BioRES - Sustainable Regional Supply Chains for Woody Bioenergy

Milestone Report about priority locations for new Biomass Logistic and Trade Centres in

Bulgaria, Croatia and Serbia

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List of abbreviations

BLTC	Biomass Logistic and Trade Centre
cbm	cubic meter
CHP	Combined Heat and Power
DH	District Heating
DKTI	German Climate and Technology Initiative (Deutsche Klima- und Technologieinitiative)
doo	Limited Liability Company
EBRD	European Bank for Reconstruction and Development
ENplus	Wood Pellet Quality Certification
FSC	Forest Stewardship Council
GHG	Green House Gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
ha	Hectare
KfW	German Development Bank (Kreditanstalt für Wiederaufbau)
km	Kilometer
kWh	kilo Watt hour
LNG	Liquid Natural Gas
MW	Megawatt
NP	National Park
PE	Public Enterprise
PEFC	Programme for the Endorsement of Forest Certification
PJ	Peta Joule
PPP	Public and Private Partnership
PSEMR	Provincial Secretary for Energy and Mining
PSP	Provincial Secretary for Agriculture
RES	Renewable Energy Sources
szr	Independent Craftsmen Store
t	Ton
UNDP	United Nations Development Programme
WP	Work Package

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Project overview: BioRES – Sustainable Regional Supply Chains for Woody Bioenergy

BioRES aims at introducing an innovative concept of Biomass Logistic and Trade Centres (BLTCs) in Serbia, Croatia, and Bulgaria based on cooperation with technology leaders from Austria, Slovenia, Germany, and Finland. This will help increasing the domestic demand for woody bioenergy products such as processed fire wood, wood chips, wood pellets, wood briquettes or charcoal in these countries and contribute to the achievement of EU targets set out in the RES Directive (2009/28/EC).

Summary of Results - Selection of priority locations for the establishment of BLTCs

15 priority locations for new BLTCs are identified achieving an important benchmark of the project. The 15 priority areas are distributed as follows: **3 in Bulgaria, 6 in Croatia and 6 in Serbia.**

As a result of the 1st international webinar with key stakeholders from the three implementing countries, four essential criteria have been identified which provided the basis for pre-selecting locations in Croatia, Serbia and Bulgaria. As a next step in a dialogue process local stakeholders and potential investors interested in BLTC development in these areas were identified.

The identification process of priority locations is based on 3 main interventions:

1) Assessment of developed criteria
2) Results from key stakeholder consultations involving both producers and potential users of woody bioenergy products
3) Assessment of regional market potentials of supply and demand for each location

Report structure and methodology

The process of identifying potential BLTC locations in Bulgaria, Croatia and Serbia is presented in three country specific parts of this report: (The National Biomass Association of Bulgaria for Bulgaria, the North-West Croatia Regional Energy Agency for Croatia and the Serbian National Biomass Association for Serbia under the coordination and guidance of North-West Croatia Regional Energy Agency (REGEA). Each partner organization takes the sole responsibility for the content of their respective country report. The general structure and methodology for all three countries is primarily based on:

- ✓ Criteria checklist for the selection of priority locations for new BLTCs (Annex I);
- ✓ Checklist used in section 2 Local market assessment of supply and demand (checklist form in Annex II); and
- ✓ Semi-structured questionnaire used in section 3 Stakeholder consultations (questionnaire form in Annex III)

As a prerequisite, all 15 priority locations meet all of the 4 essential criteria for the selection of priority locations for the establishment of new BLTCs namely:

1. FINANCE OPTIONS: existing interest of private investors/local authorities
2. MARKET DEMAND: existence of consumers
3. KNOWLEDGE: existing awareness of the population
4. SUPPLY: woody biomass potential and existing supply chains (30-40 km radius)

In all three countries local stakeholders along supply chains for each priority location are identified. In each location at least 5 types of stakeholders have been interviewed using the

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semi structured interview questionnaire (Annex III) representing one of the following stakeholder categories: investor, local authority, forest owner, consumer, national authority.

BioRES definition of BLTC

Within the scope of BioRES the following generic criteria apply:

1. *"A BLTC is a local or regional centre with optimized logistics and trading organization, where different woody bioenergy products (or heat) are marketed at standardised quality focusing on the domestic market uptake*".
2. At the initial investment stage, a BLTC can be a marketing and sales platform
   → can develop into a BLTC with its own production, storage and logistic facilities when the local market reaches critical volumes allowing the amortisation of investments
3. A BLTC develops adaptive business models for competitively operating as intermediator organising regional bioenergy supply chains
   Requirements:
   1) Nomination of executives representing the BLTC
   2) MoU/statute of BLTC constituting for supply and sale contracts

In case of Bulgaria and Serbia this generic BioRES definition will apply, while for Croatia additional criteria have been agreed upon:

- own storage capacity (infrastructure); and
- biomass processing machinery (for example chipper, splitter)

The respective definition of BLTC will be applied throughout the project.

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Part I: Country report BULGARIA

prepared by National Biomass Association of Bulgaria (BGBIOM)

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1. Overview of priority locations

1.1. Background

Bulgarian forests are mostly situated in the mountain and sub-mountain areas with small parts near rivers and dams. Most of the old forests are in the national parks and under Natura 2000 protection. The biggest forest area lies in the Stara Planina and Predbalkan region with 34% of forest (38% of timber reserves) and Rodopi Mountain – 23% (27%). The total wood resource of Bulgarian forests is approximately 650 Mio m³. In the last years, 6-7,5 Mio m³ of standing dead wood and 5-6 Mio m³ of lying dead wood have been yearly produced with the possibilities of an increase up to 14 Mio m³ annually.

Definition of BLTC and initial status of operational BLTCs in the country

In identifying stakeholders and potential investors, the generic definition of BLTC was used. As investment funds are limited, the concept of a marketing sales platform for organising trade and logistics is introduced at the first phase. The investment in physical infrastructure is suggested as next phase if the market is stable and expanding during the operation of BLTC. In Bulgaria there are some biomass centres that are selling biomass boilers, solar panels, biogas boilers and other tools for heating, and provide education for installers. Firewood is traditionally used in all parts of the country due to its low price and initial investment. In rural areas the population has some quota for logging or ready-to-use firewood organised by the population. In all priority locations wood residues and certified pellets and wood chips will be of primal interest. In the location of Chepelare the BLTC could expand existing supply and demand chains and create new ones. In location of Borino the focus would be on mobilising production as the demand is increasing. In location Marica the BLTC would provide a platform helping customers accessing woody energy products and information and arranging deliveries.

Analysis of Priority locations

The National Biomass Association of Bulgaria (BGBIOM) consulted regional and national stakeholders, including: Sustainable Energy Development Agency; State Forestry Enterprises and State Forest Departments; Black Sea Regional Energy Centre; Union of Energetics; University of Forestry; University of Agriculture; Regional Union of Machinery; University of Food Technologies (which has studies in heat technologies). Taking in mind the distribution of forests, forest use, industrial development, supply and demand for woody biomass, and the opinions of contacted national stakeholders, several preliminary locations have been identified:

- The regions in the Central and Western parts of Rodopi mountain, with highest reserves of pine timber and relatively high production of woody biomass products;
- Marica – which is near the big city of Plovdiv with high demand of woody bioenergy products, including pellets and logged wood for household heating, wood chips for industrial heat and many municipal buildings which have the intent to switch from

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fossil fuels. The location is near the Rodopi Mountains and has existing supply chains for wood products from there.

- South-Eastern region – It includes Haskovo with pellet factory and pellet boilers and is an important centre for exporting wood products to Turkey and Greece.
- North-Eastern region – in this location there are no identified pellet, wood chips or briquette producers. The demand is high but the main supply chain is from agricultural residues. In this location several potential stakeholders were contacted and interviewed (2 interviews from energy consulting companies and 1 from the municipality). The main biomass energy actor in the region, Black Sea Regional Energy Centre, informed about some ongoing biomass projects but BLTC from woody biomass will be difficult to implement as woody biomass is not available in this area.

In all these locations and in the radius of 40km stakeholders were identified and contacted, including local authorities, wood biomass producers, forest owners and state forest departments, potential consumers and investors. At the first contact the National Biomass Association of Bulgaria introduced the BLTC concept to stakeholders, as this concept is new in Bulgaria and was not introduced by previous projects. On 19th March 2015 the project was presented on a seminar organized by local unit of "Scientific and Technical Union - Bulgaria" and Regional Union of Machinery. The main topic of the seminar was "Energy from Biomass" and the audience was more than 50 people from business, science institutes and universities from different parts of Bulgaria. After that, interview questions were sent or meetings scheduled with stakeholders who expressed interest in the project.

In all analysed locations there are stakeholders interested in organising the local supply and demand of wood products. But some of those stakeholders have no funds for investments. However it will be difficult for outsiders to invest and be accepted by local actors. Some stakeholders fear price uptakes if there will be more intervention as in their view forest owners or pellet producers have organised their work in the best possible way for the local economy climate.

The main stakeholders for the pre-identified location in Haskovo, including the state forest department, did not respond or expressed support to the project. The most important company in the region, Erato Holding, is working in the field of bio-energy and heating on RES, including pellet boilers expressed no interest in BLTC development as they already have their own supply chain, educational courses, and dissemination activities and provide logistic of fuel to their biggest customers in Haskovo, Plovdiv and Sofia. As a result the location was omitted.

In the pre-identified location of Rakitovo the local authorities and forest department did not agree to do the interview or were not very interested. Some pellet producers in Rakitovo express the opinion that such centre will have problems with finding enough raw materials as the logging and forestry companies have long term contracts with pellet producers. They are not interested in BLTCs as most of their production is exported to Italy and the buyers

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provide all logistic and transport services. All the remaining woody biomass is sold to several hotels and municipal buildings in the SPA resort in the region. One producer from Rakitovo agreed to cooperate and tried to find additional interested producers, but without success. In the last years business project for increasing local use of woody biomass has been tried without success.

The reasons for low interest in some pre-identified potential locations include:

- no access to financial tools for initial investment;
- little or no understanding of quality standards for woody energy products
- limited access to bank credit lines for green energy
- unwillingness of rural population to cooperate locally
- little or no political support;
- distrust in EU projects due to problems with access to EU funds in the past
- lack of management plan for wood residues in the forests;
- lack of qualified management staff in rural areas.

2015 a new programme period for national subsidies has started. In it the support for woody biomass was reduced dramatically. There were specific state subsidies that were available for building biomass plants in rural and mountain areas and for fuel switch in municipal and public buildings. These subsidies were under measure 124 of Operational program "Development of rural areas" in the ministry of regional development (active in the program period 2009-2014). In the new program period 2015-2020 the funds are redirected to energy saving and efficiency. The renewable energy targets for 2020 are reached with solar, wind and water power plants. Bulgaria had previously agreed to produce 16% of its energy from renewable sources by 2020. This goal was achieved in 2012 and in 2013 the target was exceeded to a 19% share. The population is unhappy as the feed-in tariffs for RES lead to increase in the price of the electricity and this lead to political consequences. There are still feed-in tariffs for electricity from biomass (including wood) but the population is raising issues that the high electricity prices are because these feed-in tariffs. Last year the feed-in tariffs for electricity form woody biomass were decreased by 10-35%.

There was a specific credit line for supporting business projects in the field of green energy producing and energy efficiency. The credit line was called Bulgarian Energy Efficiency and Renewable energy Credit Line (BEERECL) and was supported by European Bank for Reconstruction and development. In Bulgaria, it was implemented through eight commercial banks disbursing EUR 150 million of possible financing. According to the information from the banks and in public press, the credit lines was stopped (or suspended) in the beginning of this year.

As consequence of the outcome from stakeholder consultation, market assessment process, and described challenges the National Biomass Association of Bulgaria in consultation with other consortium partners re-evaluated pre-identified locations. This re-evaluation process and intensification of awareness raising about the BioRES concept resulted in the identification of 3 priority locations in Bulgaria.

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1.2. Priority locations

The following priority locations for BLTCs in Bulgaria have been selected:

1. Location **Borino**
2. Location **Marica**
3. Location **Chepelare**

The priority locations are indicated in the map below:

Description of locations and rationale for selection

1) Location Borino

The location is centred in the area of the village of Borino. It is situated in the southern part of the Rodopi mountains, between the cities of Dospat and Devin. The area is highly forested. The municipality of Borino has 3500 inhabitants mostly working in the field of forestry, woodwork and tourism. The neighbouring municipalities of Devin and Dospat have 13500 and 9000 inhabitants respectively.

The main mountain roads are in the neighbouring Dospat and Devin municipalities and are some 20 km away.

In the area there are six state forestry departments with forest areas of over 65000 ha with annual timber use of 150,000 m3. More information on wood supply will be given in the next chapter.

The main industry in the area is forestry and wood processing as well as recreational and eco-tourism. In the area there are a few big pellet factories that export to Greece and Italy and many entrepreneurs producing small quantities of pellets and wood chips for Bulgarian and local market.

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The main part of the firewood production is used in local households, while the production of pellets and wood chips is exported or transferred to industries in the regions of Peshtera and Pazardzhik. The production of pellets by private entrepreneurs is sold locally to hotels and SPA complexes. There are several public buildings that use pellet heating (incl. nurseries, hospitals, dormitories) and many private hotels and houses. Some of the hotel owner showed interest in the development of the project as it will stabilise the local supply of fuel. In the village of Barutin (Dospat municipality), 20 km away from Borino, there is a biomass power plant with a potential to use 13000 ton of wood residues to produce 625 MWh of electricity and 24000 MWh heat. The stakeholder from the power plant expressed the opinion that BLTC development will stimulate the remaining of the wood biomass in the region instead of exporting it, which will strengthen the local economy. The municipalities in the region hope the project can raise the awareness of local people for sustainable forest use. But the limited budget of the small municipalities and limited administrative capacities could prevent them from active participation in the building of BLTC.

In this location the National Biomass Association of Bulgaria is in contact with an interested potential investor expressing that in the area there is no such logistic centre and it will be helpful if it stimulates the local people to use the wood material more efficiently. Hotels and industries in the region are planning to use the wood potential in the region to reduce their expenses.

2) Location Marica

The location is centred in the Marica municipality. The municipality with 23300 inhabitants has 19 villages with total of 33000 inhabitants. The location is near the town of Stamboliyski, between the Marica River and Rodopi mountains.

The municipality of Marica is situated on the both sides of the main Bulgarian highway “Trakia” part of which is merged with the international E80 route. There are many wood processing factories in the area, including a big paper factory. There are pellet factories in Plovdiv.

The location has high demand for wood pellets for household heating in the winter and wood chips in the factories in the nearby industrial areas. Many animal and crop farms as well as food industries are potential wood chips buyers. The big city of Plovdiv is nearby and there are many private houses and block of apartments that use pellet heating. The private customers attempt to organise themselves and the pellet market to ease the access to wood energy products in a predictable way.

Apart from private houses and apartment blocks in the cities big industrial areas between Stamboliyski and Plovdiv intend a fuel switch. One of the biggest consumers of wood chips and pellets for industrial heat is Vinprom Peshtera SA, a leader in the production of alcoholic beverages and quality wines.

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In the location there are several pellet factories and wood trade centres that have expressed interest in implementing new BLTC as an expansion to their work.
The municipality's concern is to stimulate the private consumers switching from coal and firewood to pellets, briquettes and/or wood chips as this will reduce the ash content in the air during winter. The municipality is not in favour of firewood as good energy source in the cities.

3) Location Chepelare

This priority location is in the area of the city of Chepelare. It is situated on the road 86 from Plovdiv to Smolyan. This road is planned to be extended to Greece and then the border should be 60 km from Chepelare.
The town of Chepelare has 7700 inhabitants and the neighbouring regional centre Smolyan has 41000 citizens. The distance between them is 27 km. In the middle of Chepelare and Smolyan there is a big ski and recreational resort of Pamporovo. Its many hotels use electricity, gas, solid oil and firewood for heating.

The area of Chepelare municipality has 17000 ha of private forest. Some of the private forest owners are organized in forest cooperatives. Nearby are the state forestry departments of Hvoyna with 19000 ha of forests, Smolyan – 22700 ha, Smilyan – 31000 ha, Shiroka Laka – 9000 ha. The forests are mainly of coniferous species, like pine, fir and spruce.

The main industry in the area is forestry and wood processing as well as ski and eco-tourism. There are several wood processing factories and small pellet and wood chips producers. The small quantities of pellets, produced locally are used in municipal buildings and private hotels. The wood residues from wood processing are transported to the furniture factory Kronospan in Bourgas, which is 300 km away.
The location was prioritized as it is one of the locations with highest share of private forests (>50%) and one of the biggest private forest owner associations - "Gorovladelets". Municipal heating is based on woody biomass. The market in the area is expanding and is very dynamic but little organised. Most of the wood residues are not used locally and there is no big pellet producer in the municipality. The local association of private forest owners and the municipality of Chepelare are potential investors for a BLTC in the region.
The municipalities of Smolyan and Chepelare are interested in the project for raising awareness of sustainable forest use and providing new workplaces, reducing the unemployment. They are interested in increasing local pellet producing as many municipal buildings use pellets for heating. The forest owners and regulatory organisations hope that the project can mobilise wood residues in the forests. The main challenge in the region is the concurrency of the two cities (Smolyan and Chepelare) in organising the regional market.

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2. Assessment of local market potentials

The assessment of local market potential is based on stakeholder interviews in the priority locations and conversations with national and local authorities in the forestry and energy sector. Provided data are based on the interviews, national statistics, the Sustainable energy development agency (SEDA) and South-central state forest enterprise (UCDP-Smolyan).

2.1. Supply

Availability of woody biomass in the location

The forests in all priority locations are under the jurisdiction of South-central state forest enterprise (UCDP-Smolyan). In the 40 km radius around every location the local forest departments are identified and contacted to assess the wood and timber reserves.

Forest dept.	Distance from location, km	Forest area, ha	Annual timber use (avg), m3	Forest roads, m/ha	Forest ownership (state / private / municipal), %	Main tree species	Forest Certification
Location Borino							
Borino	0	10782	17786	6.5	83 / 4 / 13	Spruce, pine	No
Dospat	17	18283	59331	No data	99 / - / -	Spruce, pine	No data
Trigrad	20	10257	25374	5.6	No data	Spruce, pine	No data
Izvora	23	16403	30462	No data	86 / 4 / 10	Pine	No
Shiroka Polyana	35	10989	25374	5.6	100 / 0 / 0	Spruce, pine	FSC
Location Marica							
Trakiya	33	27139	47864	No data	80 / 13 / 7	Oak pine, beech, spruce	No
Plovdiv	10	18836	21881	No data	99 / - / -	Oak pine, beech, spruce	No data
Location Chepelare							
Hvoyna	10	10067	20787	6.4	35 / 60 / 5	Spruce, pine	FSC
Smolyan	30	17185	27190	6.0	60 / 36 / 4	Pine, spruce, fir, beech	FSC
Shiroka Laka	25	1869	6203	No data	20 / 75 / 5	Spruce, pine	No

Source: South-Central Forest Enterprise, Ministry of Agriculture and Food (May 2015)

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Biomass potential as energy products

The largest share of wood is used in the primary and the end energy consumption in the country. The mean annual volume of production achieved by the companies varies among 250-10000 t of pellets, 400-1100 t of briquettes and 100-5000 t of charcoal, respectively. The low volumes are typical for the small factories while the high ones are achieved by the large scale producers as plants. About 60% of the manufacturers of pellets are using small press machines.

The overall production of pellets from woody biomass in Bulgaria is shown on the figure:

Source: Scientific Paper [*Lyubcho Trichkov, Dinko Dinev, "STATE AND TRENDS FOR UTILIZAION OF THE WOOD BIOMASS FOR BIOFUELS IN BULGARIA" 47th International Symposium on Forestry Mechanisation: "Forest engineering: propelling the forest value chain", September 23-26, 2014 in Gerardmer, France*]

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In the priority locations there are many of private logging companies and small pellet producers which do not provide data of their production. There is no official organization of pellet producers in Bulgaria and data is based on estimations, as the producers consider this as confidential. Moreover, in rural locations there is a big number of pellet presses with very small capacities that are used for local needs. Their production cannot be counted and their demand for raw material is unknown. The bigger companies provide information of production capacities but not the actual load of machines.

Main woody biomass producer

The majority of forests in the locations are managed by state forest departments in the regions. The producers of woody biomass are mainly private companies that win the right to use the state forest resources by public tenders. The forest departments organise the tenders and monitor the work but the governing state enterprise for all three locations is UCDP-Smolyan. South-Central State Forestry (called UCDP Smolyan, as the headquarters is in the city of Smolyan) manages 36 regional departments of which 29 are forest departments and 7 hunting departments. The enterprise manages the state forests in four counties (Plovdiv, Smolyan, Pazardzhik, Kardzhali) with total size of 856 231 ha, 59% of which are part of »Natura 2000«. The most common tree species are: pine – 31%; spruce – 15%; fir – 9%; oak – 18%; beech – 15%. The total wood reserves are estimated to 132 Mio cbm and the average age of the tree is 62 years. The annual use of timber is 1.1 Mio cbm, which is 47% of the annual growth.

Overview of wood processing companies per location

In the locations of Borino and Chepelare there are many forest companies. Many small enterprises for wood-work use the timber for producing building materials or raw material for furniture. In location Marica there is a big paper factory and many surrounding small factories extract cellulose from raw material and use residues for producing chips and pellets. These companies will play an important role in supplying the BLTCs with raw biomass material. Some of them expressed interest in participating in BLTC consortium formation while others are interested in contracts for supply of wood and wood residues.

Some of the wood processing companies in the regions are contacted during the selection of priority location. The most important ones are shown in the table.

Location	Sawmills	Forest works
Borino	Borikom-Amt	Borikom-Amt
Borino	-	ET Gluharche – Zdravko Lohovski
Borino	-	Forestry “Borika”
Borino	-	Tehnika de Evropa
Marica	Mondi Stamboliyski JSC	Valkin Les Ltd
Marica	-	State Forest Department Plovdiv
Chepelare	ET TONIKI - Mariyana Belovodska	ET TONIKI - Mariyana Belovodska
Chepelare	Nefertiti Vardjievi Ltd.	Nefertiti Vardjievi Ltd.
Chepelare	Yola OOD	Forestry “Borika”

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2.2. Demand

The total distribution of energy consumption per type of energy product and specific for households is shown in the table below.

Structure of energy products consumption
(Per cent)

2008	2009	2010	2011	2012	2013	
100.0	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**Final energy consumption - total**
4.8	3.7	4.6	4.5	4.2	3.9	Coal
1.3	0.3	0.3	0.6	0.6	0.5	Fuels from coal and lignite
37.3	38.6	36.0	33.4	34.3	32.3	Crude oil and petroleum products
12.9	10.0	10.5	11.9	10.8	11.4	Natural gas
25.8	27.2	26.7	26.9	26.4	27.5	Electricity
9.7	11.0	11.0	11.5	10.9	10.5	Heat
8.3	9.3	10.9	11.3	12.8	13.9	Biomass and IW
100.0	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**Final energy consumption in households**
8.4	7.0	8.3	8.7	8.6	7.2	Coal
1.5	1.0	1.1	2.0	2.2	1.9	Fuels from coal and lignite
1.1	1.2	1.0	1.2	1.1	1.1	Petroleum products
1.8	2.4	2.2	2.3	2.2	2.0	Natural gas
40.6	41.2	40.1	39.2	39.2	40.1	Electricity
16.5	16.8	15.6	15.0	14.5	14.1	Heat

(Source: NSI: Energy Balance Sheet 2013)

The actual final energy consumption by industry and by households in tonnes of oil equivalent is shown in the table below.

Final energy consumption by energy products
(Thousand tonnes of oil equivalent)

2007	2008	2009	2010	2011	2012	2013	
9748	**9552**	**8493**	**8720**	**9050**	**9044**	**8598**	**Total**
3831	3451	2443	2549	2693	2576	2579	Industry
2073	2125	2149	2262	2391	2377	2257	Households
516	**455**	**310**	**402**	**407**	**380**	**334**	**Coal**
346	267	152	207	193	169	160	Industry
161	179	150	187	207	204	163	Households
296	**125**	**27**	**27**	**53**	**54**	**45**	**Fuels from coal and lignite**
231	90	1	-	2	1	1	Industry
63	32	22	26	49	53	43	Households
3705	**3561**	**3281**	**3135**	**3027**	**3098**	**2775**	**Crude oil and petroleum products**
818	596	375	320	213	206	205	Industry
26	23	26	22	28	25	24	Households
1301	**1231**	**849**	**916**	**1073**	**981**	**978**	**Natural gas**
1131	1041	657	696	845	758	756	Industry
33	39	51	49	56	53	45	Households
2339	**2462**	**2309**	**2328**	**2434**	**2389**	**2367**	**Electricity**
875	899	725	673	726	708	733	Industry
806	862	886	908	938	932	906	Households
815	**925**	**931**	**958**	**1037**	**982**	**906**	**Heat**
313	463	455	480	520	518	475	Industry
377	351	361	354	359	344	318	Households
776	**793**	**786**	**954**	**1019**	**1160**	**1193**	**Biomass and IW and other RES**
117	95	78	173	194	216	249	Industry

(Source: NSI: Energy Balance Sheet 2013)

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Households

There is no published data about consumption of wood energy products for regions and municipalities. According to press 31% of households use logged wood for heating, 28.6% - electricity, 0.7% - gas. In the big cities 38.3% of households use electricity for heating, 22.8% - logged wood or wood products, 22.7 – distinct heating. In the rural and forest areas 62.8% of households use firewood (or any other wood products) for heating, 32.4 – some kind of coal, only 4% use electricity (newspaper "Sega", volume 4683 (106), 09/05/2013, Desislava Koleva, "Analysis by the Centre for Research of Democracy"). Location Marica is in urbanized area, so it can be assumed that 22.8% of the households use wood products for heating. The two other priority locations are in rural, forest areas and could be assumed that 62.8% of households use wood products for heating. Location Borino includes the municipalities of Borino (3600), Dospat (9000) and Devin (13000). Location Chepelare includes municipalities of Chepelare (8000) and Smolyan (41000) as well as several small municipalities in between. Location Marica, which is in the Plovdiv region, can cover the city of Plovdiv (340000) and Marica municipality (32000). Using above data and assumptions the rough estimation of the consumption of wood energy products for heating in the locations is as follows: Borino – 62.8% of 25600, or around 16000 people; Marica – 22.3% of 372000, or around 85000 people; Chepelare – 62.85 of 49000, or around 31000 people.

In all of the priority locations there is increasing interest in using woody biomass products for heating. In the case of firewood the driving force is the low prices of fuel and very small initial investment in stoves or fireplace. In the case of pellets the driving force is the ability to automate the burning and the decreased amount of ash in the smoke, ease of cleaning and no need for additional preparing of the fuel.

In Borino and Chepelare most of the private houses traditionally use firewood for heating but more are changing to high energy value products as pellets or briquettes and even more plan to make a switching.

In location Marica, in last few years the number of households with local heating on firewood is increasing fast and the number using pellets even faster. One reason for this is the increasing prices of electricity which was the preferred option for heating in cities. In the location there are Distinct heating companies that are competing on the market for heat but the infrastructure is developing slowly and there are uncertainty with prices and the way of measuring the consumption. In this location, meetings were taken out with groups of private customers that organise themselves for buying pellets. With organisation the cost of pellets is lower and the transport, logistic and storage is easier. Typical size of such organisation is 5-10 households with overall consumption of 30-60 tonnes per year. Such organisations occur for buying firewood but with lower quantities.

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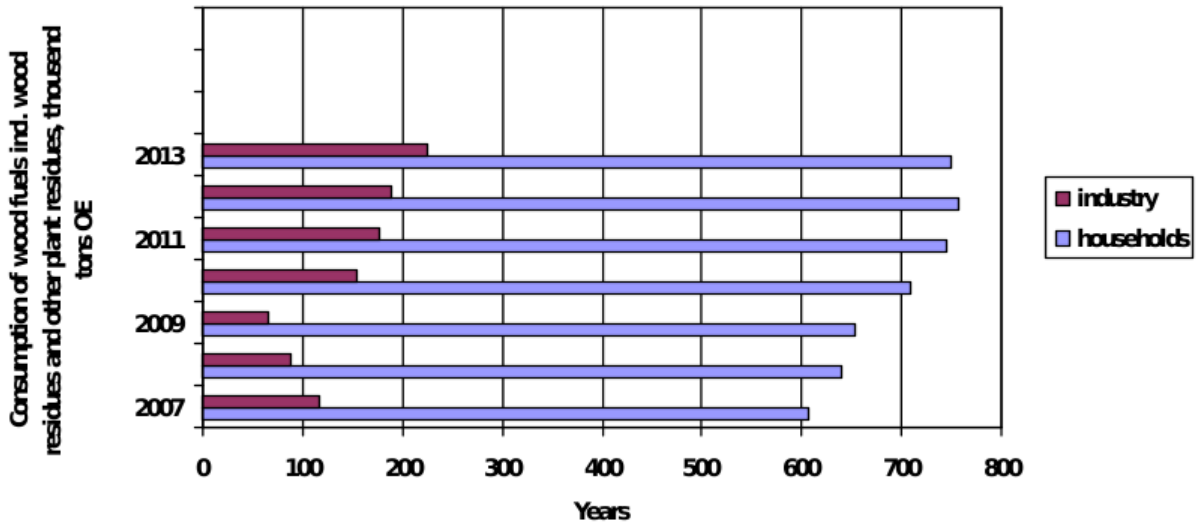
Industry

There is no detailed statistics for the energy consumption for specific regions or municipalities. Such information can be obtained for the whole country.

The consumption of wood products by industry and households is shown on the graph and table below.

Consumption of logged wood and woody products for heating



	2007	2008	2009	2010	2011	2012	2013
Households	607	639	653	710	746	758	749
Industry	117	89	66	155	176	188	225
Total	775	748	735	879	937	999	1003

(source: NSI: Energy Consumption, 2014)

According to the publicly available data, in location of Marica there are industrial buildings that use pellets for heating. The power of installations they use is from 60 to 180 kW. There are several hotels with heating on pellets and one private hospital with heat installations power of 60 to 100 kW. In the 40 km radius there is big factory for producing ethanol, which uses wood chips, pellets and straw for industrial heating. The factory has currently working supply chain but is looking for alternatives. The wood product for them must be high quality, fixed sized and certified.

As the private industries are not obliged to provide data for the registers of biomass user, the aforementioned enterprises are only a small amount of all.

In locations of Borino there are several factories that use wood biomass for heating. “Eco Energy Dospat” EAD, which is CHP that use wood residues for producing wood gas for electricity and heat, has annual consumption of 5000 tonnes. Another factory that uses wood biomass is a mineral and spring water company (Devin AD) with consumption of 50 tonnes per year. This is the half of their energy consumption and the other half is on natural gas, but they are planning to switch fully to wood energy.

In location of Chepelare most of the hotels in the ski resort use wood energy for heating. In the city of Smolyan there are some factories that use pellets and wood chips form heating.

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Public buildings

The municipality and public buildings in the locations have presented high interest in the fuel switching for fossil to biomass. In most of the locations preferred biomass source is the wood products (chips, pellets, firewood, wood, gas). At the moment of the interviews they expressed the obstacle that currently they have no financing options for such fuel switch and the possibility is depending on the political decisions at government level. Nevertheless, in location Chepelare and nearby municipalities most of the municipal buildings use pellets or firewood.

The organization SEDA (Sustainable Energy Development Agency), which is an executive agency within the Ministry of Energy, has a public registry of public and municipal buildings that use solid fuel for heating. The registration is voluntary so some information can be missing. Solid fuel can be logged wood, pellets, briquettes, or wood chips. In the table below, some of the public buildings that use pellets or logged wood are listed.

Public buildings using wood energy for heating

Location	Public building	Address	Type of fuel	Power of boiler, kW
Borino	Municipality building	1,Hristo Botev str, Borino	firewood	120
Borino	Municipality building	1, Druzhba str, Devin	firewood	160
Borino	Municipality building	2, Zdravec str, Dospat	firewood	175
Borino	School “Yane Sandanski”	village Brashten	firewood	175
Borino	Kindergarten “Kokiche”	village Brashten	firewood	175
Borino	School “Nikola Vaptsarov”	village Krancha	firewood	116
Chepelare	School “prof Asen Zlatarov”	7, Tundzha str, Raykovo, Smolyan	firewood	233
Chepelare	Municipal Medical Centre	44B, Belomorska str, Chepelare	pellets	410
Chepelare	Kindergarten “Elhica”	1, Perelik str, Chepelare	pellets	271
Chepelare	Kindergarten “Zdravec”	1, Zdravec str, Chepelare	pellets	290
Chepelare	Kindergarten “Radost”	53, Hristo Botev str, Chepelare	pellets	290
Chepelare	Sport School	19, Sportna str, Chepelare	pellets	349
Chepelare	Rodpska Iskra dormitory	25V, Vasil Dechev str, Chepelare	briquettes, charcoal, firewood	160

(source: Sustainable Energy Development Agency, 2015)

The municipal and public buildings in the regions of Chepelare and Borino are using wood energy products for heating. In location Marica only in the rural parts the municipalities are switching to wood products. In the big cities, the use of firewood in public buildings is not accepted as the smoke lead to increased air pollution. Pellets are competing with natural gas and biogas. The above mentioned public buildings will play an important role as consumers for BLTCs.

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2.3. Comparative cost analysis

Prices of all fuels (fossil, woody biomass, other) for heating

According to calculations presented by the stakeholders (especially - pellet producers and traders), the wood products are very competitive when used for heating.

Cost of all fuels

Fuel	Price
Firewood	70 €/t
Electricity	0.10 €/kWh
LNG	400 €/cbm
Natural gas	250 € / 1000 cbm
LPG	1100 €/t
Diesel	1050 €/t
Industrial oil	950 €/t
Wood pellets	190 €/t

source: Internet (www.peychinovltd.com)

The best value for money comes with firewood, but it requires more operations before usage (cutting, no automatic feeding). The best positive in switching to pellets is reducing the ash content in the smoke, which is very important for the cities in the winter. The obstacle is the big initial investment for the boiler and heating installation, compared to firewood.

Analysis of ability to compete of biomass vs. fossil fuels in the location

For public buildings in the cities it is a recommendation to switch in the next few years and the best fuel choice are wood pellets as chips need special storage and firewood will increase the dust particles in the air in winter. So, in Marica location it is foreseen that public buildings should slowly change to biomass. The competitor to wood energy products in the region is biogas from municipal, agricultural waste and livestock breeding.

For the locations Borino and Chepelare the switching from fossil to woody biomass for industrial and household heating has started in the last years, as the wood energy products are widely available locally. The only obstacle is the size of initial investment for boiler and heat distribution. In some of the municipalities there are projects for implementation of Distant Heating on pellets and/or wood chips which are waiting to find investment, political support and community acceptance.

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2.4. Conclusion on possible future developments of biomass consumption

The analysis of the market potential in the priority locations show some increase in the demand of woody bio-energy while the potential of supply is not fully exploited. As the prices of electricity and fossil fuels elevate and the supply of gas from outside EU is unsustainable, the population and industry is switching to locally available energy products. This process develops slowly as there are limited investment funds and financial tools available. In the rural areas, the willingness to exploit wood residues has increased, as they see possibilities for profit in adding energy value to their unused “waste”. The market is still at early stage and disorganised. Prices can vary in wide ranges, especially in the big cities where only the end products are sold. Consumers are trying to make some cooperation in order to cope with the market uncertainties. On the other hand, pellet and wood chips producers are taking steps in developing into a professional union for lobbying for their interests and searching political and financial support as well as social acceptance.

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3. Local stakeholder consultations

3.1. List of identified local stakeholders and their roles

	Borino	**Marica**	**Chepelare**
Investor	Tehnika de Europa	Group of private persons	Yola EOOD
Investor 2		AHIRA JSC	Uruchev Ltd, Smolyan
Local authority 1	Municipality of Devin	Municipality of Plovdiv	Municipality of Chepelare
Local authority 2	Municipality of Borino		Municipality of Smolyan
Forest owner 1	UCDP-Smoylan	UCDP-Smoylan	UCDP-Smoylan
Forest owner 2	State Forest Department Pazardzhik		Forestry "Borika", private forest owner associations
Consumer 1	Devin AD	Factory "Milara"	Yola EOOD (hotel)
Consumer 2	ISA Engineering EOOD	Private hospital "Selena" Private Hotel	Municipality of Laki
Consumer 3	Eco Energy Dospat	Group of private persons	Municipality of Chepelare
National authority 1	UCDP-Smoylan	UCDP-Smoylan	UCDP-Smoylan
National authority 2	SEDA	SEDA	SEDA

3.2. Results of stakeholder consultations

Almost all of the interviewed people are very familiar with wood products, wood for energy and this is the same for almost all the communities in forest regions.

Support for renewable energy production

Most of the interviewees have heard about EU projects concerning woody biomass but small businesses in the rural areas have little information about how they can profit from EU projects. Many have knowledge about previous national support schemes but the overall opinion is that the bureaucracy is the main obstacle and need too much effort in paper work. Most of the national support was for big power plants or for poor rural areas. The political support for woody biomass is sensed very weak by the stakeholders in rural areas.

Customers and end users of biomass products conclude that the government and local authorities did not provide political support for woody biomass use. They suggest some tax refunds for installing pellet or wood chips boilers at home or in business buildings.

Use of forests and wood products

The increase in demand for wood energy products in urban areas and increasing markets for exports drive the development of the supply in forest areas. Some people invest or plan to invest small funds in splitter and sieve or in small pellet presses. Bigger investment is difficult as the credit lines for woody energy projects and government support schemes are suspended at the moment. Additional limitations arise from the forest administration, with

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not enough educated young people in forestry and unwillingness of people to cooperate with each other.

The pellet production is mainly exported to Turkey, Italy, Greece, Macedonia, while small quantities are delivered to big Bulgarian cities. Wood chips are transported to factories in the industrial areas up to 150 km. The firewood is widely used locally but some quantities are exported to Greece or transported to the markets in the cities. Some wood products are transported far – 300-400 km away to furniture factories.

Forest owners and state forest departments suggest using of forest residues in the forest after logging as potential supply material. On other hand the logging companies and producers of pellets and wood chips conclude that this is not financially viable. They see its collection would be difficult.

Stakeholders and BLTC establishment

According to most of the answers, the wood production companies and forestry enterprises must be incorporated in the BLTCs organisation for the supply side. The logging companies are important in the regions with state forests. Interested investors from outside the region could be investment banks or investment companies, but most probably the big consumers and biomass traders. Producers of pellets from outside the regions without big pellet factory are interested in using the wood residues. Some residues from Chepelare can be used in 40km away pellet factories in Smolyan.

According to half of the stakeholders, the best form of BLTCs operator model could be a private company. The other part views that public-private partnership model is needed as the municipality should take part in the organisation and state forest department should be responsible for wood residues in the forests. Some stakeholders suggested cooperatives of local people will be good form for the local community.

Before 1990s in Bulgaria there were cooperatives organized by the state and the people were forced to participate with land, forests, animals and farm technical tools. This is a big obstacle for making a cooperatives work efficiently as the people do not like this way of organisation. Additionally, some of the local people think of each other as a competitor for work and profit and do not want to cooperate.

The best way of communication with stakeholders and for raising the awareness for biomass use will be with local meetings. These meetings should be organised by a person well known in the region, not by an outsider.

Implementation phase and running of a BLTC

The main perceived benefits of BLTCs would be: expanding the markets, reducing the air pollution from firewood heating, new jobs and rural development.

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Possible driving forces for BLTCs can be found in social improvement for the community which will follow the economic increase. The main stimuli expected from BLTCs must be profit and new job creation.

The public opinion for BLTCs establishment is divided. These results show that it is important to increase local awareness about benefits of biomass and joint discussions about how local woody bioenergy supply chains could be organised and demonstrating best practice examples of BLTCs from other countries.

The most critical factors stated are finding a viable business model, coordination with local forest and wood production companies, political support (local and national), community acceptance. The main risk in BLTC establishment will be:

1. financing and investment: some representatives of local community perceive that project partners should set-up BLTCs themselves
2. illegal trading of wood: local operators need training in management and economics of biomass logistics and trading.

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Part II: Country report CROATIA

prepared by North-West Croatia Regional Energy Agency (REGEA)

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1. Overview of priority locations

1.1. Background

Definition of BLTC and initial status of operational BLTCs in the country

For planning of BLTCs in Croatia based on the generic definition of BLTCS within the scope of BioRES additional requirements regarding physical infrastructure including storage capacity and wood processing machinery apply. This BLTC definition is consistent with the IEE BTCII project[1] as well as with the IPA BioHeatLocal project[2]. It refers to previous education and knowledge dissemination activities regarding BLTCs undertaken in Croatia.

In Croatia there is one operational BLTC located in the municipality of Jasenovac, which was established in 2011 by the private company Ante Mijić Quercus Ltd (www.quercus-am.hr). The BLTC mainly produces and trades wood chips in total approximately 50.000 t/y, with a total area of 2.500 m^2 including storage capacity. Approximately 80% of the production is exported, mostly to neighbouring EU countries Slovenia, Austria, and Italy. However the BLTC also operates on the domestic market. This BLTC can serve as an example of a BLTC business model in Croatia.

Between 10 and 15 private companies or entrepreneurs are producing wood chips[3], with most of them using mobile chippers and trucks/tractors. Mobile wood chips production needs storage capacity at the forest or at the customer location (if chipping is provided as service). Most of the feedstock for wood chips comes from state owned forests through the company Hrvatske šume Ltd. Several wood chip producers are considering or have started the establishment of BLTCs in order to optimise the transportation and logistics, and decrease operational and transport costs.

Firewood has traditionally been used for heating households in rural parts of Croatia and there are many small companies or entrepreneurs producing and trading firewood locally. These companies are not defined as a BLTC since neither production nor trade of different woody bioenergy products or heat is taking place.

Currently 9 wood pellet producers are operating in Croatia with installed capacity over200.000 t/y. Most of the production (approximately 90%) is exported (mainly to Italy, Austria, Slovenia and Switzerland). However, in the last few years there has been a considerable increase in pellets consumption in Croatia. Three to four years ago the exports amounted to 99% of total production. Nowadays pellets are being sold in many

[1] http://www.biomasstradecentre2.eu

[2] http://www.bioheatlocal.com

[3] Katalog proizvođača šumske biomase u Hrvatskoj (Catalogue of forest biomass producers in Croatia), available at: http://www.biomasstradecentre2.eu/wood-biomass-production/catalogues/

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supermarkets and gas stations. The pellet producers have storage capacity as well as equipment for wood processing (including wood chippers); however do not operate BLTCs as defined.

1.2. Priority locations

The following priority locations for BLTCs in Croatia have been selected:

1. Location Jastrebarsko
2. Location Pokupsko
3. Location Josipdol
4. Location Sveti Križ Začretje
5. Location Slunj
6. Location Velika Gorica

The priority locations are indicated on the map of Croatia below.

All priority locations in Croatia meet all of the 4 essential criteria for the selection of priority locations for the establishment of new BLTCs listed in the introduction.
In each priority location potential investors were identified as key stakeholders and were involved in the interview process summarized under section 3 of this report. Information regarding potential investors is included for each location in section 1 of this report (Reference to essential criteria No 1. FINANCE OPTIONS: existing interest of private investors/local authorities).

The North-West Croatia Regional Energy Agency has organised several workshops and trainings targeting the North-West part of Croatia which includes all priority locations.

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Interventions through previous EU funded projects (such as BTCII and BioHeatLocal) focused on utilisation of biomass, including establishment of BLTCs. Thus all locations meet the essential criteria No 3. KNOWLEDGE - existing awareness of the population.

The main forest owner in Croatia is Hrvatske šume d.o.o., a state owned company responsible for managing state owned forests, which account to approximately 78% of all Croatian forests. Headquartered in Zagreb, Hrvatske šume d.o.o. has nationwide operations with 16 regional forest administrations (subsidiaries) and 171 regional forest offices. Most of the commercial production of woody biomass is taking place in state owned forests and therefore Hrvatke šume d.o.o. as a key stakeholder was involved in the interview process summarized under section 3 which is directly linked to essential criteria No 4 SUPPLY: woody biomass potential and existing supply chains (30-40 km radius).

In Croatia regional authorities, i.e. counties, as founders of e.g. schools and hospitals, are responsible for energy bills of public buildings and thus regional authorities represent the views of energy consumers. Amongst the consumers there are also representatives of selected cities and municipalities because of the increasing number of public buildings switching to wood pellets for heating, as is the case in the City of Slunj and City of Jastrebarsko. The municipality of Pokupsko is included as a consumer because currently a biomass district heating system is being constructed in Pokupsko with the municipality being the investor and will be responsible for the operation of the biomass plant. Therefore regional authorities and local municipalities are key stakeholders and were involved in the interview process which is directly linked to essential criteria No 2 MARKET DEMAND: existence of consumers.

Two identified potential investors in selected priority locations Jastrebarsko (private forest company) and Josipdol (Association of war veterans Kapela) have been involved within the EU funded project IEE BTCII (implemented from 2011 to 2014). The support provided to these potential investors included the preparation of a pre-feasibility study for the establishment of a BLTC. Most of the activities within BTCII were focused on general education and promotion of the BLTC concept. However, the BLTCs planned to be constructed by the potential investors in both locations are still in early planning phase and additional advisory support for a successful establishment and competitive operation on the domestic market is needed. More details on the type of support which is planned to be provided are included in the description of every location.

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Description of locations and rationale for selection

1) Location Jastrebarsko

The location is around the City of Jastrebarsko which has a population of approximately 16.000 inhabitants. The location extends to the most part of Zagreb County and to a lesser extent covers the area of Karlovac County and Krapina-zagorje County. Due to the close proximity to the border with Slovenia, export of biomass is possible.

Within a radius of 30-40 km there are several producers of wood logs and wood chips which have expressed their interest in establishing a BLTC. The main reason behind the interest is the expectation of access to knowledge and training for optimisation of transport and logistic costs of biomass procurement and delivery to customers, i.e. lowering the operational costs and increasing the profitability of operations. One potential investor is located within the city of Jastrebarsko and is currently producing approximately 20.000 t of wood chips per year which are mostly exported. However, currently this potential investor lacks storage and drying capacity with a possibility that a BLTC with full infrastructure could be established in this location.

The representatives of the city of Jastrebarsko also expressed their interest to support the local entrepreneurs and private forest owners to increase their economic activity and local market development through the establishment of a BLTC. The city of Jastrebarsko has adopted its Sustainable Energy Action Plan (SEAP) in 2011 and an increased production and utilisation of biomass is fully in line with activities and measures envisaged within the SEAP.

The identified potential investor which considers the establishment of a BLTC is facing challenges regarding the financing of infrastructure and additional equipment, but also needs technical assistance and advice on issues related to the BLTC establishment and operation (optimal storage capacity, optimal drying capacity and technology, etc.). Taking into account that there is existing equipment and woodchip production based on prior experience in forest operations, the main focus of BioRES support will be on financial aspects including development of business plan, assistance in negotiations with financial institutions, assistance in application to possible grants and subsidies (through Operational Programme for Rural Development 2014-2020 and Fund for Environment Protection and Energy Efficiency), marketing and quality control.

The main consumers of firewood within the Jastrebarsko location are households, with an estimated consumption of approximately 23.500 t/y (based on data from population census in 2011), while potential consumers of wood chips are mostly public buildings. The total forest area within this location is approximately 25.000 ha, of which approximately 45% are private forests. The annual allowable cut of forest wood amounts to approximately 75.000 m^3.

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2) Location Pokupsko

The location is around the Municipality of Pokupsko which has a population of approximately 2.200 inhabitants. The location extends to the most part of Zagreb County and to a lesser extent covers the area of Sisak-Moslavina County and Karlovac County.

Pokupsko is currently building a biomass district heating plant which is financed through the IPARD pre-accession programme with a boiler capacity of 1 MW. The construction of the plant should be finalised in August 2015 and start up is expected in October 2015. The district heating system will consume an estimated 1.000 tonnes per year of wood chips after the connection of all planned consumers to the heating network, which is expected in 2017.

The Municipality of Pokupsko has expressed a very strong interest in building and operating a Biomass trade and Logistic Centre either as direct investment from the municipality of through private entrepreneurs near the location of the biomass boiler, from which wood chips would be supplied for the district heating system but also for other smaller consumers. The Croatian Operational Programme for Rural Development 2014-2020 envisages the co-financing of projects (e.g. establishing BLTCs) and more generally forest management with up to 50% of the total investment, while the eligible applicants include both municipalities and private entrepreneurs.

The biomass district heating project for the Pokupsko municipality has been coordinated by the North-West Croatia Regional Energy Agency since 2008 and numerous workshops, trainings, presentations and study tours have been organised for all key stakeholders in the municipality. Thus there is considerable knowledge, awareness and support. In this location, the project support should focus on organizational and logistical aspects, but also quality control and to a lesser extent financial and technical aspects.

The total forest area within this location is approximately 26.000 ha, of which approximately 65% are private forests. The annual allowable cut of forest wood amounts to approximately 80.000 m^3.

3) Location Josipdol

The location is around the Municipality of Josipdol which has a population of approximately 3.800 inhabitants. The location extends to the most part of Karlovac County and to a lesser extent covers the area of Primorsko-goranska County and Lika-Senj County.

The municipality of Josipdol started a project of construction of a biomass district heating system in 2011 and the main project design has been developed and the building permit has been issued. The Municipality is currently seeking financial subsidies for the construction through EU structural funds and application of the project for financing is expected by end of 2015.

The Association of war veterans ‘Kapela’ is active within the Municipality of Josipdol and has started production of wood chips and is planning to establish a BLTC since 2011, which is

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also supported by the municipality. The main reason behind this support as well as the interest for setting up a BLTC is based on the fact that the municipality of Josipdol is one of the founders of the Kapela association, together with municipalities of Saborsko and Rakovica, National Park Plitvice lakes and 12 war veterans.

The North-West Croatia Regional Energy Agency has continuously provided support to the Kapela association since its initial idea to establish a BLTC both within the IEE BTCII project and as part of its regular activities performed for Karlovac County (one of the founders of North-West Croatia Regional Energy Agency). Kapela association has recently expressed the need for further support. The main challenges to the establishment of the BLTC planned by the Kapela association and the reasons why the BLTC has still not been established are the lack of financial resources, the lack of knowledge, and experience in operating a BLTC. Taking into account that there is existing equipment and woodchip production based on prior experience in forest operations, the main focus of BioRES support should be on financial aspects, marketing, quality control and organizational aspects. The detailed site specific feasibility study for the establishment of the BLTC by Kapela association which will be developed through BioRES will answer key questions such as optimal storage and drying capacity and technology. Financial and economic aspects of the establishment and operation of the BLTC will be analysed within the business plan, which will also serve as one of the key documents for the planned application for co-financing through the Operational Programme of Rural Development 2014-2020 (as specified in the call for proposals). Both the feasibility study and the business plan will build upon the prefeasibility study developed within the BTCII project, but will considerably extend the content and level of detail. The prefeasibility study did not include financial and economic aspects nor a detailed analysis regarding technology, storage/drying capacity, quality issues and similar. All of this will be included in the feasibility study and the business plan.

Needed support, to be also provided through BioRES, includes negotiations with financial institutions, negotiations regarding biomass procurement (with company Hrvatske Šume Ltd.) and preparation of model contracts with customers and similar activities.

The main consumers of firewood within the Josipdol location (including the City of Ogulin and Municipality of Plaški, which are all located within 40 km radius) are households, with an estimated consumption of approximately 19.000 t/y (based on data from population census in 2011), while potential consumers of wood chips are mostly public buildings.

The total forest area within this location is approximately 70.000 ha, of which approximately 15% are private forests, thus most of the forests are state owned and managed by the state company Hrvatske Šume d.o.o. (Croatian Forests Ltd.). The annual allowable cut of forest wood amounts to approximately 250.000 m^3. The role of Hrvatske šume is specified in chapter 3 of this report.

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4) Location Sveti Križ Začretje

The location is around the Municipality of Sveti Križ Začretje (located in Krapina-zagorje County) which has a population of approximately 6.200 inhabitants. The location extends to the most part of Krapina-zagorje County and to a lesser extent covers the area of Varazdin County and Zagreb County. The close proximity to the border with Slovenia makes export of biomass presumably.

Within this location there is one producer of wood chips and several smaller producers of firewood which have expressed their interest in establishing a BLTC. The representatives of the Municipality of Sveti Križ Začretje and also the representatives of Krapina-zagorje County have expressed their interest to support the local entrepreneurs and private forest owners. The main reason behind this interest is the desire to increase economic activity and new market channels by the establishment of a BLTC. Additionally, Krapina-zagorje County, North-West Croatia Regional Energy Agency and seven cities and municipalities within the County in 2014 signed a Memorandum of understanding for the establishment of biomass district heating systems and BLTCs can organise the needed biomass supply for the future biomass plants.

In this location, the private company Drvoambalaža d.o.o. specialised in manufacturing and repair of wooden packaging (pallets) is interested in investing in the establishment of a BLTC in Sveti Križ Začretje. The owner intends to use the company's by-products that would otherwise go to waste as woody biomass for the operation of a BLTC. Given the specific circumstances in this location the full range of BioRES support is requested because no prior experience in bioenergy supply chain management exists.

The main consumers of firewood within the Sveti Križ Začretje location are households, with an estimated consumption of approximately 14.000 t/y (based on data from population census in 2011), while potential consumers of wood chips are mostly public buildings.

The total forest area within this location is approximately 10.000 ha, of which over 80% are private forests. The annual allowable cut of forest wood amounts to approximately 20.000 m^3.

5) Location Slunj

The location is around the City of Slunj (located in Karlovac County) which has a population of approximately 5.100 inhabitants. The location extends to the most part of Karlovac County and to a lesser extent covers the area of Sisak-Moslavina County and Lika-Senj County. Due to the close proximity to the border with Bosnia and Herzegovina there is opportunity also for export of biomass.

Within this location there is an investor currently building a wood pellet production plant but which has also expressed interest in production of wood chips and establishment of a BLTC, which would complement the future pellet production plant. There are also several smaller producers of firewood. The representatives of the City of Slunj support local entrepreneurs

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with the main interest to increase the currently rather poor economic activity. The City of Slunj has adopted its Sustainable Energy Action Plan (SEAP) in 2012 and increased production and utilisation of biomass is one of the measures specified within the SEAP to reach the 2020 targets. In this specific context BioRES interventions can have a high impact in this area.

The main consumers of wood logs within the Slunj location are households, with an estimated consumption of approximately 10.000 t/y (based on data from population census in 2011), while potential consumers of wood chips are mostly public buildings. Karlovac County in which the City of Slunj is located and which is responsible for the functioning of schools and hospitals has started a programme of reconstruction of its public buildings through the installation of biomass (mostly wood chips) boilers based on heat contracting models. Two of the schools for which the tenders have been published are located in the City of Slunj.

The total forest area within this location is approximately 35.000 ha, of which approximately 35% are private forests. The annual allowable cut of forest wood amounts to approximately 120.000 m^3.

6) Location Velika Gorica

This location is around the City of Velika Gorica (located in Zagreb County) which has a population of approximately 63.000 inhabitants. The capital of Zagreb with a population of approximately 800.000 is located within 30 km, and the location also extends partly to Sisak-Moslavina County.

There are several producers of firewood and wood chips, as well as wood processing companies. One company producing wood chips has expressed interest in establishing a BLTC with full infrastructure. The representatives of the City of Velika Gorica generally support any entrepreneurial activities regarding increased utilisation of biomass, including establishment of BLTCs. The main focus of further support provided through BioRES should be on financial aspects (including development of business plan), marketing and quality control.

The main consumers of firewood within the Velika Gorica location are households, with an estimated consumption of approximately 200.000 t/y (data from population census in 2011), and with over 160.000 t/y being consumed within the City of Zagreb. Potential consumers of wood chips are public buildings, while there is a possibility that biomass boilers will be installed within the district heating system of the City of Velika Gorica (total installed capacity of over 50 MWth). The City of Velika Gorica has adopted its Sustainable Energy Action Plan (SEAP) in 2011 and the installation of biomass boilers within the city district heating system and consequent increased production and utilisation of biomass is one of the measures specified within the SEAP to reach the 2020 targets. A biomass cogeneration project near the City of Velika Gorica was being developed by HEP (national electric utility

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company owned by the Government), with the planned capacity of 20 MWe, however since 2014 this has been stopped.

The total forest area within this location is approximately 15.000 ha, of which approximately 25% are private forests. The annual allowable cut of forest wood amounts to approximately 50.000 m^3.

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2. Assessment of local market potentials

The analysis of supply and demand is based on completed checklists for each location (Annex I). The information in the checklists is based on either real data or estimations for the radius of 30-40 km for each location.

2.1. Supply

Availability of woody biomass in the location

The forest area covered in each location is presented below. In the location Sveti Križ Začretje private owned forests are dominant, while in all other locations state owned forests make up more than half of the forests.

Table 1: Forest area and ownership status of forest area in %

	Jastrebarsko	**Pokupsko**	**Josipdol**	**Sveti Križ Začretje**	**Slunj**	**Velika Gorica**
Total forest area (ha)	15.000	13.000	65.000	8.000	35.000	15.000
Share of state owned forests (%)	56%	55%	87%	20%	70%	75%
Share of private owned forests (%)	44%	45%	13%	80%	30%	25%

Source: Hrvatske šume d.o.o., North-West Croatia Regional Energy Agency

Biomass potential as energy products

The estimation for biomass potential as energy products has been calculated based on available data for the annual allowable cut for private and state owned forests combined (Table 2).

Table 2: Biomass potential as energy products in t/year per type of fuel

	Jastrebarsko	**Pokupsko**	**Josipdol**	**Sveti Križ Začretje**	**Slunj**	**Velika Gorica**
Logs	20.000 t/year	25.000 t/year	60.000 t/year	5.000 t/year	40.000 t/year	15.000 t/year
Woodchips	15.000 t/year	20.000 t/year	40.000 t/year	5.000 t/year	20.000 t/year	10.000 t/year
Other (pellets, briquettes etc)	0	0	0	0	0	0

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Source: Hrvatske šume d.o.o., North-West Croatia Regional Energy Agency

Table 3: Biomass potential as energy products in t/year of the wood processing industry

	Jastrebarsko	**Pokupsko**	**Josipdol**	**Sveti Križ Začretje**	**Slunj**	**Velika Gorica**
Total quantity of woodchips	5.000 t/year	5.000 t/year	20.000 t/year	5.000 t/year	10.000 t/year	15.000 t/year

Source: *Hrvatske šume d.o.o., North-West Croatia Regional Energy Agency*

Overview of wood processing companies per location

The following overview presents wood processing companies for each location taking into account only the immediate surrounding while the list of all potentially relevant companies covering the entire areas of Karlovac County, Zagreb County and Krapina-zagorje County is included in the catalogue of forest biomass producers in Croatia which was produced by the EU project Biomass TradeCentre II co-funded by the Intelligent Energy Europe Programme[4]. Apart from the company Forest d.o.o. (footnote 2), companies listed in this subsection were not identified as key stakeholders and are not involved in the local stakeholder interviews described under section 3 of the report. For the purposes of this report they represent potential suppliers of wood residues and their interest and conditions to act as a supplier of raw material will be investigated in more detail within the development of site specific feasibility studies.

Location	**Sawmills**	**Forest works**
Jastrebarsko	Drvoproizvod d.d., V.Holjevca 23, Jastrebarsko	Beton-rad d.o.o., Rakitovec 242a
Jastrebarsko	Pilana Krašić d.o.o., Krašić 66, Krašić	Forest d.o.o[5]., bana Tome Erdedija Bakača23/1, Jastrebarsko
Pokupsko Velika Gorica	PPS Galeković d.o.o., braće radića 199a, Mraclin	Beton-rad d.o.o., Rakitovec 242a
Josipdol	DIP Karlovac d.d. Banija 127, Karlovac	Trgovački obrt Gajo, Karlovačka 15, Josipdol
Josipdol	-	Uslužni obrt Keser, Siča 37, Josipdol

[4] http://www.biomasstradecentre2.eu/wood-biomass-production/catalogues/

[5] potential private investor for priority location Jastrebarsko involved in local stakeholder interviews in section 3 of this report

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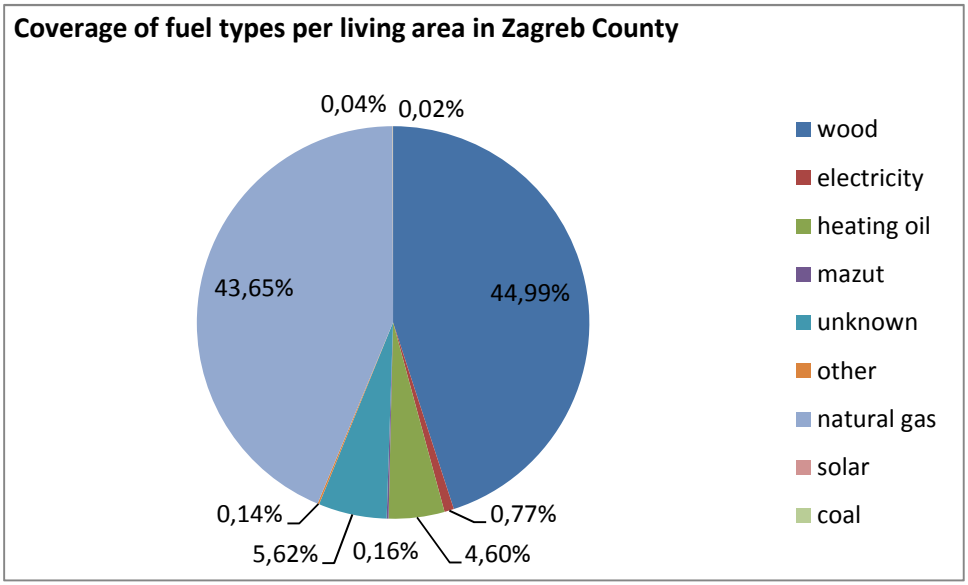
Sveti Križ Začretje	-	Smreka, Macelj Donji 74, Đurmanec
Sveti Križ Začretje	-	Valent Lamot, gornji Macelj 9, Gornji Macelj
Slunj	MPS 67 d.o.o., Nikole Zrinkskog 3, Slunj	Japa d.o.o., Nikole Zrinskog 1, Slunj

Supply of other types of fuels per location

For the locations Jastrebarsko, Josipdol, Velika Gorica and Sveti Križ Začretje there is existing natural gas infrastructure, while in Pokupsko and Slunj there is no natural gas infrastructure. Taking into account the current price of natural gas, the opportunity for biomass demand is higher in locations where no gas infrastructure exists (i.e. locations where heating oil is used as fossil fuel to be replaced with biomass).

The available data for the coverage of fuel types is presented per county.

Zagreb County – Jastrebarsko, Pokupsko and Velika Gorica



Source: Croatian Bureau of Statistics, Census 2011

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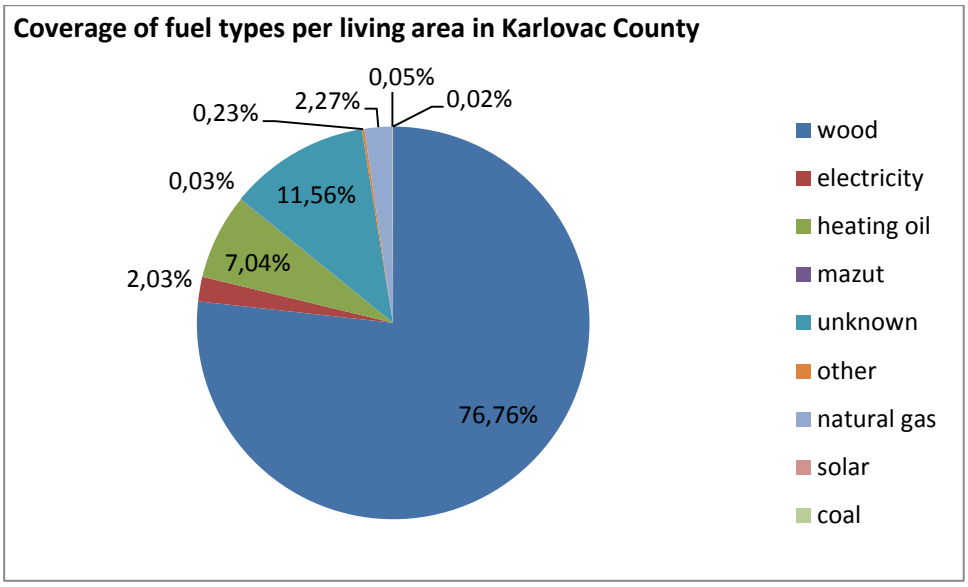
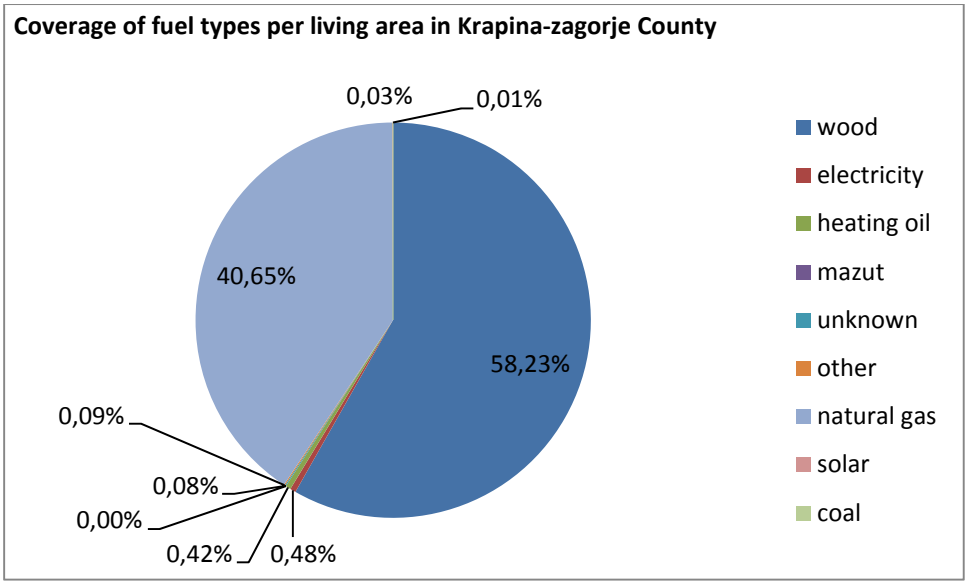
Karlovac County – Josipdol and Slunj



Source: Croatian Bureau of Statistics, Census 2011

Krapina-zagorje County – Sveti Križ Začretje



Source: Croatian Bureau of Statistics, Census 2011

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2.2. Demand

The estimated consumption of different type of fuels for heating is presented in energy units (PJ) per year and divided into three categories, households, industry and buildings, public and commercial in nature, and presented below. Even though the data on biomass demand are not available, the data on consumption can give an indication on possible future demand.

Households

Firewood is the traditional fuel used and recognized in all priority locations. Although at present most of the biomass in households is used in old and inefficient wood stoves, the demand for new boilers for dominantly pellets, but also new firewood stoves is in rise. The data in table 4 presented provides an indication of the potential demand.

Table 4: Household consumption of fuels per type and per location in PJ per year

	Jastrebarsko	**Pokupsko**	**Josipdol**	**Sveti Križ Začretje**	**Slunj**	**Velika Gorica**
Natural gas	0,584	0,876	0,014	0,517	0,021	2,743
Heating oil (PJ)	0,038	0,057	0,043	0	0,065	0,430
Biomass (PJ)	0,525	0,788	0,167[6]	0,345[1]	0,251[1]	1,117
Other [7] (PJ)	0,832	1,249	0,283	0,268	0,425	2,659

Sources: Programme for energy efficiency in direct energy use in Zagreb County 2012-2014., Programme for energy efficiency in direct energy use in Krapina-zagorje County 2014-2016., Programme for energy efficiency in direct energy use in Karlovac County 2012-2014., Sustainable Energy Action Plan (SEAP) of the City of Zagreb

Industry

In the industry sector the predominant fuel in use is heating oil, but there is a rising trend to decrease energy costs and switch to alternative fuels. Taking into account the current prices, biomass is cheaper than heating oil and indicating potential demand for a switch to biomass. In the industry sector however, where natural gas infrastructure is present, fuel switch to biomass is less likely to happen. As an example of the demand for heating oil, in the location of Pokupsko this amounts to 0,125 PJ which is approximately 11.000 tons of wood chips.

Table 5: Industry consumption of fuels per type and per location in PJ per year

	Jastrebarsko	**Pokupsko**	**Josipdol**	**Sveti Križ Začretje**	**Slunj**	**Velika Gorica**
Natural gas	0,546	0,468	0,076	0,834	0,091	1,024
Heating oil	0,146	0,125	0,037	0,014	0,044	0,345

[6] firewood

[7] in case of Jastrebarsko: electricity, solar, heat and heating oil; in case of Josipdol: electricity, heat and heating oil; in case of Sv.Križ Začretje: electricity only; in case of Pokupsko: heating oil and electricity; in case of Velika Gorica: district heating, heating oil, electricity, solar

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Biomass	0,202	0,173	0	0,015	0	0,283
Other[8]	0,388	0,332	0,131	0,231	0,157	1,100

Sources.: Programme for energy efficiency in direct energy use in Zagreb County 2012-2014., Programme for energy efficiency in direct energy use in Krapina-zagorje County 2014-2016., Programme for energy efficiency in direct energy use in Karlovac County 2012-2014., Sustainable Energy Action Plan (SEAP) of the City of Zagreb

Public and commercial buildings

Local and regional authorities are investing in energy retrofits and new investments for switching to biomass, predominantly pellets for heating in public buildings. This is the case in the City of Slunj and City of Jastrebarsko where the respective counties as founders of schools and hospitals are responsible for energy bills and take every opportunity to decrease the costs. The representatives of regional governments in these two locations are included in the local stakeholder interview and their views are summarized in section 3 of this report. This year the national programmes for ESI funds have launched the first calls for proposals precisely for retrofits of public buildings which perform educational or pre-school activities and even though the results and the exact numbers of proposals submitted and funded are not public yet the interest for participation was very high.

Table 6: Consumption of fuels in public and commercial buildings per type and per location in PJ per year

	Jastrebarsko	**Pokupsko**	**Josipdol**	**Sveti Križ Začretje**	**Slunj**	**Velika Gorica**
Natural gas	0,308	0,264	0,045	0,156	0,053	1,084
Heating oil	0,165	0,142	0,101	0,011	0,121	0,213
Biomass	0	0	0,001[1]	0	0,001[1]	0
Other [9]	0,386	0,331	0,099	0,110	0,119	1,875

Sources.: Programme for energy efficiency in direct energy use in Zagreb County 2012-2014., Programme for energy efficiency in direct energy use in Krapina-zagorje County 2014-2016., Programme for energy efficiency in direct energy use in Karlovac County 2012-2014., Sustainable Energy Action Plan (SEAP) of the City of Zagreb

[8] in case of Jastrebarsko and Pokupsko: electricity and LNG; in case of Josipdol and Slunj: electricity, LNG, heat and diesel; in case of Sv. Križ Začretje: electricity, diesel, heat, in case of Velika Gorica: electricity, LNG, diesel, district heating

[9] in case of Jastrebarsko, Pokupsko, Josipdol and Slunj: LNG, heat and electricity; in case of Sv. Križ Začretje: electricity only, in case of Velika Gorica: electricity and district heating

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2.3. Comparative cost analysis

Prices of all fuels (fossil, woody biomass, other) for heating

The cost of all fuels for heating is the same for all six locations as there is only one price per fuel for the whole territory of Croatia. All prices shown below are excluding VAT:

	Woodchips	Firewood	Pellets	Natural gas	Heating oil
Cost in EUR/kWh	0,016	0,017	0,0430	0,045	0,056

Source: North-West Croatia Regional Energy Agency, City gasworks Zagreb, Ministry of Economy

Analysis of ability to compete of biomass vs. fossil fuels in the location

The price of woody bioenergy is below the cost of natural gas and heating oil. Taking into account the cost of transport for biomass fuels, which accounts to approximately 10% of the price, woodchips, pellets and firewood are still below the price of fossil fuels. Based on the price comparison biomass is in a favourable position to compete with fossil fuels in Croatia.

The main challenge increasing utilisation of biomass remains the relatively high investment cost for the installation of biomass boilers. However, the availability of EU structural funds as well as use of financial mechanisms/models such as heat contracting is seen as an effective solution to this challenge.

2.4. Conclusion on regional market assessment in Croatia

The overall consumption of fuels which can be substituted with biomass (heating oil and natural gas) and the rising trend to switch to biomass in all sectors show that the potential demand is high. As an example, in households alone the consumption of heating oil and natural gas for all locations amounts to 5 PJ which is approximately 440.000 t/year of woody biomass (chips or firewood). The potential of forest residues and wood residues from processing industry in all six priority locations is not mobilised yet.

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3. Local stakeholder consultations

3.1. List of identified stakeholders and their roles

	Josipdol	**Pokupsko**	**Jastrebarsko**	**Sveti Križ Začretje**	**Slunj**	**Velika Gorica**
Investor 1	Cooperative of war veterans Kapela	Association of private forest owners Pokupsko	Obrt Forest	Drvoambalaža ltd	Špelić d.o.o.	Betonrad d.o.o.
Investor 2	-	Municipality of Pokupsko				
Local authority	City of Karlovac	Municipality of Pokupsko	City of Jastrebarsko	Municipality Sv. Križ Začretje	City of Slunj	City of Velika Gorica
Forest owner 1	HR šume	HR šume	HR šume	HR šume	HR šume	HR šume
Forest owner 2	-	Association of private forest owners Pokupsko	-	-	-	-
Consumer 1	Karlovac County	Zagreb County	Zagreb County	Krapina-zagorje County	Karlovac County	Zagreb County
Consumer 2	Private consumer	Municipality of Pokupsko	City of Jastrebarsko	Private consumer	City of Slunj	City of Velika Gorica
Consumer 3	-	-	-	-	Private consumer	
National authority	Ministry of Agriculture	Ministry of Agriculture	Ministry of Agriculture	Ministry of Agriculture	Ministry of Agriculture	Ministry of Agriculture

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3.2. Results of stakeholder consultations

The overview of results of stakeholder interviews is presented following the form of the semi-structured questionnaire used in the interview process.

1. Support for renewable energy production

1.1 How national/regional administration is supporting the energy efficiency or production and use of renewable energy or wood based bioenergy? What measures, actions or decisions have been done (Laws, action plans, renewable/bioenergy programs etc.)? What support schemes do you know?

All stakeholders are acquainted with the support schemes provided by the Fund for environment protection and energy efficiency (FZOEU) on national level. FZOEU has been identified as the most significant institution in implementing measures and providing financial support for projects in the area of renewables and energy efficiency and amongst the representatives of local authorities and investors alike there are active users of various grant schemes. Representatives of local and regional authorities are well informed about the legal basis and strategic framework for the use of renewables and are actively implementing retrofitting projects in public buildings. Citizens are aware of the local/regional initiatives regarding the use of biomass and are informed about the financing schemes provided on local and regional level.

1.2 How local/regional/national administration is supporting the energy efficiency or production and use of renewable energy at local level? What measures or decisions have been done? What is your opinion about the level of support?

Local authorities support energy efficiency and the use of renewables through the development of local strategic frameworks (legal obligation) and additional financial support which mainly depends on the available budget. One example of local authority support for the establishment of BLTC (in Josipdol) is by providing the investor a land plot free of charge. Apart from some private consumers all other stakeholders are informed about local initiatives.

1.3 What is the current status of renewable energy production on your region?

Biomass is used mostly in households for heating purposes and there is a rise in use of biomass in public buildings. The production of forest biomass is mostly taking place in state owned forests. Besides biomass, solar collectors and hydropower stations were singled out. The general conclusion is that the use of renewable energy is below real possibilities.

1.4 How do you see the possibilities to increase the renewable energy production at local level? (main sources of renewables and energy production possibilities)

Increase of financial support (for instance for mechanical equipment in case of biomass production) and incentives (for solar energy and small scale hydro plants) or/and better use of available EU funds. Stable political and financial framework conditions at national level would encourage investment at local level. Forest biomass was identified as the main source of renewable energy due to large forest areas in the region, but the potential must be

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mobilised. Currently, forest works focus on timber and leave the slashes and remains unused.

1.5 Are there existing actions to support energy efficiency or use of renewable energy at local/regional/national level? (ongoing projects, investments, funding schemes etc.)

There are many activities on local level, but the number of projects in implementation and investments are not fully using the available potentials. Several local projects on the use of biomass mainly for household level are financed through FZOEU (national level).

1.6 What is the public opinion towards the renewable/wood based energy production at local level/in your region? (Explain the use of forest biomass for energy production in the area; households, heating plants, other)

All stakeholders see the public opinion on the use of biomass very positive given that many public buildings and households especially in rural areas use biomass (firewood and pellets mostly) but the investment in boilers is costly. There is also a well recognized potential for the increase of production of forest biomass, specifically woodchips. Nevertheless, although the general opinion is positive because of the rising trends in the energy sector and recent developments in environment protection, some stakeholders stressed that the public should be further sensitized about this topic, especially addressing environmental concerns when it comes to the use of forests. Another key issue is also the traditional use of woody biomass for energy purposes, i.e. burning in stoves, which are not energy efficient.

2. Use of forests and wood products

2.1 and 2.2. How aware local stakeholders are about the possibilities of using forests and wood products for energy production?

The opinions are divided where one part of the interviewees believe that the local community is well informed and aware, and the other part who see not sufficient awareness of the local community suggesting that awareness raising and educational activities should be continuously implemented.

2.3 What are the main obstacles or limitations of increasing the use of forests/wood in your region? (forest ownership, nature conservation, recreation, lack of management, lack of technology and supply chains, unexciting markets, insufficient woody biomass potential, price level, peoples' opinions etc.)

Lack of mechanical equipment (i.e. chippers and trailers) is perceived as the main obstacle amongst investors and consumers, while representatives of local/regional/national authorities consider also administrative challenges, and most importantly ownership structure and limitations regarding the amount of resources. With regard to sustainable forest management the amount of forest biomass is limited taking also into account relatively small lots of private forest owners who individually do not see the economic viability in using forest as a resource. Finally, legal obstacles in short rotation forestry and missing BLTCs were also identified as obstacles.

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2.4 What are the main drivers of increasing the use of forest/wood in your region? (unutilized resources, jobs, income, energy production, political decisions/support, available markets, available subsidies, price level, etc.)

The main identified driver is the creation of new jobs combined with mobilising unused resources, which should be achieved by connecting consumers and producers of biomass. One interviewee considered the lack of private investors as an issue.

2.5 Are there existing issues which might pose a problem or threat for successful establishment of a BLTC? (forest ownership, nature conservation, recreation, lack of management, lack of technology and supply chains, unexciting markets, insufficient woody biomass potential, price level, peoples' opinions etc.)

A major issue is the underdeveloped local and regional market, especially with regard to woodchips in case of Croatia. Woodchips are exported into neighbouring countries such as Slovenia. Another challenge is financing of mechanical equipment and professional marketing activities. None of these challenges were perceived as a real threat to the successful establishment of a BLTC. Particularly related to location Sveti Križ Začretje it was mentioned that attention should be on defining ownership structure of a BLTC given that the forest area in this region is mostly privately owned.

3. Forest biomass supply chains

3.1 Are there existing companies, supply chains and technology for forest biomass/wood procurement? What kind? (lumberjacks, motor-manual operations, mechanized harvesting, farm tractors, harvesters, chippers etc.)

Several private businesses act as contractors for Hrvatske šume d.o.o. in the region. Sawmills and companies supply households with firewood (mostly motor-manual operations). The general conclusion was that supply chains and technology exist and are adapted to the particularity of each forest.

3.2 What are the main forest/wood products in the region and where and how are they harvested? (sawlogs, pulpwood, firewood, slashes, logging residues).

The main forest product is timber followed by pulpwood and firewood, while logging residues and slashes are unused.

3.3 What are the main wood based energy products in the region and where are they produced? Describe the production process and supply chain. (forest chips, pellets, briquettes, firewood)

The main wood based energy product is firewood produced by small private businesses (motor-manual operations).

3.4 Where are the main forest/wood products used? Are they used in the region or exported? (sawmills, wood products factories, pulp mills, biorefineries, CHP, district heating, farms, domestic households)

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Firewood is used locally in households for heating purposes. Several wood companies and sawmills in the region process timber and a significant part of processed biomass is used for export.

3.5 Is there existing and operating small/medium/large scale user of wood based energy products in the area or in neighbouring areas? Explain and define the market structure, number of potential customers, customer base if possible.

Despite some existing plans (for example the construction of a heating plant in the municipality of Josipdol) the Croatian market is a developing market and currently there is only a small number of BLTC operators. Given such a situation, produced fuels are mostly exported into different EU markets.

3.6 Is there existing and operating BLTC in the area or in neighbouring areas? Explain and define the market structure, number of potential customers, customer base if possible.

All local stakeholders stated that to their knowledge there are no BLTCs focusing on the domestic market.

4. Stakeholders and BLTC establishment

4.1 Who are potential stakeholders for a BLTC establishment process in you region? Who should be involved and why?

As expected, the most important parties are private investors and (some mentioned in particular private forest owners) supported by local authorities. Interestingly, consultants were mentioned as well.

4.2 Which external stakeholders (outside your region) should be involved in a BLTC project? Why? (For instance; lack of expertise, skilled operators, investors and/or funding)

On one hand investors and local authorities perceive that the involvement of external actors (such as local development or energy agencies) for technical support such as finding financing mechanisms would be beneficial or in some cases are needed but on another hand it is considered that all necessary resources are available in the region.

4.3 Who should be in charge of a BLTC establishment process? (public sector, private companies, public-private together, investors etc.)

Public sector should establish necessary framework for the establishment of a BLTC, which should be realized through a public-private partnership or where feasible as a private investment undertaken by a private company or a cooperative.

4.4 From your opinion, what would be the main benefits of establishing a BLTC for wood based products such as forest chips, pellets, briquettes and ?

The main benefit is realized by setting strong foundation for better market development and an increased use of forest biomass for energy purposes. The establishment of a BLTC with

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known amounts of available wood based energy products would create a more secure supply chain of (probably cheaper) energy products for energy plants which in turn would contribute to the development of such projects. The other more immediate benefit is the creation of new jobs. Finally in the opinion of stakeholders a BLTC would contribute to forest maintenance through management of forest remains.

4.5 What are the main objectives and drivers of establishing a BLTC? (Make money, create work, support local economy, decrease GHG emissions, …)

The overall objective is to establish a local market for biomass which will lead to employment, profit and the development of local economy, whereas the main emphasis is on employment.

4.6 In your opinion, what is the expected response and opinion of public towards the establishment of BLTC?

All stakeholders agree that the expected response of the public is positive, especially given the benefits of such projects.

4.7 What measures should be taken within the community to explain the establishment of a BLTC to public and or stakeholders? (Meetings, workshops, newsletter, e-mails. webinars,…)

From the organizational point of view workshops and public events seem to be the best choice for national and local authorities, but representatives of investors and consumers considered also meetings and one-on-one dialogues to be beneficial as well as newsletters.

4.8 What are the main risks concerning a BLTC project? (Technological failures, market immature, finance, funding issues, lack of skills, etc.)

All stakeholders agree that the underdeveloped market is the main risk regarding the BLTC project. The representative of national authority additionally stressed the importance of an insufficiently informed and sensitized public, while all other stakeholders singled out funding issues as potential risk.

4.9 What kind of management structure should be chosen for BLTC and why? (cooperative, private entrepreneur, ltd, etc.)

Cooperatives or limited liability companies are considered the most suitable management structure.

5. Investment and funding possibilities

5.1 Which sources of funding are available for a BLTC establishment and which one should be chosen? (investment subsidies, bank loans, etc.)

All sorts of sources are available and despite the fact that grants are the most preferred sources of funding for the best rate of success all sources should be used in combination (private capital, subventions and loans). In particular the Operational Programme for Rural

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Development 2014-2020 was singled out as a good source for obtaining grants, but also green credit lines offered by commercial banks.

5.2 Which are the most critical factors for (funding/investment decisions? (level of risk, payback time, available capital, community support, political support…)

In all cases, the support of local community and political support is very important for a BLTC project, but the level of risk and payback time is a critical factor as perceived by stakeholders. In addition, when considering grants, the conditions of the tender were also listed as a critical factor for funding decisions.

5.3 Who should be responsible for obtaining the funding for a BLTC?

All stakeholders agreed that the investor, be it a public-private partnership or fully private, should be responsible for obtaining the funding, in some cases accompanied with support of local and regional authorities.

6. Implementation phase and running of a BLTC

6.1 What kind of permissions and legal procedures are necessary when establishing a BLTC?

The only identified permit needed is the construction permit.

6.2 From your opinion, are there enough skilled employees and expertise in your region for successful operation and running of a BLTC? (Biomass harvesting and logistics, production of wood based energy product, quality management, business management)

According to gathered opinions, there is a solid potential of qualified human resources with relevant skills, more specifically related to biomass harvesting and production of wood based products (woodchips). However, in the field of quality management and business management special trainings should be organized on a need basis.

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Part III: Country report SERBIA

Prepared by Serbian National Biomass Association (Serbio)

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1 Overview of priority locations

1.1 Background

The Serbian National Biomass Association as implementing partner of the BioRES project closely cooperates with the GIZ/KfW DKTI programme in Serbia funded by Germany. GIZ DKTI programme: "Development of a sustainable bioenergy market in Serbia" aims to enhance sustainable biomass supply chains by supporting development of local structures for the provision of biomass in selected regions; providing consultancy services for district heating companies and suppliers entering into biomass supply contracts; support to the establishment of public/private companies interested in using biomass; consultancy and training for biomass suppliers in sustainable mobilization of biomass; and monitoring the origin and sustainability of biomass use. Synergies between BioRES and GIZ DKTI Programme are used in selection of priority locations based on development achieved in implementation of GIZ DKTI program and their support toward fossil to biomass fuel switch in district heating companies. Apart from DKTI there are other programs supporting bioenergy market development and fuel switch in district heating systems such as EBRD program for support to district heating companies. Local administration and DH companies in some of the selected locations already participate in mentioned programs, but there are other participating municipalities as potential locations for BLTC development in: Ivanjica, Arilje, Pirot, Mali Zvornik, Novi Pazar, Prijepolje, Boljevac, Knjazevac, Negotin, Kladovo, Trstenik, Velika Plana, Kosjeric, Cacak and others.

Definition of BLTC and initial status of operational BLTCs in the country

In case of Serbia the generic BioRES definition is applied. In Serbia there is one BLTC - Centre for biomass distribution in Majdanpek, which is not yet operational. This centre is a result of the project: Capacity building for formation of regional centre for biomass distribution in Majdanpek[10] which received financial support by, by the Austrian Development Agency (2013 to 2014).

In Serbia there are several private companies active in wood chips production[11]. Almost all of them use mobile wood chipping machines and trucks, thus organizing just in time delivery to consumers. They process raw biomass at sellers point at sawmills or at the forest. However there is one company (Jela Star[12] Prijepolje, interviewed as potential investor) which has characteristics of a BLTC. This company owns a sawmill and a pellet factory plus they produce substantial quantities of wood chips supplying pellet and chipboard factories. The Company has several storage points for raw biomass – forest and sawmill residues, mobile wood chippers and truck transport. The storage at the railway station is used for export of

[10] http://www.resurscentar.rs/news.php?extend.367

[11] http://bioenergy-serbia.rs/images/documents/studies/Wood_Chips_Serbia_Market_Assessment.pdf

[12] http://www.jelastar.rs/index.php/en/

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wood chips. The company has interest for supplying future biomass based DH systems or CHPs in the region and potential interest to develop storage and production points in other cities as well. Other mobile wood chipping companies could be potentially investors for setting up new BLTCs.

A number of private companies trade firewood, charcoal, briquettes and pellets. Those companies have storage capacities for firewood and basic machines for firewood processing. The firewood production is aimed for local market or export, thus they do not produce wood chips or other wood fuels and are not in line with the criteria as defined for BLTCs.

Over 50 wood pellet factories[13] use forest residues; sawmill residues and firewood in Serbia for pellet production. All of them have wood chippers, wood transport machinery and pelletizing equipment in various scales. Most of their production is for export; however some have wood pellet retail sales or even wood pellet delivery to local consumers. Nevertheless, they do not produce or trade with firewood, wood chips or other wood fuels so cannot be defined as BLTCs.

1.2. Priority locations

The following priority locations for BLTCs in Serbia are selected:

1. Location Leskovac
2. Location Nova Varos & Priboj
3. Location Bajina Basta
4. Location Sabac
5. Location Pecinci
6. Location Zrenjanin

The six selected priority locations are indicated on the map of Serbia below. All priority locations in Serbia meet all of the 4 essential criteria for the selection of priority locations for the establishment of new BLTCs listed in the introduction. In all priority locations there are **financing** options for investment and interest of local administration to **support** the BLTC development; there are existing or developing biomass **consumers**; **awareness** of local population about usage of wood and biomass is traditionally developed and additional awareness raising campaigns are in the process of implementation; and finally there is a **supply** potential and organized supply from both state and privately owned forests.

Map 1: Priority locations distribution

[13] http://bioenergy-serbia.rs/images/documents/studies/WOOD_PELLET_PRODUCTION_AND_MARKET_STRUCTURE_IN_SERBIA.pdf

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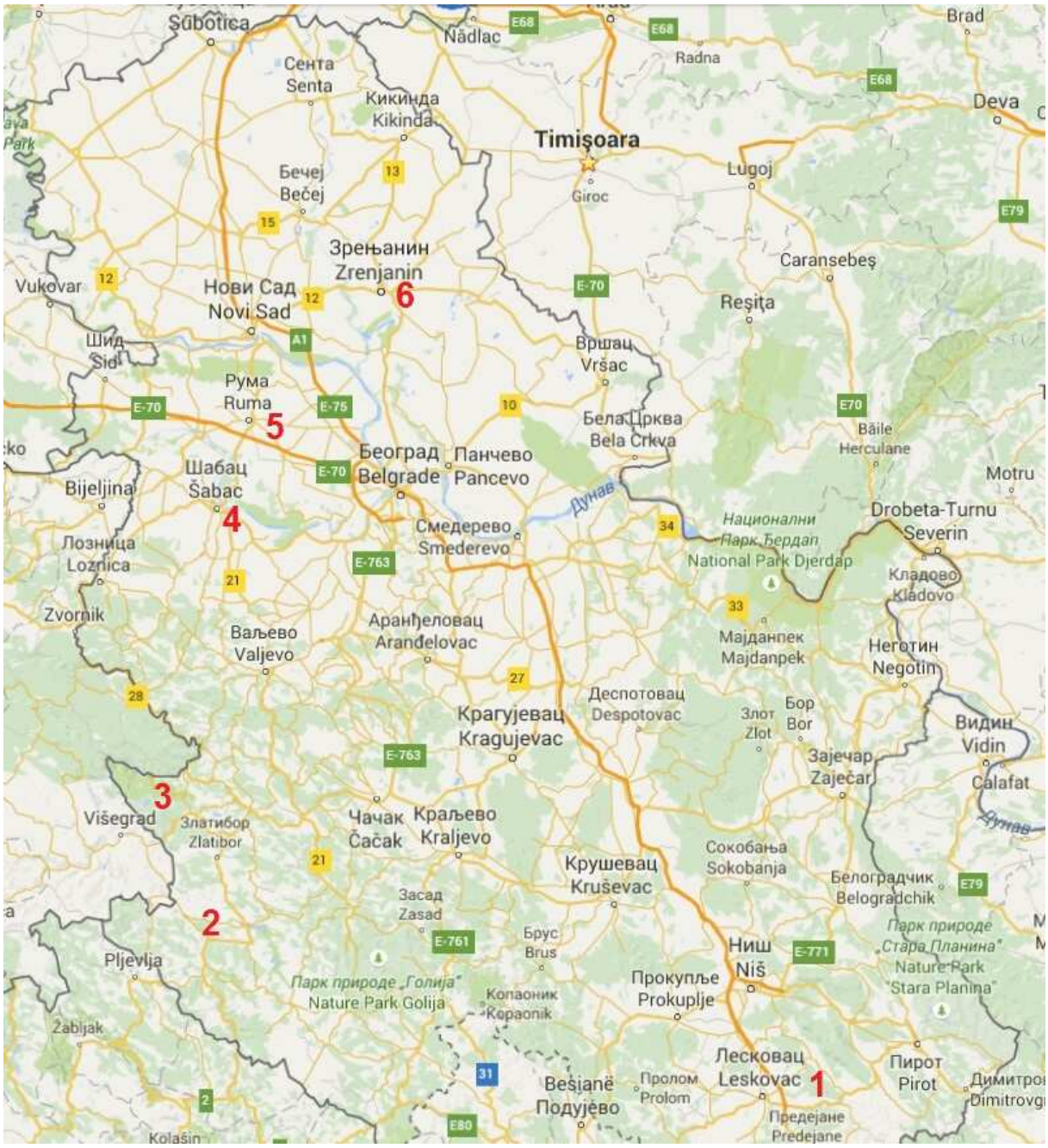

Description of locations and rationale for selection

1) Location Leskovac

The location is situated around Leskovac city, in the county of Jablanica in south-eastern part of Serbia. Total population of the city is 60,288 people, and population of the municipality is 144,206. Leskovac has significant forest coverage. Annual allowable harvest in Leskovac and surrounding municipalities exceeds 100,000 cbm. Total forest area is over 110,000 ha and private forests managed by small scale forest owners are present in over 70% of total forest area. All state forests are managed by Public Enterprise Srbijasume. Most dominant wood species are beech and oak.

Due to the natural resources forestry and wood processing are very important industries in Leskovac, especially for small-scale forest owners. Additionally, significant volumes of

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firewood from Leskovac municipality are delivered to firewood markets in larger cities such as Nis and Belgrade, and large quantities are also used for supply to numerous pellets factories, while a portion is exported to Macedonia and Greece. Households in Leskovac and villages around are important consumers of firewood, while district heating system in the city is based on heavy oil and coal.

The Leskovac city administration is interested in fuel switch, additionally in Leskovac area GIZ DKTI project is much focused at awareness rising in terms of energy efficiency, efficiency of firewood usage and biomass market development. In Leskovac, there are financing options for investment and the interest of local administration to support the BLTC development, especially in case of DH fuel switch. In case of fuel switch DH system will on one side need stable supply, while the other companies interested for wood chips supply to DH need investment in production, storage and transportation capacities. Firewood consumption is high, while wood pellet consumption is rising. However the pellet supply to local consumers mostly occurs directly from factories. With rise of wood pellet consumption future BLTC can also develop the wood pellet trade. A good woody biomass supply potential from both state and privately owned forests exists, while private forest owners need organizational capacities enabling more efficient biomass mobilisation. All these factors make Leskovac meeting all of the essential criteria for the selection of priority locations for the establishment of new BLTCs.

2) Location Nova Varos/Priboj

The location is situated around Nova Varos/Priboj municipality, in Zlatiborski County in south-western part of Serbia. Total population of the town of Nova Varos is 8,795 inhabitants, while municipality counts 16,638, while total population of Priboj town is 14,920 inhabitants, while municipality counts 27,000. Both Nova Varos and Priboj have significant forest resources and the two towns are only 30km away from each other. Forests in Nova Varos municipality cover over 22,000 ha, and share of the state forests is 60%. Forests in Priboj municipality cover over 36,000 ha, and share of the state forests is over 50%. All state forests in both municipalities are managed by Public Enterprise Srbijasume, while private forests are managed by small scale forest owners and smaller part by Serbian Orthodox Church. Annual allowable harvest in Nova Varos municipality is around 33,000 cbm, while in Priboj municipality it is 30,000 cbm. However, when surrounding municipalities are included total annual allowable harvest exceeds 160,000 cbm. Most dominant wood species are beech, pine and spruce.

Forestry and wood processing are an important industry sector in Nova Varos and Priboj. There are many sawmills, and recently two pellet factories started to develop along with specialized producers for wood chips. Both Nova Varos and Priboj district heating systems are based on heavy oil and municipal authorities are eager to find biomass based solution for town heat energy provision. Nova Varos and Priboj participated in German Cooperation facilitated by Serbian Ministry of mining and energy financed by KfW for fossil fuels to biomass switch. The fuel switch of their heating system is considered to be feasible and economically viable. In addition there are several investors which expressed their interest for

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public-private partnership in heat energy production and local administrations in both Nova Varos and Priboj are considering KfW subsidized loans for fuel switch. Also, there are touristic capacities and hospitals in which biomass based heating can be installed. Firewood is a major source of heat energy for rural communities. The fuel switch in DH would require a stable system of biomass supply which could be facilitated by BLTC development. The role of BLTC is especially important for private forest owners and sawmills, which wood, forest and sawmill residues can be efficiently processed, stored and delivered via BLTC.

Financing options for investment in BLTC exist, either from local administration and heating company which will organize supply in case of subsidies investment in DH system, or existing private companies which already produce and trade with wood biomass. Local administration is definitely interested to support the BLTC development. In the area there are wood and wood chips consumers. The GIZ DKTI Program is implementing awareness raising activities in Nova Varos and Priboj area. Supply potential is substantial and organized supply of wood and wood chips both from state and privately owned forests and wood industry is developed more than in other regions of Serbia. The selected priority area for Nova Varos and/or Priboj meets all of the four essential criteria for the selection of priority locations establishing new BLTCs.

3) Location Bajina Basta

The location is situated around Bajina Basta town, Bajina Basta municipality in Zlatiborski County in south-western part of Serbia. Total population of the town is 9,100 inhabitants, while municipality counts 26,000. Forests in Bajina Basta municipality cover over 31,000 ha, and share of the private forests is over 55%. The state forests within municipality are managed by Public Enterprise National Park Tara[14], while private forests are managed by small scale forest owners and the Serbian Orthodox Church. Annual allowable harvest in Bajina Basta municipality exceeds 88,000 cbm. However, when surrounding municipalities are included total annual allowable harvest exceeds 265,000 cbm. Most dominant wood species are fir, beech, spruce and pine.

In Bajina Basta there are plenty of sawmills and several wood pellet factories. Bajina Basta district heating system is based on coal. Bajina Basta participates in the KfW finance program for fossil to biomass fuel switch of their heating system which is considered to be feasible and economically viable. In addition there are touristic capacities in which biomass based heating is already installed and new capacities planned in which it can be installed. There are several investors who expressed interest for public-private partnership in heat energy production, therefore in case of fuel switch in DH system a stable and organized supply of wood chips will be required, which can enable further development of BLTC. Considering rising demand of wood chips for fuel switch, for both the National Park Tara as major state forest manager in Bajina Basta and private forest owners, the BLTC development is a possibility to organize efficient processing, storing and delivery of woody biomass to DH Company and other consumers.

[14] http://www.nptara.rs/en/

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Financing options for investment in BLTC development of potential private and public investors exist. The local administration will support the BLTC development. In addition there are firewood, wood chips and wood pellet consumers, while awareness of local population about usage of wood and biomass is very developed due to the fact that Bajina Basta has very long tradition of forestry and wood industry. Also in Bajina Basta the German GIZ DKTI Program implements additional raising awareness. This location meets all of the essential criteria for the selection of priority locations for the establishment of new BLTCs.

4) Location Sabac

The location is situated around City of Sabac in Macva County in north-western part of Serbia. Total population of the City is 70,000 inhabitants, while city and rural areas count total of 120,000 inhabitants. Sabac itself and neighbouring municipalities have significant and much diversified forest resources, due to its position – from beech forests on the mountains south of the City, through oak forests in hilly parts east of the city to oak and poplar plantations west of the city and north of Sava River. These forest areas diversify supply potential from state and privately owned forests and wood industry. Total forest area in Sabac City territory alone is 10,000 ha, however in surrounding municipalities around Sabac; there are around 140,000 ha of forests from which 55% are privately managed by small scale forest owners or Serbian Orthodox Church. State forests within municipality are managed by Public Enterprise Srbijasume and Public Enterprise Vojvodinasume[15]. Annual allowable harvest in Sabac and surrounding municipalities is 380,000 cbm.

Forestry and wood processing is not as important as agriculture; however the City administration expressed interest in development of biomass based district heating system and participates both in KfW and EBRD[16] program for fuel switch. Sabac is in the process of developing a biomass based DH system which could be financially supported by EBRD. A well organized and stable supply of big volumes of biomass for such DH system is a necessity. Financing options for investment in BLTC exists and the local administration would support BLTC development, especially since development of supply of woody biomass is a prerequisite for DH development. It can be expected that interest of potential suppliers to DH system and their propensity to invest in transport, storage and wood chips production capacities, will grow. Awareness of local population about usage of wood and biomass is traditionally developed. This location meets all of the essential criteria for the selection of priority locations for the establishment of new BLTCs.

5) Location Pecinci

The location is situated in Pecinci municipality, in Srem County in north-western part of Serbia – province of Vojvodina. Total population of the municipality is 20,000 inhabitants. Forests in vicinity of Pecinci cover around 40,000 ha and are situated on Sava River. Most of the forests are state owned and managed by PE Vojvodinasume. Sremska Mitrovica forest

[15] http://www.vojvodinasume.rs/en/
[16] http://www.ebrd.com/work-with-us/projects/psd/sabac-district-heating-upgrade.html

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estate, which manages forests in Pecinci municipality as well, exceeds annual harvest of 210,000 cbm. Most dominant wood species are oak and poplars.

Pecinci local administration is considering the switch from fossil fuel to biomass, due to prices of fossil fuels and abundance of agricultural and forest land. Moreover, municipality have a very well developed industrial zone around the village of Simanovci, in which companies also use natural gas, however price level of fossil fuels is increasing the competitiveness of biomass as a fuel source. A coffee processing company uses biomass from coffee processing residues for its energy production. Indjija and Belgrade with very developed industrial capacities mainly use natural gas 20 km from Pecinci, which in future can be potentially interested for fuel switch. The location has a high biomass potential from forest residues of poplar plantations which are already utilized for wood chips for chipboard production or exported to Slovenia, Croatia and Austria. Around Pecinci sawmill residues are an unused potential supply. In the flat terrain a good forest road network along with very long forest management and planning tradition makes forest biomass utilization feasible and economically viable. In addition low quality of agricultural land in southern part of the municipality with very good water supply makes the region adequate for development of energy plantations of willows and poplars. Several energy plantation growers started developing a business.

In case the local DH Company or industrial zone decides to make a fuel switch options for investment exist. The local administration expressed support for BLTC development. Also energy plantation growers and other potential suppliers are interested to participate in BLTC development as with further concretisation of development of biomass based DH company investments, reliable woody biomass supply channels are needed to. Thus awareness of local population about usage of wood and biomass is developing. There is a diversified supply potential from state forests, wood industry and developing energy plantations. This location meets all of the essential criteria for the selection of priority locations for the establishment of new BLTCs.

6) Location Zrenjanin

The location is situated in City of Zrenjanin, in Central Banat County in north-eastern part of Serbia – province of Vojvodina. The Zrenjanin City population is around 132,000 inhabitants including villages. Forests in vicinity of Pecinci cover around 35,000 ha and are situated in Banatsko, Juzno-Backo, Severno-Backo, Sremsko and Posavko-Podunavsko forest area. Most of the forests are situated on banks of the rivers Tisa, Tamis, Begej and Danube. The forest area is mainly state owned and managed by PE Vojvodinasume and PE Srbijasume, while very small portion is managed by PE Vode Vojvodine – Water Management Company. Vojvodinasume, which manages forests in Zrenjanin and surrounding municipalities as well, in this area harvests around of 190,000 cbm. Most dominant wood species are poplars produced in plantations.

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Zrenjanin district heating system is based on natural gas and City authorities are active in finding biomass based solution for town heat energy provision. Zrenjanin participates in the German Cooperation facilitated by Serbian Ministry of mining and energy financed by KfW for fossil fuels to biomass switch. Options of using agro biomass and woody biomass have been assessed. The fuel switch of their heating system is considered to be feasible and economically viable. In addition there are several investors which expressed their interest for public-private partnership in heat energy production. The local administration is also considering KfW subsidized loans for fuel switch. Moreover, the city administration is interested for establishing energy plantations together with private partners, where woody biomass for DH system will be produced.
The GIZ DKTI program prepared a study assessing potentials of energy plantations establishment in Zrenjanin, which also came to positive conclusions. Firewood and agro biomass is a major source of heat energy for rural communities. The fuel switch in DH would require a stable system of biomass supply which could be facilitated by setting up a BLTC.

Financing options for investment in BLTC exist, either from local administration and heating company which will organize supply in case of subsidies investment in DH system, or existing private consortia of companies and land owners which are trading wood or are interested in participation for development of energy plantations and woody biomass supply channels. Local administration would be supportive in BLTC development. In the area there are no wood chips consumers. Together with the city administration, the GIZ DKTI Program is implementing awareness raising activities. . The selected priority area for Zrenjanin meets all of the four essential criteria for the selection of priority locations establishing new BLTCs.

Omitting the location Majdanpek during revision process following risk mitigation measures:
One BLTC is in development in Majdanpek; however it is not operational yet. This centre is a result of the project “Capacity building for formation of regional centre for biomass distribution in Majdanpek” financed by Austrian Development Agency (ADA) in 2013. Based on the project proposal ADA financed machinery procurement (wood chipper, telescopic handler, firewood processor), and some other equipment (water content measuring device), training was carried out for potential BLTC managers and operators, and awareness raising activities have been done. The Non-Governmental Organization Resurs Centar Majdanpek was the main implementing partner of the project. The District Heating Company of Majdanpek established a company called Biomass Distribution Centre Majdanpek. Originally the BLTC should have been organized together with the Majdanpek Forest Owners Association but the Municipality of Majdanpek provided the location instead of Majdanpek Forest Owners' Association. The stakeholder involvement striving for getting the Biomass Distribution Centre Majdanpek operational implies certain conflicts which could not been resolved by the Serbian National Biomass Association. Issues on financing for connecting the Centre to the electricity network and additional investments are not resolved . Even though Majdanpek as a potential priority location was analysed (market analysis and interview survey), as result of continued stakeholder conflicts, the Serbian National Biomass Association decided to replace this previously selected location by the priority location of Zrenjanin as more promising location for the further BLTC set-up process.

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The location is situated around Majdanpek town. Majdanpek municipality lies in the county of Bor in eastern part of Serbia. Total population of the Municipality is 18,179 people, and population of the town is 7,367. Majdanpek is the most forested municipality in Serbia with forest coverage over 70% or 63,000 ha. Annual allowable harvest in Majdanpek municipality exceeds 130,000 cbm (highest in Serbia). However the forests are underutilized since actual harvest is around 100,000 cbm. Most of the forests in Majdanpek municipality are state owned and managed by Public enterprise Srbijasume and Public Enterprise National Park Djerdap. 35% of the forests are private and managed by local small-scale private forest owners. Most dominant wood species are beech and oak.
Although the major industry in Majdanpek is mining (coper and gold), the forestry and wood sector is very important in Majdanpek, especially for small-scale forest owners, charcoal producers and wood processing companies. Additionally, significant volumes of wood from Majdanpek municipality are delivered to wood companies in other parts of Serbia. Kronospan and several wood pellet producers are established in the region. Majdanpek has significant problems in heat energy procurement, since it is outdated and based on heavy oil. Therefore there are initiatives from municipal authorities to make a district heating switch from fossil fuels to biomass.

Several private investors are interested in public-private--partnership in biomass based heat production and some are interested in development of CHPs in the area. Also, a number of public buildings in Majdanpek, other villages and smaller towns (Rudna Glava, Donji Milanovac) have inadequate heating system and express rising interest in efficient biomass boilers. Firewood is a major source for heat production of households in rural areas, but also in Majdanpek town itself, since plenty of residents decided to install wood boilers in their houses or apartments due to the inefficient district heating system.

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2. Assessment of local market potentials

The analysis of supply and demand is based on literature review, and provided local data during the onsite interview survey. The regional market analysis on supply and demand for wood biomass is presented for each of the selected priority locations.

2.1. Supply

Wood production and availability of woody biomass in priority locations

Over 50% of forests in Serbia are private. Private forests in Serbia are managed by small scale individual forest owners, or large scale owners such as Serbian Orthodox Church or monasteries. Private forests are managed either by their owners or by entrepreneurs and companies buying wood on stump. State forests are managed by public enterprises Srbijasume and Vojvodinasume and national parks of Tara, Djerdap, Fruska Gora and Kopaonik. State forests are managed by private harvesting companies with a special case of Vojvodinasume which manages its state forest themselves. The usual system of harvesting is chainsaw felling and extraction with skidders or adapted agricultural tractors. In steep terrains and with lack of adequate forest roads, firewood is being extracted with horses as well. In general, forest roads are in bad conditions due to high maintenance costs. On the other hand in flat terrains along river banks harvesting machines are used while wood is extracted with forwarders. Usually wood is transported to the buyer with trucks, whereas trains or water transport is used very rarely for transport. Basic data on forest area, ownership structure and wood production for each of selected locations are presented in the table below.

Table: Basic data on forests and wood production

Location	Majdanpek	Leskovac	Nova Varos/Priboj	Bajina Basta	Sabac	Pecinci	Zrenjanin
Forest area ha	63.000	115.000	98.000	31.000	183.000	43.000	35.000
State forests share	65%	35%	55%	45%	43%	93%	97%
Private forests share	35%	65%	45%	55%	57%	7%	3%
FSC certified forests	30%	35%	55%	0%	43%	93%	95%
Planned production cbm	130.000	205.000	100.000	88.000	400.000	230.000	190.000
Logs cbm	45.000	55.000	55.000	40.000	180.000	120.000	110.000
Firewood cbm	55.000	130.000	35.000	28.000	180.000	90.000	60.000
Forest residues cbm	10.000	18.500	9.000	6.800	36.000	21.000	20.000
Total gross harvest cbm	**110.000**	**203.500**	**99.000**	**74.800**	**396.000**	**231.000**	**190.000**

Source: Forest management plans for Timocko, Severno-Kucajsko, Limsko, Tarsko-Zlatiborsko, Podrinjsko-Kolubarsko, Sremsko forest Banatsko, Juzno Backo, Severno Backo and Posavsko Podunavsko forest area and national parks of Djerdap and Tara

In spite of general rules for forest area division in Serbia, where one municipality as a whole is part of one forest area, together with surrounding municipalities, **Majdanpek** is a special case. The municipality territory is a part of Severnokucajsko, Timocko and National Park

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Djerdap. Majdanpek is also very close to Juznokucajsko forest area, so supply is possible from this region as well. Total area of private forests is 22,000 ha, while state forests cover 41,000 ha. Private forests owners, managing 1 to 50 ha, and few individual forest owners manage up to 100 ha. State forests are managed by the public enterprise Srbijasume and Public Enterprise of the National Park Djerdap. The most dominant forest type is monodominant beech forest of seed and coppice origin. There are areas of coppice and seed origin oak forests and small areas of spruce and pine plantations. NP Djerdap sells wood on stump to harvesting companies and individuals. The forest road network is in the level of Serbian average – around 7km/1,000 ha, however it is much lower in private forests – below 2km/1,000 ha. Over 20,000 ha of state owned forests in this area are FSC certified. The annual planned wood production is 130,000 cbm. There are possibilities for an increase in production if the forest management practice would change and the forest infrastructure would improve. The annual wood production in regarded area is around 110,000 cbm per year, out of which over 55,000 cbm of firewood is produced.

Leskovac City territory is a part of Jablanicko forest area. Forest resources in Jablanicko forest area are taken into consideration, although there is additional possibility to supply from other areas such as Moravsko, Nisavsko, Juznomoravsko and Toplicko. Total area of beech forests in Jablanicko forest area is 115,000 ha. Total area of private forests is 74,000 ha, while state forests cover 40,000 ha. Private forests are managed by individual small scale private forest owners, managing 1 to 50 ha. Forests in Jablanicko forest area are underused in some regions and over utilized in others. Forest road network is in the level of Serbian average, however it is much lower in private forests – below 2km/1,000 ha. Around 40,000 ha of state owned forests, managed by Srbijasume are FSC certified. Annual planned and realized wood production in whole forest area is around 200,000 cbm out of which 140,000 cbm of firewood is produced.

Both **Nova Varos and Priboj** are located in Limsko forest area, but there are possibilities for supply from other forest areas such as Tarsko Zlatiborsko, Rasko and NP Tara. Total area of the forests of Limsko forest area is around 98,000 ha. Total area of private forests is 44,000 ha, while state forests cover 58,000 ha. The Serbian Orthodox Church also owns and manages some forests. State forests are managed by PE Srbijasume. Most important type of forests are spruce forests, beech and pine forests. Areas of coppice and seed origin oak forests are in lower areas. Forest road network is around 16 km/1,000 ha. Around 54,000 ha of state owned forests, managed by PE Srbijasume are FSC certified. Annual planned wood production is around 100,000 cbm, while there are possibilities for increase. Annual wood production in regarded area is around 100,000 cbm per year, out of which 40,000 cbm of firewood is produced.

Most of the **Bajina Basta** municipal territory is in NP Tara, and covering also Tarsko-Zlatiborsko forest area. The total area of the forests in Bajina Basta municipality is 31,000 ha. Total area of private forests is 17,000 ha, while state forests cover 14,000 ha. Private forests are managed by individual small scale private forests owners, managing 1 to 50 ha. Serbian Orthodox Church also owns and manages some forests. State forests are managed by PE NP

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Tara. Most important type of forests is mixed stands of fir, spruce and beech, beech forests and pine forests. In lower areas grow oak forests. Private forests are managed either by their owners or by entrepreneurs and companies buying wood on stump. State forests in NP Tara are harvested by NP Tara administration or by private harvesting companies. Annual planned wood production is around 88,000 cbm, while there are very limited possibilities for increase since most of the area is in National Park. Annual wood production in regarded area is over 70,000 cbm per year, out of which 30,000 cbm of firewood is produced.

Sabac is located in Podrinjsko-kolubarsko forest area, while across Sava River, there is Sremsko forest area. Total area of the forests of Podrinjsko-kolubarsko forest area is 140,000 ha, while area of Sremsko forest area is around 43,000 ha. The total area of private forests is 103,000 ha, while state forests cover 80,000 ha. Serbian Orthodox Church also owns and manages around 4,000 ha. State forests are managed by PE Srbijasume in Podrinjsko-kolubarsko and by PE Vojvodinasume in Sremsko forest area. The most important forest type are beech forests south of Sabac, oak forests east of Sabac and poplar plantations north of Sabac. In lowlands north of Sabac, harvesting is performed by PE Vojvodinasume. Due to terrain features, wood is harvested with chainsaws or harvesters and extracted with forwarders. All state forests, managed by PE Srbijasume and PE Vojvodinasume are FSC certified. Annual planned and realized wood production is over 400,000 cbm. Annually around 200,000 cbm of firewood is produced.

Pecinci municipal territory is in Sremsko forest area. Sremsko forest area is around 43,000 ha of which 40,000 ha is state owned, while private forests cover less than 3,000 ha. Private forests are managed by individual small scale private forests owners, while State forests are managed by PE Vojvodinasume. Most important forest types are oak and poplar forests on Sava river banks. There is potential for establishment of energy plantations on low quality agricultural land in proximity of existing poplar plantations. Harvesting is taking place with chainsaws or harvesters and extraction with forwarders. All state owned forests are FSC certified. Annual planned and realized wood production in Sremsko forest area is around 230,000 cbm. Annual firewood production is up to 100,000 cbm.

The Zrenjanin city territory is in Banat forest area, however it is in close proximity of Posavsko-Podunavsko, Juzno-Backo, Severno-Backo and Sremsko forest area. Total forest area in surrounding municipalities and cities is around 35,000 ha of which over 97% is state owned. The most important forest type is poplar forests on Tisa, Tamis, Begej and Danube river banks. There are exceptional potentials for establishment energy plantations on low quality agricultural land in proximity of existing poplar plantations. Harvesting is taking place with chainsaws or harvesters and extraction with forwarders. All state owned forests are FSC certified. Annual wood production in the city of Zrenjanin and surrounding municipalities and cities is around 190,000 cbm. Annual firewood production is up to 60,000 cbm.

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Overview of wood processing companies per location

Most important wood processing companies for each location are presented in a table below. In **Majdanpek** harvesting and firewood production is organized by small harvesting companies, there is only one important sawmill, there are no operational wood chips producers, except biomass trade centre in Majdanpek which is not fully operational, while there are plenty of small scale charcoal producers. Although Majdanpek municipality does not have at present wood pellet demand in its territory, there are 5 wood pellet factories (2 ENplus A2 certified) which have wood supply from the region. Those factories produced around 80,000 tons of wood pellets in 2014.

In **Leskovac** wood harvesting and firewood production is organized by small scale local companies. There are several sawmills and around 5 wood pellet factories is supplying from the area produced around 50,000 t of wood pellets in 2014.

In **Nova Varos and Priboj** wood harvesting and firewood production is organized by small harvesting companies. There are several sawmills. Also, wood chips from forest residues and sawmill residues is produced, and there are companies specialized for wood chips production with developed trading routes for wood chips export and supply to local consumers and chipboard and wood pellet production companies. This company also brings sawmill and forest residues and wood chips from other areas of Serbia as well and has annual production of over 50,000 tons of wood chips. In the region of Limsko forest area there are 2 wood pellet factories (1 ENplus A2 certified) which have wood supply from the region. Those factories produced over 30,000 tons of wood pellets in 2014.

In **Bajina Basta** wood harvesting and firewood production is organized by small harvesting companies and partially by NP Tara. There is a number of sawmills. Wood chips from forest residues and sawmill residues is produced by wood pellet factories with occasional processing performed by mobile wood chipping companies from other regions. In Bajina Basta municipality there are 3 wood pellet factories which have wood supply from the region. Those factories produced over 15,000tons of wood pellet in 2014.

In **Sabac** wood harvesting and firewood production is organized by small harvesting companies or PE Vojvodinasume. There are several sawmills. Wood chips from forest residues and sawmill residues is produced by wood pellet factories or for chipboard factories with occasional processing of mobile wood chipping companies. In forest regions in question there are 3 wood pellet factories which have wood supply from the region. Those factories in 2014 produced over 15,000 tons of wood pellets.

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Table: Wood processing companies in priority locations

Location	Majdanpek (omitted during revision process)	Leskovac	Nova Varos/Priboj	Bajina Basta	Sabac	Pecinci	Zrenjanin
Sawmills	Beomark doo, Mosna	Bland doo, Leskovac	Jela Star doo, Prijepolje	Gorstak doo, Bajina Basta	Vukovic tim, Mali Zvornik	Saga Drvo, Stara Pazova	
		4M, Leskovac		Holzarbeit, Bajina Basta	Pilana Trifonovic	Novi Drvni Kombinat, Sremska Mitrovica	Eko Furnir, Kovin
		Drvopromet, Leskovac	Zlatarsped, doo	Microtri, Bajina Basta	Div Company, Loznica	Pilana Hrast, Ruma	Vizard, Vrsac
				Vasimil, Bajina Basta	Pilana Beli, Sabac	Menina, Ruma	Banija Pal, Temerin
Wood chips producers	Biomass Trade Center – not operational	/	Jela Star doo, Prijepolje	Jela Star doo, Prijepolje	Energy center, Valjevo	Holz Tim, Ivanjica	Gradina Sistem, Temerin
				Holz Tim, Ivanjica	Holz Tim, Ivanjica		Holz Tim, Ivanjica
							Eko Furnir, Kovin
Chipboard producers	Kronospan srb doo, Lapovo	Kronospan Srb doo, Lapovo	Kronospan srb doo, Lapovo	Kronospan srb doo, Lapovo	Kronospan srb doo, Lapovo	Kronospan srb doo, Lapovo	
			SPIK Iverica, Ivanjica	SPIK Iverica, Ivanjica	SPIK Iverica, Ivanjica	SPIK Iverica, Ivanjica	Kronospan Srb doo, Lapovo
Pellet producers	Miboro Pelet doo, Golubac	Verso il Paradiso, Leskovac	Jela Star doo, Prijepolje	Drina Ital wood, Bajina Basta	S biom, Loznica	/	
	KMD, Kladovo	4M, Leskovac					Legus Energy, Perlez
	Bioenergy point, Boljevac	Bland doo, Leskovac		Gorstak doo, Bajina Basta	Swiss eco pellet doo, Loznica		
	Eco Wood Petrovac	Vlasina pelet, Vlasotince	Nanix wood, Nova Varos		Pelet Vukovic, Mali Zvornik		Biobrick, Titel
	Sudex doo, Zagubica	Forest Alpha Plam, Doljevac		Ras Pellets, Bajina Basta			KSR, Pancevo
Charcoal producers	Fagos doo, Majdanpek	/	/	/	/	/	/
	Ana Mosna doo, Mosna						
	Lozac szr, Klokocevac						

Source: BioRES desk and field research

In **Pecinci** wood harvesting and firewood production is organized by PE Vojvodinasume. There are several sawmills and other wood processing producers such as fruit crates, caskets or plywood in the region. Wood chips from forest residues and sawmill residues is occasionally produced by mobile wood chipping companies and delivered to chipboard factories or exported. There are no operational wood pellet producers in the area.

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Supply of other types of fuels per location

For the locations Sabac, Pecinci and partially Leskovac there is existing natural gas infrastructure, while in Majdanpek, Nova Varos&Priboj and Bajina Basta there is still no natural gas infrastructure. DH systems in all of presented locations exist however they are based on fossil fuels such as coal and heavy oil, while only Sabac and Pecinci DH system partially are based on natural gas. Nevertheless, due to the increase of price of natural gas, biomass switch in DH or industry is realized equally in locations with or without natural gas infrastructure.

2.2. Demand

Situation on wood biomass and fossil fuels consumption and demand is presented for each of the locations separately in following subchapters.

Households and biomass processing

Wood biomass consumption by households and biomass processing industry is presented in a table below.

Table: Wood biomass consumption

Location	Majdanpek	Leskovac	Nova Varos/Priboj	Bajina Basta	Sabac	Pecinci	Zrenjanin
No of households	7.216	43.603	15.160	8.938	39.091	6.251	45.000
Estimated local firewood consumption t	25.000	100.000	40.000	30.000	50.000	15.000	50.000
Estimated firewood transported to other consumers or exported t	15.000	20.000	-	-	-	-	-
Wood for wood chips t	-	-	20.000	10.000	10.000	5.000	5.000
Wood for pellets, briquettes, charcoal and chipboard t	45.000	40.000	30.000	25.000	140.000	80.000	50.000
Total estimated wood biomass production t	85.000	160.000	90.000	65.000	200.000	100.000	60.000

Source: National statistics

In **Majdanpek**, firewood is consumed by local population and is transported to larger cities such as Belgrade or cities in Vojvodina in the North of Serbia. Total urban population of Majdanpek municipality is around 8,000 inhabitants while rural population is 10,000. Total number of urban households is 3,000, while there are around 4,000 rural households. Total annual consumption of firewood is estimated to 25,000 tons, while another 15,000 tons are transported to other larger cities. There are more than 200 kilns for charcoal production, annually consuming around 15,000 tons of wood, required for production of 4,000 tons of charcoal. Forest residues are not used. It is estimated that pellet factories annually buy around 15,000 tons of wood from the regarded region. In addition there is a large scale chipboard company which buys around 15,000 tons of wood from the region.

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In **Leskovac**, firewood is consumed by local population but substantial part is also transported to larger cities such as Nis, Kragujevac, Belgrade or cities in Vojvodina. Partly firewood is also exported to Macedonia, Greece and Kosovo. All wood pellets are exported. Total urban population of Leskovac city is 80,000 while rural population is 70,000. Total number of urban households is around 25,000, while there are around 20,000 rural households. All rural households consume firewood for heating. While 80% of urban households setting annual firewood consumption at around 100,000 tons, additional 20,000 tons are being transported to other cities. It is estimated that pellet factories annually buy around 20,000 tons of wood from the regarded region. In addition there is a large scale chipboard company which buys around 20,000 tons for wood from the region.

In **Nova Varos and Priboj**, firewood is consumed by local population and wood pellet is exported. Total urban population of Nova Varos and Priboj municipality is around 23,000 inhabitants while rural population is 20,000. Total number of urban households is 7,000, while there are around 5,000 rural households. All rural households consume firewood for heating, while urban households consume heat produced on heavy oil distributed by DH companies or firewood. Nova Varos and Priboj towns annually consumes around 40-50,000tons of firewood per year. It is estimated that wood pellet and chipboard factories are buying 30,000 tons of wood or wood chips from the area.

In **Bajina Basta**, firewood is consumed by local population and wood pellet is exported and also consumed by local population and touristic facilities. Total urban population of Bajina Basta municipality is around 9,000 inhabitants while rural population is 18,000. Total number of urban households is 3,000, while there are around 6,000 rural households. All rural households consume firewood for heating, while urban households consume heat produced on heavy oil and oil distributed by DH companies and firewood as well. Bajina Basta households consume around 30,000 tons per year of firewood. Wood pellet and chipboard factories consume around 25,000 tons of wood from the region.

In **Sabac,** firewood is consumed by local population and wood pellet is exported. Total urban population of Sabac City is around 70,000 inhabitants while rural population is 50,000. Total number of urban households is 24,000, while there are around 15,000 rural households. Most of rural households consume firewood for heating, while urban households consume heat produced on heavy oil and natural gas distributed by DH companies or firewood and natural gas as well. Estimated consumption of firewood in Sabac is 50-60,000tons per year. Wood pellet and chipboard factories consume over 100,000 tons of wood from the area.

In **Pecinci**, firewood is consumed by local population or chipboard factories. Total urban population of Pecinci municipality is around 3,000 inhabitants while rural population is 17,000. Total number of urban households is 1,000, while there are around 5,000 rural households. Rural households consume firewood, wood and agro pellet and natural gas for heating, while urban households consume heat produced on heavy oil and natural gas distributed by DH companies and firewood. Total consumption of firewood in the area is

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estimated to 15,000 tons, while major chipboard factories supplying from the area consume up to 80,000 tons.

In **Zrenjanin**, firewood is consumed by local population or chipboard factories. Total urban population of Zrenjanin is around 80,000 inhabitants while rural population is 52,000. Total number of urban households is 30,000, while there are around 15,000 rural households. Rural households consume firewood and agriculture residues. Urban households consume firewood, wood and agro pellet and natural gas for heating or consume heat produced on natural gas distributed by DH companies and firewood. Total consumption of firewood in the area is estimated to 50,000tons, while major chipboard and pellet factories supplying from the area consume up to 60,000 tons. Almost all wood produced in Zrenjanin area is softwood, therefore population rather consumer hardwood delivered to Zrenjanin from other areas of Serbia.

District heating systems and the industry

At present there is no biomass based DH system in any of potential locations, while industrial consumption of wood based fuels is limited to wood industry, though there are few examples of other industries using biomass based fuels.

In **Majdanpek**, all rural households consume firewood for heating, while urban households consume heat produced on heavy oil distributed by DH Company or firewood as well. Most of the industry consumes heavy oil as well. Although most of the urban population live in apartments, there is an increasing trend of households switching from District Heating system and installing firewood boilers. There are actual detailed studies on fuel switch not only DH system but a CHP in Majdanpek available. In addition there are several investors interested for CHP or DH development already present for Majdanpek and Donji Milanovac towns. In Majdanpek there is an ongoing project development of 10MW CHP and in case of implementation this CHP would require for 80,000 tons of wood chips per year. Also, 1MW CHP in Donji Milanovac would have demand for around 10,000 tons of wood chips per year. Its realisation would also increase demand for woody biomass in the future. The surrounding forests are still underutilized (Harvesting rates far below allowable cut) and there are possibilities to increase forest utilization. Better forest management requires changes in the management and harvesting practice and investment in in forest infrastructure as well as the organization of private forest owners. This could lead to an increase of harvest rates by 10-20%. Wood pellet and charcoal are exported to neighbouring countries. Several investors are also interested in establishing wood pellet factories.

In **Leskovac**, most of the public buildings are supplied with heat via DH system running on coal and heavy oil, while public buildings in rural areas use firewood. Industry uses also heavy oil, coal and natural gas. At present the wood industry companies either use their residues for own energy needs, pellet or briquette production or are selling their residues to chipboard and pellet companies. Detailed feasibility studies of fuel switch for Leskovac are not available, but the District Heating plant of Leskovac is considering partial fuel switch to wood chips.

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In **Nova Varos and Priboj**, major industry use coal and heavy oil, while public buildings are connected to DH system or use firewood in rural areas. Fuel switch in DH from heavy oil to wood biomass was a subject of KfW program and detailed studies have elaborated it. Since considered as feasible both Nova Varos and Priboj continued participation in KfW program in terms of loans for fuel switch. Also, private investors expressed interest in public private partnership and there are initiatives for CHP development by private investors as well. All of this along with development of wood pellet factories and wood chips producers will increase demand for wood biomass and competition in supply which can result in increase of wood biomass prices. It is important to stress that possibilities to increase harvesting are limited.

Table: Fossil fuel consumption industrial, residential and total

Statistical grid[17]	Cox coal t	Stone coal t	Brown coal t	Lignite t	Liquid fuels t	Heavy oil t	Natural gas - KMcbm	Liquid gas t
Majdanpek, Zagubica								
Total industrial fuel consumption					6.475	2.873		85
Mining industry					6.459			
Processing industry					16	246		85
Electricity, gas and steam supply						2.627		
Fuel consumption in industrial boiler houses					6.475	246		85
Fuel consumption in residential district heating system						2.726		
Leskovac, Vladičin Han, Surdulica, Vlasotince, Lebane, Crna Trava								
Total industrial fuel consumption	7.659		8.227		1.764	7.016	5.115	1.784
Processing industry	7.659		797		1.759	4.636	5.115	1.784
Electricity, gas and steam supply			7.430		5	2.380		
Fuel consumption in industrial boiler houses	7.659		797		1.759	4.636	5.115	1.784
Fuel consumption in residential district heating system			7.430		5	2.380		
Bajina Basta, Uzice								
Total industrial fuel consumption		53	1.038	351	2.231	4.645	24.171	247
Processing industry		53	25		2.231	1.362	20.325	247
Electricity, gas and steam supply			1.013	351		3.283	3.846	
Fuel consumption in industrial boiler houses		53	25		2.231	1.362	20.325	247
Fuel consumption in residential district heating system			1.013	351		3.283	3.846	
Pecinci,Obrenovac, Cukarica, Vladimirci								
Total industrial fuel consumption				27.190.512	1.056	16.629	21.088	324
Mining industry					9			
Processing industry				4.581	1.029	949	20.688	324
Electricity, gas and steam supply				27.185.931	18	15.680	400	
Fuel consumption in industrial boiler houses				4.581	1.038	949	20.688	324
Fuel consumption in residential district heating system							400	
Žitište, Zrenjanin, Nova Crnja								
Total industrial fuel consumption	1.897			15	9.993		18.740	5.769
Electricity, gas and steam supply			1.013	351		3.283	3.846	
Fuel consumption in industrial boiler houses	1.897			15	9.993		33.175	5.679
Fuel consumption in residential district heating system							37.495	15
Sabac, Osecina, Koceljeva, Loznica, Krupanj								
Total industrial fuel consumption	1.300		205	4.671	2.742	8.575	25.076	948
Mining industry					953	104		
Processing industry	1.300		205	4.671	1.789	8.177	14.481	948
Electricity, gas and steam supply						294	10.595	
Fuel consumption in industrial boiler houses	1.300		205	4.671	2.742	8.281	12.892	948
Fuel consumption in residential district heating system						294	10.595	
Nova Varos, Cajetina, Arilje, Pozega								

[17] Statistical grid covers the area of several municipalites.

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Total industrial fuel consumption		768	810	13.440	4.360	1.626	4.480	89
Processing industry		768	810	13.440	4.360	1.006	4.480	89
Electricity, gas and steam supply						620		
Fuel consumption in industrial boiler houses		768	810	13.440	4.360	1.006	4.480	89
Fuel consumption in residential district heating system						620		
Priboj, Prijepolje								
Total industrial fuel consumption		200	457	547	54	2.614		77
Processing industry		200	457	98	54	132		77
Electricity, gas and steam supply				449		2.482		
Fuel consumption in industrial boiler houses		200	457	98	54	132		77
Fuel consumption in residential district heating system				449		2.482		

Source: National statistics

In **Bajina Basta**, major industry use coal and heavy oil while most of the public buildings are supplied with heat via DH system, while public buildings in rural areas use firewood.
Bajina Basta continues participating in KfW credit line program for fuel switch. Also, private investors expressed interest in public private partnership in DH fuel switch. All of this along with development of wood pellet factories can result in increase of wood biomass demand.

In **Sabac**, major industry use natural gas, coal and heavy oil. Most of the public buildings are supplied with heat via DH system. Fuel switch in DH from heavy oil and natural gas to wood biomass was a subject of KfW and EBRD program and detailed studies have been elaborated. In case of fuel switch annual demand for wood chips in DH will be up to 15,000 tons per year, which will increase demand for wood biomass to a certain extent but not dramatically, especially considering the fact that forest residues in most cases remain unused. In addition, there are already existing activities in establishment of energy plantations.

In **Pecinci**, major industry uses natural gas, but there are examples of companies using biomass for energy production while most of the public buildings are supplied with heat via DH system. Fuel switch in DH from heavy oil and natural gas have not yet been subjected to a feasibility study, although due to high gas and heavy oil prices and availability of both wood and agro biomass, this is considered by local administration. In vicinity of Pecinci in the town of Simanovci a very developed industrial zone, could switch from natural gas to biomass. Wood biomass demand in Pecinci is not high at this stage, but there are significant potentials in terms of forest residues, sawmill residues and energy plantations.

In **Zrenjanin**, major industry use natural gas. Most of the public buildings are supplied with heat via DH system based on natural gas. Fuel switch in DH from natural gas to wood biomass was a subject of the KfW program and detailed studies have been elaborated. In case of fuel switch encompassing 10MW wood biomass boiler installation, annual demand for wood chips in DH will be up to 17,000 tons per year, which can either be supplied from existing forests or wood industry residues or from around 600 ha of energy plantations.

2.3. Comparative cost analysis

Competitiveness of biomass vs. fossil fuels

Prices of fossil and wood based fuels are presented in the table below. There are no significant differences between prices of fossil and biomass based fuels between priority locations.

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Table: fossil and wood based fuels prices

Fuel	Parity	Unit	EUR per unit	EUR/kWh
Split firewood	DDP	t	50,00	0,014
Wood Chips	DDP	t	50,00	0,014
Wood Pellets	DDP	t	200,00	0,042
Wood Briquettes	DDP	t	180,00	0,038
Charcoal	DDP	t	300,00	0,043
Lignite coal	DDP	t	150,00	0,029
Natural gas	DDP	sqm	0,50	0,050
Heating oil	DDP	l	0,50	0,042

Source: BioRES desk research, National Statistics

The price of energy produced from wood chips or firewood is below the cost of natural gas, heating oil and coal. On the other hand prices of wood pellets and briquettes are at the level of fossil fuels. Based on the price comparison it can be concluded that biomass is in a favourable position to compete with fossil fuels in Serbia.

2.4. Conclusion on regional market assessment in Serbia

It can be concluded that the supply is feasible for all locations from forests, even without inclusion of wood processing industry. On the other hand, the figures for the overall demand of fuels which can be substituted with biomass (heating oil, coal and natural gas) show that the potential demand is high especially since local administration in all locations is planning or implementing fuel switch in their DH system, while BLTC can be position as potential supplier of wood chips for DH systems. Additionally, high demand for firewood enables future development of BLTC in terms of firewood supply to local household and introduction of wood pellet and briquette supply as well.

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3. Local stakeholder consultations

3.1. List of identified stakeholders and their roles

In total 37 key stakeholders for 7 potential priority locations of BLTCs in Serbia were identified and interviewed in June and August 2015. On national and subnational level the ministries of energy and agriculture and provincial secretariats for energy and agriculture and state forest managers from the public enterprises Srbijasume and Vojvodinasume and international development organisations are important stakeholders for BLTC development in the identified locations. The stakeholder mapping for potential BLTCs in Serbia is presented in table below.

Table: stakeholder mapping

Role/Location	Majdanpek	Leskovac	Nova Varos/Priboj	Bajina Basta	Sabac	Pecinci	Zrenjanin
National administration	Ministry of Agriculture and Environment	Ministry of Agriculture and Environment	Ministry of Agriculture and Environment	Ministry of Agriculture and Environment	Ministry of Agriculture and Environment	Ministry of Agriculture and Environment	Ministry of Agriculture and Environment
Provincial administration 1	-	-	-	-	-	Provincial Secretariat for Energy and mining	Provincial Secretariat for Energy and mining
Provincial administration 2	-	-	-	-	-	Provincial Secretariat for Agriculture	Provincial Secretariat for Agriculture
Local administration	Municipality of Majdanpek	City of Leskovac	Municipality of Nova Varos	Municipality of Bajina Basta	City of Sabac	Municipality of Pecinci	City of Zrenjanin
Local/regional development Agency	-	Center for development of Pcinja and Jablanica county	Agency for development of Zlatiobor county	Agency for development of Zlatiobor county	PE For Sabac City Land planning	-	-
Support to development of biomass market 1	UNDP	UNDP	UNDP	UNDP	UNDP	UNDP	UNDP
Support to development of biomass market 2	GIZ DKTI	GIZ DKTI	GIZ DKTI	GIZ DKTI	GIZ DKTI	GIZ DKTI	GIZ DKTI
Forest owner/manager 1	PE Srbijasume	PE Srbijasume	PE Srbijasume	PE NP Tara	PE Srbijasume	PE Vojvodinasume	PE Vojvodinasume
Forest owner/manager 2	PE NP Djerdap	-	-	PE Srbijasume	PE Vojvodinasume	-	-
Forest owner/manager 3	Private forest owner	Private forest owner	Kamena Gora private forest owners' association	Private forest owners' Association Rastiste	-	Energy plantation grower	-
Forest owner/manager 4	-	-	-	Raca Monastery	-	-	-
Consumer 1	District heating plant Majdanpek	DH plant Leskovac	Toplotna energija doo/DH company Nova Varos	BB Term - DH company Bajina Basta	DH Company Sabac	District heating plant Pecinci	District heating plant Zrenjanin
Consumer 2	-	-	DH company Priboj	-	-	-	-
Existing BLTC, Potential Investor or Competitor	Center for biomass distribution	-	Star jela doo	Gorstak doo	-	-	RebinaAgrar doo

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3.2. Results of stakeholder consultations

Identified stakeholders attitudes where collected via semi structured interviews held in personal meetings with representatives of different stakeholder groups.

1) Majdanpek

Support for renewable energy production

Most of interviewed stakeholders are aware about existing regulations (Law on Energy and Energy Efficiency), plans (RES action plans), programs (support projects) and incentives (feed in tariffs for electricity production). Local support exists in terms of support for investors, measures for energy efficiency and awareness raising. Apart from firewood used by local population and some small companies RES are not used. Woody biomass is the most important local RES carrier, with potentials for wind, mini hydro and solar. Increasing awareness raising, improving energy efficiency, introducing incentives and clear regulations are crucial. Potential is also in replacing fossil fuels in public buildings and DH with biomass, and most of the potentials for increase of biomass production are in private forests. There are development projects such as GIZ DKTI or UNDP[18] for all Serbia, however long term policy of support does not exist. CHP and DH projects and BLTC are still not operational. Some funds from Municipality can be available for energy efficiency projects. The population is accustomed of using firewood in traditional manner, and not informed enough of possibilities to use wood biomass efficiently for energy production. However in case of right approach positive response can be expected.

Use of forests and wood products

Population and stakeholders are aware about possibility of using wood in general and of its economic importance. Communication between forest managers and local population could be improved. Awareness raising activities create better understanding in population and stakeholders about possibilities of using wood biomass for energy production. Utilization of forests can be increased, however limitations are lack of the market, forest management practice, and poor forest infrastructure. Main drivers of forest utilization are market demand and improved forest management operations. Most important obstacles for BLTC development are financing, economic viability, sustainability, market and price fluctuations of wood biomass.

Forest operations and supply chains

Private companies perform forest harvesting in State forests and individuals and private companies perform harvesting in private forests. Such companies are small scale and are equipped with chainsaws, adapted agricultural tractors or skidders, or horses. Equipment is usually outdated. Main wood fuel products are firewood and charcoal produced in brick built kilns from firewood or harvesting residues. Firewood is used locally or regionally - transported to Belgrade or cities in Vojvodina. Long firewood is transported to wood pellet

[18] http://biomasa.undp.org.rs/?lang=en

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and chipboard factories. Logs are used regionally - transported to sawmill. Charcoal is exported. There are wood processing companies using wood for energy production for steam and drying. There are small companies using wood for heating of their objects. Most stakeholders are unaware of the establishment of a BLTC in Majdanpek and this BLTC is not yet operational.

Stakeholders and BLTC establishment

Most important local stakeholders to be included in BLTC development are: Local administration, forest management companies, private forest owners and DH Companies. Support of local administration is crucial. Most important external stakeholders to be included in BLTC project are: investors, educational and training institutions, development organizations and biomass association. Public-private partnership is a most favourable solution to run the BLTC, or a private company with public control. Most important benefits of BLTC establishment are: better quality and prices for consumers, development of local economy, secure supply and prices for local biomass suppliers. Most important objectives and drivers for BLTC establishment are: development of local economy, employment and profit. Some suspicion can be expected at the beginning at it is important to present BLTC as local project oriented for domestic market. Most important tools for explaining BLTC development to the public should be local workshops and direct communication including meetings with stakeholders and local media. Main risks for BLTC development are in lack of finances, lack of market, poor communication with stakeholders and costs of woody biomass mobilization.

Investment and funding possibilities

Most adequate sources of funding are private capital supported by subsidies from local or national administration, donations and bank loans. Most important factors for investment decisions regarding BLTC are: available capital, political and local support, stability of prices and rate of return. BLTC partners and company should be responsible for financing procurement involving the local administration.

Implementation phase and running of a BLTC

Local stakeholders believe that apart from company registration required permissions and regulations encompass: construction permits, environmental impact assessments (especially in regard to noise and dust) and anti-fire regulations. There are professionals to cover all aspects of BLTC work, but additional training is needed.

2) Leskovac

Support for renewable energy production

Most of interviewed stakeholders are not aware about existing regulations (Law on Energy and Energy Efficiency), plans (RES action plans) and programs (support projects) and believe that concrete measures of support do not exist. Also local support does not exist. Apart from firewood used by local population and mini hydro power plants RES are not used. The City established a solar power plant company, but this company stopped working. Wood biomass is most important RES in the location, with potentials for hydro and solar. The population is

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accustomed of using firewood in traditional manner, and not informed enough of possibilities to use wood biomass efficiently for energy production. Plenty of education is needed.

Use of forests and wood products

The population is not aware of possibilities of using wood biomass for energy production, and majority is accustomed in using firewood traditionally. Most important risks are that the population might not be interested and potential lack of political will to support the project.

Forest operations and supply chains

Firewood is used locally or regionally, part is exported. Logs are used locally or regionally while pellet and charcoals are mainly exported. Only some wood processing companies are using wood for energy production for steam and drying. All large energy consumers use coal and natural gas. BLTCs do not exist in the area.

Stakeholders and BLTC establishment

Most important local stakeholders to be included in BLTC development are: Local administration and DH Company. Most important external stakeholders to be included in BLTC project are: ministries, experts and financial supporters. Most important benefits of BLTC are seen in: employment, reduction of GHG and change of habits. Most important objectives and drivers for BLTC are: profit, support to local economy, employment and GHG reduction. Most appropriate management structure for BLTC in opinion of most public sector respondents is Public company or PPP, for respondents from private sector only private company can run BLTC.

Investment and funding possibilities

Most adequate sources of funding are finances from the City, subsidies, donations, loans and private capital in case of PPP. Most important factors for investment decisions regarding BLTC are: political support, available capital, local support and rate of return. Respondents believe that City should be responsible for financing procurement for BLTC establishment.

Implementation phase and running of a BLTC

Local stakeholders believe that if the city establishes a BLTC in form of a company, the local administration will complete all procedures. There are adequate professionals for BLTC development and should be additionally trained.

3) Nova Varos & Priboj

Support for renewable energy production

Most of interviewed stakeholders are aware about existing regulations (Law on Energy and Energy Efficiency), plans (RES action plans), programs (support projects) and incentives (feed in tariffs for electricity production). However organized support for concrete actions does not exist. Local support does not exist except support for investors and the adopted energy efficiency action program. Apart from firewood used by local population and some small

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companies RES are not used. There are developed wood pellet factories and wood chips mainly aimed for export. Woody biomass is the most important RES in location, with potentials for wind, mini hydro, geothermal and solar. Municipalities in the area participate in GIZ/KfW DKTI program as well as UNDP so further development can be expected. Also there are operational hydro power plants and ongoing projects for new ones. Municipalities are supporting energy efficiency and fuel switch in public buildings. There are private companies which developed pellet and wood chips production. Firewood is used traditionally but public awareness is rising due to activities of local administration and development projects. Also good examples of successfully operating private companies raise awareness.

Use of forests and wood products

More cooperation between state forest managers and local administration is needed and also wood processing industry is still not aware of possibilities of biomass utilization or thinks it is better to sell biomass than to use it. The public is becoming aware about possibilities to use wood fuels especially since the local administration is active in fuel switch initiatives and there are private companies active in biomass processing. Most important threats for BLTC development can be in the market and competition with existing wood pellet factories and wood chips producers in terms of biomass supply. Also there is a problem in possible price escalation due to increase of demand for woody biomass.

Forest operations and supply chains

The Wood pellet factories and wood chips producers have modern equipment and developed capacities. Main wood fuels products are firewood, wood pellets and wood chips from sawmill residues. Logs and firewood are used locally or regionally. Wood pellet is used regionally or exported, while wood chips are exported in most cases or used regionally. Currently there are no large consumers of wood based fuels. Wood fuels are used by wood industry (sawmills and pellet producers) and touristic capacities. Jela Star doo can be regarded as active and operational BLTC in the region. This company has an organized system of biomass supply from sawmills, production capacities for wood chips and pellet production and developed market channels for supply of local and regional consumers of wood pellet and wood chips as well established trading channels for exporting wood chips and wood pellets.

Stakeholders and BLTC establishment

According to respondents' opinion the local administration, together with forest managers and forest owners and wood processing industry should be included in BLTC establishment. Investors, donors and experts are required as outside stakeholders. Public-private partnership or even a public company seems as most adequate option to most of the respondents. Most important benefits of BLTC are stated in improvement of wood fuel quality, employment and increase of wood biomass utilization and market development. Most important drivers of BLTC establishment are support to local economy and profit gains. Positive response should be expected from public. Workshops, meetings with suppliers and other stakeholders along with local media promotion are most important channels for BLTC

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promotion. Main risks for BLTC development apart from financing issues are in competition for biomass supply and possible price escalation due to increased demand for biomass. Respondents have very diverse opinion in terms of management structure, for some private company or cooperative are most favourable solutions, while for others PPP or even public company are most adequate. Also there are opinions that ownership share and management should be mixed between public or private actors.

Investment and funding possibilities

Respondents have diverse opinions and depending on management structure finances should be obtained from investors but also from banks or local or even state budget. Most important factors for investment decisions about BLTC are available capital, existing market, sustainability and political support. Partners in BLTC should be responsible for provision of financing.

Implementation phase and running of a BLTC

Local stakeholders believe that apart from company registration required permissions and regulations encompass: construction permits, environmental impact assessments (especially in regard to noise and dust) and anti-fire regulations. There are professionals locally or state wide to cover management and skilled operators in local communities.

4) Bajina Basta

Support for renewable energy production

Awareness of respondents about state support is diversified, while local administration and DH Company are aware, forest managers and forest owners are not aware. Awareness of respondents about local support is diverse, while local administration and DH company claim local support except related to financing exist. Forest managers and forest owners are not aware about it. There are some projects in mini hydro, but large potential for wood biomass utilization remain unused. Biomass, hydro, solar and even geothermal potential exist, however potentials are not utilized. There is a lack of stimulation of local consumers and more support is needed from local administration. Municipality and DH Company are implementing the KfW program on fuel switch and there are private investments in wood pellet production and small hydro power plants. The population is accustomed of using firewood in a traditional manner. The public is also aware about energy production from wood and positive response with right approach can be expected.

Use of forests and wood products

Biomass from forest residues remains unused. Major limitations in increase of forest resource use are in nature protection (most of the area is within National Park Tara), forest management, conditions of forest infrastructure and lacking technology. Most important obstacles for BLTC development are stated regarding nature protection restrictions and low market level.

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Forest operations and supply chains

NP Tara has its own machinery and production capacities. Equipment is usually outdated. Wood processing machines are present only in wood pellet factories. Main wood fuel products are firewood, and wood pellets. Firewood and logs are used locally or regionally. Pellets (Bajina Basta town have highest share of wood pellet used per capita) are used locally and are exported. There are wood processing companies using wood for satisfying their energy needs.

Stakeholders and BLTC establishment

Most important local stakeholders to be included in BLTC development are: Local administration, forest management companies, private forest owners and DH Company, along with local wood industry. Most important external stakeholders in BLTC project are investors. Answers on most favourable solution to run the BLTC, are very diverse from PPP to exclusively private company. Most important benefits of BLTC are seen in: secure supply and profit. It is important to involve local administration in the process. Most important tools for explaining BLTC to the public should be meetings with stakeholders, workshops and local media. Main risks for BLTC development are lack of finances, lack of market, inadequate equipment and poor communication with stakeholders.

Investment and funding possibilities

Most adequate sources of funding are private capital supported by subsidies from local or national administration. Most important factors for investment decisions regarding BLTC are: available capital, political and local support, rate of return and availability of biomass. BLTC partners and company should be responsible for financing procurement also local administration should support.

Implementation phase and running of a BLTC

Local stakeholders believe that apart from company registration required permissions and regulations encompass: construction permits, environmental impact assessments (especially in regard to noise and dust) and anti-fire regulations. There are professionals to cover all aspects of BLTC work.

5) Sabac

Support for renewable energy production

Most of interviewed stakeholders except state forest managers are aware about existing regulations (Law on Energy and Energy Efficiency), plans (RES action plans), programs (support projects) and incentives (feed in tariffs for electricity production). Local support exists in promotion and energy efficiency. City of Sabac participates in KfW program for grid rehabilitation, in KfW studies for fuel switch and also EBRD studies and support in fuel switch are in progress. There are some industrial and individual users of biomass and firewood is traditionally used by households. Biomass is most important - it is necessary of develop long term strategy, provide more information and encourage private and public sector in consumption and supply. City supports energy efficiency and fuel switch measures.

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Awareness is rising but the public is not so familiar with modern technologies. Energy plantations are starting to be established.

Use of forests and wood products

Public is not aware enough about possibilities to use wood and not informed about wood potentials, while stakeholders are. Limitations for increasing forest utilization development: nature conservation and lack of technologies. Main drivers of forest utilization are market demand, price of wood and price of fossil fuels. Most important obstacles for BLTC development are availability of wood biomass, forest ownership and less developed market.

Forest operations and supply chains

Respondents are unaware about BLTCs in Sabac area but have expressed a need for BLTC if DH makes a fuel switch to biomass - it will need regular supply.

Stakeholders and BLTC establishment

Most important local stakeholders to be included in BLTC development are: Local administration, biomass suppliers (private forest owners, PE Srbijasume and PE Vojvodinasume), heat installer, consumers and boiler suppliers. However PE Vojvodinasume does not see the interest in participating in BLTC since they do not need a BLTC to control the biomass market. Most important external stakeholders to be included in BLTC project are: experts, banks, funds and investors. Public company and Public-private partnership are a most favourable solution to run the BLTC. Most important benefits of BLTC are seen in: saving in energy costs and secure supply with additional revenues. Most important objectives and drivers for BLTC is development of local economy. Main risks mentioned for BLTC development: finances, lack of technologies, short term planning and availability of wood biomass. Most appropriate management structure for BLTC is a Public company or PPP.

Investment and funding possibilities

Most adequate sources of funding are private capital, subsidies, loans and donations. Most important factors for investment decisions regarding BLTC are: return of investment and available capital. BLTC partners and local administration should be responsible for financing procurement.

Implementation phase and running of a BLTC

Local stakeholders believe that ecological permits, long term contracts with suppliers and energy legislation determine BLTC development. There are no professionals for BLTC development but should be identified and trained.

6) Pecinci

Support for renewable energy production

Most of interviewed stakeholders except state forest managers are aware about existing regulations (Law on Energy and Energy Efficiency), plans (RES action plans) and programs (support projects) and incentives (feed in tariffs for electricity production). However also

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most believe that support is weak, and some are aware about support from the Province of Vojvodina. Apart from agro biomass used in DH Sremska Mitrovica and some industrial and individual users RES are not used except firewood by households. Most see potential in better usage of forest residues and in establishment of energy plantations. PSEMR supports concrete projects for biomass usage by farmers and in public buildings, also some other organizations organize promotion, but local stakeholders still believe support is not strong enough. Awareness is rising but public is cautious and curious, however positive response can be expected.

Use of forests and wood products

The public is not aware enough about the possibilities using wood. Vojvodina is mainly agricultural area and there are almost no private forests. Most forests are state owned and managed by PE Vojvodinasume. People use wood for heating their households buying it from traders. Limitations for increase of forest utilization are low forest resources in Vojvodina, nature conservation, and lack of technologies. Main drivers of forest utilization are market demand. Most important obstacles for development of BLTC are availability of wood biomass, nature conservation and market.

Forest operations and supply chains

PE Vojvodinasume has very developed and modern capacities for forest utilization including harvesters, forwarders and other needed machinery. Also they have skilled human resources. Private companies exist but are not adequately equipped. Large quantities of firewood are transported from other parts of Serbia or are imported. There are wood processing companies using wood for energy production for steam and drying. Some small companies use wood for their industrial purposes.

Stakeholders and BLTC establishment

Most important local stakeholders to be included in BLTC development are: Local administration, forest management companies, energy plantation growers and DH Company. However PE Vojvodinasume does not see the interest in participating in BLTC since they do not need BLTC to manipulate with biomass. Most important external stakeholders to be included in BLTC project are: experts, related ministries and investors. Public-private partnership is a most favourable solution to run the BLTC, or a private company with public control. Most important benefits of BLTC are: secure supply, energy efficiency and reduction of energy dependence. Most important objectives and drivers for BLTC are: profit, GHG emission reduction and employment. Most appropriate management structure for BLTC is a PPP or cooperative or a private company if public participation is procured.

Investment and funding possibilities

Most adequate sources of funding are private capital supported by subsidies from local, provincial or national administration. Most important factors for investment decisions regarding BLTC are: return of investment, available capital and political support. BLTC partners and company should be responsible for financing procurement.

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Implementation phase and running of a BLTC

Local stakeholders believe that apart from company registration required permissions and regulations encompass construction permits. There are professionals to cover all aspects of BLTC work, but additional training is needed.

7) Zrenjanin

Support for renewable energy production

Most of interviewed stakeholders except state forest managers are aware about existing regulations (Law on Energy and Energy Efficiency), plans (RES action plans) and programs (support projects) and incentives (feed in tariffs for electricity production). The city of Zrenjanin adopted a plan for energy development and supports energy efficiency and renewable energy production. Zrenjanin introduced new tariff system for charging heat based on consumption instead of heating area, also they plan to introduce subsidies for energy efficiency and utilization of RES. Private actors however believe that local administration does not support utilization of biomass sufficiently. Some companies use agro biomass (sunflower husk and agro pellets), while firewood is used in households. Most important renewables are woody and agro biomass, solar and geothermal. PSEMR support concrete projects for biomass usage by farmers and in public buildings, also some other organizations organize promotion. City of Zrenjanin formed a working group for development of biomass utilization focussing on DH plant. In cooperation with KfW and GIZ DKTI studies have been conducted about fuel switch based on agro and woody biomass and establishment of energy plantations. The potential for development of energy plantations is significant. The DH plant could rely on energy plantations for future heat supply based on wood chips. The public awareness is rising, however population already have experience in agro biomass utilization and firewood for heating.

Use of forests and wood products

There is an increasing trend of using firewood due to increase of price of natural gas. However there are impediments which include lack of interest from state forest managers in woody biomass mobilization. Another obstacle is regulations. -It is still not possible to make long term lease contract for state owned land to establish energy plantations. Most forests are state owned and managed by PE Vojvodinasume, which poses all capacities for forest utilization. Smaller part of the state owned forest is managed by PE Vode Vojvodine, which sell wood on stump to private companies. Limitations for increase of forest utilization are low forest resources in Vojvodina. Main drivers of forest utilization are the increasing market demand. Most important obstacles are availability of woody biomass, undeveloped supply and wood prices.

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Forest operations and supply chains

PE Vojvodinasume has very developed and modern capacities for forest utilization including harvesters, forwarders and other needed machinery as well as skilled human resources. Private companies exist but are not adequately equipped. Logs and firewood are the main forest products. Logs are consumed regionally. Large quantities of firewood are transported from other parts of Serbia or are imported. The city of Zrenjanin has plans to utilize woody biomass in DH system but also to include wood based fuels (pellets) in schools, hospitals and other public buildings. Respondents are unaware of BLTC existence in the area.

Stakeholders and BLTC establishment

Most important local stakeholders to be included in BLTC development are: Local administration, forest management company, energy plantation growers, wood traders, other biomass suppliers, boiler distributers, and DH company. However, PE Vojvodinasume does not see the interest in participating in the market based BLTC development. Most important external stakeholders to be included in BLTC project are: experts, related ministries and investors. Cooperative or Public-private partnership is a most favourable business model option for developing a BLTC. Most important benefits of BLTC are: reduction of heating costs, reduction of import and reduction of energy dependence.

Investment and funding possibilities

Most adequate sources of funding are private capital and loans. Most important factors for investment decisions regarding BLTC are: return of investment, available capital and political support. BLTC partners are responsible for financing procurement.

Implementation phase and running of a BLTC

Local stakeholders believe that apart from company registration required permissions and regulations encompass construction permits. There are professionals to cover all aspects of BLTC work.

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Annex I

Criteria checklist

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Criteria Checklist for the selection of priority locations for new BLTCs in Croatia, Bulgaria and Serbia

In the assessment process for prioritising feasible BLTC locations and dialogue with local stakeholders and potential investors for BLTCs all listed criteria below need to be evaluated.

A) **Biomass potential** in the region (30-40 Km as orientation):

- (technically and economically feasible) availability of wooden raw material;
- sources of biomass (forests, plantation, wood processing industry);
- ownership structure of forests (private, state owned, church);
- suppliers and their location;

B) **Consumer market situation for wood**:

- Trade situation (which type of energy wood is mostly sold and used in region (logwood, woodchips, pellets…)
- customer readiness with buying capacity (in volumes) in the region (e.g. biomass heat plants or CHP);
- number and consuming biomass volumes of private consumers: households, business entrepreneurs;
- Existence of wood industry and suppliers? How is the regional wood market organised?
- Potential of market actors getting involved in BLTC development
- Characteristics of current marketing/branding situation for woody products

C) Price and supply structure of **competing energy supply** (natural gas, other renewables);

- Potential for fuel switch from fossil fuels to woody energy products

D) Number and **Composition of farmer cooperatives and forest owners**/associations in region interested in participating in the supply chain management and operating of BLTC;if there are, some of the important information about them are:

- size of the average forest/land plot possible for short rotation plantation;
- potential of annual raw material supply;
- available transport infrastructure;
- available mechanical equipment;

E) **Investment/Finance options** (local, regional, national, private-public)

F) Type of **current wood supply actions** in the region:

- Woody energy production (which products) ?, or only/mainly storage for private consumption,
- Existing trading routes?

G) **Features of possibly feasible location/plot for BLTC set-up**:

- Accessibility to suppliers and consumers – short distances – central location for suppliers and consumers

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- Exposed surface (no adjacent residential area: noise/dust)
- As little as possible shading – good through ventilation, rather windy place should be preferred
- The location should be next to a city (visibility, accessibility, marketing)
- No adjacent waters (high air humidity)
- Next to good road network
- Existing Transport possibilities and alternatives in general
- Existing storage and/or processing facilities
- Current characteristics of wood delivery for energy purposes (quality, amount etc.)
- Accessibility option for trucks (e.g. street regulations / weight restrictions on bridges)
- Kind of available technical equipment
- Interested Entrepreneur personalities?
- Kind of legal permissions required for set-up of a BLTC consortia and description of required authority procedures; support by local authorities?
- Complexity of local/regional//national legal procedures relevant for BLTC set-up?
- Local acceptance by key actors?

H) **Sustainability**:

- Existing certified forests and operators (which certification schemes, figures about certified heactares and certified operators and trade)
- Availability of accredited certification bodies
- Potential of BLTC site for becoming a "flagship-project" with high public outreach for rural development and sustainability in the region

For identifiying priority locations in each of the countries: Croatia, Bulgaria and Serbia the following essential criteria **need to be fulfilled**:

1. FINANCE OPTIONS: existing interest of private investors/local authorities
2. MARKET DEMAND: existence of consumers
3. KNOWLEDGE: existing awareness of the population
4. SUPPLY: existing potential from private forests (does not apply for Bulgaria) and existing supply chains

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Annex II

Checklist Form

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1. Location		
1.1 Country	*Bulgaria/Croatia/Serbia*	
1.2 Region/district/ city		
1.3 Topography in the region	*Flat/Hilly/Mountain*	
1.4 Vicinity to a city/town and distance in km		
1.5 Transport connections		**If yes, distance in km**
Highway	yes/no	
Railway	yes/no	
Waterway	yes/no	
1.6 Road transport restrictions		**details/additional information (tons etc.)**
Weight limits	yes/no	
Other road restrictions	yes/no	
Other accessibility restrictions	yes/no	
1.7 Forest road network density in the supply area	**m/ha**	**qualitative classification**
forest roads		Poor/Average/Good
winter roads		Poor/average/Good
1.8 Accessibility of potential BLTC by vehicles		**details/additional information**
Truck	yes/no	
Van/car with trailer	yes/no	
Van/car	yes/no	
Tractor	yes/no	
Chipper	yes/no	
Other	yes/no	
1.9 Environmental		

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aspects	
Is noise or dust a problem for surroundings or environment (households, farms, public infrastructure)?	yes/no/describe
Is there nature conservation area (-s) nearby which should be taken into consideration?	yes/no/describe
Is there a chance that operations are increasing the risks for safety or health of people and animals nearby?	yes/no/describe
Is there a risk (-s) for the safety and functions of operation due the environment or public infrastructure (powerlines, natural hazards, traffic)?	yes/no/describe
1.10 Quality of location as BLTC	
Good site properties facilitating natural drying and improving raw material and product quality (open, sunny, windy, southward direction, no adjacent waters)?	yes/no/describe
Is there a chance that operations are increasing the risks for safety or health of people and animals nearby?	yes/no/describe
Which legal permissions are required for set-up of a BLTC??	describe

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2. Biomass potential (criteria A)		
2.1 Forest biomass potential in the supply region (technically & economically feasible potential);		**m^3/a in a radius of km**
Tree species 1	*Spruce, Pine, Birch, Aspen, Alder, Beech, Poplar, Willow, Oak, Hornbeam, Fir, Black lobus, Lime, Other*	
Tree species 2	*Spruce, Pine, Birch, Aspen, Alder, Beech, Poplar, Willow, Oak, Hornbeam, Fir, Black lobus, Lime, Other*	
Tree species 3	*Spruce, Pine, Birch, Aspen, Alder, Beech, Poplar, Willow, Oak, Hornbeam, Fir, Black lobus, Lime, Other*	
Tree species 4	*Spruce, Pine, Birch, Aspen, Alder, Beech, Poplar, Willow, Oak, Hornbeam, Fir, Black lobus, Lime, Other*	
2.2 Biomass potential as energy products from:		
1) forests	**m^3/a**	**MWh/a**
Forest chips		
Firewood logs		
Other		
2) short rotation plantations	**m^3/a**	**MWh/a**
Forest chips		
Firewood logs		
Other		
3) wood processing industry		

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wood chips			
pellets			
briquettes			
other			
		Share, %	
2.3 Primary origin/ownership of biomass	*Private forests, state owned forests, church, private plantations, wood processing industry*		
2.4 Secondary origin of biomass	*Private forests, state owned forests, church, private plantations, wood processing industry*		
2.5. Sustainability certification			
How many percent and/or hectares of the forest area are under a forest certification scheme?	describe the certification situation		
Which certification schemes for sustainable and quality controlled wood energy products are used so far?	*PEFC, FSC, Other*	**distance to certified forests and/or chain of custody certified operators (km):**	
Accredited certification bodies are available in the region?	yes/no/describe		
2.6 Number of biomass suppliers and their forest/land area in the region			
2.7 Potential supply of biomass through suppliers in the region *(associations cooperatives, farmers, etc., see 3.1-3.3*)	**m^3/a or t/year** **please indicate**	**MWh/a**	

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Wood chips *(list of different qualities if possible)*		
Pellets *(list of different qualities if possible)*		
Briquettes *(list of different qualities if possible)*		
Firewood logs *(list of different qualities if possible)*		
Charcoal *(list of different qualities if possible)*		
Other *(list of different qualities if possible)*		
3. Market analysis (criteria B & C)		
3.1 Total use/sales of woody biomass in the region (please specify if	**m^3/a or t/year** **please indicate**	**MWh/a**

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used in the region or exported)		
Wood chips *(list of different qualities if possible)*		
Pellets *(list of different qualities if possible)*		
Briquettes *(list of different qualities if possible)*		
Firewood logs *(list of different qualities if possible)*		
Charcoal *(list of different qualities if possible)*		
Other *(list of different qualities if possible)*		
3.2 Types and number of biomass users on the area		**details/additional** **information: share (%), number, annual use (t or MWh per year)**
Type of user 1	*CHP plant, district heating plant, school, public facilities, office building, farm, private household, wood processing industry, charcoal producer, pellet factory, other*	
Type of user 2	*CHP plant, district heating plant, school, public facilities, office building, farm, private household, wood processing industry, charcoal producer, pellet factory, other*	
Type of user 3	*CHP plant, district heating plant, school, public facilities, office building, farm, private household, wood processing industry, charcoal producer, pellet factory, other*	
3.3 Description of	describe	

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existing trading routes			
3.4 Number of competing biomass suppliers in the area		**m^3/a**	**MWh/a**
Type of supplier 1 and volume	*Wood processing industry, other BLTC, something else*		
Type of supplier 2 and volume	*Wood processing industry, other BLTC, something else*		
Type of supplier 3 and volume	*Wood processing industry, other BLTC, something else*		
3.5 Price and supply structure of competitive energy supply		**MWh/a**	
Type of supplier 1	*Natural gas, oil, coal, nuclear, wind, solar, hydro*		
Type of supplier 2	*Natural gas, oil, coal, nuclear, wind, solar, hydro*		
Type of supplier 3	*Natural gas, oil, coal, nuclear, wind, solar, hydro*		
3.6 Is there good potential for fuel switch from fossil fuels to woody energy products?	yes/no/describe:		
3.7 Minimum and maximum distance to main/potential customers in km	describe the distance:		
3.8 Description of customer readiness with buying capacity	describe; m3/tons in the region		
3.9 Characteristics of current marketing/branding situation for woody products in the	describe:		

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area/region			
4. BLTC establishment/operation (criteria D)			
4.1 Are there existing farmer/forest owner associations in the region/area?	yes/no	If yes, how many members, how large forest/land area and average annual biomass production from associated members?	
4.2 Are there existing farmer/forest owner cooperatives in the region/area?	yes/no	If yes, how many members, how large forest/land area and average annual biomass production from associated members?	
4.3 Are there other active farmer/forest owner groups in the area?	yes/no	If yes, how many members, how large forest/land area and average annual biomass production from associated members?	
4.3.1 Are there companies producing biomass or wood industry with a high biomass know how in the region?	yes/no	If yes, how many companies, what actions?	
4.4 Is there existing interest/awareness of the stakeholders *(4.1, 4.2 or 4.3)* **towards establishment of BLTC?**	yes/no		
4.5 Are there market actors *(4.1, 4.2 or 4.3)* **willing to invest in BLTC in the area?**	yes/no	If yes, please specify (local, regional, national, private, public):	
4.6 Available personnel for BLTC operation and management		**details/additional information (number of persons etc.)**	
management	yes/no		
BLTC operation	yes/no		
raw material procurement	yes/no		
In general, are there skilled or trained employees for BLTC/supply chain	yes/no		

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operation?		
4.7 Existing facilities for BLTC		**details/additional information**
Total size (area), m^2		
Type of actions	*Raw material storage, fuel production, trade*	
Buildings 1	*Office building, storage, other*	
Buildings 2	*Office building, storage, other*	
Storage facilities 1	*Boiler house silo, open storage area (yard),storage house, storage hall, no storage, other*	
Storage facilities 2	*Boiler house silo, open storage area (yard),storage house, storage hall, no storage, other*	
Machinery 1	*Chipper, truck, tractor, trailer, crusher, drier, firewood processor, log splitter, telehandler, other*	
Machinery 2	*Chipper, truck, tractor, trailer, crusher, drier, firewood processor, log splitter, telehandler, other*	
Machinery 3	*Chipper, truck, tractor, trailer, crusher, drier, firewood processor, log splitter, telehandler, other*	
Machinery 4	*Chipper, truck, tractor, trailer, crusher, drier, firewood processor, log splitter, telehandler, other*	
Machinery 5	*Chipper, truck, tractor, trailer, crusher, drier, firewood processor, log splitter, telehandler, other*	
Equipment 1	*Moisture meter, scales, quality measurement*	
Equipment 2	*Moisture meter, scales, quality measurement*	
Other		
4.8 Delivery options		**details/additional information**
Type of delivery	*Delivery is included to the service, customer takes care of deliveries, flexible delivery service*	
4.9 Potential of BLTC site for becoming a "flagship-project" with high public outreach for rural	describe	

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development and sustainability in the region *(free description)*		
4.10 Describe the Legal procedures for BLTC set-up *(free description regarding complexity, lead time required from submission till approval, local/ regional/national)*	describe	
4.11 Support of local authorities *(free description)*	describe	
4.12 Who/what are the key actors and what is their level of acceptance? *(free description)*	describe	
5. Finance		
5.1 Estimated investment costs **Option 1: Without own physical infrastructure (web/shop based)** **Option 2: With own physical infrastructure:**		
5.2 Description of possible finance models for BLTC in this area	describe	
5.4 Existing subsidies		**Details/additional information (€,%,…)**
investment	yes/no	

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production	yes/no	
feed-in tariff	yes/no	
other	yes/no	

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Annex III

Form semi-structured interview questionnaire

Interview form; WP3 stakeholder interviews

Interviewer (name/organization): _____

Stakeholder data:

Name: _____

Organisation: _____

Role in BLTC project: _____

1 Support for renewable energy production

1.1 How national/regional administration is supporting the energy efficiency or production and use of renewable energy or wood based bioenergy? What measures, actions or decisions have been done *(Laws, action plans, renewable/bioenergy programs etc.)*? What support schemes do you know?

1.2 How local/regional/national administration is supporting the energy efficiency or production and use of renewable energy **at local level**? What measures or decisions have been done? What is your opinion about the level of support?

1.3 What is the **current status of renewable energy production** on your region?

1.4 How do you see the possibilities to increase the renewable energy production **at local level?** *(main sources of renewables and energy production possibilities)*

1.5 Are there existing actions to support energy efficiency or use of renewable energy **at local/regional/national level**? *(ongoing projects, investments, funding schemes etc.)*

1.6 What is the public opinion towards the renewable/wood based energy production **at local level/in your region**? *(Explain the use of forest biomass for energy production in the area; households, heating plants, other)*

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2 Use of forests and wood products

2.1 How **aware** local stakeholders are about the possibilities of using forests and wood products?

2.2 How **aware** local stakeholders are about using forests and wood **for energy production**?

2.3 What are the **main obstacles** or **limitations** of increasing the use of forests/wood in your region? *(forest ownership, nature conservation, recreation, lack of management, lack of technology and supply chains, unexciting markets, insufficient woody biomass potential, price level, peoples' opinions etc.)*

2.4 What are the **main drivers** of increasing the use of forest/wood in your region? *(unutilized resources, jobs, income, energy production, political decisions/support, available markets, available subsidies, price level, etc.)*

2.5 Are there **existing issues** which might pose a problem or threat for successful establishment of a BLTC? *(forest ownership, nature conservation, recreation, lack of management, lack of technology and supply chains, unexciting markets, insufficient woody biomass potential, price level, peoples' opinions etc.)*

3 Forest operations and supply chains

3.1 Are there **existing companies, supply chains and technology** for forest biomass/wood procurement? What kind? *(lumberjacks, motor-manual operations, mechanized harvesting, farm tractors, harvesters, chippers etc.)*

3.2 What are the **main forest/wood products** in the region and where and how are they harvested? (sawlogs, pulpwood, firewood, slashes, logging residues).

3.3 What are the **main wood based energy products** in the region and where are they produced? Describe the production process and supply chain. *(forest chips, pellets, briquettes, firewood)*

3.4 Where the main forest/wood products are used? Are they used in the region or exported? *(sawmills, wood products factories, pulp mills, biorefineries, CHP, district heating, farms, domestic households)*

3.5 Is there **existing and operating small/medium/large scale user of wood based energy products** in the area or in neighboring areas? Explain and define the market structure, number of potential customers, customer base if possible.

3.6 Is there **existing and operating BLTC** in the area or in neighboring areas? Explain and define the market structure, number of potential customers, customer base if possible.

4 Stakeholders and BLTC establishment

4.1 Who are **potential stakeholders** for a BLTC establishment process in you region? Who should be involved and why?

4.2 Which **external stakeholders** (outside your region) should be involved in a BLTC project? Why? *(For instance; lack of expertise, skilled operators, investors and/or funding)*

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4.3 Who should be **in charge** of a BLTC establishment process? *(public sector, private companies, public-private together, investors etc.)*

4.4 From your opinion, what would be the **main benefits of establishing a BLTC** for wood based products such as forest chips, pellets, briquettes and ?

4.5 What are the **main objectives and drivers** of establishing a BLTC? *(Make money, create work, support local economy, decrease GHG emissions, …)*

4.6 In your opinion, **what is the expected response and opinion of public** towards the establishment of BLTC?

4.7 What measures should be taken within the community to **explain the establishment** of a BLTC to public and or stakeholders? *(Meetings, workshops, newsletter, e-mails. webinars,…)*

4.8 What are the **main risks** concerning a BLTC project? *(Technological failures, market immature, finance, funding issues, lack of skills, etc.)*

4.9 What kind of **management structure** should be chosen for BLTC and why? (cooperative, private entrepreneur, ltd, etc.)

5 Investment and funding possibilities

5.1 Which **sources of funding** are available for a BLTC establishment and which one should be chosen? *(investment subsidies, bank loans, etc.)*

5.2 Which are the most **critical factors for (funding/)investment** decisions? (level of risk, payback time, available capital, community support, political support…)

5.3 Who should be **responsible** for obtaining the funding for a BLTC?

6 Implementation phase and running of a BLTC

6.1 What kind of **permissions and legal procedures** are necessary when establishing a BLTC?

6.2 From your opinion, are there enough **skilled employees and expertise** in your region for successful operation and running of a BLTC? *(Biomass harvesting and logistics, production of wood based energy product, quality management, business management)*

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