

## **Regional Profile of the Biomass Sector in *Serbia***

### ***Timok Forest Area***

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## **1 Introduction**

Forests are one of the most important renewable resources of the Republic of Serbia, with still underused potential. Forestry and wood industry potentially could play an important role in recovery of national economy and achieving of country's social stability. However, the general state of the Serbian forests is unsatisfactory, while the pressure on forests is increased, as a result of the difficult economic conditions and increased needs for products and services from forests.

## **2 Condition and structure of regional/national forests**

### **2.1 Geography and topography**

Total area of the Republic of Serbia is around 8.83 million ha. Area of the Republic of Serbia, without Kosovo (as defined under UNSCR 1244) is around 7.74 million ha. Data received from the National Forest Inventory<sup>1</sup> referring to the period 2006 – 2008, shows that forests in Serbia cover the area of 2.252.400 ha or 29, 1% of total area of the Republic. Geographically, based on Law on Forests<sup>2</sup> - forests are divided into 27 forest districts (22 without Kosovo). Forest district include State-owned and private forests. State-owned forests that are not included in the forest districts and belong to national parks are managed by special public enterprises. Forest districts have been formed according to geographical and natural conditions, which indicate the whole area, based on which the organization of republic's forestry was performed.

### **2.2 Forest condition**

On the basis of obtained results, it can be concluded that Serbia is a middle-forested country. According to the present state, around 35% of the Republic area has only one purpose which is related to forest and forestry. Other data referring to the situation of the Serbian forests are not encouraging. They indicate that the level of coppice forests is very high (1.45 million ha or 64.7% of the total area under the forests). These forests have a very low average volume (124.4 m<sup>3</sup>/ha) and increment (3.1 m<sup>3</sup>/ha), so their production, ecological, aesthetic and other potential are minimal. Encouraging fact is that are 174.800 ha (7.8%) registered as an artificially raised forests, which is the result of intensive afforestation works since the second half of the twentieth century. Compared to previous forest inventory, which was conducted in 1979, the difference in area is positive, 270.000 ha, and relatively around 9.000 ha per year. Increase of the forest area is a result of the conducted intensive afforestation, and natural afforestation of abandoned agricultural land in mountain areas.

Other indicators of forests conditions are wood volume which is 362.5 million m<sup>3</sup> or 160.9 m<sup>3</sup>/ha and annual increment of 9.08 million m<sup>3</sup> or 4.0 m<sup>3</sup>/ha. These indicators, and particularly the wood volume per hectare, are significantly below the optimal values, which indicate that the production potential

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<sup>1</sup> The National Forest Inventory of the Republic of Serbia, Ministry of Agriculture, Forestry and Water Management, 2009

<sup>2</sup> Official Gazette of Serbia, № 46/91

of habitat is not used in the optimal extent. However, positive changes of values indicate continuous improvement of forest conditions.

## 2.3 Forest ownership structure

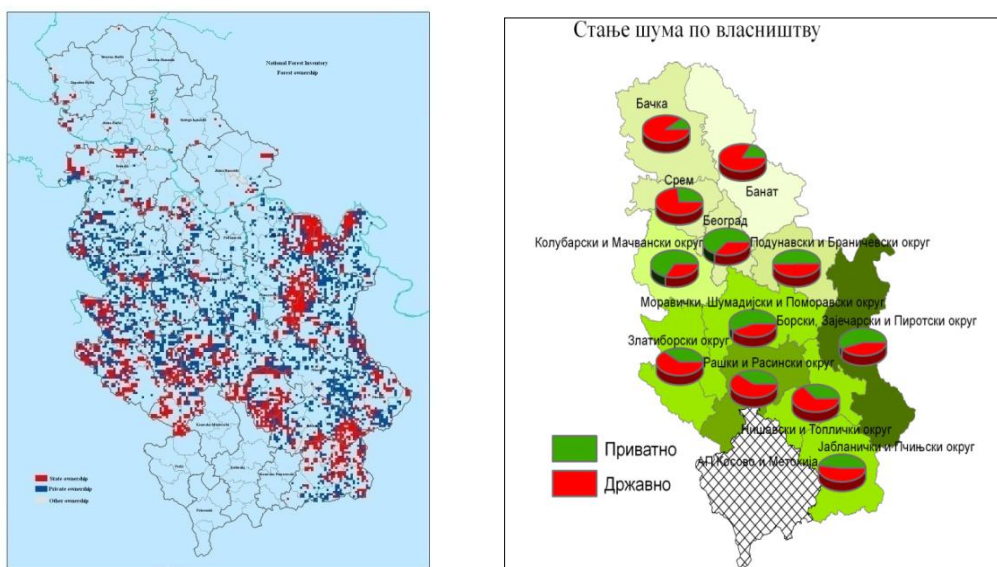
Out of the total 2,252,400 ha of forests in Serbia, 1,194,000 ha is state-owned (53.0%), and 1,058,408 ha is privately owned (47.0%).

**Table 1:** Ownership structure of forests in Serbia

Ownership	Area		Volume			Volume increment			
	forest (ha)	%	total	per ha	%	total	per ha	%	% of V
<b>State ownership</b>	1,194,000.0	53.0	221,417,935.9	185.4	61.1	5,395,093.0	4.5	59.4	2.4
<b>Private ownership</b>	1,058,400.0	47.0	141,069,481.7	133.3	38.9	3,684,680.0	3.5	40.6	2.6
<b>SVG</b>	2,252,400.0	100.0	362,487,417.6	160.9	100.0	9,079,772.0	4.0	100.0	2.5

Source: National forest inventory

The condition of state-owned forests in general can be characterized as satisfactory, considering that the average volume in these forests is 184 m<sup>3</sup>/ha, and current volume increment is 4.5 m<sup>3</sup>/ha. Percentage of increment is 2.4%, which is a significant value indicating that Serbian forests may improve their condition with through sustainable use and good forest practice.



Map 1: Ownership structure of forests

**Table 2:** Forest in state ownership by origin

Stand origin	Area	Volume	Volume per ha	Volume increment total	Volume increment per ha
<b>High natural stand</b>	442 400	117 875 059	266.4	2 481 287	5.6
<b>Coppice natural stand</b>	616 000	84 001 965	136.4	1 918 476	3.1
<b>Artificial afforested stand</b>	135 600	19 540 911	144.1	995 330	7.3
<b>Total</b>	1 194 000	221 417 936	185.4	5 395 093	4.5

Source: National Forest Inventory

**Privately owned forests** are in a worse situation, with average volume of 133 m<sup>3</sup>/ha and annual volume increment of 3.5 m<sup>3</sup>/ha. Percentage of increment in these forests is slightly higher than in the state -owned ones (2.6%), and reasons are the dominant coppice origin and found age structure.

**Table 3:** Forest in private ownership by origin

Stand origin	Area	sum V	V	Volume increment total	Volume increment per ha
<b>Coppice natural stand</b>	840 400	97 186 949	115.6	2 539 716	5.6
<b>High natural stand</b>	178 800	39 636 204	221.7	906 672	5.1
<b>Artificial afforested stand</b>	39 200	4 246 329	108.3	238 291	6.1
<b>Total</b>	1 058 400	141 069 482	133.3	3 684 680	3.5

Source: National forest inventory

Looking at ownership structure of forests, it can be noted that the state owned forests are mostly located in large entities, in the area of major mountain massifs, which are generally not populated and which allows for better organization of management and protection of these forests. Contrary, the privately owned forests are in the village areas and populated places, smaller distances from the villages and towns.

Privately owned forests in Serbia are also characterized by very small average plot size, estimated at around 0.3ha. Moreover, the number of private forest owners is very high amounting to about 500,000 owners. This means that the average private forest owner has about 2 hectares of forests that stretch along the 6 to 7 plots, which are very often not spatially related. This spatial distribution, as well as a very large number of small forest owners, leads to the impossibility of establishing appropriate organization in private forests, and also creates difficulties in the implementation of measures of sustainable forest management. Due to their small size and low productivity, owners cannot afford to pay for professional management of their forests.

## 2.4 Forest owner cooperations (FOCs)

The area of privately owned forests is insufficiently regulated. Private forests cover almost 50 % of total forest area, which represents significant resources, however, the size of the average forest plot is 0,3 ha aggravated and very often disable implementation of adequate measures for forest management. On the other hand, in Serbia there are about 500,000 individual forest owners, which are unorganized, except for several local associations of private owners.

Professional jobs in private forests, which include remittance of trees for cutting, issuance of documentation for timber traffic and partially advisory assistance, performing public companies for the forests management and national parks by the obligations that derive from the Law on Forests (management services for private forests). According to available data the total number of employees in jobs in private forests in the PE "Srbijašume" is 320, of which 53 graduated engineers of forestry and 267 technicians. At the level of PE "Srbijašume", for the purpose of performing professional services in the private forests, annually is done on average:

- 111 temporary annual plans (by municipalities);
- 1.332 project documentation for afforestation and melioration (for cadastral parcels );
- 641.733 m<sup>3</sup> remittances of trees for cutting;
- 490.617 m<sup>3</sup> stamping of average wood;
- 9.638 professional investigation;

- 2.804 submission of expert information;
- 62.105 issuance of shipping document

The owners of private forests often carry out forest management and forest use activities to satisfy their current needs, without taking into account the real needs of forests. The reason for this can be found in the unfavorable economic situation and the fact that many forest owners have left the forest area and now live far away from the forest property, thus changing their attitude towards the forest.

The situation in private forests, which is primarily characterized by lack of organization, leading to a situation, in the area where private forest ownership is dominant, more frequent illegal logging and other activities are being carried out.

In order to improve organization of private forest owners – significant activities on their association have been started, with aim that more significant role in protection and management of their forest is taken by them. First initiatives for private owners association derived from UN/FAO<sup>3</sup> projects. The first of several associations of private forest owners was formed in 2006: Rastište - Bjelovar, Miličinica - Valjevo and Podgorac - Boljevac, and then the process is continued in other areas.

**Table 4:** Associations of private forest owners in Serbia (2008)

No.	Name
1.	Rastište – Bajina Bašta 2006.
2.	Miličinica – Valjevo 2006.
3.	Podgorac – Boljevac 2006.
4.	Zlot - Bor 2006.
5.	Krivelj – Bor 2006.
6.	Brestovac – Bor 2006.
7.	Bigrenica – Čuprija 2007.
8.	Selacka – Zaječar 2007.
9.	Negotin - Negotin 2007.
10.	Mačkov Kamen - Krupanj 2008.

Source: Milijić (2007) i internal data of private forests association

### 3 Biomass resources

Biomass as a commodity that previously had little economic value (eg. bark, harvesting and logging residues, woody biomass outside forests, wood recycled after usual consumption) has been in increasing demand on the market in Serbia, and the amounts that are mobilized and traded are increasing rapidly. The potential of biomass in Serbia lies in the agricultural residues and woody biomass, a total of about 2 700 000 t (1 700 000 t in the remains of agricultural production and about

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<sup>3</sup> Project: FAO/TCP/YUG/2902(A): “Program Institucionalni razvoj i izgradnja kapaciteta za Nacionalni šumarski program” ([www.forestserbia-fao.sr.gov.rs](http://www.forestserbia-fao.sr.gov.rs)), i projekat GCP/FRY/003/FIN: “Razvoj sektora šumarstva i Srbije” ([www.forestryprojectserbia.org](http://www.forestryprojectserbia.org)).

1 000 000 t of wood biomass). In addition to these two major sources of biomass sources can be further single out the rest of the livestock production. The second group of biomass energy sources are plant energy crops (eg mishantus, fast-growing poplar, etc.), and plants that are used as raw material for biodiesel, bioethanol (rapeseed, sunflower, corn, etc.).

### 3.1 Forest biomass

Forest biomass includes wood, mostly of poor quality, the use of which is not appropriate for other purposes (mostly technical). Intentional biomass production in plantations of fast-growing tree species is still not present, while the quantity of biomass produced from wood residues after harvesting is minimal. Quantities of wood residues from primary and final wood processing also represent a potentially significant source of biomass for energy purposes but under present conditions, they are mainly used in the production of wood- based panels (Kronospan factory in Lapovo).

Also, it is important to emphasize that forest biomass represent a conditionally renewable natural resource whose management should be based on and conducted in compliance with the principles of sustainable management and use of forests and other natural resources. Volumes of use must be consistent with the production potential of forests and the forest use method and other management measures carried out in accordance with the needs of each stand.

Potential of forest woody biomass production can reach the amount of 0.795 mil. m<sup>3</sup> on an annual level. An amount of 0.5 mil. m<sup>3</sup> could be reached in initial years of use and does not require significant investments. An amount of 0.795 mil. m<sup>3</sup> of woody biomass annually is estimated for the following period of use and it requires significant investments, technical preparations, subsidy measures and other preconditions. If production is realized in this amount, and that previously necessary requirements have not been met or consumption of fuel wood not reduced, with certainty it can be estimated that sustainability of forest yield is to be compromised.

**Table 4: Potential annual production of forest woody biomass (without firewood) in Serbia**

Resource	Biomass [10 <sup>3</sup> m <sup>3</sup> /god]	Tons of dry wood [10 <sup>3</sup> t/god]	Toe
Wood residue after fellings	435	300	86.439
Reconstruction of devastated forests	220	152	43.716
Restoration of burnt forests	40	23	7.948
Short-rotation plantations	100	50	19.871
<b>Total</b>	<b>795</b>	<b>525</b>	<b>157.975</b>

Source: original calculations

After the first years of forest woody biomass use, further increase of use is possible and will depend on achieved development objectives in the previous period. This primarily depends on the results achieved in the reconstruction of devastated forests, growing of dedicated plantations, extent of forest roads construction, technical equipment and other factors.

Amounts of forest woody biomass are estimated only for forests and woodland. Abandoned agricultural and other land, which in natural succession is overgrown with bushes and forest trees,



represents potentially significant resource of forest biomass and it should be analyzed from the aspect of agricultural areas preservation. If agrarian policy defines the need to preserve these areas for agricultural purposes and if subsidy measures are used to stimulate activities for the removal of bush and tree vegetation, additional amounts of biomass could be produced. On the other hand, by changing the purpose of these areas in the direction of biomass production also opens new perspectives in long term.

It should be mentioned that the realization of the stated plans requires unambiguous and clear support of authorized institutions and subsidies from the budget of the Republic of Serbia. Realization also requires establishment of control and supervision system in the chain of forest woody biomass use, as well as the adaptation of planning and forest management systems. It must not be allowed for uncontrolled market development and increase of woody biomass demand to lead to intensified pressure on forests and exceeding the allowed cuts. In that case, positive effects of biomass use on one side could lead to the degradation of forests on the other.

### **3.2 Short-rotation coppice**

One of the objectives of the Forestry Development Strategy for the Republic of Serbia, which originates from insufficient percentage of forest cover in Serbia, implies the necessity to prevent the decrease of areas covered by forests and taking measures for their enlargement.

The Spatial Plan of the Republic from 1996 defined that present percentage of forest cover should be increased to 41.4%, which was then determined to be the optimal level of forest cover. This percentage of forest cover also remained in the Spatial Plan of the Republic of Serbia (2010-2014-2021). Practically, for achieving the stated objective it is necessary to grow about a million hectares of new forests in long term.

By applying different methodology and approach from the one applied in the Spatial Plan of the Republic of Serbia from 1996, the National Forest Inventory also estimated with quite high reliability that there were 474,400 ha (6.1%) of the so called other wooded and barren land in Serbia. The Forest Inventory did not cover agricultural and marginal agricultural land, so that plans about potential million hectares of new forests are not unfounded. In the Spatial Plan from 1996, total agricultural land was planned to be reduced by about 342 thousand to the benefit of other purposes, including forests. The valid Spatial Plan of the Republic of Serbia anticipates that 26,900 ha should be afforested in the period 2010-2014, or 5380 ha/year.

Having in mind these plans referring to the enlargement of areas covered with forests and the needs of society for a significant amount of biomass, it is necessary that part of new forests are earmarked for biomass production. Due to the significance of woody biomass, the percentage of dedicated plantations for its production should not be less than 10% of total afforested areas.

If objectives from the Spatial Plan of the Republic of Serbia are accepted where annual afforestation level of about 5,000 ha is planned and only 10% is intended for dedicated production of forest woody biomass, data is obtained that in the next 10 years it is necessary to grow new 5,000 ha of forests for this purpose. If identical area of agricultural land is dedicated for the same purpose, annual level of planting of 10,000 ha of short-rotation dedicated plantations for woody biomass production could be reached. Having in mind that this is dedicated planting of fast-growing tree species, total average

annual production of these stands should not be less than 100,000 m<sup>3</sup> of forest woody biomass. Further increase of the area under forest plantations is certainly possible and can significantly affect the increase in biomass production.

### 3.3 Wood residues

Present practice of forest use is such that out of the overall tree biomass, the part of stem above ground and branches thicker than 7cm are most frequently used. All other biomass (root, thin branches, leaves), including rotten, damaged and unusable parts because of other reasons, remains in the forest as forest wood residue. From the environmental aspect of forest management, this residue is not harmful because in the decomposition process it transforms into useful substances. However, observed from the economic aspect, it can represent reduction of income from forest use.

The amount of wood that remains in the forest after cuts depends primarily on tree species, forest age and quality, regeneration type and organization of operations regarding forest utilization, etc. Technology of cuts and extraction of wood assortments may have an impact on increase of wood utilization and its application depends on investments in modern equipment, stand condition and forest management pattern, accessibility of terrain and many other factors. As a rule, clear cuts as well as high intensity cuts enable higher utilization degree of forest woody biomass, however, they are frequently less desirable from the aspect of forest management.

Compared to the present situation regarding biomass use in Serbia, it is indisputable that certain amounts of wood which could be used for energy purposes remain in forests after cuts.

Based on the records of the executed works regarding forest use at the SE “Srbijašume”, which implies the recording of gross and net logged wood, for the period from 2000 to 2009<sup>4</sup>, it was found that average forest residue ranged from 15.2% to 22.4% of gross wood volume. Average value of residue on annual level was 18.4%. This percentage includes tree parts above ground which cannot be processed into standard forest assortments.

Another source of data on wood residue amounts after cuts can be found in assortment tables which are used for qualitative estimation of wood assortment production. Assortment tables for the territory of Serbia are made for beech high and coppice forests]. Average value of wood residue after cuts is 14.15% for high forests and 15.48% for coppices, according to these tables. There are no assortment tables for other tree species for the territory of Serbia.

Wood residue amounts obtained in the analysis of performed cuts and amounts from volume tables sufficiently overlap in order to be accepted for further estimations. If minimal value of wood residue from the records of performed cuts of 15.2% is taken as an initial value, which is approximate to the value of assortment tables for beech, and compared to the total annual allowable cut in state forests, data is reached that 0.42mil.m<sup>3</sup> of forest residue suitable for woody biomass can be expected on annual level.

Practice of forest biomass use in Serbia is not developed yet, consequently there is no experience based on which degree of possible utilization could be determined. Taking into consideration the

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<sup>4</sup> Observed for 34,500 stands where harvesting occurred in the period 2000-2009

experience from other countries as well as the existing limitations present in Serbia referring to the lack of modern technology, insufficient openness of forests, undeveloped market of forest woody biomass and other weaknesses, the estimation is that in first phases about 40% of available amounts of wood residue can be used. Based on the given estimation in state forests, annual production of woody biomass is possible on the level of 170,000 m<sup>3</sup>, which is expected to be cost-effective. Use of total wood residue after cuts in the amount of 0,4 mil m<sup>3</sup> is realistically not achievable without significant investments in forest machinery and improvement of all segments of forest use technology.

Extent and effects of private forests use in Serbia are not known to the level as for state forests. Therefore, estimation of potentials for forest woody biomass production cannot be done pursuant to the same methodology. Assortment tables for beech coppice forests in Serbia and for sessile oak forests in Bosnia can be taken as the only sufficiently reliable data on the amount of wood residue in private forests, which have significant presence in private forests. According to these tables, average percentage of forest waste is 11.7% for oak and 15.5% for beech coppice, which is about 0.4 mil. m<sup>3</sup> annually.

However, owners of private forests largely use all available wood, including the wood with quality below official standards, so that these data on forest residue should be taken as orientational potential. On the other hand, cuts in private forests are mostly thinning and sanitation cuts characterized by the cut of thinner trees with smaller percentage of waste. Many other problems that exist in the private forestry sector point at the assumption that degree of the increase of cut wood utilization in private forests cannot be entirely identified with state forests, however residue utilization could be expected in the amount of 8% of gross wood volume. Compared with total possible allowable cut in private forests, estimation of annual amounts of 0.27 mil. m<sup>3</sup> of wood is reached.

**Table 5:** Estimation of potential use of wood residue after cuts in forests in Serbia

Statistical territorial unit NSTJ-3	Total Yield			Biomass after cuts		
	State	Private	Total	State	Private	Total
	[10 <sup>3</sup> m <sup>3</sup> /god]					
Beograd	97	87	184	6	7	13
Kolubara and Mačva Districts	109	394	503	7	32	39
Podunavlje and Braničevo Districts	173	219	391	11	18	29
Zlatibor District	191	421	612	12	34	46
Morava, Šumadija and Pomoravlje Districts	256	501	757	16	40	56
Bor, Zaječar and Pirot Districts	314	639	952	19	51	70
Raška and Rasina	311	414	724	19	33	52
Niš and Toplica Districts	170	174	344	10	14	24
Jablanica and Pčinj Districts	176	360	536	11	29	40
Srem	240	72	312	24	6	30
Bačka	98	19	116	10	1	11
Banat	251	15	266	25	1	26
<b>Total</b>	<b>2385</b>	<b>3316</b>	<b>5701</b>	<b>170</b>	<b>265</b>	<b>435</b>

Source: Calculation based on possible yield and increasing of utilization level

### 3.4 Agricultural biomass

Agricultural biomass has rarely been used for energy production in Serbia.

## 4 Wood and Biomass use in country/region

### 4.1 Production and demand of biomass in country/region

#### 4.1.1 Wood chips



Under current conditions, wood chipping is done in a pellet plant. Chipping is done in inadequate equipment or chipping machines whose strength and capacity are adjusted to the size of feedstock. The wood used for the production in a high percentage make the trunk larger (often up to 50 cm), with bumps and thick nodes for which the chipping need more power and capacity chipping machines.

Figure 1, chipping of wood

#### 4.1.2 Firewood

The use of firewood in Serbia is often identified with the use of forest biomass, since it is primarily intended for the production of heatenergy. However, the traditional use of firewood is contrary to the objectives of the modern use of biomass and needs to be considered separately from other assortments. The use of firewood/fuel wood has a pronounced social component as it is the only energy source available to much of the population. Nowadays, firewood in Serbia has a developed market and consumers who spend almost all produced quantities. Diverting the firewood market from current consumers to other consumption types (central heating systems, pellets, wood panels, etc..) could lead to undesirable social problems (due to the reduced supply of firewood for residents) or to an increased volume of forest use, i.e. the social and ecological components of forest management could be disrupted. For these reasons firewood in the present volume of production and consumption patterns can not contribute to the provision of additional biomass quantities. However, increasing the efficiency of the use of this energy source, can create new opportunities for its use.

Firewood is often categorized as biomass since it is primarily intended for the production of thermal energy. However, traditional manner of firewood use is contrary to the objectives of modern biomass use and it should be observed separately.

Today in Serbia, firewood has a very developed market and consumers spend practically all produced amounts. The use of firewood has a highly expressed social component because it is the only available energy-generating product for a large part of the population. Redirection of firewood market from present consumers to another consumption type (district heating systems, pellets, wood panels, etc.) could lead either to social problems (because of the reduction of firewood supply for population) or to increased scope of forest use (over the allowed limits), namely social and economic component of forest management would be significantly jeopardized. These are the reasons why firewood in the present consumption manner cannot contribute to the provision of additional amounts of biomass in Serbia.

However, many studies on firewood consumption point at the fact that actual firewood consumption is much higher than the officially registered. According to the study on evaluation and financing of forests in Serbia, consumption of firewood from forests was determined to be 8.72 million m<sup>3</sup>. According to Glavonjić, based on the results of the TCP/FAO Project “Wood-based energy for sustainable rural development in Serbia”, total firewood consumption for household heating purposes was 6.36 mil. m<sup>3</sup> in 2010. Research in this project represents the most comprehensive research conducted to date in Serbia regarding woody biomass consumption, which implies the conclusion that the obtained results have a high level of reliability.

energy resource in households is extremely irrational. In the traditional manner of wood use, its efficiency of use rarely exceeds 40% due to the use of outdated and inadequate stoves. This leads to an obvious conclusion that with the increase of efficiency degree of firewood use significant amounts



could be “released” which would contribute to the increase of modern biomass production. Practically, transfer from traditional to modern way of biomass use can create space for the substitution of other energy-generating products without increasing cuts.

#### 4.1.3 Pellets

In Serbia, mainly produces pellets from hardwood and beech which also adds spruce. Pellets also includes a crust that no producer in Serbia is not removed with the exception of Benevento, where the company produces pellets only without peel. Pellets are produced from raw wood or wood by-products industry. Packing pellets in bags of 15 kg or big bag of 1 ton system. Manufacturers pellet are possessing different certificates. Desirable is ONORM 7135, and then DINPlus, Swisspellet certificates. Pellets must be free of additives such as resins, adhesives, plastics, metals, etc.. Only natural binders are allowed such as lignin, or element of any tree. The most important producers of pellets are:

- BIOENERGY POINT d.o.o.
- BENEVENTOU.M.S. d.o.o.
- ZELENADRINAd.o.o.
- FOREST ENTERPRISES d.o.o.
- BIO-THERM d.o.o.
- GOTAPellets d.o.o.
- ENWOd.o.o.
- ANGLER d.o.o.

#### 4.2 Energetic use of Biomass

As a result of many domestic and international activities that have led to an increase in the importance of biomass in energy production<sup>5</sup>, the Ministry of Energy, Development and Environmental Protection has planned the production and consumption of energy from wood biomass more realistically in the 2013 Energy Balance Proposal for the Republic of Serbia. The planned production of solid biomass<sup>6</sup> in year 2013, according to the Balance, is 1,068 Mtoe, which is about 3.5 times a higher value than the officially published value of consumption in 2011. Also, the social importance of biomass in Serbia is appropriately determined by this Energy Balance. *"The consumption of solid biomass takes place predominantly within consumer spending and in the household sector and partly in public and commercial sectors for space heating. The use of firewood for heating is a characteristic of rural areas and peripheral parts of the suburbs. As a rule, rural regions gravitate towards areas with high production of timber or they are away from other sources of supply and the households are with low purchasing power, so that the price of firewood is the most appropriate and with no alternative. The use of firewood in the peripheral parts of the suburbs will be retained in the following years". "The total amount of primary energy needed to power the year 2013 amounts to 16,739 Mtoe, which is 5% higher than the estimated total amount of primary energy consumption in 2012 which amounts to 15,992 Mtoe". "In the structure of primary energy production, coal accounts for 69%, oil 11%, natural gas 4%, hydro potentials 7%, **firewood 9%**, and geothermal, solar and wind energy and biogas for less than 1%". (Ministry, 2013).*

It should be borne in mind that the Republic of Serbia has pledged to reduce final energy consumption by 9% until 2018 in comparison with 2008, as well as to increase the share of renewable energy sources in final energy consumption to 27% until the year of 2020. (Macura, 2012). In the structure of the planned domestic production for year 2013, renewable energy sources account for 1,835 Mtoe or 16% of the domestic production of primary energy. In this structure, the share of solid biomass is 58%, hydro potentials 41% , and biogas, wind, solar and geothermal energy account for less than 1% (Ministry, 2013).

### 4.3 Costs of solid biofuels

The prices of the Bioenergy purchased tree from Srbijasume in 2012. These are average prices that vary depending on the assortments that are taking.

**Table 6:** The prices of the Bioenergy buying wood from the Srbijasume in 2012.

Org. Unit	Name	m3	RSD	EUR	EUR/m3
3001	ŠU Kučevo	4,770.9	16,181,673.8	147,106.1	30.8
3002	ŠU Majdanpek	9,807.6	30,780,062.4	279,818.7	28.5
3003	ŠU Žagubica	3,560.8	11,148,072.6	101,346.1	28.5
3101	ŠU Boljevac	16,889.6	56,747,004.4	515,881.9	30.5
3102	ŠU Bor	3,173.0	11,072,305.3	100,657.3	31.7
3103	ŠU Kladovo	2,818.0	8,944,928.7	81,317.5	28.9
3104	ŠU Knjaževac	1,675.9	5,038,819.1	45,807.4	27.3
3105	ŠU Negotin	426.7	763,029.0	6,936.6	16.3
3106	ŠU Zaječar	2,130.9	7,055,926.8	64,144.8	30.1
3107	ŠU D.Milanovac	3,941.1	12,795,944.5	116,326.8	29.5
3201	ŠU Despotovac	856.8	2,852,904.3	25,935.5	30.3
3202	ŠU Čuprija	119.1	384,487.2	3,495.3	29.4
3203	ŠU Paraćin	6,077.8	20,070,319.1	182,457.4	30.0
	<b>Total</b>	<b>56,248.3</b>	<b>183,835,477.0</b>	<b>1,671,231.6</b>	<b>29.7</b>



**Table 7:** Price list of forest products

<b>PRICE LIST OF FOREST PRODUCTS</b>			
<b>No.</b>	<b>NAME OF PRODUCTS</b>	<b>Measurements</b>	<b>Price FCO forest truck road (EUR/m3)</b>
1	<b>Cellulose wood and wood for boards</b>		
	Hard broadleaves	m3	33,40
	Hard broadleaves	prm	23,04
	Conifers and soft broadleaves	m3	22,35
	Conifers and soft broadleaves	prm	15,42
2	<b>Firewood - hard broadleaves</b>		
	I class	m3	33,40
	I class	prm	23,04
	II class	m3	25,35
	II class	prm	17,49
	Small round billets	m3	23,04
	Small round billets	prm	12,68
	Tree stump	m3	18,44
	Tree stump	prm	8,31
	Forest residue	m3	20,19
	Forest residue	prm	8,07
	Several meters firewood I class	m3	30,27
	Several meters firewood II class	m3	22,89
3	<b>Firewood - soft broadleaves and conifers</b>		
	I class	m3	22,35
	I class	prm	15,42
	II class	m3	16,60
	II class	prm	11,46
	Small round billets	m3	10,64
	Small round billets	prm	5,86
	Tree stump	m3	10,64
	Tree stump	prm	4,80
	Forest residue	m3	11,97
	Forest residue	prm	4,80



#### **4.3.1 Price for wood chips**

Wood chips are not used for energy in Serbia, and it is used only by Kronospan for their production. Wood chips market is not established because there is no central heating systems to biomass so that it is not possible to express its price. It is desirable that the chips is produced according to ONORM 7133 standard.

#### **4.3.2 Price for wood pellets**

The price of pellets ranges between 120-200 EU/t. When we interviewed people from Bioenergy Point, they told us that the price of pellets around 140 EUR, though it may vary from month to month, ranging up to 165. You need to be very careful about the choice of pellets because the quality greatly influences combustion, energy exploitation and thus consumption.

### **4.4 Technical standards for solid biofuels**

The most important standard in the area of solid biofuels is EN 14961 Solid Biofuels – Fuel specifications and classes. This standard consist of six chapters. The first chapter applies to general requirements. Second chapter discusses about wood pellets for non-industrial use. In the following sections are talking about: wood briquettes for non-industrial use, wood chips for non-industrial use, firewood for non-industrial use, and non-woody pellets for non-industrial use.

#### **4.4.1 Standards for wood chips**

Relevant standards for wood chips are SRPS EN 14961-4:2012, Fuel specifications and classes - Part 4: Wood chips for non-industrial use. This European standard determines the fuel quality classes and specifications for non-industrial wood chips. This European standard covers only wood chip produced from the following raw materials (see EN 14961-1:2010, Table 1): - 1.1 Forest, plantation and other virgin wood; - 1.2 By-products and residues from wood processing industry; - 1.3 Used wood. NOTE For the avoidance of doubt, demolition wood is not included in the scope of this European Standard. Demolition wood is “used wood arising from demolition of buildings or civil engineering installations” (EN 14588:2010, 4.52).

#### **4.4.2 Standards for wood pellets**

Relevant standards for wood pellets are SRPS EN 14961-2:2012, Fuel specifications and classes - Part 2: Wood pellets for non-industrial use. This European standard determines the fuel quality classes and specifications of wood pellets for non-industrial use. This European standard covers only wood pellets produced from the following raw materials (see EN 14961-1:2010, Table 1): - 1.1 Forest, plantation and other virgin wood; - 1.2 By-products and residues from wood processing industry; - 1.3 Used wood. NOTE 1 For the avoidance of doubt, demolition wood is not included in the scope of this European Standard. Demolition wood is “used wood arising from demolition of buildings or civil engineering installations” (EN 14588:2010, 4.52). NOTE 2 Torrefied pellets are not included in the scope of this European Standard. Torrefaction is a mild pre-treatment of biomass at a temperature between 200 °C to 300 °C.

#### **4.4.3 Conversion factors**

Standard SRPS EN 15296:2012 Solid biofuels - Conversion of analytical results from one basis to another gives equations, which allow analytical data relating to solid biofuels to be expressed on the different bases in common use. Consideration is given to corrections that may be applied to certain determined values for solid biofuels prior to their calculation to other bases. In the informative Annex A tools for integrity checks of analytical results are given. In the informative Annex B conversion factors for calculation into other units are given. The informative Annex C is a guideline for the use of validation parameters as can be found in CEN analytical standards.

## **5 Forest Infrastructure and logistics**

### **5.1 Forest road infrastructure**

Construction of forest roads, i.e. adequate openness, is the basis of technical equipment of forests or forest areas. It is also the largest and most expensive investment in forestry. On the other hand, such an investment provides a permanent solution for all activities that are carried out in the forest and also provides valorization of all the other values of the forest. This term implies forest truck roads and skid tracks. Forest truck roads are divided into two categories:

- 1) MAIN (HARD) roads with built carriageway construction
- 2) LOCAL (SOFT) roads built without carriageway construction

Construction of roads in Serbia began in the late '50s, i.e. in the period of the formation of large wood processing facilities. The needs of installed capacities required a greater and permanent amount of mostly technical wood. A good part of the then-built roads was designed for transportation vehicles such as solo trucks (without trailers).

With the establishing of PE "SRBIJAŠUME", technical standards for the design and construction of roads and technical standards for the design of skid tracks were defined. Keeping records on roads built by categories (hard, soft) in length with respect to each forest estate and for the entire Enterprise on an annual basis was organized. During 1994 and 1995 an inventory was made of the current state of the road network in the Enterprise, also according to the categories of roads (public - asphalt, local -hard, local - soft; forest - hard and forest -soft) and data were provided on the density of roads i.e. forest and forest land openness. Starting from the level of Management Unit, to Forest Administration and Forest Estate, and ending with the whole Enterprise. In the period from the foundation of the Enterprise on 01/01/1992 to 31/12/2010, a total of 3,773 km of roads (66km of hard roads and 133km of soft roads) were built.

It is evident that the structure of the constructed roads is not good because only 33% of hard roads and 67% of soft roads were built. In recent years, a tendency toward change in the structure of built roads has been expressed and they are built in an inverse proportion, i.e., there are mostly hard roads (with a carriageway construction in operation throughout the year) and the soft roads are built only where necessary. Information on built roads in year 2006 indicate 67 km of hard roads and 49 km of soft roads.

According to the data of the current forest openness in PE "SRBIJAŠUME", road density is far from what is actually needed. Current value of forest openness is 12.59 m/ha, of which hard roads 6.18

m/ha and soft roads 6.41 m /ha. In the last few years, the Enterprise has emphasized as one of the priorities the need to intensify the construction of forest roads, with special emphasis on the qualitative change in the structure of the constructed roads. This means that priority is given to building hard roads and due to this fact, the structure i.e. the percentage of built hard roads against soft roads is 4:1 in favor of the hard ones.

## **5.2 Biomass supply chain**

Two different supply chains have been analysed for Serbia In the scope of the FOROPA-Project

### **5.2.1 Actors in the supply chain**

*Actors involved in the supply chain of biomass are:*

- *SE Srbijašume,*
- Factory for the production of pellets
- Small forest owners or forest enterprise
- Transport company
- Consumer

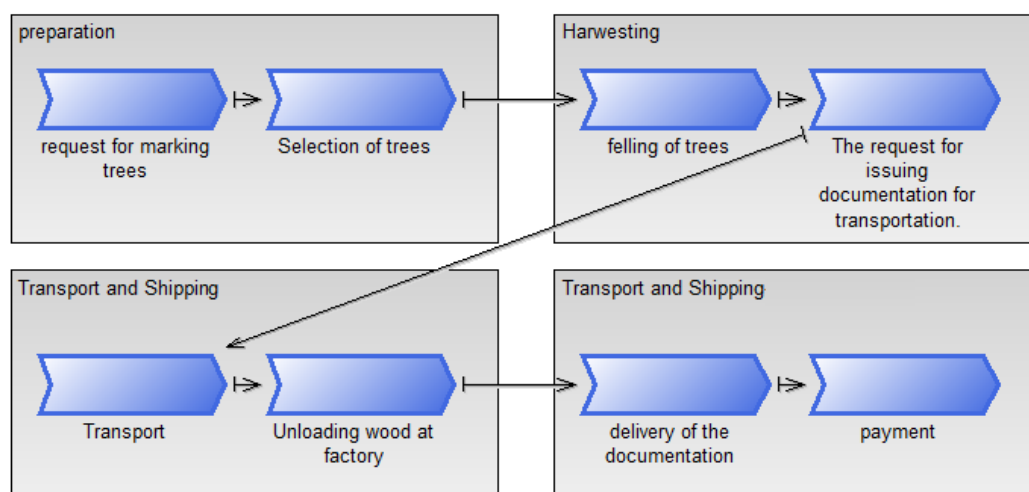
### **5.2.2 Chain 1: Standing Trees in Private Forests - Storage Pellet Plant**

Procedures in private forests that are to be followed, from tree felling to the supply of manufactured assortments, are also mainly prescribed by the Forest Law. The primary purpose of these procedures is to prevent illegal logging and implement appropriate measures for sustainable forest management. The measures also provide the control of cutting volume by the owner, i. e. they prevent the volume of logging to be greater than that allowed by a qualified person.

Forest owners' associations exist in this area, but they are very few and still incapable of conducting activities related to the production processes of wood and biomass on behalf of the owners . The owners are confronted with the necessity to organize all the jobs themselves.

**Table 9:** Description of the process of „Standing Trees in Private Forests - Storage Pellet Plant,,

No.	Business processes	Description of the process	Period – frequency	Duration
1	Request for tree marking	The forest owner is required to submit a written request to the forest office which contains data on the parcel/plot and the desired volume of timber cutting.	whole year	
2	Selection of trees	The marking of trees to be cut is executed by a professional forestry service within the SE which carries out these tasks for forest owners according to the Forest Law.	April-Sept previous year	1 engineer a day for 100m3
3	Felling of trees	After the qualified person has marked the trees for felling, the forest owner himself organizes cutting and extracting of timber to the forest road. Quite often it is the very owner who performs these tasks.	whole year	
3	Request for issuance of shipping document	When the cutting is finished, the owner is not allowed to move the felled tree as long as (s)he receives appropriate timber transport documentation. This documentation is issued by the same person who performed the tree marking for cutting, at the request of the owner. This person controls whether the cut amount is in accordance with the selected amount and issues the appropriate transport document (waybill).	whole year	1 day
8	Transport	The forest owner organizes transportation by himself, using a private vehicle (tractor) or hiring a local carrier.	whole year	1 day
11	Unloading wood at factory	Timber is unloaded at a warehouse in the factory. The buyer receives the goods and issues a document on received quantity.	whole year	1 hour
12	Delivery of the documentation	The carrier and the worker who performed the shipping of timber, turn in the documentation in the accounting department according to which amounts are recorded and invoicing is done.	every day Mon-Fri	1 day
13	Disbursement	Disbursement to the bank account or at the factory cash desk.	every day Mon-Fri	1 day



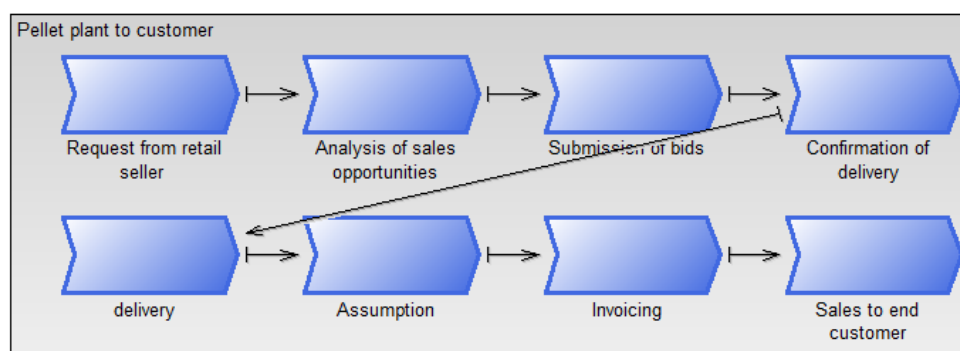
### 5.2.3 Chain 2: Pellet Plant to Customer (B2C)

Despite the fact that Bioenergy Point is a significant producer of pellets, and that local consumption by households is growing rapidly, there are frequent complaints by customers that required quantities of pellets are difficult to buy on the local market. Namely, in accordance with the legislation, Bioenergy Point is not in a position to perform direct retail sales, for the factory exclusively deals with wholesale, primarily by exporting. Retail sales can be exercised only through retail stores registered for these product types. At present, retail of pellets in local conditions is underdeveloped and represents one of the limiting factors that affect its local application.

Analysis of the processes related to the delivery to retail stores will be the subject of a more detailed study. In the following diagram only the basic processes which can be identified in current organizational conditions are shown:

**Table 10:** Description of the process of „Pellet Plant to Customer (B2C) „

No.	Business processes	Description of the process	Period – frequency	Duration
1	Request from retail seller	The retail seller submits a request for purchasing a certain quantity of pellets.	whole year	1 day
2	Analysis of sales opportunities	The manufacturer, based on inventories and contracted delivery, analyzes sales opportunities. Contracts on annual basis for local retail sellers do not exist.	whole year	1 day
3	Submission of bids	The manufacturer submits bid with price and possible delivery quantity.	whole year	1 day
4	Confirmation of delivery	The buyer makes a written declaration on the offer. If advance payment was required, s/he makes the payment and submits receipt for payment.		1 day
5	Delivery	The manufacturer hires the carrier with whom they have a commercial contract to supply the required quantity.	whole year	1 day
6	Assumption	The retailer takes over the goods and signs the receipt document.	whole year	1 day
7	Invoicing	According to the bill of lading, the manufacturer invoices the goods supplied.	whole year	1 day
8	Sales to end customer	The end customer buys necessary quantity at the retail store.	whole year	1 day



## 6 Stakeholders

*Short description of relevant stakeholders in the biomass sector.*

### 6.1 Regional stakeholders

#### 6.1.1 Pellet Plant “Bioenergy Point” in Boljevac



Bioenergy Point, a business company founded in 2007, is registered for business operations in the area of renewable energy sources. As a leader on the Serbian market, company started the production of wood pellets in its newly built production plant in Boljevac, Eastern Serbia, in October 2008. The production plant's capacity is 35,000 tons per year. The production plant boasts brand new equipment, obtained in the Netherlands (CPM – presses), Germany (BRUKS-Kloeckner – chipper), Croatia (Seting

– drying plants) and Slovenia (Robotika – packing machines).

In present conditions, the company works round the clock, i.e. follows a 24/7 work schedule with 100% sales of its products, mainly to foreign markets. The most significant market is Italy. In addition, it exports to Greece, Albania and Macedonia. The company emphasizes the growth of domestic demand for pellets. Except for Belgrade power plants, which represent the rare few plants in Serbia that use pellets, the company is anticipating new domestic clients in this sector.

#### 6.1.2 Heating plant in Belgrade in Senjak

Belgrade power plants are engaged in manufacturing and distribution of energy for heating and delivering hot water. Heating plant in Beograd in Senjak not only used pellets for energy production, already it was added as a supplement production. This plant is taken as an example of good practice, because it is the first in Serbia began to use biomass for energy production. Heating plant in Belgrade "Senjak" and plant "Barajevo" with an installed capacity of 9.5 MW fueled by pellets. These objects during an average winter for thermal energy for residential heating use approximately 2,000 tons of pellets.

Production facilities "Beoelektrane" average spend about 350 million Sm<sup>3</sup> of gas, 46 000 tons of fuel oil, 3 200 tons of coal, 500 000 liters of fuel oil, 2 000 tons of pellets and 1 500 tons of briquettes.

For thermal energy is used: natural gas about 85,6 %; heavy fuel oil - crude oil, about 13,5%; coal is about 0,4 %; fuel oil about 0,13 %; biomass - pellets 0.24% and briquettes 0.2 %.

### **6.1.3 Moca Ltd. Jablanica**

The company was founded in 1920. year, and during the time of the carpenter's workshop grew into a wood processing plant. Than in 1991. became the company and today has a strong and stable production elements obtained by processing beech.

Moca Ltd Products:

- Raw elements (certified production)
- Dry elements (certified production)
- Planed (hoblovan) elements (certified production)
- Pellet (certified production)
- Briquettes (certified production).

## **6.2 National stakeholders**

### **6.2.1 PE Srbijasume**

Srbijašume are state-owned company who was founded in 1991. The funds at the disposal of the Public Enterprise "Srbijasume" are owned by the state. The management bodies PE "Srbijašume" are Board of Directors, General Manager and Supervisory Board. Board of Directors shall consist of eleven members, six of which are representatives of the state, and five by the company. The Supervisory Board PE "Srbijašume" has five members, three members appointed by the State, and two are appointed by the company.

### **6.2.2 PE Vojvodinasume**

Public Enterprise "Vojvodinašume" is organized into three organizational levels: Directorate companies, parts of companies, four forest estates and the fifth part of the "Vojvodinašume-Lovoturs" Petrovaradin, and work units - forest management and other operating units.

The public company employs more than 1855 employees, of which 165 forest engineers, 270 forestry technicians, 80 with a high school degree (economists, lawyers, mechanical engineers, programmers and others.) And 1340 other staff.

### **6.2.3 Ministry of Energy, Development and Environmental Protection of Republic of Serbia**

Ministry of Energy, Development and Environmental Protection of Republic of Serbia was established by the Law on Ministries. The Department of Power performs duties relating to: Electric Power, to take measures to ensure the conditions for a safe supply of electricity and coal, to take measures to ensure the conditions for the functioning of the company in the field of power and coal, as well as other activities in the field of electrical engineering. The Department of Environmental Protection to perform tasks related to: participate in the drafting of strategic documents, the implementation of international conventions, laws and regulations related to the protection of air, water, nature protection, environmental protection in other sectors;

#### **6.2.4 Ministry of agriculture, forestry and water management**

Ministry of Agriculture, Forestry and Water Management was established by the Law on Ministries. Department of Forestry, as a body within the Ministry of Agriculture, Forestry and Water Management is responsible for state administration and technical tasks related to: forestry policy; forest preservation; promotion and use of forests and wildlife; implementation of protection of forests and wildlife, control of seeds and seedlings in forestry inspection in the field of forestry and hunting carried out in accordance with the law, carries out other activities in this area.

#### **6.2.5 National Association for biomass SERBIO**

National Biomass Association aims to bring together individuals and organizations active in the field of bioenergy and joint performance contributing to the promotion of bioenergy sector in Serbia. SERBIO objectives are to develop the market and a favorable business environment for sustainable bioenergy sector in Serbia and increase public awareness about the possibilities of using biomass. SERBIO's founders are: Association of Citizens Resource Center Majdanpek, CA Forest Owners Association of Majdanpek, CA Center for Energy Efficiency CEFIX Vrsac, CA Association for the Development of Bor, Peler Ltd. Ratkovo, CA Unekoop Paracin, CA Crni vrh Bor, CA Association expert business and industrial management Serbia Bor, CA Resource Center Bor, Envi Only Ltd. Belgrade, and several individual experts working in the field of biomass.

### **7 Future scenarios**

The importance of biomass in Serbia is undoubtedly increasing. It should be considered that the Republic of Serbia has pledged to reduce final energy consumption by 9% by year 2018 compared to 2008, as well as to increase the share of renewable energy sources in final energy consumption to 27% by year 2020. (Macura, 2012). In the structure of the planned domestic production of primary energy for 2013, renewable energy sources account for 1,835 Mtoe or 16% of the domestic production of primary energy. In this structure, the largest share is that of solid biomass - 58%, hydropotential - 41 , and biogas, wind, solar and geothermal energy account for less than 1% (Ministry, 2013).

The current state of consumption (and production) of fuel wood and wood biomass should not be seen as static and unchangeable. A lot of activities in the field of renewable energy sources and the obligations undertaken towards the EU are pointing to possible significant increases in the area of energy production from wood, and above all in the following segments:

- Domestic consumption of pellets, according to manufacturers' statements, has been recording a continuous growth. If the total current production, which is drawing near to the amount of 0.1 million tons/ year, is used for domestic consumption, an increase will be gained in the consumption of energy from biomass by 1800 TJ.
- Studies of assessing the potential for conversion of existing heating systems, by the transition from coal to wood biomass, anticipate the construction (reconstruction) of capacities for



about 14 municipalities, and studies are being planned for another 6 municipalities.<sup>5</sup> So far, the estimated amount of biomass needed to supply these heating plants is 0.1 million tons.

- A new tariff system for feed-in tariffs has been adopted, by which electricity generated from biomass is subsidized in the amount of 13.26 to 8.22 / 15.66 to 12.31 c€ / kWh, depending on the installed capacity, making a significant incentive for investment in this area.
- Increased prices of other energy sources, as well as the impact of the economic crisis, will further increase the consumption of firewood by the local population.

## 8 Annex

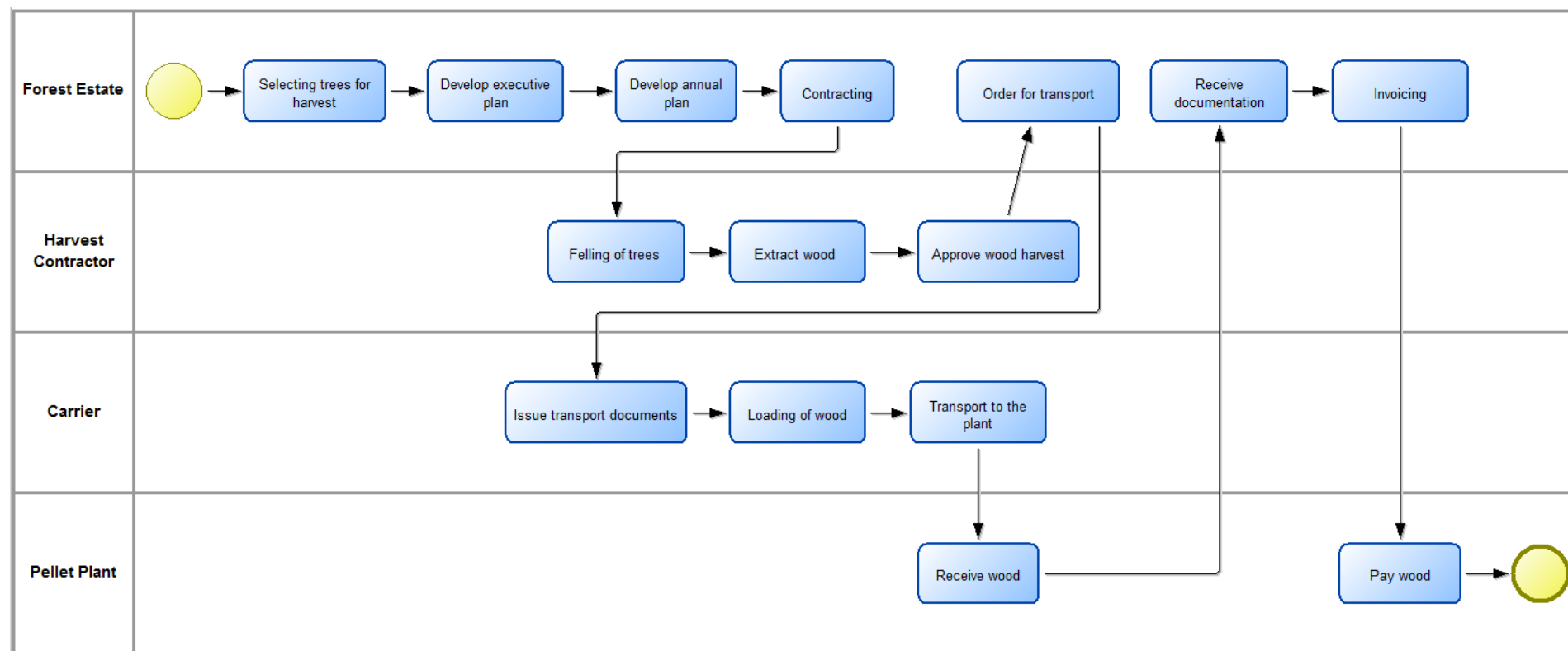
### 8.1 Annex 1: regional SWOT(S)

**Table 12:** Result of the SWOT analysis, internal and external issues characterising biomass supply chain

Internal strengths	Internal weaknesses
S1. Available, inexpensive and high quality raw materials. S2. Good location in relation to the resource and communication. S3. Representation of public and private forests. S4. Lack of competition in relation to the production of pellets and biomass. S5. Production volume (as all the other producers in Serbia together).	W1. Use of fuel wood instead wood residue, as a raw material for the production of pellets. W2. No assurance for long-term supply of raw materials. W3. Poor forest roads. W4. Problems in the supply of raw materials in the winter.
External opportunities	External threats
O1. Opportunities to use forest waste after harvest as a raw material that is now not in use. O2. Activation potential from private forest. O3. Ability to increase production capacities and additional quantities of raw materials. O4. The leading company in the production of pellets and biomass	T1. The emergence of new competition especially in central heating systems. T2. New investments in the production of pellets T3. The limited potential of raw materials T4. Lack of workforce for logging and harvesting

<sup>5</sup> USAID Study "Biomass Cost and Availability Study", 2011, for the municipalities of Majdanpek, Bor, Knjazevac Trstenik, Zajecar, Bjelovar, Kosjeric, Nova Varos, Novi Pazar, Priboj. CESID Study "Quantifying the potential of biomass for the supply of district heating systems in selected cities in Serbia" for the municipalities of Pirot, Zrenjanin and Vrbas.

## 8.2 Annex 2: Process model(s)



## 9 References

*Biomass Action Plan 2010-2012, the Government of RS, the Decree on Incentive Measures for Privileged Energy Producers, the results of the TCP / FAO project "Wood-based energy for sustainable rural development in Serbia", obligations which the Republic of Serbia has under the Energy Community Treaty and others.*

*Official Gazette of Serbia, № 46/91*

*Project: FAO/TCP/YUG/2902(A): "Program Institucionalni razvoj i izgradnja kapaciteta za Nacionalni šumarski program" ([www.forestserbia-fao.sr.gov.rs](http://www.forestserbia-fao.sr.gov.rs)), i projekat GCP/FRY/003/FIN: "Razvoj sektora šumarstva i Srbiji" ([www.forestryprojectserbia.org](http://www.forestryprojectserbia.org)).*

*Production and consumption of solid biomass includes the production and consumption of firewood, pellets and briquettes for energy ( heating).*

*Regulation on the conditions and procedure for acquiring the status of privileged power producers ("Off. Gazette" No. 8/2013), Decree on Incentives for the privileged power producers ("Off. Gazette» 8/2013).*

*The National Forest Inventory of the Republic of Serbia, Ministry of Agriculture, Forestry and Water Management*

*USAID Study "Biomass Cost and Availability Study", 2011, for the municipalities of Majdanpek, Bor, Knjazevac Trstenik, Zajecar, Bjelovar, Kosjeric, Nova Varos, Novi Pazar, Priboj. CESID Study "Quantifying the potential of biomass for the supply of district heating systems in selected cities in Serbia" for the municipalities of Pirot, Zrenjanin and Vrbas.*