



*Empowered lives.
Resilient nations.*



POSSIBILITIES OF USING BIOMASS FROM FORESTRY AND WOOD INDUSTRY IN BOSNIA AND HERZEGOVINA

CONTENTS

1. INTRODUCTION	3
2. FOREST RESOURCES IN BOSNIA AND HERZEGOVINA	4
3. METHODOLOGY OF WORK	6
4. RESULTS AND DISCUSSION	7
4.1. Identification of key terms related to wood-based energy use	7
4.2. Assessment of available quantities of biomass in BiH forests	7
4.3. Identification of key institutional and legal conditions for mobilization and sustainable use of forest biomass in BiH	10
4.3.1. Responsible government institutions	10
4.3.2. Intersectoral cooperation	11
4.3.3. Strategic and legislative preconditions for using forest biomass	11
4.3.4. Associations and non-governmental organizations	12
5. CONCLUSIONS AND RECOMMENDATIONS	13
6. LITERATURE	16
SUPPLEMENTS	19

LIST OF GRAPHS

Graph 1: Trend of wood production in BiH in the period 2008 - 2012	8
Graph 2: Replies of the respondents to the question: „To what purpose do you use your forest?“	12

LIST OF PICTURES

Picture 1: Forest Cover in BiH	4
Picture 2: Assessment of available quantities of forest wood biomass in BiH	7

LIST OF TABLES

Table 1: Structure of forest areas and forest land according to vegetation form, purpose of use and accessibility in BiH	5
Table 2: Categories of forest wood products in BiH	9
Table 3: Available quantities of wood biomass for energy production	9

LIST OF ACRONYMS

IEO	International Energy Outlook
BiH	Bosnia and Herzegovina
Btu	British thermal unit
FBiH	Federation of Bosnia and Herzegovina
FAO	Food and Agriculture Organization
OECD	Organisation for Economic Co-operation and Development
RES	Renewable Energy Sources
RES&CG	Renewable Energy Sources and Efficient Cogeneration
CW	Cordwood
REZ	Regional development agency for Central BiH
RS	Republika Srpska
FWD	Forest wood products
UNDP	United Nations Development Programme
FIRMA	Fostering Interventions for Rapid Market Advancement
WESSPROFOR	Research project: „Opportunities for Wood Energy Production from Private Forests in the SEE Countries“

1. INTRODUCTION

Energy and energy resources are key factors of economic development of every state. Changes of energy prices have a considerable impact on economic growth, which is particularly noticeable in countries forced to import energy due to a shortage of their own production capacities or natural resources. International Energy Outlook 2013 predicts that energy consumption in the world will increase by 56% in the period between 2010 and 2040. Countries which are not members of the Organization for Economic Cooperation and Development – OECD) have recorded increased consumption of energy caused by long-term economic growth. Predictions are that energy consumption in non-OECD countries will increase by 90%, while this growth in OECD countries has been estimated at 17% (IEO, 2013).

The global trend in using energy production resources has recorded a considerable increase of energy share obtained from renewable sources. Renewable energy sources and nuclear power stations are the world's fastest growing energy sources with an annual increment of 2.5%. Explanation to this trend – dizzying in many countries – is hidden in the growing prices of fossil fuel energy, growing fossil fuel dependence risks and growing greenhouse gas emissions during fossil fuel energy production. Still, predictions are that fossil fuels will be a source for 80% of totally produced energy at the world level by 2014 (IEO, 2013).

Many countries in the world have large forested areas which, if managed in a sustainable way, can yield large quantities of raw materials for production of heat or electrical energy. The term „bioenergy“ refers to all types of energy obtained from biofuel or fuel obtained from biological materials, i.e. biomass (FAO, 2004). Bioenergy offers a possibility of reducing greenhouse gas emissions per produced energy unit, reducing energy import dependence and at the same time reducing fossil fuel prices. Depending on the level of institutional and legislative development of the state, biomass production offers possibilities for promotion of sustainable management of natural resources, advancement of rural development and opening of new jobs.

Bosnia and Herzegovina belongs to a group of countries which have a large percentage of territory covered by forest resources, which indicates a certain potential for energy production based on sustainable use of forest biomass. War destruction caused heavy human losses and devastation of business capacities and infrastructure required for economic growth and raising living standards. Forestry and other branches of economy relying on the use of natural resources were the backbone of the recovery of the national economy in the post-war period. For example, in 1999, 54%

of the Federation of Bosnia and Herzegovina exports were: aluminium, beech logs and electricity (Đulan and Bešlić, 1999). When it comes to production and consumption of all forms of energy, the dominant form is the energy obtained from coal with a share of about 45%, then liquid fuels (21%) and wood biomass (20.5%), while other forms of energy (hydro energy, natural gas and imported electricity) participate with about 13% (METROPOLI, 2012).

Considering that forests and forest land cover more than 50% of the territory of Bosnia and Herzegovina, they represent arguably one of the most important natural resources of this state. Regardless of the significant resource base, there is no strategic commitment in Bosnia and Herzegovina for production of fuel and energy from biomass. Therefore, the most widespread use of wood biomass is in the form of firewood for production of heat energy, although modern technologies offer possibilities for processing wood into various products which have better energy efficiency than firewood. Since consumption of fossil fuels has an adverse effect on the environment and the fact is that prices of other energy sources are on the constant rise, use of wood biomass for production of energy is expected to intensify in Bosnia and Herzegovina. Consequently, promoting production of wood chips, briquette and pellets would make a considerable contribution to development of rural areas and increase of the number of jobs. However, research into potential wood biomass in the area of Bosnia and Herzegovina is still sporadic. Several authors have addressed various aspects of assessments of energy potentials of wood biomass in Bosnia and Herzegovina (Jovanović et al, 2008) or its entities (Danilović et al, 2013), and issues of energy potential of renewable energy sources (Malkočević, 2006; Gvero, 2008; Doleček and Karabegović, 2012). The problems of using wood biomass from privately owned forests were comprehensively researched within the framework of the research project entitled: „Opportunities for Wood Energy Production from Private Forests in the SEE Countries (WESSPROFOR)“, implemented by scientific and research institutions from the Western Balkans countries. Despite this, research with the aim of making assessments of potentials of wood biomass on the basis of real production in the forestry sector in Bosnia and Herzegovina is still in an initial stage. In connection with this, the objective of this study is to analyze the indicators of available quantities of wood biomass and identify institutional and legislative preconditions for its mobilization and sustainable use.

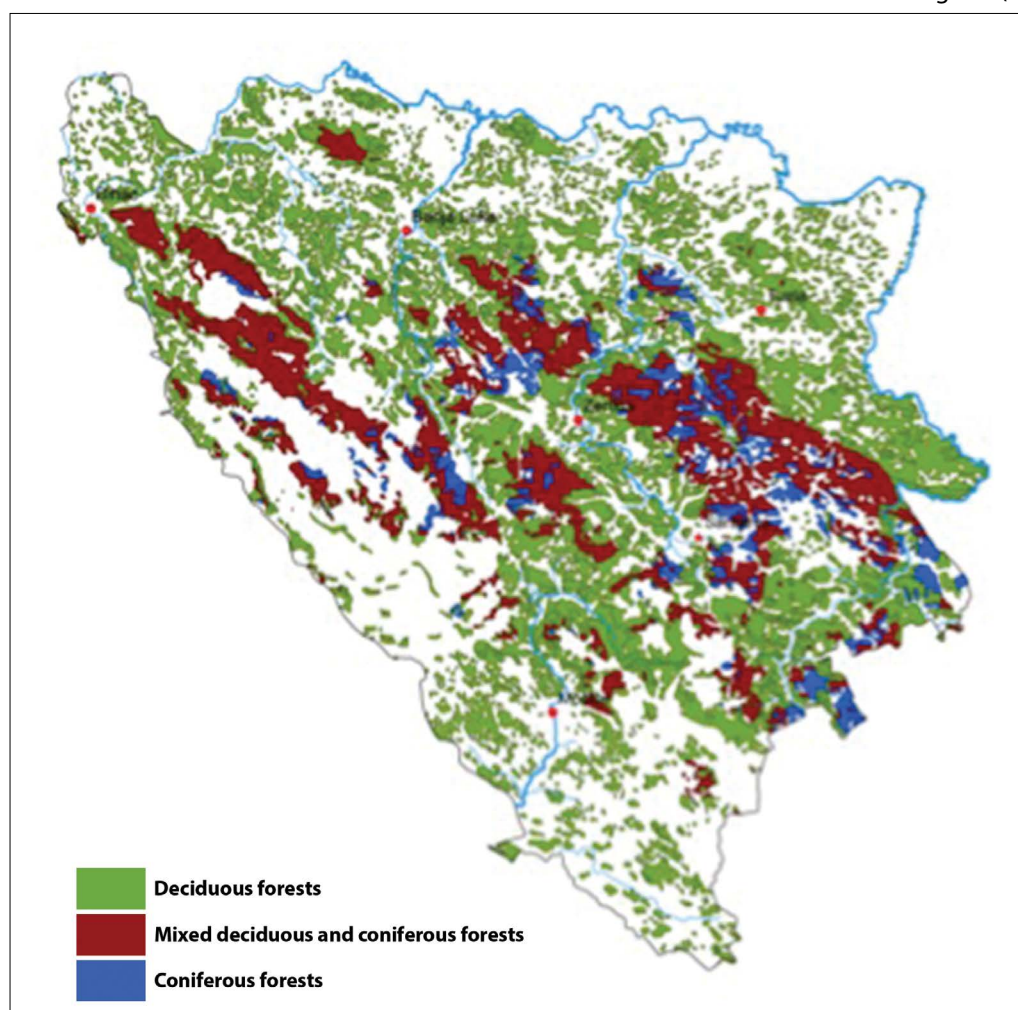


2. FOREST RESOURCES IN BOSNIA AND HERZEGOVINA

Bosnia and Herzegovina (hereinafter: BiH) belongs to a group of European countries which are extremely rich in forest resources from the aspect of their distribution and biological diversity. The fact that over 50% of BiH territory is covered with forests (Picture 1) indicates their importance in ensuring multiple benefits for the broader community. Forest resources are a backbone of economy in many local communities and often represent the only resource for income for many

aggravated by the disorderly institutional, legislative and policy frameworks for forest resource management, which is, to a certain extent, insufficiently responsive due to a complex administrative organization of BiH. This points out a necessity for undertaking a range of strategic steps and implementation of a set of forestry policy tools in order to preserve and promote current forest resource potentials in BiH.

Picture 1: Forest Cover in BiH
(based on the Map of Real Forest Vegetation in BiH, Stefanović and Beus 1983)



households. Besides, a large number of businesses are involved directly or indirectly in the production chain based on forest wood or non-wood products.

The war and economic recovery in the post-war period, based mainly on the use of natural resources, had certain negative impacts on the forest resources in BiH. Degradation of forest resources caused by uncontrolled logging, pest and forest fires has become a frequent occurrence, the consequence of which is reduction of potentials of forest compartments for providing long-term benefits to the society. This situation is

A traditional approach to managing forest resources in BiH is based on ecological (close to nature) postulates, which

primarily reflect in the manner of planning and implementing operational activities in the forestry sector. Thanks to this, forest resources in BiH still have a natural structure. Operational activities in managed forests (forests used for production) are implemented with a view to supporting the cycles of natural renewal of forest compartments, preservation of biological diversity and advancement of potentials for rendering generally useful functions. Official data on the structure and areas under forests and forest lands are still based on the information contained in the First Inventory of Forests in Large Areas from 1968, according to which forests in BiH account for about 2.70 million hectares, or 53% of the total area. In order to obtain new information on the condition of forest resources in BiH, a Second National Forest Inventory in Large Areas was undertaken in the period

between 2006 and 2009. The published preliminary data indicate a positive trend of changes in forest areas by more than 500,000 hectares. Besides, analysis of this data showed that certain forest areas had to be categorized as inaccessible, for fear of mines. Such areas cover about 420,000 hectares, of which, based on ground and vegetation characteristics, about 407,000 would belong to productive forests – Table 1 (FIRMA, 2013).

Table 1: Structure of forest areas and forest land according to vegetation form, purpose of use and accessibility in BiH

Vegetation form	Accessible areas				Inaccessible areas	Total
	Commercial	Forests with low commercial value	Exclusively protective forests	Special purpose forests		
	ha	ha	ha	ha	ha	ha
1. High forests	1.329.500	46.300	5.200	8.800	262.600	1.652.400
2. Coppice forests	843.200	158.700	1.600	2.400	246.300	1.252.200
1+2. All forests	2.172.700	205.000	6.800	11.200	508.900	2.904.600
3. Brushwood	52.700	41.100	0	100	36.700	130.600
4. Bare ground	55.700	88.400	800	3.400	38.900	187.200
3+4. Brushwood and bare ground	108.400	129.500	800	3.500	75.600	317.800
5. Other forest areas	3.300	3.100		100	2.600	9.100
FAO forests (1+2+3+5)	2.228.700	241.600	6.800	11.400	548.200	3.035.700
6. All forests and forest land	2.284.400	337.600	7.600	14.800	587.100	3.231.500

Source: FIRMA (2013)- *Opportunities for Using Low-Value Forest Wood Products and Conversion of Coppice Woods in BiH*

According to this table, looking at the representation of certain commercial categories of forests, their structure is not at a satisfactory level. High forests with natural renewal are represented with 1,652,400 ha, coppice forests with 1,252,200 ha, while shrubs account for 130,600 ha. Besides, it should be noted that a relatively small area (7,600 ha) has an exclusively protective purpose. This information is important because it indicates a need for an increase of the percentage of formally protected forest areas, as a response to ever more pronounced demands and initiatives from the environmental protection sector. In connection with this, we can conclude that these initiatives and demands for establishing new protected areas in the future, among other things, will have an impact on the production-based functions of forest resources.

Apart from the fact that some forest resource areas cannot be used for production purposes (mined areas, protective forests and special purpose forests) it is important to note that effective use of production potentials of forest resources is primarily hampered, and often made impossible, by insufficient accessibility of forest complexes by means of a forest road infrastructure. Accessibility of high forests by means of a primary forest road network in BiH amounts to 9.93 km/1000 ha and is somewhat higher than in coppice woods, which is 8.65 km/1000 ha, which is far below the average of developed European countries, where this accessibility ranges between 20 and 30 km/1000 ha (FIRMA, 2013). Insufficient levels of primary and secondary forest road networks limits the implementation of the planned activities, which frequently leads to destruction of permitted wood cutting levels in such forest areas that are not sufficiently accessible (Bajrić et al, 2011). In accordance with this, an increase in using wood

mass in BiH and realizing the planned permitted wood cutting levels requires considerable investment. These activities primarily reflect in de-mining forest areas and construction and improvement of the primary roads network. Reaching a certain level of investment in the forestry sector would lay down a basis for realizing the planned scope of the cutting and its more uniform distribution in the total forest area and create opportunities for ensuring additional quantities of wood to be offered on the market.



3. METHODOLOGY OF WORK



The analysis of energy production based on renewable energy sources (hereinafter: RES) is founded on the understanding of mutual relations between the key elements for their use. In this process, the following will be necessary:

- Understand the interaction between potential RES share in the resolution of global ecological problems in relation to real (ecologically acceptable) resource capacities.
- Identify key institutional and legal preconditions to establish and regulate RES and identify potential aspects to be advanced in order to mobilize effectively the current potentials.
- Identify the level of demand for RES energy and existence of required technological solutions and infrastructural preconditions for effective use of available resource potentials.

This report is based on an analysis and presentation of data related to the currently available resource base of forest biomass for energy production and identification of key institutional and legal preconditions for mobilization of the available resource base. For the needs of this report, available literary sources were analyzed and the process was implemented in three steps:

1. Identification of key terms related to wood-based energy use, implying definition of terminological and numerical values related to the process of production and use of wood biomass energy.
2. Assessment of available biomass from BiH forests based on available data.
3. Identification of key institutional and legal preconditions for mobilization and sustainable use of forest biomass.

4. RESULTS AND DISCUSSION

4.1. Identification of key terms related to wood-based energy use

The question of energy production based on forest resources and their share in the total energy balance is in the focus of professionals and scientists, who are trying to define potential energy products obtainable from this resource. In accordance with the definitions of the Food and Agriculture Organization of the United Nations (hereinafter: FAO) from 2004, all energy products based on wood can be divided into the following groups:

- Wood based solid fuels – firewood (chopped wood, wood chips, sawdust, charcoal and pellets)
- Wood based liquid fuels – „black liquor“ (as a by-product of wood pulp industry) and ethanol, methanol and pyrolytic oil (as a product of thermo-chemical or bio-chemical treatment of wood),
- Wood based gas fuels – pyrolytic gases (as a product of gasification of solid and liquid wood based fuels).

In accordance with the current situation in BiH and trends of investing into sustainable use of renewable energy sources, the text below will, for the needs of this report, address exclusively the real potentials of solid fuel production on the basis of wood biomass. When it comes to potential sources for wood based energy production they can be divided into direct – or those which originated as products of standard operations in the forestry sector, and indirect – or those which originated as by-products of other factors (FAO, 1998). Acknowledging the current range of wood products in BiH offered on the market, the following products have been identified as direct sources for wood based energy production:

- Firewood (cordwood for heat energy)
- Residues after wood cutting and processing of forest wood products (remnants originating from the processing of forest wood products)
- Residues after wood cutting (branches and trunk parts including trunk tops of coniferous trees the diameter of which is up to 7 cm at the thick end).
- Stumps

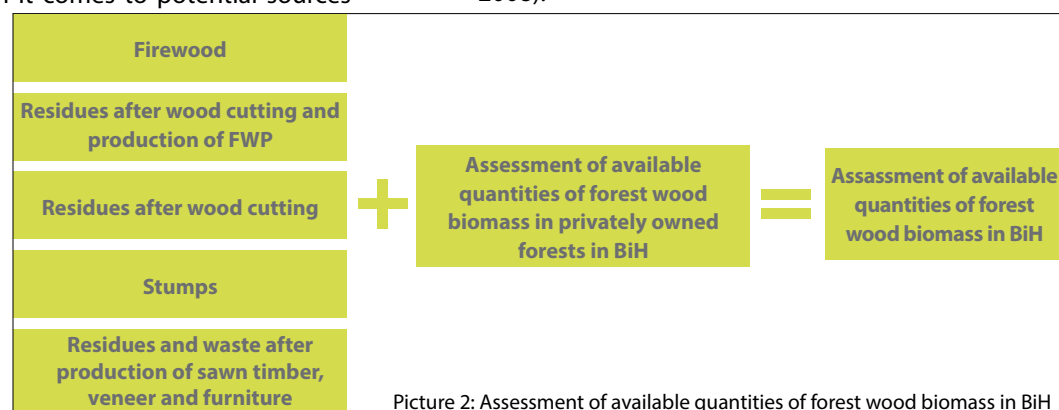
On the other side, the following products can be classified as indirect sources for wood based energy production:

- Residues and waste after production of sawn timber, veneer and furniture

- Other wood waste (from the construction industry or packaging industry such as pallets, boxes, etc.)
- Residues originating from maintenance of parks and other green areas.

Numerical indicators relevant for assessments of available quantities of wood biomass are based mainly on the percentages which can yield the values of totally produced quantities of forest wood biomass on the basis of available data on the levels of production in the forestry sector. The following numerical indicators were adopted for the needs of an assessment of available quantities of wood biomass in the area of BiH:

- Residues after wood cutting and processing of forest wood products – 16.3% with conifers, 11.7% with deciduous trees (Jovanović et al, 2008; Matić et al, 1990);
- Percentage of small branches (residues after wood cutting) - 15% with conifers, 18% with deciduous trees (Jovanović et al, 2008; Matić et al, 1990);
- Percentage of stumps – on average 15% of the total quantity of large wood (Anatoljak et al, 19491);
- Percentage of residues and waste after production of sawn timber, veneer and furniture – 30% with conifers, 35% with deciduous trees (Jovanović et al, 2008).



4.2. Assessment of available quantities of biomass in BiH forests

The basic source of data for obtaining necessary information for an assessment of available quantities of biomass from wood resources in the area of BiH were the statistical sources on the production of forest wood products (hereinafter: FWP). In contrast to the potential (permissible) quantities of FWP, information on realized levels of FWP production gives a real picture of available quantities of wood biomass originating from the regular production cycle which is possible to obtain without additional investment, primarily into the construction of road infrastructure. These data served as input for calculation of available quantities of forest wood biomass in BiH (Picture 2).

¹ It is generally considered that the European average for a ratio of forest wood biomass under and below the ground amounts to 4:1 (Schmithusen et al, 2014).

The starting point when assessing available quantities of forest biomass in BiH is the data on the realized quantities of forest wood products in state-owned forests (Ministry of Agriculture, Water Management and Forestry, FBIH, 2013; Institute of Statistics of Republika Srpska, 2013). Using the overview of the structure of forest wood products in BiH it is possible to identify produced quantities of firewood (cordwood for obtaining heat energy) and logs for sawmill processing. Waste after wood cutting and production of FWP, stumps and residues and waste after production of sawn timber, veneer and furniture can be assessed by applying appropriate calculation percentages based on experience and scientific indicators during the production process in forestry and wood processing industry.

When it comes to privately owned forest resources, their share in the total forest area and forest land in BiH amounts to 19,3% (Glück et al, 2009). The same authors indicate that privately owned forests are of lower quality than state-owned forests and that they are mostly coppice woods. These types of woods will in the future be subjected to intensive cultivating interventions, which will result in an increased supply of low-quality wood products suitable for energy production. According to preliminary data of the Second National Inventory in Large Areas in BiH, the percentage of privately owned forests is on the increase. This trend is most probably the result of cessation of intensive cultivation of agricultural land in rural areas, occurring as a result of increased migrations of rural population to urban areas in BiH. On the basis of official data on average forest supply in BiH it can be established that an average supply of state owned forests amounts to 228 m³/ha, and privately owned forests 143 m³/ha (FIRMA, 2013). The above facts were taken into consideration as a basis for an assessment of potential quantities of wood biomass from privately owned forests, and the final amount of potential forest wood biomass was obtained in a way that the assessed quantities of wood biomass from state owned forests was increased by 20%.

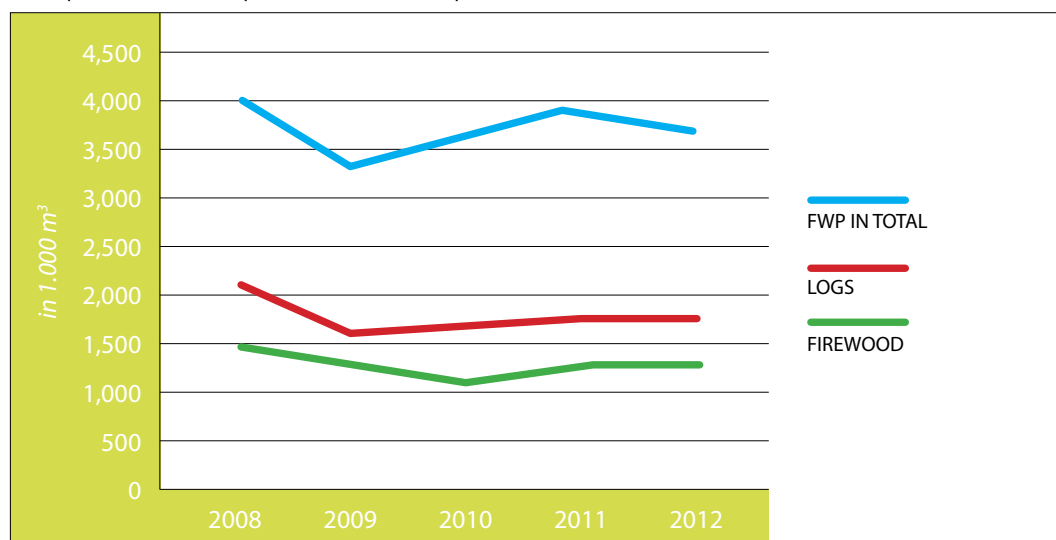
Production levels in the forestry sector depend on a series of market and institutional factors. In order to improve the production process and enable a more effective use of forest resource potentials, additional funds should be invested into the accompanying infrastructure, primarily into the opening of the forest complexes. Currently, the forestry sector in BiH is not able to allocate from its current activities sufficient funds for additional investment into construction of the primary forest road infrastructure. All this indicates a need to find additional (external) funding sources with a view to fully realizing the planned scope of the cutting (permissible). Realizing the planned cutting scope would mean a quantitative increase of the supply of forest wood products in the market.

The trend of the overall production of FWP in BiH in the period between 2008 and 2012 is relatively uniform, with a certain fluctuation in 2009 when a drop in the production occurred (Graph 1). After 2009, a mild increase of total production of FWP was recorded. Importantly, in the analyzed

period, the level of real production did not come close to the permissible scope of cutting, which, among other things, leads to a conclusion that there were no infrastructural improvements of the forest use system, primarily in the context of opening forest complexes by a primary road infrastructure network. This fact indicates that, when making an assessment of available forest wood biomass, one should analyze the realized – not planned – quantities of FWP. Such an analysis will show the really available quantities of forest wood biomass which can be used for energy production with minimum investment in the forest resource management system. If the planned scope of the cutting (permissible) is to be used as a basis for an analysis, it is necessary to analyze additionally the level of investments which would lead to an effective use of forest resource potential when it comes to the issue of forest wood biomass production.

Speaking of the trend of production of logs for sawmill processing in the period 2008 – 2012, a certain drop in this production is noticeable in 2009. This situation is a consequence of a fall in demand for logs for sawmill processing in this year, caused by global economic disruptions in the market. On the

Graph 1: Trend of wood production in BiH in the period 2008 - 2012



Source: RS Institute of Statistics, 2013; FBIH Ministry of Economy, Water Management and Forestry, 2013

other hand, production of cordwood for energy (firewood) did not go through considerable deviations in the observed period. As a consequence of a uniform demand for cordwood to be used for energy, the above indicates the necessity of finding ways to mobilize - from the current forest resources of BiH, with a certain level of investment - and offer to the market as large quantities of these products as possible in the form of forest wood biomass, to be used for energy production.

In order to establish the real available quantities of forest wood biomass which can be mobilized with minimum investment and offered to the market, the quantities of realized wood products in BiH for 2012 were used as a starting point of the analysis (Table 2).

As shown by the above data in 2012, the BiH market was supplied with a total amount of about 3.7 million m³ of FWP in a net amount (wood mass of finished forest wood products offered to the market as finished products). On the basis of the percentages shown at the beginning of this chapter, quantities of residues originating from wood cutting and production of the shown quantities of FWP were assessed at about 603,334 m³. According to many years of forest resource management experience, this quantity of forest wood biomass originating from wood cutting and processing of wood products largely stays in forest compartments. The need for preservation of

Table 2: Categories of forest wood products in BiH

	Logs	Other round wood	Pulpwood	Firewood	Net mass of large wood	Residue after cutting and production of FWP	Gross mass of large wood
	m ³						
Federation BiH	905.830	53.952	248.017	669.375	1.877.174	306.569	2.183.743
Republika Srpska	862.997	84.811	340.073	560.777	1.848.658	296.765	2.145.423
BiH	1.768.827 ²	138.763	588.090	1.230.152	3.725.932	603.334	4.329.166

Source: RS Institute of Statistics, 2013; FBiH Ministry of Economy, Water Management and Forestry, 2013

natural processes and biodiversity of forest eco-systems implies retention of a share of cut wood biomass in the forest. Still, some of the residues after wood cutting may represent a potential source of additional quantities of raw wood material, which can be offered to the market for energy production. Having in mind the specificities of managing forests in BiH, characteristics of forest compartments and a pronounced biological diversity of BiH forests, it is necessary to create and adopt a methodology for defining sufficient quantities of residues to be left in forest eco-systems with a view to avoiding jeopardy to ecological stability and biodiversity of forest eco-systems.

The same calculation method was applied to the calculation of other direct and indirect sources for production of wood-based energy, shown in Table 3. Due to unavailability of official data concerning the quantities of wood biomass originating from the maintenance of parks and in construction industry and packaging industry, it was not possible to make an assessment of potential wood biomass originating from these activities.

The largest source of forest biomass for energy production is cordwood for energy, i.e. firewood. The total quantity of this product in the analyzed year was about 1.23 million m³. A considerable amount of this product – in the form of chopped wood – is used traditionally for production of heat energy in households, which is one of the main causes of stable demand for this product regardless of market disruptions. Although this is an energy efficient way of using wood, this category of FWP cannot be viewed as a wood based energy production resource in the short term – instead, with awareness raising measures about the importance of efficient use of wood and creation of appropriate economic instruments of forestry policy it is possible to have an impact on the awareness of end users to change their customs and use new technological solutions for obtaining heat energy (pellets, briquette and other solid wood based fuels).

A large quantity of wood biomass stays in wood compartments in the form of small branches and residues after the process of producing wood products. The total amount of small branches and residues after wood cutting and processing of wood products which stayed unused amounts to more than 1.3 million m³. This potential should be used as much as possible and in this way additional quantities of wood to be used for energy production could be provided for the market. In this endeavour, it is necessary to take into account that the process of using forest resources should ensure a certain quantity of wood which should remain in forest compartments with a view to preserving and promoting soil quality and biological diversity. In localities characterized by good accessibility and possibilities of using machines in the process of forests exploitation, small branches and residues after wood cutting and production of FWP can be mobilized with minimum investments. On the other hand, in terrains with extremely unfavourable orographic characteristics and poor accessibility to forest compartments, economy of using these products is questionable.

Quantities of raw wood materials originating from the process of production of sawn timber, veneer and furniture are also significant and amount to 0.55 million m³. With minimum investment, these quantities of wood can be turned into wood based energy products (pellets and briquette). The majority of sawmills in BiH, to a certain extent, use wood residues after the production process for heating plants or as an energy source for drying timber.

When it comes to stumps, a considerable quantity of wood biomass remains in forest eco-systems (about 650 thousand m³). To use stumps from forest eco-systems it is necessary to have adequate machinery and adequate openness of forest compartments for this process to be financially profitable. In this case, one should pay attention to the fact that stumps represent an important factor in the promotion and maintenance of stability of forest eco-systems, because the decaying and rotting process returns a considerable quantity of nutrients into the soil.

Table 3: Available quantities of wood biomass for energy production

Sources	CONFIFERS	DICIDUOUS TREES	TOTAL
	m ³	m ³	m ³
Cordwood for energy	1.711	1.228.441	1.230.152
Residues after cutting and production of FWP	342.181	261.154	603.334
Small branches	314.848	401.432	716.280
Residues and waste after production of sawn timber, veneer and furniture	354.857	200.843	555.701
Stumps	314.848	334.527	649.375
Total:	1.328.446	2.426.396	3.754.842

² The share of conifers in 2012 amounted to 1,185,692 m³, while the share of logs of deciduous trees was: 583,135 m³.

4.3. Identification of key institutional and legal conditions for mobilization and sustainable use of forest biomass in BiH

Taking into consideration the data above which indicate a certain misbalance between forest eco-system potentials and their current use for energy production in BiH, the next step in the analysis of the current situation and future improvements in the use of forest biomass for energy production is the question of identification of key institutional and legal preconditions. In this regard, it is important to emphasize that it is these preconditions that are often considered to be an aggravating factor in the process of mobilization of this resource for the needs of energy production. Other authors (Fejzibegović, Gvero, Malkočević) also consider the current institutional and legal solutions to be the main reason for inadequate use of forest biomass and RES in BiH.

Institutions are characterized by formal and informal rules, norms and procedures, which, when changed, make new rules and norms in a society, having an impact on defining all policies (Arts et al, 2011). An important characteristic of institutions is the so-called "long durée" (Giddens, 1984, quoted in Arts et al, 2011). In other words, institutions are stable and rarely change overnight (Arts et al, 2011). Having in mind the importance of institutional and legal solutions for the functioning of each sector, these characteristics represent a real framework for planning and realizing activities within each sector. Taking into consideration the given definition of the term „institution“ and the complexity of the issue of using forest biomass in BiH, the basic factors of the institutional and legal framework for using forest biomass in BiH take into consideration the following:

- Government institutions with competencies for energy and RES, including forest biomass
- Intersectoral cooperation. Considering the complexity of the issue of sustainable use of forest biomass for the needs of energy production, mutual cooperation between representatives of the energy, agriculture, forestry, environment and rural development sectors represents the basic precondition for its successful solution. In order to enable this, it must be founded on objective grounds based on having information and knowledge related to forest biomass and its sustainable use.
- Strategic and legislative preconditions regulating the issue of using forest biomass.
- Associations and non-governmental organizations, primarily associations of private forest owners who own considerable raw material potentials for energy production.

4.3.1. Responsible government institutions

Due to a complex administrative and political setup of BiH, the issue of using forest biomass and RES is divided between state-level and entity-level institutions, which is further decentralized to the cantonal level in the Federation of BiH. Government institutions for the issue of energy and RES at the state-level are: State Regulatory Electricity Commission, Electricity Transmission Company of Bosnia and Herzegovina

and Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina (Sector for Natural Resources, Energy and Environmental Protection). Analyzing the activities and basic goals of these institutions, one can conclude that the issues of RES and forest wood biomass is insufficiently represented in their activities. On the other hand, at the entity level, the issues of RES and forest biomass for energy production have been approached from a number of aspects. So, in the case of the Federation of BiH, the issue of responsibility for forest wood biomass is divided between the following ministries:

- Federation Ministry of Energy, Mining and Industry, as the umbrella ministry responsible for energy issues,
- Federation Ministry of Agriculture, Water Management and Forestry, as a ministry responsible, among other things, for forestry as well,
- Federation Ministry of Spatial Planning, responsible, among other things, for channelling long-term development of the use of natural resources, and
- Federation Ministry of Environment and Tourism.

At the Federation level, there is also the Regulatory Energy Commission of the Federation of BiH and the Chamber of Commerce of the Federation of BiH. As for Republika Srpska, the ministries with responsibilities which, among other things, refer to the issues of using forest biomass are:

- Ministry of Industry, Energy and Mining
- Ministry of Agriculture, Forestry and Water Management
- Ministry of Spatial Planning, Construction Industry and Ecology

At the level of Republika Srpska, there is also the Regulatory Energy Commission of Republika Srpska and Chamber of Commerce of Republika Srpska.

Division of responsibilities between the specified entity ministries is necessary in the endeavour to ensure sustainable use of forest biomass and stimulate mobilization of unused resources. Yet, as in the majority of branches of economy in BiH, unclearly defined issues of vertical subordination and horizontal coordination lead to overlapping of competencies and responsibilities related to the use of forest biomass and RES in general. Overlapping competencies lead to a confused fragmentation of government responsibilities by means of a number of ministries at different levels, entity coordinating bodies and state-level ministries (World Bank, 2004).

4.3.2. Intersectoral cooperation

In order to realize in full the nominal commitment for sustainable use of forest biomass it is necessary to develop and constantly improve coordination and cooperation between state, entity, cantonal and local institutions and the public. The problem of intersectoral cooperation implies definition of the level to which public institutions responsible for the sectors which are directly or indirectly involved in the issue of using forest biomass (mining, agriculture, forestry, transport, spatial planning, environmental protection, protection of nature, finances, etc.) mutually cooperate and coordinate their activities. Their strengthening should be based on mutual exchange of information on the importance and advantages of using forest biomass. United in joint endeavours, representatives of responsible ministries and other government institutions should put in additional

efforts to inform the public and make an impact on raising awareness of citizens as potential end users of energy based on renewable resources by developing an appropriate set of information instruments of environmental policies.

In this regard, the recently adopted Law on Using Renewable Sources of Energy and Efficient Cogeneration (Official Gazette of the Federation of BiH, No: 70/13) and Law on Renewable Sources of Energy and Efficient Cogeneration (Official Gazette of Republika Srpska, No: 39/13), specify that the Federation Ministry of Industry, Energy and Mining and the Ministry of Industry, Energy and Mining of Republika Srpska, entity Regulatory Commissions and Operators of RES&EC (renewable energy sources and efficient cogeneration), each within their own scopes of competencies, have an obligation to inform the public about incentives for RES&EC. These same institutions also have an obligation to develop appropriate training programs, public and professional discussions, workshops and trainings with a view to present information on RES&EC to interested parties and citizens of the F BiH (Article 32 of the Law on Using Renewable Energy Sources and Efficient Cogeneration). The same activity is stipulated by Article 36 of the Law on Renewable Sources of Energy and Efficient Cogeneration of Republika Srpska.

4.3.3. Strategic and legislative preconditions for using forest biomass

Apart from the final report of the Study of the Energy Sector in BiH, at the level of BiH there is still no strategic document of the energy sector. On the other hand, the F BiH Strategic Energy Sector Development Plan and Program was created in 2009, and the Draft Strategy for Energy Development until 2030 was created in Republika Srpska. Both strategic documents address the issue of renewable energy sources and forest biomass to a satisfactory extent, which gives realistic preconditions for better use of the forest biomass in the future.

On the other hand, in the largest number of laws making up a broader legislative framework for using RES, including forest biomass, these terms are not mentioned at all. A step forward in regulating the use of RES and forest biomass is the adoption of entity Law on Use of Renewable Energy Sources and Efficient Cogeneration (Federation of BiH) and the Law on Renewable Sources of Energy and Efficient Cogeneration of Republika Srpska. The main goal of these laws is promoting production of energy from RES and efficient cogeneration and increase of RES in overall consumption of energy, and ensuring development of incentives, regulatory framework and technical infrastructure for RES&EC. In order for the specified goals to be met, the Law on Using Renewable Sources of Energy and Efficient Cogeneration (Official Gazette of the Federation of BiH, No: 70/13) and Law on Renewable Sources of Energy and Efficient Cogeneration (Official Gazette of Republika Srpska, No: 39/13), as one of mandatory goals for using RES, specify adoption of a National Action Plan for Using RES of Bosnia and Herzegovina (Article 4 of the Law on Using Renewable Energy Sources and Efficient Cogeneration, Official Gazette of the Federation of BiH, No: 70/13). A constituent part of this plan is the Action Plan for Using Renewable Energy Sources in the Federation: „ (...) which, within the framework of the national goal in the use of renewable energy sources, specify mandatory goals of the Federation in the share of RES energy in the final consumption of electricity, heating

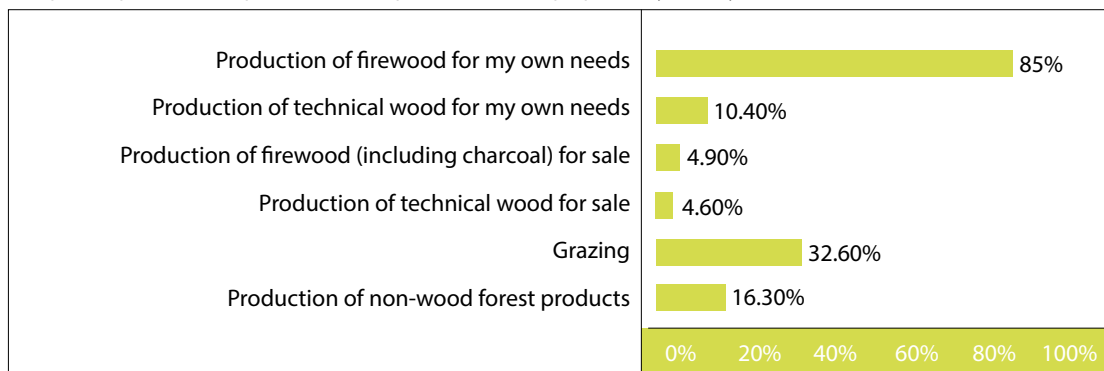
and/or cooling energy and transport energy, acknowledging the effects of regulatory measures related to the promotion of energy efficiency and energy saving by the end users, and other measures with the purpose of meeting the set goals“ (Article 4, paragraph 2 of the Law on Using Renewable Sources of Energy and Efficient Cogeneration (Official Gazette of the Federation of BiH, No: 70/13). According to Article 5 of this Law, the Federation RES Action Plan: „ (...) prepared in cooperation with the Federation Ministry of Spatial Planning, Federation Ministry of Agriculture, Water Management and Forestry, Federation Ministry of Transport and Communications, Federation Ministry of Environment and Tourism and the responsible cantonal ministries upon a proposal of the Ministry, shall be adopted by the Federation Government within six months from the day of entering into force of this Law“. Concerning the Law on Renewable Sources of Energy and Efficient Cogeneration (Official Gazette of Republika Srpska, No: 39/13), the question of adopting the Action Plan for Republika Srpska for using renewable energy sources is regulated by Article 10 of this Law. Adoption of this Action Plan by the RS Government: „ (...) expresses the goals of the Republic in the share of renewable source energy in the gross final consumption of electricity, heating and cooling energy and transport energy, acknowledging the effects of the regulatory measures related to the improvement of the promotion of energy efficiency and energy saving, as well as other measures for the purpose of meeting the set goals.“ Paragraph 2 of Article 10 of this Law further emphasizes that using RES achieves the goals of Republika Srpska in the field of energy generation laid down by the Strategy of Development of the Energy Sector of Republika Srpska up to 2013 and international agreements. This would be the first time that strategic documents are created in BiH which would be exclusively related to the use of RES.

Since the Law on Forests makes up an unavoidable component of the legislative framework for using forest biomass, it needs to be mentioned that the Constitutional Court of the F BiH, deciding on a request submitted to the Court by the Konjic Municipality and the Association of Municipalities and Towns of the Federation of BiH for protection of the right to local self-governance, in connection with the Law on Forests, issued a decision on 21 April 2009 specifying that the Law on Forests („Official Gazette of the Federation of BiH“, No: 20/02, 29/03 and 37/04) was in violation of the municipalities' right to self-governance. A new Law on Forests has not been adopted at the Federation level yet. As a reaction to such a situation, many cantons in the F BiH adopted cantonal laws on forests, which additionally complicates and fragments the functioning of the forestry sector, and thus, the use of forest biomass in the F BiH.

4.3.4. Associations and non-governmental organizations

Analyzing institutional capacities for sustainable use of forest biomass, one should not neglect the capacities of private forest owners for production of forest biomass, more so as an analysis of the quality of forest eco-systems in BiH showed that privately owned forests are of a lower quality and therefore are very suitable for production of forest biomass for the needs of energy production. In order to obtain data on the readiness of private forest owners to produce forest biomass, a research project entitled „Opportunities for Wood Energy Production

Graph 2: Replies of the respondents to the question: "To what purpose do you use your forest?"



Source: WESSPROFOR project

from Small Scale Forests in the SEE Region (WESSPROFOR)“ was realized as part of the project „Consolidation of Human Capacities in Forest Policy and Economics Education and Research in the South East European Region – FOPER II, EFI). The research, among other things, includes forest owners in BiH. The results of the research conducted in BiH show that the majority (73%) of respondents recognize the benefits to be obtained by the production of biomass. In the majority of cases, the respondents believed that production of wood biomass from privately owned forests can contribute to their better use and ensuring economic benefit for the owner. As the results of the PRIFORT project showed (Glück et al. 2011), private forest owners in BiH, although numerous, are not organized into associations, that is, interest associations through which they could articulate their demands and interests to forestry policy makers. Accordingly, the results of the PRIFORT project show that 80% of private forest owners think that their interests are not represented appropriately. On the other hand, the majority of respondents of this research conducted for the needs of the PRIFORT project expressed their readiness to become members of private forest owner associations, while about a half of the respondents expressed readiness to participate in their establishment. Speaking about characteristics of privately owned forests, it is important to note that the results of the PRIFORT project showed that private forest holdings in BiH are mainly fragmented and small (two thirds of the respondents included in the PRIFORT research own less than 1 ha of forests). Taking into consideration the above results and the fact that the majority of the respondents included in the research conducted for the needs of WESSPROFOR project recognized the benefits of forest biomass production, one can assume that there is a need for establishment of private forest owner associations, the goal of which can be association for the benefit of joint production and sale of forest biomass.

When it comes to ways of using privately owned forests, 85% of the respondents, among other things, use their forests for provision of firewood for their own needs (Graph 2). Then, 32.6% of the respondents use their forests for grazing and production on non-wood products (16.3%). These results, with the indicated characteristics of private forest holdings, show that it is only by association of private forest owners in BiH that a sustainable and market-oriented use of forest biomass from private forests can be achieved.

It is important to note that the Law on the Use of Renewable Energy Sources and Efficient Cogeneration (F BiH) and the Law on Renewable Energy Sources and Cogeneration (RS), among other things, regulate the incentives for production of electrical and heat energy from RES and EC and creation of conditions for establishment/development of a market for electrical energy produced by the use of RES. On the basis of such a legislative solution, private forest owner associations could apply for appropriate financial assistance to responsible entity institutions for joint production of forest biomass and joint mobilization of unused potentials of privately owned forests.



5. CONCLUSIONS AND RECOMMENDATIONS

The impact of the global ecological disruptions and frequent changes on the global market of main energy products redefine the role of forest resources and change global policies related to them. The role of forest resources in the mitigation of negative impact of climate change is more and more pronounced, primarily from the aspect of strategic measures and plans adopted at all administrative levels. Global efforts to reduce greenhouse gas emissions through the use of energy resources from renewable sources currently dominate globally. Forest biomass is one of the elements underpinning global policies of strengthening the participation of renewable energy sources in its production and consumption. Accordingly, due to a large percentage of forests in the whole territory of the country, BiH should base its strategic energy activities on increasing forest biomass production, primarily due to the fact that local economic development is reinforced in this way, but also because this is a way to reach the set goals which BiH must realize in order to become a full EU member.

On the basis of assessments of available quantities of wood biomass on the territory of BiH it can be concluded that, with the current production levels in the forestry sector, its quantities amount to about 4.5 million m³. It is important to note that the presented framework of wood biomass for energy production contains a considerable amount of wood (cordwood for heat energy) which is traditionally used for production of heat energy in households. Besides, the mentioned quantities also contain forest wood biomass, which is traditionally left in forest compartments through operational activities, and which, with a certain level of investment in infrastructure, can be mobilized and offered to the market. Acknowledging the fact that there is a certain potential of wood biomass for energy production which is currently not used, the important role of wood residues (residues after wood cutting and processing of wood products, small branches and stumps) in the preservation and improvement of the condition of forest eco-systems must not be forgotten. This leads to a conclusion that, before a decision is made on the use of wood residues after wood cutting and processing of wood products, it is extremely important to determine the quantity which should remain in forest compartments. In connection with this, a recommendation is to define a methodology for determining optimum quantities of wood residues which should be retained in forest compartments in order to preserve and promote the condition of the soil and biodiversity.

Although forest resources in BiH represent an important resource for economic growth, primarily in rural areas, the traditional approach in their management and use is still dominant. This approach is characterized by being based on wood as the primary forestry product, while other forest products are mainly neglected and their economic evaluation is often absent. Besides, a certain amount of wood biomass is left in the forest although it could be economically evaluated, or offered to the market with minimum investment in infrastructure and technological solutions which would enable its more effective exploitation. In connection with this, one can conclude that it is necessary to conduct a detailed analysis of financial indicators for an economic evaluation of all forest

products and services, which is particularly pronounced in case of a commitment towards intensification of using forest biomass for energy production. This primarily refers to the question of use and economic evaluation of wood residues originating from operational activities of wood cutting and processing of wood products.

In order to carry out an effective mobilization of forest wood biomass in the area of BiH it is necessary to consider the condition of the market and determine technological potentials for its removal from the forest and further processing, and establish a level of demand for this type of wood product. An important factor for increasing the demand for wood based energy sources (wood chips, briquette and pellets) is the degree to which end users are informed about the advantages of investing into technological solutions which make their use for production of heat energy in households possible. In this regard, it can be concluded that the process of mobilization of forest wood biomass would benefit greatly from promotional activities directed at end users, in particular those who traditionally use firewood for heating their homes. Promotional and informative activities can point out financial advantages of more effective use of wood for production of heat energy. On the other hand, end users can be supplied with information about a positive impact on the condition of the environment through the use of forest biomass for energy production and thus have an impact on the environmental awareness of end users.

As a consequence of an increased demand for cordwood for heat energy, both on the local and foreign markets, ways must be found to mobilize and offer – using the existing forest resources and with minimum investments – to the market as large quantities of these products as possible in the form of forest biomass which could be used for energy production. In this way, the forestry sector, and wood industry companies in BiH, can use their competitive advantages (low purchasing price of raw materials and low labour force cost) and try to find a place on the foreign markets for wood based energy sources. Using forest biomass for production of wood based energy may considerably improve exporting capabilities of companies working in the forestry and wood processing sector. In order to facilitate and promote export of wood based energy products it is necessary to inform potential companies of the regulations and limitations defining the foreign market, primarily the EU (e.g. EU TR provisions). Apart from this, in order to improve their competitive advantages and to be in compliance with the regulations and limitations concerning wood import on the EU market, activities must be initiated to introduce standards and certifications of forestry and wood processing companies.

The traditional method of managing forest resources in BiH does not ensure sufficiently the implementation of everything that would be required to maximize the benefits of forests, from the ecological, economic and sociological aspects. This is particularly expressed when considering privately owned forests. Insufficient care about their own forest holdings leads to a reduction of quality of existing compartments and diminished value of these goods for their owners.

State authorities at all levels do not have adequate measures of forestry policy to be able to have an impact on private owners of forest resources and contribute to their more effective use. This proves the fact that private forest holdings in BiH have been neglected by the public forestry administration, which causes its insufficient use. On the basis of the above, one can conclude that there are certain quantities of wood in privately owned forests, which, with application of economic instruments of forestry policy (incentives and benefits), can be mobilized and offered to the market as a resource for production of wood based energy resources. In this regard, it is necessary to work on the process of associating private forest owners in interest associations and work on their strengthening in order to ensure common care about forest resources and appear on the market on the one hand, and on the other, establish communication with public forest administration on important issues regarding private forest holdings.

Mobilization of existing potentials of forest wood biomass in BiH is not possible without a consistent forestry policy on all administrative levels, which should ensure a strategic and legislative framework for its effective use. It is necessary to establish cooperation between all relevant sectors in the fields of energy generation, agriculture and forestry and maintain a continuous exchange of information in order to be able to set realistically achievable goals when it comes to using forest wood biomass for energy production.



6. LITERATURE

1. Anatoljak, R. (1949): Mali šumarsko-tehnički priručnik, Sekcija šumarstva i drvne industrije društva inženjera i tehničara NR Hrvatske, Zagreb. /Small Forestry-Technical Manual, Forestry and Wood Industry Club of the Engineer and Technician Society of the NR of Croatia, Zagreb/
2. Arts, B. J. M., Appelstrand, M., Kleinschmit, D., Pülzl, H., Visseren-Hamakers, I.J., Eba'a Atyi, R., Enters, T., McGinley, K., Yasmi, Y. (2010): Discourses, actors and instruments in international forest governance, chapter in the book - Embracing complexity: Meeting the challenges of international forest governance. A global assessment report (IUFRO World Series 28).
3. Bajrić M., Pičman D., Sokolović DŽ., Gurda S. (2011): Prevođenje traktorskih vlaka uzdužnog nagiba do 12% u prilazne kamionske puteve, Radovi Šumarskog Fakulteta, Univerziteta u Sarajevu, Volume 41, broj 1. /Transforming Tractor Logging Tracks with 12% Longitudinal Gradient into Truck Access Roads, Works of the School of Forestry, University of Sarajevo, Volume 41, No 1/
4. Danilović, M., Karić, S., Stojić, D., Dražić, S., Kašić, S. (2013): Program korišćenja šumske biomase iz šuma Republike Srpske, Sokolac. /Program of Using Forest Biomass from Republika Srpska Forests, Sokolac/
5. Doleček V., Karabegović I. (2013): Biomasa kao energetska potencijal obnovljivih izvora energije u Bosni i Hercegovini /Biomass as Energy Potential of Renewable Energy Sources in Bosnia and Herzegovina [Available at: <http://forestfires.ba/work/biomasa-rad>].
6. Đulan M., Bešlić, E. (1999): Izvoz po svaku cijenu, Oslobođenje, 30.09.1999. Sarajevo. /Export at Any Cost, Oslobođenje, 30 September 1999, Sarajevo/
7. Federation Ministry of Agriculture, Water Management and Forestry (2014): Report on Forest Management in the F BiH in 2012 and Forest Management Plans for 2013, Sarajevo [Available at: <http://www.fmpvs.gov.ba/>].
8. Fejzibegović, S. (2007): Mediterranean and National Strategies for Sustainable Development Priority Field of Action 2: Energy and Climate Change Energy Efficiency and Renewable Energy Bosnia & Herzegovina - National study's summary, Hydro-Engineering Institute Sarajevo.
9. FIRMA - Fostering Interventions for Rapid Market Advancement (2013): Mogućnosti korišćenja niskovrijednih drvnih sortimenata i konverzija izdanačkih šuma u Bosni i Hercegovini, Završni izvještaj, Sarajevo. / Opportunities for Using Low-Value Wood Products and Conversion of Coppice Forests in Bosnia and Herzegovina, Final Report, Sarajevo/
10. Food Agriculture Organisation of the United Nations (2004): Unified bioenergy terminology, [Available at: www.fao.org].
11. Food Agriculture Organisation of the United Nations (2008): Forests and Energy – Key issues, Rome, [Available at: www.fao.org].
12. Glück, P., Avdibegović, M., Čabaravdić, A., Nonić, D., Petrović, N., Posavec, S., Stojanovska, M. (2011): Private Forest Owners in the Western Balkans – Ready for the Formation of Interest Associations, European Forest Institute, Research Report No. 25.
13. Gvero P. (2008): Biomasa kao gorivo, Udruženje šumarstva prerade drveta Interfob. /Biomass as Fuel, Wood Processing Association – Interfob/.
14. Gvero, P. M. (2007): The Potential of Renewable Energy Sources in Bosnia and Herzegovina, "Climate Change in South-Eastern European Countries: Causes, Impacts, Solutions" Graz, Austria.
15. Jovanović B., Musić J., Lojo A. (2008): Energetski potencijal drvene biomase u Bosni i Hercegovini, Radovi Šumarskog Fakulteta, Univerziteta u Sarajevu, Volume 38, broj 1. /Energy Potentials of Wood Biomass in Bosnia and Herzegovina, Works of the School of Forestry, University of Sarajevo, Volume 38, No 1/
16. Malkočević, A. (2006): Incentives and barriers for the development of renewable energy sources Bosnia and Herzegovina: country analysis, Ecology and Energy Center.
17. Matić, V., Drinić, P., Pavlič, J., Prolić, N., Stojanović, O., Vukmirović, V., Koprivica, M (1990): Tablice taksacionih elemenata visokih i izdanačkih šuma u Bosni i Hercegovini, Šumarski fakultet Univerziteta u Sarajevu, Sarajevo. /Tables of Inventorial Elements of High and Coppice Woods in Bosnia and Herzegovina, School of Forestry of the University of Sarajevo, Sarajevo/
18. METROPOLI (2012): Report on Analysis of the Condition of Environmental Technologies and Renewable Sources of Energy in Bosnia and Herzegovina, Sarajevo.
19. Republika Srpska Institute of Statistics (2013): Forestry – Statistical Bulletin [Available at: <http://www.rzs.rs.ba/>].
20. Schmithusen, F., Kaiser, B., Schmidhauser, A., Mellinghoff, S., Perchthaler, K., Kammerhofer, W. A. (2014): Entrepreneurship and Management in Forestry and Wood Processing, Routledge.
21. U.S. Energy Information Administration (2013): International Energy Outlook 2013, Washington [Available at: <http://www.eia.gov/forecasts/ieo/>].
22. UNDP (2011): Analysis of Wood Residues in BiH with a Particular Focus on the Municipalities of Srebrenica, Bratunac and Milići.
23. World Bank - Infrastructure and Energy Department Europe & Central Asia Region, (2004): Bosnia and Herzegovina: Infrastructure and Energy Strategy, Report No. 29023-BA.
24. Law on Renewable Energy Sources and Efficient Cogeneration, Official Gazette of Republika Srpska, No39/13.
25. Law on the Use of Renewable Energy Sources and Efficient Cogeneration, Official Gazette of the Federation of BiH, No 70/13.

SUPPLEMENTS

Supplement 1: Questionnaire for forestry companies

1. What production levels of certain forest wood products have you achieved in the past five years?

Type of product	2009	2010	2011	2012	2013
	m ³				
Logs for sawmill processing					
Other roundwood					
Pulpwood					
Firewood					
Other					

* Please enter data as net amounts of large wood

2. Are you currently offering to the market a possibility of purchasing wood biomass originating from wood cutting and processing of wood products and residues after wood cutting (small branches and stumps)

- YES

- NO (If your answer is NO please continue filling the Questionnaire from Question number 6)

3. Please give a short description of the manner of sale of wood biomass remaining from wood cutting and processing of wood products, including the residues after wood cutting (small branches and stumps)?

4. Please indicate the quantities of sold wood biomass remaining from wood cutting and processing of wood products, including the residues after wood cutting (small branches and stumps) in the period of the past five years?

2009	2010	2011	2012	2013
		m ³		

5. Please indicate the average price of sold biomass originating from wood cutting and processing of wood products and residues after wood cutting (small branches and stumps) in the period of the past five years?

2009	2010	2011	2012	2013
		KM/m ³		

6. Please identify and describe the main factors which hamper commercialization of wood biomass originating from wood cutting and processing of wood products and residues after wood cutting (small branches and stumps)?

7. Please identify and describe the main measures which, in your opinion, should be undertaken to improve and have a successful commercialization of wood biomass originating from wood cutting and processing of wood products and residues after wood cutting (small branches and stumps)?

8. Please identify and describe the main institutions which, in your opinion, should implement the identified measures with a view to promoting commercialization of biomass originating from wood cutting and processing of wood products and residues after wood cutting (small branches and stumps)?

9. Assuming that the indicated limiting factors are removed, what quantity of wood biomass originating from wood cutting and processing of wood products and residues after wood cutting (small branches and stumps) would you be prepared to offer to the market?

_____ m³

Thank you for your cooperation

Supplement 2: Questionnaire for wood industry companies

1. What production level (wood processing), by the main types of products which your company produces, have you achieved in the past five years?

Types of product	2009	2010	2011	2012	2013
	m ³				

2. What is the average percentage of residues and waste in the process of production of your company's products?

_____ %

3. Are you currently offering to the market an option of purchasing residues and waste originating from the process of production in your company?

- YES

- NO (If your answer is NO please continue filling the Questionnaire from Question No 8)

4. Please give a short description of the manner of sale of wood residues and waste originating from the process of production in your company?

5. Please indicate the quantity of sold wood residues and waste originating from the process of production in your company in the period of the past five years?

2009	2010	2011	2012	2013
		m ³		

** You can express the required quantities in the units you customarily use in your business (tons, cubic meters).*

6. Please indicate the average price realized for sold wood residues and waste originating from the process of production in your company in the past five years?

2009	2010	2011	2012	2013
		KM/m ³		

** You can express the required quantities in the units you customarily use in your business (tons, cubic meters).*

8. Do you use wood residues and waste originating from the process of production in your company for your own needs?

- YES

- NO

If your answer is YES please describe the purposes to which you use wood residues and waste originating from the process of production in your company?

9. Please identify and describe the main factors which hamper sales, i.e. use for your own purposes, of wood residues and waste originating from the process of production in your company?

10. Please identify and describe the main measures which, in your opinion, should be undertaken to improve sales and achieve better own use, of wood residues and waste originating from the process of production in your company?

11. Please identify and describe the main institutions which, in your opinion, should implement the identified measures with a view to promoting or better using for your own purposes of wood residues and waste originating from the process of production in your company?

12. Assuming that the indicated limiting factors are removed, what quantity of wood residues and waste originating from the process of production in your company would you be prepared to offer to the market?

_____m³

** You can express the required quantities in the units you customarily use in your business (tons, cubic meters).*

Thank you for your cooperation



*Empowered lives.
Resilient nations.*

**Razvojni program Ujedinjenih nacija
u Bosni i Hercegovini**

**United Nations Development Programme
in Bosnia and Herzegovina**

Zmaja od Bosne b.b.. 71000 Sarajevo
Bosna i Hercegovina/Bosnia and Herzegovina
Tel: (387 33) 293 400, Fax: (387 33) 552 330
www.ba.undp.org

©2014