# ENERGY BARGE

**Building a Green Energy and Logistics Belt**

**Project Code: DTP1-175-3.2**

# Deliverable 5.1.3

**Wiener Hafen und Lager Ausbau- und Vermögensverwaltung, GmbH & Co. KG**

**Pre-feasibility Pilot Study**

***June 2018***

*For the implementation of the project "ENERGY BARGE – Building a Green Energy and Logistics Belt" a subsidy is awarded from the European Regional Development Fund under the Danube Transnational Programme.*



## I. About the ENERGY BARGE project

The Danube region offers a great potential for green energy in the form of biomass. The main objective of ENERGY BARGE is to exploit this potential in a sustainable way, considering the Renewable Energy Directive 2009/28/EC, thereby increasing energy security and efficiency in the Danube countries. The project brings together key actors along the entire value chain, biomass companies and Danube ports as well as relevant public authorities and policy stakeholders. The project maps value chains and facilitates the market uptake of biomass, supports better connected transport systems for green logistics and provides practical solutions and policy guidelines. The Agency for Renewable Resources (FNR) coordinates the ENERGY BARGE project consortium with fourteen partners from Austria, Bulgaria, Croatia, Germany, Hungary, Slovakia and Romania.

## Project coordinator

| | | |
|---|---|---|
| Agency for Renewable Resources<br>Fachagentur Nachwachsende Rohstoffe e.V. | FNR | Germany |

## Project partners

| | | |
|---|---|---|
| BioCampus Straubing GmbH | BCG | Germany |
| Deggendorf Institute of Technology | DIT | Germany |
| Austrian Waterway Company | VIA | Austria |
| Port of Vienna | PoVi | Austria |
| Bioenergy2020+ GmbH | BE2020 | Austria |
| International Centre of Applied Research and Sustainable Technology | ICARST | Slovakia |
| Slovak Shipping and Ports JSC | SPaP | Slovakia |
| National Agricultural Research and Innovation Center | NARIC | Hungary |
| MAHART-Freeport Co. Ltd. | MAHART | Hungary |
| International Centre for Sustainable Development of Energy, Water and Environment Systems | SDEWES Centre | Croatia |
| Public Institution Port Authority Vukovar | PoVu | Croatia |
| Technology Center Sofia Ltd. | TCS | Bulgaria |
| Romanian Association of Biomass and Biogas | ARBIO | Romania |
| Federation of owners of forests and grasslands in Romania | Nostra Silva | Romania |

## II. About this document

This report corresponds to Deliverable 5.1.3 Pre-feasibility pilot studies of ENERGY BARGE. It has been prepared by Port of Vienna, PoVi.

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## Background

Deliverable "D 5.1.3 Pre-feasibility pilot studies to prepare large-scale investments to transfer ports into biomass hubs" is based on the task as described in the latest approved version of the Application Form (AF) of the project ENERGY BARGE (Project Code: DTP1-175-3.2).

- Activity 5.1. *Pre-feasibility pilot studies to prepare large-scale investments to transfer ports into biomass hubs* (Lead: MAHART)

The port partners of the project elaborated pre-feasibility pilot studies (including investment plans) in order to define development plans and investment needs required to strengthen ports as logistics hubs for the bioenergy sector, where biomass is handled, stored and manipulated in the most appropriate way.

Individual pre-feasibility pilot studies were prepared following a common methodology (D 5.1.2) which helped the port partners to develop their pre-feasibility studies following a unified approach and it will also support the preparation of the synthesis report (D 5.3.2). Each individual pre-feasibility study defined development plans and investment needs - to prepare large scale investments beyond the project duration - of participating Danube ports in bioenergy logistics alongside the Danube river. Studies investigated existing value chains, industrial and logistics capacities and identified technological solutions and related investment projects with a budget, cost-benefit analysis and timeframe. All of the five studies are interlinked in a way that the investment plans were coordinated to avoid competition and overlap.

Coordinator: MAHART (HU)

Involved Danube ports: BCG (DE), PoVi (AT), SPAP (SK), MAHART (HU), PoVu (HR)

All involved Danube ports prepared their own pre-feasibility pilot study following the D 5.1.2 common methodology. They were also responsible for the involvement of policy makers and at least five industry stakeholders to derive industry knowledge and experience.

The key focus of the pre-feasibility study structure was to provide a guideline for the elaboration of feasible and economically sound investments to strengthen ports as logistics hubs for the bioenergy sector alongside the Danube. The study structure was elaborated based on previous experience gained in the preparation of infrastructure development projects funded by the EU and also guides issued by various development organizations including the European Commission (*eg. Guide to Cost-Benefit Analysis of Investment Projects Economic appraisal tool for Cohesion Policy 2014-2020 (European Commission 2014 - http://ec.europa.eu/regional_policy/sources/docgener/studies/pdf/cba_guide.pdf).* Previous ENERGY BARGE activities and deliverables, including experiences gained during the preparation of D 5.1.1 surveys, impressions gathered during the port exchange workshop and results and deliverables of WP4, also contributed to the development of the structure and finally the pre-feasibility studies.

Local biomass markets are at a various development stages in each involved Danube port area. It is also reflected in the subject and results of the pre-feasibility studies:

- Port of Straubing (PP1 – BioCampus Straubing) is an operational logistics hub for biomass handling with a main focus on bioenergy utilization. The focus of its study is a preliminary analysis of options to develop additional storage space for biobased feedstock and products serving the needs of current and future potential customers of services offered

in the port by both port management itself and the private logistics companies operating based on the port's infra- and superstructure.

- Port of Vukovar (PP11 – Public Institution Port Authority Vukovar): several analyses on biomass market prices in the wider environment indicated the possibility of inclusion of the port in the production chain, and thus in the value chain via the establishment of a major biomass trade centre primarily for pellets and wood chips provided by the hinterland area of the Port of Vukovar.
- Port of Bratislava (PP7 – Slovak Shipping and Ports JSC): responding to the needs of a growing market and building upon the country's large forest areas on the supply side, the subject of the study is to develop the transshipment and storage facility in Port of Bratislava suitable for the handling of wood pellets and wood chips in bulk.
- Port of Budapest (PP9 – MAHART-Freeport Co. Ltd) is located at an ideal site for the implementation of a biomass-based energy production project. The necessary raw materials can be supplied through a waterway-based logistics network. With the planned Galvani Bridge nearby the Freeport a key district heating pipe network will be built very close to the planned place of implementation. For the feed in of green electricity transformers are available on the site as potential connection points. Preliminary calculations show that a profitable biomass-based power plant could be set up in the port.
- Port of Vienna (PP4 – Port of Vienna): is already the largest port and trimodal logistics centre on the Danube in Austria. The study investigates the potentials of log wood/roundwood and waste wood / wood residues in the Danube Region east of Austria up to the coast of the Black Sea in order to disclose relevant insights into price structures and trends to justify business cases and/or logistical value chains. As a conclusion a conveyor belt system is to be installed which will also serve the new generation of the wagon fleets carrying biomass to the port.

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# 1. Executive Summary

The subject Pre-Feasibility Study on the availability of log wood and waste wood in selected Danube ports and its inland waterway transport potential is the result of analyses performed on behalf of the Port of Vienna (Hafen Wien), in its position as project partner of the INTERREG project „Energy Barge“(2017-2019). It was elaborated between April and June 2018 by a Consultants team, comprising of iC consulenten (Austria) in cooperation with CES clean energy solutions (Austria) and ForAgroBio Consulting Company (Serbia). The hereunder presented results from the major input for the deliverable of the “Energy Barge” task WP 5.1 “Preparation of a Feasibility Study to prepare investments to transfer ports into biomass hubs”. (Malcherek et al., 2018)

Before the strategical goal to convert Danube ports (here the Port of Vienna) to a logistical hub for biomass products, the study investigates the potentials of log wood/roundwood and waste wood / wood residues in the Danube Region east of Austria up to the coast of the Black Sea, making use of the S2Biom database. For analysing the various markets for different wood products in 9 countries of Central and Southeast Europe and the situation of the Danube inland water transport (IWT), surveys and interviews were made, in order to disclose relevant insights into price structures and trends that could justify business cases and/or logistical value chains. (Malcherek et al., 2018)

Moreover, best practices were studied for efficient solutions of storage, transshipment and transport of (waste) wood, according to existing examples outside the Danube region. (Malcherek et al., 2018)

Main findings

Log wood availability analysis in Danube Region

Based on the S2BIOM database (S2BIOM, 2018), the technical potential could be analysed to quantify the availability of log wood in ports and regions. The projections are based on a scientifically developed methodology used for forestry and wood production projections. Regions with most significant availability of log wood are the districts in Western Romania and Central Hungary. Projections conclude that availability will be reduced in most of regions by 2030 in comparison to 2020. In practice, the market demand for log wood is higher than the output resp. the technical potential, therefore the buyers' willingness to pay is determining the market. The obvious trend of increasing demand for log wood is driven by the global demand for construction wood, furniture, pulp and paper, chipboard, wood pellets, firewood, wood chips and other semi products and final products (Malcherek et al., 2018).

Maritime log wood transport

As regards the maritime log wood Transport in the Black Sea, seaports in Romania and the Ukraine were contacted. For the Port of Constanta, the most important seaport of the Danube Region, no details on type of wood products were disclosed as no imports or exports from/to Danube countries are handled in Constanta. Small amounts of wood products are imported from Turkey and Finland, while exports of wood products are maintained to Egypt, Tunisia, Lebanon, Turkey, and Syria. Inland waterways transportation of any wood products was recently not recorded in Constanta. With regard to Ukraine, the largest transport hubs for exporting wood and wood materials are the ports of: Bilhorod-Dnistrovsky, Kherson and Chornomorsk. Out of these ports, only the Port of Kherson provided some statistics on their wood handling while overall statistics for timber export (all ports level) demonstrate a declining trend over last years. For timber and wood chips export at private ports, no data is made available. The Ukrainian Danube ports are said to be not economically suitable timber or chips exports of, being located too far from logging sites, while high consolidation costs and a lack of technologies for chip compressing for barge loading has been reported (Malcherek et al., 2018).

Inland waterway wood transport of log wood

As regards, the log wood transport on inland waterway of the Danube Region, no round wood is handled in Slovak and Croatian ports, while in Hungary only local transport of round wood is recorded (Port of Baja), however responses from other Hungarian ports were not received. In Serbia, only local transport of round wood is present (outside official ports). No response was received from Romanian Danube ports. Scarce data and scarce quantities of round wood are recorded in Bulgaria (only total quantities, no origins, no destination, as special data protection agreements are required for further data collection from port operators) (Malcherek et al., 2018).

Possible value chains for log wood transport to Vienna

The recent high demand for log wood indicates a lack of wood on the market. Thus, it is hard to contract the procurement of required quantities. There is a visible price increase in Romania and Serbia, while Austria still has very competitive prices.

Truck transport of round wood is most competitive below 200 km distance. At higher distances and escalating costs, railway is most competitive up to 500 km, while IWT becomes more competitive than railway in distances over 500 km. Log transport on Danube may achieve a competitive price if shipped from Romania and Bulgaria to Vienna.

Firewood prices and delivery costs are too high, in order to compete with existing firewood prices in Austria. With regard to railway, both logs and firewood prices and delivery costs are too high to compete with existing prices in Austria. Regarding truck (road) transport both logs and firewood prices and delivery costs are too high to compete with existing prices in Austria, except for Slovakia, where costs and prices are similar due to a low transport distance to Vienna. (Malcherek et al., 2018)

Wood residues availability in the Danube Region

The technical availability potential for wood residues was specifically investigated in this Pre-feasibility study. Regions with the highest availability of wood residues are again districts in Central Hungary and Western Romania. Projections show that its availability will slightly increase by 2030 (compared to 2020). The demand for round wood is very high, while the demand for wood residues differs from category to category. In general, wood residues are bulky, usual dry and light, which makes it hardly transportable. If used at all, this is performed in proximity of their origin. (Malcherek et al., 2018)

Driftwood availability in the Danube Region

The driftwood potential of the Danube has been investigated. The only dam with considerable quantities of driftwood extraction is Djerdap I (Kladovo, Serbia/Romania border). Already all driftwood shall be used as fuel for a local biomass based District Heating system.

Analysis of Danube inland waterway transport of waste wood

There is no waste wood handling recorded in Slovak, Hungarian, Croatian and Serbian ports and no information could be retrieved from Romanian Danube ports. Wood residues (material for paper production) are handled in smaller quantities in Bulgarian Danube ports. As mentioned above, Bulgarian ports provided a minimum of data only, also for waste wood. (Malcherek et al., 2018)

Therefore the study bases on own experience and desktop research. For technically-economic reasons, there is no woodchip transport on the Danube, due to very low stowage factor of wood chips (0.25-0.35 t/$m^3$) requiring vast spaces in cargo holds – low weight utilisation of barges and low income with high freight rates. In general, 25-30 barges are needed for just 5 000 t of cargo. On the other hand, barges with high walls are used outside Europe. Compactors are sometimes used for vessel loading. Wood pellets have higher stowage factors and are convenient for barge transportation. They require covered barges for protection from moisture and precipitation. (Malcherek et al., 2018)

Possible value chains for wood residues transport to Vienna

A number of different challenges exist for the transport of wood residues– from the low bulk density to different values and usability of different types of residues. Wood residues prices in Austria are slightly higher than in other countries. IWT transport costs are higher than costs of all other transport modes until 1,000 km distance. Railway is the most competitive form of wood residues transport above 100 km, while road transport is competitive below. This shows the non-competitiveness of IWT for unprocessed wood residues. (Malcherek et al., 2018)

To a certain extent, it can be competitive to ship wood residues by rail from locations in Slovakia and Hungary below 250 km distance to Vienna. Finally, it is deemed competitive to transport wood residues by truck from points in Slovakia and Hungary below 100 km transport distance to Vienna. (Malcherek et al., 2018)

Best practise analyses

With regard to best practise examples of round wood and wood residues transport, storage and transshipment the response rate to the survey was not high. Nevertheless, different examples could be analysed. In principle, wood transport allows for quick adaptation to market condition and the use of most profitable transport modes. (Malcherek et al., 2018)

End products (boards, beams) which are not sensitive as well as raw materials with large density (round wood) are usually transported by IWT. On larger distances, more valuable and sensitive products are usually transported by trucks, while cheap roundwood is transported by railway. Wood residues and wood chips are transported by trucks or railway but over small distances.

Storage properties, position and size are most important for Biomass Logistic and Trade Centres (BLTC) development. BLTCs have been successfully developed in Austria, Germany (Bavaria) and Slovenia and are considered to be best practice examples for Biomass storage. While some parts of operation can be outsourced, the logistics and storage organization is a core part of their business. (Malcherek et al., 2018)

Efficient transshipment of log wood was discussed with operators from Serbia, Bulgaria and also based on own experience. Log wood is handled with standard port loading equipment, but with special grabs. In case of rail wagons, logs are loaded with standard port equipment with log grabs on flat wagons with vertical metal bars for stabilization; at the end they are lashed for extra safety. In case of trucks, same procedure applies, except for self-loading trucks. Wood chips are loaded/unloaded with grabs, conveyors, gravitational funnels and pneumatic unloaders. Several technical solutions are described in this report. (Malcherek et al., 2018)

## 2. Introduction of the implementing organisation

The Port of Vienna has an area of 3 million m². Wiener Hafen group is part of the Wien Holding group and with its subsidiaries it operates three large cargo terminals including the corresponding infrastructure: Freudenau harbour, Albern harbour and Lobau oil terminal. These three ports handle around 1,000 cargo vessels a year. The Danube is used for the transport in particular of oil products, road salt, building materials such as cement, sand or steel products, and agricultural products such as grain and fertilizers. The passenger terminal close to the Reichsbrücke and Marina Wien are also part of the Wiener Hafen group. (Hafen Wien, 2018)

Looking to the future, the Port of Vienna is a multifunctional service company offering decades of experience and also the latest technologies.

Thanks to its optimum rail, road and water links and the proximity to Vienna International Airport in Schwechat, it provides an important and practical interface for international trade and transportation.

The Port of Vienna operates the largest free port in Austria. There are modern warehouses and well trained and equipped staff for the storage and handling of customs and domestic goods as well as a customs office for rapid clearance. The site is guarded round the clock and feeder roads are exempt from the night driving ban in Vienna. The three ports on the Danube in Vienna are notable for their modern handling facilities, excellent infrastructure and dependable, well trained workers, ensuring the reliable and rapid handling of all goods, the building materials, containers, general cargo or bulk goods. (Hafen Wien, 2018)

## 2.1. Organizational structure and activities

**Organigramm Wiener Hafen Gruppe**

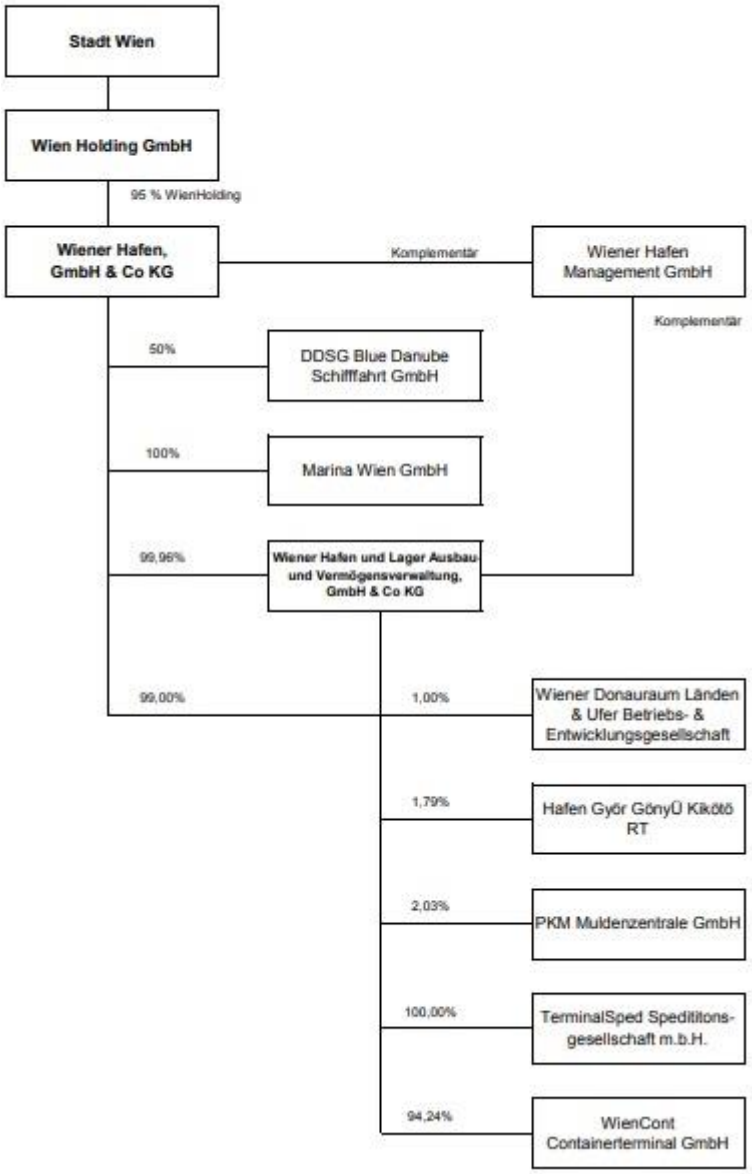



Figure 1: Organisation Chart Wiener Hafen Group (Hafen Wien, 2018).

Ownership, administration (governance) and operation

Wiener Hafen, GmbH & Co KG is a member of a public company Wien Holding which has 95% of ownership of Wiener Hafen, while the Vienna Economic Chamber (Wirtschaftskammer Wien) has a 5% share in the company. Wiener Hafen, GmbH & Co KG is the owner of the port facilities comprising real estate, buildings and wharfs equipment and operates the harbours in Freudenau, Albern and Lobau. Apart from ownership and operation of all storage and vehicle facilities and all real estate that is not directly located in the port, the company Wiener Hafen und Lager Ausbau- und Vermögensverwaltung, GmbH & Co KG is responsible for all crane operations required for cargo handling. It also manages the holdings WienCont. Wiener Hafen, GmbH & Co KG and Wiener Hafen und Lager Ausbau- und Vermögensverwaltung, GmbH & Co KG form the unit publicly known as port of Vienna (Hafen Wien) offering solutions tailored to the needs of its customers. (Hafen Wien, 2018)

## 2.2. Description of technical, financial and legal capacity

**Infrastructure assessment**

The port area covers roughly 350 ha of port land, in three cargo locations, accompanied by the area belonging to the passenger terminal and a marina for leisure and sport vessels. Information on any port land available for the development of port-related activities was not available at the time of writing of this report. Nevertheless, based on the development projects that include the land reclamation from the waterfront areas within the port, it can be concluded that the port has no available space for development as it has to reclaim the space from the areas currently occupied by water surface of the port basins. As mentioned earlier, the port has 3 port basins, providing for the maximum draft of 2.7 m. Cargo handling capacity was not available at the time of writing this report, except in TEU per year, which reached 450,000 TEU per year. (Hafen Wien, 2018)

**Location Freudenau (rkm 1920.1)**

Freudenau harbour is the centre of the cargo handling facilities on the Danube in Vienna.

It contains the handling amenities for bulk goods and raw materials, the container terminal, a car terminal, warehouses and depots, distribution centres for brand articles, the largest free port in Austria with a customs office and its own police station and the offices of the Port of Vienna. It is also a haven and winter harbour. Following facilities are located in Freudenau:

- Management and general administrative headquarters
- Free port / customs office
- Warehouse and brand article distribution centre
- Car terminal
- Cargo handling terminal
- Container terminal
- Police station
- Haven and winter harbour
- Location Albern (rkm 1,918.3)

**Albern harbour** handles building materials, agricultural and steel products. There are five large grain silos on the site with a capacity of 90,000 t, making Albern the most important grain handling location in Eastern Austria. Following facilities exist in the Albern harbour:

- Building materials terminal
- Grain handling and storage
- Heavy goods handling
- Automatic weighbridge

**Location Lobau (rkm 1916.4)**

On this location the storage and handling of mineral oil production is provided. Every year around 1,000 tankers dock in the seven berths in the oil terminal and around one million tonnes of mineral oil products are handled there. The oil terminal is connected by pipelines to the central Lobau fuel depot and the oil refinery in Schwechat. There is also a rail freight station connecting to the railway network. The terminal stations have online measuring systems and automatic loading systems. The pump and loading stations are on floating pontoons.

**General Infrastructure**

General cargo and bulk goods such as agricultural products, building materials, metals, salts, vehicles and containers are handled in Freudenau and Albern. Liquid products such as mineral oil derivatives are handled at the Lobau oil terminal.

Heavy transports and motorboats are also handled in Freudenau.

- Highly qualified personnel ensure rapid and reliable processing.
- Bulk goods and raw material warehouses
- Open-air storage areas
- Crane installation with 6-160 t lifting capacity
- Mobile excavators
- Rail connection
- Covered loading zones
- Ro-ro ramp
- Two weighbridges

Port of Vienna has more than 18 km of quays and river banks, but only 5 km of quay walls are operational (used for transport operations). Vertical quays are with a total length of 10,500 m and sloped quays with a total length of 7,600 m.

The anchorage capacity is 80 vessels in all three ports. Bunkering facilities are available in the zone of the Port of Vienna. Facilities for supply of alternative clean fuels (e.g. LNG, etc.) are not available in the Port of Vienna and no such plans or future projects have been reported.

Shore-side power supply facilities are not available in the port of Vienna. Waste collection facilities are available, but the info on the facilities for collection of used oils, oily waters, sludge and similar liquid waste was not available at the time of writing of this report (Hafen Wien, 2018).

**Hinterland connections (road, rail and IWW)**

Access by roads: B 14 Freudenauer Hafenstraße along the port, highway connection in 500 m (A 4 Ost Autobahn and S 1 Wiener Außenring Schnellstraße; East and South) respectively, 3 km (A 23 Südosttangente; North and West). Total number of road entrances to port is 4 (including a passenger terminal), with 8 road lanes in total. Access by railways: port locations are accessed by rail through connection to shunting stations Donaukaibahnhof (3 km, through Donauuferbahn) and Kledering (8 km, through Winterhafenbrücke) and the main Austrian railway network, all providing 3 railway accesses to the port locations with minimum three railway tracks.

The port is located on the Danube River which is a part of the Rhine-Danube Core Network Corridor. (Hafen Wien, 2018)

**Hinterland (economic situation in the port's hinterland)**

Hinterland of the port of Vienna is mostly related to the so called Vienna Region - including the three federal states Vienna, Lower Austria and Burgenland.

The central geographical location, its focus on advanced technologies and its top-ranked quality of life are three of the factors which catapult the Vienna Region into its ranking as Central Europe's leading economic region and as one of the EU's foremost economic areas. 45% of Austria's gross domestic product is generated in the Vienna Region.

As the capital of Austria, Vienna has the highest gross regional product of all Austrian federal provinces (GRP per capita 47,200 EUR). The economic structure is marked by a strong trend towards the service sector, a high number of business-related services, banking and insurance companies as well as international organisations and enterprises. The industry is currently characterised by the increasingly successful development of new technologies, for example life sciences, energy and environment, mobility, information and communication (ICT) and creative industries. Vienna Region has 3,7 million inhabitants.

Both, the strong manufacturing tradition of Lower Austria, (especially in steel and metal processing and in the chemical industry) and the flexibility of its entrepreneurs have enabled the region to profit markedly from the opening of Eastern Europe.

Compared to the rest of Austria, the service sector has a modestly developed share of the gross regional product of Burgenland. The industry is particularly based on food and beverage production, textiles and wood processing. During recent years the state has undergone change towards technology and tourism with the help of European structural programmes.

In averaged values for the entire Vienna Region, it needs to be noted that the Vienna Region contributes to 44% of the total Austrian Gross Domestic Product, with EUR 38,500 of GDP/capita (Vienna Region). (Hafen Wien, 2018)

The share of the industrial sector (figures for 2013) in the economic output in Austria (28,2%) is high in comparison with the EU average (24,6%). Structure of value creation is as follows:

Vienna City

- Primary sector (agriculture, forestry, fishing): 0.1%
- Secondary sector (goods production, mining, energy & water supply, construction): 14.5%
- Tertiary sector (trade and services): 85.5%

Lower Austria

- Primary sector (agriculture, forestry, fishing): 2.9%
- Secondary sector (goods production, mining, energy & water supply, construction): 30.3%
- Tertiary sector (trade and services): 66.8%

Burgenland

- Primary sector (agriculture, forestry, fishing): 3.7%
- Secondary sector (goods production, mining, energy & water supply, construction): 29.1%
- Tertiary sector (trade and services): 67.2%

**Major port users**

The following major companies are part of the Port of Vienna Group: Wiener Hafen Management GmbH, WienCont Container Terminal Gesellschaft m.b.H. and Wiener Hafen und Lager Ausbau- und Vermögensverwaltung GmbH & Co KG. Wiener Donauraum Länden und Ufer Betriebs- und Entwicklungs GmbH and Marina Wien GmbH also belong to Port of Vienna. The Port of Vienna Group employs some 250 people in total.

Besides businesses belonging to the Port of Vienna Group, more than 120 companies specialising in logistics, trade, construction materials and fuels have settled at the Port of Vienna. These include logistics companies such as Schenker, DHL and Rail Cargo Austria, companies from the trade and construction sector such as Thyssen Krupp Stahlunion, Lafarge Perlmoser and Wopfinger Transportbeton, and companies from the fuel sector including the company OMV and Biodiesel Vienna. The enterprises in the Port of Vienna Group and the more than 120 companies located at the port employ some 5,000 people, illustrating how important the Port of Vienna is as a driver of economic growth for the Austrian capital.

Unfortunately, no info on shares of cargo throughput of the major port users was available at the moment of writing this report, mostly due to the limitations imposed by the data protection laws.

**Potential port users**

Since the scope and the available budget of this project did not allow for any detailed research on potential port users, especially on the potential volumes they might handle over the Port of Vienna, the following conclusions were made on the basis of the assessment performed in project INWAPO (Upgrading of Inland Waterway and Sea Ports), related to the potential cargoes for the port of Vienna. (Hafen Wien, 2018)

Automotive components and cars

According to many experts in the automotive industry, the countries of the Danube region (especially in South East Europe) will additionally gain importance as location for car manufacturers. The most important advantages in terms of vehicle logistics are the waterway's capacity to transport mass volumes (up to 500 passenger vehicles in a 2-unit pushed convoy), as well as the high levels of safety and security offered by inland waterway transport. In this study promising potentials were first and foremost identified in the transport of new cars. Along with low transport costs, weekend driving bans in many European countries result in an additional competitive advantage of inland navigation.

In the recovery of end-of-life vehicles potential is identified in the transport of end-of-life vehicles from scrap yards to recycling sites. Metal scrap which is processed of end-of-life vehicles can also potentially transported by inland vessels to steel plants which are located close to the Danube. (Hafen Wien, 2018)

Chemical products

In the Danube corridor relatively few chemical plants are located directly along the waterway. Consequently, transporting chemical products via the Danube waterway from or to the manufacturing plant usually means that pre- and post-haulage becomes part of the transport route resulting in additional costs. Establishing scheduled container transport services along the Danube, in combination with the necessary telematics systems for tracking raw materials and products (especially important for dangerous goods) represents an interesting transport alternative for the chemical industry. With regards to product categories, the demand for fertilizers should further increase because of extensive farming land and an increasing purchasing power in South East Europe. Also the plastics industry expects further increases in transport volumes as many automotive companies are opening new factories in Central and South East Europe. The demand for chemicals is also expected to grow in the Black Sea region which can be served via inland navigation and short sea shipping. (Hafen Wien, 2018)

Waste and recycling products

To use inland vessels to transport household waste, excavation waste and soil, scrap metals, glass, plastics and paper, whether in bulk or in containers, seems to be a promising solution. Given the fact that especially the Austrian scrap metal sector is mainly export-oriented and no specialized vessel types are required to transport waste and recycling products on the Danube, this transports could be an interesting back load for vessels transporting industrial raw materials upstream (e.g. iron ore, coal). Given the fact, that this cargo is most of the time transported in large volumes and transport time does not play a major role, inland navigation can be in a competitive position compared to trucking and rail. As the prices for industrial raw materials constantly rise, the demand for recycled raw materials also increases at the same time. This is especially true for the developing countries of the Black Sea Region (e.g. Turkey). (Hafen Wien, 2018)

Construction material

Due to the forecasted on going increase in construction activities in Central and South East Europe a higher demand for construction materials can be predicted for the Danube region. At the same

time Austrian companies are opening new production and distribution locations in Central and Eastern Europe and Southeast Europe countries. (Hafen Wien, 2018)

In the field of raw materials natural stone has potential to be shifted on the inland waterway. Speaking of construction products cement and bricks show the highest potential for a modal shift. The presented best practices show, that companies are using the advantages of inland navigation in this sector. The main benefit for the construction industry is the advantage in terms of costs deriving from the bulk capacity of inland vessels. Construction material can be transported by conventional Danube vessels as bulk cargo, as goods on pallets or in containers. (Hafen Wien, 2018)

Empty containers

Currently the trend points towards increasing costs for road transport caused by higher road charges, the development of fuel prices and weekend driving bans. Inland navigation is a cost-effective alternative for imbalances of rail and road transports, since transport time in the field of empty container steering does not play a major role in comparison to other types of transport. At the same time there is a significant number of ports having container terminals with high quality handling equipment. In addition, several depots for empty containers were built and extended in the vicinity of the Danube over the last years. (Hafen Wien, 2018)

Renewable resources

Austria to a large extent supplies its domestic production with domestic raw materials. So far Austria was net exporter of grain which might change due to the rising demand for energetic use and in the case of a bad harvest. In the field of bioethanol, inland waterway transport will play a major role for the transport of raw materials in the future. A mix of all transport modes is required.

In terms of raw materials for the production of biodiesel high amounts of oil seeds and oil will have to be imported in future due to an ever rising demand. With stricter regulations regarding the mandatory blending of mineral diesel with biodiesel the amounts transported on the Danube could significantly increase.

The main growing areas of the wood industry in all countries in the Danube region either have relatively good rail connections (e.g. Bavaria, Austria) or are located at a large distance to the waterway (e.g. Ukraine, Romania). In most of the cases the required pre-haulage to the Danube is rather complicated. Due to a high density of railway sidings, the competition by other modes of transport is fierce. On the other hand, there are still free capacities in inland navigation. With its bulk capacity inland navigation is a good transport choice for round wood and wood products. (Hafen Wien, 2018)

High & Heavy Cargo

High & Heavy cargo has a high potential for Danube navigation. In the future the growing markets in South East Europe and the Black Sea Region will bring a big increase of H&H transports especially for the construction industry (e.g. bridges) and energy supply (e.g. wind energy). Furthermore, there is a trend towards ever larger cargo. At the same time the maximum sizes allowed on roads and motorways could be potentially reduced to improve the safety on the road. This could lead to an additional shift of oversized and heavy cargo to inland navigation.

The transshipment from road to rail or inland navigation needs special equipment. Some special ports exist along the Danube and the Rhine which offer adequate crane capacities. In addition, mobile cranes and Ro-Ro transshipment technology also offer reasonable possibilities for the transshipment of High & Heavy cargo. (Hafen Wien, 2018)

Machinery

The Austrian machinery industry is well-positioned and internationally competitive in the fields of plants for metallurgy, plastics machines, and machines for railway engineering, chemical plants, energy mechanical engineering and mining technology. There are also intense transnational trade relations with Eastern Europe in this sector. Thus machines have a high potential for a modal shift towards inland waterway transport. In South East Europe there is especially an increasing demand for agricultural machines as efficiency in the agricultural industry grows and purchasing power increases. Along agricultural vehicles other rolling cargo can also be transported conveniently in large volumes by inland vessels as there are many Ro-Ro ramps available in South Eastern European ports. (Hafen Wien, 2018)

Paper and pulp

The paper industry represents a key market with Austria being one of Europe´s most important paper producers. Currently almost the half of the transport volume is transported by rail, the other half by trucks. Inland navigation only plays a minor role. In terms of volumes, trade flows and locations there is potential for paper, paper board and card board to be transported by inland vessels with a special focus of raw materials and recovered paper. The main import countries and export countries for paper, paper board and card board are located in the Danube region (e.g. Germany (to some extent), Hungary, Slovakia, and Croatia). (Hafen Wien, 2018)

**Table 1: main port infrastructure and equipment in possession and operation (Hafen Wien, 2018).**

<table>
<tr><td rowspan="2">Total transshipment capacity</td><td colspan="5">450,000 TEU Capacity/year</td></tr>
<tr><td colspan="5">6,6 million t Capacity/year</td></tr>
<tr><td>Total container storage capacity</td><td colspan="5">8,000 TEU</td></tr>
<tr><td rowspan="3">Number of gantry cranes/lifting capacity</td><td rowspan="2">Max. lifting capacity in t</td><td rowspan="2">Projection capacity over the waterside in m</td><td colspan="3">Transshipment capacity</td></tr>
<tr><td>TEU [TEU/hr]</td><td colspan="2">General cargo [t/hr]</td></tr>
<tr><td>84 t</td><td>22m</td><td>40</td><td colspan="2">240 t/hr</td></tr>
<tr><td rowspan="5">Number of other cranes/lifting capacity</td><td rowspan="2">Max. lifting capacity in t</td><td rowspan="2">Crane type</td><td colspan="3">Transshipment capacity</td></tr>
<tr><td>Bulk cargo [t/hr]</td><td>TEU TEU/hr</td><td>General cargo [t/hr]</td></tr>
<tr><td>15.8 t</td><td>Grabber</td><td rowspan="3">200</td><td rowspan="3">15</td><td rowspan="3">200</td></tr>
<tr><td>18 t</td><td>Standard crane</td></tr>
<tr><td>84 t</td><td>Heavy mobile Crane</td></tr>
<tr><td>Availability of reach stackers</td><td colspan="5">YES; #7</td></tr>
<tr><td>Availability of fork lifters</td><td colspan="2">Fork lifter lifting capacity</td><td colspan="3">Amount</td></tr>
</table>

| | | | |
|---|---|---|---|
| | <3 t | | 15 |
| | >5 t | | 3 |
| | >10 t | | 1 |
| **Availability of conveyor belts** | YES; capacity 200m$^3$/hr | | |
| **Availability of pneumatic equipment** | NO | | |
| **Availability of Ro-Ro ramp** | **Cars** | **Trucks** | **Rail wagons** |
| | YES;<br>Capacity [cars/hr]: 100 | YES;<br>Capacity: Unknown | No |
| **Availability of port management information system** | Resource management | | |
| | Waste management | | |
| | Port facility security | | |
| **Availability of other transshipment and container moving equipment** | **Equipment type/name** | | **Transshipment capacity** |
| | 1 Wheel loader | | 100-200 t depending on the material |
| | Terminal tractor | | |
| | E-Crane: hook: 13.5 t; grabber: 12.5 t | | 300 t/hour |
| **Availability of terminal for transshipment of mineral oils (other liquids)** | YES | | |

## 2.3. Previous and current investments

**Land Reclamation**

NATIONAL FUNDING: SCHIG – Anschlussbahn and Terminal Funding

Containerterminal Construction Stage I

Total cost [€]: 5,116,590,-

Schig Funding [€]: 1,600,000,-

Containerterminal Construction Stage II

Total cost [€]: 6,572,000,-

Schig Funding [€]: 1,500,000,-

INTERNATIONAL FUNDING: Ten-T Funding

Land Reclamation

EU Funding 20% [€]: 2,534,154,-

Containerterminal Planning

EU Funding 50% [€]: 2,882,000,-

(Hafen Wien, 2018)

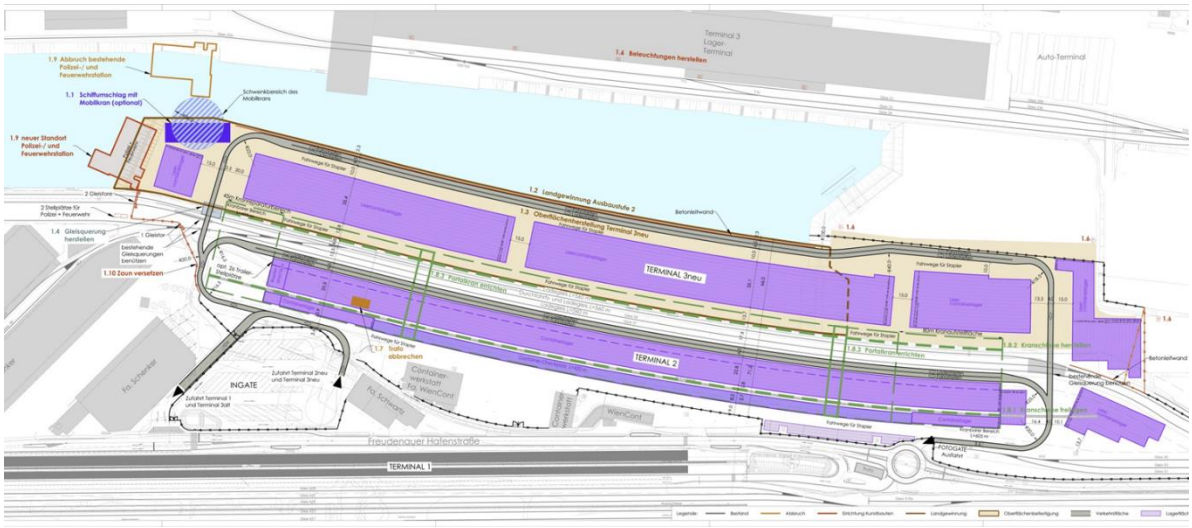



Figure 2: Land Reclamation Port of Vienna (Hafen Wien, 2018).

## 3. Analysis of the current situation

We do transshipments of Biomass like round timber, old wooden chips and all kinds of agricultural goods. It is not necessarily a commodity which is burned in a power station. The port of Vienna and its transport branches is not competitive in this case. We also do not have the technical infrastructure like silos or a fork-lifter with specialized equipment. But we are competitive in all cases where the inland waterways are involved. Unfortunately, we face one big problem: There is enough wood on the Austrian market and an import from other countries connected with the transport is currently not profitable. The transportability is given. There aren't any issues in kind of transportation to the port of Vienna and combined transshipments from our side. (Hafen Wien, 2018)

Currently present biomass transport:

- **Old wood** Fundermax – Departure Germany

Old and deadwood as a new transport and processing branch – Development takes already place. We could develop in conveyer infrastructure for faster transshipment operations. The conveyor systems are necessary to be able to unload modern/next generation wagons. The port of Vienna is already handling such business transactions.

- **Round timber** Alfons Köster – Destination China

Round Timber - For a customer, we stuff round wood into containers, which are then transported to an ocean port and shipped overseas

- **All kinds of agricultural products** like grains

The port of Vienna has a special food approved warehouse, which is divided into six boxes. Most of the time it is used up with agricultural products such as wheat and cereals. (Hafen Wien, 2018)

Main Challenges:

- Domestic cheap wood price
- Closures of freight terminals
- Awareness Raising for the mode of transport

The biomass sector does not impose any special requirements on transport modalities! Clearly, the generally known challenges the waterway transport branch faces also apply for the port of Vienna and the companies handling and processing biomass. Especially low tides have an influence on the travel time. The Viennese power plants do not have any limitations in their storage capacities, which mean they are not necessarily dependent on regular deliveries. (Hafen Wien, 2018)

Most important aspects of each element of the SWOT analysis for the Port of Vienna are listed in the below table.

Table 2: General SWOT Analyses Port of Vienna, (Hafen Wien, 2018).

| Strengths | Weaknesses |
|---|---|
| Good location on national level | Low capacity utilization |
| Modern standards | Capital intensity |
| Trimodality | Business model |
| Transnational connections | Lack of expansion space |
| Qualified staff | Small market sector |
| **Opportunities** | **Threats** |
| New city logistics | Problems with Danube navigability |
| Real estate industry | Stricter environmental regulations |
| One belt – one road | Road & rail competition |
| Containerization of cargo | Emigration of industry |
| Infrastructure flexibility | International (global) economy |

**Strengths**

Good location on national level: optimal geographic location of the ports in Austria; close distances to the well-developed regions and industrialized centres; good economic regional surroundings.

Modern standards: ports of Austria are well developed and provide very good and modern infrastructure standards with sufficient capacity installed (huge investments in the last decades), including intermodal terminals with great capacities are installed.

Trimodality: excellent modal split is developed; trimodality is state of the art operation in Austrian ports (rail-road-IWW); proximity and good connections to international airports (European regional hub Vienna).

Transnational connections: very good connections to seaports in Europe in the north and west relations, also to black sea region and Adriatic seaports; in general Austrian has got a very great potential to direct connections in the middle section of the New Silk Road (one belt one road) in the eastern part of the country (new detailed plan just started recently) as well as the south section of this strategic corridor via the Danube axis.

Qualified staff: high level qualified logistic experts and workers of all levels are available in Austria; specialized education in this sector is provided.

**Weaknesses**

Low capacity utilization: low capacity utilization factors of installed waterside infrastructure; excess capacity for water-side transshipment is available and the port is facing a decreasing water cargo statistics in Austria; even the whole Danube in Austria is still used to a quite small rate compared to the river Rhine.

Capital intensity: high financial efforts for port investments in general and long payback rates for these huge investments; high financial thresholds for new investments and long capital binding periods lead to economic pressure.

Business models: business models for water transshipment are old and do not support todays dynamic demands of the relevant market and client needs; due to public ownership the ports are faced with relatively complex decision processes and supervising structures.

Lack of expansion space: expansion space is scarce and critical in most port areas.

Small market sector: port business in general is a small market and acts in a narrow niche, few market partners, small competition – no boosting and booming market situation with intrinsic improvement and dynamic processes.

**Opportunities**

New city logistics: hubs for city logistics next to urban areas; distribution centres in combination with low emission / zero emission logistics and not available free spaces and transshipment areas in city regions (high prices will force alternatives).

Real estate industry: growing "immobility business" of the port companies itself (supra structure, leasing constructions, public private partnership …).

One belt - one road: close connection of the Austria Danube to the New Silk Road, especially the middle range via railway connection to eastern part of Austria and southern part via Black Sea.

Containerization of cargo: container business will grow and bring new options for growing of Austrian ports which are still engaged in container business, even empty container management in Europe by IWW.

Infrastructure flexibility: creation of multipurpose transshipment infrastructure.

**Threats**

Problems with Danube navigability: problems with navigability of Danube, supply chains may be interrupted for long parts of the year (especially due to problems outside of Austria) – frequently lead to loss of customers or cargo.

Stricter environmental regulations: laws will bring stricter regulations and more cost for ports (especially precipitation water and pre-treatment equipment – "water frame regulations").

Road & rail competition: strong competition of these two sectors, cargo shift towards road (cheap drivers) and rail (strong market pressure in combination with insufficient navigability performance).

Emigration of industry: relocation of heavy industry from (parts of) Europe to locations with cheaper production cost (energy regions of the world, sea coast regions, etc.).

<u>Port management:</u>

- Managing director
- Port master
- Technical director

<u>Logistics companies:</u>

- Wiener Hafen und Lager Ausbau- und Vermögensverwaltung, GmbH & Co KG
- More than 120 settled companies with logistical background

<u>Current port clients / forwarding companies biomass:</u>

- Österreichische Bundesforste AG
- Fundermax
- various customers in the field of agriculture

As the development goal of the port is not only to facilitate biomass transport, but to also become a production and value creation hub, no specific focus on a certain type of biomass, but rather an encompassing overview on the regional supply and demand situation with a focus on the industrial players active in the port is given. (Hafen Wien, 2018)

### 3.1. Supply of bio-based raw materials on regional level

**Analysis of Stock and Potential of Log Wood in Danube port cities**

This chapter provides a comprehensive overview on round wood production stock and potential. The methodology at first consisted of the identification of relevant ports in the Area of Investigation on River Danube and major tributaries. A total of 52 ports were identified. (S2BIOM, 2018)

As a second step, data sources were identified and analysed for the round wood production projections on NUTS3 region's level for 2020 and 2030. Major data sources used were S2Biom project, EUROSTAT and FAOstat. As a third step, a 100 km radius circles around each port location was applied in mapping software. The radius of 100 km was chosen from own expertise and identified transport practices, which has found out that usual road transport distance for round wood is 150-170 km, considered as economically viable.

Finally, for the round wood availability an area of 100 km bee-line radius around port was calculated. (EUROSTAT, 2017)

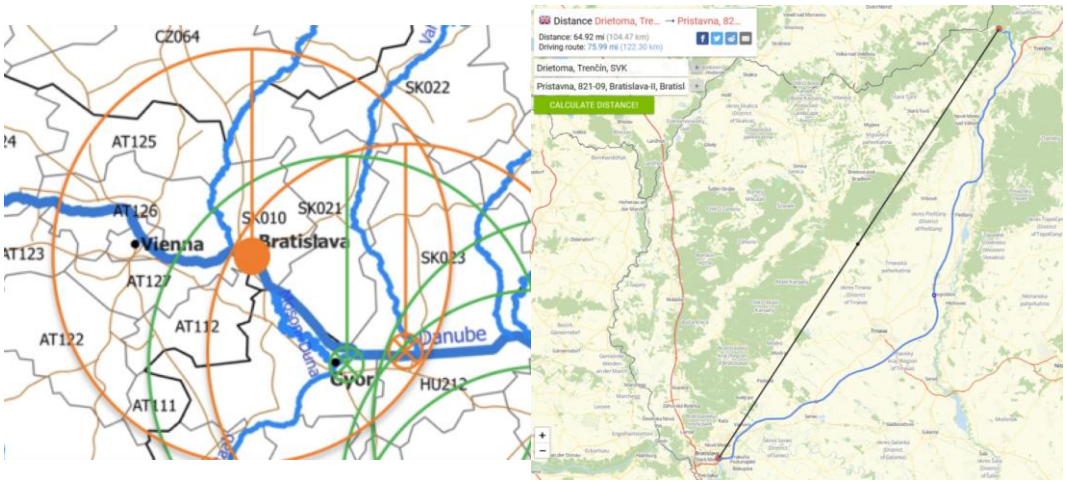



Figure 3: Methodology for Supply radius and illustration of deviation factor for roads, (FAOSTAT, 2018).

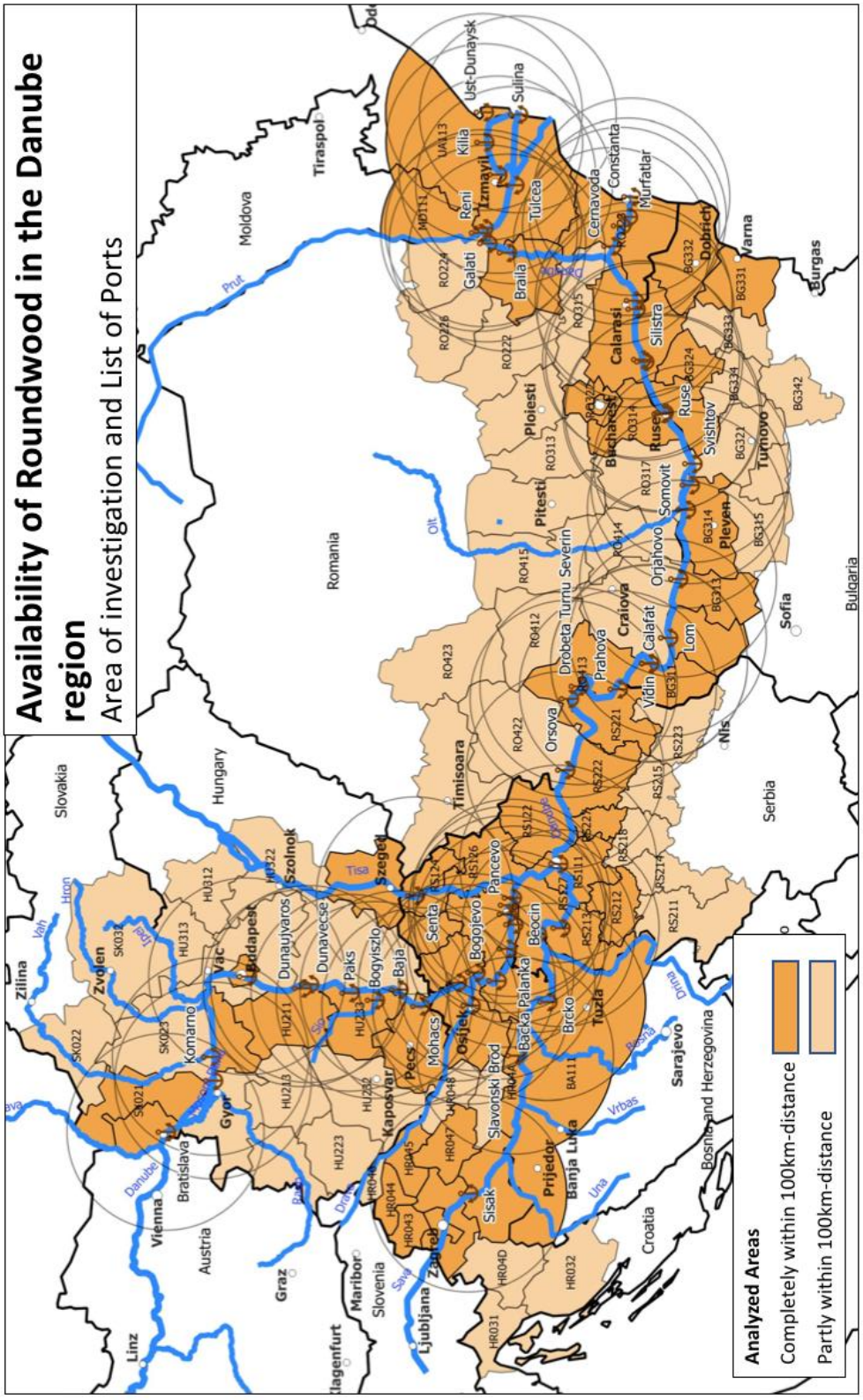



Figure 4: Roundwood availability Inland Ports and coinciding NUTS 3 regions, (Malcherek et al., 2018).

The S2biom database has been used to calculate the theoretical round wood availability at each port. The Base data (2012) for projections for stem wood production in 2020 and 2030 was

calculated by the S2biom Project (FRP 7 programme) for each European NUTS3 region. Calculations are basing on the European Forest Information SCENario model (EFISCEN) and the European Forest Dynamics Model (EFDM). (S2BIOM, 2018)

Data we have used to calculate round wood production are for a projection of technical potential in 2020 and 2030, namely for Stem wood from final felling and thinning, each for both non-conifer and conifer trees S2Biom Data for total production of stem wood are given in atro tonnes, and were for this study converted into tonnes at usual 40% water content of transported stem wood. The factor used for conversion from dry to wet tonnes in this case was 1.45 t. (S2BIOM, 2018)

The calculated amounts of conifer and non-conifer stem wood was distributed into wood products categories defined by FAO: firewood, saw logs and veneer logs, pulp wood, round wood and split and other industrial round wood.

Eurostat statistics of production for those wood products was applied to calculate average shares of firewood, saw logs and veneer logs, pulp wood, round wood and split and other industrial round wood in stem wood from conifers and non-conifers. (S2BIOM, 2018)

**The projections show that round wood availability will not increase when comparing 2020 and 2030, but the reduction will not be significant.**

NUTS3 regions with highest projected availability of Roundwood are:

- Caras-Severin, Southwestern Romania (RO422)
- Parts of Bosnia and Herzegovina (BA111)
- Tulcea, Eastern Romania (RO225)
- Gorj, Southwestern Romania (RO412)
- Baranya, Southern Hungary (HU231)

Similarly, ports in proximity of regions with highest Roundwood availability, all exceeding 2 million t per year, are:

- Drobeta Turnu-Severin, Romania
- Bogyiszló, Central Hungary
- Paks, Central Hungary
- Dunaújváros, Central Hungary
- Budapest, Central Hungary

Presented projections are related to technical potential and it is the fraction of the theoretical potential which is available under the regarded techno-structural framework conditions with the current technological possibilities (such as harvesting techniques, infrastructure and accessibility, processing techniques). (FAOSTAT, 2018)

It also takes into account spatial confinements due to other land uses (food, feed and fibre production) as well as ecological (e.g. nature reserves) and possibly other non-technical constraints. Although round wood is considered as available in practice market demand is higher than output thus demand is higher than technical potential, therefore possibility to supply depends on buyers' willingness to pay.

Trend of increased demand for round wood derives from increased demand for construction wood, furniture, pulp and paper, chipboard, wood pellet, firewood, wood chips and other semi products and final products, for which demand grows as economy develops. (EUROSTAT, 2017)

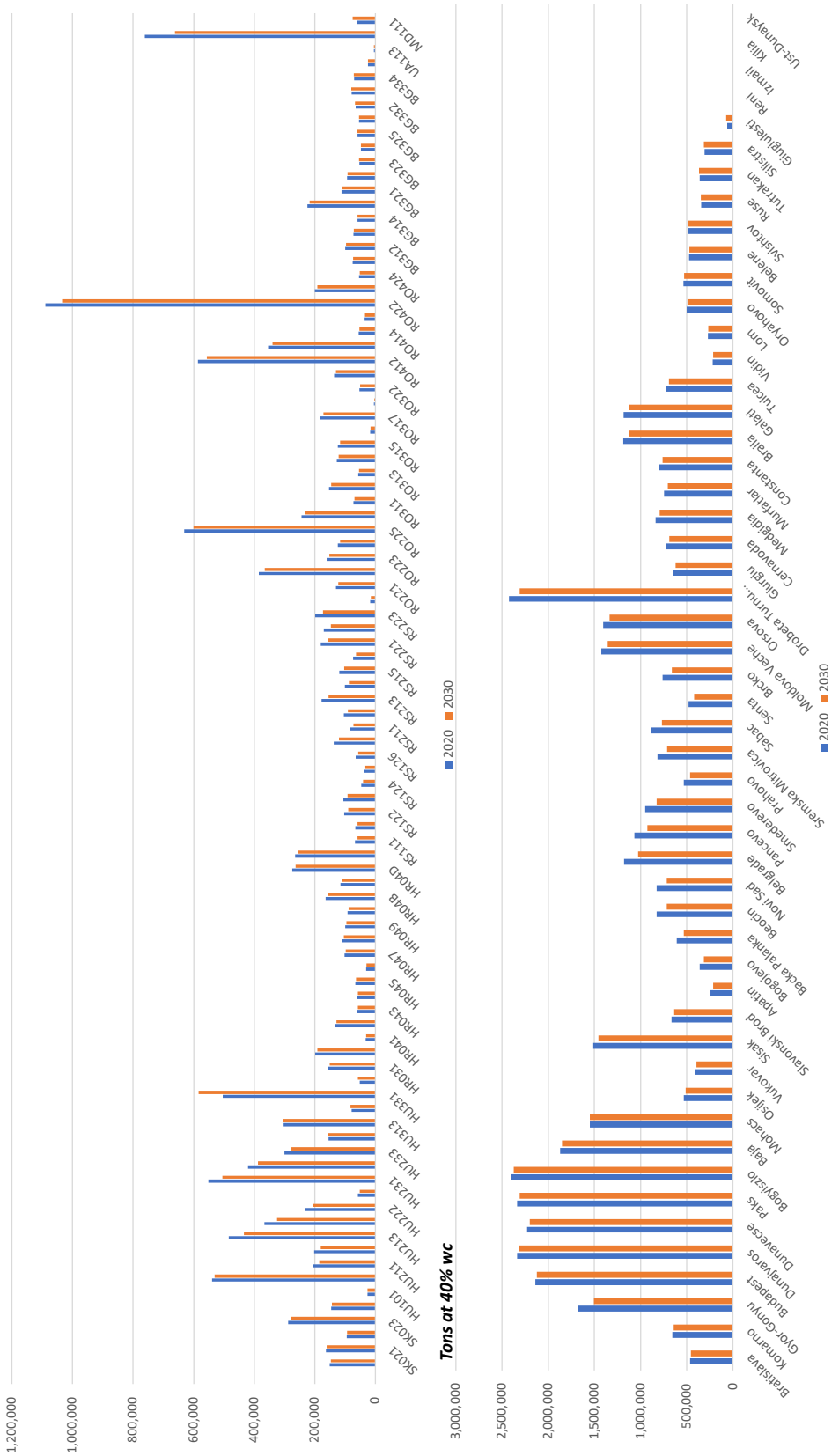



Figure 5: Ports and NUTS3 regions - Roundwood availability projections for 2020 and 2030, (Malcherek et al., 2018).

This section shall provide an overview of existing sea transport on the Black Sea, which is related to the transport of wood based products or energy sources, such as log wood.

In order to obtain the data on eventual cargo flows of log wood in the Black Sea area, the Consultant contacted various port authorities in Romania and Ukraine. In case of no response situations, all targeted ports were contacted at least twice, before further contact attempts were dropped.

**In Romania**, the largest port of Constanta was contacted directly, as well as the river-sea port of Galati, both directly and via Romanian Ministry of Transport as the highest institution in charge for ports in Romania. Whilst contacts with the Port Authority of Constanta (Maritime Port Administration of Constanta, hereinafter: MPAC) were successful, no responses were received for the Port of Galati, neither directly, nor via the Ministry of Transport, until the reporting date [early June 2018].

**In the Ukraine**, the following tasks were executed:

- Elaboration of available information resources on the potential of (harvest) wood waste as biofuels and their exports via ports from Ukraine, including
    - sites of the Ukrainian Sea Ports Authority (hereinafter - USPA) and corresponding ports (11) that are in the area of its management;
    - State Agency for Forest Resources (hereinafter - SAFR);
    - companies specializing in the harvesting and exporting of woodchips;
    - The Bioenergy Association of Ukraine (hereinafter - BAU),
    - the Ukrainian Pellet Union (hereinafter referred to as UPU), and others like that;
- Performing consultations with representatives of USPA (2), SAFR (1), Kherson seaport (2), BAU (1) and UPU (1), as well as brokerage company (1), which provides services for customs clearance of timber for export;

An invitation to participate in the study was sent to officials of state (7) and private (1) ports of Ukraine, as well as companies (2) who specialize in harvesting and exporting woodchips.

<u>Cargo flows via the Port of Constanta</u>

According to the information received from the MPAC, only total wood products throughput was recorded, with no detailed division. Large quantities of wood products were handled although the figures are declining constantly in the last three years. No further detail on the type of wood or of wood waste was received from MPAC.

An overview on wood handled in Constanta Port in the last three years is given in the following graph below.

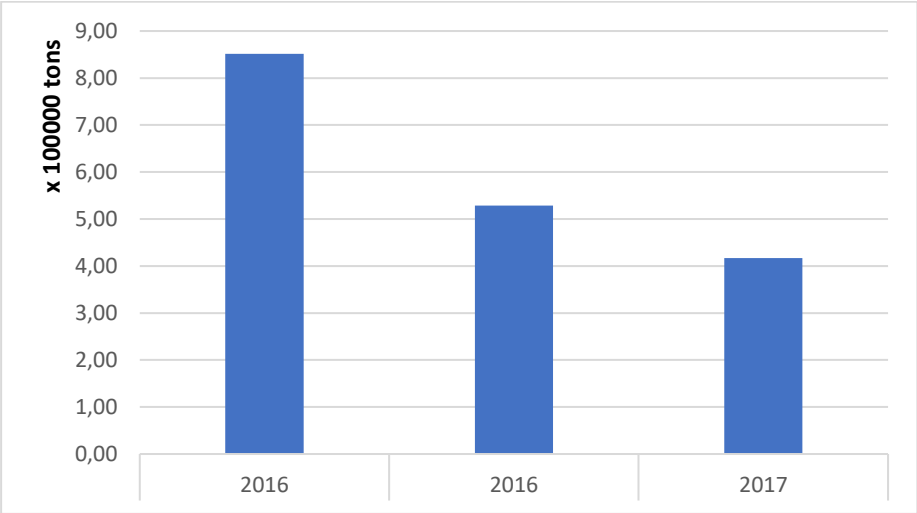



Figure 6: Transshipment of wood waste in the Port of Constanta, (Malcherek et al., 2018).

No import or export of log or wood waste was recorded in Constanta Port from/to Danube countries.

**Possible value chains for Log wood transport to Vienna**

This section shall provide an overview of possible Wood Transport Value Chains from the Black Sea Region to Vienna. Different wood transport possibilities to Port of Vienna were analysed: Inland Water Transport (IWT), Railway and Road trucks. For both, round wood and wood residues, the methodology consisted of identifying local prices of round wood and wood residues in Austria, Slovakia, Hungary, Croatia, Serbia, Bosnia and Herzegovina, Romania and Bulgaria. Also, transport prices of different transport modes were analysed. Finally, the comprehensive price of wood delivered to Vienna from different countries was compared with the local wood price in Vienna delivered from regional suppliers.

**Log Wood Prices and Transport Costs for Round wood from Danube area**

Central and Eastern Europe are now facing very a high demand for round wood. What is harvested is consumed, and what is planned for harvesting is harvested in most cases. In all analysed countries, there is a lack of wood and it is hard to contract the procurement of required quantities. Currently, Round wood prices are growing. In Romania, the price of round wood for firewood increased by 250% from 2011 to 2017 and is still growing.

One of the reasons for the lack of wood in Eastern Europe is the ban for exporting round wood from Ukraine and Belarus which is valid since January 2017. In Serbia, there was a price escalation of 20% in 2017 due to the competition of chipboards and pellet producers. In Slovakia, Croatia, Serbia and Bosnia-Herzegovina it is hard to conclude contracts with the state-owned Forest Companies which are the dominant market players. (Malcherek et al., 2018)

Log wood prime cost

In general, temporary price reductions can also appear, but only when natural disasters occur such as ice breaks in forests. Log prices at forest road in Austria are slightly higher than in other analysed countries, except Slovakia. On the other hand, the price of firewood in Austria is similar to prices in the other countries. (Malcherek et al., 2018)

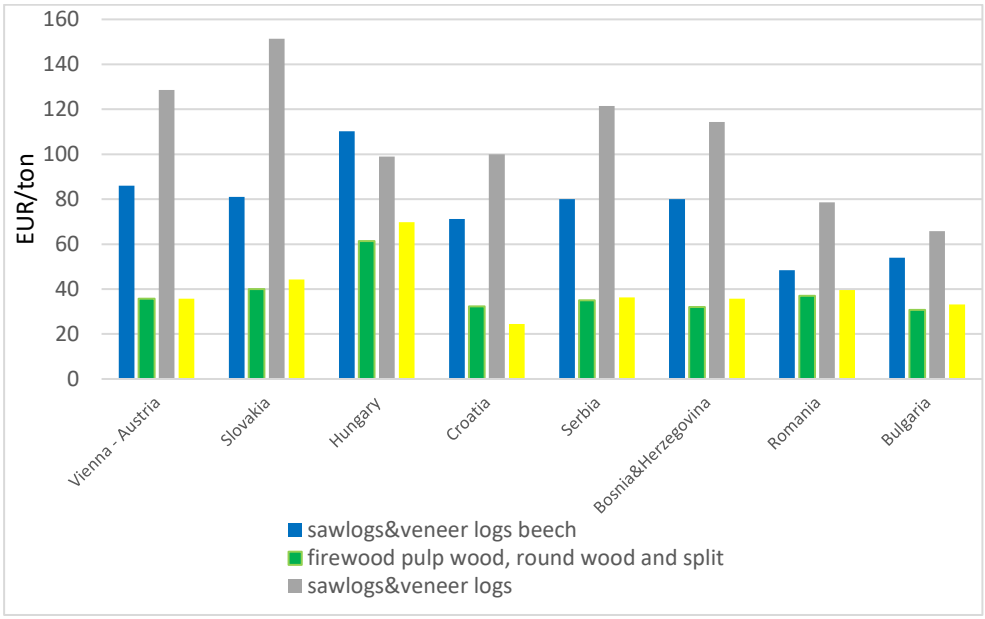



**Figure 7: Log wood prices at forest road per wood category and country, (Malcherek et al., 2018).**

Transport costs for Log wood

For Austria, only the transport cost of truck delivery up to 100 km is considered. For other countries, IWT cost includes road transport up to 100 km to the port of loading, the loading and manipulation costs itself and the barge transport costs.

The railway costs include road transport up to 50 km, the costs of loading round wood to wagons and the cost of railway transport.

Road transport costs only include transport costs of the truck with specialized trailers for round wood transport from forest road to Vienna, including loading costs.

As a result, it becomes visible that road transport costs significantly escalate over 250 km distance, while IWT becomes more competitive than railway in distances over 500 km. (Malcherek et al., 2018)

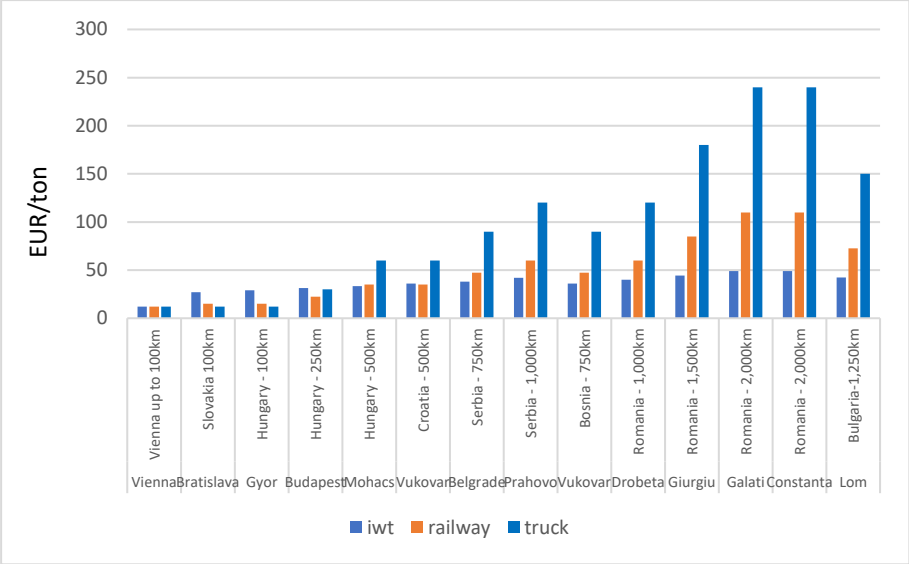



Figure 8: Transport costs to Vienna for log wood by mode (without wood cost), (Malcherek et al., 2018).

Supply price for log wood with inland water transport. The supply price is consisting of the prime cost and the transport costs. For logs, the price can be competitive if shipped from Romania and Bulgaria. Firewood prices and delivery costs are too high to compete with existing firewood prices in Austria. (Malcherek et al., 2018)

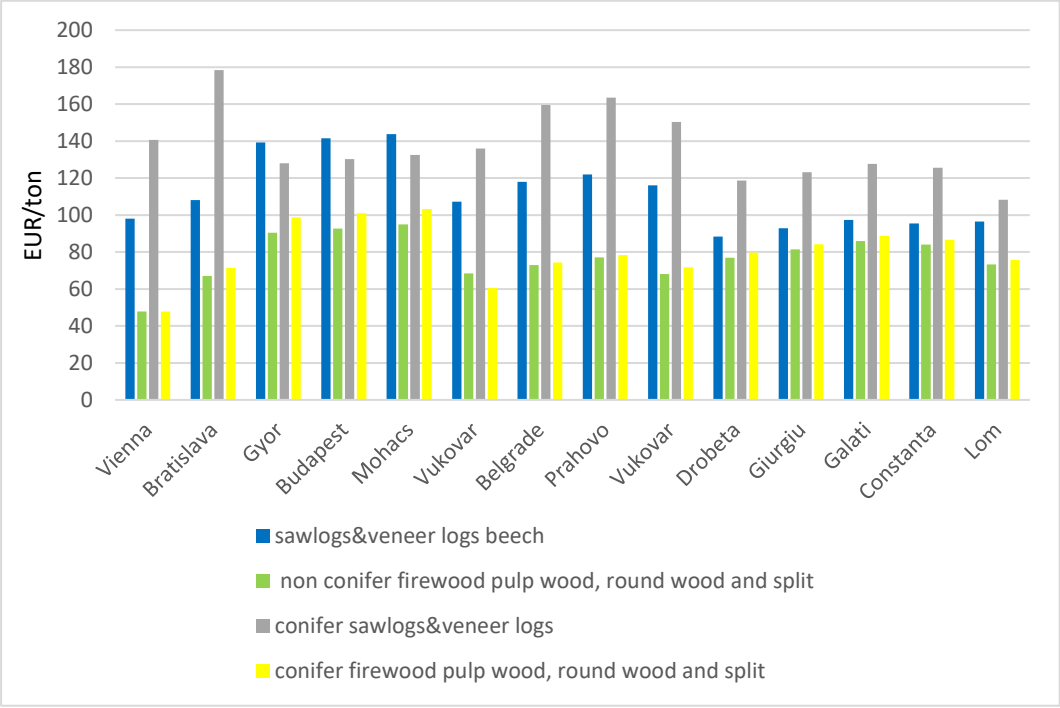



Figure 9: Log wood prices – IWT delivered to Vienna, (Malcherek et al., 2018).

Supply price for log wood with rail transport

The supply price is consisting of the prime cost and the transport costs.

Following Figure shows the railway-based wood delivery costs to Vienna compared with wood prices in Vienna delivered by truck.

For both logs and firewood, the prices including delivery costs are too high in order to compete with existing prices in Austria. (Malcherek et al., 2018)

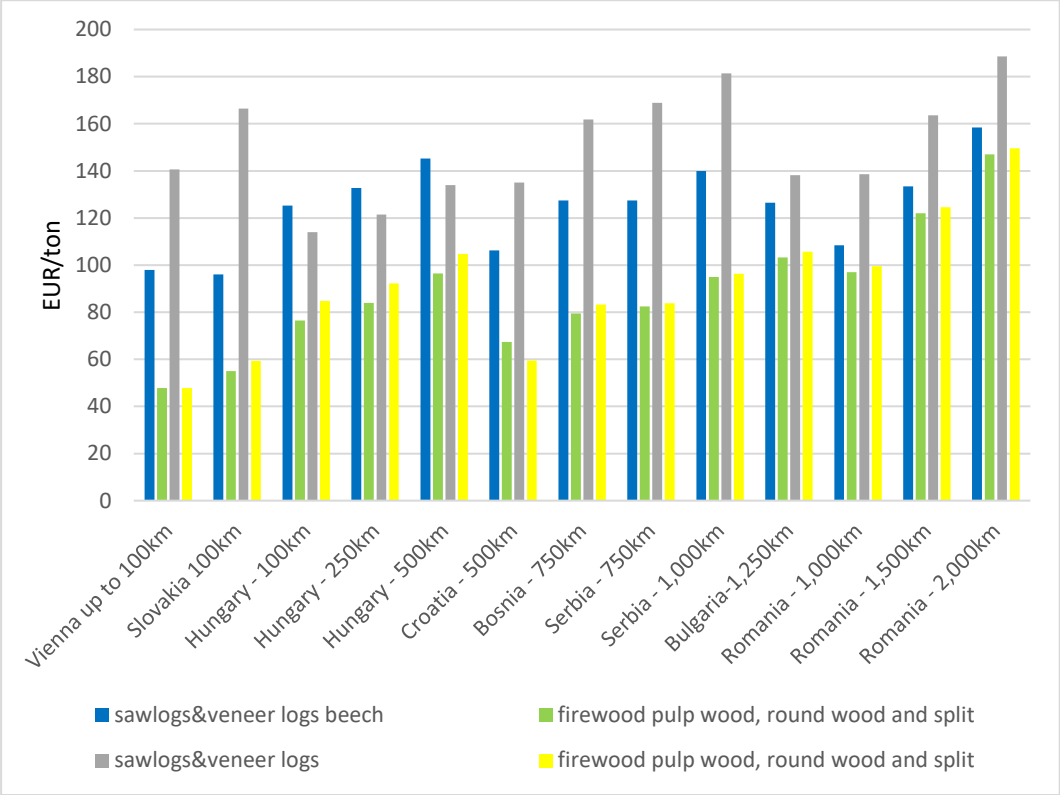



**Figure 10: Log wood prices – delivered to Vienna by railway, (Malcherek et al., 2018).**

Supply price for log wood with road transport. The supply price is consisting of the prime cost and the transport costs. For both, logs and firewood the prices including delivery costs are too high in order to compete with existing prices in Austria, except for Slovakia where costs and prices are similar due to low transport distance. (Malcherek et al., 2018)

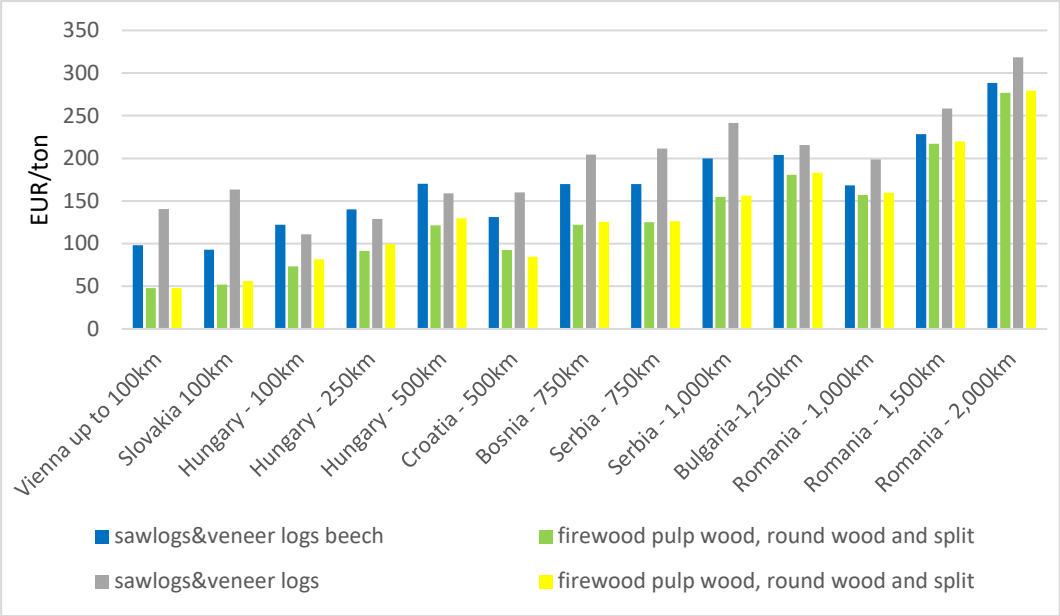



Figure 11: Log Wood prices – delivered to Vienna by truck, (Malcherek et al., 2018).

The recent high demand for Log wood indicates a lack of wood on the market. Thus, it is hard to contract the procurement of required quantities. There is a visible price increase in Romania and Serbia, while Austria still has very competitive prices.

The following findings can be drawn. Truck transport of round wood is most competitive below 200 km distance. At higher distances and escalating costs, railway is most competitive up to 500 km, while **IWT becomes more competitive than railway in distances over 500 km. Log transport on Danube may achieve a competitive price if shipped from Romania and Bulgaria to Vienna**.

Firewood supply prices incl. delivery costs were too high, in order to compete with existing firewood prices in Austria.

For Log wood, the prime costs and delivery costs for rail and road are too high to compete with existing prices in Austria. The only exception is Log wood from places in Slovakia, located closer than 100 km from Vienna, for which prime costs and transport costs are similar to Austrian market. (Malcherek et al., 2018)

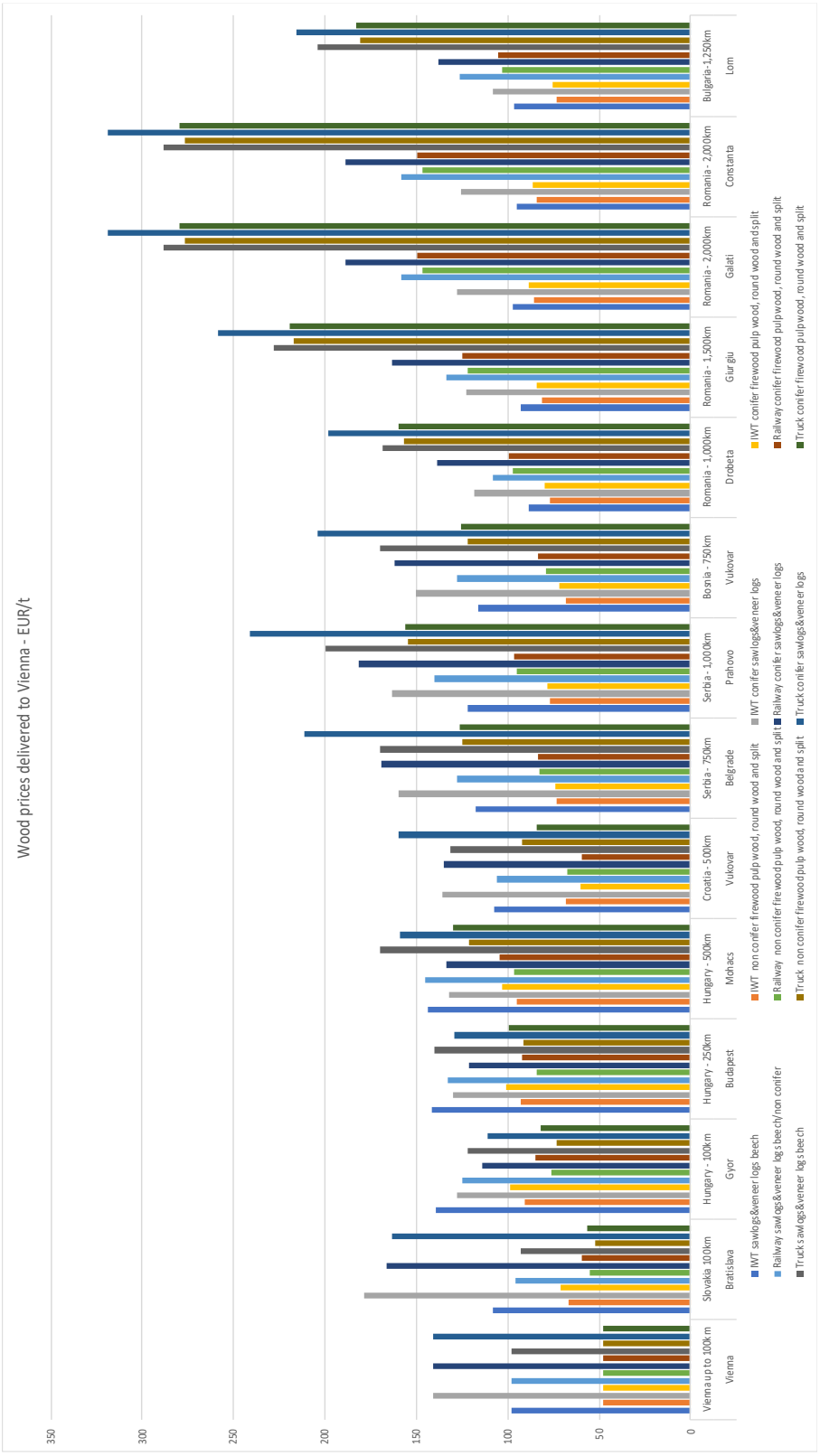



**Figure 12: Log wood prices – delivered to Vienna by different transport modes (synopsis), (Malcherek et al., 2018).**

**Analysis of the Danube Inland Waterway Transport of Log Wood products**

Goal of this section is to assess in detail the inland waterway transport along the Danube, which is related to the transport of wood based products or energy sources.

The Consultant has contacted the port authorities of Slovakia, Hungary, Croatia, Serbia, Romania and Bulgaria in order to obtain records on transport of log wood (round wood) on the Danube to/from these ports. Thus, this section provides an overview on recorded cargo flows of round wood on the Danube. Port authorities in Slovakia and Croatia confirmed that there were no transshipments of round wood in their ports during the last 5 years.

In Hungary, only the public Port of Baja reported minor quantities of round wood handled in their port: 6,300 t in 2015, 10,500 t in 2016 and 7,500 t in 2017. All quantities are for local use; nothing is imported or exported. (Malcherek et al., 2018)

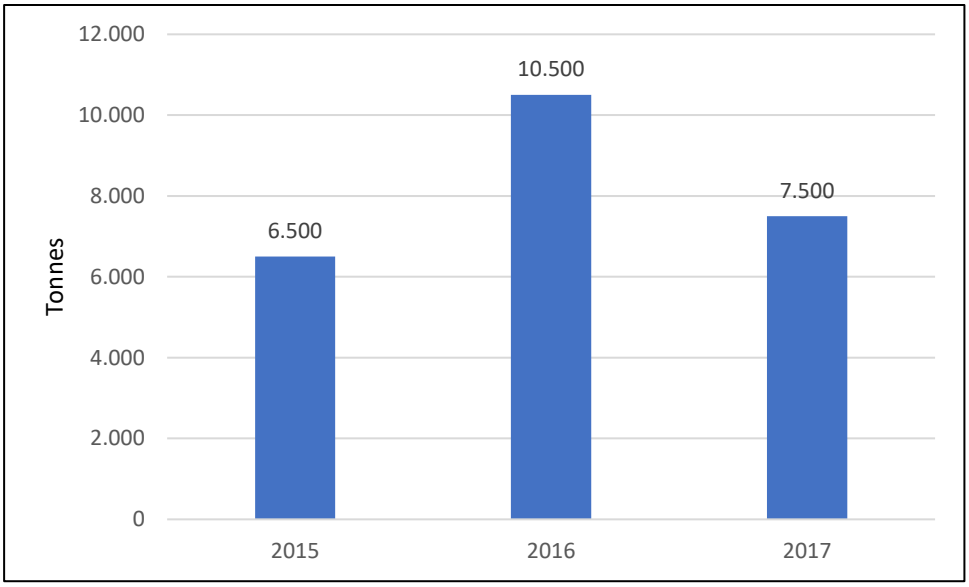



Figure 13: Transport volumes of round wood in Hungary (Port of Baja only), (Malcherek et al., 2018).

Responses from Romanian ports have not reached the Consultant until the moment of writing of this report (4 June 2018).

Certain amounts of round wood were recorded in Serbia and Bulgaria. Round wood shipped in Serbia is shipped only locally, outside official ports with special permissions authorized by the Port Governance Agency, acting as the Central port authority for Serbia.

Round wood is loaded into barges at an improvised loading site close to the harvesting area and shipped by barge to the nearby processing facilities where it is unloaded also at improvised unloading site. Neither exports nor import of any type of wood was recorded in Serbia. (Malcherek et al., 2018)

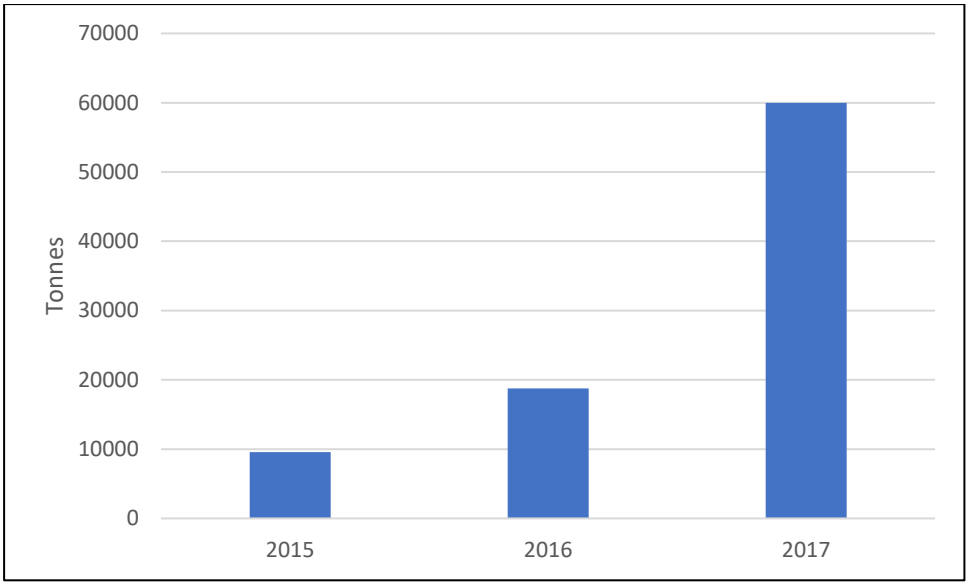



Figure 14: Transport volumes of round wood in Serbia (local transport only), (Malcherek et al., 2018).

Shipments of round wood in Bulgaria are also very scarce as in Serbia. Data for only two years (2015 and 2016) were available, and only for total flows (export and import together). Providing detailed information as requested is "subject to agreement with the port operators since individual data are protected by law and are provided by Executive Agency Maritime Administration or by the operators themselves". The timeframe for the execution of this study was too short in order to identify operators of log wood, to contact them with a data request, to ensure sufficient response rates, to reach written agreements on data exchange and receive requested data. However, the Available data for Bulgarian river ports is given. (Malcherek et al., 2018)

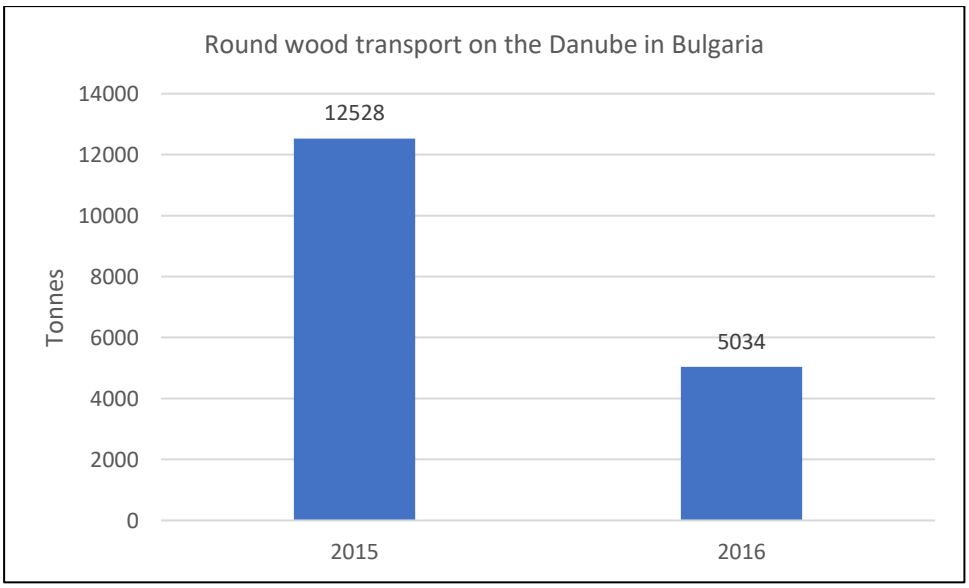



Figure 15: Round wood transport by barges in Bulgaria, (Malcherek et al., 2018).

## Wood Residues analysis

### Analysis of Stock and Potential of Wood Residues in Danube port cities

This chapter provides comprehensive overview on wood residues production projections for 2020 and 2030 in 50 km radius from Danube (and its tributaries) ports. Methodology applied consisted of identification of relevant ports – same ports as for round wood availability were considered. Second part was sources review and analysis of wood residues production projections on NUTS3 level. Major sources used in analysis of round wood production were S2biom project (S2BIOM, 2018). In the next steps application of 50 km radius circles on Southeast Europe map containing NUTS3 level borders was applied. Radius of 50 km was applied since usual transport distance for waste wood is up to 70 km, so it is considered as economically viable. Finally, waste wood availability within 50 km radius was calculated. (Malcherek et al., 2018)

S2biom project data has been used for calculation of round wood availability. Base data for projections for logging residues production in 2020 and 2030 are calculated for each European country on NUTS3 level. (S2BIOM, 2018)

Calculations for logging residues are based on the European Forest Information SCENario model (EFISCEN).

Volumes for wood industry residues, i.e. ratios of residues in wood production, and post-consumer wood were obtained from Forest Biomass Resource Assessments performed under the EUwood and EFSOS II studies. The bio waste and wood waste share from the municipal waste data was provided by EUROSTAT on NUTS3 regional level.

**Figure 16: Example pictures for different types of wood residues: logging residues, sawdust, sawmill, residues, wood industry residues and post-consumer wood (Malcherek et al., 2018).**

S2biom data are given for the total production of

- logging residues non-conifer resp. conifer,
- sawdust conifer resp. non-conifer,
- sawmill residues conifer resp., non-conifer,
- other residues,
- bark,
- hazardous and non-hazardous wood residues.

S2biom data have been presented in atro-tonnes as units, and converted in this study into tonnes at usual water content for logging residues – i.e. around 40%. The factor used for conversion of dry to wet tonnes was 1.45 t.

For sawmill residues, as assuming water content of 30%, the conversion factor of dry to wet tonnes was 1.25 t. For other residues, hazardous and non-hazardous wood residues, a water content of 10%was considered while a conversion factor of 1.05 was applied.

The Projections show that wood residues' availability will slightly increase when comparing 2020 and 2030.

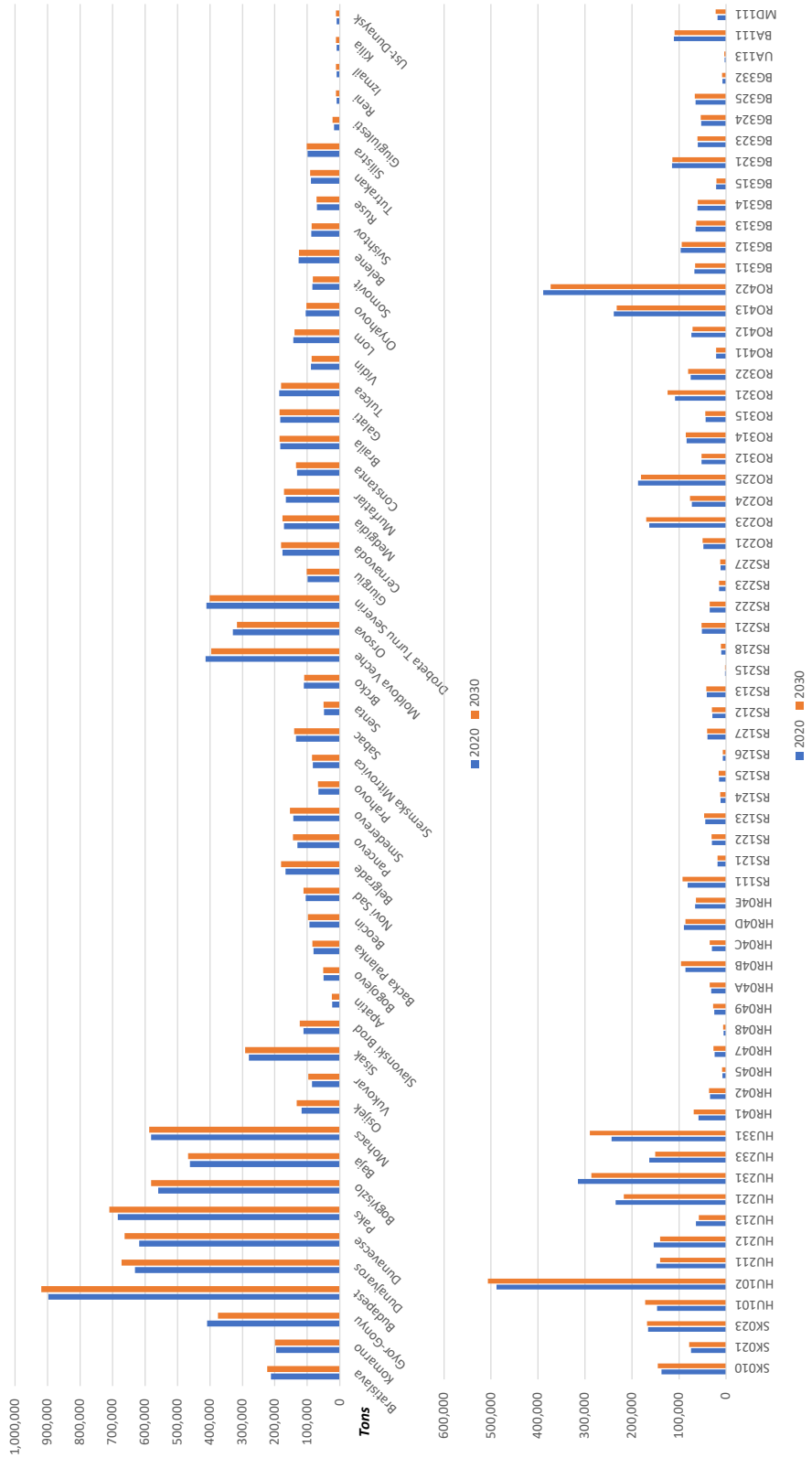



**Figure 17: Ports and NUTS3 regions: Wood residues availability projections 2020 / 2030, (Malcherek et al., 2018).**

NUTS3 regions with highest projected availability of wood residues are:

- Pest, Central Hungary (HU102)

- Caraş-Severin, South West Romania (RO422)
- Baranya, Southern Hungary (HU231)
- Bács-Kiskun, Southern Hungary (HU331)
- Mehedinţi, South West Romania (RO413)

Similarly, ports in proximity of regions with highest wood residues availability, all exceeding 500,000 t per year, are:

- Budapest
- Paks
- Dunaújváros
- Dunavecse
- Mohacs

Presented projections are related to the technical potential provided from S2biom database. Even though, the demand for round wood is very high, the demand for wood residues differs from category to category. In terms of logging residues, the demand is deriving from wood chips demand and energy production, which is not equally developed.

On the other hand, not all logging residues are extractable and in some cases the cost of extraction/collection of forest residues makes the process financially unviable.

Nevertheless, the demand for sawmill residues, especially for sawdust and slabs, is very high, considering that they are used for the production of wood chips, pellets and chipboards and their no-cost "production" at sawmills is cheaper than the extraction from forests. Residues from other wood industries have a similar no-cost price.

Finally, the demand for post-consumer wood differs very much. In general, where energy production from biomass combustion is established, such residues are utilized. Often, there are legislative barriers in terms of using and transporting hazardous wood residues.

In general, wood residues are bulky, usual dry and light, which makes them hardly transportable. If wood residues are used at all, then this is performed in proximity of their production. (Malcherek et al., 2018)

**Possible value chains for wood residues transport to Vienna**

There are different critical issues in wood residues logistics. The first challenge is their bulk density. While round wood is compound and 1m3 weights from 700 - 1,200 kg depending on wood species and water content, bulk density of residues is ranging from 100 - 200 kg per $m^3$.

Wood chips are usual semi products deriving in first phase of wood residues processing, but have a bulk density of 200 - 350 kg per $m^3$ which is much lower than round wood.

Wood pellets are usual products deriving from sawmill residues and are more transportable, considering their bulk density at 8% water content exceeds 600 kg/$m^3$.

However, logging residues and post-consumer wood cannot be used for pellet production.

Another challenge is that various logistical options, with different prices for each residue variant, have to be thoroughly analysed. Residues can be transported to Vienna Port by: (a) barges, (b) railway, (c) trucks combined with a plenty of material options with different prices:

- Logging residues
  - Unchipped for transport
  - chipped in the forests and wood chips transported
  - chipped at the forest road and wood chips transported
  - chipped at the storage and wood chips transported
  - chipped at the port or railway station or other storage and wood chips transported
- Sawmill/Wood industry residues
  - Unchipped
  - chipped at the sawmill and wood chips transported
  - chipped at the port or railway or other storage and wood chips transported
- Post-consumer wood chipped at the sawmill and wood chips transported
  - Non-Hazardous
  - Hazardous

Also, there are different prices for woodchips and wood residues that show significant differences between woodchips from: logging residues (bark, green parts, high ash content and high-water content), sawmill residues (dry, low ash content) and post-consumer wood.

Therefore, for the purpose of the study we have analysed an equal mix of conifer logging residues, non-conifer logging residues, sawmill and wood industry residues and post-consumer wood.

Wood residues prime cost

The following graph shows the prime cost of logging residues and sawmills residues per country. Data on logging residues prices was taken from S2biom project which are only considering costs of their extraction to the forest road. (Malcherek et al., 2018)

A demand for logging residues exists only in areas where the energy production utilizes also woody biomass. This is not the case in Serbia, Bulgaria and Romania. However, the demand for sawmill residues is very high in all countries deriving from chipboard and pellet factories. Considering wood pellet and chipboards, the price is similar in all analysed countries.

The price of sawmill residues is also similar since it is consumed locally.

Finally, for post-consumer wood (waste wood) a 0 EUR/t price has been assumed, considering the low demand for it on one side, and waste disposal solution in energy production on the other side. (Malcherek et al., 2018)

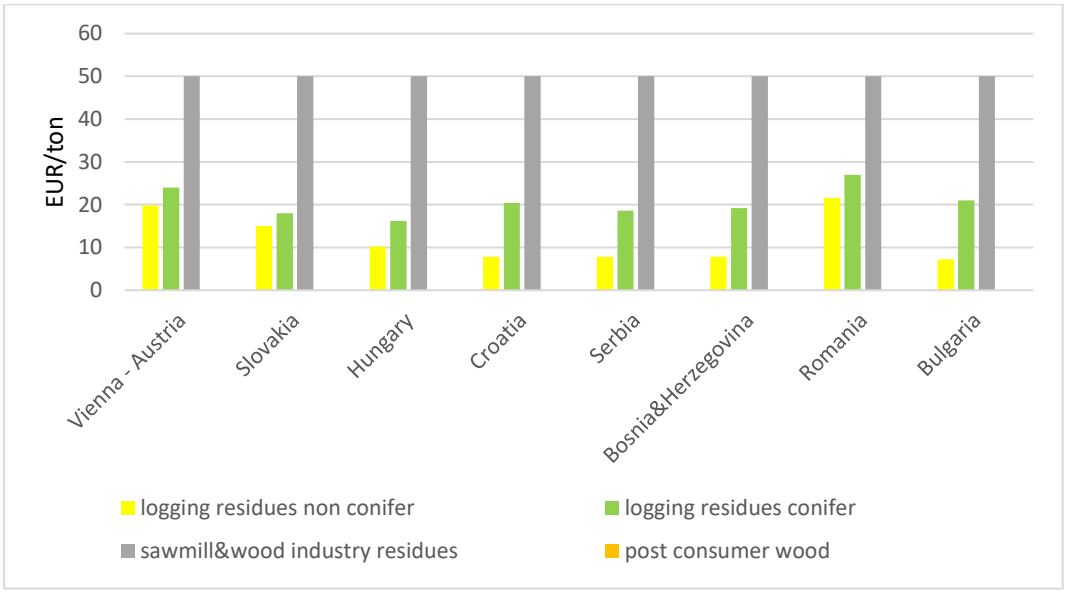



**Figure 18: Wood residues prices at forest road/sawmill/storage in € per ton, (Malcherek et al., 2018).**

Transport cost for Wood residues

For Austria only, transport cost of truck delivery of up to 100 km is considered. For other countries IWT cost include truck transport up to 50 km to the port of loading, loading and manipulation costs and IWT transport costs.

Railway costs include truck transport for up to 50 km, costs of loading round wood to wagons and cost of railway transport. Truck transport include only transport costs of truck with walking floor trailers for bulk transport, from residues production site to Vienna, including loading.

IWT transport costs are higher than all other forms until 1,000 km distance, where trucks become the least favourable option. Railway is the most competitive transport mode for residues transport above 100 km, while road trucks are competitive for less than 100 km transport. (Malcherek et al., 2018)

Transport costs are presented in Figure 25.

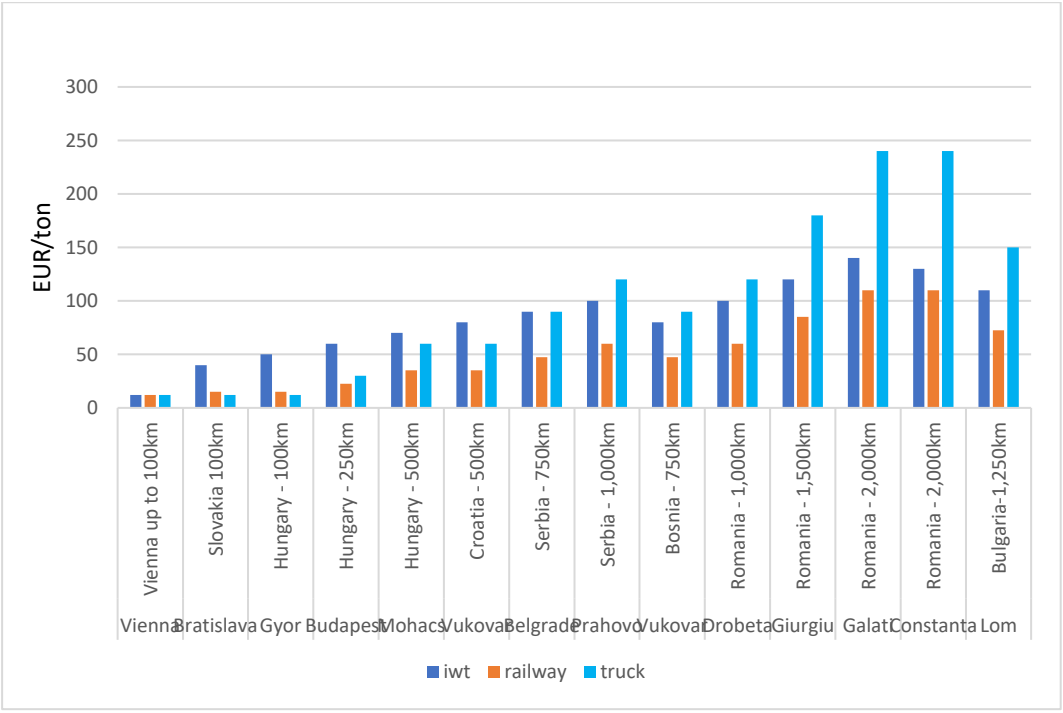



**Figure 19: Transport costs for wood residues in € per ton, (Malcherek et al., 2018).**

Supply price for wood residues with inland water transport. The supply price is consisting of the prime cost and the transport costs.

The following graph presents the wood delivery costs to Vienna using IWT, compared with wood residues prices in Vienna delivered by truck. It shows that a transport of unprocessed wood residues by IWT is not competitive. (Malcherek et al., 2018)

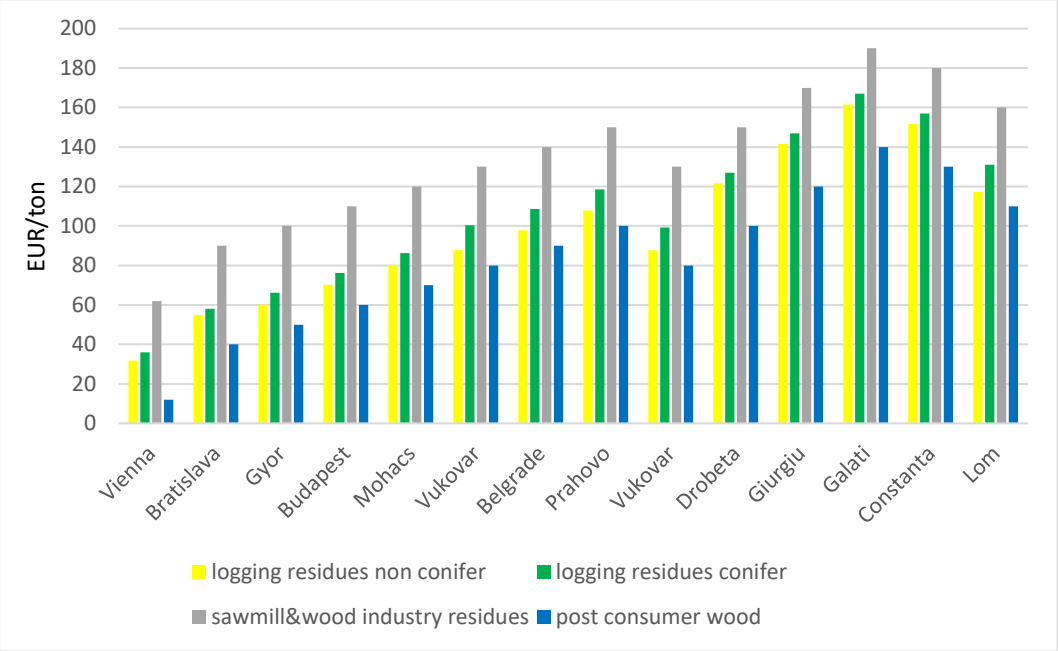



**Figure 20: Wood residues prices – delivered to Vienna by IWT, (Malcherek et al., 2018).**

Supply price for wood residues with rail transport. The supply price is consisting of the prime cost and the transport costs.

The following graph presents the wood residues delivery costs to Vienna by railway, compared with wood residues prices in Vienna delivered by truck. To a certain extent, it can be competitive to transport wood residues to Vienna from Slovakia and Hungary until 250 km distance. (Malcherek et al., 2018)

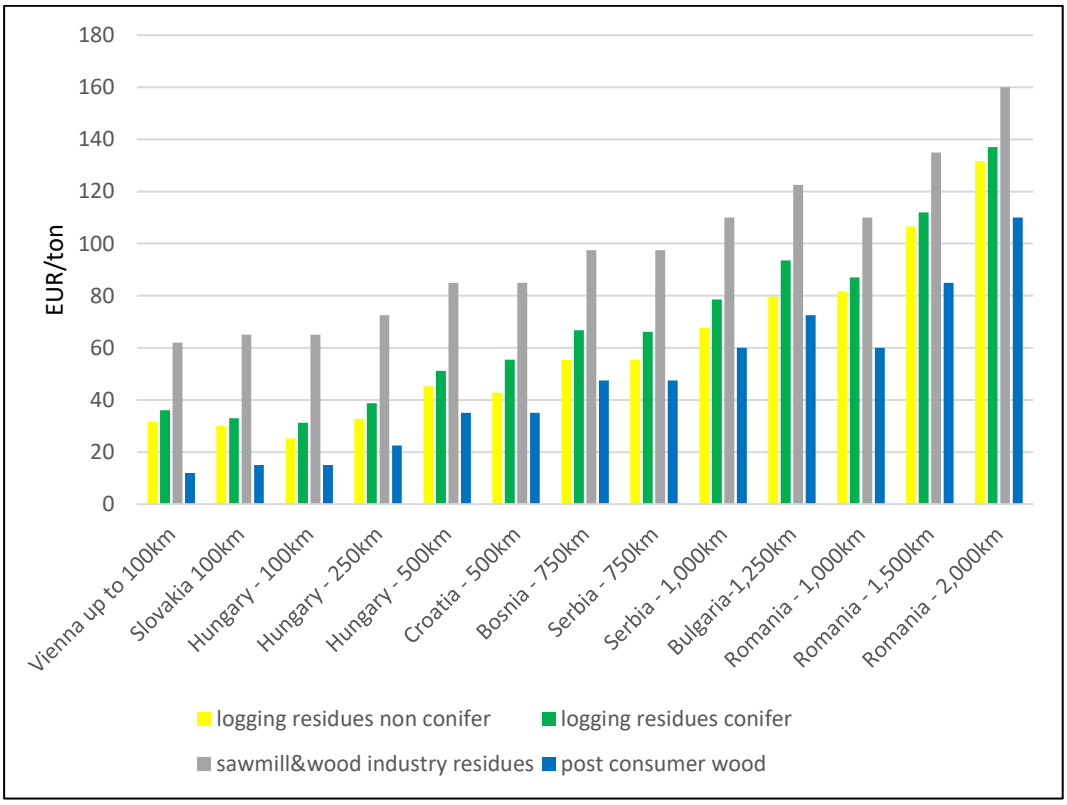



**Figure 21: Wood residues prices – delivered to Vienna by railway, (Malcherek et al., 2018).**

Supply price for wood residues with road transport

The supply price is consisting of the prime cost and the transport costs.

The following graph presents the wood delivery costs to Vienna by truck. It can be competitive to transport wood residues to Vienna from Slovakia and Hungary by road transport up to 100 km transport distance. (Malcherek et al., 2018)

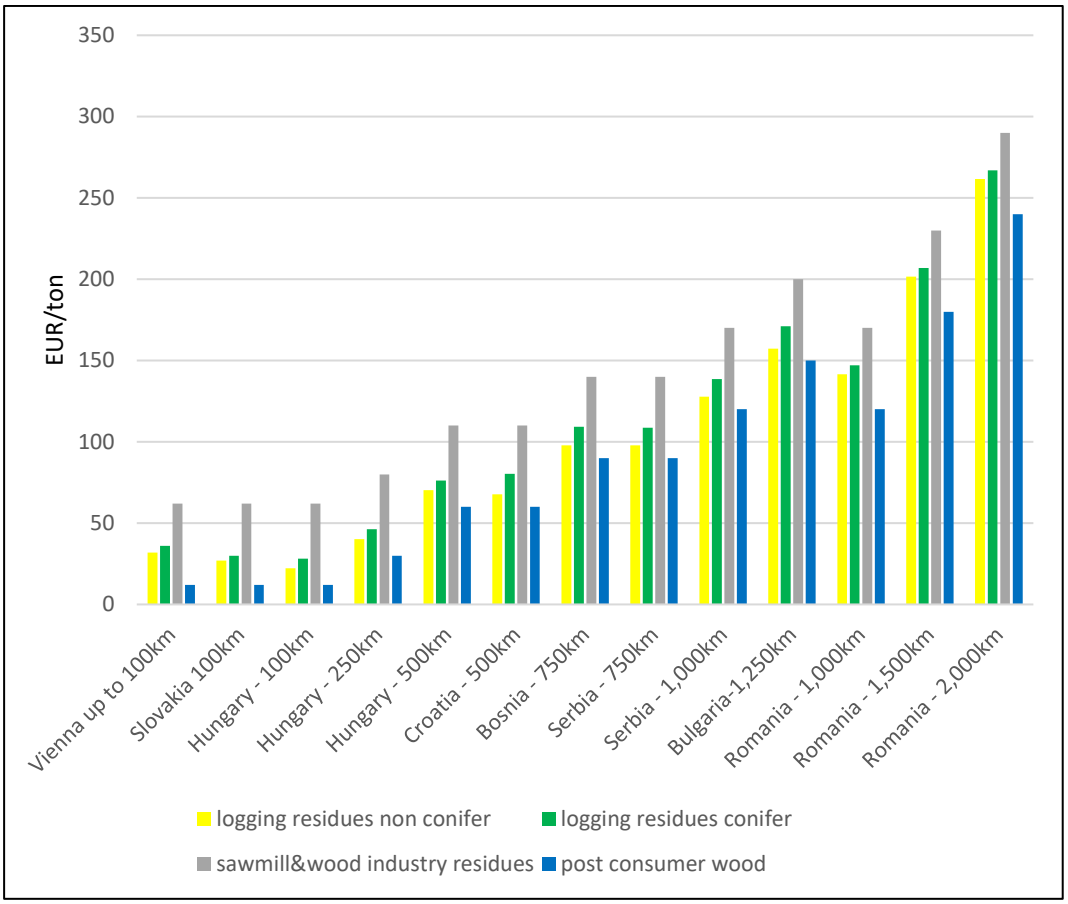



**Figure 22: Wood residues prices – delivered to Vienna by truck, (Malcherek et al., 2018).**

Summarizing this section, a number of different challenges exist for the transport of wood residues– from the low bulk density to different values and usability of different types of residues. Wood residues prices in Austria are slightly higher than in other countries.

As shown in Figure 28, IWT transport costs are higher than costs of all other transport modes until 1,000 km distance.

Railway is the most competitive form of wood residues transport above 100 km, while road transport is competitive below.

This shows the non-competitiveness of IWT for unprocessed wood residues.

To a certain extent, it can be competitive to ship wood residues by rail from locations in Slovakia and Hungary below 250 km distance to Vienna.

Finally, it is deemed competitive to transport wood residues by truck from points in Slovakia and Hungary below 100 km transport distance to Vienna. (Malcherek et al., 2018)

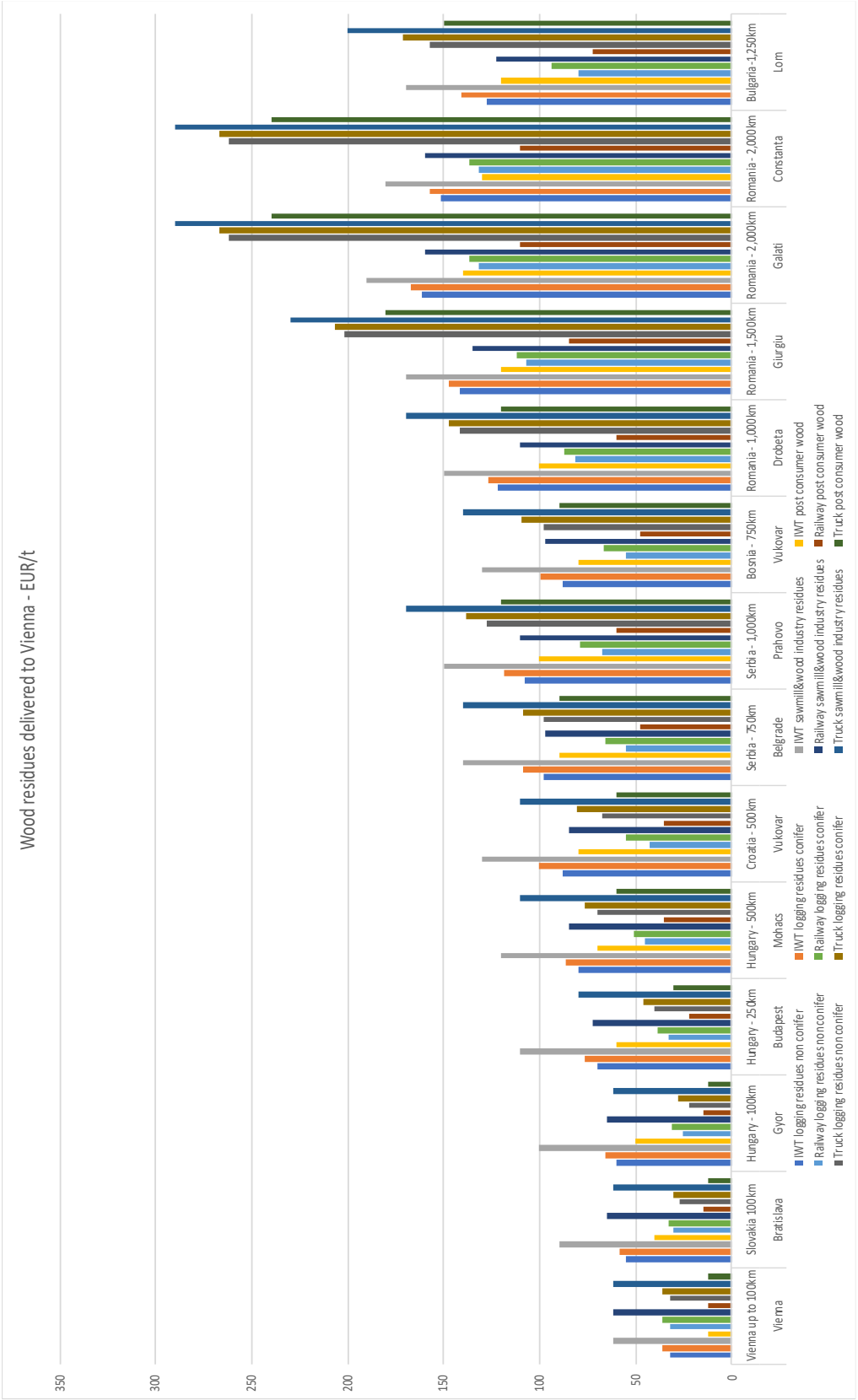



**Figure 23: Wood residues prices – delivered to Vienna by different transport modes (synopsis), (Malcherek et al., 2018).**

**Analysis of the Danube Inland Waterway Transport of Waste Wood products**

This section describes the detailed assessment of the inland waterway transport along the Danube, which is related to the transport of waste wood products or energy sources.

The Consultant has contacted the port authorities of Slovakia, Hungary, Croatia, Serbia, Romania and Bulgaria in order to obtain records on transport of wood waste (wood residues) on the Danube to/from these ports.

Recorded cargo flows of wood residues on the Danube

The Port authorities of Slovakia and Croatia confirmed that there was no transshipment of wood residues in their ports during the last five years. According to information obtained from the Hungarian Federation of Inland Ports, no wood waste handling is registered in Hungary. Responses from Romanian ports have not reached the Consultant until the moment of writing of this report.

Certain quantities of wood residues (materials for paper production) have been recorded in Bulgaria for 2015 and 2016. Providing detailed information as requested would however be "subject to agreement with the port operators since individual data are protected by law and are provided by Executive Agency Maritime Administration or by the operators themselves".

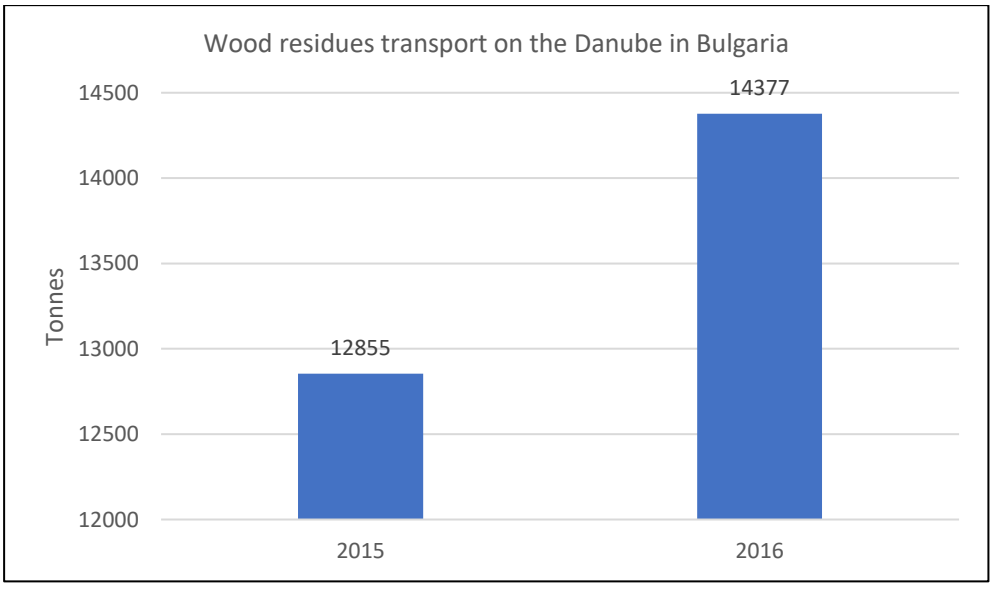



Figure 24: Transport volumes of wood residues in Bulgarian Danube ports, (Malcherek et al., 2018).

### 3.2. Demand for biobased raw materials

There is a comparatively strong demand in the vicinity of the port of Vienna for biobased raw materials, both for energetic and material use. Below-mentioned are the most important industrial actors in the region.

Biomass use has increased by 44% since 2005. Between 2005 and 2011, gross domestic consumption of bioenergy (including biogenic household waste) increased from 159 PJ to 229 PJ, or 44%. Wood is and remains the most important resource for the bioenergy market. 79%of the total biomass used in Austria in 2011 were wood (including lyes) in various forms. With a share of 27%, logs (firewood) are the most important biogenic energy carriers. In total, more primary energy was provided by wood chips, sawed products and bark (35%) than by logwood. Biofuels accounted for 10% of the gross domestic consumption of biofuels in 2011. This was followed by other biogenic solid fuels with 5.5%, biogas, sewage gas and landfill gas with 2.9% and biogenic waste with 2.5%. (Arbeitsgemeinschaft Biomasse-Nahwärme, 2011)

By 2020, biomass use in Austria could once again be increased by 25% to a total of 287 PJ. The prerequisite is that it is possible to mobilize the available potentials of 58 PJ from agriculture, forestry and timber as well as the waste sector. Around 52% of the development potential is accounted for by wood-based raw materials (including lye), 25% by biofuels, 18% by biogas, and 5% by other biogenic solid fuels. Without the mobilization of the raw material potentials outside the forestry and timber industry, biomass use can be increased by a maximum of 14%, as the further potential for exploitation from the forest is limited. Altogether, around 24,3 million solid m of wood were used in Austria in 2010. Of this, around 51.4% accounted for raw materials from the cascade use of wood (bark, sawed products, industrial wood, pressed products, lye). About 48.6% of the energy wood came directly from the forestry (firewood, wood chips) as well as from woody shrubs, shrubs, old wood and other sources. (Regio Energy, 2008):

Energy wood: energy production in Austria could be increased by 12% or 2,9 million fixed metres to 27,2 million fixed metres by 2020. However, this is only successful if the wood use in Austria is both in terms of material as well as in energy utilization, and rapid measures are being taken to mobilize the potential, especially in small peasants' forests. To this end, infrastructure in the forestry sector needs to be improved. Investments in the expansion of the forestry network are necessary. The ecological limits must be taken into account when using biomass. (Arbeitsgemeinschaft Biomasse-Nahwärme, 2011)

The stock of wood in the Austrian forest has exceeded the billions of fixed metres by the turn of the millennium. A decade later, it has already risen to 1,135 billion $cm^3$. At the same time, the forest area of Austria between the two past forest enterprises (ÖWI) has increased by 30,000 ha to 3,99 million ha.

As a result, Austria's forest share is 47.6%. The Federal Research and Training Centre for Forest, Natural Hazards and Landscape (BFW) assumes that even in case of an intensification of use, the supply in the small-scale forest will continue to increase, unless large-scale calamities lead to an overnight stay. The sustainable use of forests is laid down in the Austrian Forestry Act and has been practiced by generational family forestry for several hundred years. (Regio Energy, 2008)

Bioenergy Markets - Heat Market Dominated The final energy consumption of bioenergy has increased by almost 43% in Austria from 139 PJ in 2005 to 199 PJ in 2011. With a share of 80.8%,

the thermal market is the central market for biomass, followed by biofuels with a market share of 11% and green electricity generation from biomass and biogas with an 8.2% share. By 2020, the final energy consumption of bioenergy could be increased by about 25% to 249 PJ, if the available resource potential can be mobilized. In the year 2020 the thermal market with an expected market share of around 77% will be the dominant area of application for biomass. Biofuels are likely to have a share of 14% and green electricity generation from biomass and biogas with a share of 9%. (Regio Energy, 2008)

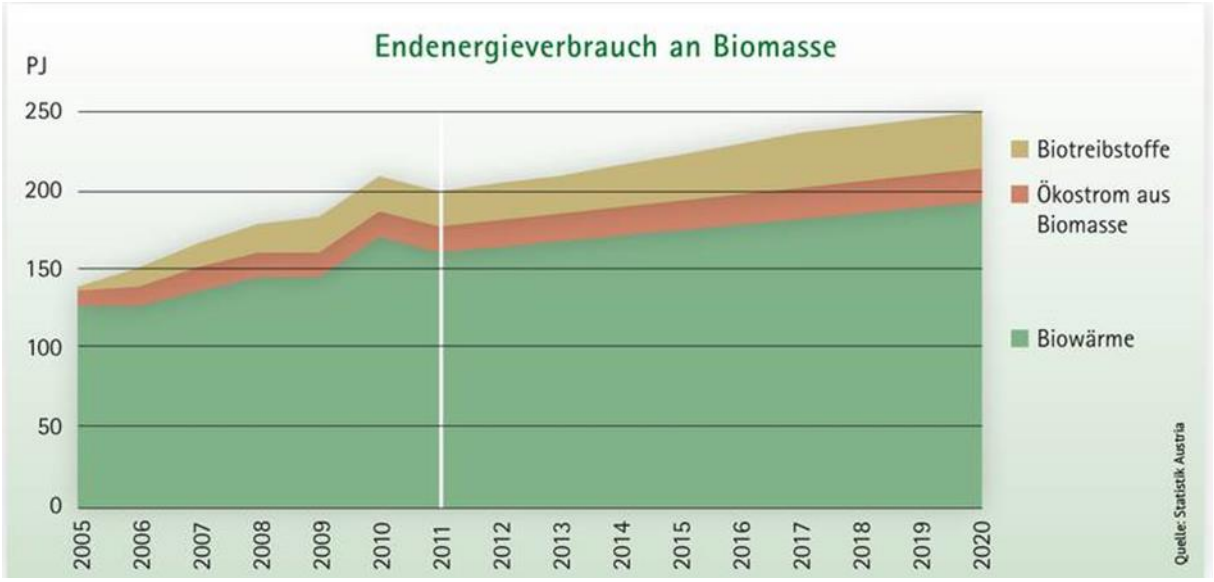



Figure 25: power consumption (Statistik Austria, 2017).

Pellet producers in the Danube region

In the ten Danube countries there are almost 300 pellet producers, most of them located in Germany. Austria, Bulgaria, Romania and Ukraine have between 30 and 40 production sites. The total production capacity of the Danube countries accounted for 8 mil t in 2008/2009 (without HR, RS, UA, MD).

Table 3: pellet production site in Danube region (Viadonau, 2016).

| Number of pellet production plants in Danube region | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| DE | AT | SK | HU | HR | RS | BG | RO | UA | MD |
| 97 | 34 | 20 | 20 | 3 | 8 | 39 | 37 | 38 | 3 |

The largest national production capacity has Germany and Romania with 2.6 mil t, followed by Slovakia with 1.4 and Austria with 1.3 mil t.

One of the biggest round timber suppliers of Austria is located at the port of Albern. He also supplies the biomass power plant in Simmering. it refers to its biomass from all over Austria and transport it to Vienna, mainly by road. Both are state owned companies. Unfortunately, they do not use the inland waterways. In the Vienna Region are 3 Biomass power plants located.

Their CORE BUSINESS

The Bundesforste offer the right wood supply for every customer: from sawn timber to biomass, to large deliveries of abrasive and pulpwood for the pulp and paper industry. (Österreichische Bundesforste, 2017)

About 80% of the timber sold is conifers, the other is hardwood. Spruce and sawn roundwood is the main branch of the Austrian Federal Forestry, which is mainly processed by domestic sawmills. (Österreichische Bundesforste, 2017)

### 3.3. Existing value chains, industrial and logistics capacities for energy biomass

**Best Practice Analysis**

Best practise analysis was focused in identification of efficient options for wood residues storage, wood residues and round wood transshipment and efficient inland water transport of wood residues and round wood. This analysis started with a survey questionnaires development for wood sector companies, which were previously identified within Deliverable 3.1.2: *Transnational inventory of biomass and bioenergy companies in the Danube corridor* in frame of Energy barge project. Also, an additional survey was attempted with transport companies, in order to acquire information about transport prices, with no official feedback.

Additionally, an analysis of woody biomass and logistic trade centres that handle and process roundwood and wood residues was performed. (Malcherek et al., 2018)

**Best practice analysis on efficient options for waste wood storage**

This section identifies existing market solutions in order to accommodate a lot of volume on a small area with as little investment as possible (e.g. boxes, floors). Using his experience on appropriate measures for waste wood storage, best practices were investigated in order to derive recommendations for proper storage of large volumes on small areas are presented.

Example of handling wood & wood residues: Biomass Logistic and Trade Centres

Biomass Logistic and Trade Centres (BLTC) are regional hubs linking wood supply from forest owners, saw mills and other wood producers with demand from bulk and small buyers. Their development started in Austria and Germany, but continued in Slovenia and other countries. Several EU projects have supported the BLTC development in Central and Eastern Europe, also in the Danube region. (Interreg Danube Transnational Programme Energy Barge, 2018)

BLTC's main benefits are deemed the provision of:

- dry wood fuels of required quality in any given moment;
- permanent and secure takeover of woody biomass in the region
- and selling the energy in fuel. (Biomass Trade Centre2, 2018)

Their supply, management, storage and logistics practices could be used as a best-practice example considering the fact, that they have developed most efficient practices related to the storage and handling of round wood and of wood residues. Examples elaborated in this study are the BLTCs in Leoben, Austria; St. Lambrecht, Austria; and Nazarje, Slovenia. (Biomass Trade Centre2, 2018)

Figure 26: Example pictures from BLTCs in Nazarje, Leoben and St. Lambrecht, (Malcherek et al., 2018).

Leoben BLTC was established in 2010 by Waldverband Steiermark GmbH. They are operating a 2.5 ha storage area for 18-24 months drying of round wood for high quality woodchips. Also different types of wood residues are procured and stored that are used for the production of low quality wood chips. In addition, Leoben BLTC produces and dries firewood. Transport and chipping services are subcontracted.

St. Lambrecht BLTC was established in 2011. Here, also a storage area with drying facilities is operated. In addition to trade of firewood and of wood chips, they run a biomass fuelled heat plant to sell heat to local farmers and to the Benedictine Abbey of St. Lambrecht.

Nazarje BLTC is owned by the company Biomasa doo. It was established in 2008 and their main business is to operate a combined heat and power plant and a municipal district heating system. In addition to a local wood pellets production, this BLTC supplies other woodchips users in Slovenia, Italy and Austria. (Malcherek et al., 2018)

Findings:

The most important element of a BLTC is the wood storage location. Most of the BLTCs have more than 2.5 ha of open storage space. The ground of the BLTC location should be paved.

It should be spacious enough in order to store the quantities of wood which are needed at least for the annual production. It must be considered that 18-24 months are needed to dry **round wood** naturally. This means to decrease water content from 45-50% to 20-25%, for the production of high quality wood chips. (Malcherek et al., 2018)

Also, storage space for **other wood residues** is needed. Wood residues can be stored under open sky on paved ground. In addition, this location needs natural air circulation and should not be close to water surfaces, in order to provide the best conditions for natural drying.

Apart from open storages, **covered sheds for wood chips** are also needed. Their major role is to keep the low humidity level of wood chips by protecting it from rain. Those sheds also need to have open sides for air circulation. Additional dryers for wood chips can be installed if needed. A few machines are required, and those can be owned or outsourced. Trucks with trailers for round wood transport are usually outsourced.

Wood chips are transported by trucks with walking floor trailers used for transport of other bulky materials. A main point for these trailers is their ability for automatic unloading.

Telehandlers are needed for manipulation at the storing site. Finally, wood chippers are used for wood chips production. They also can be outsourced or owned, depending on the business model and availability. Additional equipment can consist of elevators, blowers, splitters, firewood processors, etc., if needed. (Malcherek et al., 2018)


Figure 27: Images of Machinery and equipment usually used in BLTCs, (Malcherek et al., 2018).

**Best practice analysis on efficient waste wood / log wood transshipment**

Aim of this task is to identify infrastructure and (stationary or movable) superstructure requirements of trimodal (rail/road/IWW) waste wood and log wood handling and to propose optimized existing market solutions to be considered as best-practice.

Due to the scarcity of Danube ports handling waste wood and log wood, the Consultant had the opportunity to discuss the transshipment methods with operators only in Serbia. These experiences are topped up with own experience of Consultant's port expert, contacts with the operator "Zuidnatie b.v." operating logs and wood pellets in the Port of Antwerp (Belgium), as well as desktop research. Operators in Constanta were not responsive to the queries for experience sharing. (Malcherek et al., 2018)

Efficient transhipment of log wood

Log wood is usually loaded and unloaded with standard port cranes or port equipment, with the specific grab device, allowing for handling of several logs at the same time, depending on the diameter of the logs, lifting capacity of the crane and the volume capacity of the grab.

When loaded, logs are either loaded directly from wagons or trucks into the vessels, the crane loads several logs (or several dozens of logs) of agreed dimensions (diameter and length), unbundled in most of the cases, placing the logs so that their longitudinal axis is parallel to the longitudinal axis of the vessel or barge. Loading is done in rows of certain height and tiers – a first row is loaded from port to starboard side of a ship, followed by a next row (leaving minimum space between rows) along the cargo hold, then the next and the next, starting from the stern and bow section of the cargo hold at the same time, advancing towards the centre of the cargo hold.

After the entire surface of cargo hold is loaded with a number of rows, then the loading continues "in tiers" – next dozens of logs are loaded on top of rows which are loaded first. In order to prevent erratic rolling of logs in the cargo space, the crane needs to lower the grab full of logs all the way down so that the grab touches the previously loaded logs and then slowly open the grab so that logs can naturally fall on top of the logs previously loaded. In case of shorter logs (cut in such way to match their length with the width of the cargo space of a barge or a ship), they can be loaded with their longitudinal axis being perpendicular to the longitudinal axis of a barge or a vessel, in the so called "box loading" system. Barges can be loaded higher than deck level, provided that vertical metal bars are placed around the cargo hold, to ensure stability of the above-deck wood loads. (Malcherek et al., 2018)

Figure 28: Loading a ship with logs with 3 m2 log grab, (Malcherek et al., 2018).

When trains are loaded, logs are usually handled with grabs with the same or lower capacity than those used to load/unload barges and seagoing vessels. Train wagons are usually of flatbed type with vertical metal bars of ca. 2 m height, used to ensure the lateral stability of log loads. (Malcherek et al., 2018)


Figure 29: Loading trains with log grabs in the Port of Lübeck, (Malcherek et al., 2018).

Once loaded, logs are securely lashed.


Figure 30: Lashing of logs loaded on a train, (Malcherek et al., 2018).

Loading of trucks is similar to that of trains. Either port equipment or own (self-loading) equipment can be used for these purposes. Trucks for log transport have a flatbed cargo space and usually tow a flatbed trailer, both being equipped with vertical metal bars acting as sides of a cargo space, aimed at securing the lateral stability of the log loads.

Figure 31: Self-loading truck loading logs in the Port of Papenburg, (Malcherek et al., 2018).

For additional safety, logs are also lashed once the truck is loaded.

Efficient transshipment of wood residues

Wood residues are most frequently transported as wood chips and wood pellets and are usually brought to the port already as chips or pellets, although there are a few port operators in Europe which offer the wood chipping and pellet forming (e.g. ports in Finland and Sweden) as their value added services for this particular type of cargo.

Whether in chips or pellets, wood residues are usually loaded with:

- standard bulk grabs,
- loading conveyors,
- gravitational funnels,
- pneumatical (suction) unloaders, etc.

The most frequent way of loading wood chips or pellets is with standard bulk grabs, whereas wood chips are suitable for the so called finger grab or “orange peel grab”, while pellets are more efficiently handled with sand grabs or enclosed grabs. (Malcherek et al., 2018)

Figure 32: Loading a barge with wood chips with finger grab, (Malcherek et al., 2018).

"Orange peel" grabs can be inefficient, depending on the size of wood chips, especially with pellets, and such handling can be slow and subject to losses.

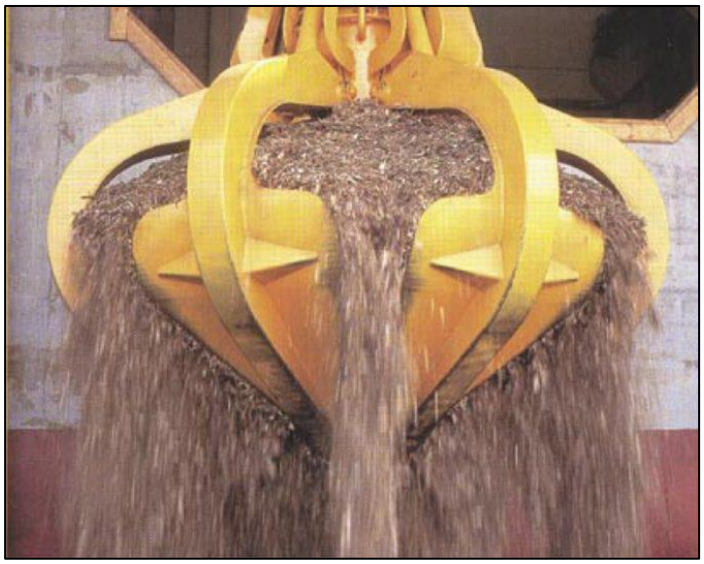


Figure 33: Inefficiencies of grab handling for smaller wood chips or pellets, (Malcherek et al., 2018).

In such cases, enclosed grabs are much more efficient.

Figure 34: Loading of chips and pellets with enclosed grabs (Biomass Trade Centre2, 2018).

If a vessel is loaded with loading conveyors, the conveyor is fed with the cargo by wheel loaders bringing the cargo from the storage area to the conveyor, or the conveyor is being fed by a truck. Most of these conveyors are fixed (they cannot move alongside the berth, from aft to fore section of the vessel), so the proper trimming requires additional equipment – usually a couple of bulldozers are being lowered into the cargo hold where they are used for cargo levelling from one side to another. (Malcherek et al., 2018)

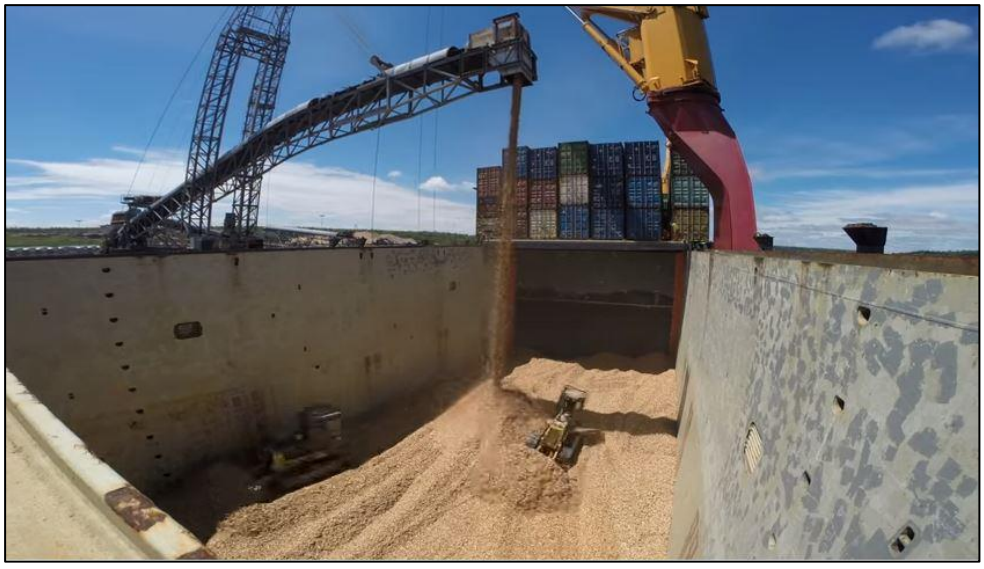


Figure 35: Loading of wood chips into a ship with fixed conveyor loader, (Malcherek et al., 2018).

Figure 36: Feeding a loading conveyor from a truck, (Biomass Trade Centre2 2018).

In case of gravitational funnels, the arriving trucks simply drive backwards on an elevated platform and unload their cargo into a funnel which is positioned above the barge which is being loaded (so no mobile equipment required in the port), whereas the gravity does the job.

In order to ensure the proper trimming of a barge, it is being moved back and forth, or a small bulldozer (Bobcat) is placed inside the cargo hold, where it levels the cargo from aft to fore side of the cargo hold. (Malcherek et al., 2018)

Figure 37: Loading of wood pellets with gravitational funnels, (Malcherek et al., 2018).

Pneumatic devices are used mostly for unloading of pellets from or from specialized wagons. In waterborne transportation, pneumatic (suction) unloaders are either fixed or mobile (i.e. it can move along the berth) and are very efficient when large quantities of suitable bulk cargo are unloaded at a given port.

Figure 38: Pneumatic suction unloading of pellets from a barge, (Biomass Trade Centre2, 2018).

Figure 39: Pneumatic unloading of bulk cargo from a specialized wagon, (Biomass Trade Centre2, 2018).

**Best practice analysis on efficient inland water transport of waste_wood**

This section shall identify optimized solutions for efficient IWT of waste wood, based on desktop research and surveys/interviews among suitable market players. Therefore, a list of market players, elaborated in the Deliverable 3.2.1 of the Energy Barge project has been utilized.

Wood transport: Survey at wood industry companies

The first case study is the company **Conimex AZ** from Niš, Serbia with wood trade as main business activity. Their experience with IWT operations dates back between 2011 and 2013.

They were loading beech round wood for firewood at the Port of Smederevo (Serbia) and shipped it to the port of Regensburg (Germany), while the roundwood origin was located maximally 100 km around Smederevo port. A total of 9,000 t was shipped in that period using self-propelled barges. The major benefit of IWT was to transport large volumes at once cheaply, whereas the major challenge was the road delivery to the port and connected logistical issues. Another special challenge is the inequality of log wood dimension: if dimensions are not fixed and wood is not stacked/sawed properly, less logs can be loaded.

Conimex stopped IWT based export in 2013 due to market disturbances. These were caused by a price decrease in Germany after storms and ice breaks in German forests. Even with the low transport cost of IWT, the import of Serbian round wood was not economically viable anymore.

Nevertheless, Conimex is still operating in wood harvesting and trade, but the company transports wood to Austria by railway, since rail stations are located closer to their current harvesting sites, whereas ports are located more than 200 km away. (Malcherek et al., 2018)

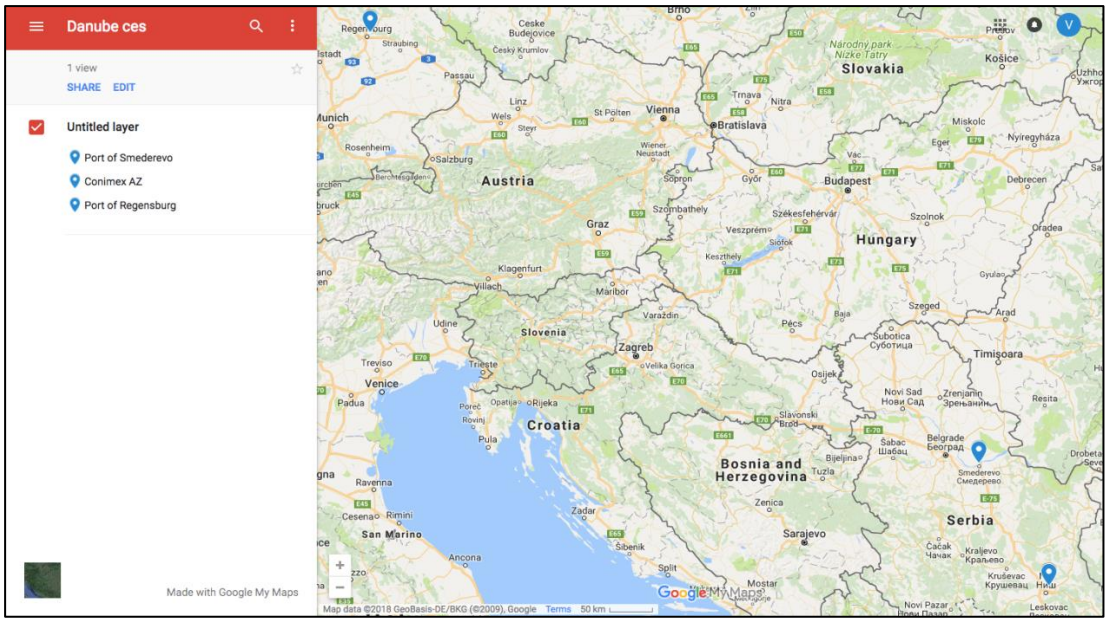



Figure 40: Map of Conimex AZ operations, (Malcherek et al., 2018).

Another business case analysed deals with the company Eko Furnir in Kovin (near Smederevo), Serbia, which is a member of Austrian Welde Group, producing plywood in Bulgaria and Romania.

The main business of Eko Furnir itself is the production of poplar veneer for plywood, while the plywood is produced in Troyan, Bulgaria.

Eko Furnir maintains IWT operations since 2008 and has experience in Danube barge transport for both, raw material and final products, while the latter has been stopped.

For IWT, over 10,000 t of round wood (poplar logs) were annually transported to the factory in Kovin using barges from free loading points at Tisza and Danube river, making use of self-propelled or pulled barges carrying 300-600 t per barge.

For Eko Furnir, the major benefit of IWT is the cheap shipping of large volumes at once, while the major challenge experienced is that barge transport is not applicable for veneer transport, as this product is too light-weighted and also requires closed barges.

For veneer transport, Eko Furnir uses road trucks for the distance of 500 km between the group-owned factories in Kovin and Troyan.

The company also trades and transports wood residues: From the residues of veneer production in Kovin, the wood chips are sold to Kronospan SRB chipboard factory in Lapovo (Serbia), using trucks for the transport of 70 km distance. (Malcherek et al., 2018)

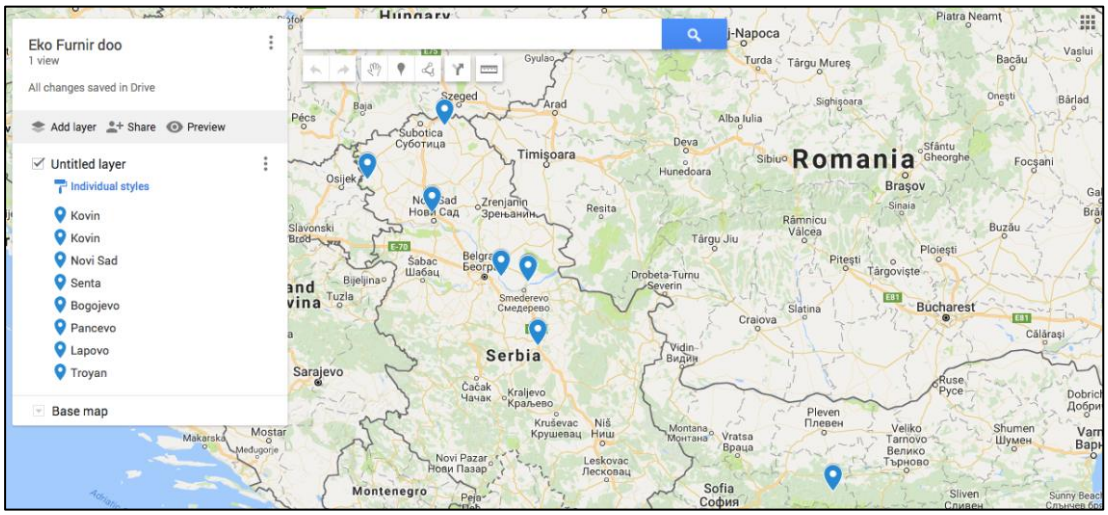



Figure 41: Map of Eko Furnir operations, (Malcherek et al., 2018).

The company Drvni Centar doo, Glina, Croatia is a member of Sherif Export Import group. Their main business is wood processing and trade. Drvni Centar is processing mainly hardwood and produces different types of planks, beams, boards and elements. They do not have experience with IWT. However, over 99% of their products are shipped in maritime transport to China, Egypt, Vietnam and other overseas countries. They are loading their products in the seaports of Rijeka and Raša / Istria, which are 200 km away from their production sites. Annually, Drvni Centar transports over 50,000 t, using exclusively closed 25-30 $m^3$ containers. The major benefit provided is the possibility to transport large volumes at once cheaply and to deliver far distances without special challenges. All raw materials such as round wood are transported by trucks, never by railway. Drvni Centar also has experience with other residues which are chipped and exported to Italy or sold as firewood locally. Finally, Drvni Centar also operates an own 1 $MW_{el}$ +4 $MW_{te}$

Combined Heat and Power Plant and uses residues for the wood chips production. (Malcherek et al., 2018)

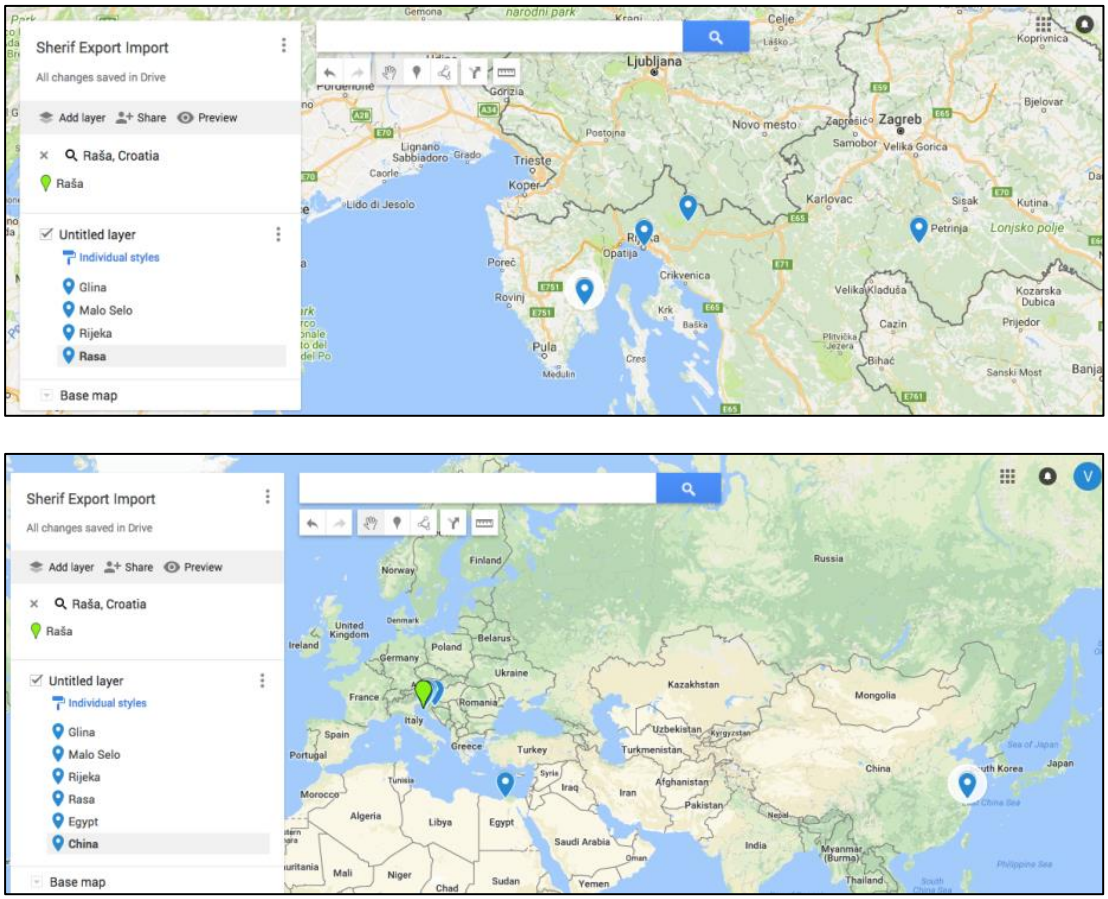



Figure 42: Map of Drvni Centar operations, (Malcherek et al., 2018).

The company Pilexim is located close to Bratislava in Slovakia. Their main business is the trade of wood chips and sawdust. Pilexim has no experience with IWT operations, as their products are transported by trucks and railway from sawmills in Slovakia to buyers' destinations in Austria, Slovakia, Czech Republic and Hungary. Their customers are heat and power producers, as well as producers of wood pellets and chipboards. Usual road transport distances do not exceed 200 km, while maximal rail transport distance is 350 km. For road transport, Pilexim uses vehicles with walking floors of 90 $m^3$ or 25 t volume. (Malcherek et al., 2018)

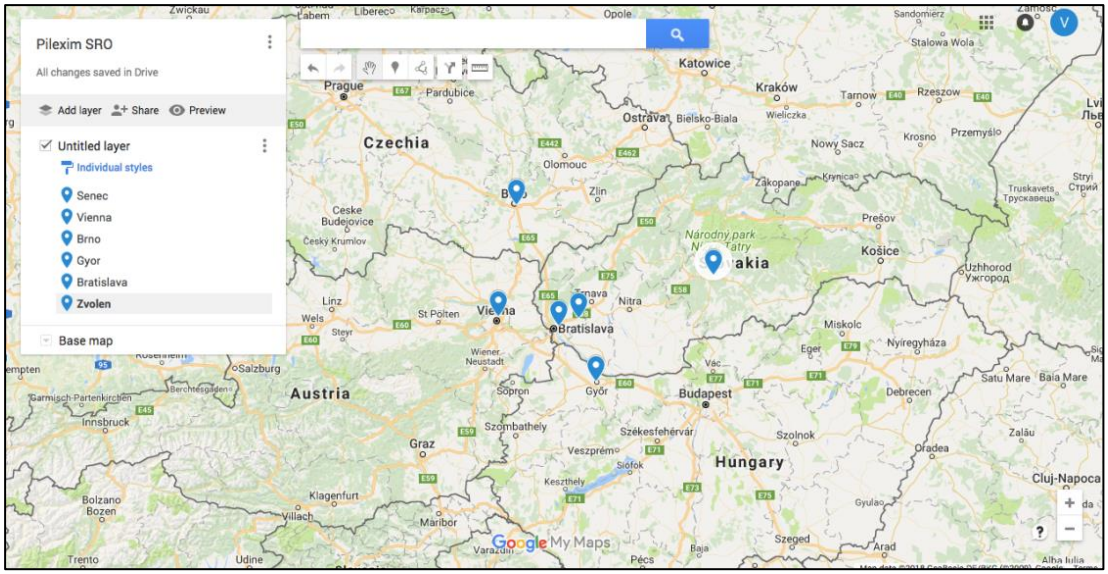



Figure 43: Map of Pilexim operations, (Malcherek et al., 2018).

Worldwide inland waterway transport of wood waste

This section is based entirely on Consultant's port expert experience and desktop research as no Danube shipping company responded to the query on inland waterways transport of log wood and wood residues.

Wood chips have never been transported by barges on the Danube, according to the available information. This is due to the fact that wood chips are not very popular cargo for barges due to their inability to withstand high prices of barging which, in turn, is caused by very low stowage factor, ca. 0.25-0.35 t per cubic meter. This means that wood chips require quite a lot of space for a very low weight.

Very important is the moisture content of the wood chips. In Northern Europe moisture of the fresh cut wood chips is about 43-4%. After hot summer in September moisture may decrease to 35-36%. After the winter, in spring the moisture raises up to 48-5%. Wood chips which have been laying long time at open storages and have been exposed to rain may have moisture content of up to 60%. The high moisture content may create a situation that a vessel is fully loaded, but the total marketable energy amount of the whole cargo carried by the ship will be very low. In other words, the cost of transportation will be much bigger than the value of the energy transported by the ship. The economic result of such deal may be drastic.

Another question besides the transportation of water is the carrying of air. Bulk density of the wood chips is very low, only about 250-350 kg per t, depending on the moisture content. The volume of the vessel has to be big enough to permit to load enough wood chips to get a positive economic result. Freight cost for wood chips transportation is paid on a "lump sum" base, which means that the charterer has to pay the whole freight independently on the quantity of the wood chips which will be loaded. Economically good results may be obtained when using bigger vessels or, barges with high walls in order to load more wood chips. Important is also trimming of the wood chips, which is performed by using bulldozers during the loading procedure. Trimming may increase the weight of the wood chips cargo by 15%.

Barges with high walls are frequently seen on inland waterways in Asia and North America, but very few of them (if any) have navigated European inland waterways (due to underpass height restriction of 5.25 m). (Malcherek et al., 2018)

Figure 44: Barge loaded with wood chips on the Mississippi River, (Biomass Trade Centre2, 2018).

Figure 45: Wood chips barge on Ohio River, (Biomass Trade Centre2, 2018).

Taking into account all analysed aspects, especially the prices for inland waterway transport discussed earlier in this report, there is no way of efficient transport of wood chips on inland waterways in the Danube area.

Physically, the transport can be done in hatchless barges, but it is simply not economical. Just as an example, a load of 5,000 t of wheat can be loaded in 4-5 standard barges used on the Danube, while the same quantity of wood chips would require 25-30 barges.

Wood pellets, however, form a somewhat different issue. Due to their higher stowage factor, wood pellets are transported in barges. Barges for transport of wood pellets are standard barges used for transport of weather sensitive cargoes, such as wheat, corn, soy beans, etc. When transported, wood pellets need to be inside cargo holds covered with hatches in order to ensure the water tightness and to protect the pellets from accumulating any excessive moisture along the way. (Malcherek et al., 2018)

Figure 46: Barge loading with wood pellets in the Port of Dordrecht, (Biomass Trade Centre2, 2018).

### 3.4. Currently available infrastructure at the port, technical conditions

In this sub-chapter, a focus is put on the available infrastructure equipped for biomass handling, transshipment and storage.

The following technical equipment is located in the Break Bulk area of the port of Vienna. (pictures are shown in the survey)

- three Conveyor belts
- Mobil Crane with various attachments (Lifting capacity 84 t), multimodal usable
- Small mobile Crane with various attachments, multimodal usable
- Fork-lifter (lifting capacity 8 t)
- Wheel loader

- E-Crane (picture), multimodal usable
- Mobil Crane: Lifting Capacity 84 t, Multimodal Usage, Attachments (Container Spreader, Scope)

## 4. Development issues

The goal of the port of Vienna is implementation of innovation, by conveying small & medium enterprises and start-ups, drive-forward cooperation and benefit from implementing intern innovation. The strategy is based on three pillars, the logistics Lab, business relocations and city logistics. The logistics Lab relies on knowledge development, research and close cooperation with start-ups. For business relocations we encourage the settlement of innovative companies at the Port of Vienna, who could benefit from our location and network. The aim of the Port of Vienna in the field of City Logistics is to act as a business accelerator, contributing to efficient and sustainable land use and to support the sectors e-mobility as well as urban logistics.

The port of Vienna itself shall run by example and include, where economically viable and sustainable, "green" solutions regarding port infra- and superstructure. Therefore, the port of Vienna would like to suggest development ideas that build on three kinds of project pillars to transform the port of Vienna into a biomass friendly City Hub.

Three Pillars:

- Innovation
- Investment
- Business Relocations

**Development 1 – Innovations / Investments**

Encouraging and supporting companies processing biomass along the value chain and related value chains to settle in the port via active business development strategies and measures to improve the port's suitability and attractiveness regarding these companies', needs feasibility Study and project ideas like the Rumplmayr project.

Possible Project implementation 2018 – Port of Vienna in cooperation with the Port of Enns and the private entity Donausäge Rumplmayr

Business Case: Esterhazy Wood from Eisenstadt to Vienna by truck – transshipment on Barge – transport to port of Enns by inland waterway, Danube

Issue of the Business Case: paired transport operations are not possible, the trucks will leave empty for Eisenstadt, which increases the price of the haulage.

Challenges: Finding a truck trailer which is suitable for several types of goods. This project would be an opportunity for the Vienna region to reduce truck transports.

Investment

In order to be able to manipulate these goods optimally, the port of Vienna additionally need a suitable forklift truck. Therefore, we want to buy a specialized biomass fork lifter to be able to handle these goods.

• 12 t forklift truck with a timber gripper: E-crane and mobile crane have a limited range; therefore, a lifting device is needed to transport the round wood to the storage location

• Forklift handling is used as a handling aid for bulk material (wheat, grain, forestry material, old wood), for example, a forklift truck is lifted into a barge to support the crane during the loading process

• 12 t forklift Truck with the right component to fill big bags; good = pellets

• Since the business cases do not require permanent acquisitions, the port of vienna would like to build up an all-rounder in the area which guarantees flexibility.

Estimated costs = €80,000

**Development 2 – Business Relocations / Investments**

Install a bioenergy Cluster in the port of Vienna – close the circle with more woodworking industrial enterprises. The Bundesforste Austria are directly located in the port of Albern and the biomass power plant in Simmering, which is in the Hinterland of the port of Albern. In between is enough space to settle down woodworking enterprises.

The long range strategy of the port of Vienna is to settle down companies and create a strategic cluster of consumer goods, for example biomass products. Customer loyalty is to be increased by manipulating the goods for our customers. Therefore, the port of vienna want to change the planned small scale investments (timber grabber, etc.…), into a conveyor belt, which is produced to unload and transport the new generation of wagons.

Project Development Old wood chips

Old and deadwood as a new transport and processing branch – Development takes already place. The port of vienna could develop in conveyer infrastructure for faster transshipment operations. Old wood chips are a good basic raw material for the processing industry.

Investment

Conveyor systems are necessary to be able to unload and load modern/next generation wagons.

- Mobile unit with power supply generator
- Moving along the stationary train
- Designed for approx. one complete train per day
- Radio remote control
- Estimated costs = €90,000

Assuming that the green electricity law isn't extended, a more efficient supply of power plants must be created. This could be the chance for the port of Vienna to develop a more favourable transport concept by means of inland shipping.

One of the biggest round timber suppliers of Austria is located at the port of Albern. He also supplies the biomass power plant in Simmering. It refers to its biomass from all over Austria and transports it to Vienna, mainly by road. Both are state owned companies. Unfortunately, they do not use the inland waterways. In the Vienna Region are 3 Biomass power plants located. The company mainly uses the transport modes road. The reason for that is that gradually freight stations are closed. The fact that the company is settled down at the port of Albern, creates a good basis for a possible partnership, or the development of a sustainable logistics concept.

Involved Partners:

- Inland Ports for example the Port of Enns
- Biomass Power plants and its Suppliers – for Example the Biomass Power Plant Simmering and the Österreichischen Bundesforste
- Biomass processing Industry
- Logistic Service Providers specialized in agricultural and forestry products
- Shipping companies

Regional Case Study

ENERGY BARGE will compile a set of regional case studies assessing the cases potential for integrated biomass and bioenergy production. Special attention will be given to the incorporation of Danube logistics and port locations. The interviews done in WP4, conducted in the field of biomass helped us to find suitable and possible ideas for a study. We will organize a group meeting and discuss what would be most helpful in terms of sustainable establishment or more efficiency in transporting biomass. Estimated Costs = €30,000

**Legal Framework conditions of the waste wood goods and of export**

General

This section should describe potential legal and documentation issues related to the export resp. import of waste wood resp. wood residues. Note that this section does not have the format of a legal expert statement, but is made to map the broader framework of norms to be considered in business cases. Thus, the following section compiles the legal norms applicable (EU Timber Regulation, EU Plant Protection Directive, incl. the phyto-sanitary controls etc.), the Certificates and Chains of Custody and the issue of hazardous materials in waste wood. (Malcherek et al., 2018)

Legal norms applicable

Coinciding EU legislation regarding the energetic and material utilization of waste wood and timber is the following:

- Regulation (EU) No 995/2010 of the European Parliament and of the Council of 20 October 2010 laying down the obligations of operators who place timber and timber products on the market (**EU Timber Regulation**)
- Regulation (EC) No 1013/2006 of the European Parliament and of the Council of 14 June 2006 on shipments of waste (**EU Waste Shipment Regulation**)
- Council Directive 2000/29/EC of 8 May 2000 on protective measures against the introduction into the Community of organisms harmful to plants or plant products and against their spread within the Community **(EU Plant Protection Directive)**

Important for Austria is:

- the Austrian Ordinance on Recycling timber (Gazette BGBL II Nr. 160/2012);

A crucial point is, whether and which kind of waste wood is considered to fall under the definition of waste (something to get rid of it or which is obvious waste). Waste wood under this study is perceived as secondary raw material and thus does not fall under waste definition.

Austrian Ordinance on Recycling timber (Recyclingholz Verordnung)

The objectives of this Regulation are:

- ensuring that suitable waste wood in the wood-based products industry is recycled without harming people or the environment;
- ensuring that the use of waste wood does not pose a higher environmental risk than a comparable primary raw material or a comparable product made from primary raw materials;
- avoiding accumulation of pollutants in the product cycle;

- promoting source-based sorting, processing and recycling of suitable waste wood in the wood-based panel industry.

This Regulation shall apply to (1) Owners of plants for the production of wood-based materials, (2) waste producers and collectors and (3) authorised experts and institutions.

Important is:

- Waste wood provided with halogen-organic coatings may not be recycled in the wood-based panel industry without prior removal of the coating.
- Waste wood which, as a result of chemical wood treatment, has hazardous properties in accordance with the Waste Catalogue Ordinance or which has been treated with particularly hazardous substances or which, due to its original purpose of use, suggests such contamination, shall be collected and kept separate from the fractions suitable for recycling and may not be recycled in the wood-based panel industry.
- Waste end for recycled wood : If recycled wood products meet the requirements of this Ordinance, recycled wood is not anymore defined as waste, what is to be documented in a declaration resp. a valid assessment certificate to be sent to the relevant Austrian Ministry.

Future amendments of this Ordinance may prohibit the energetic use of recycling wood. Already now the dumping of wood in landfills (as wood has a total organic carbon content >5 mass %) is prohibited.

### 4.1. Analysis of future requirements and demand

Due to the situation described in the previous section, the following analysis only focuses on future requirements the port of Port of Vienna faces with respect to currently known bottlenecks, requirements in the context of storage and handling options and for biomass feedstock.

Besides these already existing connections and infrastructure, the strategic goal of the port of Vienna is to further extend and diversify the biomass freight being transhipped in the port for energetic purpose– mainly by settling companies using and processing these kinds of feedstock in the port. To do so, a specific business development strategy and active customer acquisition are part of the port management and shall be further strengthened in the following years.

We do transshipments of Biomass like round timber, old wooden chips and all kinds of agricultural goods. It is not necessarily a commodity which is burned in a power station. The port of Vienna and its transport branches is not competitive in this case. We also do not have the technical infrastructure like silos or a fork-lifter with specialized equipment. But we are competitive in all cases where the inland waterways are involved. Unfortunately, we face one big problem: There is enough wood on the Austrian market and an import from other countries connected with the transport is currently not profitable.

The transportability is given. There aren't any issues in kind of transportation to the port of Vienna and combined transshipments from our side.

Currently present biomass transport:

- Old wood Fundermax – Departure Germany

Old and deadwood as a new transport and processing branch – Development takes already place. We could develop in conveyer infrastructure for faster transshipment operations.

The conveyor systems are necessary to be able to unload modern/next generation wagons. The port of Vienna is already handling such business transactions.

- Round timber Alfons Köster – Destination China

Round Timber - For a customer, we stuff round wood into containers, which are then transported to an ocean port and shipped overseas

- All kinds of agricultural products like grains

The port of Vienna has a special food approved warehouse, which is divided into six boxes. Most of the time it is used up with agricultural products such as wheat and cereals

Main Challenges:

- Domestic cheap wood price
- Closures of freight terminals
- Awareness Raising for the mode of transport

The biomass sector does not impose any special requirements on transport modalities! Clearly, the generally known challenges the waterway transport branch faces also apply for the port of Vienna and the companies handling and processing biomass. Especially low tides have an influence on the travel time. The Viennese power plants do not have any limitations in their storage capacity, which means they are not necessarily dependent on regular deliveries.

The set of these requests indicates a clear rising demand for industrial sites for bioeconomy projects which require a suitable site portfolio including logistics infrastructure and storage, competitive feedstock availability, utilities in place such as steam, as well as favourable and attractive living conditions. This in turn corroborates the assumed additional demand of trading, transhipping and processing companies, both already settled and interest in settling, for versatile options for short and medium term storage of biomass cargo, both inbound and outbound.

### 4.2. New technological solutions foreseen

**Proposals for next steps**

As requested, the Port of Vienna management could additional follow the following actions:

- To increase contact with potential business partners at trade fairs, city networks and in research projects.
- To permanently or regularly observe the market: to establish Price Alerts, when critical prices benchmarks are achieved.
- To clarify and define the most demanded biomass/wood types among the Port of Vienna's potential local clients.
- To share the Pre-FS with other stakeholder in order to initiate further case studies.
- To consider a Ports Supply network, with other inland ports, being feeders resp. consumers, incl. Maritime ports and overseas transport.

**Proposals for further Investments**

As requested, the Port of Vienna management could additional follow the following actions:

- One Result out of the market observation is to constantly invest in port infrastructure. The Best Practice analysis shows the necessity of a high quality Infra- and Suprastructure. Therefore, to increase the supply chain efficiency it is highly recommended to purchase a conveyor belt, which is not present yet in the Port of Vienna.

In response to the market analysis cited in the previous chapter, the Port of Vienna decided to buy a conveyor belt. We hope that this investment will increase our demand for our core services. In addition, we were forced to make this investment, as the wagon fleets are converted to the new generation and we have not been able to serve them till now.

Project Development Old wood chips

Old and deadwood as a new transport and processing branch – Development takes already place. We could develop in conveyer infrastructure for faster transshipment operations. Old wood chips are a good basic raw material for the processing industry.

### 4.3. SWOT analysis on biomass logistics

In the following table, an assessment the current and future performance of biomass logistics in the port of Vienna with a focus on wood and woody biomass residues is provided.

Table 4: SWOT analysis biomass logistics port of Port of Vienna.

| | Strengths | Weaknesses |
|---|---|---|
| Infrastructural connections of the port | - Proximity to Schwechat International Airport<br>- Good rail, road, water links<br>- Access to 3 TEN-T corridors: Rhine – Danube corridor, Baltic – Adriatic corridor, Balkans-/Eastern-Med corridor<br>- IWW: connection to ARA ports and Constantia<br>- Competitiveness where inland waterways are involved | - Simmering refers to its biomass from all over Austria and transports it to Vienna, but mainly by road. Such state-owned companies not use IWW |
| Technological background of the port | - Trimodal port (water, road, rail)<br>- Largest free port in Austria- modern, large warehousing zone and harbour area in between A23 ring road and A4 east motorway<br>- 3 large cargo terminals: Freudenau (cargo handling), Albern (building materials, agricultural and steel products, 5 grain silos 90,000 ton capacity, most important grain handling location in Eastern Austria), Lobau oil terminal<br>- Break bulk area of the port of Vienna<br>- 3 conveyor belts<br>- Mobile crane with various attachments (lifting capacity 84 t), multimodal usability (container spreader, scope)<br>- Small mobile crane with various attachments, multimodal usability<br>- Fork-lifter (lifting capacity 8 t)<br>- Wheel loader<br>- E-crane, multimodal usability | - No silos, no fork-lifter with spec. adapter or equipment<br>- No conveyor belts for loading and unloading the new generation of Wagons<br>- The port management itself does currently not offer extensive and versatile storage options for biomass products (warehouses, silos, roofed areas) |

| | | |
|---|---|---|
| Supply side of biomass industry | - Port of Albern: one of the biggest round timber suppliers, supplying the biomass power plant in Simmering.<br>- The Alpine regions have high biomass potential forestry areas.<br>- Region of Vienna is rich at sugar beets and oil seeds fields and almost a full coverage of grain cereal cultivation. agrarian farming regions in Eastern Austria<br>- Viennese Forest covers 135,000 ha, 70,000 ha (52%) is forest<br>- 67,000 ha Biosphere park Wienerwald – one of the largest contiguous beech forest areas in Europe<br>- 25 forestry companies (beach and oak, oak hornbeam, high-yield forests, small-scale meadows and black alder forests, regional specialties: black pine forests, warm-growing downy woodlands, summit ash forests)<br>- Forest ecosystem services: wood production, nature conservation, carbon storage, recreation, habitat certification<br>- Theoretical exploitation of potential of the studied beech and oak denominated stocks is about 12-20% contrast to previous forestry use depending on the age of total biomass.<br>- The values refer to oak and beech forests with an age of more than 80 years and a stock between 400 and 600 $m^3$ / ha.<br>- Approximately 8-10 (5%) to 16-20 (10%) trees per ha of forest area are to be available as dead wood / old wood as well as old wood contenders depending on the stock (supply 400 to 600$m^3$ / ha). | |
| Demand side of biomass industry | - Austria is the 4th largest pellet producer in the Danube region with 1.3 million tonnes annually<br>- Approx. 50-60,000 households and institutions are provided with biomass based electricity and heat in the region (including Simmering forest biomass power plant) | - operations are not involved in the supply of the biomass power plants in the vicinity of the port |
| | **Opportunities** | **Threats** |

| | | |
|---|---|---|
| Infrastructural connections of the port | - Modal shift shall be promoted, since 95% of transport takes place by trucks<br>- Building up a Woodworking Industry Cluster in the port of Albern or Freudenau<br>- build multipurpose infrastructure | - Low tides have an influence on the travel time<br>- Closures of freight terminals<br>- Transshipment Speed in the high and heavy cargo Area<br>- Space Shortages = Bottleneck |
| Technological background of the port | - among the three specified terminals, Lobau serving vessels with oil could be developed as the market share of biofuels increase from the current 8% to the estimated 9% by 2020 and this demand for technologically well-equipped port services occurs<br>- The Viennese power plants do not have any limitations in their storage capacities, which means they are not necessarily dependent on regular deliveries | - |
| Supply side of biomass industry | - Wood supply is the core business in Austria: wood is used by sawmills and the paper industry. opportunity is to have bigger share in the energy biomass industry and less in the paper industry | - According to the existing rules, a power plant is only promoted if the biomass is provided within a radius of 60 km |
| Demand side of biomass industry | - 3 Viennese biomass power plants will mean a huge demand in the future too. | - The entire market is unpredictable, since the Green Electricity Act in Austria applies only to 2019 |

## 5. Project description

In response to the market analysis cited in the previous chapter, the Port of Vienna decided to buy a conveyor belt. We hope that this investment will increase our demand for our core services. In addition, we were forced to make this investment, as the wagon fleets are converted to the new generation and we have not been able to serve them till now.

Project Development Old wood chips

Old and deadwood as a new transport and processing branch – Development takes already place. We could develop in conveyer infrastructure for faster transshipment operations. Old wood chips are a good basic raw material for the processing industry.

Investment

- Conveyor systems are necessary to be able to unload and load modern/next generation wagons.
- Mobile unit with power supply generator
- Moving along the stationary train
- Designed for approx. one complete train per day
- Radio remote control
- Estimated costs = €90,000

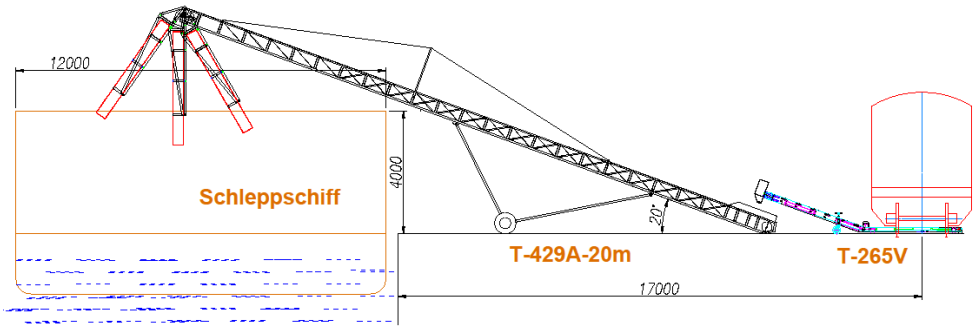



Figure 47: Conveyor Belt

### 5.1. Aims of the development

Overall, as described above, the main aim of the development project under review is to improve the port's overall attractiveness in terms of services and infra/superstructure provided. The port shall be equally appealing to currently existing clients from the biomass and bioenergy value chains (suppliers, traders, logistics service providers, processors, end users) as well as function as a site advantage for project developers.

This main aim can be specified as follows into a set of sub-objectives:

- Serving currently unmet demand of current and potential clients with additional service offers in a restricted manner in the short to medium-term as long as greater port expansion has not taken place
- Providing input for the greater port development plan and the Vision 2020
- Widening the currently restricted client and cargo portfolio towards wood-based supply- and value chains
- Re-attracting wood-based cargo into the port
- Encouraging a modal shift in favour of IWT
- Further improving the port's and region's profile as a model region for the energetic and material use of biomass.
- Establishing a broader set of infra- and super-structural site advantages in the competition for bio economy investment projects
- Re-attracting the Viennese Region for Industrial Branches

### 5.2. Definition of development needs

The analysis above has shown that developing additional machinery for woody biomass at this stage mainly serves as an intermediary solution to serve existing demands for wood transshipment and to cater potential new settlers looking for additional machinery solutions to reach the Viennese region.

The following needs have to be addressed by the development project based on the demand analysis:

- Suitability for break bulk, residues material & wood chips
- Location at quay to facilitate loading and unloading of vessels
- Accessibility by road and rail for multimodal transshipment
- Availability of mobile coverage solutions
- Accessibility/Usability for multiple users
- Availability of suitable handling equipment
- Training of the employees who operate the device

### 5.3. Definition of planned products/services

The development project shall offer a set of services.

These are:

- transport of all kinds of bulk goods
- trimodal cargo handling of all kinds of bulk goods
- The conveyor belt can be paid hourly depending on the project, or rented permanently
- For every business model, the port of Vienna is the operator (no external employee is allowed to operate the machine)
- Possibility of unloading the latest generation of freight trains

### 5.4. Target group/stakeholders

As described above, a number of different actors have expressed transshipment need for biomass material, mainly log wood and wood chips. These actors are the potential customers of the storage area and thus can be described as primary target group.

Generally speaking, the following sub-customer groups can be identified – these can be both SMEs as well as larger enterprises in the field of bio based industries and bioenergy as defined by the project:

- Private transshipment and logistics companies (transport, handling, storage) commissioning for their clients
- Wood suppliers
- Wood traders
- Wood processors
- Wood end users

The conveyor belt can be used trimodally, so it does not make a difference which transport mode is used for the biomass

Besides the main target group, being the customers, a set of additional stakeholders needs to be identified, considered and involved at specific stages of the potential project development, such as political advocacy.

All other logistics service providers settled in the port of Vienna which are currently not active in wood logistics and transport have to be considered as well since they might enter into this business segment once suitable infrastructure is available. Therefore, these actors also need to be included in a deeper market demand analysis. They depict the group of SMEs and enterprises from the Danube logistics sector.

### 5.5. Location, site

As has been defined above in the needs assessment, the machinery needs to have trimodal accessibility, meaning that it has to be located directly at the quay as well as with connection to the rail tracks. As can be seen in the figure below, all current quay areas are built on and in

possession or utilization, respectively, by the port management and/or private transshipment companies.

In the red markings, the expansion measures as foreseen in the port development plan being drafted are indicated.

General cargo and bulk cargo as well as project shipments are transshipped at the Port of Freudenau. Container transshipments are carried out by the subsidiary WienCont at Freudenau. The Port of Freudenau also serves as a transport hub for agricultural products, building materials and steel. High & heavy loads are also handled at the Port.

Criteria:

- Bulk cargo/general cargo
- Crane for handling up to 84 t
- Storage boxes, bulk cargo warehouses with 44,000 $m^3$ capacity, raw material warehouses with 3,000 $m^3$ capacity, outdoor storage space
- GMP+ certified
- Conveyor belt systems, excavators/dredgers and wheel loaders may be used according to individual requirements
- Loading silo for bulk cargo
- Unloading gutter for bulk cargo wagons
- Weighbridges, rail connection
- Loading/unloading of cargo to/from trucks, railway wagons and ships
- Transshipment of Big Bags by truck, rail & ship
- Loading of silo trucks

The red marking in the following pictures shows the port of Freudenau with the business unit break bulk and heavy goods. In this area, the conveyor belt will be used and placed on the quayside, which is shown by the right picture. Lengthwise, there are track systems on the quay, which the E-Crane needs to move. The hall in the middle on the right picture with the white roof will become the shelter for the conveyor belt, so that it is not exposed to the weather, or it can be optimally maintained

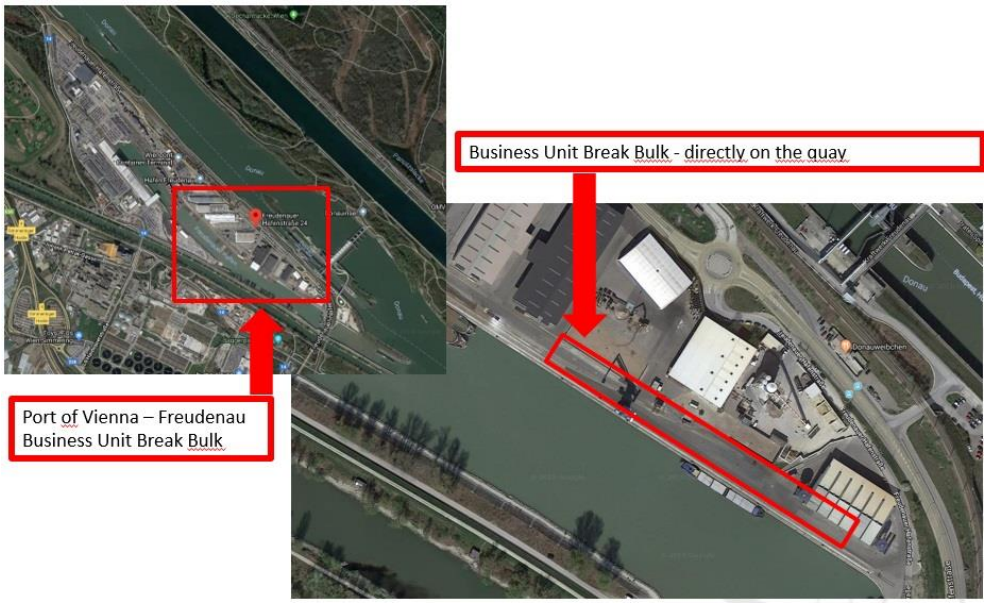



Figure 48: Location of the Conveyor Belt in the Port of Vienna.

## 5.6. Technical parameters/capacities

Table 5: Offer (own visualization).

| | | | Fa. Alexkft | |
|---|---|---|---|---|
| Conveyor | Description | Number | *Price* | *Unit Price* |
| **Mobile Conveyor - 20m** | Achsabstand: 20,000mm | 1 Stk. | € 22,850.00 | |
| | Leistung: 200-250 t/h<br>Gurtband: Gummi, drei-lagig, V-Profil; Höhe:25mm<br>Gurtbandbreite: 800mm<br>Motorleistung: 7.5 kW<br>Bandgeschwindigkeit: 3.15 m/s<br>Winkelverstellung mit Motor 0.75 kW<br>mit Fahrgestell u. Anhängerkupplung | | | |
| | ***Equipment:*** | | | |
| | Swing-Oberteil mit Motoantrieb 0.75 kW<br>Auslaufrohr Durchm. 350mm;<br>Länge 5m | 1 Stk. | € 2,250.00 | |
| | Stufenlose Geschwindigkeitsregelung des Gurtes 1,5 - 3,0 m/s | 1 Stk. | € 1,150.00 | |
| | Trommelmotor gummiert | 1 Stk. | € 680.00 | |

| | | | | |
|---|---|---|---|---|
| **Mobile Conveyor - 15m** | Achsabstand: 15,000mm<br><br>Leistung: 200 - 250 t/h<br>Gurtband: Gummi, drei-lagig, ohne Profil, glatt<br>Gurtbandbreite: 800 mm<br>Motorleistung: 4.0 kW<br>Bandgeschwindigkeit: 3.15 m/s<br>ohne Hebewerk<br>mit 4 Stk. Pendelrädern<br><br>***Equipment:*** | 2 Stk. | € 31,800.00 | *€ 15,900.00* |
| | Trommelmotor gummiert | 2 Stk. | € 1,360.00 | *€ 680.00* |
| **Mobile Acceptance Conveyor 3,5m** | Leistung: 200 t/h<br><br>Gerüst: Stahl lackiert<br>Annahmelänge: 3,500mm; Gesamtlänge: 9,000mm<br>Gummi-Gurt, dreilagig mit Wellenkante 80mm<br>Gurtbreite: 800mm<br>Trommelmotoleistung: 5.5 kW<br>Bandgeschw.: Regelung Frequenzumr. 2.0 – 3.15 m/s<br>Annahmehöhe: ca. 600mm<br>Seitenwände in 3 Stufen verstellbar<br>mit Abgabetrichter | 1 Stk. | € 17,700.00 | |
| **Mobile wagon unloading belt** | Trommelabstand: 6.3m<br><br>Förderleistung: 100 t/h<br>Gurtgeschwindigkeit: 2,0 m/s<br>Gurtbreite: 1.200 mm<br>Gurtband: zwei-lagig; mit Leisten, Höhe: 10 mm<br>Minimale Waggonentladehöhe: 250 mm (bel. Waggon)<br>Abgabehöhe: 950 mm<br>Förderwinkel: 20 Grad<br>Motorleitung: 5.5 kW<br>mit Schaltschrank, ohne Verlängerungskabel<br><br>***Zubehör:*** | 1 Stk. | € 12,800.00 | |
| | Trommelmotor gummiert | 1 Stk. | € 680.00 | |
| ***Sum*** | | | *€ 91,270.00* | |
| **Additional Costs** | | | ***Costs of Transportation***<br>*Beladung d. Masch. Im Werk Szolnok*<br>*Entladung im Hafen Wien auf Kosten Käufer*<br>*Haftung: Wiener Hafen* | ***€ 1,500.00*** |

***Assembly*** **€ 2,500.00**
*3 Monteure, 2 Tage mit Reise- u. Übernachtgskost.*

The development project under scrutiny here is not a complex technological facility as for example a biomass power plant would be. However, a number of parameters need to be considered.

Additionally, the following parameters have to be ensured:

- Accessibility via road, also with heavy duty vehicles
- Accessibility via rail
- Accessibility via inland waterway
- Option to store mobile temporary cover equipment (tarp, fleece)
- Construction and engineering-related integration into the other development projects (port development plan, port master's office, container terminal) taking place at the site

### 5.7. Technology and equipment

As described above, the foreseen development project as a stand-alone solution is not a technologically complex facility. The most important equipment elements required only for the planned investment are listed in the following:

- well-fortified ground
- Cover or safe shelter
- Drainage systems to ensure safe operations on the quayside
- the corresponding devices to feed the device (Forklift, Gripper)
- the corresponding devices to pick up the moved goods (Barge)
- a scale, in whatever form
- Monitoring System

### 5.8. Design and permissions

In connection with the idea of a conveyor belt for a pilot study in the EU project Energy Barge, the provider was asked by telephone about the feasibility of the construction of the conveyor system. Finally, the request for tenders with specification of services on 20.03. 2018 e-mailed to a potential provider. The regulation fulfils as direct award according to BVergG and based on the company's internal purchasing guidelines. Three offers about price level.

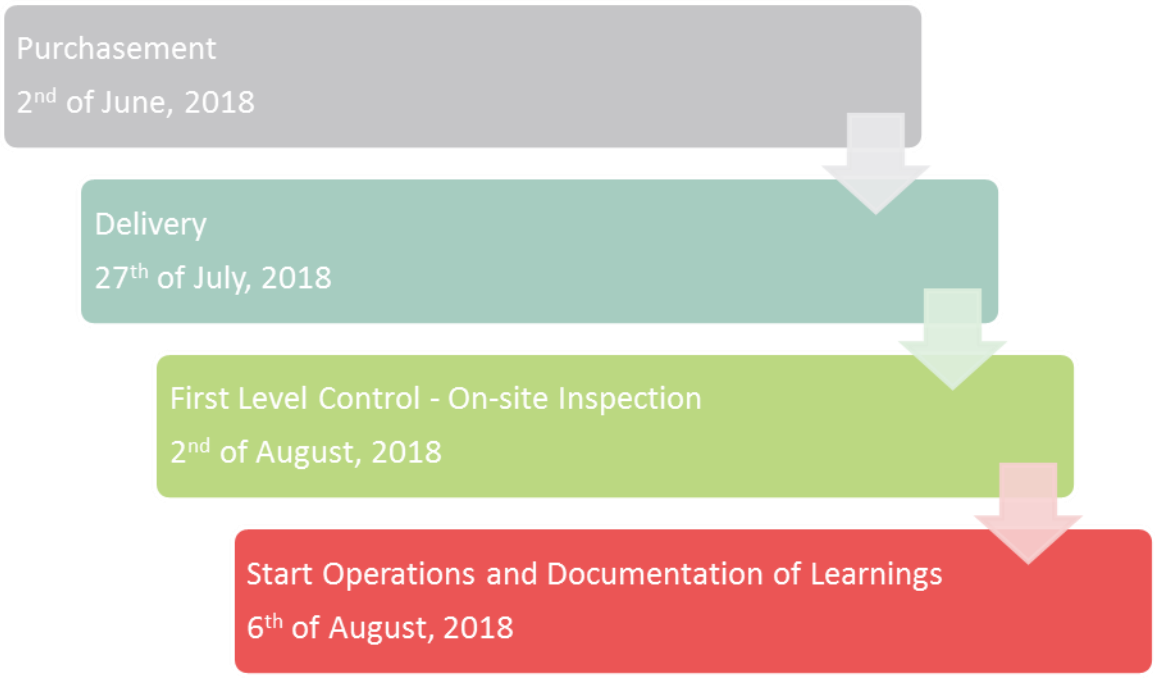
### 5.9. Partners to be involved

Besides the potential target group of the development project, namely the customers, as mentioned above, a set of partners and stakeholders play a significant role in the further planning and operations. These also include the actors involved in the projects being developed in parallel in order to ensure integrative processes. As described in the project, a learning curve is to be created from completed business cases in order to convey our experiences to other ports. This learning curve will be developed with the help of the stakeholders of the department break bulk, which are:

- Bausysteme GmbH
- Beiselen Ges.m.b.H
- BTG Spedition und Logistik GmbH
- Cargo Partner GmbH
- Danube Metals Ltd.
- Compag Handels GmbH
- DHL Global Forwarding
- Expeditors Speditions GmbH
- GD European Land Systems
- Gebrüder Weiss Gesellschaft
- Getreide Gutscher GmbH & Co KG
- Worldwide Logistics
- Logwin Air + Ocean Austria GmbH
- Mechtler GmbH
- Multifreight Internationale Spedition
- Panalpina Welttransport GmbH
- RWA Raiffeisen Ware Austria
- Schenker & Co AG
- TRABA Logistics BV
- Transocean Shipping Transport

The main objective is to use the facility in a sustainable, efficient and effective manner.

### 5.10. Recommended implementation schedule



### 5.11. Investment costs, financing

The total Investment Costs are €99,700. Consisting of the amount specified in chapter 5.6 plus transport, installation and additional hardware. The additional hardware is an electronic control box which enables the controller to control the entire system. The subsidy rate on this investment is 85% with a ceiling of €90,000. The additional costs incurred are borne by the port.

## 6. Operation

The Port of Vienna itself will operate the conveyor Belt. There are no other partners involved in the operations. We will enter into cooperation with an already existing customer, which imports old wood. It will be a strategic long-term partnership for storage and handling Biomass related goods.

Content of the Partnership:

- Storage 5,000m2 – 10,000m2 business unit break bulk
- 1 to 2 ships per month, sent from Germany to the Port of Vienna
- Shovel of equipment either too big or too small for efficient truck loading
- Transshipment cases:
  - Ship to Storage/Truck
  - Storage to Truck/Train
  - Train to Storage

There will be an hourly fee plus crew and without crew sold by the sales department.

### 6.1. Project Management Organisation, human resources

It has been pointed out before that the port of Vienna will operate the conveyor belt with already existing employees, which are very well trained. In addition, the port of Vienna takes over the complete project management until the machine is placed at the port and has been technically checked, see timetable.

Relevant roles to be taken over are:

- Owner – Port of Vienna
- Involved Departments
  - Business Development Department
  - Purchasing Department
  - Break Bulk Department
- Investor/Grantor
- Operator incl. maintenance

### 6.2. Operation and maintenance costs

Clearly, the operations and maintenance costs depend on the final size and features of the machinery realized as well as the business model version opted for as presented in the previous chapter.

The classical operations tasks involved in running the machine include – based on the business model chosen – the following aspects (non-exhaustive list):

- Commissioning and management of orders including issuing offers, scheduling of stored goods and storing durations
- Provision and operation of additional handling equipment as needed (crane, gripper)
- Provision of storage documents and planning
- Logistics on site
- Provision of trained staff
- Monitoring and provision of safety regulations including insurance and liability disclaimer during loading/unloading times
- Management of freight documents
- Surveillance and security
- Cleaning and maintenance of loading and storage areas
- Maintenance of handling equipment
- Marketing

As the owner and operator of the conveyor belt will be the port of Vienna, it also takes over all the tasks that have just been named. Officially, there is a maintenance booklet that is not extensive. t is only recommended a larger maintenance every two years, depending on the previous operating hours. This means that the maintenance costs will be limited.

### 6.3. Pricing

The plant is calculated exactly like the rest of the port machinery. The actual required time is calculated, or in half an hour cycles.

The hourly rate of the machine results from the fixed and variable costs of the machine per year, by the expected operating time of the machine. There will be a separate sale price and a combined with working time and other machines. In addition, any request from potential or existing customers will be specifically addressed and the pricing model adjusted

Investment

Sum = €99,700 – 100% financed by the Port of Vienna

Estimated Operating Life 10 years

Depreciation €9,970 per year

Fixed costs:

- Depreciation €9,970 (by 10 years of operating life)
- Insurance around €100 per year

Total Fixed Costs €10,070

Variable Costs

Operating costs per hour

- Power – 4 kWh = 23 Cent/€ per Hour = 92 cent

Predicted Operating hours

- 250 per year
- €10,070/250 = €40.28 per hour

**Retail Price**

Total Fixed Costs / Operating Hours per Year + 5% Margin

- €10,070/250 = €40.28 + €2.1 = €42.40 per hour

### 6.4. Preliminary cash flow estimates

Since the cash flow is the dependent variable of pricing, fees, demand quantification and quality and operation costs and neither indicator for pricing nor for demand quantification is available in a reliable manner, it is at this current point not possible to provide reliable and realistic preliminary cash flow estimates.

It is clear that once available, the cash flow estimates must be positive in order for a final investment decision to be positive.

### 6.5. Cost-benefit analysis

Based on the price model, the system will pay for itself after 10 years, assuming that the machine is in operation 250 hours a year. If the operating hours per year increase, the payback period is reduced and also vice versa, if the operating hours per year decrease, the payback period is extended.

### 6.6. Market analysis and marketing concept

Originally, the Port of Vienna planned to invest in the abovementioned equipment to handle wooden biomass. Due to the circumstance that the Port of Vienna is currently not able to find customers in the timber sector, they had to adjust their planned investment and intend to purchase a conveyor system instead to widen the range of biomass cargo that could be handled.

The attached offer from ALEX Kft. for a conveyor system amounts to €91,270 and thus is higher than the originally foreseen investment budget of €90,000. The Port of Vienna declared that all costs above the originally envisaged investment budget of €90,000 will be covered by the Port of Vienna.

The Port of Vienna adjusted their planned pilot investment and intends to purchase a conveyor belt instead of the originally foreseen equipment for the commodity group of round timber. Compared to the previously planned equipment, the envisaged conveyor belt, equipped with different components, would entail the advantage to be able to handle a wider range of different cargo and operate more flexible with regards to existing requests of customers as well as future business cases of the port. Furthermore, the use of the existing heavy machinery in the port could be reduced by using a conveyor belt instead, which would contribute to decrease the fuel consumption and the connected pollutant emissions.

The envisaged small-scale investment offers an opportunity for the Port of Vienna to develop a more favourable transport concept by means of inland shipping in order to develop a more efficient supply for biomass power plants in the future.

- Conveyor systems are necessary to be able to unload and load modern/next generation wagons.
- Mobile unit with power supply generator
- Moving along the stationary train
- Designed for approx. one complete train per day
- Radio remote control
- Investment budget: €90,000 (all costs above the amount will be covered by the Port of Vienna)

The conveyor belt will be used for the handling of different biomass cargo and thus will follow the same purpose as originally foreseen in the Application Form. Thus, the envisaged adjustment does not affect the quality of the pilot investment nor the intervention logic of the project to support the development of new value chains and to demonstrate the effectiveness of such a small-scale pilot investment in the port. The objective to create transferable solutions to other ports in the Danube region with a transnational learning effect, also outside the project, will not be affected by the adjustment of the pilot investment.

### 6.7. Partners to be involved

It has been determined that the conveyor belt shall be in investment- and ownership of the port of Vienna and shall be operated also by the port of Vienna.

In the following list, all stakeholders involved in the operation of the new conveyor belt along and aside the supply and value chain are mentioned:

- Wiener Hafen und Lager Ausbau- und Vermögensverwaltung, GmbH & Co KG
- Maintenance service providers, e.g. Manufacturer
- Shipping companies
- Logistics service providers
- Biomass processing companies, e.g. Fundermax
- Forestry owners, e.g. Österreichische Bundesforste
- Permitting authorities
- Security service providers
- Other port operators and authorities active in woody biomass logistics

### 6.8. Co-operation possibilities with other ports

Before the pre-feasibility study was started, the following logic for transnational cooperation with other ports was drafted:

A system that could be used to establish and facilitate cooperation between ports would be the upgrading value chain system, assuming e.g. that sunflowers are harvested in Bulgaria, brought to a port where e.g. storage for the sunflower seeds is needed before transport, or where e.g. the seeds are already hulled and storage for the hulls and the actual seeds are needed and then transported onwards and in an upstream-port, e.g. a conversion facility is nearby and again, the second port could offer storage for the seeds and even potentially for the sunflower oil.

Since the ENERGY BARGE partner port of Straubing, Port of Budapest and Vukovar in Croatia are also studying investments into upgrading their logistics performance and service portfolio for wood-based cargo, here a cooperation and coordination of the relevant business and trading actors at these three sites is a definite necessity for follow-up negotiations once the studies have been concluded. Also, other ports outside the project consortium could act as business development partners according to the pattern described above. (Kaufmann et al., 2018)

# 7. Risks and barriers

## 7.1. Risks and barriers during the implementation

Those risks and barriers are presented here in a theoretical manner and cover the following aspects:

- Institutional and strategic risks
- Financial and economic risks
- Technical risks

Moreover, the likelihood for a risk to materialize can differ. For reasons of simplification, the following categories are chosen:

- Low risk
- Medium risk
- High risk

The impact level of a risk in case of occurrence differs as well:

- No or insignificant impact
- Medium impact
- Significant impact

Based on these conditions, the following risk assessment for the time before and during implementation as well as during operation can be done.

Table 6: Risk assessment table (Kaufmann et al., 2018)

| Type of risk incl. specification | Likelihood of risk | Impact of risk |
|---|---|---|
| Institutional and strategic risks | | |
| Port development plan does not suggest follow-up investment | Medium | Significant (project exit) |
| Planning and construction process gets delayed (legal, planning, subcontracting, etc.) | high | medium |
| Conflicts arise between different stakeholders | low | medium |
| Development decisions and procedures are too slow and site advantages are lost / attractiveness for investors vanes | medium | significant |
| Financial and economic risks | | |
| Lack of shareholder interest | low | significant |
| Lack of public funding | medium | Medium |
| Construction cost spikes and increases | medium | Medium |
| Inland waterway navigation conditions further deteriorate, transport mode loses standing with forwarding companies | medium | significant |

| | | |
|---|---|---|
| Biobased economy does not manage to enter into growth and investment phase, resulting in lack of demand | Medium | significant |
| Technical risks | | |
| Technical issues occurring during construction or operation | Medium | low |
| High maintenance costs | low | medium |

### 7.2. Risks and barriers during operations

- From the point of view of the port of Vienna there are the following risks:
- Non-achievement of the annual operating hours calculation - hourly rate too low
- Training of staff is inferior - Machine defect due to misuse
- Finding of defects and bugs which cause inaccuracy in design- delays of launch of the operation, delays of transshipments, possible extra costs, discontent of stakeholders
- Customers react to errors with emigration to other Danube ports
- Customers react to errors by switching trading routes or using other modes of transport
- Breakdown of technical equipment which causes delays and extra cost
- Lack of cargo due to geopolitical-, economic issues and natural disasters
- Disruption due to weather conditions causes delays and extra costs

For all these risks in chapter 7.1 and 7.2, a risk management strategy was designed which develops measures to mitigate or prevent the materialization of the mentioned risks or at least establishes foresight procedures which could provide strategies for resolution. Each risk is revalued quarterly and included in the strategic planning of the port.

## 8. Recommendations

**Proposals for further studies**

In this section, based on the findings presented before, some options for future analysis steps for the Port of Vienna are outlined.

From this perspective, the Port of Vienna should consider topics for in-depth feasibility studies:

(1) Inland water transport of Roundwood from Romania and Bulgaria to Vienna

(2) Participation in post-consumer wood/waste disposal logistics

(3) Participation in biomass fuels logistics (pellet, wood chips)

(4) Participation in the logistical chain of Round wood (container) export to China

Ad (1): The major challenge in round wood transport to Vienna is that round wood prices in Austria are very competitive compared to Eastern Europe. On the other hand, the availability of round wood products from Austrian forests can be a driving factor for wood import. With regard to transport mode, it can be financially viable to use IWT from Romanian and Bulgaria ports, but only for log wood. On the other hand, railway transport of logs can be economically viable for distances up to 1,000 km, while truck transport is only competitive from Slovakia. A detailed elaboration of Round wood IWT from Romania and Bulgaria can be thus recommended as a further activity including quality and quantity analysis. To depict a full supply chain may help to find new market potentials.

Ad (2): The prices for firewood, pellet wood, chipboard wood is already at a very competitive (low) level in Austria. Therefore, in the current situation is promising only for road transport from Slovakia up to 100 km to Vienna. The main reason is a high demand for this type of wood due to local pellets and chipboard production. Contrary to roundwood, the transport possibilities for wood residues are very limited due to the high local demand of some types of residues and due to the low bulk density of residues, even if they are chipped. In the case of wood chips and residues, it would be more economic to transport it with trucks up to 100 km or by railway below 200 km. Another possibility is to elaborate opportunities in post-consumer wood import, transport and processing from those regions where waste disposal is subsidised.

Ad (3): As an alternative to the import of round wood and wood residues to Austria, one of the options to be further analysed is biomass fuels logistics. Considering the high demand for wood chips and pellets one the one side; and the ports' capability for multi-modal transport on the other side, an investigation how to participate in overseas wood pellets export should be elaborated. The potential of wood transport should be studied in bi-directional models, in order to use saving potentials. However, the CO2 emission impact of global wood transport might be considered as well.

Ad (4): With regard to round wood and primary wood processing, especially China showed an utmost import demand for hard wood logs and for processed wood in the last few years. Recently,

logs and processed wood is transported in containers to Chinese ports from Slovakia, Czech Republic, Serbia, Croatia, Bulgaria and Romania by road and railways to the European seaports.

**Proposals for next steps**

As requested, the Port of Vienna management could additional follow the following actions:

- To increase contact with potential business partners at trade fairs, city networks and in research projects.
- To permanently or regularly observe the market: to establish Price Alerts, when critical prices benchmarks are achieved.
- To clarify and define the most demanded biomass/wood types among the Port of Vienna's potential local clients.
- To share the Pre-FS with other stakeholder in order to initiate further case studies.
- To consider a Ports Supply network, with other inland ports, being feeders resp. consumers, incl. Maritime ports and overseas transport.

**Proposals for further Investments**

As requested, the Port of Vienna management could additional follow the following actions:

- One Result out of the market observation is to constantly invest in port infrastructure. The Best Practice analysis shows the necessity of a high quality Infra- and Suprastructure.

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