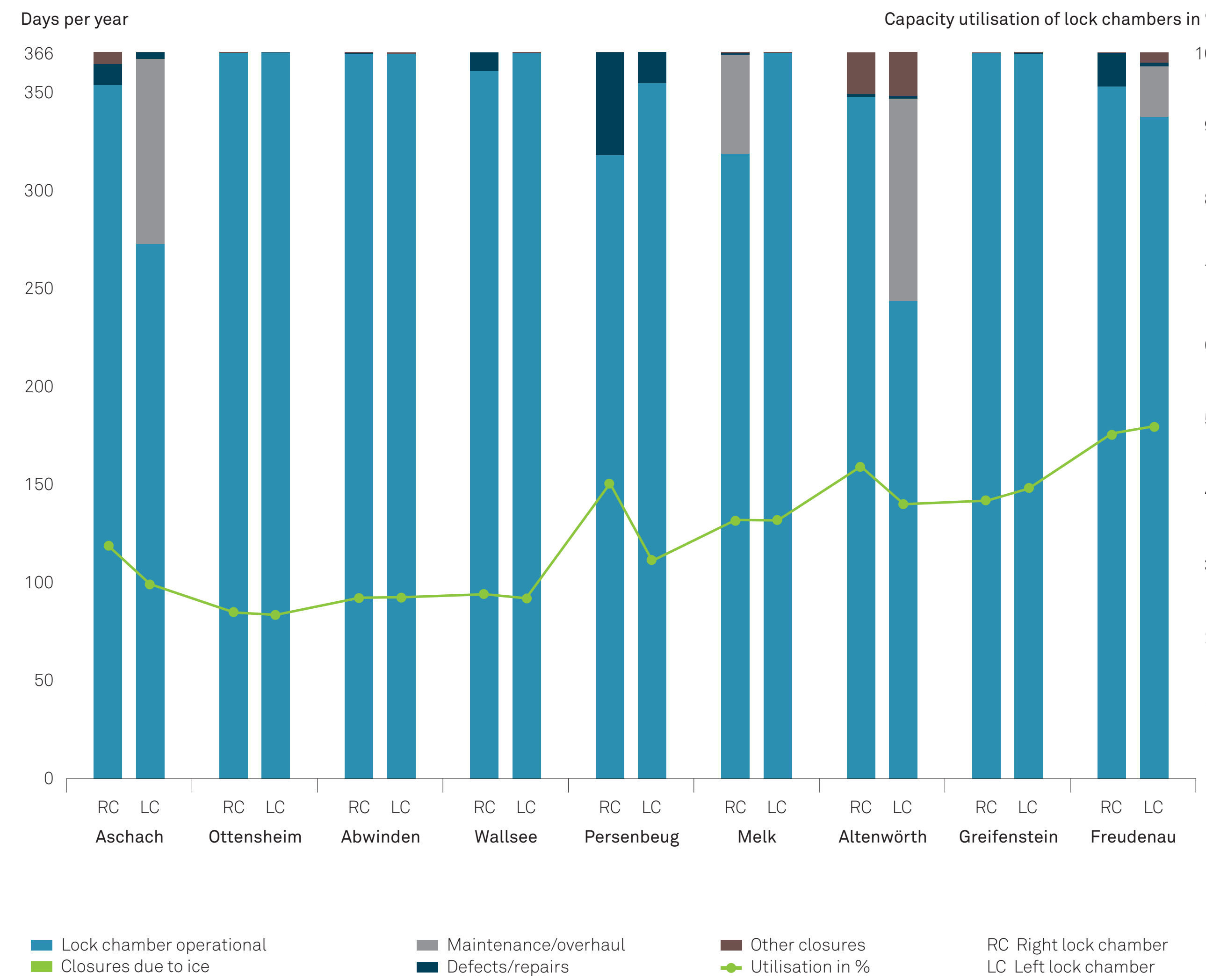
Other reasons for lock closures included periodic repairs caused by technical defects and damage to lock facilities caused by vessels. These accounted for approximately 5% of all closure days. In addition, approximately 12% of closures were attributed to modification or maintenance work, dredging in and around lock facilities and surveying, the majority of which was due to necessary conversion work on the Altenwörth lock. With the exception of a short closure due to ice at the Aschach lock, there were no weather-related locks closures in 2018.

The continuous availability of the 18 lock chambers on the Austrian Danube amounted to almost 365 days (99.9%) in 2018. Complete closures were primarily caused by unforeseen disruptive events at three lock installations as well as a case of water pollution in the vicinity of a lock, resulting in a complete non-availability of about eleven hours.

Lock availability also has an influence on waiting times. On average, 6.7% of all shipping units (commercial freight and passenger vessels) experienced waiting times on the Austrian section of the Danube in 2018. The average waiting time for these vessels amounted to approximately 37 minutes for the year as a whole.

FIGURES DATA FACTS

Availability of Austrian Danube locks 2018



Source: viadonau

FIGURES DATA FACTS

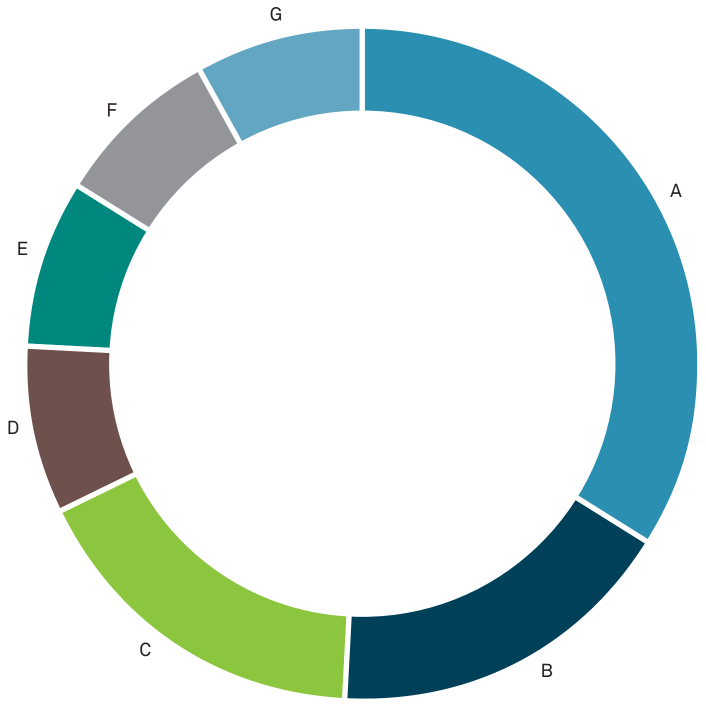
Traffic accidents according to type of damage on the Austrian Danube 2018

G
1 collision with structures (excluding lock facilities)
8 %

F
1 grounding
8%

E
1 bridge strike
8%

D
1 riverbank collision
8%



A
4 collisions with lock facilities
34%

B
2 collisions of ships in service
17%

C
2 collisions of ships in locks
17%

Source: Supreme Navigation Authority in the Federal Ministry of Transport, Innovation and Technology, adapted by viadonau

ACCIDENTS

Strong decrease in traffic accidents No personal injuries in 2018

Danube navigation has an unbeatable safety and accident record when compared to the land transportation modes of rail and road. A total of 12 accidents involving commercial passenger ships, freight vessels or convoys resulting in damage to property and/or personal injury occurred during the course of 2018 on the Austrian section of the Danube. Six accidents involving cargo vessels were recorded, another six incidents resulted in damage to passenger ships.

When split into accident types, four incidents were vessel collisions. Two cases involved vessels colliding with each other whilst in service and two cases involved vessel collisions within the confines of a lock facility. Another four incidents involved collisions with the lock facilities. There was one incident with a vessel running aground due to navigating outside the fairway, one collision with the river bank and one collision causing damage to a facility. Finally, one vessel was involved in a collision with a bridge.

No personal injuries were recorded for freight and passenger ships on the Austrian section of the Danube in 2018. There were also no incidents of water pollution or load spillages recorded.

The majority of accidents in 2018 occurred within the vicinity of lock facilities (whilst being locked-through or in either the headwater or tailwater area of the lock). In total, six such accidents were registered, including four accidents involving vessels colliding with a lock facility and two incidents involving vessels colliding with each other within the confines of a lock facility. Five accidents occurred on the impounded sections of the Danube, including two ship collisions, one incident with damage to facilities, one collision with a bridge and one collision with the riverbank. One accident due to a vessel running aground occurred on the free-flowing section of the Danube east of Vienna. On the free-flowing section of the river between Melk and Krems (Wachau), there were no incidents in 2018.

Sports and recreational boating, which is not included in the accidents described above (except in the case of collisions with commercial freight and passenger vessels), recorded two accidents involving damage on the Austrian section of the Danube in 2018. One involved a collision with the riverbank, the other one a collision of two leisure crafts. Neither incident resulted in injury or death.

- Collisions with lock facilities and ship collisions were the most frequent types of accidents in 2018
- No personal injuries
- Six accidents involving freight vessels and another six accidents involving passenger ships

MODAL SPLIT

Cross-border transport on the rise again Danube's share of modal split down

- Road transport on the rise
- Danube suffers highest decline in share in western traffic
- Danube continues to be of great importance for eastern traffic

Within the Austrian Danube corridor, approximately 91.5 million tons of freight were transported in 2018, excluding purely domestic traffic. This corresponds to an increase of 3.4 % over 2017.

However, due to the severe low water situation during the second half of 2018, the environmentally-friendly transportation mode Danube was not able to benefit from the continuing increase in transport volume. The Danube's share of the total transport volume across all modes declined from 10 % to 8 %.

The share of rail also declined from 29% in the previous year to 28%. Accordingly, the proportion of road transport by truck increased from 61% to 64%. The unfavourable water conditions in 2018 had a particularly severe impact on the quantities of goods transported by inland waterway vessels across the border with Germany for export and import as well as in transit traffic to the west. Although the volume of exported and imported goods transported across the western border of the Danube corridor increased against 2017 by 1.2% to 42.5 million tons, the share of the Danube as a mode of transport halved to 3.9% in exports and 2.4% in imports.

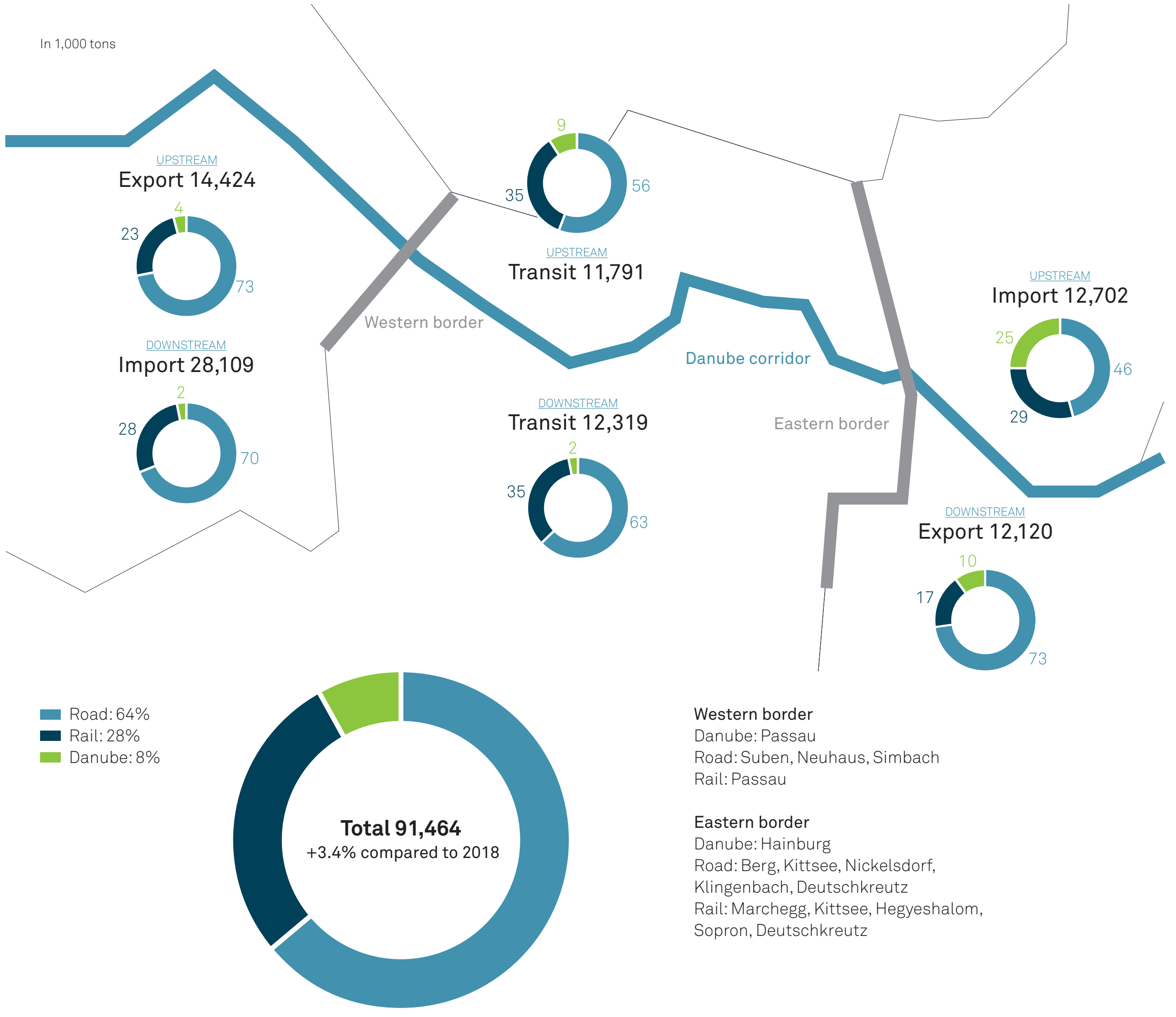
At the same time, the share of goods transported by rail across the western border of the Danube corridor decreased slightly in proportion to the volume of goods transported, so that road transport recorded a significant increase to 73.4% of exports and 69.7% of imports. In upstream transit traffic, shipping also experienced a significant decline from 14.4% to 9.2% of the transport volume.

In 2018, the Danube made the highest contributions to the modal split in exports and imports across the eastern border of the Danube corridor. Despite a declining trend, 10.0% in exports and 24.6% in imports were achieved here, which underlines the unbroken importance of the Danube in eastern traffic.

From a cross-modal perspective, however, the figures in the chart also illustrate that the western border of the Austrian Danube corridor is of greater significance to transport than its eastern border. Whereas in 2018 a total of 66.6 million tons were transported across the western border in export, import and transit traffic, only 48.9 million tons were transported across the eastern border.

FIGURES DATA FACTS

Cross-border freight traffic in the Austrian Danube corridor 2018



Western border
Danube: Passau
Road: Suben, Neuhaus, Simbach
Rail: Passau

Eastern border
Danube: Hainburg
Road: Berg, Kittsee, Nickelsdorf, Klingenbach, Deutschkreutz
Rail: Marchegg, Kittsee, Hegyeshalom, Sopron, Deutschkreutz

As no official data are available yet, the figures for the transportation modes of rail and road include projections for the 4th quarter of 2018.

Source: Austrian Institute for Spatial Planning (ÖIR), adapted by viadonau

The Danube economic region

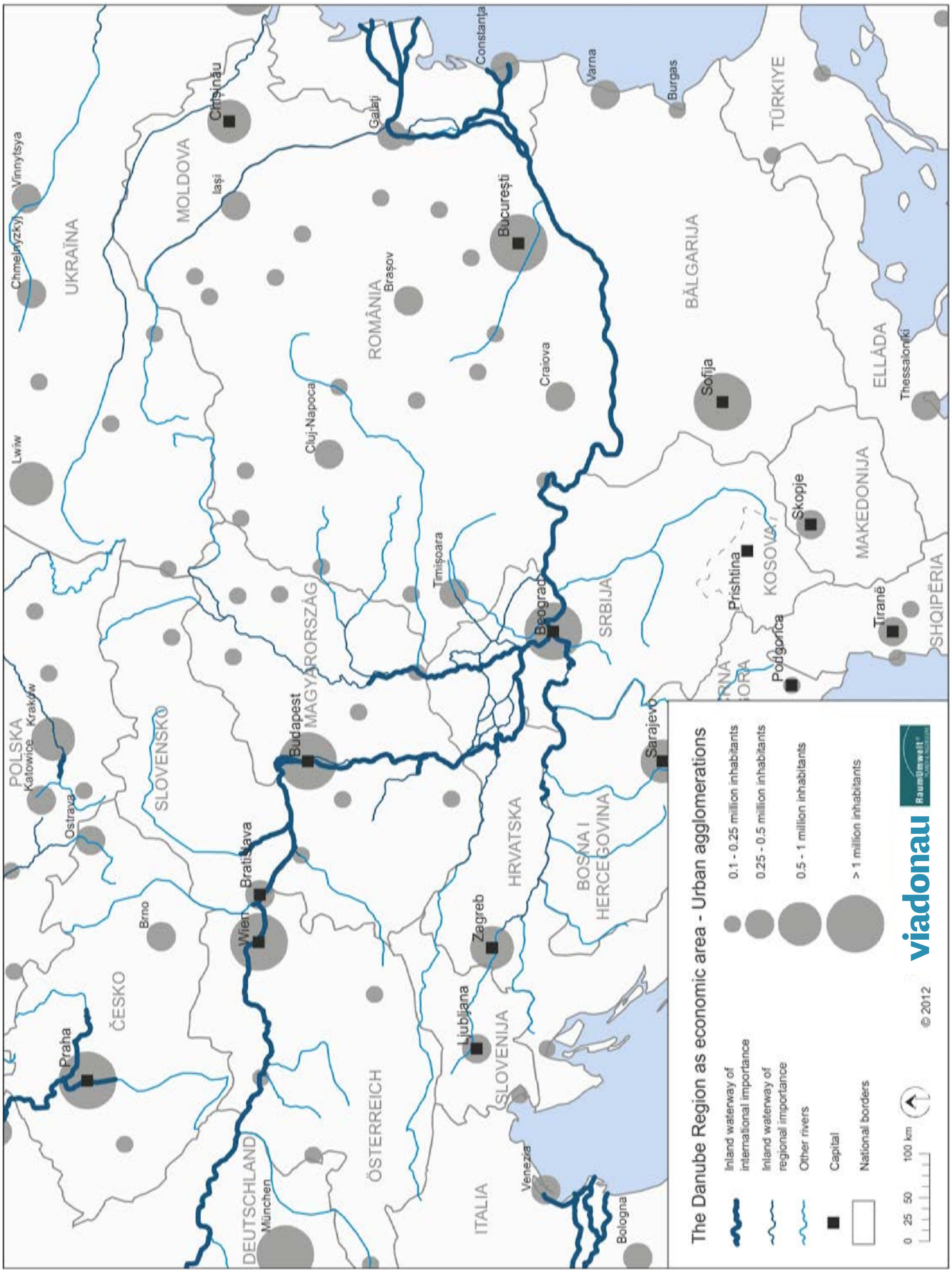
The Danube as an axis of economic development

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 regions 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, as well as Croatia's accession in 2013, marked the start of a new phase of economic development in the Danube region. Serbia was given accession candidate status in 2012. Accession negotiations with the European Union started in 2014.

With approximately **90 million inhabitants**, the Danube region is of great economic interest. 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 transhipment 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 is exported overseas via the Rhine-Main-Danube axis and the respective seaports (North Sea and Black Sea).


The Danube Region as economic area - Urban agglomerations
Inland waterway of international importance
Inland waterway of regional importance
Other rivers
Capital
National borders
0.1 - 0.25 million inhabitants
0.25 - 0.5 million inhabitants
0.5 - 1 million inhabitants
> 1 million inhabitants
0 25 50 100 km
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POLSKA
SLOVENSKO
ÖSTERREICH
ITALIA
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HRVATSKA
BOSNA I HERCEGOVINA
MAGYARORSZÁG
SRBIJA
KOSOVA
MAKEDONIJA
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ELLÁDA
BĂLGARIJA
TÜRKIYE
ROMÂNIA
MOLDOVA
UKRAÏNA
München
Praha
Brno
Ostrava
Katowice
Kraków
Wien
Bratislava
Budapest
Venezia
Bologna
Ljubljana
Zagreb
Sarajevo
Podgorica
Tiranë
Prishtina
Skopje
Beograd
Timișoara
Cluj-Napoca
Brașov
Craiova
București
Sofija
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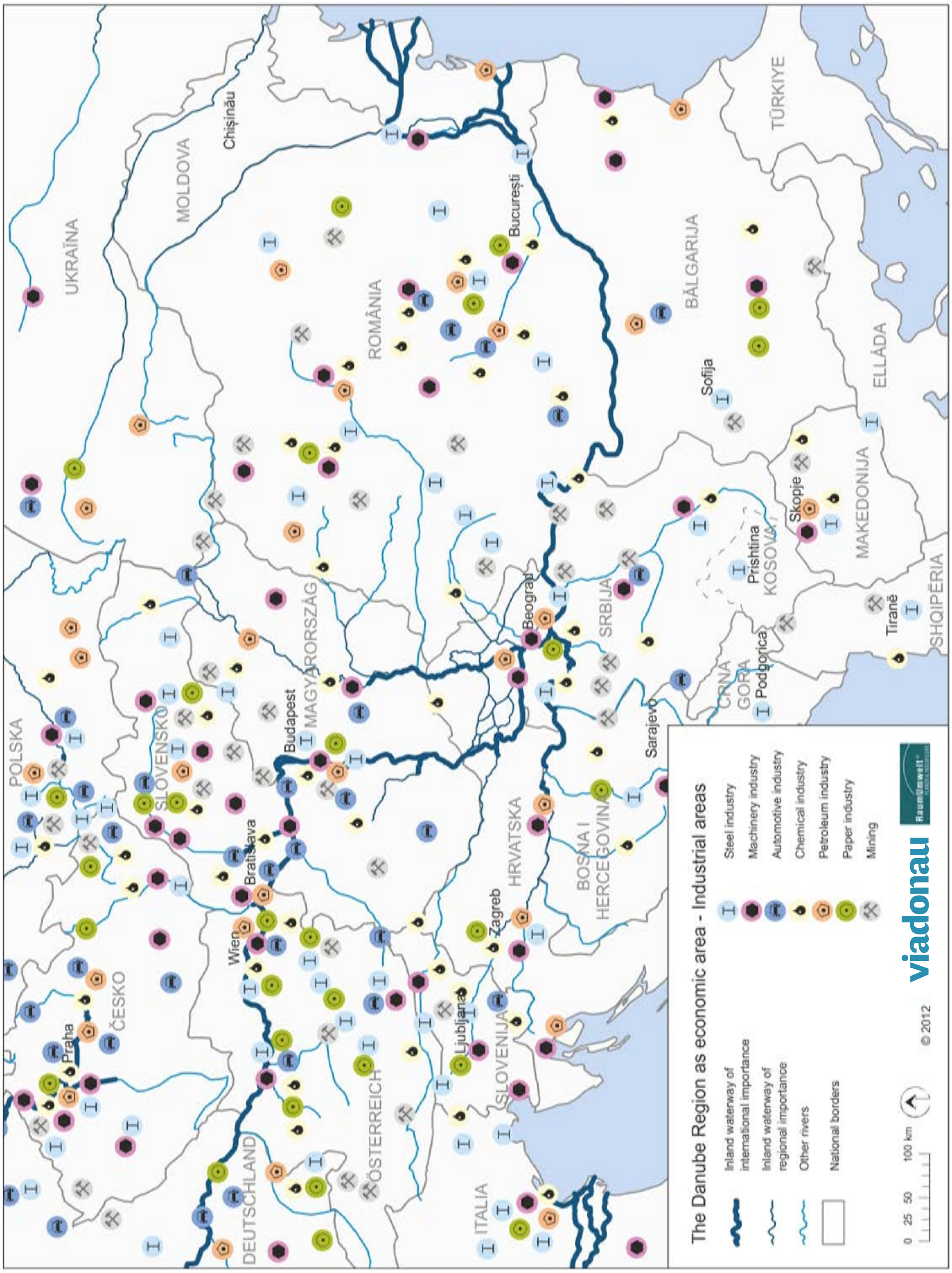
Varna
Constanța
Galați
Iași
Chișinău
Lwiw
Chmelnyzkyj
Vinnytsya


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
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ELLÁDA
MAKEDONIJA
Skopje
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Prishtina
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Tiranë
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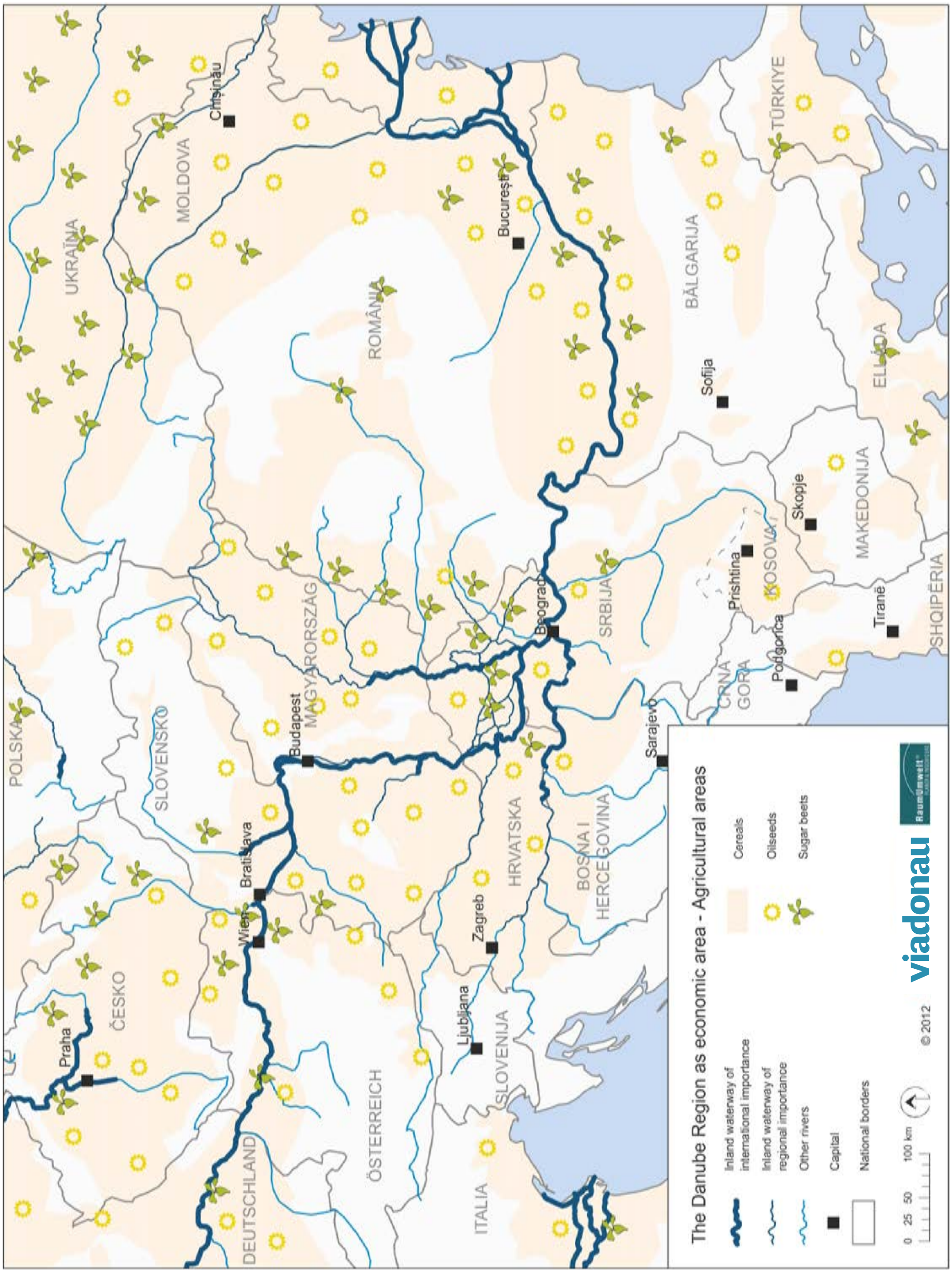
The Danube Region as economic area - Agricultural areas
Inland waterway of international importance
Inland waterway of regional importance
Other rivers
Capital
National borders
Cereals
Oilseeds
Sugar beets
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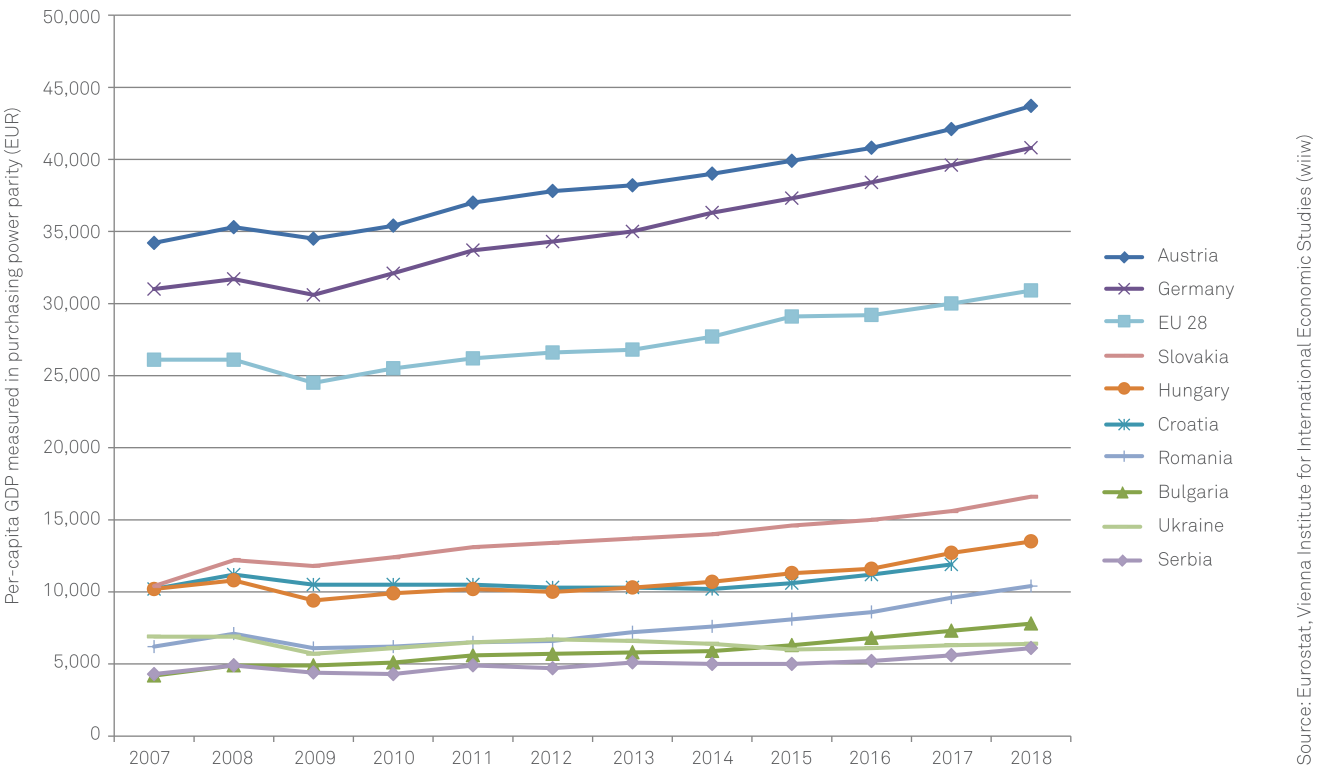
ITALIA

Competitiveness and growth

Among the most striking characteristics of the Danube region are the substantial differences in national income and macroeconomic productivity. The **income and productivity levels** – measured in purchasing power parity of per-capita gross domestic product (GDP) – ranged from approximately 43,700 Euros in Austria to 6,100 Euros in Serbia in the year 2018. This was equivalent to a ratio of almost 7:1.

A clear picture emerges if you take a detailed look at the development of GDP in the individual Danube riparian states in recent years: All Danube riparian states have recorded steady growth since the economic crisis of 2009.



According to the national statistics agency of Croatia, no data for 2018 was available at the time of the publication of this manual;

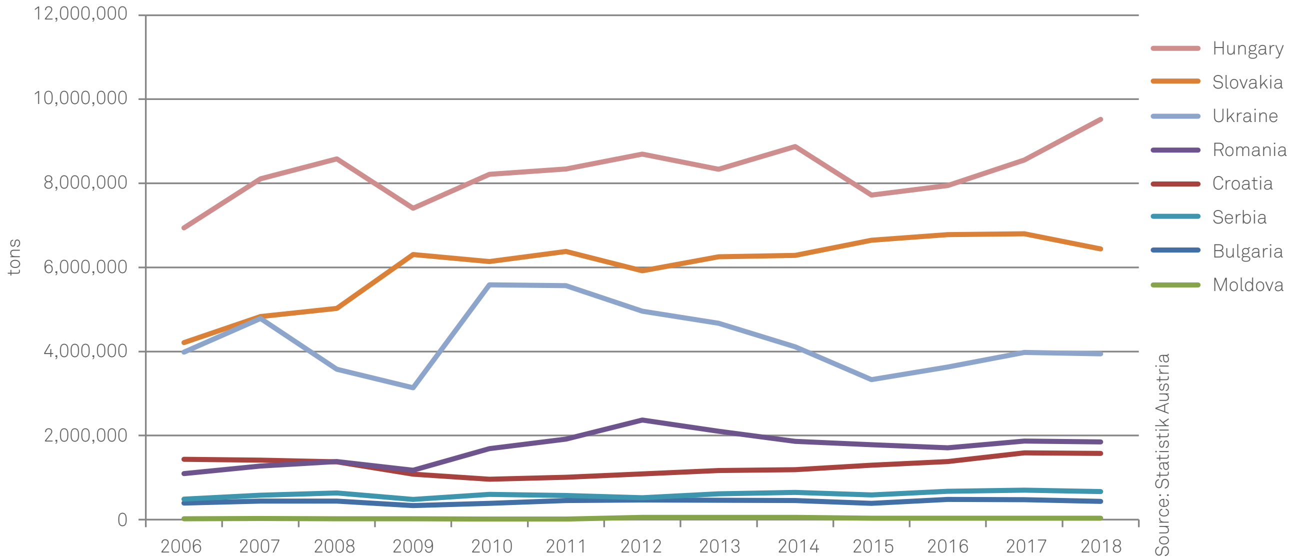
GDP development in the Danube region

Austria's foreign trade links in the Danube region

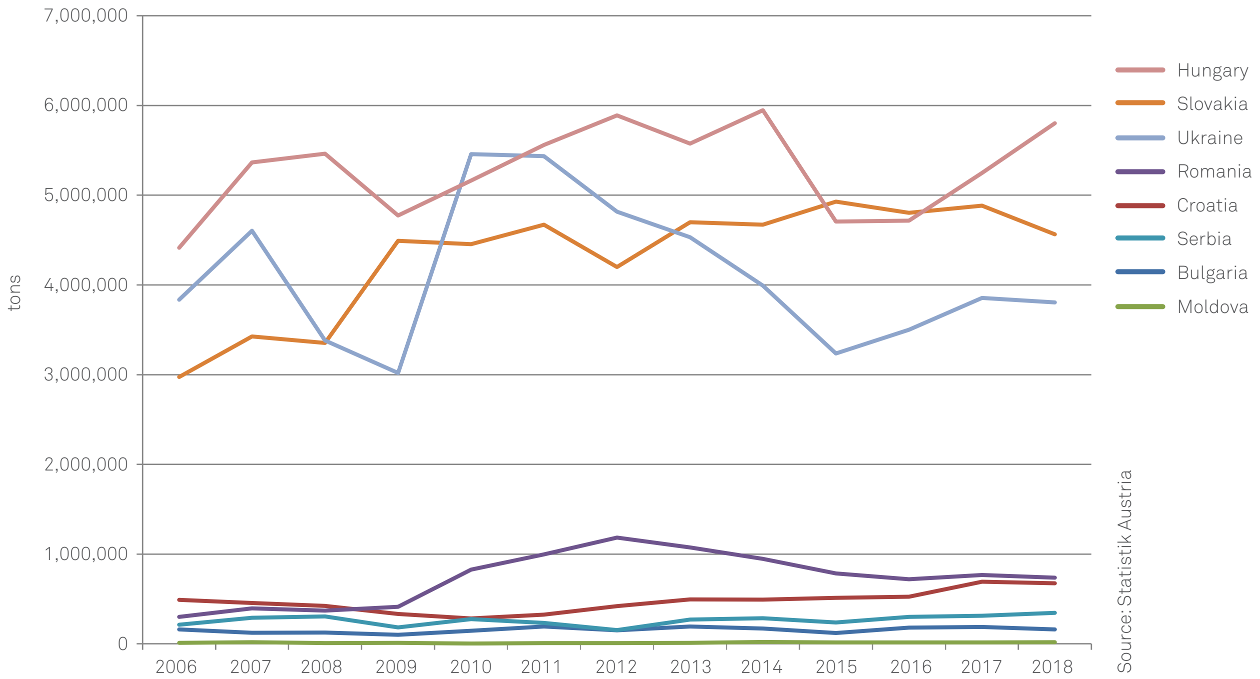
Increasing deregulation of the European single market and integration of the states of Central and South-Eastern Europe within the European Union have led to a fundamental restructuring of foreign trade flows in recent years. The Danube riparian states and Austria in particular have benefited from this development.

With an annual trade volume of about 47 million tons in 2018 (combined imports and exports), Germany is Austria's most important trade partner by far. Nonetheless, the data for Germany was consciously omitted from the following diagram in order to focus on Austria's trade relationships with the states of Central and Eastern Europe.

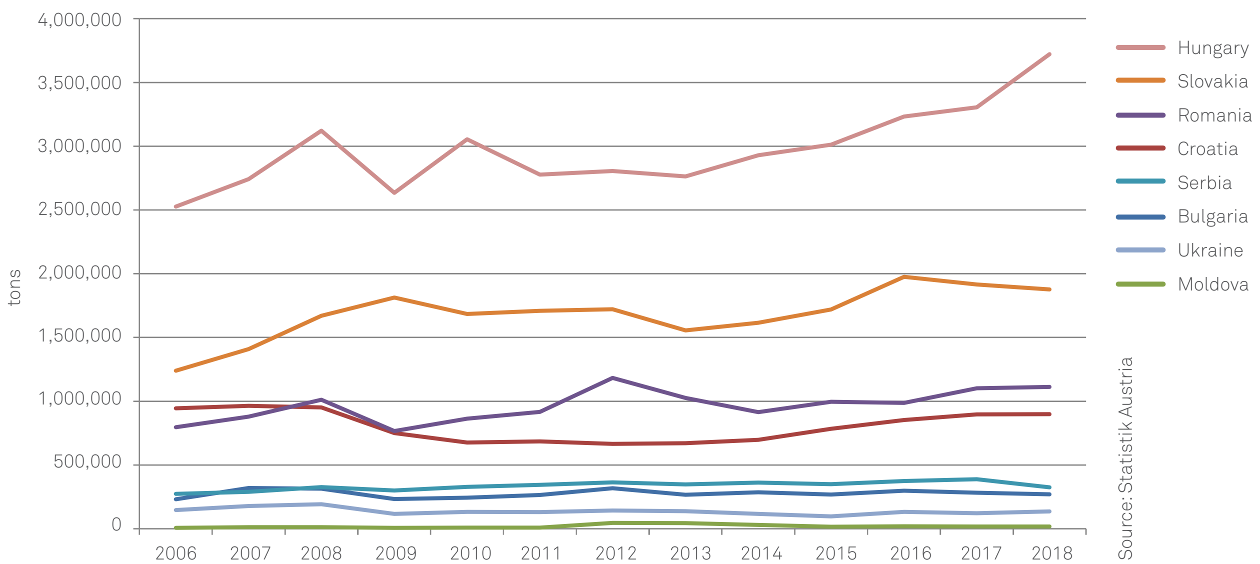
Austria's accumulated export trade volumes in the Danube region have risen by 5.9 million tons or 31.8% since 2006.



Austria's foreign trade links in the Danube region 2006–2018



Austrian imports from the Danube region 2006–2018



Austrian exports to the Danube region 2006–2018

Hungary is Austria's most important trade partner among Central and Eastern European countries.

Hungary, Slovakia and Ukraine top the list for **imports** to Austria. In total, 16.1 million tons of goods were imported to Austria from the Danube riparian states (not counting Germany) in 2018. This is equivalent to a growth rate of 29.9% since 2006.

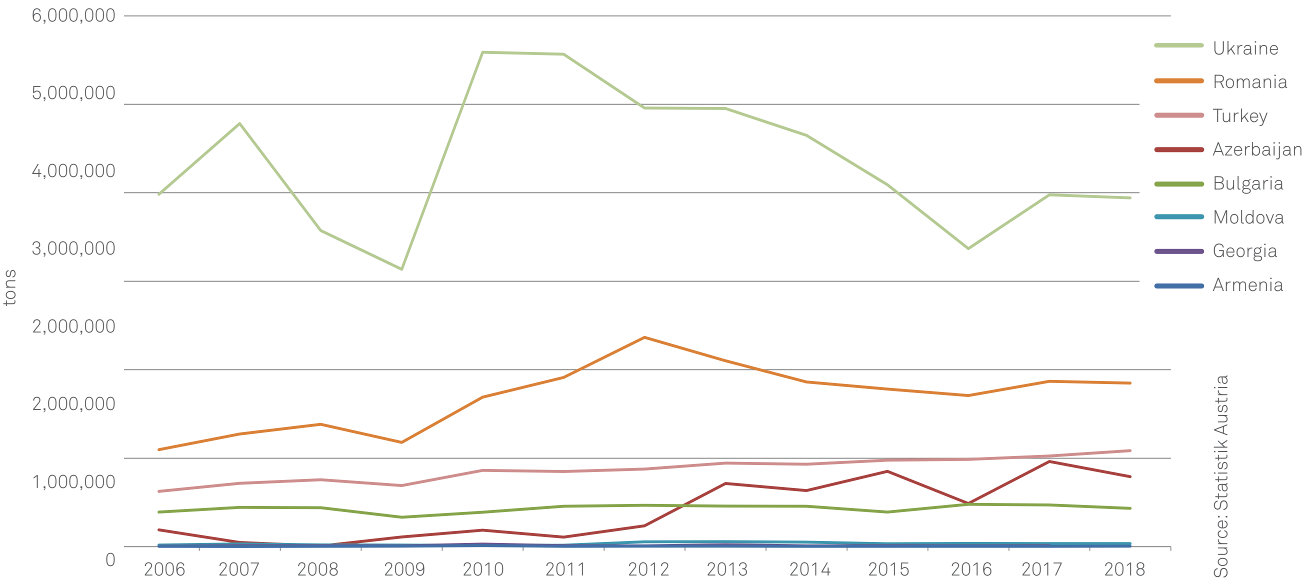
Hungary takes the top slot for **exports** to the Danube region by a considerable margin. It is followed in second and third place by Slovakia and Romania, respectively. In total, 8.4 million tons of goods were exported to the Danube riparian states (not counting Germany) from Austria in 2018. This is equivalent to a growth rate of 35.6% since 2006.

The Danube as a link to the Black Sea region

For the European Union, the Danube represents an important link to the Black Sea region. With more than 145 million inhabitants, this region is a future market with considerable development potential.

The Black Sea region comprises Armenia, Azerbaijan, Georgia, the Republic of Moldova, the Russian Province of Krasnodar (Sotchi), Turkey and Ukraine, as well as the two EU member states Romania and Bulgaria, whose national economies are becoming increasingly linked with the Black Sea riparian states via the seaports (e.g. Constanţa, Varna).

The EU Strategy for the Danube Region and transnational projects could open up further opportunities for increased cooperation with the Black Sea region.



Austria's foreign trade links in the Black Sea region 2006–2018

Austria's foreign trade links with the Black Sea region

Among the Black Sea riparian states, the Russian Federation is by far the most important trade partner for Austria. No clearly assignable data material is available for the region of Krasnodar bordering the Black Sea, so Russia was consciously omitted from the diagram in order to preserve the regional focus.

Despite fluctuating trade volumes, Ukraine is still one of Austria's most important trade partners in the Black Sea region, accounting for 3.9 million tons in 2018. Romania comes second with approximately 1.8 million tons, and trade volumes with Turkey, as the third most important partner, have risen steadily since 2006 (2018: 1.1 million tons).

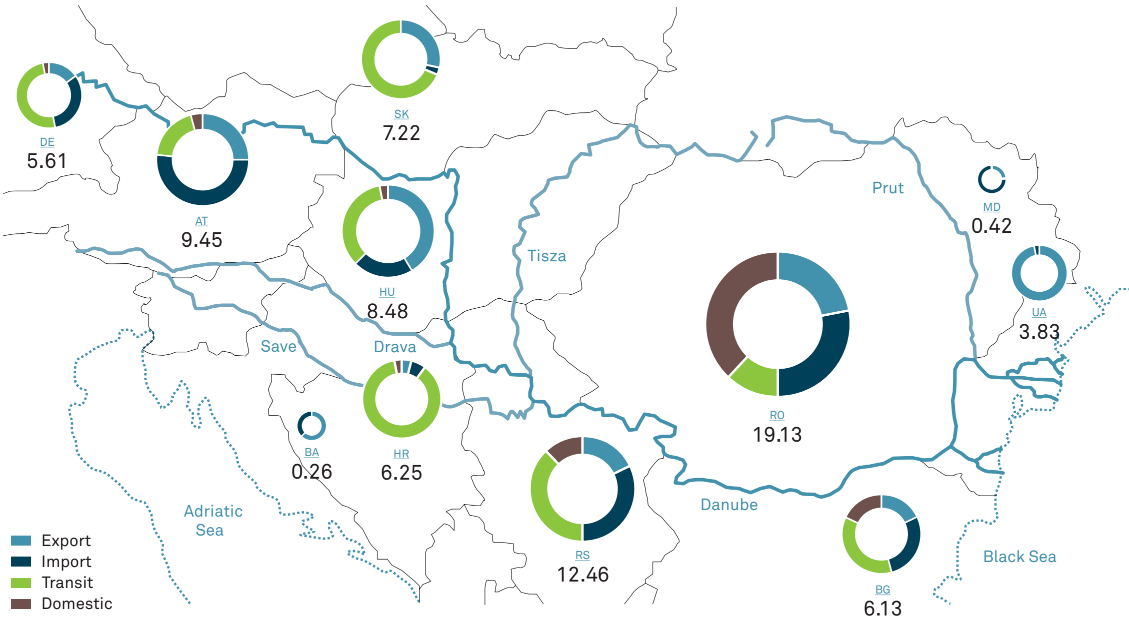
Processed goods (especially for Romania and Turkey), as well as chemical products and raw materials (for Romania) are Austria's principal **export** categories. Raw materials (mainly ores and steel from Ukraine), fuels (from Azerbaijan) and foods (from Romania) are the main categories on the **import** side.

Transport volume

The latest figures available for the overall volume of goods transported on inland waterways within the Danube region date from the year 2017 (viadonau, 2019). This data provides a good overview of the volumes transported, major transport relations and the importance of Danube navigation in the riparian states.

In total, **39.3 million tons of goods** were transported on the Danube waterway and its tributaries in the year 2017. 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.

By far the largest transport volume for 2017 was recorded by Romania with 19.1 million tons, followed by Serbia with 12.5 million tons and Austria with 9.5 million tons. Romania was the **biggest** Danube **exporter** in 2017. In total, Romania shipped 4.2 million tons of goods in this year. Of all the Danube riparian states, Romania also had **the biggest volume of imports** in the year 2017 – standing at 5.4 million tons. As far as **transit traffic** on the Danube was concerned, the largest transport volume of 5.7 million tons was registered in Croatia. Romania was again by far the most important country for **domestic transport**, with 7.3 million tons.



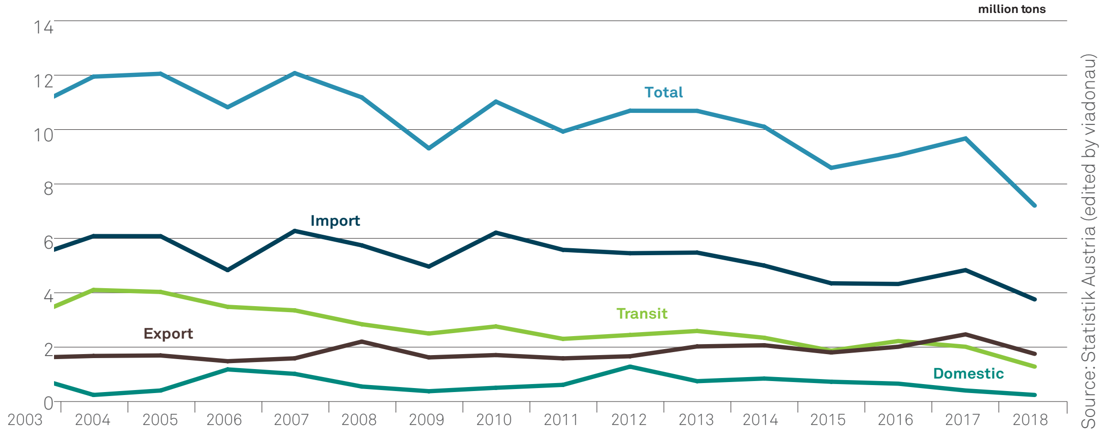
Million Tons	DE	AT	SK	HU	HR	BA	RS	RO	BG	MD	UA
Export	0.84	2.40	2.09	3.50	0.19	0.17	2.30	4.21	1.11	0.10	3.67
Import	1.81	4.82	0.10	1.81	0.33	0.09	3.96	5.40	1.73	0.32	0.15
Transit	2.78	1.84	5.01	2.92	5.67	0.00	4.76	2.20	2.20	0.00	0.00
Domestic	0.18	0.39	0.02	0.25	0.06	0.00	1.44	7.32	1.09	0.00	0.01
Total	5.61	9.45	7.22	8.48	6.25	0.26	12.46	19.13	6.13	0.42	3.83

Source: Eurostat, national transport statistics, viadonau (edited by viadonau)

Transport volume on the Danube and its navigable tributaries in 2017

Transport volumes in Austria

The following diagram visualises developments in goods transport on the Austrian section of the Danube in a long-term review. Besides the economic situation, low water periods especially have significantly affected traffic volumes on the Danube. These circumstances highlight the need for proactive transport policies to rectify the nautical issues along the Danube as quickly as possible and to introduce customer-oriented and proactive water management along the entire Danube based on the Austrian model. This is the only way to ensure an effective shift of transports towards Danube navigation.



Transport volume on the Austrian Danube 2003–2018

Dry bulk transports (coal, ore and corn) and **liquid bulk transports** (mainly petroleum) account for the largest share of goods transports. Industrial sectors in Austria that require high volumes of raw materials benefit in particular from this low-cost transport mode and its bulk freight capacity. For instance, most of the raw materials supplied to the voestalpine steel plant in Linz are carried by inland vessels.

The western section to the North Sea ports of Amsterdam, Rotterdam and Antwerp is predominantly used to transport **semi-finished and finished products**. Transits play an important role in the transport of **agricultural products** from Hungary, Bulgaria and Romania to Western Europe.

On the Austrian side, however, there are increasing volumes of **higher-quality general cargo** transports by inland vessel. Besides RoRo transports (e.g. new vehicles, as well as agricultural and construction machinery), the Danube is principally used to carry project cargo (heavy and oversized cargo such as transformers, turbines and generators).

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 cargo owners** 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 cargo owner 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 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 contract forms used for Danube navigation and the transport modes on which they are based are also described in this section.

Supply side of Danube navigation

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

Transport companies

Shipping companies are commercial ship transport companies that professionally organise and implement the transport of goods. They use their own vessels or those from other companies for this purpose. Several ships are operated in all cases. 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 ship owners 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.

Source: viadonau

Motor cargo vessel

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 ship owners often use ship brokers. The ship broker is the contract partner of the enterprise 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 **ship broker** is regulated by means of a subcharter. In other words, the broker 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 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.

Port and terminal operators

Further information on ports and terminals can be found in the chapter 'System elements of Danube navigation: Ports and terminals'

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

The transhipment 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 for customers and border checks at the outer borders of the Schengen Area (Croatia, Romania and Bulgaria are not yet members of the Schengen Area; Serbia, Moldova and Ukraine are not EU Members).

Transport companies operating on the Danube

The Blue Pages

'The Blue Pages' have been an indispensable source of information for cargo owners in the Danube region since 2009. The comprehensive directory of shipping companies and ship brokers operating on the Danube can be accessed in English at www.danube-logistics.info/the-blue-pages. Companies are invited to create a free business profile to field enquiries for transport services.

Danube Ports

'Danube Ports' provides information and data on more than 60 ports and terminals along the entire Danube. The online platform can be accessed at www.danube-logistics.info/danube-ports. Besides general information, the detailed port profiles include contact details of the port operator and administration, important data on the infra- and suprastructure, as well as on storage and transhipment facilities. The local terminal operators and their services are described as well.

Demand side of Danube navigation

The demand side of the inland waterway transport market firstly includes, for the most part, cargo owners, i.e. industrial companies that receive or convey goods. Secondly there are forwarders and logistics service providers operating in this field who carry 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 over long distances.

However, the system requires the availability of high-quality logistics services along the waterway (transhipment, 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 a vital transport mode for the **steel industry**. Iron ore accounts for example for 25-30% of the total transport volume shipped 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.

The most important steel plant in Austria is voestalpine, which is headquartered in Linz. This company operates a private port on its own premises that has an annual waterside transhipment of 3-4 million tons. This is also Austria's most important port in that it has handled almost half of all waterside transhipment in Austria in recent years.

Source: viadonau

Transhipment of steel coils

Other major steel plants in the Danube region are located in Dunaújváros/Hungary (ISD Dunaferr Group), Smederevo/Serbia (HBIS Group) and Galaţi/Romania (Arcelor-Mittal).

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. Wood transports (for instance logs, pellets) vary greatly, depending on the regional raw material availability.

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) have settled directly on the waterway. Many companies have already established factory transhipment 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: Voies navigables de France

Transhipment of agricultural goods

Petroleum products from the **mineral oil industry** account for a large share of total transport volumes on the Austrian stretch of the Danube and therefore constitute a key market. In the Danube region there are many refineries located either on or near the waterway.

Due to their great bulk freight capacity, low transport costs and high level of safety, inland vessels are absolutely ideal 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. As a transport axis, the Danube waterway therefore makes an important contribution to the security of supply in the region.

Petroleum products and their derivatives are classed as hazardous goods and for this reason are transported in special vessel units equipped with the 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/or their weight, as well as the available infrastructure, inland vessels are ideally suited for special transport such as **heavy goods or oversized cargo** (high & heavy), e.g. construction machinery, generators, turbines or wind power plants. The greatest advantages here compared to conventional road transport are that no special authorisations or modifications are needed along the route, e.g. the dismantling of traffic lights and traffic signs or protective covers for plants. In addition, charges such as toll or axle load taxes are not levied on international waterways like the Danube. 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.

Source: viadonau

High & heavy transport by inland vessels

The increasing scarcity of non-renewable raw materials and the requirements introduced by the European Commission to increase the proportion of final energy consumption through renewable energies necessitate innovative logistics solutions for the inclusion of **renewable resources**.

Today already, the Danube is a logistics axis of pan-European significance for the bundling, storage and processing of renewable raw materials (for instance grain, oilseed and timber). Cultivation areas for renewables are readily available along the entire course of the river. Numerous companies from the biomass sector – producers, traders, processors and consumers – are located close to the Danube and represent an immense potential for inland navigation. In addition, there is a large number of Danube ports with efficient equipment for the transhipment and storage of renewable resources existing already.

Source: viadonau

Storage of rapeseed

The recycling sector is also becoming an increasingly important economic factor for Danube logistics due to the progressive, global scarcity of resources and the simultaneous, immense demand for secondary raw materials. Cost-efficient planning and execution of transports are essential factors due to the high price sensitivity associated with **recycling products**. With its capacity to handle bulk transports and the consequent low of cost of transport itself, inland navigation is a useful transport solution for the recycling sector. This is among the most important arguments for transport by inland navigation, combined with the significant prevalence of recycling products in the Danube riparian states. The major urban areas located directly on the Danube (e.g. Vienna, Bratislava, Budapest and Belgrade) are reliable suppliers of secondary raw materials. Moreover, the Danube region is home to numerous companies that process recycling products and that would be able to integrate inland navigation as a crucial link in their logistics chains.

Old metals and scrap, old glass and old plastics are particularly suitable for transport as bulk or general cargo on inland vessels.

Source: viadonau

Scrap metal warehouses close to the Danube

The **construction materials sector** is also a promising industry for Danube transports: The transport of mineral raw materials, as well as products and semi-finished products that are used in the building industry, has particularly significant potential for relocation to the waterways. Numerous infrastructure projects along the Danube corridor present an opportunity for inland navigation as well. Included in this category are bridge building and roadworks projects in Austria, Hungary, Bulgaria and Romania. Other ventures with relevance for Danube logistics are railway and port infrastructure projects along the Middle and Lower Danube.

Inland vessels can be used for (dry) bulk cargo, general cargo (for instance concrete components) and for rolling cargo (e.g. construction machinery and cranes).

Source: viadonau

Transport of construction materials by inland vessel

The **chemical and petrochemical industry** is another important sector for shipping.

Large quantities of fertilisers in particular are currently being transported on the Danube. They 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. The development of cost-efficient concepts for pre- and end-haulage as well as the establishment of warehouse space for bulk cargo are auspicious opportunities to improve the integration of inland navigation within the logistics chains of the chemical industry along the entire transport corridor.

Source: viadonau

Storage of chemical products

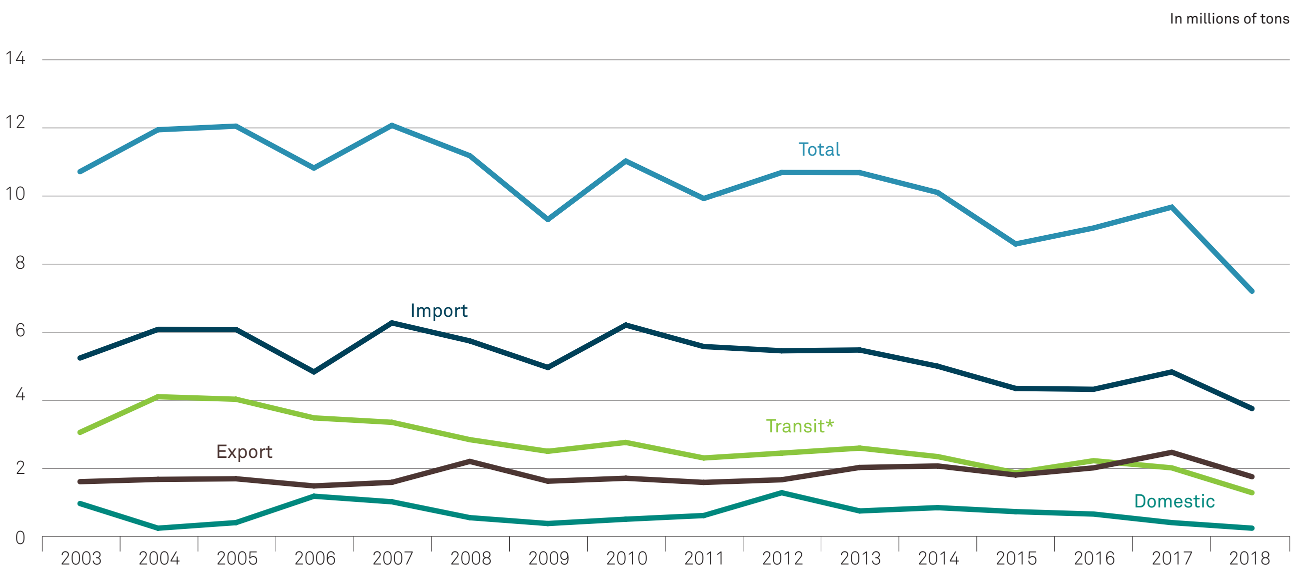
Types of contract and transport solutions

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 transhipment equipment and long-term transport planning.


Freight transport on the Austrian Danube 2015–2018
2018
7,202,368 tons
2017
9,619,520 tons
2016
9,071,478 tons
2015
8,599,354 tons

FIGURES DATA FACTS

Freight traffic on the Austrian Danube 2003–2018



Transport volumes in tons	Import	Export	Transit*	Domestic	Total
2018	3,793,364	1,776,694	1,355,563	276,747	7,202,368
2017	4,822,231	2,380,773	2,027,367	389,148	9,619,520
2016	4,299,854	1,975,592	2,187,190	608,842	9,071,478
2015	4,325,020	1,763,975	1,830,024	680,335	8,599,354
2014	4,982,130	2,031,587	2,309,212	798,797	10,121,726

* Due to a lack of statutory resources, there are no complete records for transit data for the years 2004 and 2005. Since 2005 figures have been extrapolated by Statistics Austria.

Source: Statistics Austria, adapted by viadonau

TRANSPORT VOLUMES

Massive decline in transport volume
Low water levels caused severe difficulties

- Transport volume down by a quarter in 2018
- The westbound route in particular was strongly affected by the low water level
- Declines in all transport sectors

In 2018, barely more than 7.2 million tons of goods were transported on the Austrian section of the Danube. The exceptional dry spell and the associated low water levels in the second half of the year led to a massive decline in the volume of goods transported by 25.1% or 2.4 million tons.

The impact of the low water level is also evident when looking at the results over the course of the year. For example, the first quarter of 2018 still saw a marked increase in transport volumes of 54.1% or 0.9 million tons compared with the same quarter of the previous year. For the following three quarters, however, only decreases were reported. In addition to the low water level, a two-week closure caused by an accident on the Bavarian Danube led to severe obstructions of shipping traffic on the westbound route in July.

The total transport performance (the product of transport volume and distance travelled) within the Austrian federal territory fell by 26.4% to just under 1.5 billion ton-kilometres. The total transport capacity, both within and outside of Austria, fell by 28.4% to just under 7 billion ton-kilometres. The number of trips made by loaded vessels on the Austrian section of the Danube declined by 14.7% (from 8,932 to 7,622).

In percentage terms, the largest decline in transport volume on the Austrian section of the Danube occurred in transit (–33.1% or about 671,800 tons). In terms of volume, imports recorded the sharpest decline in the volume of goods transported – by 21.3% or roughly 1.0 million tons to 3.8 million tons. Cross-border freight traffic (the sum of exports, imports and transit) contracted by 25.0% or slightly less than 2.3 million tons. In total, only just over 6.9 million tons were transported across borders.

Exports on the Danube waterway also fell in 2018 by 25.4%, or approximately 604,000 tons. Domestic traffic accounted for the smallest share of the total transport volume. It decreased by 28.9% or just over 112,400 tons.

PORT TRANSHIPMENT

Low water has a noticeable impact
Decline in waterside transhipment

- Low water in the last two quarters resulted in a massive decline in the waterside transhipment volume against 2017
- With around 2.6 million tons, the voestalpine industrial port remained the most significant port on the Austrian Danube

The year 2018 was impacted by low water in the Danube over the course of several months. The resulting reduction in transhipment volume was noticeable at all Austrian Danube ports and transhipment sites.

A total of 6.1 million tons were handled in 2018, which corresponds to a decrease of 23.3% or 1.9 million tons compared to 2017. Regarding the individual ports, the decline in transhipment volumes ranged from –7.7% to –35.3%.

As in the previous year, voestalpine's industrial port in Linz recorded the highest waterside transhipment volume of all Austrian Danube ports with a total volume of around 2.6 million tons. In total, around 42.6% of the total transhipment volume in Austria was therefore handled at this port. The difficult conditions during the year under review led to a decrease by approximately 1.0 million tons.

With 18.0% of the total volume, the other private ports and transhipment sites (Aschach, the heavy-cargo port at Linz, Pöchlarn, Pischelsdorf, Korneuburg and Bad Deutsch Altenburg) rank second among the Austrian ports and transhipment sites. In total, 1.1 million tons were handled waterside, which corresponds to a decline of approximately 0.3 million tons against the previous year.

The Port of Vienna with the associated ports of Freudenau, Lobau and Albern along with the transhipment sites Lagerhaus and Zwischenbrücken increased its share in the total Austrian transhipment volume. In 2018, waterside transhipment amounted to more than 1.0 million tons, which corresponds to 17.0% of the total volume. In 2017, this figure had been at 14.1%. At 7.7%, the Port of Vienna recorded the smallest decline in transhipment volume in Austria.

At the ports of Linz AG (industrial port and oil port), the cargo handling volumes declined by 15.3% to approximately 540,000 tons during the year under review. Compared to the previous year, it stands out that the two Linz AG ports handled more goods on the waterside than the port of Enns, which recorded a total volume of around 480,000 tons in 2018. The latter recorded a 28.3% reduction in waterside transhipment volumes.

The Port of Krems had to take the biggest percental decline in waterside transhipment. With 347,882 tons of goods handled waterside, the share of the total cargo handling volume decreased by 35.3% to 5.7%.

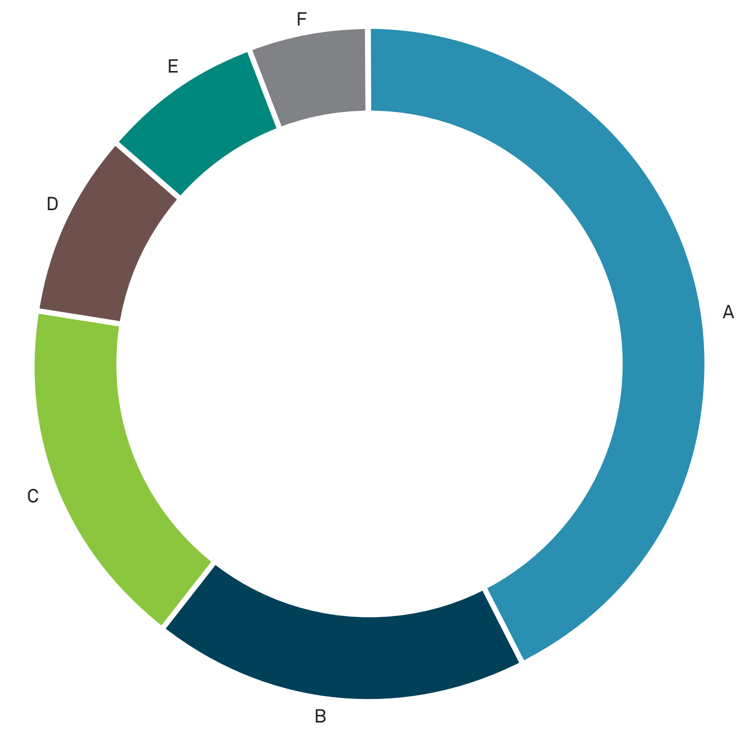
FIGURES DATA FACTS

Waterside transhipment at Austrian Danube ports and transhipment sites 2018

F
Krems
5.7%
347,882 tons
(–35.3%)

E
Enns
7.9%
483,340 tons
(–28.3%)

D
Linz AG[4]
8.8%
535,947 tons
(–15.3%)



A
Linz voestalpine[1]
42.6%
2,612,851 tons
(–27.3%)

B
Others[2]
18.0%
1,101,422 tons
(–22.0%)

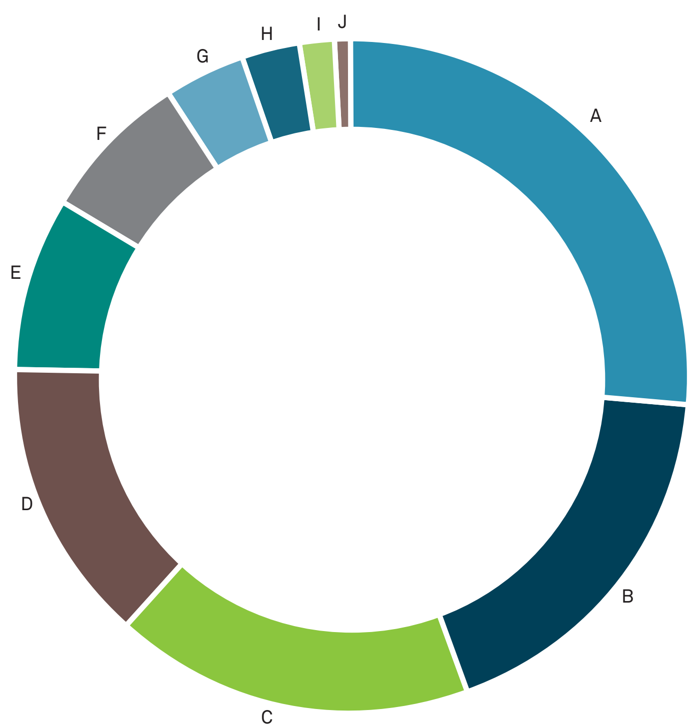
C
Port of Vienna[3]
17.0%
1,042,111 tons
(–7.7%)

[1] Including waterside transhipment at Industrie Logistik Linz GmbH.
[2] Other ports and transhipment sites include: Aschach, Schwerlasthafen Linz, Pöchlarn, Pischelsdorf, Korneuburg, Bad Deutsch Altenburg.
[3] The three ports of Freudenau, Albern and Lobau (oil port) and the two transhipment sites Lagerhaus and Zwischenbrücken have been grouped together to compile the total turnover figures for the Port of Vienna.
[4] Data from both the commercial port and the oil port in Linz have been grouped together to compile the total turnover figures for the Port of Linz.

Source: Statistics Austria, adapted by viadonau

FIGURES DATA FACTS

Transport volumes by commodity groups on the Austrian Danube 2018



J
Chemical products
0.4%

I
Solid fuels
1.4%

H
Machinery, vehicles, and other articles
2.8%

G
Foodstuffs and animal fodder
3.8%

F
Fertilisers
7.3%

A
Ores and metal waste
26.7%

B
Petroleum products
18.0%

C
Agricultural and forestry products
17.3%

D
Metal products
14.0%

E
Crude and manufactured minerals
8.3%

Goods classification according to NST/R*	Domestic	Import	Export	Transit	Total 2018	Change
Agricultural and forestry products	3,495	583,645	79,723	578,281	1,245,144	–25.4%
Foodstuffs and animal fodder	1,988	150,884	43,324	76,505	272,701	–33.1%
Solid fuels	424	80,466	–	23,845	104,735	–63.3%
Petroleum products	188,877	563,538	537,131	10,365	1,299,911	–5.0%
Ores and metal waste	–	1,912,590	7,943	–	1,920,533	–25.5%
Metal products	1,686	212,469	551,733	243,093	1,008,981	–18.4%
Crude and manufactured minerals, building materials	77,262	224,403	204,313	88,267	594,245	–31.4%
Fertilisers	2,995	50,717	327,983	143,144	524,839	–40.8%
Chemical products	–	0	–	26,354	26,354	–39.9%
Machinery, vehicles and other articles	20	14,652	24,543	165,710	204,925	–25.9%
Total	276,747	3,793,364	1,776,693	1,355,564	7,202,368	–25.1%

* NST/R = Standard Goods Classification for Transport Statistics/revised.

Source: Statistics Austria, adapted by viadonau

COMMODITY GROUPS

Ores and metal waste strongest group
Petroleum products defy low water

- Declines in transport volumes across all commodity groups due to low water levels
- Petroleum products register smallest decreases

In 2018, ores and metal waste remained the largest commodity group with just under 1.9 million tons. Compared to the previous year, the transport volume within the product group dropped by 25.5% due to low water levels.

With a 5.0% decline in transport volumes, petroleum products showed a relatively high resilience under these difficult conditions. In terms of export volume, this product group even recorded an increase of 64,600 tons, an increase by 13.7% over the previous year. Overall, the group of petroleum products came second in terms of percentage share.

Agricultural and forestry products were the third-strongest commodity group in terms of transport volume, accounting for 17.3% of the total volume as in the previous year. A total of around 1.2 million tons were shipped on the Austrian Danube within this product group. Compared with the previous year, the volume of agricultural and forestry products transported declined by 25.4% or 423,005 tons.

Imports of metal products increased by 15,203 tons compared with the previous year, which corresponds to a change of 7.7%. Here too, however, the total volume of goods transported fell by 18.4% to just over 1 million tons. In terms of percentage, metal products came in fourth.

Domestic transport of crude and manufactured minerals suffered a sharp decline. The additional losses in imports, exports and transit led to an overall decrease in transport volumes of 31.4%.

Declines in transport volumes against the previous year were also observed for foodstuffs and animal fodder as well as machinery, vehicles and other articles. These, too, were attributable to the difficult overall conditions. There was a slight increase in domestic shipments of fertilisers. This was offset, however, by a decline in imports, exports and transit traffic.
Solid fuels suffered the strongest decline in freight transport. Overall, the decrease in the transport volume amounted to 63.3%.

In 2018, 26,354 tons of chemical products were transported exclusively in transit. In terms of volume, they therefore continue to represent the smallest group of goods transported on the Austrian Danube.

PASSENGER TRANSPORT

Number of passengers slightly declining River cruises continue to boom

- 3.3% more passengers on river cruises
- Six new cruise ships in operation on the Danube
- Liner and non-scheduled services declining

For the first time in four years, passenger transport on the Austrian Danube section recorded a decline in 2018. A total of approximately 1,260,000 passengers were transported, representing a decrease of 0.4% against 2017.

The number of river cruises continued to rise in 2018, exceeding last year's record with 465,000 passengers transported (+3.3 % against 2017). A total of six newly constructed vessels were brought into service on the Austrian section of the Danube, thereby increasing the number of operational cabin vessels to 182 (+4.6%). In total, 5,197 journeys (+4.4%) were completed. Due to the continuing growth of the existing fleet, the capacity for river cruises increased to 37,000 passengers (+7.6 %), which corresponds to an average of 203 passenger places per ship.

In 2018, liner services carried approximately 700,000 people (–0.7%). DDSG Blue Danube Schiffahrt GmbH recorded a total of 272,300 passengers (+9.1%) transported in the Wachau and Vienna. A total of 147,777 passengers (±0.0%) were transported between Vienna and Bratislava on the two Twin City Liners. 41,338 passengers (–18.8%) took advantage of the services offered by Donau-Schifffahrts-Gesellschaft mbH (formerly known as Donau Touristik). The Slovakian hydrofoils operating between Vienna and Bratislava recorded the largest decrease due to the low water level, carrying only 3,627 passengers (–80.4%) in 2018.

Non-scheduled services carried approximately 95,000 passengers (–13.6 %) in 2018. DDSG Blue Danube Schiffahrt GmbH carried 46,600 passengers (–19.9 %) on theme, special and charter cruises, while MS Kaiserin Elisabeth (owned by the Donau-Schiffahrts-Gesellschaft mbh) recorded 10,680 (+8.0 %) passengers on non-scheduled trips. MS Donaunixe and MS Maria, owned by Donauschiffahrt Ardagger GmbH, recorded approximately 5,543 passengers (–6.6%).

Passenger traffic volumes for companies which carried less than 5,000 passengers in 2018 are not reported separately here. There are no figures available for this reporting period for other scheduled and non-scheduled services operated on the Austrian section of the Danube.

FIGURES DATA FACTS

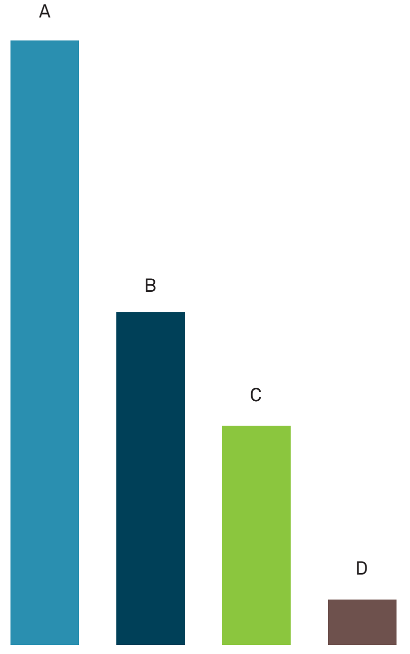
Passengers on the Austrian Danube 2018[1]

A
Total
1,260,000

B
Liner services
700,000

C
River cruises
465,000

D
Non-scheduled services
95,000



Dockings and passengers at passenger ports in Vienna[2]	Dockings ships	% to previous year	Passengers processed	% to previous year
2018	7,606	+1.6	709,185	+2.1
2017	7,484	+2.0	694,848	+3.9
2016	7,337	+7.8	668,805	+6.6
2015	6,805	–1.6	627,194	+4.6

1 Due to the fact that passenger traffic on the Danube ceased to be statistically compiled in Austria in 2003 (due to a change in legislative basis), the above figures include additional estimates in passenger numbers on liner services and non-scheduled traffic, based on an assumed average capacity utilisation of 40% on passenger ships. The calculation of the total number of passengers on cabin vessels is based on the number of trips these ships made through the locks at Aschach and Freudenau, with an assumed average capacity utilisation of 75%, whereby a deduction of 30% for double counting has been estimated.
2 Landing stages at Handelskai, Danube Canal and Nussdorf, including cabin vessels and the Twin City Liners.

Sources: 1. Wiener Bootstaxi, Brigitte Wilhelm, Central Danube Region Marketing & Development GmbH, DDSG Blue Danube Schiffahrt GmbH, Donauschiffahrt Ardagger GmbH, Donauschifffahrt Wurm & Noé GmbH & Co. OHG, DSGL – Donau-Schifffahrts-Gesellschaft mbH, Event-Schifffahrt Haider e. U., Genuss-Schiffahrt GmbH/Donauparadies Gierlinger, MAHART PassNave Ltd., Nostalgie Tours Video & Consulting GesmbH, ÖGEG Österreichische Gesellschaft für Eisenbahngeschichte GmbH, Schiffahrtsunternehmen Wilhelm Stift GmbH, Slovak Shipping and Ports – Passenger Shipping JSC (SPaP-LOD, a. s.), viadonau, WGD Donau Oberösterreich Tourismus GmbH, Wiener Donauraum Länden und Ufer Betriebs- und Entwicklungs GmbH, Wikingerabenteuer – Koblmüller Alois

TRANSPORT DENSITY

Upstream transports most important
Highest frequency at border AT/SK

- 4.9 million tons of goods upstream
- Import dominates with 3.8 million tons
- With 3.2 million tons of transhipment, the port location Linz represents a noticeable break in the transport density

A total of 7.2 million tons of goods were transported along the approximately 351 kilometre long section of the Austrian Danube in 2018.

The transport density illustrates that the majority of the transported volumes (4.9 million tons) were shipped upstream. The dominant position of imports is also evident, exceeding exports as well as transit and domestic transports by a clear margin at 3.8 million tons.

The port location Linz continues to represent a noticeable break in the transport density. A total of 3.2 million tons were handled in the Linz ports in 2018, with the industrial port of the voestalpine AG making the most significant contribution at 2.6 million tons.

The characteristic composition of the transport density is primarily due to the very high volume of 1.7 million tons imported by voestalpine AG from the eastern Danube riparian states and the approximately 1.1 million tons of goods transported from east to west via the Austrian Danube in transit traffic.

Overall, however, exports exceeded transit traffic by 31.1% with a volume of 1.8 million tons. Here, too, at 1.2 million tons, the largest quantities were shipped to ports of destination east of Austria.

The important position of Eastern traffic is also illustrated by the comparison between the volume of goods shipped via the Austrian-Slovak border and the volume of goods shipped via the Austrian-German border: At 5.7 million tons, the volume shipped across the eastern border exceeded the volume shipped across the border with Germany by 120.2%.

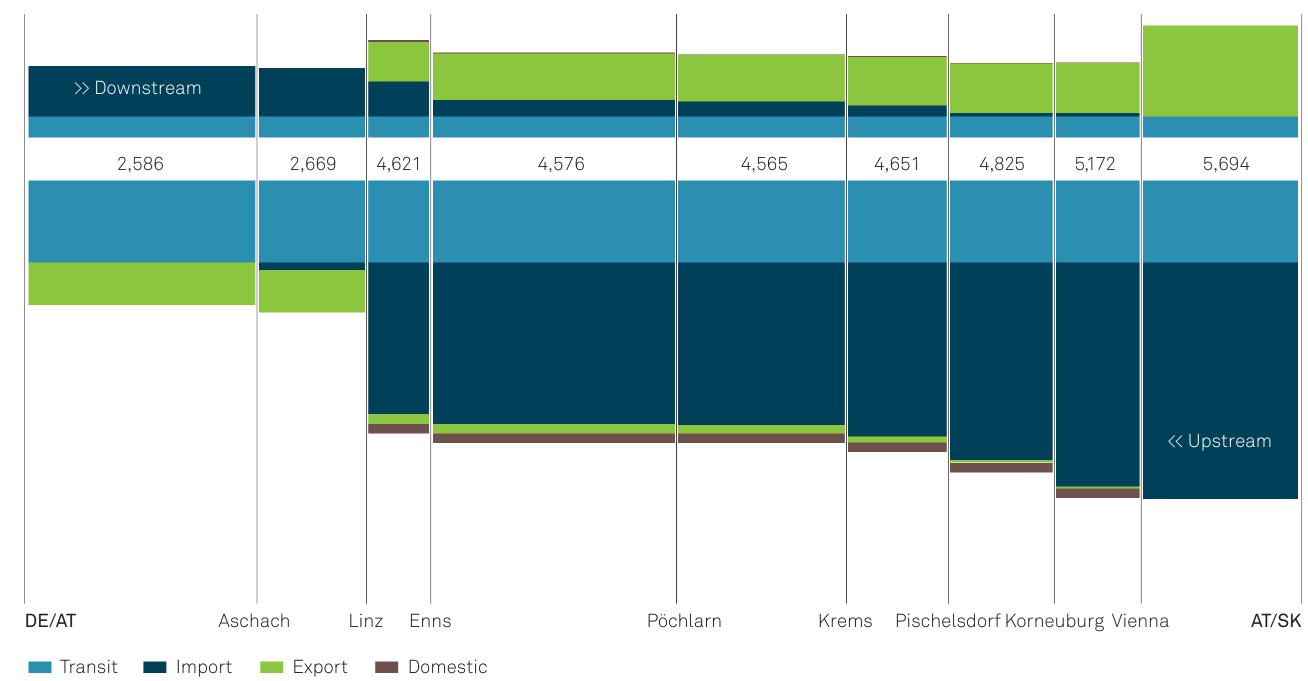
Accordingly, in 2018, the Danube section between Vienna and the Austrian-Slovak border was again the section with the highest volume of goods shipped on the Austrian Danube, while the section between the German-Austrian border and Aschach once again recorded the lowest transport volumes.

Finally, transport density illustrates the subordinate importance of domestic traffic within Austria.

Calculated on a daily basis, an average of 19,347 tons of goods were carried on the Austrian Danube, corresponding to the load carried by 774 lorries (25 net tons per vehicle) or 484 railway wagons (40 net tons per wagon).

FIGURES DATA FACTS

Density of freight traffic on the Austrian Danube 2018

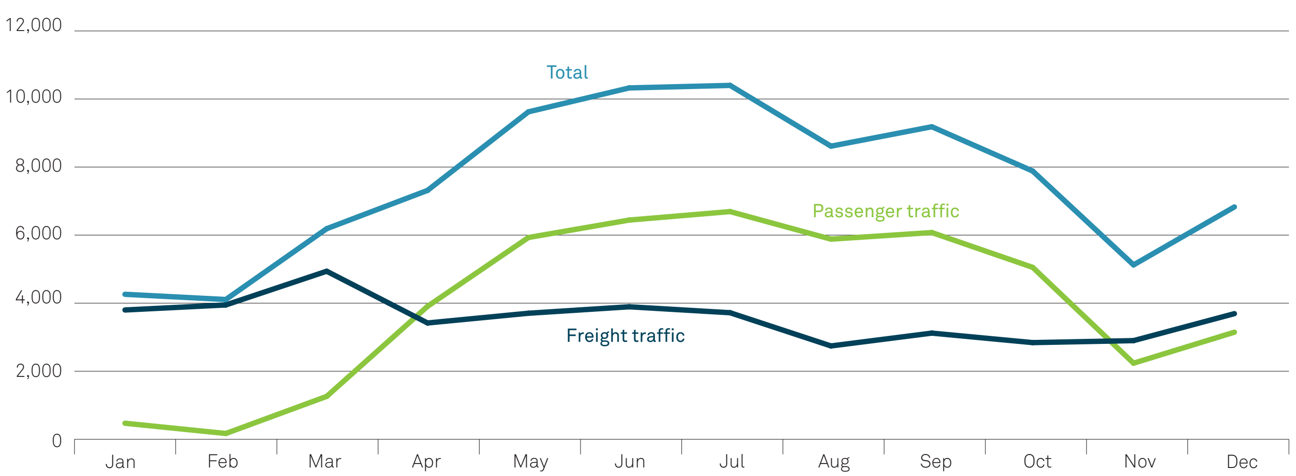


Section in 1,000 tons	Length in km	Import upstr.	Import d'str.	Export upstr.	Export d'str.	Domestic upstr.	Domestic d'str.	Transit upstr.	Transit d'str.	Total upstr.	Total d'str.	In sum
Border DE/AT–Aschach	63.21	0	669	562	0	0	0	1,079	276	1,641	945	**2,586**
Aschach–Linz	31.30	108	644	562	0	0	0	1,079	276	1,749	920	**2,669**
Linz–Enns	16.87	2,011	464	133	526	123	9	1,079	276	3,346	1,275	**4,621**
Enns–Pöchlarn	67.63	2,138	219	123	616	123	2	1,079	276	3,463	1,113	**4,576**
Pöchlarn–Krems	46.20	2,149	197	123	616	123	2	1,079	276	3,474	1,091	**4,565**
Krems–Pischelsdorf	26.30	2,303	147	81	639	123	3	1,079	276	3,586	1,065	**4,651**
Pischelsdorf–Korneuburg	29.60	2,611	46	33	656	123	1	1,079	276	3,846	979	**4,825**
Korneuburg–Vienna	23.64	2,963	46	24	660	123	1	1,079	276	4,189	983	**5,172**
Vienna–Border AT/SK	45.76	3,124	0	0	1,215	0	0	1,079	276	4,203	1,491	**5,694**

Source: Statistics Austria, adapted by viadonau

FIGURES DATA FACTS

Vessel units in freight and passenger transport locked through Austrian Danube locks in 2018*



	Freight traffic	% to previous year	Passenger traffic	% to previous year	Total	% to previous year
2018	42,597	–16.7	47,147	+7.1	89,744	–5.7
2017	51,164	–0.9	44,020	+5.6	95,184	+2.0
2016	51,603	+1.6	41,695	+6.0	93,298	+3.5
2015	50,781	–18.7	39,347	+1.6	90,128	–10.9
2014	62,449	–1.1	38,716	+19.8	101,165	+6.0

* Vessel units in freight transport include convoys (pushers, motor cargo vessels or motor tankers with cargo and tank lighters or barges) and individual vessels (motor cargo vessels and motor tankers or individual pushers and tugs). Passenger vessels include day-trip vessels and cabin vessels.

Source: viadonau

LOCKED-THROUGH VESSEL UNITS

90,000 units locked through Decrease in freight transport

A total of 89,744 passenger and cargo vessel units, travelling both upstream and downstream, were locked through the nine Austrian lock facilities in 2018 (excluding the Jochenstein power station on the Austrian-German border). Included in this number were 26,919 motor cargo vessels and motor tankers (–15.9% compared to 2017), 15,678 pushers (–18.2%) and 47,147 passenger vessels (+7.1%). A total of 34,851 cargo and tank lighters or barges (–21.4%) were also locked through as part of coupled and pushed convoys. Taking all types of vessels and convoys into consideration, the total number of locked-through vessel units in freight and passenger transport showed a decline of 5.7% against 2017.

Freight transport on the Austrian Danube saw a significant decrease in locked-through vessel units (–16.7% or 8,567 units). In passenger transport, on the other hand, a substantial increase was recorded (+7.1% or 3,127 vessel units). In 2018, freight transport had a share of 47.5% of total shipping volumes (–6.3%) with passenger traffic accounting for the remaining 52.5% (+6.3%).

In relation to 2018 as a whole, the average number of vessels passing through an individual Austrian Danube lock facility amounted to 9,972 convoys and individual vessels (–604 vessel units). This is equivalent to 831 (–50) vessel movements per month and an average of 28 locked-through vessels per day. As in previous years, the highest volume of vessels was once again recorded at the Freudenau lock in Vienna with 11,972 vessels and convoys passing through the lock (–6.8%), followed by the Greifenstein lock with 10,729 units. Aschach lock recorded the smallest number of locked-through vessels with 8,551 units.

In addition to commercial freight and passenger vessel units, 11,071 (+7.8%) small sports and leisure crafts also passed through lock facilities on the Austrian Danube in 2018, together with a further 1,697 vessels, which included public authority and rescue crafts.

"Each of thousands of ships that pass the locks every year with passengers from all over the world shows us the significant importance of education and the high sense of responsibility in our job. To be close to the river and in the middle of Danube navigation and to ensure an optimal traffic regulation – these are parts of the most beautiful sites of my profession as a lock supervisor."

MARKUS SIEGER
Lock Supervision Freudenau

MODAL SPLIT

Cross-border transport on the rise again
Danube's share of modal split down

- Road transport on the rise
- Danube suffers highest decline in share in western traffic
- Danube continues to be of great importance for eastern traffic

Within the Austrian Danube corridor, approximately 91.5 million tons of freight were transported in 2018, excluding purely domestic traffic. This corresponds to an increase of 3.4 % over 2017.

However, due to the severe low water situation during the second half of 2018, the environmentally-friendly transportation mode Danube was not able to benefit from the continuing increase in transport volume. The Danube's share of the total transport volume across all modes declined from 10 % to 8 %.

The share of rail also declined from 29% in the previous year to 28%. Accordingly, the proportion of road transport by truck increased from 61% to 64%. The unfavourable water conditions in 2018 had a particularly severe impact on the quantities of goods transported by inland waterway vessels across the border with Germany for export and import as well as in transit traffic to the west. Although the volume of exported and imported goods transported across the western border of the Danube corridor increased against 2017 by 1.2% to 42.5 million tons, the share of the Danube as a mode of transport halved to 3.9% in exports and 2.4% in imports.

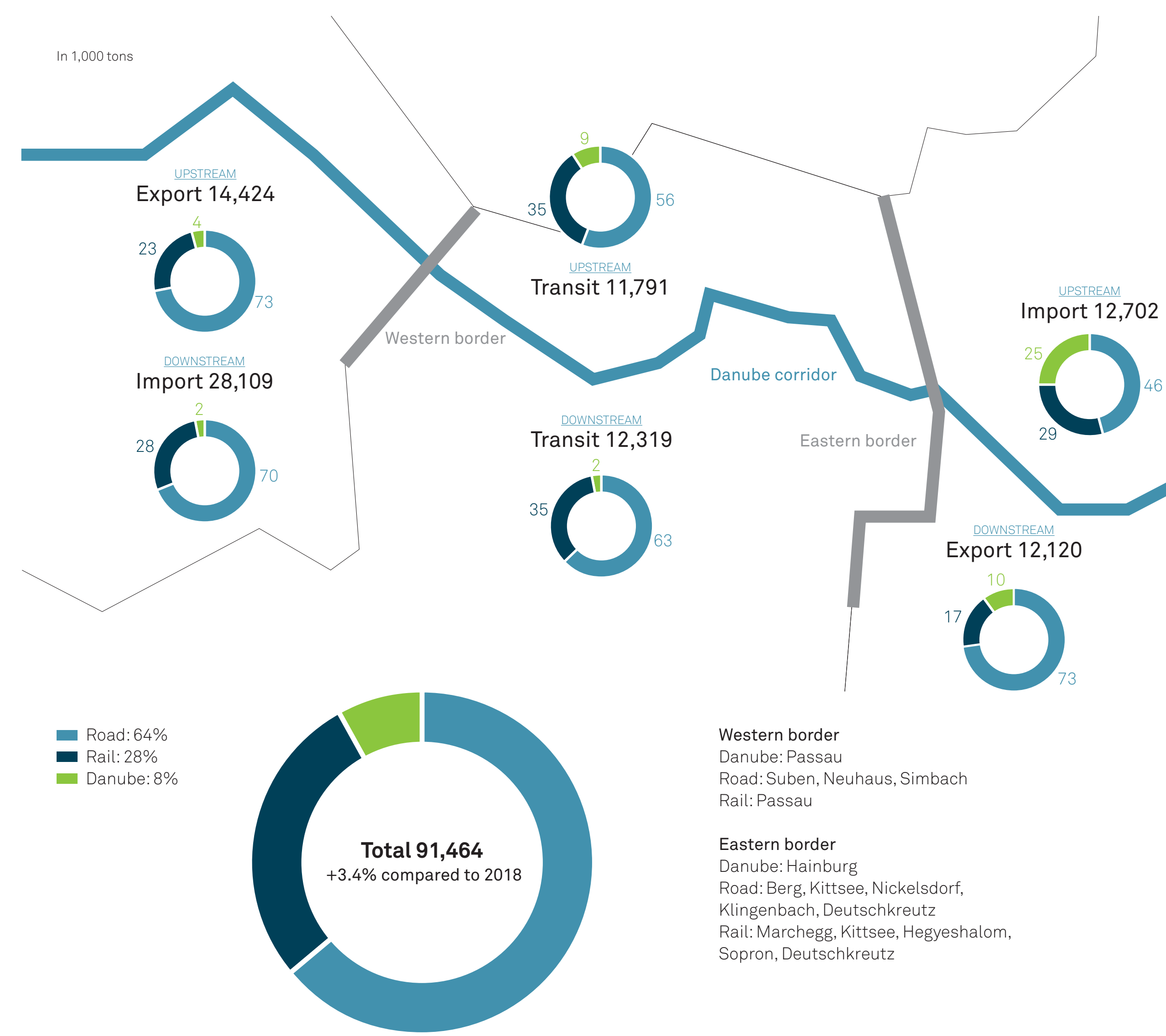
At the same time, the share of goods transported by rail across the western border of the Danube corridor decreased slightly in proportion to the volume of goods transported, so that road transport recorded a significant increase to 73.4% of exports and 69.7% of imports. In upstream transit traffic, shipping also experienced a significant decline from 14.4% to 9.2% of the transport volume.

In 2018, the Danube made the highest contributions to the modal split in exports and imports across the eastern border of the Danube corridor. Despite a declining trend, 10.0% in exports and 24.6% in imports were achieved here, which underlines the unbroken importance of the Danube in eastern traffic.

From a cross-modal perspective, however, the figures in the chart also illustrate that the western border of the Austrian Danube corridor is of greater significance to transport than its eastern border. Whereas in 2018 a total of 66.6 million tons were transported across the western border in export, import and transit traffic, only 48.9 million tons were transported across the eastern border.

FIGURES DATA FACTS

Cross-border freight traffic in the Austrian Danube corridor 2018

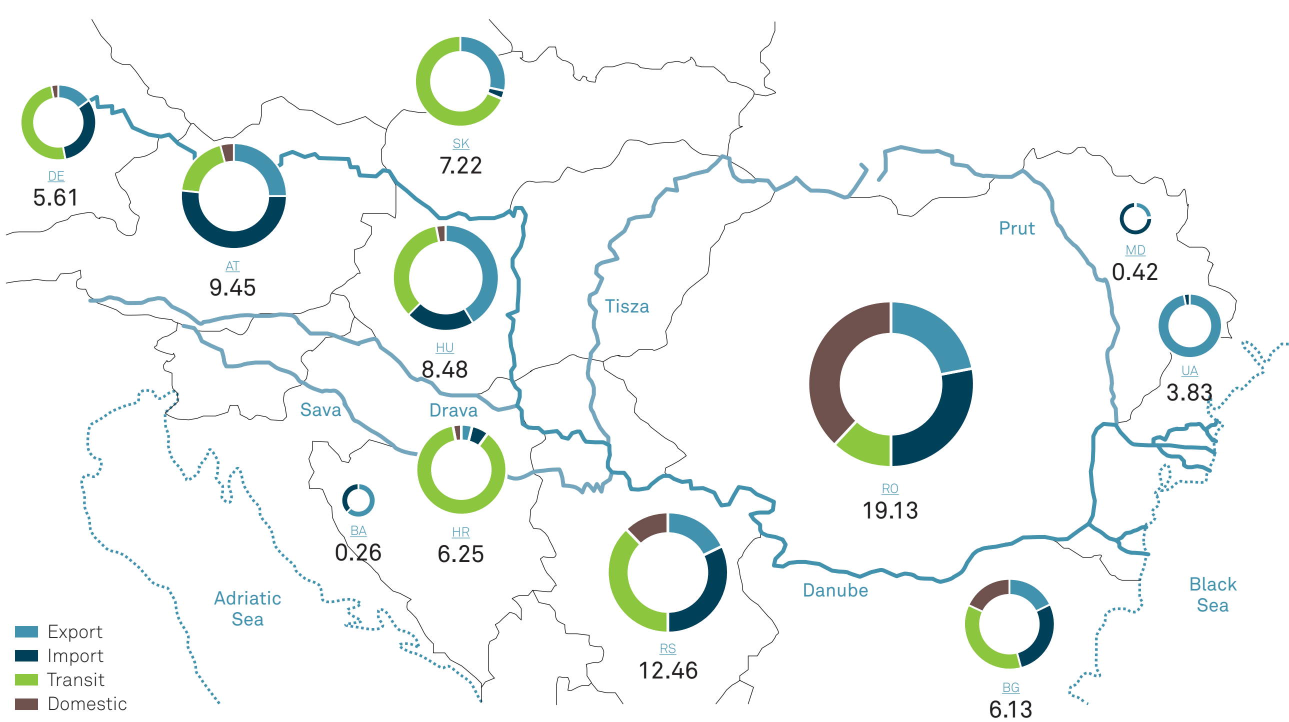


As no official data are available yet, the figures for the transportation modes of rail and road include projections for the 4th quarter of 2018.

Source: Austrian Institute for Spatial Planning (ÖIR), adapted by viadonau

FIGURES DATA FACTS

Freight transport on the entire Danube 2017



In millions of tons	DE	AT	SK	HU	HR	BA	RS	RO	BG	MD	UA
Export	0.84	2.40	2.09	3.50	0.19	0.17	2.30	4.21	1.11	0.10	3.67
Import	1.81	4.82	0.10	1.81	0.33	0.09	3.96	5.40	1.73	0.32	0.15
Transit	2.78	1.84	5.01	2.92	5.67	0.00	4.76	2.20	2.20	0.00	0.00
Domestic	0.18	0.39	0.02	0.25	0.06	0.00	1.44	7.32	1.09	0.00	0.01
Total	5.61	9.45	7.22	8.48	6.25	0.26	12.46	19.13	6.13	0.42	3.83

Source: Eurostat, national traffic statistics, viadonau, adapted by viadonau

FREIGHT TRANSPORT ON THE ENTIRE DANUBE 2017

39.3 million tons in 2017
Increase in maritime Danube transport

The most current available figures regarding the volume of freight transport on inland waterways in the Danube region are from the year 2017. This year saw 39.3 million tons of goods transported on the Danube waterway and its tributaries – a slight decrease of 0.8% or approximately 300,000 tons compared to 2016.

In a separate analysis of inland waterway transport on the Danube (including tributaries) and river-sea transport on the maritime Danube route, however, the development of the quantities of goods transported presents itself differently: Cross-border traffic between the Danube countries decreased by 5.6% or almost 2 million tons compared to 2016, while the maritime traffic on the lower Danube recorded a remarkable increase of 40.2% or almost 1.7 million tons – from 4.2 to 5.8 million tons.

The decline in the volume of cross-border traffic between Danube riparian countries compared to 2016 results from an average decrease in the volume of goods transported by inland waterway in the countries of the middle and lower Danube downstream from Hungary by 9.3%. By contrast, the volume of goods transported on the upper Danube and in Hungary increased by an average of 4.6%.

As in previous years, Romania again recorded by far the largest transport volume on the Danube in 2017 with just over 19 million tons, followed by Serbia with 12.5 million tons and Austria with 9.5 million tons.

With 4.2 million tons of goods shipped (+1.9%), Romania was the largest exporter on the Danube in 2017, followed by the Ukraine with 3.7 million tons (–13.0%) and Hungary with 3.5 million tons (+2.6%).

In terms of imports, Romania is also in the lead with 5.4 million tons (–23.8%). In second and third place are Austria (+10.6% or 4.8 million tons) and Serbia (–2.0% or 4.0 million tons).

On the Romanian Danube-Black Sea Canal (including its side channel), a total of 13.8 million tons were transported in 2017 (including river-sea traffic of around 57,000 tons). Compared to 2016, this represents a decrease of 5.4% or around 0.8 million tons of goods transported.

In maritime transport on the Danube via river-sea vessels or sea-going vessels, 4.3 million tons of goods were transported via the Romanian Sulina Canal (+14.4% compared to 2016) and 1.5 million tons via the Ukrainian Kilia-Bystroe arm – a remarkable increase of 362.1% compared to 2016.

- Total transport volumes on the Danube at the level of 2016 (–0.8%)
- Romania was the most important exporter and importer on the waterway
- Approximately 5.8 million tons of goods in maritime transport on the Danube (+40.2% compared to 2016)

Source: Felbermayr

High & Heavy transhipment at the heavy-load port of Linz

Success stories in Austria

High & Heavy – Felbermayr thinks highly of the Danube

Operating Europe-wide, Felbermayr Holding is an enterprise within the transport and construction industries. It has 68 locations in 18 countries. The company operates as a heavy load haulage contractor for road, rail and inland navigation in the transport and lifting technology segment. The construction division adds to the company's portfolio in the areas of structural, underground and hydraulic engineering.

Felbermayr is committed to inland navigation as a green mode of transport and operates three heavy load terminals with direct connection to waterways. The establishment of facilities along the waterways gives the heavy cargo specialist a strategic advantage over its competitors. Besides its proprietary heavy load port at the Linz location, terminals for high & heavy transhipment are also operated at the ports in Vienna Albern and in Krefeld (Germany) with a lifting capacity of 450, i.e. 500 tons, respectively.

A 27.5 hectare complex, the heavy load port in Linz was purchased in 1996. Extending more than one hundred metres and with a width of 17 metres, the basin can accommodate the standard inland vessels travelling the Danube. Two port cranes with an aggregate lifting capacity of up to 600 tons are available at the port. Moreover, over 220,000 m² of open area and roughly 55,000 m² heavy load warehouse capacity is available at the Linz complex. These warehouses are rented to a variety of customers to preassemble extremely large parts, which can then be shifted directly to the waterways without pre-haulage on road or rail.

Source: aerial photograph Redl, AGRANA

Bio-refinery Pischelsdorf

Renewable raw materials:
AGRANA turns Pischelsdorf into a logistics hub for biomass

The AGRANA Group is a leading international enterprise for the production and processing of fruit, starch products and bioethanol, as well as sugar and isoglucose.

The AGRANA plant in Pischelsdorf was constructed in 2007 as a bioethanol refinery and expanded in 2013 as a facility for the processing of wheat starch. This efficient bio-refinery, which belongs to the starch products business unit, perfectly implements the sustainable refinement of agrarian raw materials. The facility uses around 840,000 tons of raw materials each year to manufacture over 100,000 tons of wheat starch, 23,500 tons of wheat protein, 240,000 m³ of bioethanol, 120,000 tons of biogenic CO_2, 190,000 tons of protein feed and 55,000 tons of clay.

Most of the biomass required for this process is sourced in the Danube region. Around half of the bioethanol output is exported to Germany. The location of the facility was selected due to the easy access to the Danube waterway and the proximity to source and sales markets.

At present, up to 40% of the raw materials and products are transported by inland vessel. The vessels are loaded and unloaded at a transhipment point with a length of 649 m. Inland vessels are principally used to transport bulk goods. At present, the capacity at the transhipment point is around 600,000 tons per year. An increase is planned for the coming years due to expansion of the wheat starch facility.

Source: Fixkraft Futtermittel GmbH

Ship loading platform at the Ennshafen

Feed: Fixkraft trusts in efficient transhipment at the Ennshafen

Fixkraft Futtermittel GmbH was established 1971 with headquarters in Eberschwang (Upper Austria). The company picked the Ennshafen as the site for its production facility in 1982. Fixkraft is close to its customers and can utilise excellent multimodal transport connections at the Ennshafen. Access to the Danube waterway in particular enables cost savings for the company's logistics. The entire production division was relocated to Enns and expanded there for this reason in 1996.

Fixkraft uses around 200 raw materials from agricultural production and food processing. The waterway is mainly used to transport protein products like soy meal and sunflower cake. Once delivered, the raw materials are stored in the 12,000-ton raw materials warehouse at the Fixkraft plant. The sales markets for Fixkraft are Austria and the neighbouring European states.

Fixkraft opened a new loading platform at the Ennshafen in early October 2017. The vessel transhipment facility is named 'KAI 13'. With its dimensions of 23 times 12 m and four dolphins, the company is well-equipped for efficient water-side transhipment in future as well. The loading platform enables quick and clean acceptance of the raw materials for feedstuff. Fixkraft will therefore focus even more on deliveries via the waterway.


Source: VFI GmbH

Silos for the storage of oilseed in Ennsdorf

Food: VFI exploits the locational advantages of the Danube

VFI GmbH is Austria's leading producer of vegetable oils and fats. It is a sixth-generation family business based in Wels.

The company built a press plant in Ennsdorf in 2016. It is a certified Austrian oil press for the manufacture of protein feed and pressed oil. The press has an annual capacity of 35,000 tons of sunflower seeds, soy beans, rape and corn seed.

In addition to the press, the Ennsdorf site is also home to a warehouse for oilseed, which was expanded in 2018 to a total capacity of 14,000 m³, a warehouse for pressed oil with an 800,000-litre capacity, as well as a warehouse for press cake that can hold 1,000 tons. VFI consciously selected the site at the Ennshafen to construct the 14 million Euro facility, as it can preserve direct access to the Danube waterway.

This means that the goods can be sourced from suppliers or transported to customers by road, rail and waterway. This has benefits for VFI, as the company attaches a lot of importance to sustainability and traceability of its raw materials, as well as to just-in-time deliveries. VFI is already planning to expand the plant at the Ennshafen location in the future.

Transhipment of prefab concrete parts in Langenlebarn

Construction materials: GEROCRET is building on the Danube

GEROCRET – Ockermüller Betonwaren GmbH is an Austrian provider of prefab concrete parts that is based at Langenlebarn an der Donau. The company produces prefab concrete parts for underground, special and building engineering with an weight of up to 50 tons per element. Customers throughout Austria and Europe are supplied with prefab parts for rail, bridge, canal, road, tunnel and industrial construction, as well as for special projects.

Seeking to introduce innovative solutions for its customers, GEROCRET recently introduced the option of transport by inland vessel. The company recommissioned the Danube quay located directly adjacent to its complex at the end of 2017 and has since shipped prefab concrete parts to a customer by inland vessel. This short pre-haulage gives GEROCRET ideal conditions for use of the Danube waterway.

In addition, the company has important sales markets located in the Danube region. Transport of heavy cargo and oversized goods by inland vessel has proven extremely cost-efficient and has provided a key sustainability benefit compared to other transport modes, as this means of transport is ideal to accommodate the high unit weights and large-format dimensions of the products.

GEROCRET is therefore planning to make more frequent use of Danube navigation in future.

Source: MOL-Gruppe

Tank storage in Korneuburg

Mineral oil products: MOL is using the direct access to the Danube

The MOL Group is an international oil and gas company that is headquartered in Budapest, Hungary. Operating in over 30 countries, the group employs a workforce of more than 25,000.

MOL currently operates three transhipment facilities on the Danube: at the MOL refinery in Százhalombatta, at the Slovnaft refinery in Bratislava and at the warehouse in Komárom. These locations along the Danube are used to supply customers in the West (Austria and eastern Germany) and in the East (Serbia and Romania).

Moreover, the MOL Group runs a tank storage complex with transhipment facility in Korneuburg (river-km 1,942 – Austria) and Giurgiu (Romania). MOL trusts in inland waterway transport as large quantities of liquid cargo need to be shipped and the tonnage costs are comparatively inexpensive. Each tanker vessel can transport up to 2,000 tons, provided the water level is ideal.

The tank storage facility in Korneuburg is used to store and distribute liquid, combustible mineral oil products (Super 95 and 98, Diesel B7, bunker fuel and Heating Oil Extra Light). The products are usually delivered by inland vessel. The tank storage facility was gradually modernised and adapted after the takeover of the previous operator (AVANTI) in 2003. There are now seven above-ground fixed-roof tanks and two horizontal tanks available at the Korneuburg site for the storage of products. The total storage capacity is approx. 6,200 m³ for petrol and 10,000 m³ for diesel and other gas oil.

What are River Information Services?

The growing demand for high-quality, cost and time-saving transport services, as well as the provision of electronic information, has become an important success factor for logistics companies. In order to better equip inland waterway transport with the necessary tools for these needs, tailored **information and management services** – so-called River Information Services (RIS) – have been developed in Europe to assist both freight and passenger shipping on the waterway.

River Information Services increase traffic safety and improve the efficiency, reliability and scheduling of transport. The available RIS data form a base of information for the support of traffic and transport related tasks.

The European Union RIS Directive

The harmonisation of River Information Services is regulated at European level by the **Directive on harmonised river information services (RIS) on inland waterways in the Community** of the European Parliament and of the Council, which entered into force on 20 October 2005 (European Commission, 2005).

Source: viadonau

Inland AIS base station

This so-called 'RIS Directive' contains mandatory technical provisions for navigational equipment and electronic data interchange along with minimum requirements for RIS implementation. This guarantees the emergence of harmonised RIS applications based on internationally compatible technologies. The Directive regulates:

- Mandatory **technical standards** for RIS implementation regarding
  - Tracking and tracing of inland vessels (Inland Automatic Identification System – Inland AIS)
  - Inland electronic navigational charts (Inland ENCs)
  - Notices to Skippers – NtS
  - Electronic reporting systems for voyage and cargo data (ERI – Electronic Reporting)

- Standardisation of **vessel equipment**

- Standardisation of **RIS data exchange**

RIS technologies

RIS technologies such as **Inland AIS**, **Inland ECDIS** (Electronic Chart Display and Information System), **NtS** and **ERI** are specified in the RIS Directive. These technologies are the basis for a variety of services, including fairway information services, traffic information, traffic management, information for transport logistics, port and terminal management, voyage planning and statistics.

This chapter provides a general overview of RIS technologies. Detailed information on the individual technologies are included in the other chapters of this manual.

Inland AIS

In inland navigation, the vessel **tracking and tracing system** Inland AIS (Inland Automatic Identification System) is used for the automatic identification and tracking and tracing of vessels. AIS was originally introduced by the International Maritime Organisation (IMO) to support maritime navigation. In order to meet the requirements of inland navigation, it was extended to the Inland AIS standard which enables the transmission of additional information.

The most important element on board an inland waterway vessel is the so-called **Inland AIS transponder**, which enables the exchange of information relevant to the positioning and identification of vessels and also facilitates the exchange of data with other Inland AIS transponders. Each vessel equipped with an Inland AIS transponder sends static (e.g. ship number, call sign, name), dynamic (e.g. position, speed, course) and voyage-related (e.g. draught, destination, estimated time of arrival) data. All vessels equipped with Inland AIS, as well as the base stations on the shore, can see the transmitting vessel which is within reach on the display of the transponder or on a computer with Inland ECDIS. This means that boatmasters are provided with an accurate overview of live traffic within the surrounding area of their vessel.

AIS transponder on board an inland vessel

Source: viadonau/Andi Bruckner

River Information Services supported by Inland AIS include:

- Automated vessel tracking and tracing
- Tactical traffic imaging
- Real-time traffic information
- Calculation of estimated time of arrival
- Tracking of accidents
- Lock management

Inland ENCs and Inland ECDIS

Inland ENCs are electronic navigational charts which are displayed using special software (Inland ECDIS). The main contents of **electronic inland navigational charts** (Inland ENCs) include:

- Limits of the navigable fairway/channel
- Current depth information, especially in the fairway and at shallow points
- Traffic control data such as buoys, restricted zones, lighting and signs
- Current gauge data
- Current vertical bridge clearance
- Structures and obstacles such as bridges, locks and weirs
- Shorelines and river engineering structures (groynes and training walls)
- Orientation guidance such as waterway axis, kilometre and hectometre markers
- Lock opening hours and contact details

Inland ENCs are fundamentally different to paper charts. The electronic storage of geographical data in the form of vector data enables the correct representation of all details and ensures a reliable and clear presentation of information. Inland ENCs are produced, updated and published either by commercial providers or by waterway administrations.

Source: viadonau/Andi Bruckner

Electronic navigational charts provide support for navigation

Benefits of Inland ENCs compared to conventional paper charts:

- Detailed and neat presentation of charts in all resolutions and sizes of the chart sections
- Simple and fast update process
- Layer technology for presenting various levels of detail
- One-click access to information on individual objects

River Information Services supported by Inland ENCs and Inland ECDIS include:

- Tactical traffic image
- Monitoring of vessel traffic
- Fairway Information Services

Notices to Skippers (NtS)

Notices to Skippers support traffic safety on inland waterways. Like traffic reports in road transport, the competent authorities use NtS to publish **information on restrictions that apply to the usability of transport infrastructure** (e.g. the fairway or locks).

The main contents of NtS are:

- **Waterway and traffic-related messages** with information about waterway sections or objects (e.g. locks, bridges) such as suspension of navigation, reduced passage heights, widths or depth
- **Water level-related information** with information about water levels, lowest fairway depths according to riverbed surveying, vertical clearance under bridges and overhead cables, discharge, flow regime or water level forecasts
- **Ice messages** containing information about obstructions and suspension of navigation caused by ice

In the past, Notices to Skippers were distributed verbally via VHF radio or written, with a posted notice or by fax in the relevant national language. Because of this, a RIS standard for Notices to Skippers was introduced for inland navigation, which allows for automatic translation of the most important safety information in the local language (🗎 European Commission, 2007; 🗎 Central Commission for the Navigation of the Rhine, 2009).

River Information Services supported by NtS include:

- Fairway information services
- Voyage planning tools

Source: viadonau

Websites in various European countries with Notices to Skippers

Electronic reporting

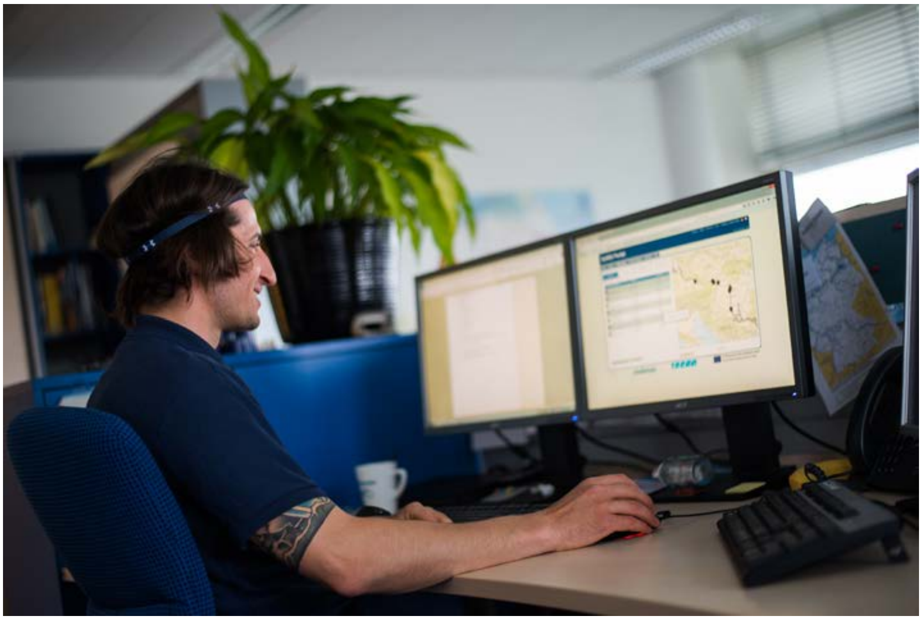
In many cases, certain **reporting requirements** apply to the transport of persons and goods on international waterways. The purpose of these reporting requirements is usually to ensure that, in the event of accidents, the competent authorities are notified promptly of important information concerning hazardous substances and the number of persons on board. Given that a standardised system of reporting requirements does not exist on the Danube, navigation companies involved in cross-border transport must submit multiple reports that may differ significantly in regard to their form and content. The RIS technology 'Electronic Reporting' provides the necessary tools to implement standardised electronic reports in the individual countries.

In practice, electronic reports require a working Internet connection. They are submitted either using standardised reporting software (e.g. BICS) or via an Internet portal (e.g. the DoRIS portal in Austria). These tools enable the preparation of reports containing details of the voyage, vessel and cargo, the editing or deletion of voyage and cargo data, as well as the import and export of voyage and cargo data. The use of standard forms and bookmarks makes it considerably easier to submit electronic reports compared to conventional paper or fax reports.

Standardised electronic reports enable unambiguous identification of the load and accurate translation into other languages. This is especially important in connection with hazardous goods. Thanks to electronic reporting, errors and mistakes can be easily avoided. Furthermore, the provision of electronic cargo information enables better planning of the loading and unloading, and paperwork is also reduced because customary reports no longer need to be sent by fax or letter.

River Information Services supported by electronic reporting include:

- Strategic traffic information
- Lock and bridge management
- Avoidance of accidents
- Transport management
- Border control and customs services
- Statistics



Source: viadonau/Thomas Bierbaumer

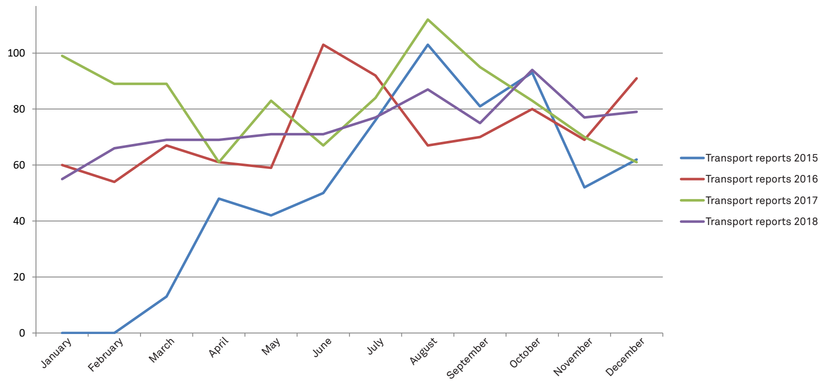
Reporting of hazardous goods on the Austrian Danube

Access to DoRIS Portal for registered users: https://portal.doris-info.at

Electronic reporting of hazardous goods in Austria

In Austria, transport reports are submitted by paper, by telephone or using an electronic system. Unlike the Rhine, mandatory electronic reporting does not apply on the Danube. In 2015, viadonau introduced a system on behalf of the BMVIT that enables registered users to submit electronic transport reports according to Section 8.02 WVO via the DoRIS portal.

At present, electronic reporting is mainly used in connection with the transport of hazardous goods that are subject to the ADN regulations. Recipients of these hazardous goods reports include the Supreme Navigation Authority, the lock supervisory authorities and the competent authorities in neighbouring countries in cases of cross-border transport. But electronic transport reports can be used in many other ways as well, also for compliance with statistical reporting requirements or to register at a port. For this to be possible, though, an amendment of the underlying laws (e.g. the Regulation for Inland Navigation Statistics) and reporting processes would be necessary.



Annual transport report trends 2015-2018

Source: viadonau

Year	Electronic transport reports (Austria, all)
2015	619
2016	873
2017	993
2018	890

At present, the principal recipients of electronic reports are the waterway and transport management authorities, as they are reliant on correct and direct data in emergencies. In future, the logistics chain will also be able to use this data in order to transmit advance notifications and messages of any changes in voyage or cargo data to other logistical users.

It is reasonable to assume that the sharing of electronic data between authorities and partners in the inland navigation sector will rise sharply in the coming years. Current trends within digitalisation indicate that electronic fulfillment will become necessary for all procedures and documents required within international trade and transport. The introduction of electronic reporting for inland navigation is a first step toward installing paperless management of all information that is needed to complete procedures within the sector and to ensure the necessary controls and services.

The DoRIS website provides information on the current state of the waterway danube: www.doris.bmvit.gv.at

The smartphone app 'DoRIS Mobile' is free of charge for Android and iOS:

River Information Services in Austria

Donau River Information Services (DoRIS) is operated by viadonau as a modern information and management system for inland navigation on the Austrian Danube. In 2006, Austria became the first country that started to roll out a comprehensive information system of this kind. Effective 1 July 2008, it became mandatory for users to carry and activate an Inland AIS transponder on the Austrian section of the Danube. This obligation has since been introduced on most of the main waterways in Europe.

DoRIS supports and provides all core **technologies within RIS**:

- Electronic charts (Inland ENCs)
- Notices to Skippers (NtS)
- Tracking and tracing (Inland AIS)
- Electronic reporting (ERI)

DoRIS provides a large **number of additional services** as well:

- DoRIS website (fairway information)
    - Access to charts
    - Gauges
    - Vertical bridge clearance
    - Notices to Skippers
    - Information on shallow sections
    - Lock status information
    - Fairway conditions
    - Austrian shipping law
- DoRIS Mobile app
    - Fairway information
    - Traffic data
- DoRIS-Portal
    - Electronic reporting
    - Access to vessel positions
    - Access to currently estimated times of arrival
- Lock management
- Value-added services
    - Inbound/outbound service
    - Monitoring of transhipment sites
    - Statistical analyses
    - Accident analyses
    - RIS data via machine-readable interfaces
- National Hull Data Management Infrastructure (only for the competent authority)

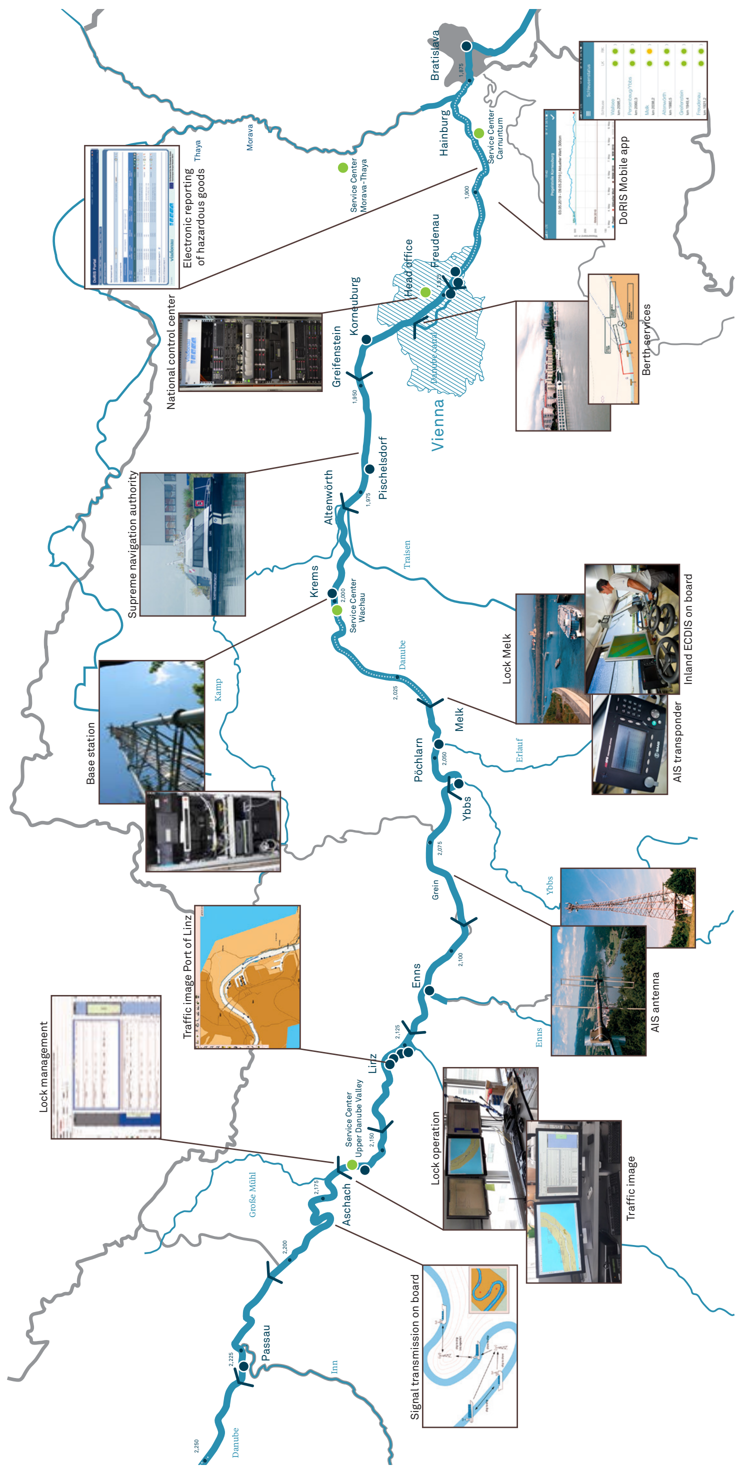
DoRIS assists all waterway users in their daily tasks. The services mainly focus on **users on board vessels**, as well as on **representatives of authorities** who are responsible for maintenance and operation of the waterway. As a rule, the information should be available to the users as quickly and reliably as possible. Important information is therefore disseminated via multiple channels.

Logistical users should benefit from DoRIS services as well. Hence, many of the services are provided as email subscriptions or via machine-readable interfaces. Needs-based services like monitoring of transhipment sites or event services (e.g. port access monitoring) were implemented as well.

The top priority at all times is to ensure **data protection** whenever sensitive information on positions or cargos is included. Information of this kind may only be made available to third parties based on legal authorisations or with the explicit consent of the data subject (ship owner).

Ongoing development of DoRIS in Austria is supported by the 'BMVIT Action Programme for the Danube until 2022' and within the framework of European initiatives.

The following diagram outlines the large number of services and technical facilities that are offered within DoRIS (for example a lock journal, the DoRIS website, electronic reports for hazardous goods). They are explained in more detail in the technical sections.



River Information Services on the Austrian Danube

Source: viadonau

RIS at European level

Similar to DoRIS, all countries connected to the network of European waterways operate their own national systems as well. Their scope and design are adapted to suit the national requirements. This circumstance often proves clumsy in practice, as it is currently not possible to obtain harmonised information during international voyages.

Information on RIS at European level can be accessed at www.riscomex.eu

Efforts are therefore under way at European level to implement international services, known as 'RIS Corridor Services'. They are intended to guarantee that users are always provided with an access point so that they may benefit from all relevant services for route and voyage planning, traffic data, electronic reports and logistics services when travelling.

Source: viadonau/Andi Bruckner

Sources

viadonau (2019): Annual Report on Austrian Danube Navigation p 6+7
viadonau (2019): Annual Report on Austrian Danube Navigation p 8-9
viadonau (2019):Annual Report on Austrian Danube Navigation p12-13
viadonau (2019):Annual Report on Austrian Danube Navigation p16-23
viadonau (2019):Annual Report on Austrian Danube Navigation p24-29
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viadonau (2019): Manual on Danube Navigation p 14
viadonau (2019): Manual on Danube Navigation p17-20
viadonau (2019): Manual on Danube Navigation p24-32
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