

ENERGY BARGE

T3 WP 5 - Bioenergy pilots in ports

T3 WP 5 - Energija iz obnovljivih izvora - pilot aktivnosti u lukama

D 5.1.1. Transnational Implementation Plan

D 5.1.1. Transnacionalni implementacijski plan

10. October 2017.

Introduction

Pursuant to project task and within the project Energy Barge managed by Port Authority Vukovar, Transnational implementation plan has been created. Its objective is to identify development possibilities of the Port based on the renewable resources of biomass, while taking into consideration geographical position of the Port, its hinterland, available resources, current supply and demand of biomass, as well as conditions and possibilities for transport of biomass along the Danube River.

One of the challenges faced while developing the Plan was information availability, especially when it comes to different types of biomass. Bodies in charge are usually different professional and authoritative bodies, and the statistics is not formed on the level of counties, but on the level of the whole state. When conducting analysis, we were constrained to use available data and interpret it carefully, citing sources and giving necessary explanations.

Although all stakeholders are familiar with the fact that Vukovar, as well as eastern Slavonia, has suffered war damages, it is necessary to emphasize that this still has a big impact on the economic development of Vukovar port, and on the intensity and capacity for development of the region. Vukovar port itself has to face many problems that stem from non-compliance of development conceptions and development plans of rail transport and Vukovar port. As part of the project *Upgrade and electrification of existing railway line for international traffic M601 Vinkovci-Vukovar* an international railway line M601 will be built and it shall pass through Vukovar port, causing it to lose that part of its territory.

All the aforementioned circumstances have affected the text, data and specifications delivered in this Plan.

1. Geographic location and embeddnees of Vukovar port

Vukovar port is situated on rkm 1335 +000 of the downstream flow of the Danube River, on its right coast in the middle part of the Danube.

The Port stretches from the East to the West and it is 1700m long and 45m wide. The port is very well situated to the main current of the river Danube, which makes it possible for the port to be navigable during the whole year regardless of water level. It is located on the crossroads of trade routes between Croatia on the West and Bosnia and Herzegovina on the South, and Hungary on the North and Romania and Serbia on the East. Vukovar port can receive ships Class 5, while the navigability and reliability of the Danube River throughout the whole year make Vukovar port the most important port in Croatia. The port is operational even during the period of the lowest water levels of the Danube, except in the cases when it is not allowed to navigate along the Danube. Vukovar port has a significant geographical and transport position. It's located on the crossroads of transport lines, on 3500 km long trans-European The Rhine–Main–Danube Canal (Corridor VII North Sea-Black Sea) , and it is connected by rail and road traffic with the Adriatic Sea (Corridor Vc).

Within the Trans- European Transport Networks (TEN- T), port Vukovar has been defined as the core network port, which highlights the importance of the port and the corridor.

The overall capacity of trans-shipment of all port operators is estimated to be around 2 million tons.

Traffic connection of Vukovar port

Croatia is located on the two corridors of the main transport network: The Mediterranean and the Rhine-Danube corridor. The Mediterranean corridor connects the south of the Iberian Peninsula, across Spanish and French coast, it goes all the way to the Alps in the north of Italy, then it continues to Slovenia and carries on to the Hungarian-Ukrainian border. The Mediterranean corridor is a road and rail corridor, and its constituent part is Rijeka-Zagreb-Budapest line (rail and road line also known as corridor Vb). It continues further to road and rail line Zagreb-Slovenija, known as corridor X. This corridor will connect Croatia with the Baltic-Adriatic corridor, which stretches from the Baltic Sea through Poland, across Vienna and Bratislava to northern Italy. The Rhine-Danube corridor is a river line which connects Strasbourg, Frankfurt, Vienna, Bratislava, Budapest (one part goes towards Romania, and the other goes through the Danube between Croatia and Serbia and towards the Black Sea), and it is known as corridor VII.



Picture 1: Position of Vukovar port compared to TEN – T

Road infrastructure

In the County area, there are four A3 highway exists (Babina Grda, Županja, Vrbanja, Lipovac). State roads interconnect cities (Ilok, Otok, Vinkovci, Vukovar and Županja), while other settlements within the County are accessible by means of local and county roads, as well as state roads. At the moment Vinkovci, Vukovar and Ilok bypasses are being built, while some parts have already been built and function as a part of public road networks. Vukovar port is located near the crossroads of the Mediterranean and Vc corridor.



Picture 2: Highway and express road network in eastern Croatia¹

Rail transport

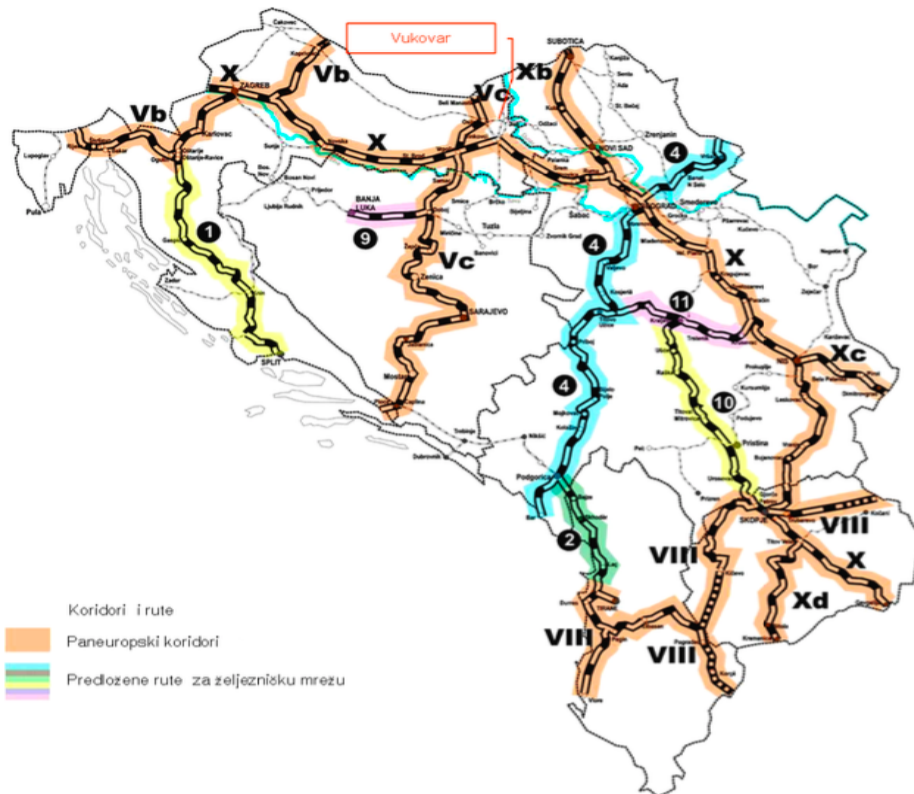
European rail corridor X crosses through Županja. Bearing in mind that significant investments are being planned and implemented in rebuilding the railway, further increase of traffic is to be expected. One track railway 18.7 km long is being rebuilt and electrified (Vinkovci-Vukovar). This is significantly important not just for the economy of Vukovar-Srijem County and Slavonia, but for the whole region. The railway was built in 1878, and today it connects RH1 corridor (ex X pan – European corridor) and TEN-T the Rhine-Danube corridor, i.e. rail line Salzburg-Villach-Ljubljana-Zagreb-Beograd-Skopje- Solun and inland waterway on the Danube.

Alongside, better integration of railways and using the Danube River for transport, i.e. intermodal type of transport, should also contribute to the increase in traffic. Moreover, it is necessary to emphasize the existence of RO-LA terminal (a terminal for the transport of road tractors in railway wagons) in Spačva.

Currently rail traffic has seven different routes in the County area.

The railway network shows construction alongside corridor X. Electrified, two track infrastructure of railways has a capacity of 250 trains (freight and passenger trains), which can be increased up to 350 trains. The capacity of electrified, one track railway is 60 trains per day, and it could go up to 100 trains. Vukovar port has its own infrastructure of railways (rail tracks 300m long), and, because of its vicinity to the important railway corridors X and Vc, is very well geographically positioned - only 20 km from the regional railway centre Vinkovci.

¹ Source:: Ministry of the Sea, Transport and Infrastructure



Picture 3: Corridors and railway network²

Waterway transport

Waterway network of inland water in Slavonija and Baranja consists of the Danube River, 137.5 km long, the Sava River, 446 km long and the Drava River, 198.6 km long.

Waterway of the Danube River (E-80) in Croatia, from Batina to Ilok (from its 1433 rkm to 1295.5 rkm) is suitable for daily and nightly navigation and its capacity is in accordance with international VI c Class requirements.

Waterway of the Sava River (E-80-12) in Croatia from the estuary of the Kupa River to Jamene – border with Serbia (from 583 rkm to 207 rkm) meets the requirements of Class III, while the part from 583 rkm until Rugvica, 653 rkm, meets the requirements of Class II.

Waterway of the Drava River (E-80-08) in Croatia from the estuary of the Danube River rkm 0 to Osijek rkm 22 meets the requirements of Class VI, the part of the Drava from Osijek rkm 22 to Donji Miholjac rkm 82 has Class III, and the part from Donji Miholjac rkm 82 to rkm 198,6 has Class II. From the estuary to the Danube to the new port rkm 13 waterway is suitable for daily and nightly navigation and it is highly navigated, while the part from rkm 13 to 198,6 is used for daily navigation only and it mainly serves to exploit gravel, sand and wood mass.

In the Vukovar-Srijem County area there are two international waterways – the Danube and the Sava. The Danube is completely navigable in Croatia and according to European Agreement on main

² Source: Vukovar port, Konceptija razvoja luke, p. 23

inland waterways of international importance (AGN) it has Class Vic. The Danube is suitable for international, regional and local traffic. The Sava is conditionally navigable, i.e. there are some restrictions and it is connected with a poorly constructed waterway (insufficient draught in specific sectors, critical points, unmarked waterway, etc.) Traffic on the Sava River depends on the water level and it is mainly of local and regional character.

According to the Regulation on inland waterway classification (the Official Gazette NO 77/11 and 66/14) waterways where load-carrying vehicles can navigate and to which international rules of navigation apply are:

Table 1. Waterways where load-carrying vehicles navigate according to international rules of navigation

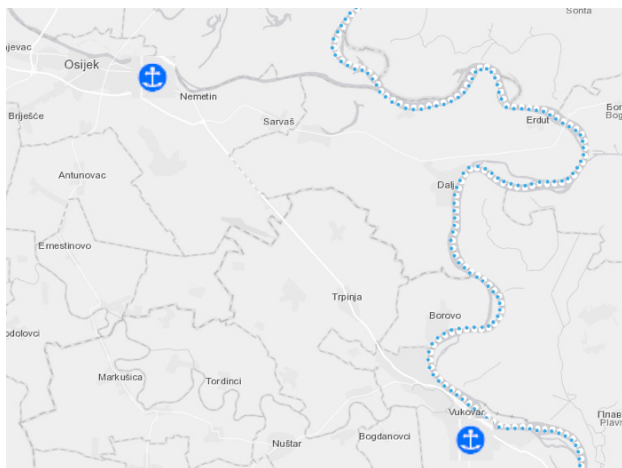
The DANUBE	1295+500 (Ilok) – 1433+100 (Batina)	137,50	Class VI.c
The SAVA	210+800 (Račinovci) – 313+700 (Sl. Šamac)	102,90	Class IV
	313+700 (Sl. Šamac) – 338+200 (Oprisavci)	24,50	Class III
	338+200 (Oprisavci) – 371+200 (Sl. Brod-city)	33,00	Class IV
	371+200 (Sl. Brod-city) – 594+000 (Sisak-Galdovo)	222,80	Class III
The DRAVA	0+000 (estuary of the Danube) – 14+000 (Osijek port Nemetin)	14,00	Class IV



Picture 4. Aerial view of Vukovar port

Tranzit port in Osijek

In the Vukovar hinterland there is Tranzit port in Osijek. The position of Tranzit port in Osijek is rkm 12+265 to 16+428 the Drava (port area), and it covers a surface of 160 ha with 240m of oblique shore and 100m of vertical shore. The port has 6 industrial tracks 3264 m long, 4 loading places, two port cranes with the load capacity of 20 (200t/h), 4 port cranes with the capacity of 5t with grabs and 6t (100t/h) with hooks, and a floating crane with the capacity of 5t (100t/h).



Although Tranzit port has a capacity of around 3 million tons per year, it actually tranships around 120.00 tons of goods. The reason for this is that the navigation through the Drava is highly dependent on its water level, so goods often end up in Vukovar port. In the proximity of the Port there is a cogeneration plant in development (investment of HEP).

Picture 5: The position of Tranzit port in Osijek in comparison to Vukovar port

2. Vukovar hinterland in the context of biomass

Vukovar port hinterland

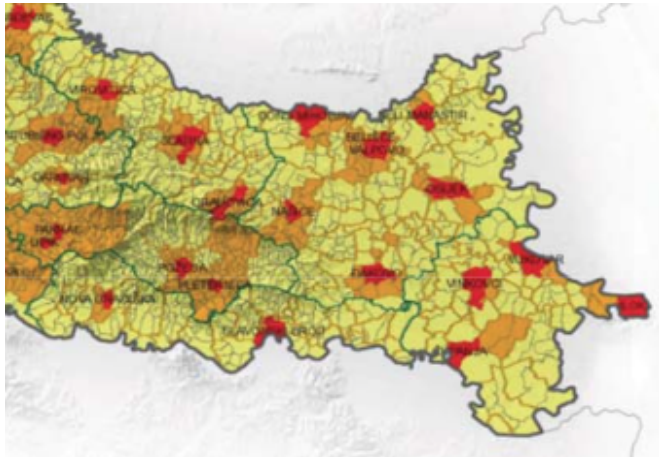
Accepting as a framework criteria 100 km distance from Vukovar port, in our further analysis as Vukovar port hinterland we will analyse five counties:



Vukovar- Srijem County with the seat in Vukovar,
 Osijek- Baranja County with the seat in Osijek,
 Brod- Posavina County with the seat in Slavonski Brod,
 Požega- Slavonia County with the seat in Požega and
 Birovitica- Podravina County with the seat in Virovitica.

Picture 6: Area of Slavonija and Baranja

These five counties form the region of Slavonija and Baranja, the least economically developed region in Croatia, below 1/3 of EU average. The area consists of the valleys of the Drava, Sava and the Danube which are utilised in agricultural purposes, but also for cattle and forestry. Bearing in mind all mineral resources, oil, gas, water and waterways here we can find the most fertile soil in Croatia. Hills are located alongside the right coast of the Danube, while near the Sava, Drava and Danube we can find wetlands (the biggest is Kopački rit Nature Park in Baranja). In the proximity of the Sava there are oak groves.

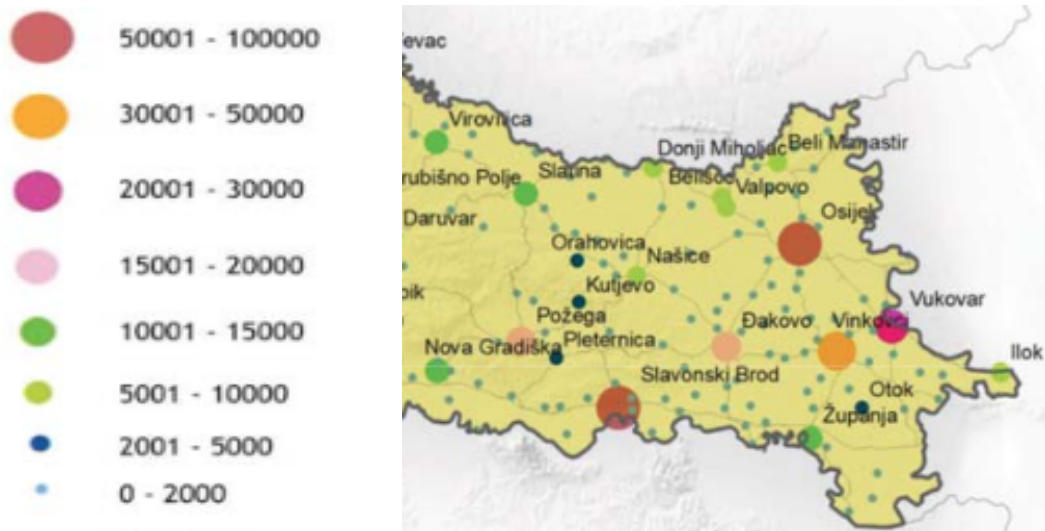


According to the data from 2012 the population of the observed area is 806.998. There are 22 cities (picture 5), and the structure according to the population is shown in picture 6.

Town seat Urban area

Picture 7: Urban hinterland of Vukovar port

The area of Slavonija and Baranja is rich in forest, which is in the most part property of the State (80%), and it is managed by *Hrvatske šume*. The total surface of forests in Vukovar port hinterland is 425.175 ha.



Picture 8: Urban settlements structure according to the population

Table 2: Forest area in Vukovar port hinterland

	FOREST AREA (ha)	PERCENTAGE IN THE TOTAL FOREST AREA IN CROATIA	FOREST AREA IN PRIVATE PROPERTY (ha)	FOREST AREA OWNED BY THE STATE (ha)
THE REPUBLIC OF CROATIA	2.759.039,05	100%		
VUKOVAR-SRIJEM ³	68.450,00	2,48%	1.400,00	67.050,00
BROD-POSAVINA ⁴	56.669,07	2,05%	8.502,74	48.166,33
OSIJEK-BARANJA ⁵	122.476,00	4,44%	24.390,00	98.086,00
POŽEGA-SLAVONIJA ⁶	112.016,99	4,06%	6.552,99	105.463,99
VIROVITICA-PODRAVINA ⁷	65.562,88	2,38%	5.245,03	60.317,85
TOTAL	425.174,94	15,41%	46.090,76	379.084,17

According to Croatian Bureau of Statistics agricultural areas cover 743.770 hectares, out of which 569.064 are being utilised. Agricultural areas in different counties are shown in the following table.

³ <https://www.google.hr/url?sa=t&rct=j&q=&esrc=s&source=web&cd=11&ved=0ahUKEwiL0rDh4dbWAhUCfFAKHVaUApA4ChAWCCMwAA&url=http%3A%2F%2Fwww.azo.hr%2Ffgs.axd%3Fid%3D2040&usg=AOvVaw1BErmEsGBkb6SlbN77dkjw>

⁴ http://www.bpz.hr/_Data/Files/1312101224991.pdf

⁵ http://www.obz.hr/hr/pdf/2013/3_sjednica/06_informacija_o_stanju_gospodarenju_i_zastiti_suma_na_podrucju_obz.pdf

⁶ https://www.google.hr/url?sa=t&rct=j&q=&esrc=s&source=web&cd=8&ved=0ahUKEwji08-6n9fWAhXKIIAKHS3SA1UQFghOMAc&url=http%3A%2F%2Fwww.panora.hr%2Frepos%2Fdownload%2F1466772297zrs-analiza_stanja_r4_5052016.pdf&usg=AOvVaw3w_IWG0uDv3ijCHDo02WW7

⁷ <http://www.vpz.com.hr/wp-content/uploads/2011/01/ŽRS-VPŽ-2011-2013.pdf>

Table 3: Agricultural and utilized agricultural areas

COUNTY ⁸	AGRICULTURAL AREAS (ha)	UTILISED AGRICULTURAL AREAS
THE REPUBLIC OF CROATIA ⁹	2.693.874	1.571.200
VUKOVAR-SRIJEM	150.856	131.722
BROD-POSAVINA	120.429	72.853
OSIJEK-BARANJA	266.245	221.725
POŽEGA-SLAVONIJA	89.489	50.069
VIROVITICA-PODRAVINA	116.751	92.695
TOTAL	743.770	569.064

Out of all utilised agricultural areas as much as 69% (392.900 ha) are being used to grown corn and cereals, while 19.836 hectares is being used to grow fruit and vineyards.

Table 4. Annual harvest levels¹⁰

CULTURE	HARVESTED AREA
WHEAT	111.200
BARLEY	30.400
RAY	500
OATS	13.100
CORN (ST)	159.500
SOY	37.700
SUNFLOWER (ST)	22.800
RAPESEED	13.300
TOBACCO	4.400
TOTAL	392.900

⁸ <https://www.dzs.hr/hrv/publication/StatisticsInLine.htm>

⁹ Report on the state in trhe area of the Republic of Croatia 2008.-2012., Ministry of construction and physical planning, Zavod za prostorno planiranje

¹⁰ "Potencijali i mogućnosti korištenja biomase iz ratarske, voćarske i vinogradarske proizvodnje u energetske svrhe na području Slavonije i Baranje", Studija Elektrotehničkog fakulteta Osijek, Sveučilište J. J. Strossmayera u Osijeku, 2013. godina

Table 5. Annual levels of planted fruit and vineyard areas ¹¹

CULTURE	AREA
	ha
FRUIT	12.111
VINEYARD	7.725
TOTAL	19.836

Considering the potential for producing biogas we have analyzed livestock in Slavonia and Baranja in 2017.

Table 6. Livestock in Slavonia and Baranja ¹²

FARM ANIMALS	FARMS	OWNERS	QUANTITIY
BOVINE	5.354	5.888	160.840
SHEEP	4.485	4559	117.525
GOATS			7.096
PIGS	33.804	34.544	793.688
EQUIDAE	1.559	6.202	26.416

We didn't analyze the area of western Slavonia as it gravitates towards Zagreb as the economic center of Croatia. However, western Slavonia has many agricultural and forest areas and significant potential for producing biogas.

3. Regional availability of raw materials – supply and demand

The forest surface area in in the hinterland of the port of Vukovar is given in Table 2, and as there are no accurate data on the available biomass at county level, the data were estimated using the data at the level of Croatia, corrected based on the share of forest surface areas in the counties concerned.

¹¹ ibid 8

¹² Source: the Ministry of agriculture

Table 7. Assessment of potential available forest biomass in the hinterland of the port of Vukovar

COUNTY	ESTIMATED AVAILABLE FOREST BIOMASS m ³ /year
VUKOVAR-SRIJEM	162,642
BROD-POSAVINA	134,649
OSIJEK-BARANJA	291,011
POŽEGA-SLAVONIA	266,160
VIROVITICA-PODRAVINA	155,782
TOTAL	1,010,244

According to the Study of the Faculty of Electrical Engineering Osijek, the University of J.J. Strossmayer in Osijek, the largest source of biomass in the agricultural production in Slavonia and Baranja is generated through cultivation of corn and grains, which accounts for more than 80% of the annual quantities of biomass from agriculture, while the larger part of the remaining quantities is accounted for by pruning of fruit trees and vineyards.

Table 8. Annual level of biomass from residues of agricultural production in Slavonia and Baranja¹³

CULTURE	BIOMASS FROM AGRICULTURAL PRODUCTION (t)
WHEAT	563,000.0
BARLEY	127,000.0
RYE	1,400.0
OATS	33,400.0
CORN (ST.)	1,060,000.0
CORN (COB)	211,900.0
SOYBEAN	190,100.0
SUNFLOWER (ST.)	127,500.0
SUNFLOWER (HEAD)	19,100.0
RAPESEED	71,700.0
TOBACCO	3,200.0
TOTAL	2,408,300.0

¹³ Ibid 10

Table 9. Annual level of estimated biomass from pruning residues in Slavonia and Baranja¹⁴

CULTURE	BIOMASS FROM PRUNING RESIDUES (t)
FRUIT TREES	13,352
VINEYARD	7,339
TOTAL	20,691

For the production of biogas, it has been assumed that the total amount of manure produced on farms in the hinterland would be exploited. The amount of waste from livestock farming, generated on an annual basis, is calculated on the basis of the number of livestock. The potential of this source is theoretical and depends on the method of livestock farming and farm size. The data were summed up using the REPAM project data from 2012.

Table 10. Annual level of estimated manure availability

COUNTY	MANURE AVAILABILITY (t)
VUKOVAR-SRIJEM	361,904
BROD-POSAVINA	222,587
OSIJEK-BARANJA	596,665
POŽEGA-SLAVONIA	149,225
VIROVITICA-PODRAVINA	186,251
TOTAL	1,516,632

Biomass from waste will largely be disposed of through collection and disposal systems in waste disposal center's and it is not advisable to count on these resources for other purposes. According to the 2015 data, about 63% of the total municipal waste disposed of is biodegradable.

Since small household boilers are the most widely used type of bioenergy plants in Croatia, the largest part of fuel wood is used for their operation, i.e. for heating the living spaces and preparing hot water in households. In areas that have not been covered by the gas distribution network and where there are no heating plants or district heating, fuel wood is the main source of primary thermal energy. Most of the fuel wood is harvested by cutting forests for energy purposes. Except for heating, large amounts of fuel wood are also used for the purposes of cooking in household's due to

¹⁴ Ibid 10

low fuel wood prices, specific type of food preparation and tradition. According to 2010 data, approximately 3.5% of total primary energy is obtained from fuel wood. However, regardless of the estimated total consumption at the national level, reliable statistical data for the regional and local level do not exist and are estimated based on the data available from the Central Bureau of Statistics that contain the number and surface area of households that use wood as the primary source of thermal energy. For Slavonia and Baranja, annual consumption is estimated at 1-2 m³ per capita, which amounts to about 1.5 million m³ per year.

At the level of Croatia, according to EIHP data, in the period from 2008 to date, a steady increase in biomass exports has been recorded with an annual rate of 25%. Export data at national level are shown in Table 13. Out of total energy exports, biomass accounts for more than 10%, and this almost in the total amount as forest biomass. According to the same source of data, the trend of biomass imports increased by 32% in the observed period. Given the lack of localized data for the needs of this demand and supply analysis, it will be assumed that national data are applicable to the hinterland of the port of Vukovar.

Considering:

- the trend of continuous annual growth of forest biomass trade exchange with the neighboring countries, most notably in the Danube River Basin area countries (Austria, Slovenia, Bulgaria, Germany and Serbia),
- the quantities of potential forest biomass shown above,
- the volume of demand on the domestic market as raw materials in the analysis of the production of refined products, as well as
- forest capacities in the hinterland of the port of Vukovar,

it becomes fully logical to look at the development of the port of Vukovar through further development of the biomass market.

4. Supply and demand of refined products

Below are data on the number of legal entities for wood processing by counties. For the purposes of this analysis, the respective legal entities represent the potential of the supply of refined products (in particular wood biomass). Residues from the wood processing industry are generated on 10 sawmills located in the observed hinterland with the maximum capacities shown in Table 10, and three pellets and 4 wood chip manufacturers are involved in the refining of the products.

Table 11: Sawmills in the region of Slavonia and Baranja¹⁵

COUNTY	SAWMILLS	MAX. CAPACITY (m3/year)
VUKOVAR-SRIJEM	2	50,000
BROD-POSAVINA	1	30,000
OSIJEK-BARANJA	5	161,000
POŽEGA-SLAVONIA	1	50,000
VIROVITICA-PODRAVINA	1	35,000
TOTAL	10	326,000

Table 12: Pallet and wood chip manufacturers in the region of Slavonia i Baranja¹⁶

COUNTY	PALLET MANUFACTURERS	MAX. CAPACITY (t/year)	WOOD CHIP MANUFACTURERS
VUKOVAR-SRIJEM	2	100,000	1
OSIJEK-BARANJA			3
POŽEGA-SLAVONIA	1	21,600	
TOTAL	3	121,600	4

Table 13: Companies with the right to exploit forests in the region of Slavonia and Baranja¹⁷

COUNTY	COMPANIES WITH THE RIGHT TO EXPLOIT FORESTS	MAX. QUANTITY FROM FORESTS (m3/year)
VUKOVAR-SRIJEM	9	53,000
BROD-POSAVINA	11	80,000
OSIJEK-BARANJA	6	37,000
POŽEGA-SLAVONIA	8	48,000
VIROVITICA-PODRAVINA	18	93,000
TOTAL	52	311,000

According to the annual energy review of the Ministry of Economy "Energy in Croatia" the utilization of the pellet production capacities is about 65% and the total production according to the data of 2013 at the level of Croatia was 181,568 tons. By localizing the data, the estimated quantities of

¹⁵ Catalogue of forest biomass producers in the Republic of Croatia

¹⁶ Ibid 15

¹⁷ Ibid 15

pellet production amount to 79,040 tons per year. Of the total production of pellets, 88% was launched on foreign markets while the rest was used on the domestic market.

Domestic demand for refined products is largely accounted for by households. Although most biomass in households is used in old and non-economic plants, according to the data at the level of the Republic of Croatia the demand for plants, primarily those fueled by pellets, is steadily increasing. This increase is the result of the co-financing program for the procurement of small heating and hot water installations for households and public institutions. This may indicate poor awareness of the use of renewable energy sources, although one should bear in mind that this is an area that is still repairing the damage caused by the war. Demand at the hinterland level of the port of Vukovar or localized demand for refined products is not recorded in the data available.

Due to the unavailability of import and export data for the Slavonia and Baranja region, an overview of imports and exports at the level of the Republic of Croatia is provided below.

Table 14: Export of refined products from the Republic of Croatia¹⁸

NAME / COUNTRY	EXPORT 2016 (t)	EXPORT 2016 (EUR)
Conifers in form of wood chips, shavings	48,430	2,028,690
Austria	912	22,358
Germany	588	114,728
Hungary	9,181	358,395
Italy	21,353	892,624
Slovenia	16,396	640,585
Wood in form of chips, shavings and like	321,785	14,980,563
Austria	71,910	3,648,043
Bosnia and Herzegovina	18	10,735
Belgium	0	11
Germany	8	13,362
Hungary	110,133	4,023,756
Italy	22,609	994,564
Slovenia	117,107	6,290,092

¹⁸ According to the Central Bureau of Statistics

Wood pellets	235,925	34,225,855
Austria	4,880	716,736
Bosnia and Herzegovina	25	3,681
Bulgaria	222	32,952
Switzerland	25	5.045
Germany	170	23,617
Denmark	873	139,157
Spain	66	8,834
France	3	705
Hong-Kong	24	3,034
Hungary	228	28,934
Italy	206,897	30,169,098
Latvia	24	3.427
Macedonja	16	2,523
Romania	6,702	904,273
Slovenia	13,381	1,844,723
Slovakia	221	36,208
Kosovo	24	3,454
Serbia	2,144	299,454

Table 15: Import of refined products in the Republic of Croatia¹⁹

NAME / COUNTRY	IMPORT 2016 (t)	IMPORT 2016 (Eur)
Conifers in form of wood chips, shavings	17,107	849,599
Austria	73	34,018
Bosnia and Herzegovina	136	13,967
Germany	1	385
United Kingdom	1	1,116
Italy	11	5,236
Netherlands	3	1,276
Slovenia	16,882	793,601
Wood in form of chips, shavings and like	6.373	345,880
Austria	103	42,732
Bosnia and Herzegovina	24	3,971
Belgium	0	273
Czech Republic	0	65
Germany	54	22,233
France	1	7,072
Hungary	1	461
Italy	2	9,610
The Netherlands	0	37
Poland	6	2,830
Slovenia	6,182	256,596
Wood pellets	13,838	1,964,574
Austria	287	53.468
Bosnia and Herzegovina	12,476	1,654,379

¹⁹ Ibid 18

Belgium	0	148
Czech Republic	36	6,833
Germany	112	93,995
Italy	59	10,656
The Netherlands	0	222
Poland	2	2,707
Romania	0	47
Slovenia	609	102,439
Serbia	256	39,680

5. Links to the Bioenergy Sector

In the hinterland of the port of Vukovar, or in the area of the observed five counties, 89 power plants are in operation or under construction, out of which 49 power plants are using or will use biomass, and 40 power plants use or will use biogas for the production of electricity and thermal energy. A large number of biomass power plants have signed multi-year contracts with Hrvatske šume for supplying wood biomass. Hrvatske šume provide about 800,000 tones of wood mass for cogeneration plants on an annual basis in the Republic of Croatia.

Table 16: Biomass power plants in Slavonia and Baranja²⁰

COUNTY	BIOMASS POWER PLANTS	ELECTRIC POWER (MW)	THERMAL POWER (MW)
VUKOVAR-SRIJEM	14	28.325	13.144
BROD-POSAVINA	5	12.62	13.2
OSIJEK-BARANJA	18	17,406	30
POŽEGA-SLAVONIA	1	1,525	
VIROVITICA-PODRAVINA	11	27,956	39,527
TOTAL	49	87,832	96,31

²⁰ Source: OIEKPP Registry on 20 September 2017

Table 17: Biogas power plants in Slavonia and Baranja²¹

COUNTY	BIOGAS POWER PLANTS	ELECTRIC POWER (MW)	THERMAL POWER (MW)
VUKOVAR-SRIJEM	14	24,099	2
BROD-POSAVINA	0	0	0
OSIJEK-BARANJA	18	17,589	5,092
POŽEGA-SLAVONIA	2	4	4
VIROVITICA-PODRAVINA	6	8	5,305
TOTAL	40	53,688	16,397

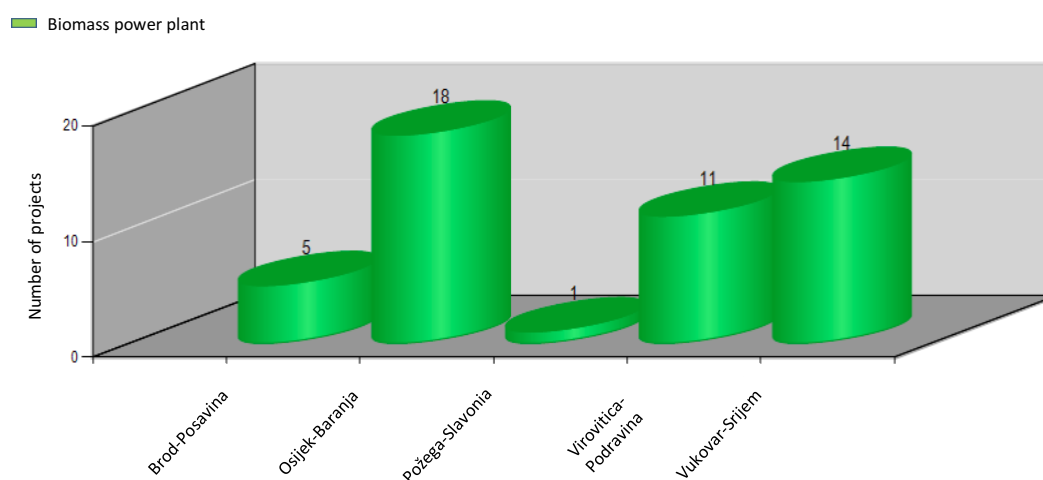


Figure 9: Biomass power plants in the observed counties

According to the annual report of the Croatian Energy Market Operator (HROTE) for the year 2016, seven biomass power plants and eleven biogas power plants in Slavonia and Baranja have entered into agreements to become eligible electricity producers and they have also concluded power purchase agreements for the national grid. The same HROTE report shows that the number of producers of energy from renewable sources increases year by year and so does their connection to the national grid. However, knowing that Slavonia and Baranja have 394 registered renewable energy sources power plants, all of which have the status of eligible electricity producers, it is clear that the development of biomass and biogas power plants is yet to be realized.

Such development has so far been stimulated through the regulations that make up the energy regulation of the Republic of Croatia. On January 1, 2016, the Act on Renewable Energy Sources and Highly Effective Cogeneration (Official Gazette NN 100/15) (hereinafter: the OIEiVUK Act) came into force, on the basis of which the earlier applicable regulations regulating the incentive system ceased to be in effect.

²¹ Ibid 20

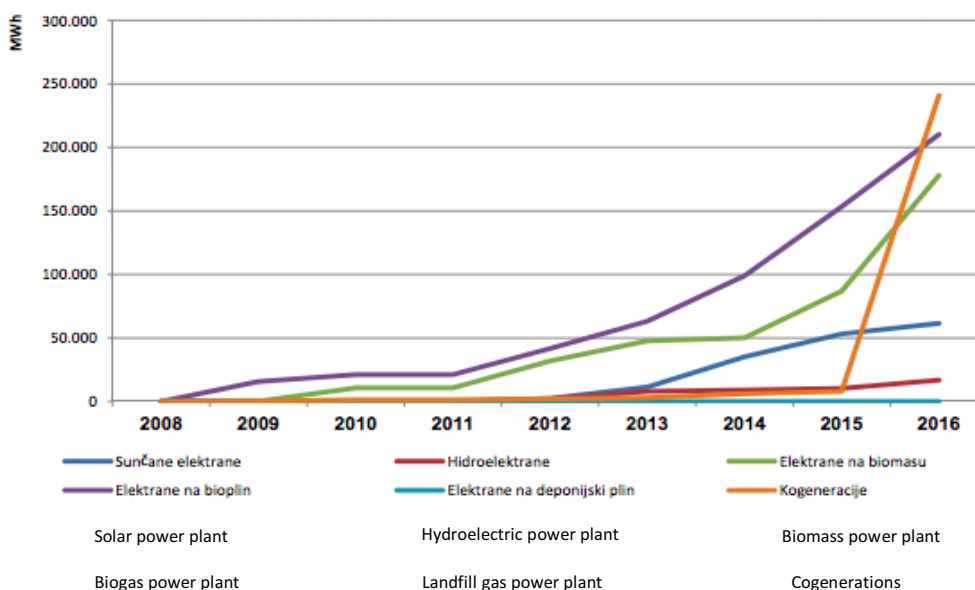


Figure 10: Production of eligible electricity producers by type of plant, wind power plants excluded²²

With the entry into force of the OIEiVUK Act, a new approach for HROTE, among other things, has been envisaged when concluding power purchase agreements for energy from renewable sources and cogenerations. This approach involves implementation of public tenders for awarding market premium as well as conclusion of agreements with a guaranteed purchase price, all based on the decision on the selection of the bidder with the economically most advantageous bid. Since the necessary by-laws have not yet been enacted, as envisaged by the provisions of the OIEiVUK Act (Regulation on quotas incentivizing generation of electricity from renewable energy sources, Ordinance on renewable energy sources and high-efficiency cogenerations and State Aid Program), HROTE has not concluded any new power purchase agreements for electricity from renewable energy sources and cogenerations.

This trend of development as well as the fact that biomass power plants are entering into multi-year agreements on biomass supply with Hrvatske šume will certainly have a significant impact on the quantities of biomass available for export or further processing in the future.

The port of Vukovar has no business connections with the stated power plants operating in Slavonia and Baranja as these are mostly supplied with biomass from domestic sources, guaranteed on the basis of multi-year raw material supply agreements.

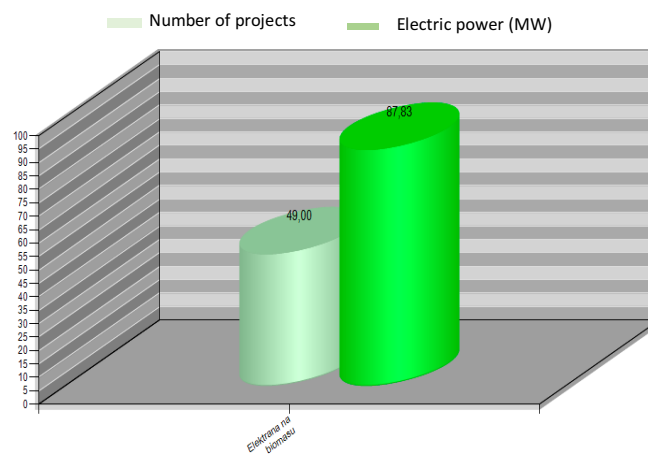


Figure 11: Production capacity of 49 biomass plants in Slavonia and Baranja

²² Source: HROTE report for 2016

6. Biomass transport along the Danube river

There are four concessionaires operating in the area of the port of Vukovar: Luka Vukovar d.o.o., Vupik d.d., Lukoil Croatia d.o.o. and Nautica Vukovar d.o.o.

According to the table below showing the equipment of the concessionaires, it is evident that Luka Vukovar d.o.o. and Vupik d.d. are equipped for solid and bulk cargo, and with the present level of equipment, they can take part in biomass transport. The other two concessionaires are specialized in reloading and storing fuel and petroleum products, and are not able or interested in working with biomass.

Table 18: Technical specifications of the port and its concessionaires

TECHNICAL DATA	LUKA VUKOVAR d.o.o.	VUPIK d.d.	LUKOIL CROATIA d.o.o.	NAUTICA VUKOVAR d.o.o.
Terminal purpose	Reloading of cargo on multi-purpose terminal for bulk, palletised, break bulk containers, special cargo	Loading, unloading, reloading, transporting and storing of bulk cargo (grains and oilseeds)	Reloading, storing and transporting of petroleum products	
Port position	1334	1336 +000	1335 + 800	1335 + 800
Operational quay	ca 450m	206	ca 75 m	ca 100m
Number of berths	4 berths	1	1	1
Type of quay		vertical quay	sloping quay + pontoon	sloping quay + pontoon
Floating dock length			75 m	PO-9-VK 76,50 m PO-1-VK 82,40 m
Fuel tank capacity			R-1 V=3000 m3 R-2 V=1000 m3 R-2 V=2000 m3 R-2 V=2000 m3	PO-9-VK – 3047 m3 PO-1-VK – 1334 m3
Equipment			Pumps, measuring instruments	Pumps, measuring instruments, weighbridge scale
Cranes	1 x 63 t Gottwald HMK 170 1 x 16/27 t Ganz 2 x 5/6 t Ganz	Static reloading tower with a mechanical elevator and transporters, capacity 200t/h (wheat 0.75t/m3) and automatic vessel shifting system		
Enclosed storage facilities	cca 3000m2	48,000 t	8,000 m3	
Open storage area	cca 15000m2			
Working machines	7 forklifts trucks with lifting capacity 2.5 – 5 t 1 forklift truck with lifting capacity 20 t 2 loaders with capacity 3 m3 diesel locomotive pusher vessel 480 HP			
Truck parking space	yes	yes – 50 parking spaces	Yes – 10 parking spaces	
Own industrial railway track	3 tracks of cca 1300m	Two tracks of total 750m in length	218 m	390 m
Maximum annual capacity	1,2-1,5 million t	300,000 t	100,000 m3	

The port of Vukovar currently does not participate in the transport of biomass along the Danube river, as can be seen from the table below providing an overview of transshipment. However, both concessionaires would be able to transship biomass, as they, for the most part, already have the appropriate equipment and available capacities.

Table 19: Statistics on the transshipment in Luka Vukovar from 2012 to 2016 (tons)

Year Type of goods	2012	2013	2014	2015	2016
Agricultural, hunting and forestry products; fish and other fish products	32,450	110,846	81,766	125,223	78,857
Coal and lignite; crude oil and natural gas	0	0	12,434	0	12,130
Metal ores and other mining and quarrying products; peat; uranium and thorium	277,662	241,717	195,917	265,285	142,014
Coke and refined petroleum products	28,111	17,363	0	0	0
Chemicals, chemical products and man-made fibers; rubber and plastic products; nuclear fuel	25,034	8,322	11,053	12,243	11,184
Other non-metallic mineral products	5,345	2,260	0	8,266	55,634
Basic metals; fabricated metal products, except machinery and equipment	81,264	44,148	20,926	12,982	32,360
Machinery and equipment not elsewhere classified; office machines and computers; electric machines and devices not elsewhere classified; radio, television and communication equipment and apparatus; medical, precision and optical instruments; watches and clocks	1,063	2,370	3,186	305	0
Other goods not elsewhere classified	0	0	1,572	0	762
Grand totals	450,929	427,026	326,854	424,304	332,941

In addition to the available capacities of Luka Vukovar, according to the port services quality indicators shown below, it can fully meet the expectations in respect of transshipment and biomass transport.

Table 20: Port services quality indicator

No.	INDICATOR	DESIGNATION	BASIS OF COMPUTATION	2016
1.	Annual throughput	Q	Throughput tons in port per month or year	209,665
2.	Ave. turnaround of vessel in port	t	Total value of vessel in port: total no. of vessels	81.43
3.	Throughput per vessel per day/hour	Q/day	Cargo quantity: total dwell time of vessel at berth	2,281.60
4.	Berth utilization	%	Oper. time of vessel at berth *100: no. of berths*360	69.0
5.	Berth occupancy rate	%	Total value of vessel at berth *100: no. of berths*360	17.3
6.	Ave. value of vessel at berth	t-sati	Total time of vessel at berth: total no. of ships	9.50
7.	Berth productivity	Q/berth	Cargo quantity: number of berths at terminal	20,967
8.	Terminal productivity	Q/worker	Cargo quantity: number of workers	78.4
9.	Shift productivity	Q/shift	Cargo quantity: number of shifts*hours	165.30
10.	Transport vehicle productivity	Q/diz	Cargo quantity: trans. vehicle hours of work*no. of trans. vehicles	54.40
11.	Average time t in port	t	Cargo quantity and dwell time from unloading until departure from port: total cargo quantity	592.88

It has already been mentioned that in the hinterland of Luka Vukovar, there is a port Tranzit in Osijek which is equipped for biomass transshipment and transport but does not participate in these operations for two reasons. The first reason is that there are no optimal quantities that would render the river transport acceptable in terms of prices, and the second and perhaps even more significant is that the port is limited in operation during the low water season, but only for goods that arrive or leave by waterway while there are no limitations for goods arriving by road and railway.

It is this low water problem that gives Luka Vukovar a great advantage in directing potential quantities of biomass to river transport, as well as indicators on the import of biomass and refined biomass products to the territory of the Republic of Croatia as well as exports from Slavonia and Baranja.

By analyzing the practice which shows that truck transport is the most common type of transport used today to export biomass and biomass products from the region of Slavonia and Baranja, we have come to the conclusion that there are two reasons for this. The first reason is that the quantities are too small, while the other reason is logistic in nature, the costs of reloading are avoided because the goods are transported by truck from one yard to another, without reloading.

This circumstance also points to the need to establish a collection and logistics center in Luka Vukovar, which would allow the optimal quantities for transport along the Danube river to be collected.

7. Present technical equipment of Luka Vukovar for biomass handling

Technical characteristics of the port system according to the Inland Waterway Navigation and Ports Act: port facilities are operational quays, breakwaters and other hydro-engineering infrastructure facilities in the port, port roads and railways, water supply, sewage and power grid, navigation safety facilities in the port, administrative buildings, warehouses, silos and reservoirs.

Operational quay

The total length of the shore within the port area of the port of Vukovar is approximately 1700, of which 205 meters are constructed as a vertical quay on pilots, 55 meters are vertical full-profile quay, 1000 m is constructed as a sloping quay while approximately 400 m is undeveloped shoreline. On the total length of the operational quay there are 7 berths for reception and dispatch of vessels.

Roads

The internal road system of the port consists of the main port road with a connection to state road D2. The internal port road network is 4,000 meters long. At the entrance to the port there is a further 12,000 m² of parking space and space for motorized individual traffic for arrival and departure.

Railway tracks

In the area of the existing port, between the buildings and the shoreline, there are three operational railway tracks for handling ship-to-shore and loading/unloading from which it is possible to carry out direct transshipment into/from rail wagons into vessels. Within the area of the Vukovar railway station there are four operational railway tracks with manually operated parking and trainset switches, which can be used for marshaling of trainsets for all port operators.

Transshipment facilities

Transshipment facilities at the terminal represent mobile facilities, transport vehicles and devices used for:

- loading, unloading, reloading cargo from vessels or to vessels
- cargo handling within the port area including vessels (tugs, dredges, grab dredgers and barges).

Transshipment facilities include:

- Locomotives DHC 400 and DHC 600 KS

- C-hook for lifting coils with lifting capacity of 25 t
- Grabs for bulk cargo from V=5m³ to V=13m³
- Spreader 20" and 40" containers
- Vehicle transporter:
 - 1) with the load capacity of 3,6 t, L=4m H= 3,4m
 - 2) with the load capacity of 2,5 t, L= 3m, H= 2,7m
- Tugboat-pusher tug PRILJEVO with 480 HP
- 10000 m² of fitted out open storage area
- 3000 m² of enclosed storage area
- 1 x forklift truck with load capacity of 20 t
- 7 x forklift trucks with load capacity of 2 to 5 tons (Linde)
- 2 x ULT loaders
- 1 x mobile harbor crane with lifting capacity of 63 t (Gottwald HMK 170)
- 2 x harbor gantry cranes with lifting capacity of 5/6 t (Ganz)
- 1 x harbor gantry crane with lifting capacity of 16/25 t (Ganz)



Picture 12: Cranes within the area of the concessionaire Luka Vukovar d.o.o.

Table 21: Technical equipment of Luka Vukovar d.o.o. and Vupik d.d.

TECHNICAL DATA	LUKA VUKOVAR d.o.o.	VUPIK d.d.
Terminal purpose	Reloading of cargo on multi-purpose terminal for bulk, palletized, break bulk containers, special cargo	Loading, unloading, reloading, transporting and storing of bulk cargo (grains and oilseeds)
Port position	1334	1336 +000
Operational quay	ca 450m	206
Number of berths	4 berths	1
Type of quay		vertical quay
Cranes	1 x 63 t Gottwald HMK 170	Static reloading tower with a mechanical elevator and transporters, capacity 200t/h (wheat 0.75t/m ³) and automatic vessel shifting system
	1 x 16/27 t Ganz	
	2 x 5/6 t Ganz	
Enclosed storage facilities	ca 3000m ²	48,000 t
Open storage area	ca 15000m ²	
Working machines	7 forklifts trucks with lifting capacity 2.5 – 5 t	
	1 forklift truck with lifting capacity 20 t	
	2 loaders with capacity 3 m ³	
	diesel locomotive	
	pusher vessel 480 HP	
Truck parking space	yes	yes – 50 parking spaces
Own industrial railway track	3 tracks of cca 1300m	Two tracks of total 750m in length
Maximum annual capacity	1,2-1,5 million t	300,000 t

As we have already mentioned, two concessionaires: Luka Vukovar d.o.o. and Vupik d.d. already have the space and equipment for the transshipment of biomass and refined biomass products. However, if the biomass traffic was to develop, both concessionaires would have to strengthen their capacities and acquire additional equipment.

Due to its technical equipment, the concessionaire Vupik d.d. is able to carry out transshipment of biomass based on agricultural products exclusively (e.g. sunflower meal, soybean meal, corn...).

There is no specific equipment for biomass transshipment on both terminals - gripper – log grapples, crusher – wood waste crushers.



Picture 13: Silo and transhipment technology of Vupik d.d.



Picture 14: Aerial view of a part of the area of the concessionaire Luka Vukovar d.o.o.

8. Summary of preliminary development ideas of the port Vukovar

According to the referred data, the area of Slavonia and Baranja is the richest biomass area in Croatia with not even one biomass trade and logistic center (hereinafter: biomass center). The traffic position of the Vukovar Port enables it to be an excellent choice for establishment of the center.

The main goals of the biomass center would be:

- the establishment of the regional biomass center that includes the area of the five counties of Slavonia and Baranja,
- center would provide the woody biomass fuel, wood chips, and other biomass fuels,
- *preservation of the supplying safety, as the provider of all kinds of the biomass*
- providing the service of transshipment while using the inland waterway transport of the biomass
- strengthening of the consistent quality standards (fuel quality, service providence)

After the establishment, the center would provide an offer which would include energy wood, wood chips and split logs. In further development, the product range of the Port could be supplemented with pellets and other alternative products of the agricultural origin.

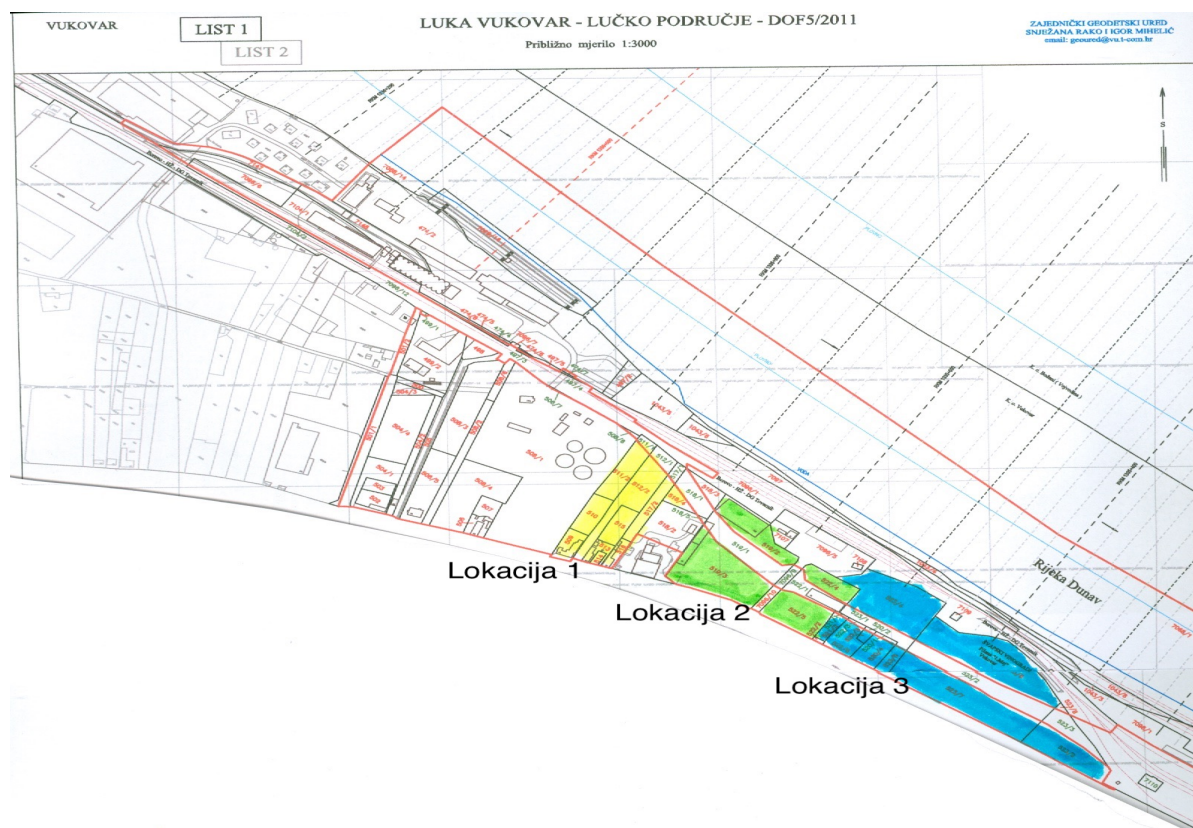
Within the existing port area there is the area of approximate 26 h that is occupied with the prevalent concession agreements so there are three available locations suitable for the establishment of the biomass center. Port's Vukovar harbor area will be denied of its share of the existing tract that will be excluded from the port area by passing the international railroad M601 which is the part of the project called: "Upgrading And Electrification of the Existing Railway Lines of Importance For the International Traffic M601 Vinkovci –Vukovar".

With the railway passing through and dividing the port area into two, the part next to Priljevo Street has the approach to the operable quay only through two level crossings.

Three potential locations are charted on the following graphic display in order to choose the most convenient location according to the needs of the future center and minding the size and the position within the port area.

When comparing the possible biomass center locations, it is noticed that the first location (yellow) is the smallest area of 9.126,62 m², the second location (green) is bigger - 11.127,09 m², and the third possible location (blue) is the biggest with 22.682,01 m².

Overview of the parcels which are within the port area is given for all the three locations.



Picture 15: Display of the possible port Vukovar's biomass center location

Table 22: The area of the first possible biomass center location

CADASTRAL PARCELS BELONGING TO THE PORT AREA - 2017.						
no.	LAND PARCELS THAT ARE PARTLY WITHIN PORT AREA	CADASTRAL PARCEL NO	LAND REGISTER FOLIO NO	PARCEL AREA ACCORDING TO LAND REGISTER FOLIO	OWNER	AREA OF THE WHOLE OR PART OF THE PARCEL WITHIN PORT AREA
1.		513	1752	442	RH - port authority	434,98
2.		514	1752	136	RH - port authority	141,52
3.		515	1752	919	RH - port authority	945,33
4.		516	2120	421	RH - port authority	430,04
5.		509	2675	779	RH - port authority	777,76
6.		510	2675	1069	RH - port authority	1.064,30
7.		512/2	4572	2425	RH - port authority	2.426,95
8.		511/2	5885	1483	RH - port authority	1.483,32
9.		517/2	9858	981	RH - port authority	982,18
10.		518/4	11561	440	RH - port authority	440,24

9.126,62

In its background, the first suggested location has not got a direct approach to the operable quay which is situated in a parallel direction with the stated particles. The only possible way of connecting with the operable quay is through the two-level crossings.

The second possible location includes the particles whose direct approach to the undeveloped part of the coast (180 m of the coast) could be enabled by the means of the existing road. Suggested particles are not situated next to each other. They are separated by the railway route, but the mutual approach is insured through the level crossing.

Table 23: The area of the second possible biomass center location

CADASTRAL PARCELS BELONGING TO THE PORT AREA - 2017.						
no.	LAND PARCELS THAT ARE PARTLY WITHIN PORT AREA	CADASTRAL PARCEL NO	LAND REGISTER FOLIO NO	PARCEL AREA ACCORDING TO LAND REGISTER FOLIO	OWNER	AREA OF THE WHOLE OR PART OF THE PARCEL WITHIN PORT AREA
1.		522/4	3072	1198	RH - port authority	1.199,35
2.		522/5	3072	2384	RH - port authority	2.385,55
3.		519/2	9366	2459	RH - port authority	2.465,03
4.		519/3	9366	5073	RH - port authority	5.077,16

11.127,09

The third possible location would be within one part of the port area whose existing concessionaire the Vukovar Port d.o.o. would be granted to perform the work of the biomass center on the part of the area he has the access to according to the concession agreement. At the moment, the concessionaire does not perform transshipment and warehousing activities on the area. The river bank on the sight is partially regulated but to provide the safe mooring additional terminal would have to be built.

Table: 24: The area of the third possible bio mass center location

CADASTRAL PARCELS BELONGING TO THE PORT AREA - 2017.						
no.	LAND PARCELS THAT ARE PARTLY WITHIN PORT AREA	CADASTRAL PARCEL NO	LAND REGISTER FOLIO NO	PARCEL AREA ACCORDING TO LAND REGISTER FOLIO	OWNER	AREA OF THE WHOLE OR PART OF THE PARCEL WITHIN PORT AREA
1.		520/4	1762	961	RH - port authority	961,81
2.		522/6	1762	1052	RH - port authority	1.053,15
3.		521/2	3546	450	RH - port authority	449,98
4.		523/4	6590	4633	RH - port authority	4.636,39
5.		523/5	6590	492	RH - port authority	492,13
6.		523/6	6590	6284	RH - port authority	6.288,85
7.		523/7	6590	5881	RH - port authority	5.885,44
8.		523/8	6707	81	RH - port authority	80,93
9.		523/9	6707	2632	RH - port authority	2.634,03
10.		520/3	11554	147	RH - port authority	146,78
11.		522/2	11554	51	RH - port authority	52,52

22.682,01

All the three-possible location would require the establishment of the infrastructure for the biomass center: warehouse building, paved manipulation area and calibrated platform scale.

It is expected for the port to participate in the river transport of the biomass in the future, so the third location has the significant advantages due to the availability of the river bank, which should be brought to port purpose in order to perform the transshipment of the biomass. It is possible to

organize the unregulated river bank as the vertical coast or the leaning coast. Also, the position of the crane moving on the crane track or the mobile crane has to be foreseen.

The biomass center equipment implies the gadgets and transshipment mechanization intended for the biomass loading and unloading: fork-lift trucks, scattered biomass loader, log loader. It is necessary to provide the basic utilities (gas, electricity, water, sewerage, telecommunications)

The advantage of third location presented in this paper is that it has been run by the concessionaire Vukovar Port d.o.o. that already owns the harbor equipment: cranes, fork-lift trucks and the 3000 m² closed warehouse nearby. It can start the production of the biomass even before the repurposing of the location.

At the same time, we find that the size of the third location enables the existence of the biomass center and the biomass storage which will be transported or transshipped. Its size also enables the establishment of the pellets production which is the next phase in the biomass center development.

The fourth location that could be possible would be outside the existing port area. According to Vukovar Port Master plan development, it would be situated upstream the existing port, in the New Port – West area from 1336 +000 to 1337 +000 on the river bank or in the hinterland.

Regardless of the biomass center location choice, future concessionaire should:

- build closed and opened warehouse buildings,
- paved manipulation area,
- provide moisture measurement in warehouse buildings to ensure product quality,
- provide calibrated platform scale,
- provide one mobile crane,
- fork-lift trucks and loader trucks,
- provide tuck access,
- provide suitable office-sales space as well as access to future customers of the Center

In order to ensure the suitable biomass and refined products port transport services requirement, it is necessary to regulate the unregulated part of the river bank on the third location.

As we have already stated, the second phase of the biomass center development foresees the establishment of the pellet production plant.

With the second phase of the project the feasibility study will be made and it will be necessary to analyze location mentioned above to choose the most appropriate and optimal solution that would enable long-term Center development, together with enabling the biomass and refined products transport port capacity development. Therefore, given the possible alternative solutions, it is not possible to indicate the framework value of the investments required at this moment.

However, it should be stressed again that both the future Center and the Port have the reason to believe that quantities of biomass located in the hinterland of the Port and the fact that even today most of the rural areas of Slavonia and Baranja use biomass for the production of energy, either thermal or electrical are good arguments for development of this project. The immediate proximity of urban settlements also opens up the possibility of promoting biomass usage as a cheaper solution, and all indicators indicate that this area is developing in Croatia as well as the relevant market.

To increase overall volumes of cargo in ports is to make inland navigation more attractive in comparison with other transport modes. According to some interviews to our stakeholders conducted in WP 4 and collected results, it is obvious that biomass itself and final products made of

biomass are not suitable for too many transshipment operations (loading/unloading) because it raises overall transportation costs.

One of the measures to move biomass from road transport would find the model of reducing overall expenditures (transshipment fee, port due, storage fee) giving the potential customers opportunity to use ports as centers where they could store higher quantities of biomass that could later be transported with vessels to the final destination.

Another positive effect in rehabilitation of inland navigation could be installation of new capacities of bio gas and biomass powered plants near ports and in close vicinity of agricultural and forests areas that could be mutually source for plants but also source of raw material for the market.

In Croatia, improvements on plan of rehabilitation of inland navigation and biomass sector are only possible with common effort and joint approach to this issue, involving all interested parties from Ministry of sea, traffic and transportation- Directorate for inland navigation, Croatian chamber of economy, Ministry of economy, entrepreneurship and crafts, Ministry of Environment and Energy, policy makers but also all stakeholders who carry out policies and activities.

9. List of policy and stakeholders to be involved

Policy makers

- The city of Vukovar
- Vukovar-Srijem County
- Ministry of finance Custom office of Vukovar
- Port authority of Vukovar
- Ministry of the sea, transport and infrastructure

Port authority and ports

- Port Vukovar
- Port Tranzit u Osijeku
- Port authority Osijek

Other providers of logistics service

- HEP - operator distribucijskog sustava d.o.o. Vukovar
- Vupik d.d. Vukovar
- PIK Vinkovci d.d. Vinkovci
- Dunavski Lloyd Sisak
- Belje d.d. Darda
- Ricardo d.o.o. Vukovar

Biomass associations

- A-pelet d.o.o. Oprisavci
- Euro-tim d.o.o. Trviž, Pazin
- Uni Viridas d.o.o. Babina Greda

Biomass suppliers

- Hrvatske šume d.o.o. Zagreb
- Hrvatske šume d.o.o. Uprave: Osijek, Vinkovci, Nova Gradiška, Požega i Našice
- Spačva d.o.o. Vinkovci
- Agro Tovarnik d.o.o. Tovarnik
- Arator d.o.o. Lovas
- Tvornica ulja Čepin
- Žito grupa Osijek
- A.M.S. Biomasa d.o.o. Darda
- Agrokor Energija d.o.o. Zagreb
- Šumska biomasa d.o.o. Zagreb
- Progresys d.o.o. Nova Gradiška

Other stakeholders

- Croatian radio Vukovar