

BIOENERGY MEETS DANUBE LOGISTICS

HANDBOOK FOR A MODAL SHIFT TOWARDS
INLAND WATERWAY TRANSPORT



Interreg
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ENERGY BARGE



IMPRINT

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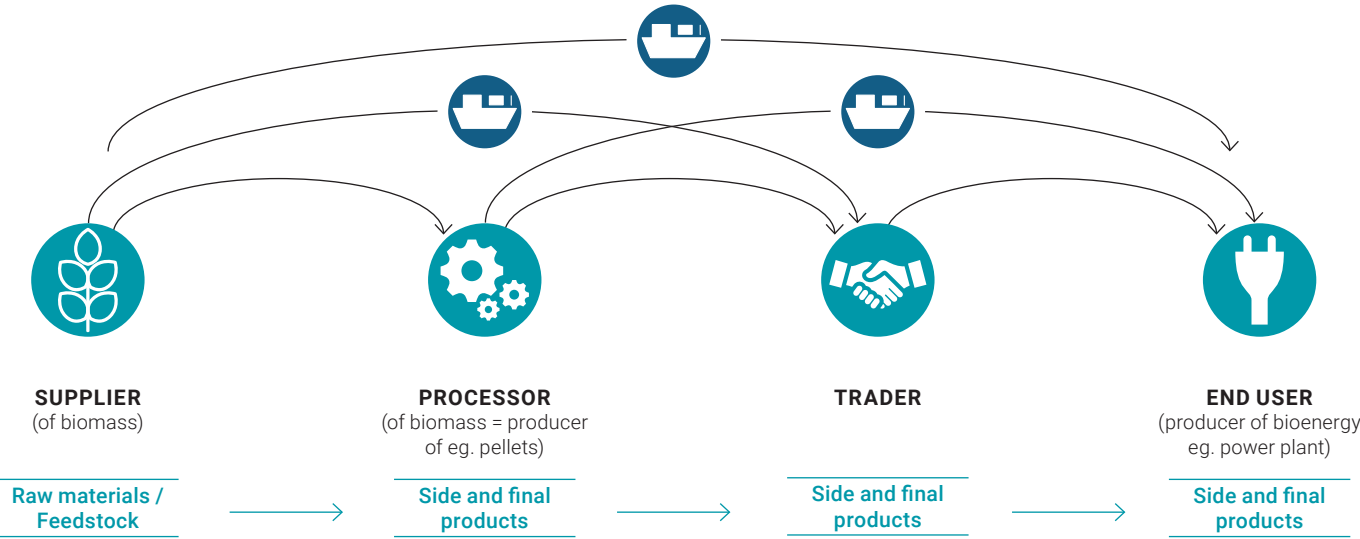
THE ENERGY BARGE HANDBOOK

PRACTICAL GUIDANCE FOR THE MODAL SHIFT OF BIOMASS TRANSPORTS TOWARDS THE DANUBE

The Danube region is characterised by its strong agricultural and forestry sectors. Therefore, it offers a great potential for green energy in the form of biomass. At the same time, the Danube functions as a logistics axis, offering a natural infrastructure for inland waterway transport.

The ENERGY BARGE project which has published this handbook aims to better tap both the biomass and bioenergy and the logistics potentials of the Danube region in a sustainable manner. To this end, the consortium developed a set of tools that inform private and public actors along the potential supply chains and across country borders, give them practical guidance for business development and bring them together. Eventually, the entire Danube region shall profit from the more widespread and sustainable utilization of its transnational, yet domestic biomass.

This handbook is one of these tools. It is designed for actors along the biomass and bioenergy supply and value chains which would like to have a “first peak” into the world of Danube navigation and what it has to offer. Danube logistics have relevance for all these actors, from biomass suppliers, processing entities such as saw mills, traders of bio-based raw materials and bioenergy products, to end users. Based on expert discussions with relevant shipping companies, port operators and logistics service providers from Germany, Austria, Hungary, Slovakia and Croatia, the following chapters provide practical information for bio-based cargo owners. The focus lies on technical and administrative framework conditions for waterway transport, handling and storage of different types of bio-based cargo.



TRANSPORT ON THE DANUBE

A LOGISTICS OPTION FOR THE BIOENERGY AND BIOECONOMY SECTOR

Bioenergy, be it used for transport, power or heating and cooling, is generated on the basis of primary or residual biomass, which in turn stems mainly from agriculture and forestry. Due to its fertile soil and vast forests, the Danube region is one of Europe’s major areas for biomass production and still has untapped potential for bioenergy generation. Additionally, with the bioeconomy gaining momentum all over Europe, another growth market opens up for both the Danube region’s biomass value and supply chains as well as for Danube logistics.

Already today, agricultural and forestry products account for around 25 % of the total volume of goods (approx. 40 Mio. tons/year) transported along the logistical axis of the Danube to be further processed and traded. Ports and transshipment sites along the river function as locations for storage and processing and thus as logistical hubs.

Currently, the major part of biomass transported on the Danube currently is classic agricultural and woody raw materials and products. However, also companies processing biomass for the bioenergy sector and, for example oil and saw mills or bioethanol plants, are oftentimes located at or close to ports (see p.9). As the bioeconomy grows, ports already experience interest from project developers aiming to utilise biomass in energetic and chemical-material ways.

Via the Main-Danube Canal, the Danube is connected to the chemical sites along the Rhine and the North Sea, where biomass products and bioenergy might play a more decisive role in coming years. Danube navigation offers advantages that explain its prime suitability for the transport of bulk cargo such as bio-based raw materials and products and for the related sectors that aim to increase their overall sustainability performance.

Log wood handling in the port of Straubing (photo: Port of Straubing).



Unloading of sunflower seeds (photo: Rhenus Donauhafen Krems).



HIGH TRANSPORT CAPACITY

Particularly surrounding the river stretch itself, the Danube region is a prime area for the production of renewable raw materials in the form of biomass. In logistics terms, most of these are bulk cargo, meaning unpacked goods which can be handled with grabs, dredgers, etc. and which occur in large quantities. Since inland waterway transport offers the best transport capacity per unit transported, it is a highly suitable transport mode for bio-based raw materials and products. Additionally, the capacity to transport large volumes of goods on long distances (bulk freight capacity) results in comparatively low transport costs especially for bulk cargo.

ENVIRONMENTAL PERFORMANCE

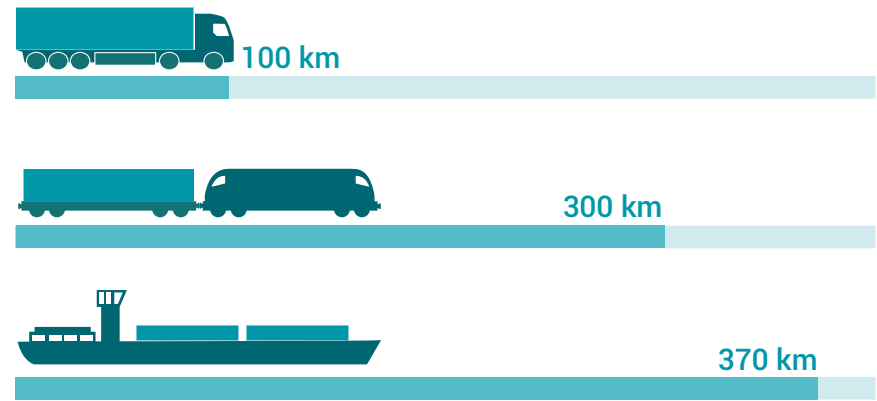
Transport distances for one ton of cargo requiring the same amount of energy (Source: viadonau). Another advantage stems from the overall positive environmental performance of inland navigation. With regard to specific energy use, it can be described as the most effective and most environmentally friendly mode of transport, since an inland vessel is able to transport one ton of cargo around four times further than a truck using the same amount of energy. Moreover, external costs, i.e. costs caused by pollution or noise emissions are lowest for inland navigation when compared to road, air and rail transport. Especially regarding CO₂ emissions, inland waterway transport outperforms the other transport modes. With the bioenergy sector aiming to contribute to achieving

the climate goals of the European Union, this is a factor that should not be underestimated when planning logistics.

AVAILABILITY OF INFRASTRUCTURE AND PARTNERS

Inland waterway navigation is a transport system based on a set of infra- and superstructural elements: the waterway itself, which is a natural transport infrastructure, the vessels and their cargo, the ports which function as multimodal hubs, meaning they connect the waterway to road, rail and air and can function as production and processing sites. Along the navigable Danube that stretches 2,415 km and connects 10 riparian countries, all these elements are available in a broad and high-quality portfolio: A dense network of Danube ports and logistics service providers offer efficient equipment for transport, handling and storage of biomass cargo, with many specializing in this segment. Good nautical conditions and maintenance of the waterway infrastructure are a precondition for inland navigation to be competitive and to offer environmentally friendly logistical concepts for our modern economy. The investment for maintaining and expanding the infrastructure is comparatively low compared to road and rail infrastructure.

More information on the inventory of ports and logistics service providers serving biomass and bioenergy customers can be found on the ENERGY BARGE Modal Shift Platform: www.energy-barge.eu.



Idealised transport distances for one ton of cargo requiring the same amount of energy (Source: viadonau)

PRACTICAL USE OF DANUBE LOGISTICS SERVICES IN BIOMASS SUPPLY CHAINS

Danube navigation offers logistics solutions for a broad portfolio of cargo types. When it comes to biomass cargo used in the bioenergy sector, shipping companies, logistics service providers and port operators mainly categorise these materials in the transport goods class of agricultural and forestry products. Grain and oilseeds as raw materials for the production of first-generation biofuels are currently still the dominating products from this segment. However, log wood transport as well as the transport of processed wood in the form of pellets and wood chips is growing.

BIO-BASED GOODS ON THE DANUBE

By offering targeted logistics services including specialised transshipment and storage equipment as well as certifications, Danube logistics can meet the high quality and safety standards required when transporting bio-based goods. Not only is inland navigation suitable for raw materials and semi-finished goods. It can service the entire bioenergy supply chain from feedstock to final product with a focus on dry and liquid bulk and a growing economic advantage when transporting large volumes. A non-exhaustive list

of bio-based cargo that Danube logistics can potentially transport, handle and store, is provided below.

RAW MATERIALS AND RESIDUES

- > Wood-based raw materials, such as log wood, postconsumer and demolition wood
- > Oilseeds, such as rapeseed, sunflower, and soy
- > Starch-based raw materials such as corn, various types of grains, gluten
- > Sugar beet and sugar pulp
- > Residue materials, such as various meals, DDGS (distiller's dried grains and solubles), pulp, slurry, slop

BIOENERGY PRODUCTS

- > Pellets, briquettes
- > Wood chips, firewood
- > Biodiesel
- > Vegetable oil
- > Bioethanol

Open storage of wood in the port of Vienna (photo: viadonau)



Different pellet types for energetic use (photo: BIOENERGY 2020+)



Sunflowers (photo: FNR)



Storage of rapeseed in the port of Vienna (photo: viadonau)



As in any step along the value chain, each of these goods has specific physical characteristics which are decisive for their quality in processing or utilization. Therefore, any logistics solution needs to safeguard the integrity of the goods’ quality. This in turn requires a broad set of technically suitable infrastructure and handling equipment and distinct knowledge about the specifications of the cargo.

The majority of potential Danube navigation goods from the biomass and bioenergy sector are either dry bulk goods

(meaning that the good is in a solid state of aggregation, e.g. pellets, oilseeds) or liquid goods (to a currently much lesser extent but with potential for growth, e.g. bioethanol). In order to accommodate these goods and their requirements, ports and service providers make use of specific technical equipment which pertain to the choice of vessel type, handling equipment and storage. Based on the information they receive from the cargo owner, tailored solutions can be found. A standardised overview of typical equipment is provided in the image below.

TRANSPORT	HANDLING	STORAGE
<p>DRY GOODS</p> 		
<p>LIQUID GOODS</p> 		

Typical equipment for the transport, handling and storage of dry and liquid cargo as occurring in the bioenergy sector (photos: viadonau, Port of Straubing, MAHART Free Port, shotshop.com)

Many biomass-processing and trading companies such as oil mills, biofuel plants, saw mills with pellet production or agricultural traders, as well as their clients in up- and downstream supply chains have settled directly on the waterway. This way, the majority of inbound, and potentially outbound logistics is shifted on inland vessels without pre- or end-haulage on road or rail. In turn, these companies

benefit from comparatively low transport costs and reduced environmental impact of their logistics. Moreover, settling at ports as multimodal logistics hubs opens up additional flexibility in transport modes, as can be seen by the example of the ADM Spyck GmbH operating an oilseed mill in the port of Straubing.

MULTIMODAL TRANSPORT OF BIOMASS IN PRACTICE

ADM SPYCK GMBH IN THE PORT OF STRAUBING: FROM RAPESEED TO OIL FOR THE BIODIESEL INDUSTRY

Source and destination	Rapeseed: from all countries along the Danube (mainly Hungary, Serbia and Croatia) to oil mill in port of Straubing Rape meal and oil: from oil mill in port of Straubing to Western Europe (refining to biodiesel, food & feed industry)
Means of transport	Inland vessel, truck and railway
Cargo on inland vessel	Rapeseed, rape meal (bulk cargo)

The following example shows how a large-scale and complex industrial site producing input for the biofuel sector can make use of the options and advantages Danube navigation and multimodal transport offer.

Since 2007, the ADM Spyck GmbH utilises the advantages of Danube navigation for its oil mill located in the port of Straubing. The mill is the biggest industrial settler in Straubing’s Danube port. One of the main feedstocks processed in the plant is rapeseed, which is converted into oil and rape meal. The company applies trimodal in- and outbound logistics, including inland waterway, road and rail as modes of transport. In 2017, approx. 400,000 - 450,000 tons of oilseeds, rapeseed and protein rape meal were transhipped in the port of Straubing on waterside, a large

proportion of which being attributable to the port’s key account ADM.

The plant is located directly at the quay. The major part of inbound logistics of the rapeseed feedstock, is facilitated via inland vessels which can – depending on source, vessel type and fairway conditions – load between 900 and 3,000 tons. Arrived at the port of Straubing, the vessel is unloaded by a crane equipped with a grabber with a capacity of approx. 200 tons/hour. Via a hopper, the seed enters the plant. After processing, the products leave the plant in a trimodal manner in Western direction for refining and industrial use (oil, mainly via rail) and to the animal nutrition industry (meal, via vessel and truck).

The ADM plant in the port of Straubing (photo: Port of Straubing)



Unloading of rapeseed with a grabber (photo: Port of Straubing)



TRANSPORT

THE DANUBE - SUSTAINABLE TRANSPORT
ROUTE FOR BIO-BASED GOODS

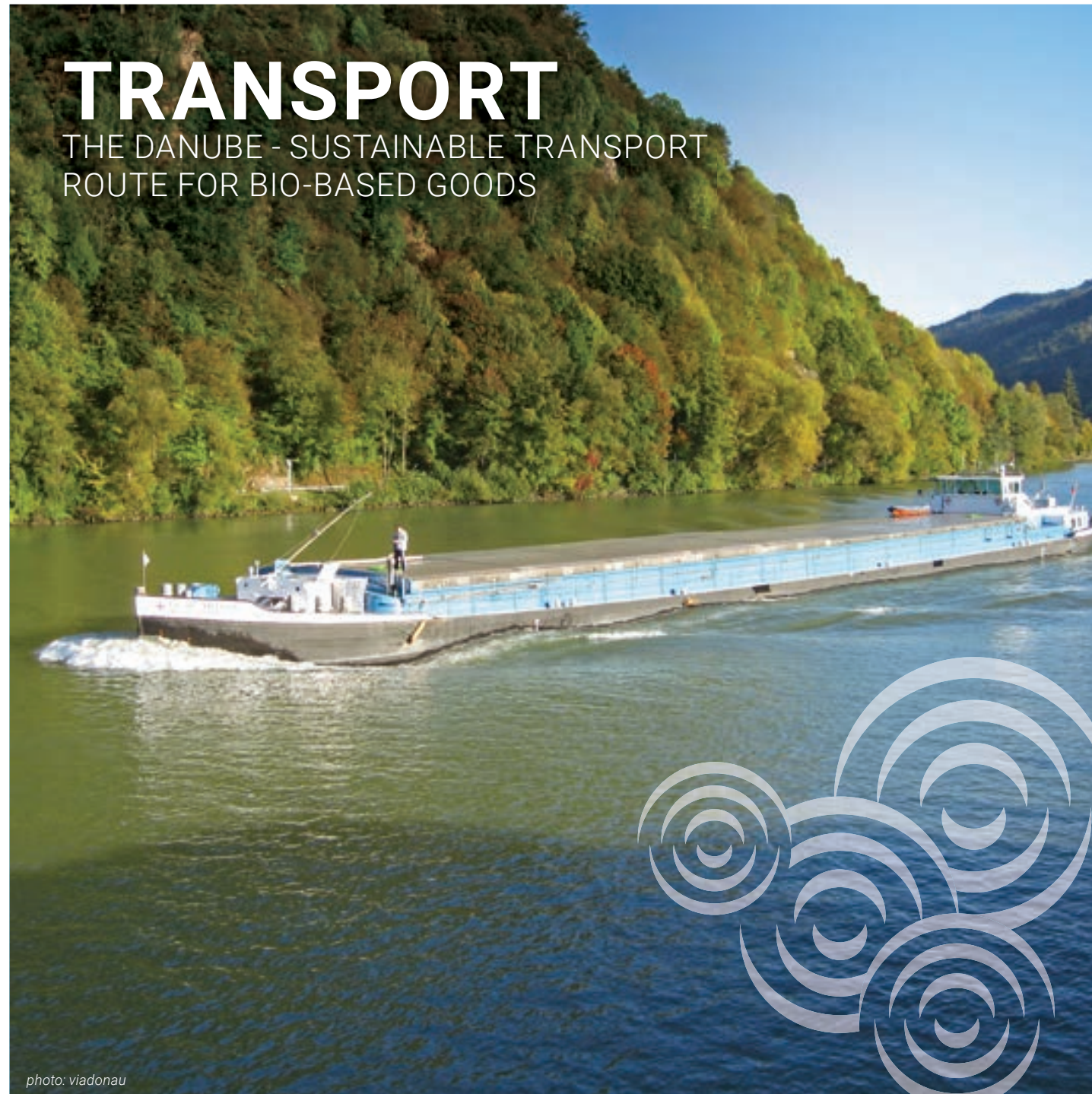


photo: viadonau

TRANSPORTING BIOMASS FEEDSTOCK AND BIOENERGY PRODUCTS ON THE DANUBE

Transporting goods on the Danube does not only mean shipping them between Kelheim and Sulina. Via the Main-Danube Canal, the Danube region is connected to the Rhine and North Sea regions, shaping a transport axis of 3,500 kilometres called the Rhine-Main-Danube corridor. The Danube-Black Sea Canal enables inland vessels to reach the Port of Constanța, the largest port located at the Black Sea. Many transport and shipping service providers serve the inland waterway between the ARA-ports (Antwerp, Rotterdam, Amsterdam) and the Black Sea and facilitate multimodal, as well as maritime transport. The Danube thus opens up a pan-European, and even global transport axis.

ADVANTAGES OF DANUBE TRANSPORT

For all cargo types, a general rule of thumb applies in Danube navigation: The larger the transport volume (dry or liquid bulk) or the size of the cargo (break bulk) and the longer the waterborne transport distance, the higher the economic competitiveness of this mode of transport becomes in monetary terms.

A four-unit pushed convoy, a motorised pusher with four non-motorised pushed lighters, for example, can transport up to 7,000 tons, resulting in an impressive bulk freight capacity. Pushed convoys are most common on most stretches of the Danube.

BIOMASS: SUITABLE FOR DANUBE TRANSPORT

Generally, bio-based feedstock and products along the bio-energy value chain are not treated differently than any other dry or liquid bulk cargo by transport service providers. Hence, no special requirements driving costs do normally occur. Nevertheless, transport solutions offered for biomass will always be carefully adapted to the specific cargo characteristics and the client's needs. In the case of biomass feedstock and bioenergy products, these characteristics typically involve moisture sensitivity, proneness to damage through mechanical devices, off-gasing (e.g. pellets), self-heating (e.g. wood chips), contamination or other sources of quality loss, and transport times, or, rarely, dangerous goods profiles (e.g. bioethanol).

TRANSPORT SOLUTIONS FOR BIOMASS

Transport service providers offer solutions to the challenges biobased cargo types and their supply chains pose. Instruments are different types of vessels, equipment on the vessels, quality and safety standards based on certification schemes and careful transport planning and management. In order to offer their services in a tailored way, shipping companies require a so-called cargo profile from their client. Based on this information, the best offer and price can be made. The next pages give an insight about what information shipping companies need, which steps and preconditions are decisive when planning the transport of biomass on the Danube and which services they offer for dry (solid) and liquid bio-based products.

ELEMENTS OF THE CARGO PROFILE

The most important features of the cargo to be transported should be summarised in a cargo profile and submitted to the logistics service provider or shipping company, both for transport and transshipment and potential storage.

For bio-based goods, it includes (non-exhaustive list):

For biobased goods, it includes (non-exhaustive list):

- > Type of cargo
- > Volumes
- > Specific weight
- > GMP+-requirements (good manufacturing practice)
- > Specific physical characteristics and requirements, incl. phytosanitary standards, proneness to risks and hazards such as humidity, moisture, diseases and contamination, shrinkage or self-heating, maximum transport/storage temperature, and necessity for ventilation
- > Port of loading, port of discharge
- > Info on time schedule
- > Spot transport? Frequency of transport?
- > Dangerous good classification?

PLANNING BIOMASS TRANSPORT ON THE DANUBE

Danube logistics service providers frequently cover the entire logistics chain from start to destination. They may dispose of vessels themselves or cooperate with shipping companies. On request, which can be via phone or in written form, they ask the client for the relevant info and subsequently submit an offer. In order to facilitate and organise the entire chain and ensure availability of vessel capacities, requests should be made no later than maximum two weeks prior to the loading. Spot business, meaning a one-time transport, is possible depending on availability, but less common than regular transports based on contracts.

Earlier booking is advised for transports between June and December due to the peak season for agricultural products, especially if logistics companies specializing in these cargo types are requested.

Besides the availability of loads and vessels, other dynamic factors that determine the price offered may include tonnage, load factor, specific requirements due to cargo type, frequency of runs (spot business or consecutive), gasoil prices, market demand and the transport period.

SERVICES OFFERED

Based on the information on the cargo characteristics, the contacted transport service provider will facilitate the requested transport route using suitable transport equipment and ensuring necessary certification standards.

Most companies may also offer a set of additional services or refer to competent partners. These services, for example, include insurance, customs clearing at border crossing, combined or maritime transport, pre- and posthaulage, or commissioning.

TRANSPORTING DRY BULK BIOMASS CARGO

Dry cargo includes all kinds of raw materials, intermediates and products in solid aggregate state, and does not refer to the dry matter content of the biomass. Most possible goods such as grains, corn, meals, slurry or seeds do not pose specific technical shipping requirements. Important to note is the increased demand for transport of agricultural products during the harvest season between June and December, although optimised storage management has flattened this peak in recent years. Many shipping companies have experience with shipping wood pellets and chips and know how to handle potential quality loss risks. For all wooden cargo, shipping companies require information about tonnage as a metric indicator.

EQUIPMENT FOR DRY BIOMASS TRANSPORT

The majority of bio-based dry bulk cargo can be transported in regular dry bulk vessels, which are either motor vessels or pushed convoys. Since these vessels can transport basically anything, so called empty runs (inbound or return routes without load) can be avoided, which benefits low costs.

For humidity-sensitive goods, closed vessels and barges with roofed cargo holds as well as with separate load compartments are available. The cargo holds can be easily cleaned and dried and allow frequent humidity and temperature checks as well as ventilation throughout the transport. Currently, around 20 % of all motor vessels have steel floors, numbers increasing.

TRANSPORTING LIQUID BULK BIOMASS CARGO

Certain shipping companies are equipped and certified for the transport of liquid cargoes. Many of these cargoes are classified as dangerous good according to the ADN (European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways). Most commonly transported liquids are fuels such as diesel (also biodiesel blends), gasoil, gasoline or chemical products such as acids, bases or methanol. Ethanol or bioethanol, which are highly flammable and thus dangerous goods, are rather rarely transported today. Moreover, bioethanol falls under strict customs rules, leading to additional complexity. Biodiesel and vegetable oil, although not classified as dangerous goods, are also among the less frequently transported liquids on water. For biodiesel, complex cleaning of the cargo holds has to be ensured to avoid mixing. Moreover, diesel and oils are prone to freezing in winter and require heating. Bioethanol might dissolve tank coatings and flame protection for the load compartment is required.

EQUIPMENT FOR LIQUID BIOFUEL TRANSPORT

Despite the small number of current transports of biofuel on the Danube, vessels meeting the challenges are available. Liquid cargo is transported in tankers with a capacity of up to 2,000 tons. Those tankers have safety features such as double hulls, cargo holds in stainless steel or with special coating, heaters and valves for easily freezing liquids like vegetable oil or biodiesel in winter, and sprinklers to avoid

heating in summer, and special loading pumps. Dedicated vessels for each specific biofuel type would depict a suitable solution for the mentioned challenges of biofuel transport on the Danube. Shipping companies interviewed showed openness to such investments, given market interest.

LEGAL ASPECTS

Most types of bio-based cargo can be transported just like any other good not classified as dangerous good. In case the good or fractions of it are used for feed purposes, the transshipment, transport and storage of these have to comply with the GMP+ certification (good manufacturing practice) standards. Many logistics service providers are GMP+ certified.

The transport of dangerous goods is governed by international regulations and recommendations, primarily the ADN (European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways). Moreover, national legislation on transport of hazardous goods plays a role. Shipping companies can support with respective documentation, equipment and procedures. They always require the so-called Material Safety Data Sheet (MSDS). Generally, only ports and transshipment sites with relevant loading equipment and national authorization to handle liquid cargo and liquid dangerous goods are allowed to load and discharge tanker vessels.

Pushed convoy with log wood (photo: viadonau)



HANDLING

VERSATILE EQUIPMENT FOR QUICK
AND SAFE TRANSHIPMENT IN DANUBE PORTS

photo: Henry Eismann

HANDLING OF BIOMASS FEEDSTOCK AND BIOENERGY PRODUCTS IN INLAND PORTS

The interchangeably used terms handling and transshipment refer to the process of moving units of goods from place A to place B and are relevant for all types of logistics. The good can be moved from an inland vessel to a storage or transport unit, another vehicle (truck, rail wagon), or directly to a processing facility, and vice versa. Also, in the process of lightering, cargo can be moved from one vessel to another vessel. Versatile technical equipment is available to facilitate these processes which mainly take place in ports or transshipment sites.

FUNCTIONS OF PORTS IN HANDLING PROCESSES

Inland ports primarily function as hubs for transshipment and handling between different transport modes and as storage sites. The respective services can be provided by the port operator, terminal operators, private logistics companies settled in the port, the processing or trading company itself, or a combination of it. Most Danube ports today offer a broad portfolio including commissioning, distribution and project logistics, sanitation and quality checks, making them multimodal nodes for multimodal transport and value-added logistics.

Since ports offer on-site handling and storage, oftentimes have settling plots available, and are well integrated into regional supply chains, ports are prime locations for processing and production of bio-based goods and energy as well as for trading companies. A number of Danube ports specialised in agricultural and forestry goods and thus can make use of a broad variety of handling facilities suitable for biomass feedstock and bioenergy products. Some ports even offer business development services for the biomass and bioenergy sector (e.g. Straubing, Aschaffenburg at the Main) or strive to become green ports by sustainable port management (e.g. Baja, Hungary) or by assessing the utilisation of renewable energy sources (e.g. Port of Rotterdam, MAHART Free Port).

ORGANIZING HANDLING OF BIOMASS

Generally, service providers offering biomass cargo handling can offer certifications such as GMP+ and ensure quality standards for other certification schemes, if known to them. Similar to transport, actors facilitating transshipment of bio-based goods need to know the determining characteristics of the respective cargo in order to submit a suitable offer and to realise the order.

The most important ones include:

- > Type of cargo
- > Volumes
- > Specific weight
- > Number of vessels
- > Time schedule
- > Used transport modes
- > Final or intermediate destination
- > GMP+-requirements
- > Specific physical characteristics and requirements, incl. phytosanitary standards, proneness to risks and hazards such as humidity, moisture, diseases and contamination, self-heating, tendency for dust development, or maximum storage temperature, certification standards

Basic information like the consignor (sender) and consignee (recipient), point of origin and destination of the consignment of goods and the route will be documented in the so-called waybill which accompanies the freight along the entire logistics chain.

The period of notice and booking prior to the actual handling can vary. Influencing factors here are the type of handling provider contacted (port or terminal operator, private logistics company) and the demand for loading and unloading in the port or at the transshipment site which can be higher during harvesting campaigns between June and December. Spot businesses are generally possible, notice should be given at least seven days prior, more common is one month in advance.

Besides demand and seasonality, other factors determining the price for handling are the type of cargo, volumes, specific weight, specific cargo requirements and regulations, vessel type, frequency and duration.

LEGAL ASPECTS

When it comes to the handling of cargo, the primary focus of regulations is on ensuring safety of workers, environment, the public, and infra- and superstructure.

Most biobased cargo types, especially dry ones, do not present any major risks during the handling process. Potentially adverse behaviour like dust development can be controlled by suitable equipment and measures. Log wood depicts an exception here. When handling log wood, the logistics service provider has to assign at least one guard who supervises the process.

Transshipment from vessels to storage units, to processing facilities or to other vehicles can also take place at so-called transshipment sites. Other than ports, transshipment sites do not dispose of an own port basin but merely have a quay wall and berths, which are the parking spots for inland vessels with a length between 100 and 130 m. In most Danube countries, certain cargoes, for example liquids like biodiesel or bioethanol, can only be handled in ports (with its own port basin), not at transshipment sites located directly at the waterway. This is to ensure highest safety standards for handling of hazardous goods.

EQUIPMENT FOR DRY BIOMASS HANDLING

Most biomass feedstock and bioenergy products are classified as bulk cargo. The dry bulk goods such as seeds, meals, slop, pellets, wood chips or log wood are transhipped via grabbers or, to a less frequent extent, pneumatic suction devices.

There are several types of grabbers with different capacities available in most ports, e.g. high volume bulk grabbers or wood grabbers. These are attached to the crane which is the main handling tool present in all ports. The crane type most commonly used for biomass handling is the so-called luffing and slewing crane. These cranes are standard equipment for most Danube ports and can be moved up and down the basin on rails. In grab operation, these cranes, depending on their capacity, have a performance of between 120 and 160 tons per hour. Sometimes, also mobile cranes are used, depending on the requirements of the cargo.

Other equipment often used includes conveyor belts and pneumatic or mechanical suction devices, e.g. for grains or meals which have a tendency to develop dust. Mobile loading hoppers facilitate transshipment of bulk goods such as e.g. meals from vessel directly to railway wagons or trucks. In order to precisely empty the load compartments, bobcats and wheel loaders are used inside the compartments.

Because many biomass products such as grains, oil seeds, or pellets have to stay dry at all times, When a tanker vessel arrives, a mobile arm with a hose is connected to it and the liquid is pumped into either a suitable storage tank or rail wagon or tank truck. Given the fact that most liquid cargo types, including bioethanol, are dangerous goods, filler units have to comply with strict safety standards. Therefore, their availability along the Danube is limited. For example, the Port of Vienna (Lobau) offers one.

transshipment is limited in adverse wheather conditions. However, many ports and logistics providers offer roofed quay sections to allow transshipment during rain. Some modern ports also offer fully-covered transshipment facilities for moisture-sensitive goods. These are mostly hall buildings which function like a garage into which the entire vessel enters and the loading or discharging is facilitated by a gantry crane spanning vessel and storage area.

EQUIPMENT FOR LIQUID BIOFUEL HANDLING

In order to tranship liquids, special suction and pumping equipment is used. These facilities are called fillers. They are comparatively complex units built directly at the water. When a tanker vessel arrives, a mobile arm with a hose is connected to it and the liquid is pumped into either a

suitable storage tank or rail wagon or tank truck. Given the fact that most liquid cargo types, including bioethanol, are dangerous goods, filler units have to comply with strict safety standards.

Therefore, their availability along the Danube is limited. For example, the Port of Vienna (Lobau) offers one.

Photos: Port of Straubing (upper row), Rhenus Donauhafen Krems (down left) viadaonau (down right)



STORAGE

OPEN, CLOSED, SHORT-TERM, LONG-TERM –
DANUBE LOGISTICS OFFER SUITABLE STORAGE

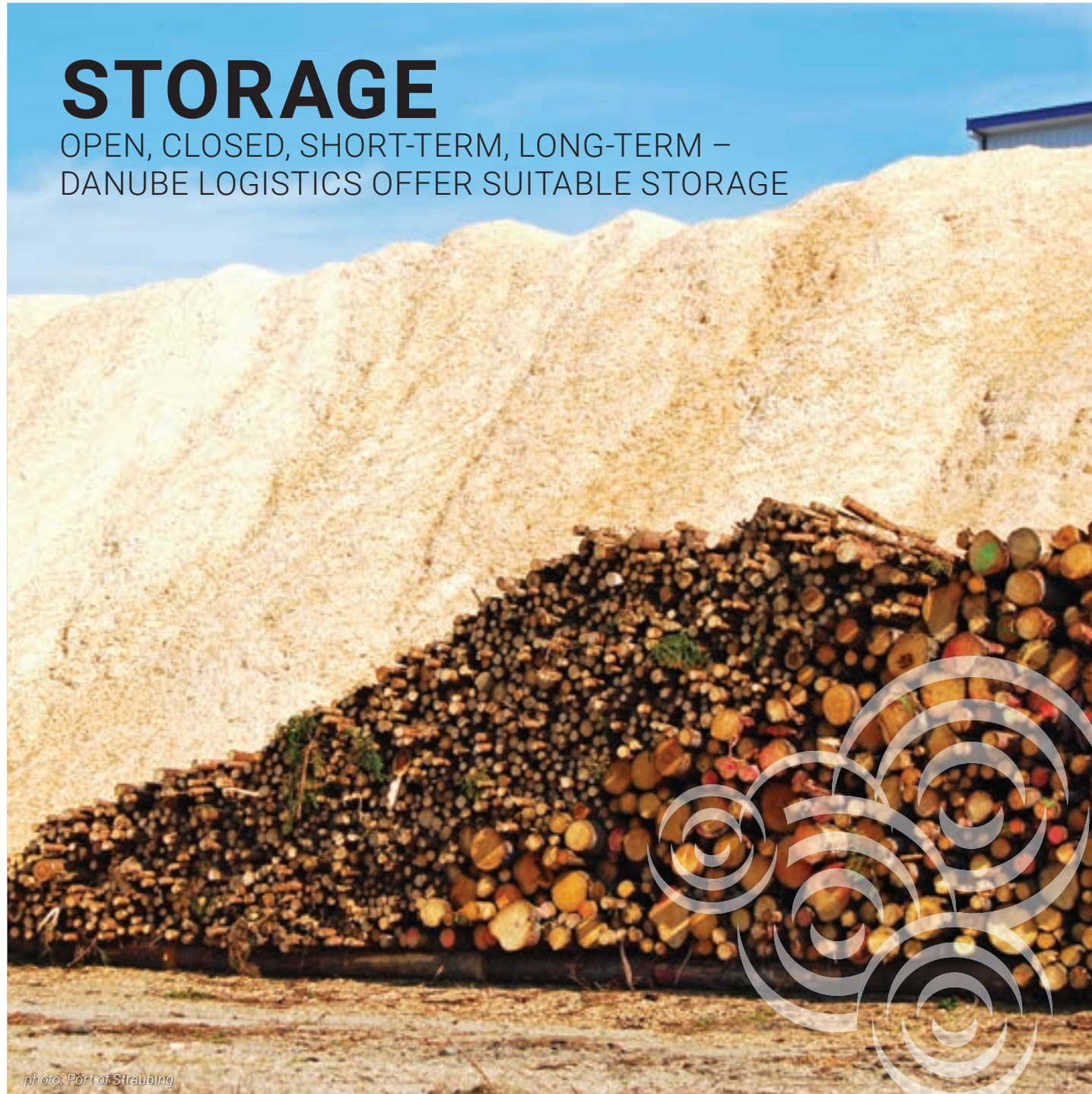


photo: Port of Straubing

STORAGE OF BIOMASS FEEDSTOCK AND BIOENERGY PRODUCTS IN INLAND PORTS

Need, type and duration of storage solutions within biomass and bioenergy supply chains are depending on a number of factors. For example, choices regarding process logistics management, location of customers, seasonality or market supply and demand and resulting market prices can influence the logistics needs of biomass processing and trading companies.

Additionally, the buffer function of storage and warehousing is important in logistics chains involving different transport modes, e.g. post-haulage by road, since the capacity differs per transport means. Therefore, ports and logistics service providers offering flexible and versatile storage solutions and warehousing for bio-based goods play an important role in bio-based supply and value chains.

BENEFITS OF PROCESSING IN PORT PROXIMITY

The economic advantages resulting from a versatile storage portfolio are especially accessible and beneficial for biomass-processing and bioenergy-generating units located close to storage options of ports or transshipment sites or directly at the port itself. These companies can make use of significant buffer functions when managing their flow of feedstock, intermediates and finished goods without costly pre- and post-haulage. Examples are bioethanol plants in Hungary or Austria.

STORING BIOMASS AND BIOENERGY PRODUCTS

Generally, since the transported and handled goods have different characteristics, e.g. danger of self-heating in grains or wood chips, different types of storage facilities must be available. This ensures the integrity and quality of the cargo at all times, irrespective of the storage duration – be it short-term, intermediate storage in between transports, or long-term storage. Depending on the purpose, thus, there are storage, transshipment and distribution warehouses which can be constructed as open, covered or special-purpose storage facilities.

ORGANIZING STORAGE OF BIOMASS

In ports or transshipment sites, a number of actors can offer storage solutions for bio-based goods: port operators, private logistics service providers, or companies involved in biomass processing or trading or bioenergy generation themselves. Those actors specializing in agricultural and forestry goods almost exclusively can ensure GMP+ certification standards for all goods stored in their depots. Oftentimes, they offer combined services including transshipment and storage.

For the provision of a reliable offer and processing of the storage, warehousing service providers most commonly require the following information:

- > Type of cargo
- > Volume
- > Specific weight
- > GMP+ or other certification requirements
- > Preference of storage type (open, closed, special)
- > Duration of storage
- > Specific physical characteristics and requirements, incl. phytosanitary standards, proneness to risks and hazards such as humidity, moisture, diseases and contamination, shrinkage or self-heating, maximum storage temperature, and necessity for ventilation, danger of pests

Regarding the required pre-booking period for storage capacities, no single rule applies since availability depends on several factors such as harvest season, location, type and duration of storage required, volumes, etc. Oftentimes, short-notice solutions can be facilitated. For large quantities however, pre-bookings up to one year in advance are possible as well. The maximum storage duration offered by most logistics companies is one year. However, theoretically longer periods are possible as well.

ADDITIONAL STORAGE SERVICES

Among the most decisive elements determining the price for storage are the type of stored good and supervision and prerequisites it requires, volumes stored, storage type, availability and duration. Companies offering biomass storage often have additional services in their portfolio. These include freight forwarding and transport facilitation, constant supervision of characteristics such as humidity or temperature, or the utilization of drying and cleaning devices such as grain cleaning units.

TYPES OF STORAGE FOR BIOMASS

Irrespective of the duration and purpose of storage, the storage solutions for biomass goods differ in the type of construction. Generally, there are open, covered and special warehouse solutions. Not all solutions are offered in all ports, but a generally broad coverage is ensured. The table below gives an exemplifying indication of which storage unit types fit which bio-based goods.

Also, storage capacities and areas differ from provider to provider and can vary from just a few tons per silo to hectares of open storage area.

EQUIPMENT FOR DRY BIOMASS STORAGE

When it comes to storage, different dry biomass types have different requirements for the depot chosen. This is mainly due to the fact that physical characteristics can vary.

Open storage without roofs is especially suitable for log wood. Oftentimes, large areas can be offered which might even allow wet storage via sprinklers or fencing for security reasons. Also, temporary coverage with tarps can be facilitated. Mostly, however, open storage is only feasible for non-sensitive goods.

For most bio-based dry bulk goods, special warehousing solutions are required. Among these are grain silos and other bulk good storage facilities such as underground bunkers. In these installations, the specific requirements of bio-based materials and products can be best catered. For example, in grain silos, oil seeds and other seasonal feedstock can be dehumidified and thus stored over longer periods of time to buffer harvest peaks.

Some ports and service providers offer storage boxes for bulk goods. These have tailored mobile roofs which allow direct transhipment from the vessel to the box. Additionally, entrance of contamination and moisture can be prevented. These boxes are especially useful for pellets or wood chips.

EQUIPMENT FOR LIQUID BIOFUEL STORAGE

In order to store liquid biofuels such as biodiesel or intermediary vegetable oils or bioethanol, storage tanks can be used. For bioethanol as a dangerous good with high flammability, special safety features have to be ensured. Moreover, the tanks have to be fenced and sealed as bioethanol is subject to strict customs regulations and access to the storage unit is only allowed under supervision of a customs official.

Different types of standard storage for biomass feedstock and bioenergy products (adaption of viadonau, 2013).

STANDARD STORAGE OPTIONS FOR BIOMASS FEEDSTOCK AND PRODUCTS		
CONSTRUCTION	Open storage	Special warehouses
STORAGE TYPES	Open storage areas in ports, underground: concrete, gravel, compacted; possibly fenced	Grain silos, liquid cargo tanks incl. dangerous goods, ventilated storage, storage boxes, halls, bunkers
CARGO TYPES	Log wood and other wood types not sensitive to humidity	Grain, soy, oil seeds, biodiesel, meals, vgetable oil, pellets, wood chips



Bulk good storage (photo: Port of Vienna, viadonau).



Typical warehouse in MAHART Freeport, Budapest (photo: MAHART)

GLOSSARY OF DANUBE NAVIGATION TERMS

AN OVERVIEW OF THE MOST RELEVANT EXPERT VOCABULARY

(Source: Manual on Danube navigation, viadonau)

ADN
abbreviation for European Agreement Concerning the International Carriage of Dangerous Goods by Inland Waterways (Accord Européen relatif au transport international des marchandises dangereuses par voies de navigation intérieures)

ARA
ports abbreviation for the universal ports in Antwerp (Belgium), Rotterdam (the Netherlands) and Amsterdam (the Netherlands)

BILL OF LADING
the transport document customary in inland navigation that controls the relationship between the freight carrier and the consignee and serves as the evidence of the right to receive the consignment

BOATMASTER
captain of a ship who bears responsibility for the ship

BULK CARGO
unpacked goods (e.g. coal, ore or grain) that are loaded with grabs, dredgers and similar equipment

BULK FREIGHT CAPACITY
the capability of a means of transport to move a large quantity of goods at one time

CABOTAGE
transport between two ports in the same country or between two ports of two different countries that are located on a coast or a river; in most cases, this is associated with restrictions for foreign vessels (prohibition of cabotage)

CHARTER CONTRACT
freight contract in shipping, which covers the entire cargo hold of a vessel (complete or full charter), individual indefinite cargo holds (partial charter) or specific cargo holds (space charter)

CMNI
abbreviation for Budapest Convention on the Contract for the Carriage of Goods by Inland Waterway (Convention de Budapest relative au contract de transport des marchandises en navigation intérieure)

COMBINED TRANSPORT
special type of intermodal transport in which the major part of the route is covered by inland vessel or cargo train and the pre- and end-haulage is covered by road but kept to a minimum

CONSIGNEE
receiving party (buyer) named by the consignor (usually a seller) in the transportation document as the party to whose order a consignment will be delivered at the port of destination contract or by law

CONSIGNMENT NOTE
record of the contents of the freight contract concluded; to be prepared by the consignor (shipper)

CONTRACT TRIP
transport covering several trips on the basis of a contract agreement for a certain time period

COUPLED FORMATION
convoy consisting of one motor cargo vessel and one or two non-motorised load carriers (pushed lighter or pushed barge) that are coupled to the drive unit on the side; see also pushed-coupled formation and pushed convoy

DEMURRAGE
remuneration charged by the port operator for a loading and/or unloading period exceeding the time either stipulated in a contract or by law

DRAUGHT LOADED
the distance between the lowest point of the bottom of a vessel when stationary and the water surface

FILLERS
suction or pumping equipment used for the transhipment of liquid cargo

FREIGHT CARRIER
commercially accepts the transport of goods at its own responsibility using its own or other ships

FREIGHT CONTRACT
contract between the consignor and the freight carrier regarding the transport of goods, which specifies the rights and obligations of the parties to the contract

GOODMANUFACTURINGPRACTICE (GMP+)
license to operate in the international feed sector. GMP+ standards have been developed to harmonise requirements for feed in order to ensure quality and safety throughout the entire feed chain. It is based on widely recognised principles of quality assurance, Hazard Analysis Critical Control Point (HACCP).

HIGHESTNAVIGABLEWATERLEVEL (HNWL)
in accordance with the definition of the Danube Commission, it is the water level that is reached or exceeded at a water gauge over a long period of time (stretching across several decades) on an average of 1% of the days in a year (i.e. on 365 days), excluding periods of ice

INTERMODAL TRANSPORT
transport of goods in one and the same loading unit or the same road vehicle on two or more transport modes, whereby the loading unit is changed but the goods being transported are not

LIFT-ON-LIFT-OFF (LO-LO)
loading or unloading intermodal loading units with the help of hoisting gear; the loading units are lifted or raised in the process

LINER SERVICE
navigation services with specific loading and clearing ports as well as arrival and departure times that are notified on a regular basis
Load compartment inspection (LCI) is a survey that determines whether the hold of a ship is suitable for the intended cargo (previous cargo, cleaning method, etc)

LOADING HOPPER
equipment for transhipment of bulk cargo from an inland vessel to the railway or truck; a crane fills the hopper from above with the bulk cargo from the vessel, while trucks or railway wagons that are under the hopper are loaded independently
Low navigable water level (LNWL) in accordance with the definition of the Danube Commission, it is the water level that is reached or exceeded at a water gauge over a long period of time (stretching across several decades) on an average of 94% of the days in a year (i.e. on 343 days), excluding periods of ice

LUFFING AND SLEWING CRANE
crane which stands on a portal construction and is provided with a rotary pole and a bent arm

MOBILE CRANE
a crane that can be moved or driven on a wheeled chassis or crawler drive

MOTOR CARGO VESSEL
self-propelled vessel with its own motor drive and cargo hold for transporting goods; generic term for dry cargo vessels, tankers, container vessels and Ro-Ro vessels

MULTIMODAL TRANSPORT
transport of goods using two or more different means of transport and transport modes

PIERAGE
port fee, especially for the use of the (cargo) pier at a port (calculated on the basis of transhipment weight)

PORTAL CRANE
rail-mounted crane for efficient loading and unloading operations; stretches across the vessel on the waterside and the road or tracks on land; the goods to be transhipped can be moved with the help of the crane bridge in the dimensions of height, width and length
Private vessel owner-operator independent ship owner with maximum three vessels without any supporting organisation on land (in contrast to a shipping company); often the ship owner and the boatmaster are a single person

PUSHED BARGE/LIGHTER
vessel without its own drive that is pushed by a suitable motorised vessel (pusher, motor cargo vessel) or is coupled or attached to it
Pushed barge/lighter vessel without its own drive that is pushed by a suitable motorised vessel (pusher, motor cargo vessel) or is coupled or attached to it

PUSHED CONVOY
convoy consisting of one pusher and one or more pushed lighters or pushed barges that are tightly connected with the pushing unit; see also coupled formation and pushed-coupled formation

PUSHED-COUPLED FORMATION

convoy consisting of one motor cargo vessel, having one to two non-motorised freight carriers on its sides (pushed lighter or pushed barge) and having multiple non-motorised freight carriers placed in front of it; see also coupled formation and pushed convoy

PUSHER

motorised vessel that does not transport any freight on its own and is used only to push non-motorised freight carriers (pushed lighters, pushed barges)

ROLL-ON-ROLL-OFF (RORO)

loading or unloading a motor vehicle, a railway wagon or an intermodal loading unit on or from a ship using its own wheels or using wheels that are placed below it for this purpose
Ship broker
company that schedules cargo loads of inland vessels and acts as a cargo agent

SHIPPER

also cargo owner, any person or organization paying for its cargo to be shipped from one place to another

SHIPPING COMPANY

ship transport company which has its own vessels as well as administration and sales organization on land

SPLIT TRANSPORT

type of multimodal transport in which the goods (packages) are reloaded on their own, in contrast to intermodal or combined transport

SPOT MARKET

market in which supply and demand transport capacities are traded in real time (in contrast to long-term contractual binding)

STOWAGE FACTOR

indicates the m³ of storage space occupied by one ton of a particular cargo

TANKER

motor cargo vessel that is equipped to transport liquid goods, including mineral oil and derivatives, chemical products or liquefied gases

TERMINAL

facility with special infrastructure and equipment for the transshipment of goods (e.g. container terminal, heavy cargo terminal) in which loading units are transhipped between water-based and land-based means of transport, i.e. vessel, truck and railway

TONS DEADWEIGHT (OF A VESSEL)

difference in weight between a fully loaded and empty vessel; including cargo, fuel, water, lubricating oil, crew and provisions; this weight represents the utilization value of cargo vessels

WATER LEVEL

water height at a certain point in the reference profile of a body of water (water gauge)

USEFUL LINKS

FOR BIOMASS AND BIOENERGY CARGO OWNERS

The aim of this handbook is to provide actors along the biomass and bioenergy value chains a first practical insight into the options offered by inland waterway logistics and technical and legal conditions revolving around Danube logistics.

For further information, please visit the following websites:

ENERGY BARGE PROJECT WEBSITE:

Here, you can find the contacts to all consortium partners, all deliverables, as well as all other DTP projects for capacity building.
www.interreg-danube.eu/energy-barge

ENERGY BARGE MODAL SHIFT:

On this website, the project consortium presents a map-based interactive platform which gives both actors from the Danube logistics and biomass and bioenergy sectors practical information to facilitate a modal shift of biomass cargo towards the Danube.
www.energy-barge.eu

DANUBE LOGISTICS PORTAL:

The ENERGY BARGE project partner via donau - Austrian Waterway Company provides a broad set of information for customers of Danube logistics, including travel time calculator, transport planner and tailored information on service providers for multiple cargo types.
www.danube-logistics.info

Further information:
www.interreg-danube.eu/energy-barge

The Danube – A Stream of Energy

www.energy-barge.eu



INLAND WATERWAYS

- Inland waterway of international importance
- Inland waterway of regional importance
- Other river

Port

Country border

- Capital city

N

1 : 4.500.000

LAND COVER - AGRICULTURE & FOREST

- Main agricultural land
- Mixed usage land (parcels of agriculture, housing, gardens)
- Mixed agricultural land (arable land interspersed with natural areas)
- Pastures and meadows
- Broad-leaved forest
- Coniferous forest
- Mixed forest

STRONG CULTIVATION AREAS OF RELEVANT AGRO-BIOMASS TYPES

- Oil seeds (rape seed, sunflower, soy)
- Sugar beet



Source:
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BIOENERGY MEETS DANUBE LOGISTICS

