

Regional Profile of the Biomass Sector in Romania

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1 Introduction

The Romanian National Forest Fund ([Report on Forest State, 2010](#)) occupies 6.515 mio. ha, representing 27.3% from the national territory. This locates Romania close to the European and global averages (31 respectively 29.6%). Also, an average of 0.30 ha per citizen locates Romania close to the European situation (0.31 ha/citizen). Forests cover an area of about 6.4mio. ha the rest being represented by other terrains and/or constructions/installations which are used mainly for forest management purposes (nurseries, administration, lakes within forest, forest roads and unproductive terrains).

Centru Region of Romania (Figure 1), covers 14.31% of the Romanian national territory, contains six counties (Alba, Braşov, Covasna, Harghita, Mureş and Sibiu) and concentrates about 12% of Romanian population. More than one third of the Central Region area is covered with forests.



Figure 1. Centru Region, Romania

Before 1989, all the Romanian forests were owned by state, but, after that, important changes were made by reinstating the ownership rights. For energetic purposes, firewood is the most relevant assortment despite the fact that important amounts of forest residues could be utilized for energy production (Bouriaud et al., 2013). Recent studies showed that the potential of biomass for energy production (agricultural and forest residues) in Romania is of 228.1 PJ (Scaralt et al., 2011). This includes the logging residues, firewood (which represents a common assortment resulted from harvesting operations) as well as wood processing residues. Also, pellet production from Romania is estimated at a capacity of 300,000 tons per year from which more than 75% is exported (Velcescu & Staicu, 2011). Over 40 plantations tests are implemented for energetic willow in most of the Romanian Counties.

However, wood has been disregarded as a major source of energy from the development strategies of Romania ([BERD, 2007](#)). In this respect, Romanian authorities plan to increase the use of “clean” energy (from renewable sources) mainly by hydro-plants development ([BERD, 2007](#)) agricultural waste, wind power, and less from wood utilization.

2 Condition and structure of regional/national forests

2.1 Geography and topography

The topography of Romania includes all the landforms starting from Danube Delta and ending with mountainous peaks higher than 2500 m. Most of the Romanian forests are located in the mountainous regions ([Report on forest state, 2010](#)), generally in conditions of steep slopes. Despite the fact that the most suitable harvesting equipment for these forests would be cable cranes and tower yarders, in the vast majority are used skidders and farm tractors, while the tree felling and processing is done by the means of mechanical chainsaws ([Sbera, 2007](#)). According to Scaralt et al., ([2011](#)), most of the forests are located in mountainous area (66%) followed by hill zones (24%) and plain (10%) – Figure 2.

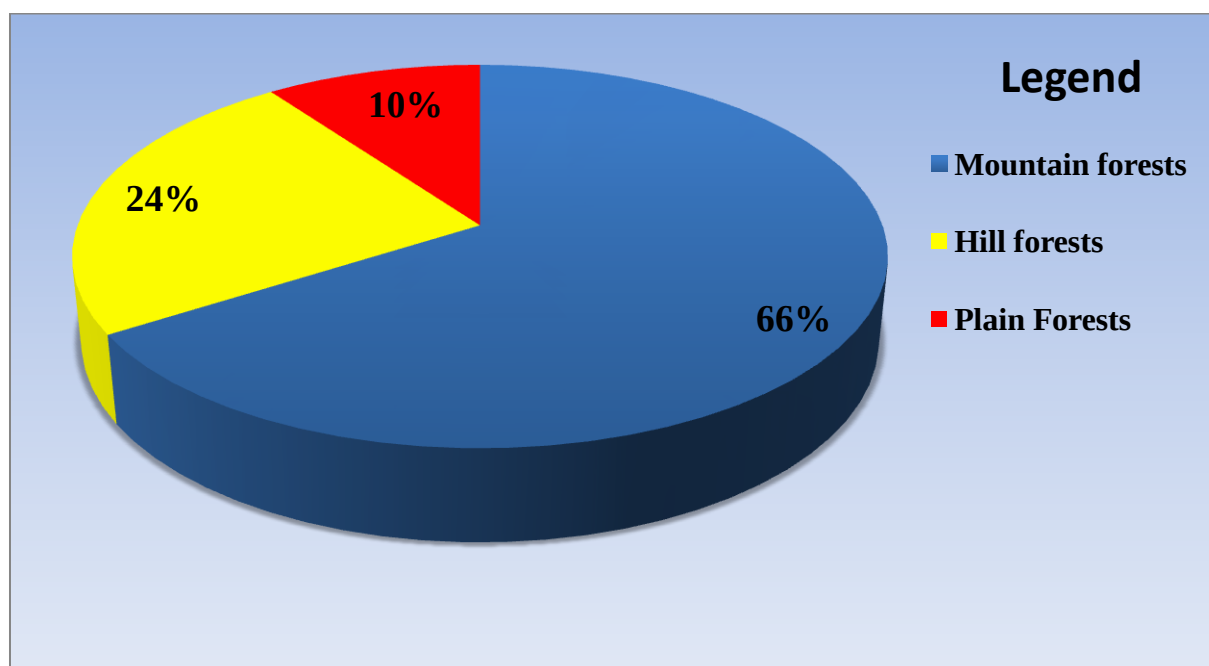


Figure 2. Forest distribution by considering the landforms. Source: Scarlat et al., 2011.

Excepting some isolated situations ([Borz et al., 2011](#)), modern cable yarders are poorly represented in Romania. This is also the case of harvesters and forwarders, which together accounted for only 35 units in 2011 ([Sbera, 2012](#)). Although the use of highly mechanized harvesting techniques is possible in all the forests, in case of very dense stands (first thinning) it is more likely to be used animal logging in tandem with other mechanized logging means, fact which considerably decreases the productivities and increases the costs ([Oprea, 2008](#)).

Regarding the Centru Region, more than 50% of forests are located in mountainous areas (Figure 3) and rest is distributed in Depresiunea Transilvaniei as hill forest. Some plain forests can be found on the main rivers large valleys like Mureş, Olt and Târnave.

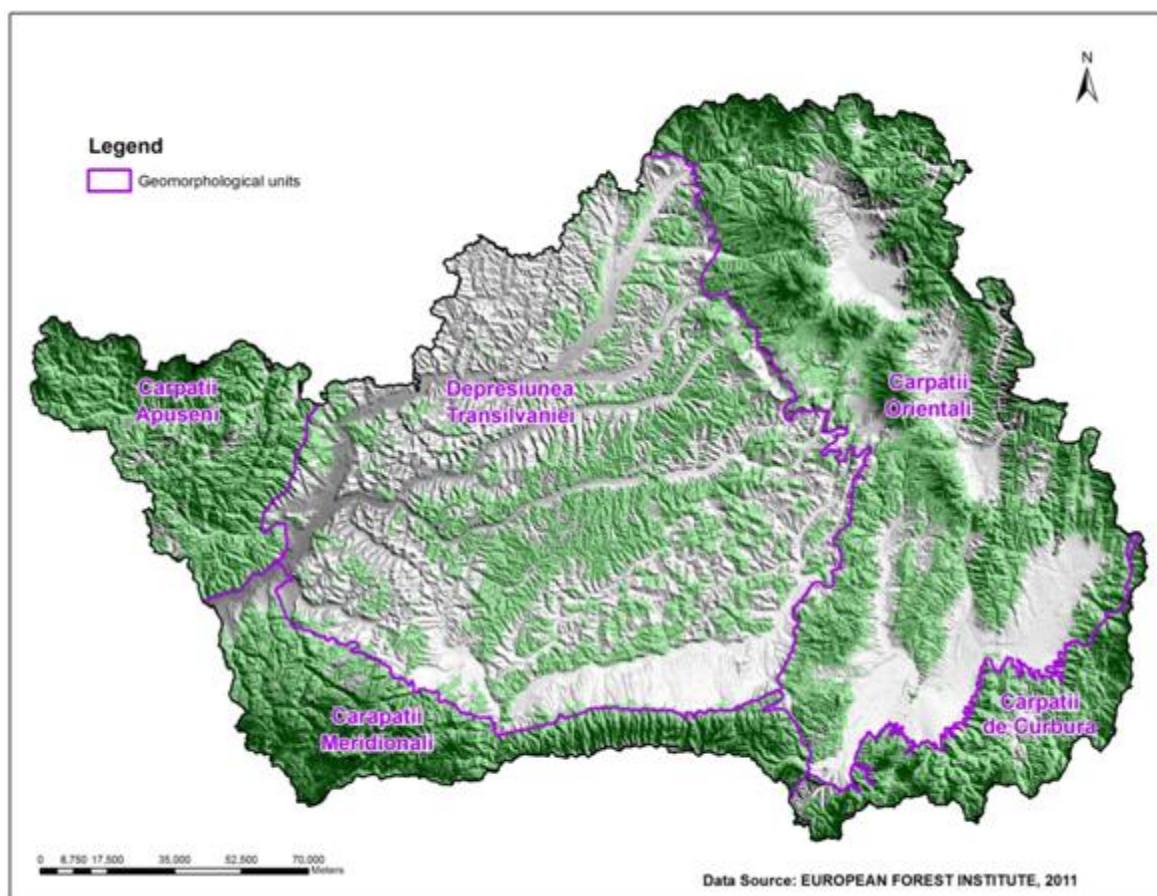


Figure 3. Forest distribution on major geomorphological units, in Centru Region (Source: European Forest Institute, 2011)

2.2 Forest condition

Romanian forested areas slightly increased in the last years ([Report on Forest State, 2010](#); [INSSE, 2011](#)), whereas the harvested volume was of about 17 mio m³ in 2010 respectively 19.7 mio. m³ in 2011. More than 4 mio m³ from the harvested volume was represented by firewood ([INSSE, 2011](#)) in 2010. Generally, the extracted wood is under the allowable amount, the average increment is of 5.6 m³ × year⁻¹ × ha⁻¹, and the average standing volume per hectare is about 217 m³. The annual allowable cut was calculated at 22 mio. m³ in 2010. At the level of 2011, in Romania existed 4908 harvesting companies including the private and state forest districts which operate in timber harvesting ([Sbera, 2012](#)). Theoretic harvesting capacity of these companies was of 24.2 m³ × year⁻¹, most of them having a harvesting capacity up to 5000m³ × year⁻¹.

The forest condition in Centru Region can be expressed also by forest density per square km. As it can be observed in Figure 4, high density forests can be found in mountainous areas where mostly coniferous forests are spreading. In the centre of region the forest is sparse, divided in smaller forest bodies due to demographic expansion and agricultural land needs.

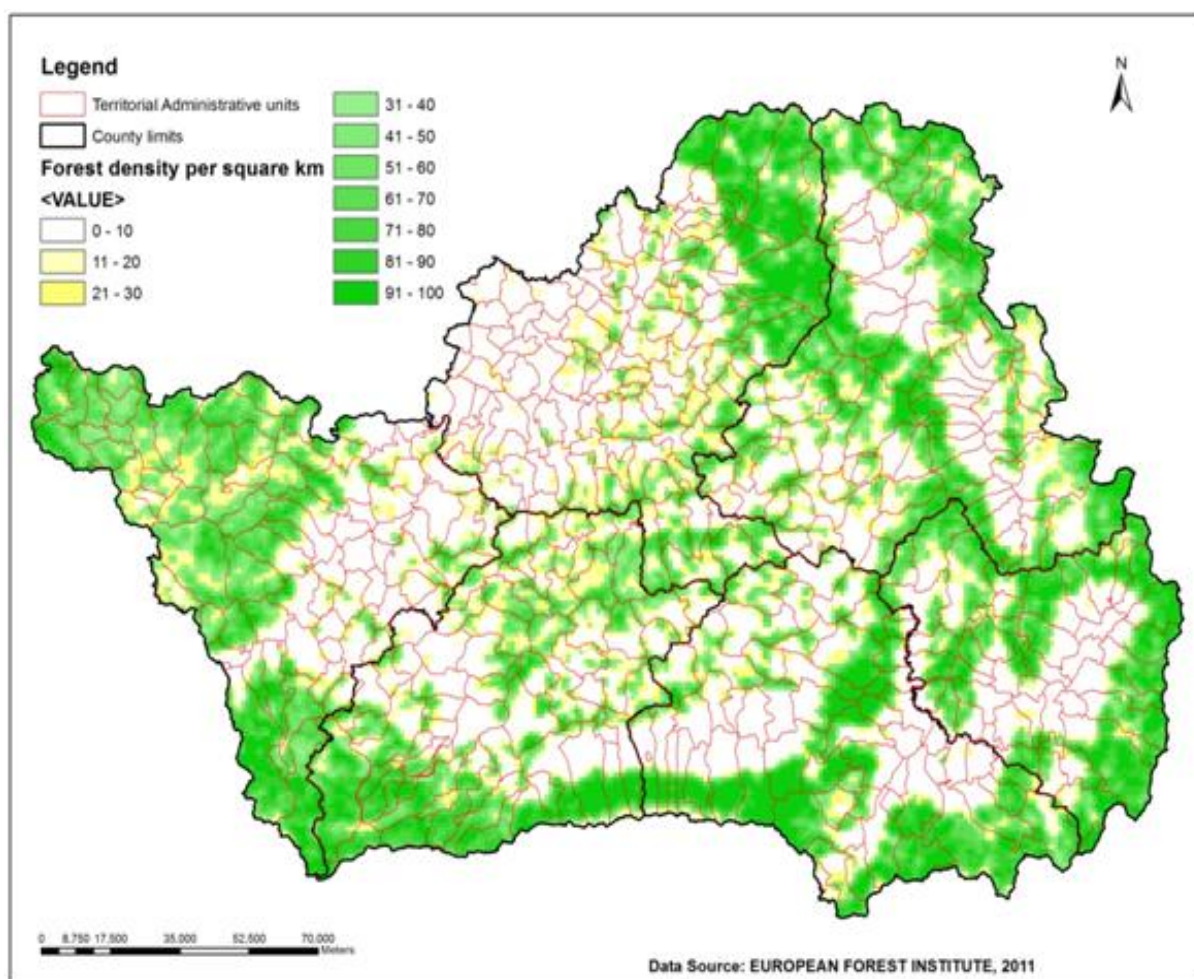


Figure 4. Forest condition expressed by forest density per square km, in Centru Region (Source: European Forest Institute, 2011)

2.3 Forest ownership structure

Most of the forests from Romania were state-owned ([Report on Forest State, 2010](#)) by 2010 (Figure 5). The newest sources indicate that about 3.35 mio. ha were restituted, representing about 50% from the Romanian forest land ([Abrudan, 2012](#)). However the restitution process is not finished yet. A probable structure of ownership after the restitution process will consider a state ownership participation of only 40% ([Abrudan, 2012](#)). Almost half of the private owned forests are administrated by private forest districts while the rest are still administrated by NFA – Romsilva ([Abrudan, 2012](#)).

The forest ownership structure in Centru Region is a little bit different than the rest of country. In here the state owned forest percentage is smaller (Figure 6). A high percentage of public forests are located mostly in south where the territorial-administrative units are the main owners (Figure 7).

In the eastern part of region (Harghita and Covasna counties) the highest percentage of ownership is attributed to private owners (either undivided or not).

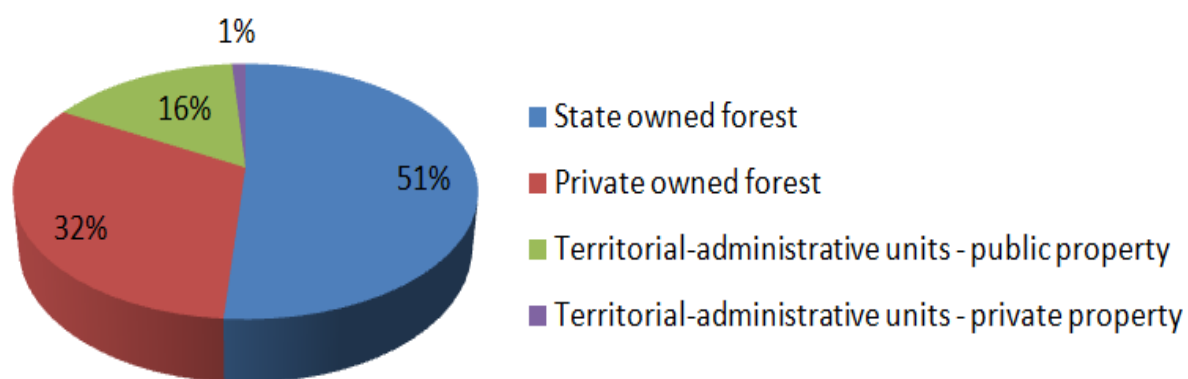


Figure 5. Forest ownership structure in Romania in 2010 (Source: www.mmediu.ro)

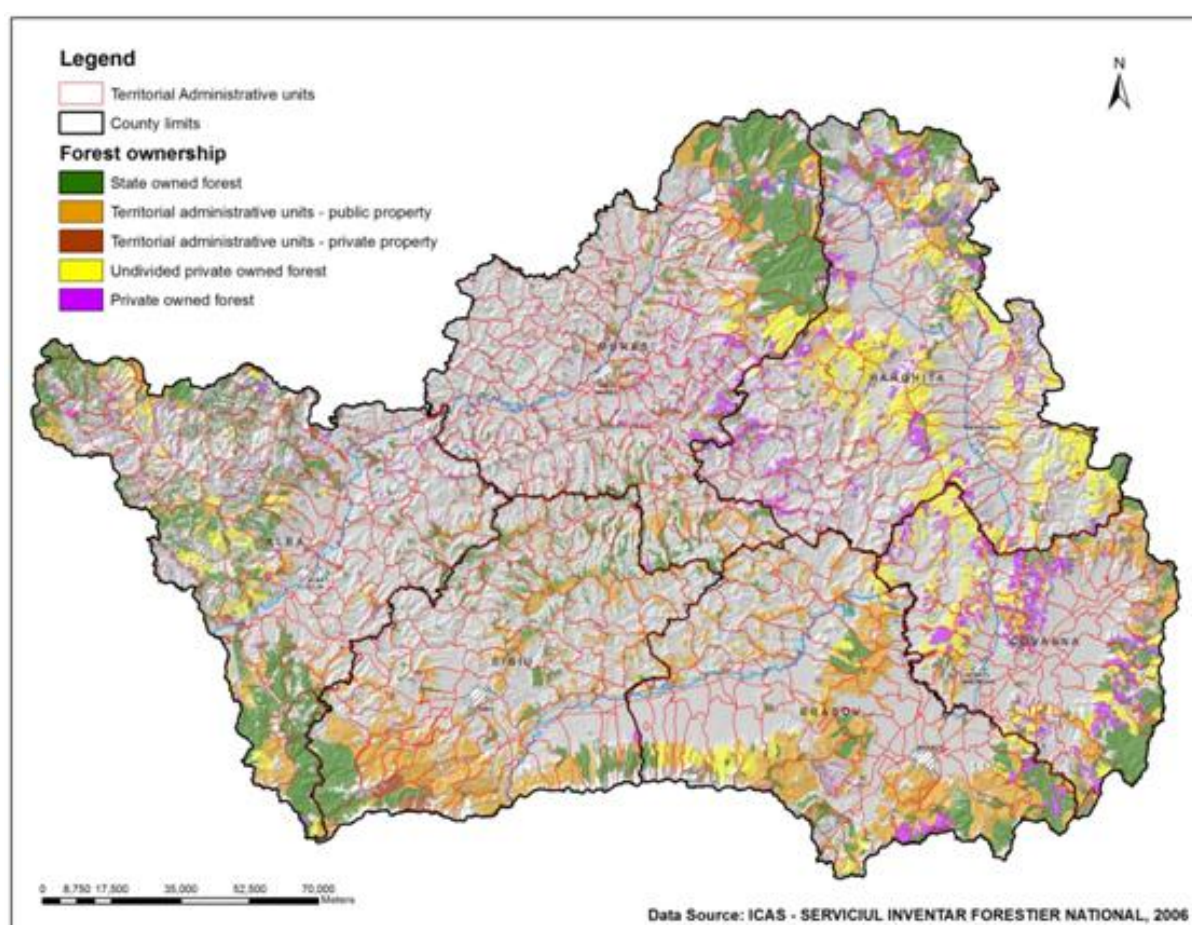


Figure 6. Forest ownership distribution on territorial administrative units in Centru Region (Source: Romanian Forest Research and Management Institute – National Forest Inventory Service 2006).

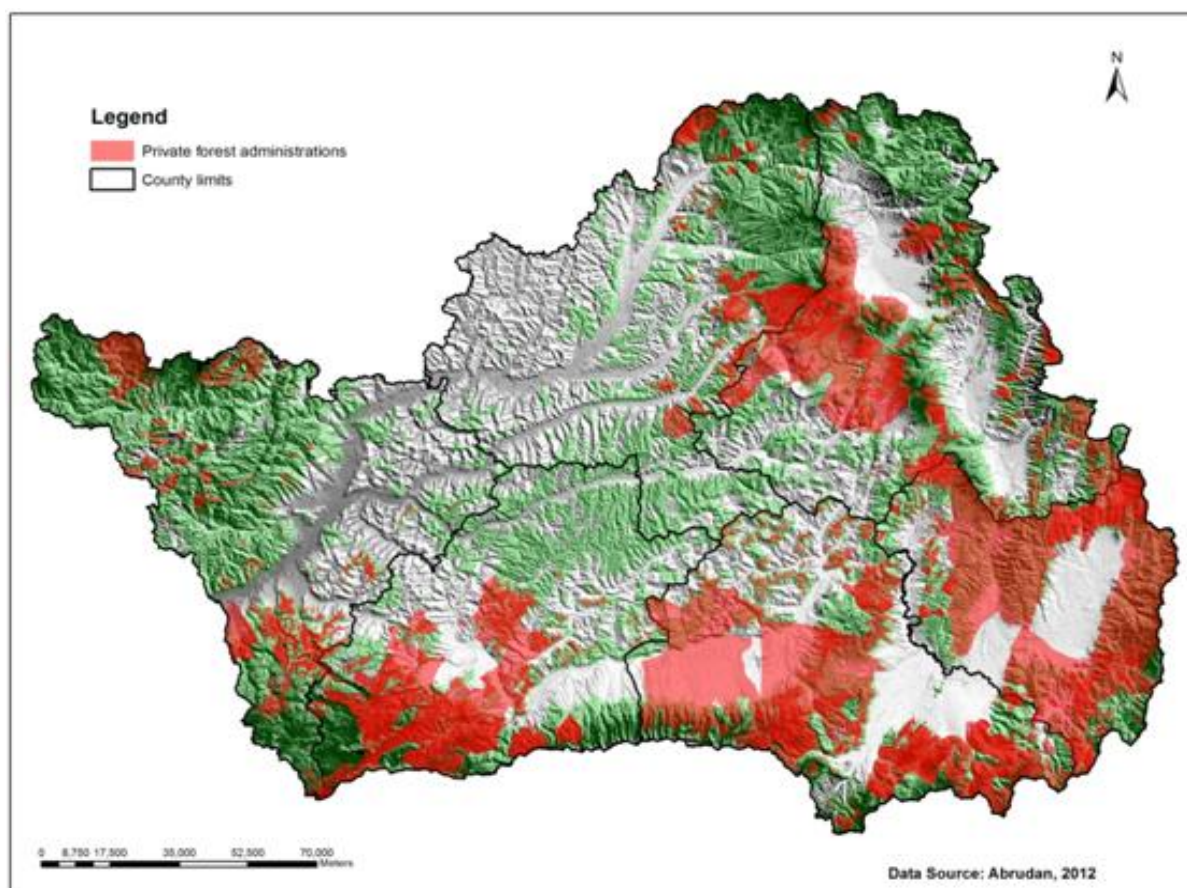


Figure 7. Private forest administrations located in Centru Region (Source: Abrudan, 2012)

2.4 Forest owner cooperations (FOCs)

Forest owner cooperations (at great scale) are still at the beginning in Romania. However, forest management is regulated through forest management plans which apply to forest areas greater than 100 ha ([Forest Code –Law 46/2008, 2008](#)). This resulted in associations of owners in order to manage together their forests and comply with law regulations. Romanian Forest Owner Association (A.P.P.R.) may be the relevant organization related to FOCs. It appeared in 1998, and today groups several forest owners from 18 Romanian counties (www.appr.org.ro).

3 Biomass resources

Romania is estimated to have a biomass energy potential of 7,594,000 toe/year (or 318 x 109MJ/year) corresponding to some 19% of the total average primary consumption ([BERD, 2007](#)). The study done by BERD in 2007 ([BERD, 2007](#)) identifies the following categories of fuels belonging to biomass (Figure 8):

- Firewood and wood waste from harvesting operations: 1,175,000 toe (48.8 x 109 MJ/year)
- Sawdust and wood waste from wood processing operations: 487,000 toe (20.4 x 109MJ/year)
- Agricultural waste: 4,799,000 toe (200.9 x 109 MJ/year)

- Biogas: 588,000 toe (24.6 x 10⁹ MJ/year)
- Household waste: 545,000 toe (22.8 x 10⁹ MJ/year)

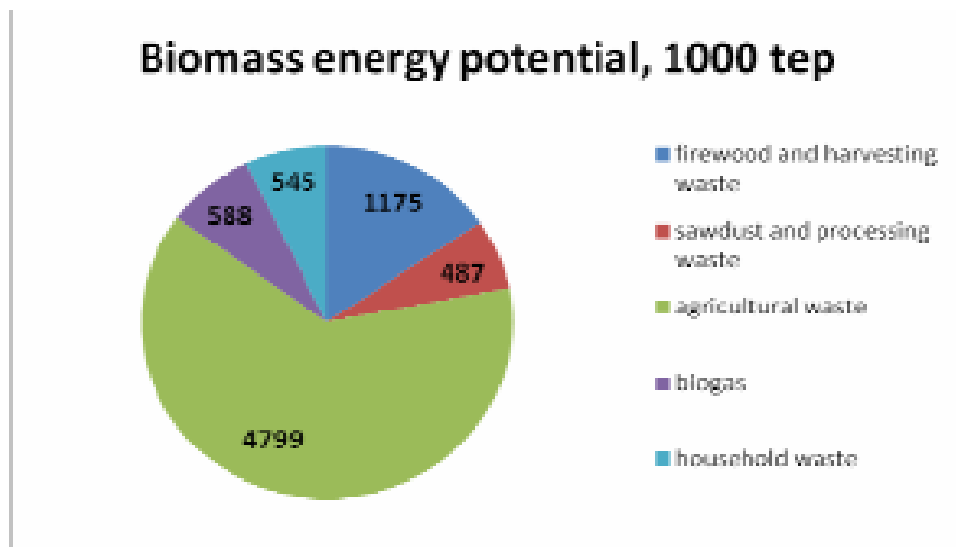


Figure 8. Contribution of different biomass materials to the total amount of biomass energy potential (Source BERD, 2007)

3.1 Forest biomass

The total wood stock in Romania (total standing volume) was estimated to about 1350 mio. m³ ([Scaralt et al., 2011](#)), of which 39% is coniferous, 37% is beech, 13% oak and 11% other species. The average wood stock is of 217 m³ × ha⁻¹, but more productive forests having a wood stock of 900-1300 m³ × ha⁻¹ are encountered in some regions (hills and mountains). The average forest increment is of 5.6 m³ × ha⁻¹ × year⁻¹ ([Scarlat, 2011](#)), representing about 35 mio. m³ha⁻¹ × year⁻¹ at national level.

In Romania, the harvested volume increased in 2011 to 19.7 mio. m³ if the year 2010 is considered as reference (17.0 mio. m³), in conditions in which the annual allowable cut was of 22.0 mio. m³ ([Sbera, 2012](#); [Report on Forest State, 2010](#)). Also, approximately 4.7 mio. m³ (representing 24% of the harvested volume) were used as firewood ([INSSE, 2013](#)) and 0.04 mio. m³ were used for charcoal production. Statistics regarding the use for other biomass products (wood chips, pellets, briquettes) are not available. However, the harvested wood for other utilizations which may include biomass products accounted for 0.05 mio. m³.

The wood (firewood and waste) is being used especially in the rural area by private households and in the towns located close to the Carpathian Mountains as follows ([BERD, 2007](#)):

- 12 million individual stoves or wood ovens for heating and cooking purposes, with a nominal power of up to 4 kWh;
- 500 steam and hot water industrial boilers for industrial use;
- 20 hot water boilers in urban area, with nominal power capacity between 0.7 and 7MWh.

An estimate of the wood available for producing energy through burning process is shown in figure 9, while the current utilization of wood for producing heat and electricity is shown in figure 10. The real utilization of wood is much less than the natural potential ([BERD, 2007](#)).

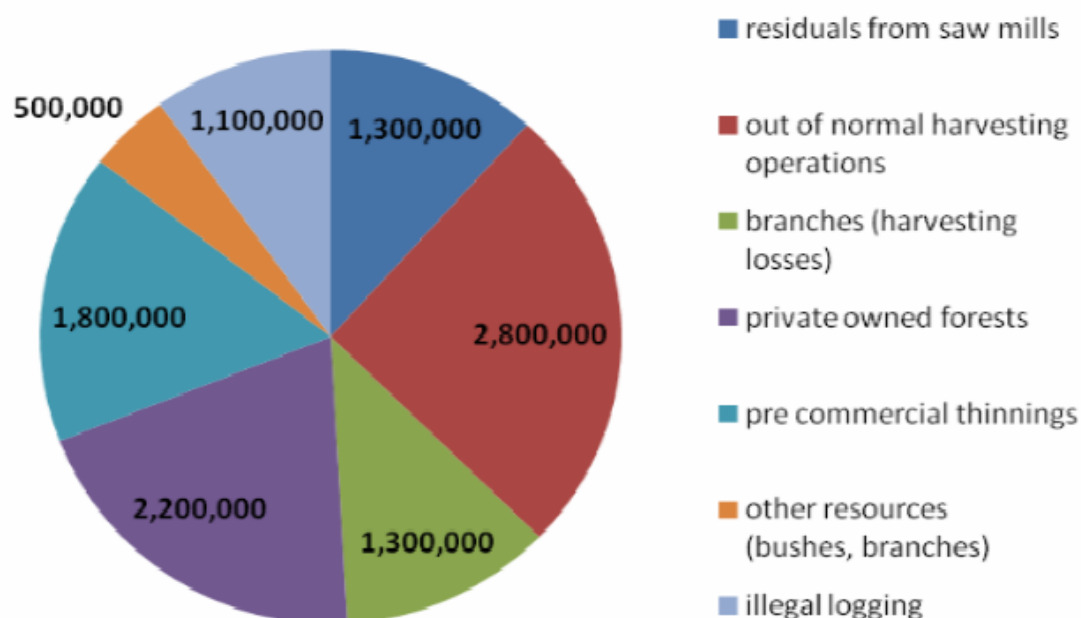


Figure 9. Potential sources of wood available for producing heat and electricity, m³ (Source BERD, 2007)

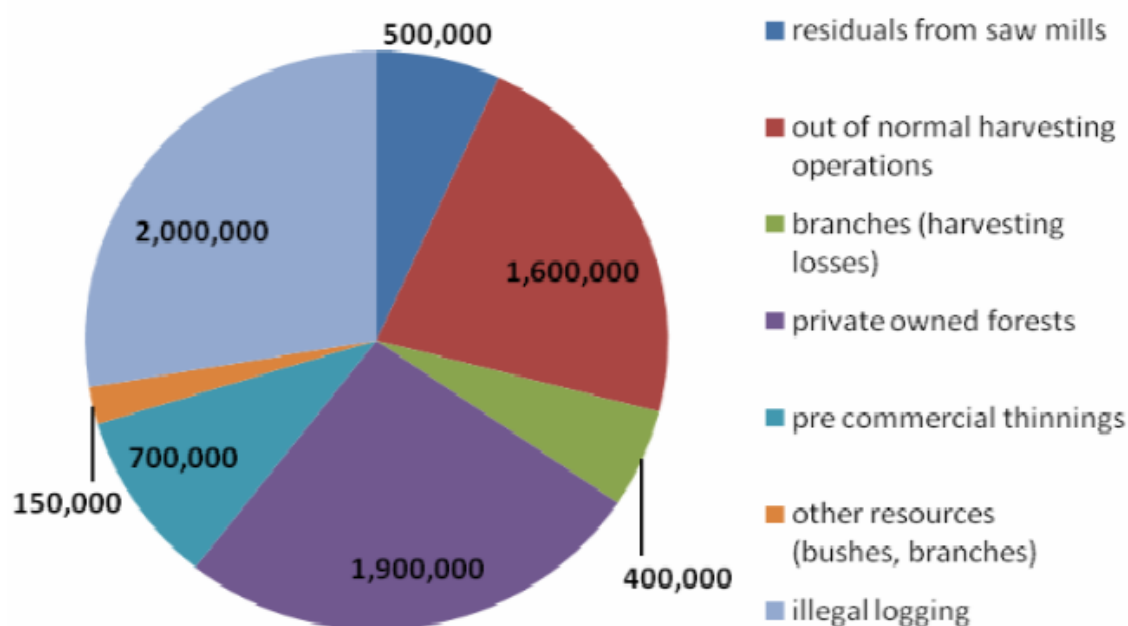


Figure 10. Current utilization of wood for producing heat and electricity (Source BERD, 2007)

3.2 Short-rotation coppice

Purpose short-rotation plantations for energetic use in Romania are still at the beginning. By 2010 ([Velcescu & Staicu, 2011](#)), a total number of 49 test plantations (Figure 11) were realized in 28 Romanian counties. It was estimated that by 2012 approximately 850 hectares of energetic willow existed in Romania. However, short-rotation coppice is also applied in forestry. For instance, Danube Meadow as well as Danube Delta are the most suitable places for poplar and willow. These forests are managed in short-rotation coppice and the management plans are realized for a 5 years period. The short-rotation coppice harvested areas at national level represent less than 5% ([Report on Forest State, 2010](#)).

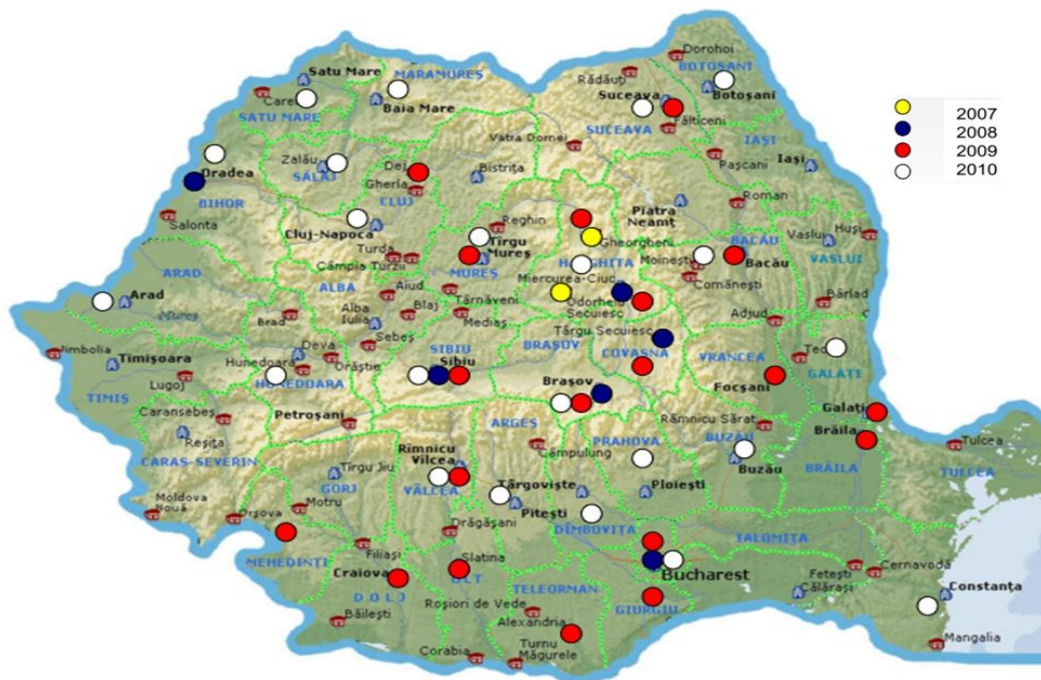


Figure 11. Willow plantation tests in Romania (Source: Velcescu & Staicu, 2011)

3.3 Wood residues

In what concerns the wood residues, there is estimated that the amount available each year is approximately 1.5 mio. tons ([Romanian Strategy for the Valorization of Renewable Energy Resources, 2003](#)). No available statistics were found regarding the utilization of this biomass category, but the transition to large wood processors brought also the integration of wood residues in their own processing activities.

3.4 Agricultural biomass

The use of agricultural biomass for energy purposes in Romania is insignificant, despite the fact that an increased potential exist in country. According to the Romanian Strategy for the Valorization of Renewable Energy Resources ([2003](#)), which was approved by a Government Decision (GD 1535/2003), the Romanian potential of agricultural biomass is about 12.6 mio. tones $\times$ year⁻¹ which

corresponds to approximately 201 PJ. However, more recent studies indicated that the amount of agricultural biomass would be of about 154 PJ ([Scarlat et al., 2011](#)), with significant annual variations. The last study refers only to the amount of biomass which is available for bioenergy by considering the agricultural biomass consumptions for other related agricultural activities.

3.5 Urban residues

An important quantity of biomass may be obtained from urban residues. According to the Romanian Strategy for the Valorization of Renewable Energy Resources ([2003](#)), the annual potential is about 4.5 mio. tones.

4 Wood and Biomass use in Romania

4.1 Production and demand of biomass in Romania

4.1.1 Wood chips

Both, production and use of woodchips is not relevant for the moment in Romania, since only a few producers exist at the present time (Table 1). In this case, the producers offer woodchips only by considering pre-established contracts. Woodchips from short rotation plantations of willow are used most often locally for heating applications.

Table 1. Main woodchips producers in Romania

No.	Name	County	Location	Source	Production
1.	SC Eleagnus SRL	Mures	Tg.Mures	http://www.bizoo.ro/firma/eleagnus	100 t×day ⁻¹
2.	SC.Kontrastwege SRL	Harghita	Miercurea Ciuc	www.kontrastwege.ro	20-25 t×ha ⁻¹ ×year ⁻¹
3.	Comtub	Dolj	Cerat	http://www.bizoo.ro/firma/comtub	-
4.	SC Genex COM SRL	Harghita	Sarmas	http://www.genexcom.ro	-

4.1.2 Firewood

The only available data refers to firewood production as assortment ([INSSE, 2013](#)), while data regarding the logging residues, and other wood processing residues which could be used as firewood is not accessible. Firewood production in Romania had an ascending trend in the last years (Figure 12).

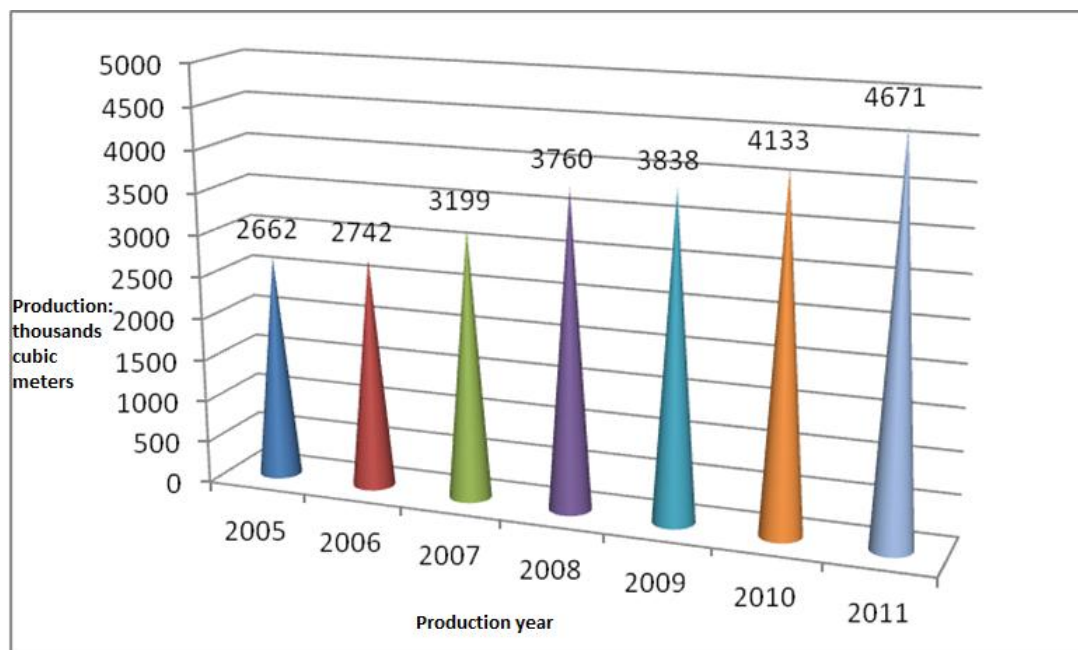


Figure 12. Production trends for firewood in Romania (Source: INSSE, 2013)

Firewood production amounts are correlated with forested areas within certain counties. Average productions per hectare and per year ([INSSE, 2011](#)), are presented for Romania in Figure 13.

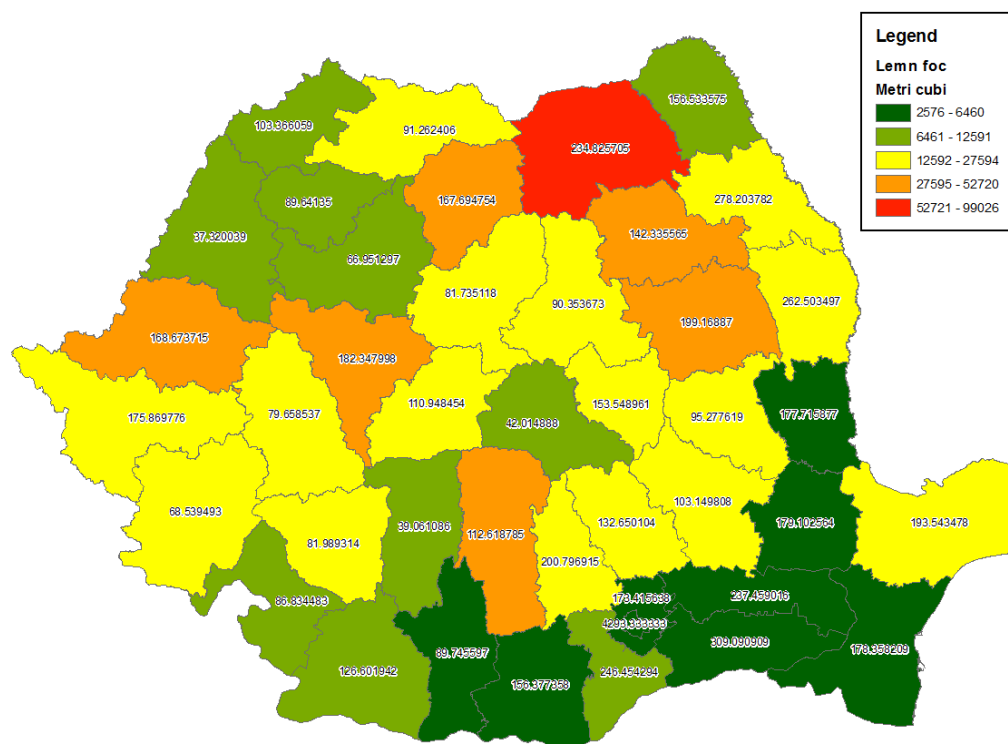


Figure 13. Firewood production in Romania in 2011 (Source: INS TEMPO Database, accessed 2012)

4.1.3 Pellets and Briquettes

Pellets and briquettes production increased in Romania mostly after the country inclusion in EU. This was and still is mostly related with the new markets in Europe. Currently, there are many pellet producers in Romania, but information about their production capacities is scarcely accessible. In general, most of the production of large companies is sold on western European markets. Small producers sell also on the Romanian market in the limit of their stocks (most of the production is realized from wood processing residues), based on pre-established contracts. Table 2 shows the main producers of pellets and briquettes from Romania, as they resulted after an Internet research.

Table 2. Production facilities for pellets and briquettes in Romania

No.	Name	County	Location	Production type and amount		Source Production amount
				Pellets	Briquettes	
1.	Phoenix CompanySA	Harghita	Miercurea Ciuc	3 txh ⁻¹	-	http://www.phxcompany.ro
2.	Massiv Forest Products SRL	Caras Severin	Buchin	-	5,000 txyear ⁻¹	http://www.massiv.ro/
3.	S.C. Ecolemn SRL	Caras Severin	Caransebes	140 txday ⁻¹	70 txday ⁻¹	http://www.ecolemn.info/ro/index.html
4.	Frigo Transilvania	Cluj	Cluj Napoca	n.a.	n.a.	http://www.frigotransilvania.ro/
5.	SC Harforest SRL	Harghita	Gheorghieni	n.a.	-	http://www.harforest.ro/
6.	EcoPellets SRL	Sibiu	Sadu	n.a.	-	www.ecopellets.ro
7.	Mems Corporation SRL	Bucuresti	Bucuresti	n.a.	-	http://www.bizoo.ro
8.	S.C. Holzindustrie Schweighofer S.R.L	Alba	Sebes	90,000 txyear ⁻¹	30,000 txyear ⁻¹	www.schweighofer.ro
9.	S.C. Holzindustrie Schweighofer S.R.L	Suceava	Radauti	90,000 txyear ⁻¹	-	www.schweighofer.ro
10.	S.C. Holzindustrie Schweighofer S.R.L	Suceava	Siret	-	10,000 txyear ⁻¹	www.schweighofer.ro
11.	S.C. Holzindustrie Schweighofer S.R.L	Bacau	Comanesti	90,000 txyear ⁻¹	-	www.schweighofer.ro
12.	Possession Recycling Energy SRL	Timis	Timisoara	n.a.	-	http://possession.ro
13.	Sc Bricrom Srl	Cluj	Gherla	n.a.	-	http://m.btclub.ro/membru_sc_bricrom_srl.html
14.	SC PRODUCTIE FORTUNAFOREST SRL	Covasna	Covasna	n.a.	n.a.	http://www.fortunaforest.ro/
15.	Ameco Renewable Energy Srl	Harghita	Gheorgheni	7.4 txh ⁻¹	1.8 txh ⁻¹	http://www.ameco.ro
16.	Vice Mar S.R.L	Iasi	Iasi	n.a.	-	www.afacerilemn.ro
17.	Art Lemn SRL	Arad	Curtici	n.a.	-	http://www.bizoo.ro
18.	Gross Kamin SRL	Bihor	Oradea	n.a.	-	http://www.cosfum.ro
19.	MarkIT	Ilfov	Voluntari	n.a.	-	http://www.armiainstal.ro/
20.	Sc Harforest Srl	Harghita	Gheorgheni	n.a.	-	www.harforest.ro/
21.	At 06 Consulting Com	Bucurest	Bucuresti	30 txmonth ⁻¹	-	http://www.rasinoase.com
22.	Epad S.r.l	Harghita	Odorheiul Secuiesc	-	30 txmonth ⁻¹	http://www.epad.ro/
23.	Sc Iovan Forest Srl	Arad	Pecica	-	n.a.	http://www.iovanforest.ro
24.	Nehoiu Srl	Buzau	Nehoiu	-	25 txday ⁻¹	http://www.bizoo.ro
25.	Barbulet Srl	Alba	Sebes	-	n.a.	http://www.bizoo.ro
26.	Sc Sortilemn Sa	Cluj	Gherla	-	n.a.	http://www.bizoo.ro
27.	SC Mobex Construct SRL	Alba	Campeni	-	n.a.	http://www.mobexconstruct.aaz.ro
28.	Sc Valnico Srl	Hunedoara	Deva	-	n.a.	http://www.bizoo.ro
29.	Hedrom Srl	Cluj	Cluj-Napoca	-	n.a.	http://www.hedrom.bizoo.ro

30.	S.C. Sortilemn SA	Cluj	Gherla	-	n.a.	http://www.sortilemn.ro/
31.	Bls Srl	Cluj	Cluj-Napoca	-	n.a.	http://www.bizoo.ro
32.	Retigered Consult Srl.	Maramures	Baia Mare	n.a.	n.a.	http://www.pyro-briq.ro/
33.	Sc Eleagnus Srl	Mures	Tg.Mures	-	0.7 txh ⁻¹	http://www.bizoo.ro/firma/eleagnus
34.	Imag Clean Srl	Dambovita	Targoviste	-	80-100 txmonth ⁻¹	http://www.bizoo.ro/firma/imaclean
35.	S.c. Profil Import Export S.r.l.	Mures	Reghin	-	n.a.	http://www.scprofil.ro
36.	Bricheterumegusfag.ro	Mures	Reghin	-	n.a.	http://www.bricheterumegusfag.ro
37.	Bioreg Product Srl	Timis	Peciu Nou	-	n.a.	http://www.bizoo.ro/firma/bioregproduct
38.	Cts Consult Trade&service Srl	Harghita	Sansimion	-	n.a.	http://www.rombrikett.com/
39.	Sage Forest	Sibiu	Sibiu	-	n.a.	http://www.sageforest.ro
40.	Auto Vip Srl	Brasov	Zarnesti	n.a.	n.a.	http://www.bizoo.ro/firma/autovip
41.	Rumegus International	Brasov	Brasov	-	n.a.	http://www.bizoo.ro/firma/rrrrrr
42.	S.c. Rompelet S.r.l.	Valcea	Ramnicu Valcea	-	350-400 txmonth ⁻¹	http://www.bizoo.ro/firma/rompelet
43.	Sc Iris Service Ciuc Sa	Harghita	Miercurea Ciuc	-	n.a.	http://www.bizoo.ro/firma/irisiciuc
44.	George & Mihai Srl	Alba	Alba Iulia	-	n.a.	http://www.bizoo.ro/firma/rusunicolaee
45.	Ecoteq Products Srl	Bihor	Tamaseu	-	n.a.	http://www.bizoo.ro/firma/ecoteq
46.	Energo Green	Brasov	Codlea	500 txmonth ⁻¹	250 txmonth ⁻¹	http://www.bizoo.ro/firma/energogreen
47.	Iuliady Energy S.r.l.	Arges	Pitesti	1 txh ⁻¹	-	http://www.bizoo.ro/firma/apalexcom
48.	Grand Dekor Emil	Constanta	Navodari	100 txday ⁻¹	-	http://www.bizoo.ro/firma/grandcarbon1
49.	Ecorompellet Production Srl	Covasna	Intorsura Buzaului	n.a.	-	http://www.bizoo.ro/firma/termoconforttop
50.	Furtuna Business Top Srl	Harghita	Toplita	n.a.	-	http://www.bizoo.ro/firma/furtunabusinesssrl
51.	Rovo	Sovata	Mures	n.a.	-	http://www.armiainstal.ro/
52.	Romchar Srl	Harghita	Sanraieni	2 txh ⁻¹	-	http://www.bizoo.ro/firma/romchar1
53.	S.c. D. G. Italrom S.r.l.	Neamt	Piatra Neamt	n.a.	-	http://www.bizoo.ro/firma/dgitalrom
54.	Tasusagro Srl	Braila	Braila	100 txday ⁻¹	300 txmonth ⁻¹	http://www.tasusagro.bizoo.ro/
55.	Romchar Srl	Sanraieni	Harghita	2 txh ⁻¹	-	http://www.bizoo.ro/firma/romchar1
56.	Nuco Business Srl	Bucuresti	Bucuresti	n.a.	n.a.	http://www.bizoo.ro/firma/nucobusiness
57.	Eco Mar Product	Iasi	Iasi	n.a.	-	http://www.bizoo.ro/firma/ecomarpellet
58.	Super Soft Prod Serv Srl	Bistrita Nasaud	Satu Nou	n.a.	-	http://www.bizoo.ro/firma/supersof
59.	S.c. D. G. Italrom S.r.l.	Neamt	Piatra Neamt	n.a.	-	http://www.bizoo.ro/firma/dgitalrom
60.	Mathpyro Srl.	Covasna	Chichis	n.a.	-	http://www.bizoo.ro/firma/mathpyro
61.	Centrale lemne si pellet Srl	Bacau	Bacau	n.a.	-	http://www.armiainstal.ro/
62.	Eco wood Srl	Bihor	Santion	n.a.	n.a.	http://www.ecowood.ro
63.	Bricom Srl	Gherla	Cluj	n.a.	-	http://www.bizoo.ro
64.	Athos-pellet Srl	Harghita	Gheorgheni	400 txmonth ⁻¹	-	http://www.athospellet.ro/
65.	Csillag Srl	Harghita	Lunca de Jos	n.a.	n.a.	http://www.woodfuel.ro/
66.	Transylpellet Srl	Harghita	Miercurea Ciuc	n.a.	-	http://www.pellet.ro/
67.	S.C Dan Prolemn SRL	Mures	Ibanesti	0.7-1.0 txh ⁻¹	-	http://www.stocuri.com/detalii-firma/3794/detalii_sc_DAN_PROLEMN_SRL.html
68.	Remir Forest Srl	Maramures	Baia Sprie	n.a.	-	http://www.armiainstal.ro/
69.	SC Romwest Euro SRL	Alba	Alba Iulia	n.a.	-	http://www.romwesteuro.ro

4.2 Energetic use of Biomass

Biomass is used in Romania mostly for thermal energy generation. According to a study realized in 2007 ([Sbera, 2007](#)) more than 50% from the generated heat had as source forest biomass burning. On national level, the last assessment regarding the firewood and other biomass resources consumptions was made in 2009 and the results were published by INSSE ([INSSE, 2011](#)). Based on the published results (Figure 14) it is obvious that the biomass plays and will play an important role in the Romanian energetic sector.

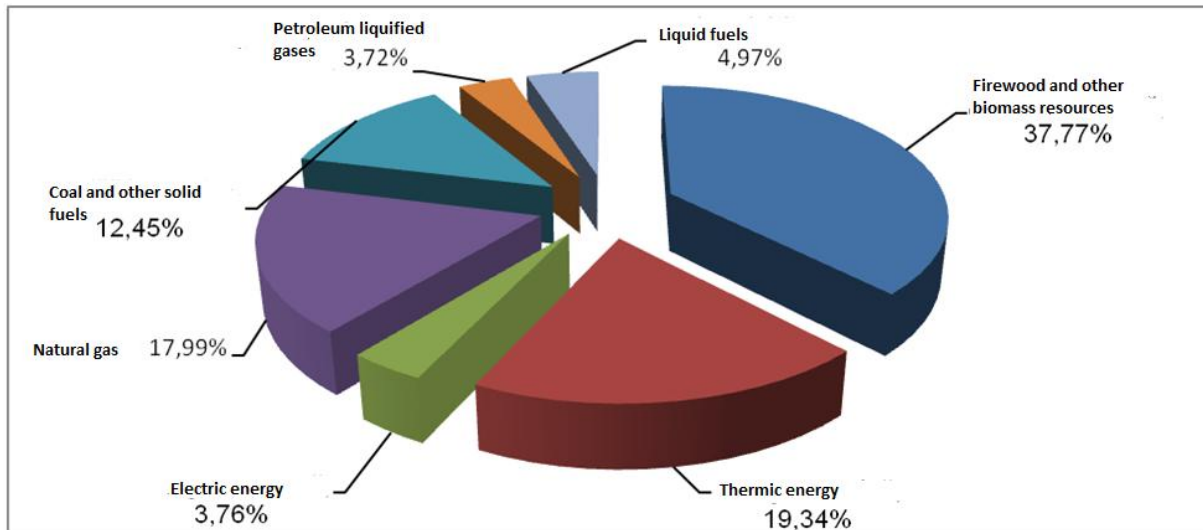


Figure 14. Mean household energy consumption in Romania in 2009 (Source: INSSE, 2011)

The strategy concerning sustainable development of Romanian energetic sector follows, along with the improvement of energetic efficiency, the resources extending and regional economic development through ([Fălcuță & Terbea, 2008](#)):

- Promotion of alternative renewable energy resources (biomass);
- Stimulation of economic growth of less developed geographical areas;
- Promoting of new economic sectors, activities and employment.

The challenges regarding the energetic use of biomass refer mainly to:

- Heating requirements which follow an ascendant trend;
- Increased pollution in the proximity of district plants which use fossil fuels;
- Increased proportion of unutilised sawdust;
- Increased proportion of small dimension wood processing residues;
- Chaotic storage of sawdust which generates environmental concerns;
- Plain zones having reduced forest resources and increased demands for firewood;
- Reduction of available fossil energy resources;
- Labour force deficit in thermal plants which generates the necessity to mechanise or to implement automatic feeding processes;

Forest biomass finds its use mostly in individual households for heating purposes as well as in district heating plants (DHP) or district co-generation plants (CHP). District heating plants for thermal energy generation had an extensive development in the past and an accelerated development is

forecasted for this kind of energy applications. The existent plants are located mainly in mountainous areas (Mieciurea Ciuc, Covasna, Sfantu Gheorghe etc.) or in the proximity of large wood processing facilities (Sebes, Radauti, Gherla etc.). According to Transelectrica (www.transelectrica.ro), currently are working 6 biomass based co-generation plants which supposed investments of 70 mio. euro. Also, (www.transelectrica.ro) currently a number of 13 biomass projects have contracts for connecting to the national network (a total capacity of 46 Mw, investment of 90 mio. euro). According to the Romanian laws (www.transelectrica.ro), energy production based on biomass is rewarded by two green certificates. Table 3 shows the currently working biomass co-generation plants.

Table 3. Biomass CHP facilities (Source: www.transelectrica.ro)

No.	Name	County	Loaction	Electric energy	Thermic energy
1	SC. HOLZINDUSTRIE SCHWEIGHOFER SRL	Alba	Sebes	2,4MW	8,6 MW
2	SC. HOLZINDUSTRIE SCHWEIGHOFER SRL	Alba	Sebes	8,5MW	24 MW
3	BIO ELECTRICA TRANSILVANIA SRL	Suceava	Radauti	4,9MW	28MW
4	BIO ELECTRICA TRANSILVANIA SRL	Suceava	Radauti	10MW	28MW
5	SC. GENERAL ENERGETIC SRL	Neamt	Pângărați	6MW	26MW
6	S.C. SORTILEMN SA	Cluj	Gherla	1,3MW	7MW

4.3 Costs of solid biofuels

4.3.1 Price for wood chips

Price for woodchips is established based on direct negotiation in Romania. However, according to the main producers, the price making mechanism is strongly related to the ordered quantity and certain quality specifications. Because currently there are only few producers of woodchips accurate information regarding the prices is not available.

4.3.2 Price for wood pellets

In what concerns the prices for wood pellets, information is available only from the main producers. Also, the prices vary from producer to producer; the vast majority of producers prefer direct negotiation, which, along with the required quantity seem to be the mechanisms for price making. Prices differ also in function of the selling season. Generally, prices between 130 and 200 euro $\times$ t⁻¹ are used by the main producers. Examples are provided in table 4.

Table 4. Prices for wood pellets

No.	Name	County	Loaction	Price/Specifications	Source
1	SC. ECOLEMN SRL	Caras Severin	Caransebes	Bags of 15 kg – 160 euro $\times t^{-1}$ Bags of 1200 kg – 150 euro $\times t^{-1}$	http://www.ecolemn.info/ro/index.html
2	FRIGO TRANSILVANIA	Cluj	Cluj Napoca	130 – 160 euro $\times t^{-1}$, depending by selling season	http://www.frigotransilvania.ro/
3	RETIGERED CONSULT SRL	Maramures	Baia Mare	180 – 200 euro $\times t^{-1}$, depending by assortment	http://www.pyrobriq.ro/

4.3.3 Price for wood briquettes

Price making mechanisms as well as the available information for wood briquettes are quite similar to the wood pellets ones. Only the large producers publish the prices on their own websites, and national wide data is not available. However, prices between 110 and 150 euro per ton are currently practiced in Romania (Table 5), depending on the ordered quantity and quality, as well as on the assortment.

Table 5. Prices for wood briquettes

No.	Name	County	Loaction	Price/Specifications	Source
1	SC. ECOLEMN SRL	Caras Severin	Caransebes	Boxes of 20 kg – 140 euro $\times t^{-1}$ Bags of 1000 kg – 130 euro $\times t^{-1}$	http://www.ecolemn.info/ro/index.html
2	SC IOVAN FOREST SRL	Arad	Pecica	150 euro $\times t^{-1}$, premium black briquettes	http://www.iovanforest.ro
3	SC SORTILEMN SA	Cluj	Gherla	110 – 140 euro $\times t^{-1}$	http://www.bizoo.ro
4	SC MOBEX CONSTRUCT SRL	Alba	Campeni	120 euro $\times t^{-1}$	http://www.mobexconstruct.aaz.ro
5	HEDROM SRL	Hunedoara	Deva	140 euro $\times t^{-1}$	http://www.hedrom.bizoo.ro
6	RETIGERED CONSULT SRL	Maramures	Baia Mare	120-200 euro $\times t^{-1}$	http://www.pyrobriq.ro/
7	SC PROFIL IMPORT EXPORT SRL	Mures	Reghin	110 euro $\times t^{-1}$	http://www.scpofil.ro
8	Bricheterumegusfag.ro	Mures	Reghin	150 euro $\times t^{-1}$	http://www.bricheterumegusfag.ro
9	SAGE FOREST	Sibiu	Sibiu	150 euro $\times t^{-1}$	http://www.sageforest.ro

4.3.4 Price for firewood

Price for firewood is strongly influenced by the available resources in a certain zone (in mountainous areas prices are smaller than in the plain zones). Generally, prices are ranging from 40 to 67 euro per m^3 (<http://www.lemn-foc.ro/preț>). The mentioned prices include transportation to the end user.

4.4 Technical standards for solid biofuels

4.4.1 Standards for wood chips

Currently, in Romania are not implemented standards for wood chips.

4.4.2 Standards for wood pellets

For the moment, in Romania are not implemented official regulations regarding the pellets quality by standardization. Therefore, there are mentioned and considered etalon standards implemented in other European countries (<http://www.tatanoassistenza.eu>), especially from Austria and Germany (Ö-NORM M 7135 respectively DIN PLUS 51731), as well as the EN PLUS (EN 14961-2) standard, which are good references for consumers. The use of Austrian and German standards is imposed by the fact that most of pellets production is exported to the mentioned countries. Presently, are certified (EN PLUS) two pellet producers (www.pelletcouncil.eu): SC Holzindustrie Schweighofer SRL (Sebes, Alba) respectively Ameco Renewable Energy SRL (Joseni, Alba). Also, SC Holzindustrie Schweighofer SRL (Sebes, Alba) is certified according to Austrian standard Ö-NORM M 7132. The mentioned are also DIN PLUS certified along with SC Eco Wood SRL (Santion, Bihor).

4.4.3 Standards for wood briquettes

The used standards for wood briquettes are DIN PLUS German Standard respectively EN 14961-3 European Standard. These standards are used in order to assure the quality required for European markets since most of production is exported. The only certified producer is SC Eco Wood SRL (Santion, Bihor) – DIN PLUS respectively EN PLUS.

4.4.4 Standards for firewood

In case of firewood assortments in Romania is used the national standard 2340/1980. According to this standard, firewood may belong to five categories (A-E), and for each category certain requirements have to be met. For instance, the firewood from category A has to meet the following specifications: broadleaved hardwood, with at most 10% broadleaved softwood or resinous wood, 1 meter in length, minimum 15 cm and maximum 25 cm for diameters (maximum 30 cm in width for split wood), moisture content of maximum 23-25%.

4.4.5 Conversion factors

Conversion factors for different biomass assortments are the same with those used in Austria since most of the produced quantities are exported in the mentioned country. The Austrian standard (ÖNORM M 7132) contains the conversion factors for different biomass assortments and is used mostly by the certified producers.

5 Forest Infrastructure and logistics

5.1 Forest road infrastructure

Generally, Romania has great problems regarding the forest road infrastructure. The most accepted number regarding the forest roads density index is of only $6.5 \text{ m} \times \text{ha}^{-1}$ ([Bereziuc et al.](#),

[2011, Olteanu, 2008](#)). However, according to recent data, more than 9000 km of forest roads are technically impracticable due to some natural calamities or other causes ([Sbera, 2012](#)). Therefore, it should be considered as being more reliable a density index of $5.13 \text{ m} \times \text{ha}^{-1}$. By difference, this means that only 24,265 km of forest roads are in use today. Also, 1,483 km of industrial roads and 7,635 km of public roads are used for wood transport, and they participate to the last mentioned road density index. The main used transportation means are forest truck-trains in mountainous regions, where the wood is generally transported in longer lengths. By comparison, additional transportation means are used in plain areas where the wood is transported in shorter lengths ([Sbera, 2007](#)). Considerably efforts are employed in developing the forest transportation infrastructure, this representing also one of the main aspects of the national forest strategy ([Bereziuc, et al., 2011](#)), but no significant results could be achieved in the last years. Although extended skid trails may exist in the forests (because skidders are the most used logging means – [Sbera, 2007](#)) no efforts were made in the attempt to assess their lengths. By comparison with other regions, standards regulating the forest roads design, construction, maintenance etc. are developed or are in process of development at national level (for example: Standards for Designing Forest Roads, Standards for Rehabilitating Forest Roads are already in use, after the revision from 2011, while standards for investments in forest roads are currently developed).

5.2 Biomass supply chain

Since the firewood represents the most important biomass resource for energetic use in Romania and the consumers are most often represented by individual households, for the scope of FOROPA project was analysed only the Private/State forest – Individual End User Supply chain for firewood procurement.

5.2.1 Actors in the supply chain

Several actors are involved in the studied supply chain, as follows:

Forest Owner/Administrator

Logging Company

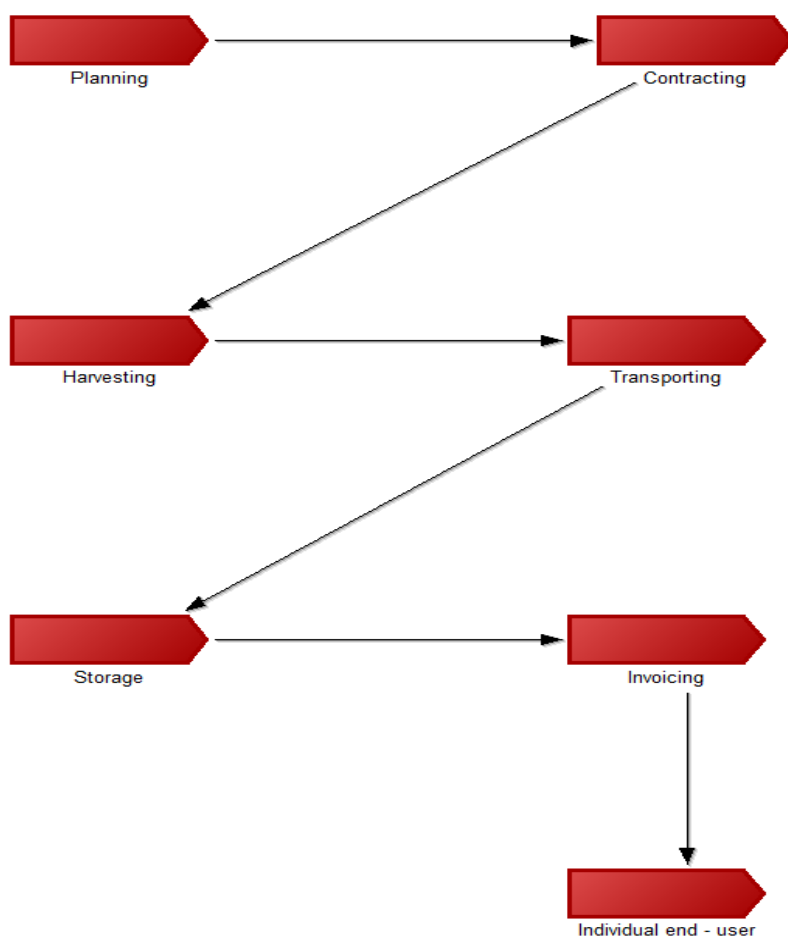
Transport Company

End User

Relations between the involved stakeholders depend in a great measure by several aspects such as the forest ownership and administration, technical endowment of harvesting companies (for instance, a harvesting company may perform also the transport), as well as the availability of forest owner/administrator to perform for its own the harvesting-transportation operations.

5.2.2 Chain 1: Private/State forest – Individual End User firewood procurement

Firewood procurement for individual household use (Figure 15) represents the main supply chain for the energetic use of forest biomass in Romania since the firewood is the most used assortment for energy production. The first group of processes within this SCORP refers to planning activities which are quite the same with respect to different forms of administration since the mentioned are the subject of law regulations. However, the information and documentation flow may differ significantly when comparing state owned/administrated or private owned/administrated forests, involving different control mechanisms and organizations. Planning refers to designating and making all the inventory work in order to assess the wood to be harvested. Contracting refers to all the contracting processes no matter where they occur within the supply chain. Therefore, this group of processes refers to contracting between forest owner/administrator and harvesting companies, contracting between harvesting companies and transport companies, contracting between transport companies and individual end users. Also, direct contracting between forest owner/administrator and end user as well as between harvesting company and end user may occur. Harvesting can either be carried out by forest owner/administrator itself or a harvesting company. The next step includes the wood transport directly to the end user, which, depending on the technical endowment, may be realized by the harvesting company or subsequent transporters. In some cases, the wood is transported by the end user itself. Storage as well as the final firewood assortment is made at end-user's premises, usually by its own. Invoicing is made in different parts of the supply chain and the number of invoicing processes depends by the number of actors involved in the supply chain.



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Figure 15. Private/State forests – Individual End User Firewood procurement

6 Stakeholders

The relevant stakeholders for the studied supply chain are presented in the following.

6.1 Stakeholders in Cetral Region

6.1.1 Regional Forest Administrations – Direcții Silvice Teritoriale

Regional Forest Administrations represent the NFA Romsilva (National Forest Administration) in territory. They have control and administration attributions at regional level, are involved in authorizing the amount of wood to be harvested as well as in checking and approval of forest related documents emitted by forest districts, according to regulations regarding the competences. Usually, they act only in the case of state owned/administrated forests.

6.1.2 Regional Forest Inspectorates – Inspectorate Teritoriale de Regim Silvic și Vânătoare

Regional Forest Inspectorates represent the Ministry of Environment and Climatic Changes in territory. They have control attributions at regional level, are involved in authorizing the amount of wood to be harvested as well as in checking and approving of forest related documents emitted by private forest districts. Usually, they act only in case of private owned/administrated forests. They have also control attributions regarding the way in which harvesting and transport companies perform their duties.

6.1.3 Private/State Forest Districts – Ocoale Silvice de Stat și Private

Private Forest Districts perform forest management activities which include harvesting planning, control, and, in some cases harvesting itself. They perform administration and security services only for private forests. They mediate the relation between forest owners and possible contractors and organize contracting events by themselves. Also, they are the subject of controls realized by Regional Forest Inspectorates.

State Forest Districts perform forest management activities which include planning, control and sometimes harvesting, under the authority of Regional Forest Administrations. They administrate and provide security services for state and private forests and are the subject of controls made by Regional Forest Inspectorates and Regional Forest Administrations. Generally, the contracting events are organized by Regional Forest Administration based on the documentation forwarded by State Forest Districts.

6.2. National stakeholders

6.2.1. Ministry of Environment and Climatic Changes – Ministerul Mediului și Schimbărilor Climatice

Ministry of Environment and Climatic Changes is the Central Public Authority in what concerns the policies developed and implemented for forest management. It is represented in territory by Forest Inspectorates.

6.2.2. National Forest Administration – Regia Națională a Pădurilor – R.N.P. Romsilva

NFA Romsilva works under the authority of Ministry of Environment and Climatic Changes and it has as a purpose the sustainable and unitary management of state owned forests. Also, it administrates private forests based on contracts. It is represented in territory by Regional Forest Administrations.

6.2.3. National Forest Inspectorate – Inspectoratul de Regim Silvic și Vânătoare

National Forest Inspectorate acts under authority of Ministry of Environment and Climatic Changes and it is an organization which represents the Ministry in territory. It has control and law enforcement attributions regarding the application of forest regime. Harvesting and transport companies as well as many of the components within the wood supply chains are the subject of control and verifications made by this organization.

6.2.4. Forest Owners Association - Asociația Proprietarilor de Păduri din România - APPR

Forest Owners Association is a nongovernmental organization which has the purpose to represent its members in relation with national and international forums in what concerns their rights related to the property. It was founded in 1998 and today it has several members (170 physical persons and other 203 associations or property forms).

6.2.5. Foresters Association of Romania - Asociația Forestierilor din România - ASFOR

Foresters Association of Romania is a legal entity which represents the employers' and professional organizations. It is autonomous, non-governmental and non-political, and represents companies and professionals from harvesting and wood processing business. It plays an important role in authorising the harvesting companies.

7. The bottlenecks within the sector

As identified in different sources ([the Romanian Strategy for the Valorization of Renewable Energy Resources, 2003](#); [BERD, 2007](#)), the main barriers in the development of the utilization of wood as an energy source are:

- **Lack of developed and constant demand (market)**, meaning that there are very few industrial operators which are actively buying wood for producing energy;
- **Infrastructure**: especially in the forest, there is a lack of roads and storage facilities, which impede the collection of wood in general, and of the small and residual wood in particular;
- **Current forestry legislation and norms** which are not supporting commercial thinning. Intensity of thinning in Romania is rather low, thus making this sort of forestry operations unattractive for the logging companies;
- **Forest privatization and restitution process**, which was complicated and long, determining opposite effects than estimated. Thus, under normal conditions, privatization of forests should reduce illegal logging, but in Romania it only increased it;
- **Lack of awareness** about the possibility to use wood (and biomass in general) to large power generation applications, supplemented by people getting accustomed to the comfort of using natural gas and electricity for heating purposes. Nevertheless, the explosive prices of natural gas and oil in the last years can play an important role in determining Romania to start using biomass as one of the main energy sources;

8. Future biomass demand

Romania has a wide range of primary energy resources (fossil and mineral): oil, coal, uranium ore, but the mentioned either are coming in small amounts or are near depletion. In the most optimistic scenario, the production from non-renewable primary energy sector will not increase in the next 2-3 decades, putting this way Romania in the situation to be dependent by imports. On the other hand, the renewable resources have an important theoretic potential, but the usable potential is smaller due to technological, economic and environmental issues. According to the National Action Plan in Renewable Energy Resources Domain ([PNAER, 2010](#)) biomass is and will be regarded mostly as a thermal energy resource. Also, future demand in biomass domain from Romania will be greater. Thus, in 2006 approximately 5 mio. m³ of wood were used for internal energetic consume, and it is forecasted that by 2015 there will be produced approximately 6.5 mio. m³ of wood for energy use in Romania. Also, by 2020 the wood production for energetic purposes will be around 7.5 m³ ([PNAER, 2010](#)). The mentioned amounts include firewood, logging residues, wood processing residues, briquettes, pellets and wood chips ([PNAER, 2010](#)).

In what concerns the Romanian objective regarding the use of renewable energy resources, there was established a target of 24% of renewables participation in the final gross energy consumption ([PNAER, 2010](#)). In order to attain this objective, the forecasted renewable energy amount is of 7.267 mio. toe. This involves the utilization of about 50% from the renewable energy potential.

9. Annex

9.2. Annex 1: regional SWOT

Standing Tree (Private/State Forests) – Nonindustrial End-User

Internal strengths

- S1. Certified forests which opened new markets
- S2. Superior utilization of the wood
- S3. Standard contracting procedures
- S4. Relative control of quality and prices
- S5. Possibility to sell in any period of the year
- S6. Security services are assured
- S7. Strong position on the local market for fire wood
- S8. Well established business relations between actors

External opportunities

- O1. Improvement of standardization (wood assortments and wood evaluation and assessment)
- O2. National programs targeting education and training for harvesting companies personnel
- O3. Market development for logging residues
- O4. Centralized web-platform for contracting issues
- O5. Possibility to present in real time of supply (offer) and its locations
- O6. Forest certification
- O7. Potential openness of new markets

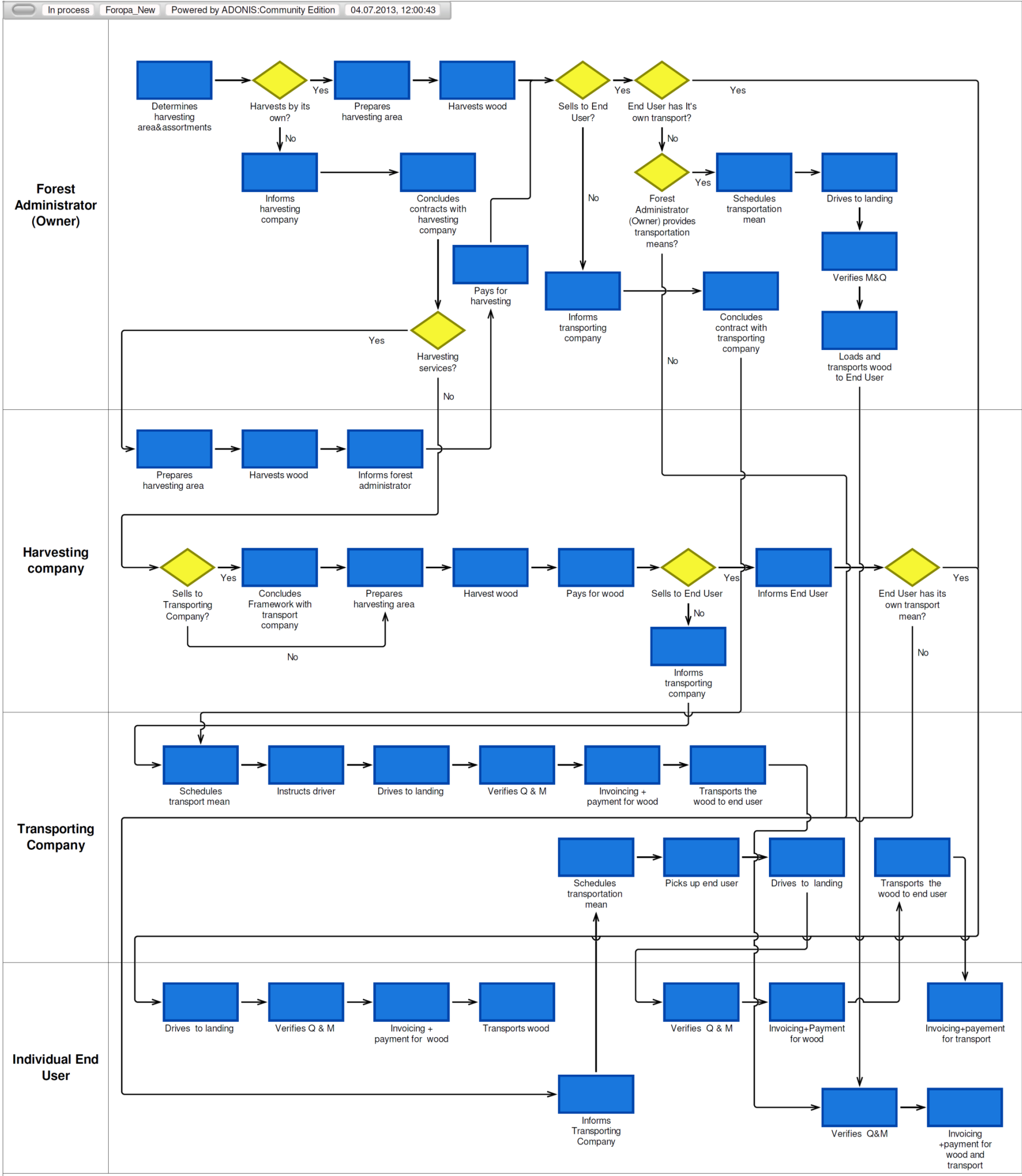
Internal weaknesses

- W1. Excessive bureaucracy
- W2. Great amounts of time for resource planning and contracting
- W3. Lack of qualification for the harvesting companies personnel
- W4. Important delays between invoices issuing and payments
- W5. Poor forest transportation infrastructure
- W6. Lack of adequate harvesting-logging technology
- W7. Lack of transparency between processes and actors
- W8. Unfair competition

External threats

- T1. Unjustified increment of the price for standing tree wood
 - T2. Lack of financial support from banks
 - T3. Excessive bureaucracy in obtaining the documents needed for activity (harvesting companies)
 - T4. Monopoly provoked by large companies
 - T5. Changes in the legal framework
-

9.3. Annex 2: Process model



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