Residential heating biofuels market state of the art

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State of the art of the biomass market. Report of Croatia

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INTRODUCTION

In Croatia biomass accounts for approximately 11% of the total primary energy supply, while the majority of fuelwood is consumed in households for heating. The total capacity of industrial biomass heating plants is estimated at 515 MW. [Source: Energy in Croatia, 2014, Ministry of Economy]

Exploitation of forest and wood biomass for energy has a long tradition in Croatia, especially fire wood and wood residue. In 1960s almost 25% of energy needs was being covered by biomass. Since then, the use of biomass has diminished. Households rather use natural gas and fuel oil, because they are more convenient to use.

The Ministry of Economy registry (RERCPPP) has more than 70 registered projects that are in process of construction on forest or wood biomass [Source: RERCPPP, 2016]. For the period from 2006 to 2015 an amount of wood mass foreseen for utilization for energy, is about 2,6 million m3 (from that amount, 2 million m3 per year is supposed to be obtained from Croatian Forests Ltd., and from the private forests owners 0,6 million m3).

More than 95% of the total pellets production was exported while little was placed on the domestic market. Wooden briquettes capacity is estimated at some 60.000 t/y while its actual production is highly dependent on the feedstock availability – waste from wood processing industry. Briquettes are also mostly exported. [Source: EIHP]

MAIN COMMERCIALIZED SOLID BIOFUELS IN CROATIA

Less than half of the population (47%) use some type of biomass for space heating, cooking or water heating in Croatia. This percentage is much higher in rural areas, where approximately three fourths of the households (73%) reported to use biomass for their daily needs, while, on the other hand, the percentage is significantly lower in urban areas (28%). [Population Census 2012] Regarding the type of biomass, firewood is used by almost all of the households that reported biomass consumption. A very small number of households (4%) use pellets and briquettes or some other type of biomass (mainly tree prunings). People obtain firewood from biomass supply centers (Croatian Forests Ltd. and local biomass suppliers) (46%), wood industries (17%) or use their own cuttings (34%). More than one third of the households that reported biomass consumption use biomass for cooking (38%). Furthermore, two thirds of them, apart from biomass, use also electricity, LPG or natural gas for cooking. Few (12%) households use biomass for water heating, mostly in combination with electricity or natural gas. [Source: Energy Community]

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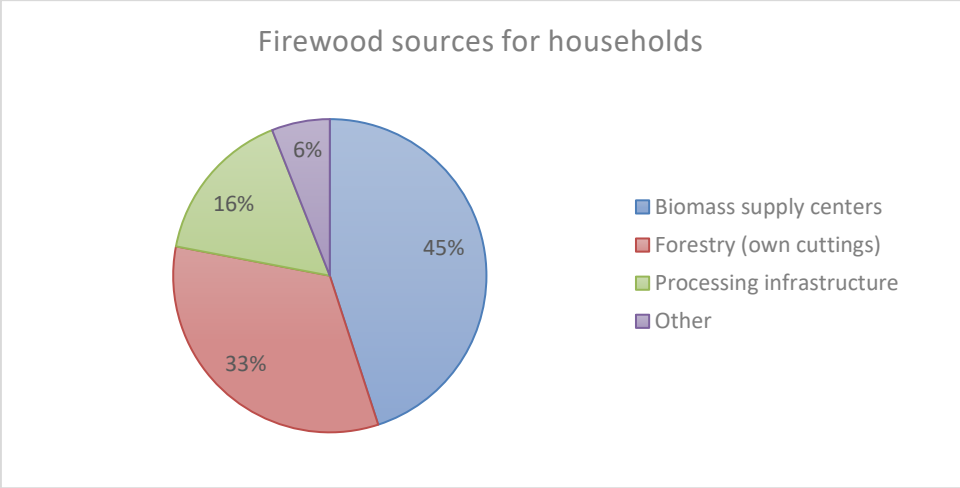

Figure 1 Firewood source for households

Relevant legal framework

The existing policy framework is generally well developed, with several regulations and financing mechanisms for each sector. National policy landscape related to the biomass supply, logistic, conversion, distribution and end use is illustrated in following diagrams. [Source: S2Biom report]

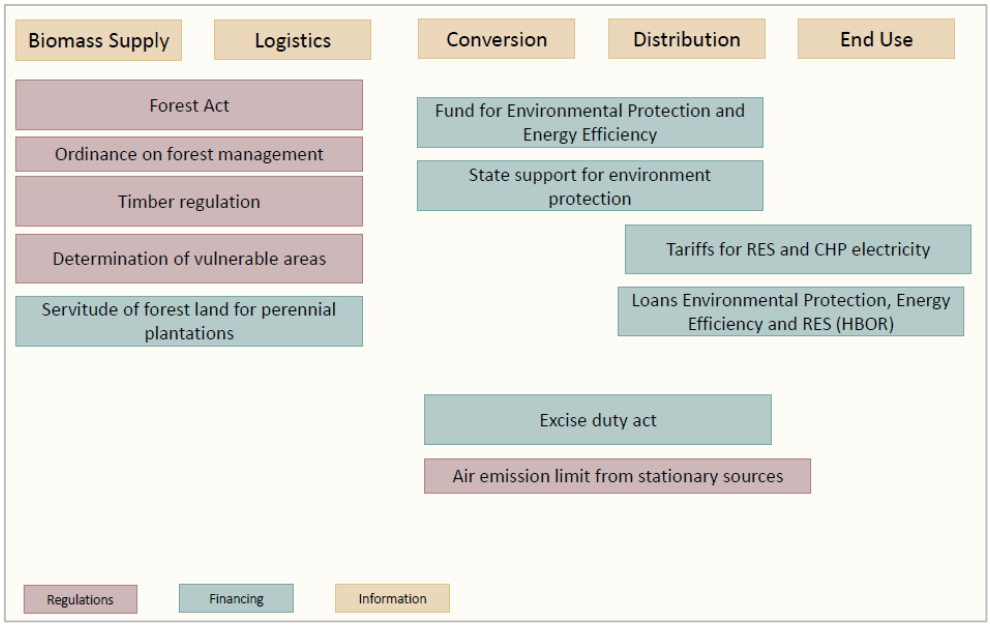

Figure 2 Current policy: Forest [Source: S2Biom report]

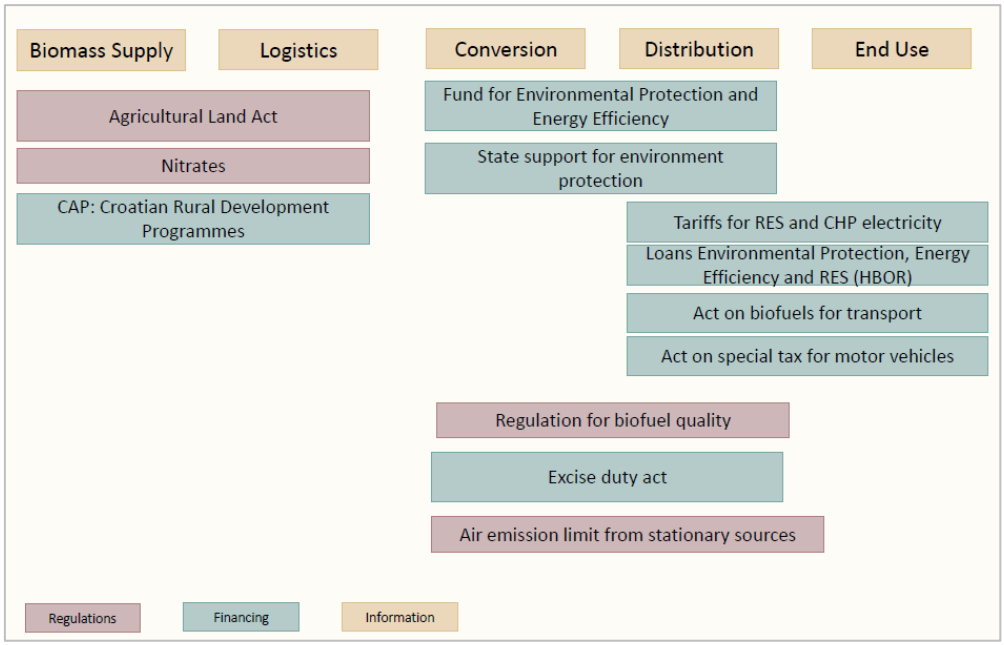

Figure 3 Current policy: Agriculture and dedicated crops [Source: S2Biom report]

Technical rules and standards that apply to heating systems are given in the table:

Table 1 Technical rules and standards for heating systems

Technology	Technical criteria
Biomass stoves used in households	Capacity between 5 and 50 kW, the fuel used can be wood chips, pellets, briquettes and logs; boiler efficiency ≥ 85%
District heating systems	Capacity of 150 to 5000 kW for heating households, public buildings (schools, hospitals, administrative centers) and office space; used fuel can be wood chips and pellets, the boiler efficiency ≥ 80%
Industrial boilers	Capacity 500-10000 kW, the fuel used can be wood waste in all forms that occur in operation wood-processing industry (bark, occasional waste wood chips, sawdust); boiler efficiency ≥ 80%
Stoves in agricultural and food industry	Capacity of 100 to 5000 kW, the fuel used can be agricultural biomass in all forms that occur in the production process (straw, corn stalks, seeds, shells); boiler efficiency ≥ 80%.

Use of biomass in small furnaces can be the cause of increased particles emissions and, therefore, the solutions with the district systems having more efficient devices for the emission reduction is stimulated. Consideration should be made due to the fact that it is not possible to exploit all the available biomass resources. Namely, of the total biomass produced on agricultural fields, 40% must be returned to the soil, 30% is used for fodder and on farms and the remaining 30% may be used to

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produce biofuels.

Energy Strategy guidelines regarding solid biofuels [Source: Energy Strategy of the Republic of Croatia, 2009]:

- Stimulate development of the Croatian wood processing industry;
- Develop forestry and facilitate all forest residues to be utilized;
- Stimulate forest cultivation and energy forest cultivation;
- Stimulate biomass fired cogeneration plants for heat and electricity generation;
- Stimulate usage of biomass for heat production

The Strategy sets goals for year 2020 – to make use of 40% of overall biomass potential (excluding energy crops), by increasing installed capacity to 140 MW, and for year 2030 – to make use of 72% of overall biomass potential (from forests and agriculture), by increasing installed capacity to 420 MW.

Objectives of the energy Strategy through the optimal use of mature technologies of RES-E (2020 and 2030):

Table 2 Objectives of the energy Strategy (RES-E)

RES technology	2020 goal: 20% RES share (MW)	2030 goal: 30% RES share (MW)	Total capacity, end-year 2015
Biomass	140	420	25 MWe (+90)
Waste	40	60	5 MWe
Wind	1200	2000	340 MWe (+400)
Big hydro (>10 MW)	300	reversible hydro power plants	N/A
Small hydro (<10 MW)	100	140	3 MWe (+5)
Geothermal	20	30	0 MWe (+5)
Solar	45	250	43 MWe (+12)

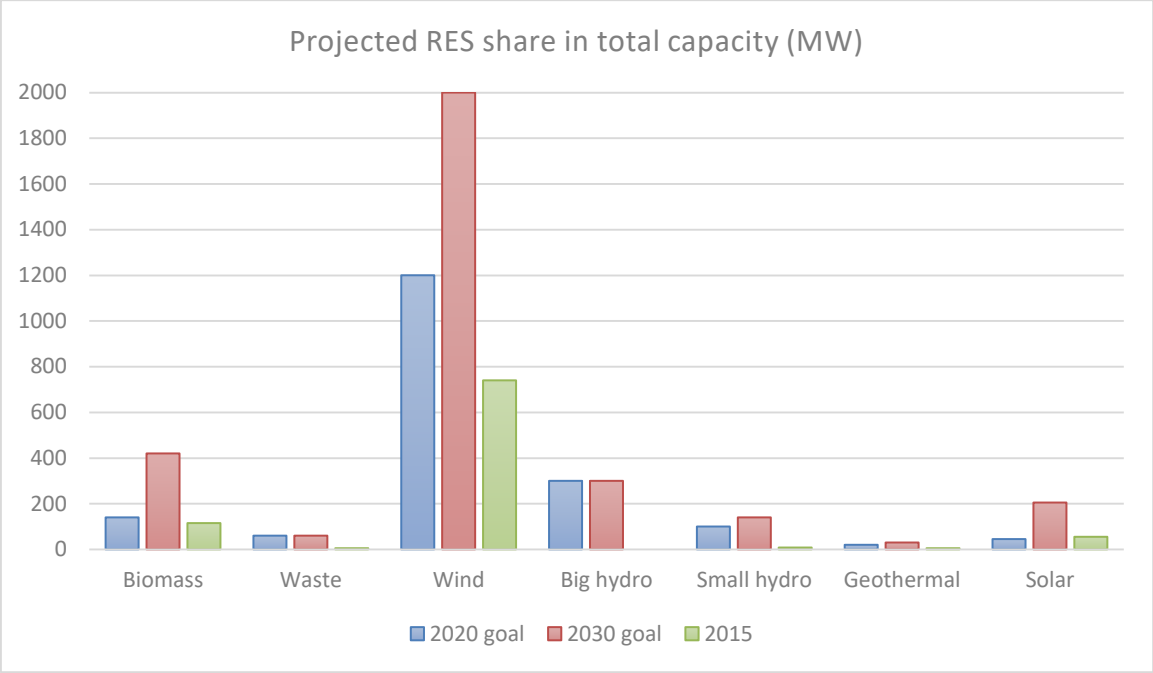

Figure 4 Projected RES share in total capacity [Source: Energy Strategy of the Republic of Croatia, 2009]

Projected RES shares in gross final energy consumption in 2020. (in percentages) are illustrated in the following diagram:

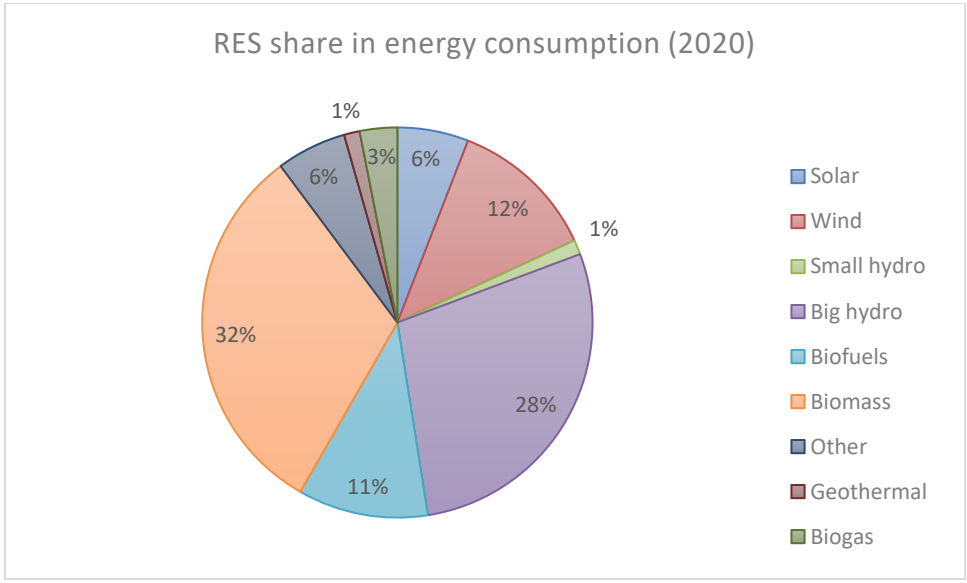

Figure 5 Projected RES shares in gross final energy consumption [Source: Energy Strategy of the Republic of Croatia, 2009]

Objectives of the energy Strategy through the optimal use of mature technologies of RES-H (2020)

Total amount of renewable energy for heating and cooling in 2020 is expected to be around 605 ktoe. Solid biomass (from forests and agriculture) will have a major role, with a share of 64.5%. Of the total consumption of biomass for heating and cooling 50.7% will account for supply for general consumption (households, services, agriculture, construction). Solar energy will have a share of 16.1%, with national target for installation of 0,225 m2 of thermal collectors per capita. Heat pumps will have a share of 15.8%. The share of geothermal energy in the total renewable energy in heating and cooling is expected to account for 2.6% by 2020.

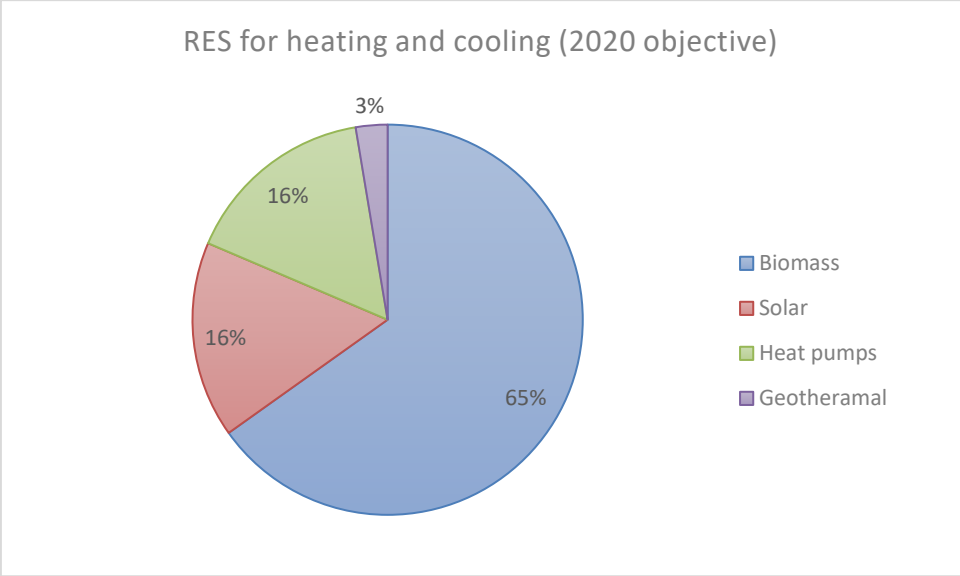

Figure 6 Objectives of the energy Strategy (RES-H) [Source: Energy Strategy of the Republic of Croatia, 2009]

Development of centralized renewable energy heating systems is expected in smaller urban areas (<10,000 inhabitants), in areas rich with forest biomass and with geothermal potential. Most of these areas don't yet have the infrastructure required for local district heating systems, and the development will have to start from the beginning. The assumption is that the new district heating systems will be developed in 10 to 15 cities, with a 30 km of new heating pipe network by 2020.

The Strategy sets the goal of using around 84 PJ of RES in 2020:

Table 3 Objectives of the energy Strategy (RES by sector)

Sector	Share of RES (%)
Electricity	9,2
Transport	2,2
Heating and cooling	8,6

Energy supply and available resources

Primary energy production and total primary energy supply by sources in Croatia in 2014.

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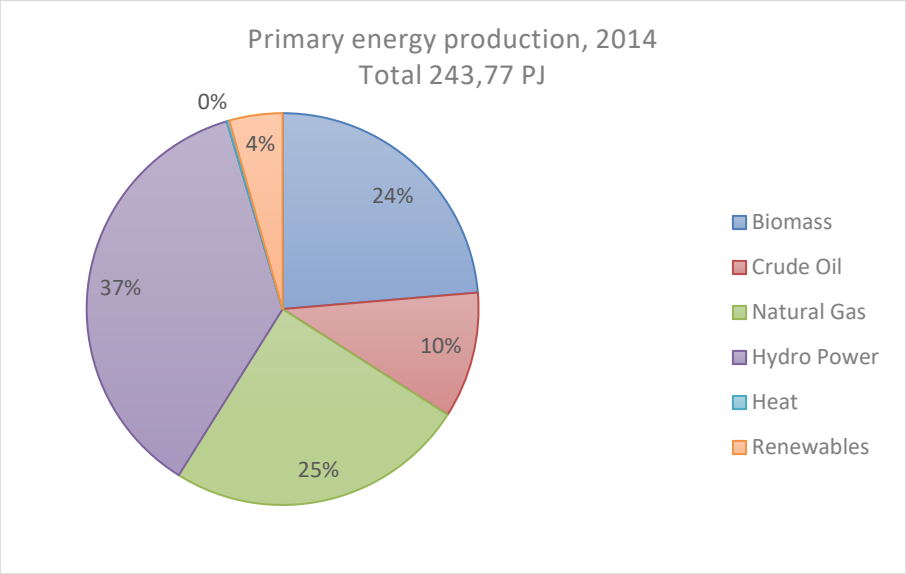

Figure 7 Primary energy production [Source: Energy in Croatia, 2014]

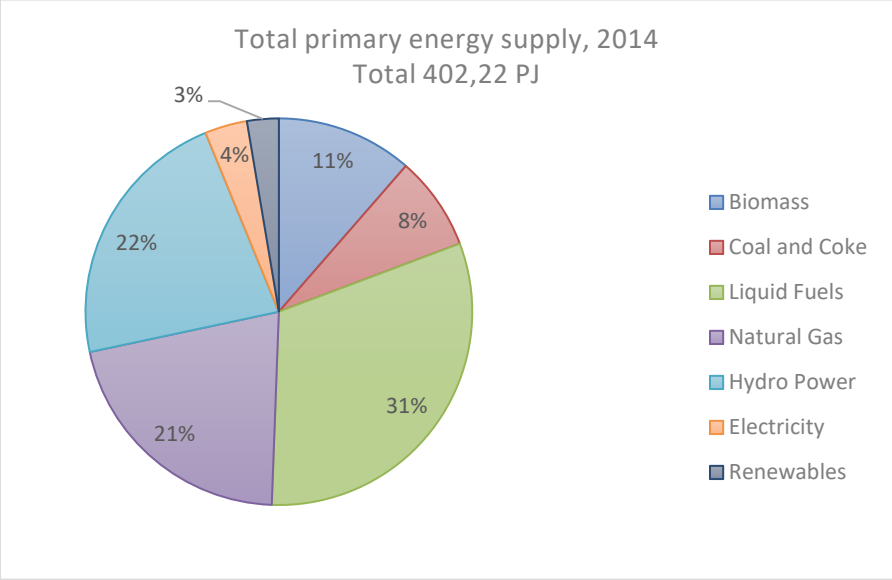

Figure 8 Primary energy supply [Source: Energy in Croatia, 2014]

In 2014, the total final energy consumption decreased by 5 percent compared to the previous year. In 2014, the consumption of other renewables increased by 32.5 percent, while the consumption of all other energy forms decreased. The biggest reduction, expressed as percentage, was recorded in the consumption of fuel wood and other biomass, amounting to 11.5 percent. Final energy consumption in households was 93,45 PJ in 2014. Compared to 2013, a decrease in energy consumption in households amounted to 10.5%.

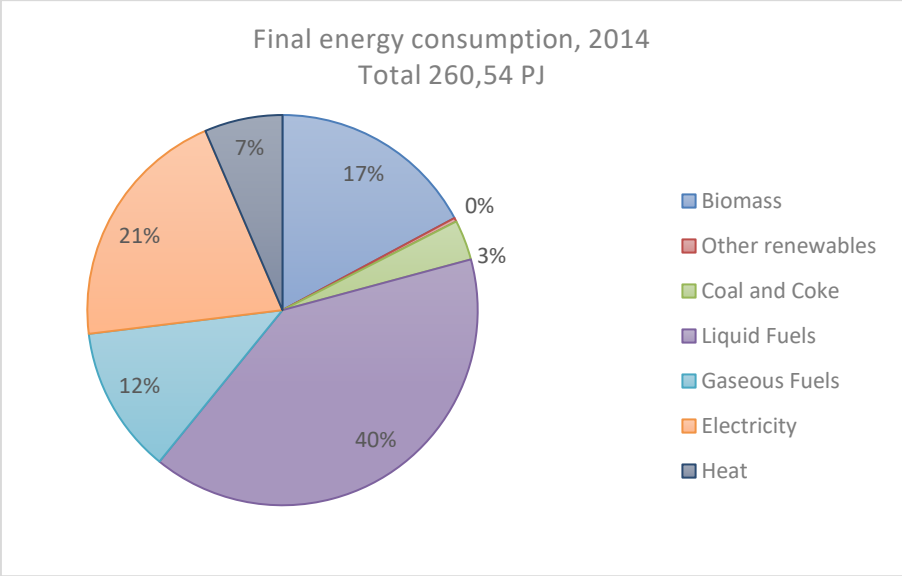

Figure 9 Final energy consumption [Source: Energy in Croatia, 2014]

Installed capacities for heat and electricity generation from renewable energy sources in Croatia for 2014 are shown in the following table.

Table 4 Installed capacities for heat and electricity generation

RES	Installed heat capacity (MW)	Installed power capacity (MW)
Solar	113,2*	33,5**
Wind	0	339,3
Biomass	515*	27,3
Small hydro power plants	0	34,2
Geothermal	52,79/124,65	0

[Source: EIHP, HEP, University of Zagreb, Faculty of Forestry – Department of Wood Processing, INA industrija nafte d.d. – geothermal energy, WGC 2015 – Croatia Country Update 2015 and On – Kolbah & others]

*estimation

**systems connected to the grid

Installed capacities growth trend for RES-H and RES-E is shown on figures below.

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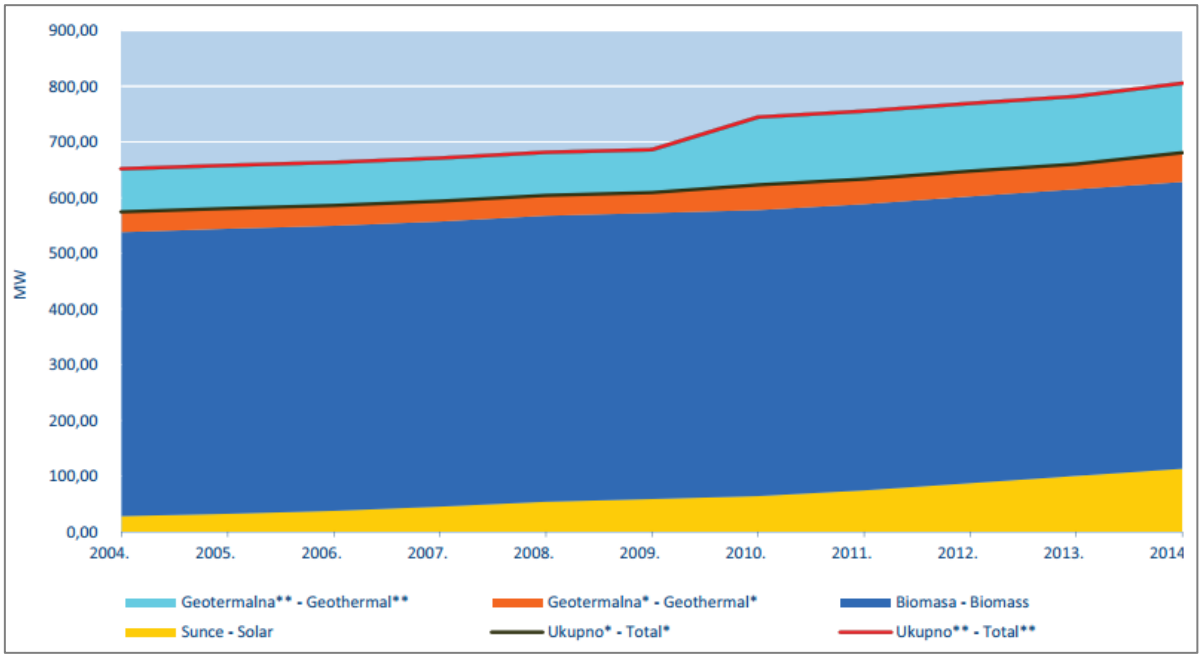

Figure 10 Growth trend for RES-H [Source: Energy in Croatia, 2014]

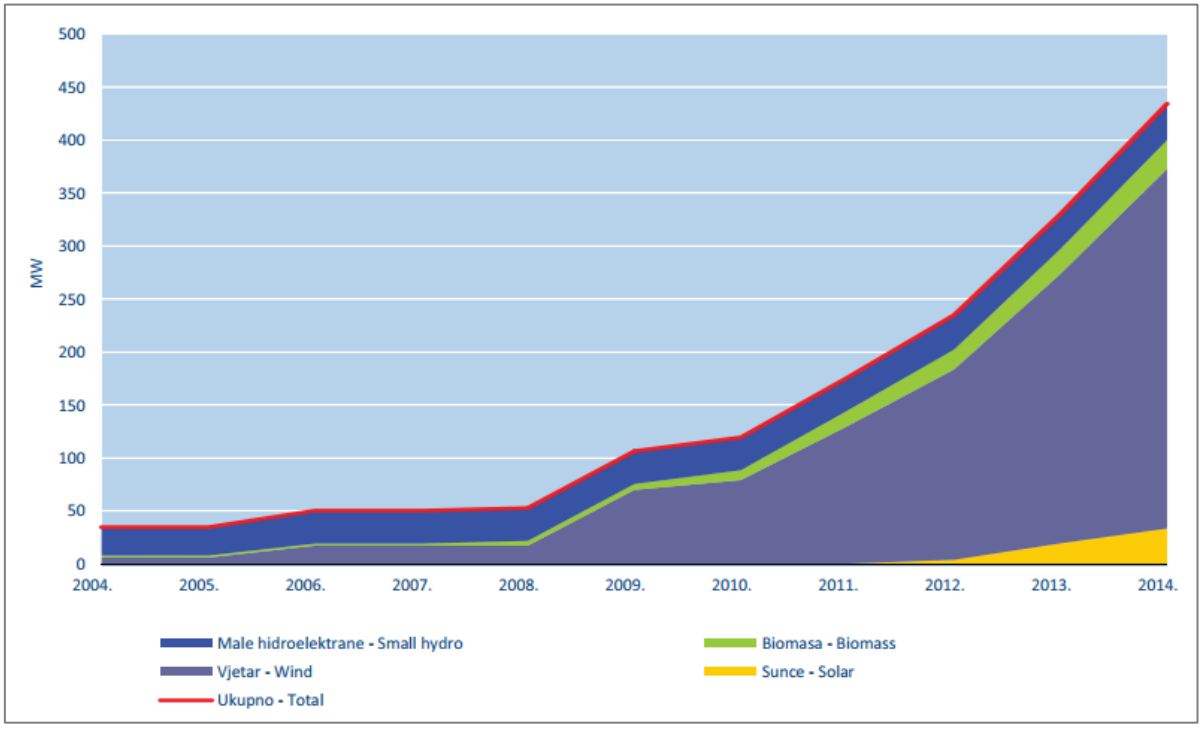

Figure 11 Growth trend for RES-E [Source: Energy in Croatia, 2014]

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Biomass resources: forests and agriculture

Data on forests in Croatia are presented below [Croatian Forests Ltd.]:

Table 5 Forests in Croatia

Forest area	2.688.687 ha	47% of total land area
Forest ownership	2.106.917 ha state forests	78% is state owned
	581.770 ha private forests	22% is privately owned

The forests in Croatia cover an area of 47% of land, and the country boasts a well-established wood industry. In relation to the population, Croatia with 0.56 ha of forest per capita belongs to the top of European countries by forests. Organization Chart of Forestry in Croatia Forest structure from the sylvicultural aspect are: high forests (63.9 %), coppices (15.8 %), brushwood, maquis, garigues (19.3 %) and plantations (1 %). Forests in Croatia are broadleaved (84 %) and coniferous (16 %). Broadleaved forests consist of the following species of trees (expressed in percentage): beech 36.5 %, pedunculate oak 13.9 %, sessile oak 10 %, hornbeam 8.2 %, ash 3.3 %, other hard broadleaved 9.9 %, soft broadleaves 3.8 %, fir 9.3 % and other conifers 5.1 %. [Source: Pentek and Poršinsky, 2010]. Growing stock amounts to about 400.000.000 m3, annual increment is up to 10.500.000 m3 and the allowable cut (etat) is around 6.600.000 m3. [Source: Croatian Forests Ltd.]

There are approximately 600 thousand private forest owners in Croatia and privately owned forests are often linked with a lack of professional knowledge in forest management. Additionally, there are no strong private forest associations, through which the forest owners would exchange knowledge and experience, and coordinate forestry interventions. This blocks participation on the market. Parts of private forests are degraded and require high investments for rehabilitation.

Wood-based fuels used in Croatia are listed below:

Pellets – most widespread modern wood fuel formed by pressing or crushing of sawdust coarse wood waste or wood chips. A dozen Croatian pellet manufacturers export up to 95% of their products, around 250.000 tons per year.

Briquettes – preceded the popular pellets and it was used by eco-conscious customers, because of small difference in price compared to traditional wood fuel.

Firewood – traditional commercial measures for firewood in Croatia is a cubic meter, and it consists of logs, one meter in length and eight to fifteen centimeters in diameter. Best raw materials for fire wood is considered hornbeam, followed by beech and other hardwoods.

Wood chips – used for fuel in large industrial heating or production electricity, with a higher percentage of moisture required in a specially constructed boiler. At the end of 2015. Croatian Forests Ltd. had contract for 1,2 mil. m3 of wood chips (calorific value of 2,5 MWh/m3), enough to supply cogeneration plants of total electric power of 60 MW (CHP-E) and heat power of 230 MW (CHP-H).

Of non-wood based biomass used in Croatia, the biggest role has corn residue. Calorific value of agricultural residues (crop, orchard and wine productions) in the region of Slavonia and Baranja are illustrated in the following diagram [Source: Ivanović and Glavaš, 2013]:

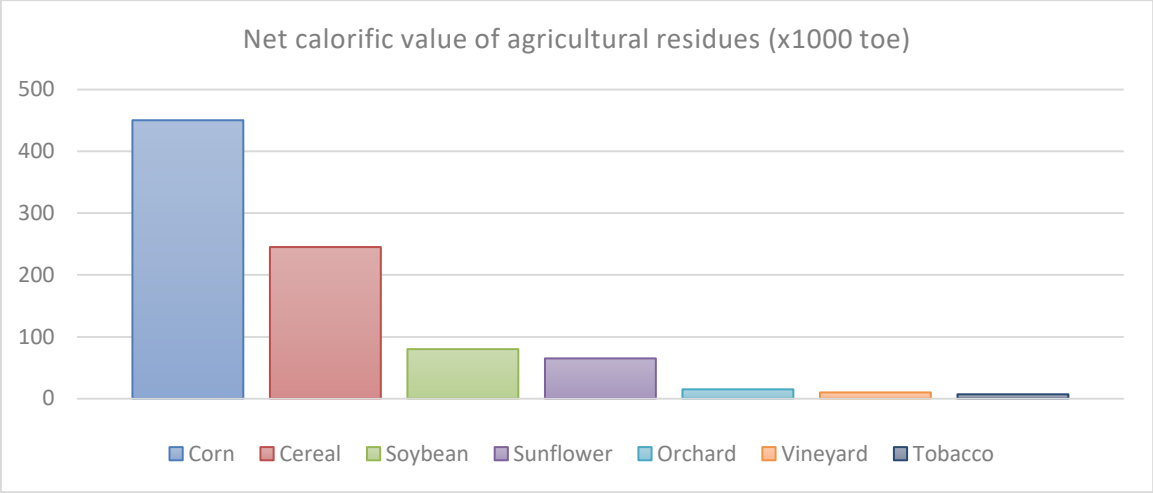

Figure 12 Calorific value of agricultural residues [Source: Ivanović and Glavaš, 2013]

Directly derived energy wood from forests, e.g. firewood and wood chips, is directly used for energy purposes.

Following graphs illustrate the annual quantities of solid biofuels produced and utilized in Croatia. Data on their main qualities (domestic or industrial) in not available. The production is calculated from 5.302.200 m3 of firewood, density of 445 kg/m3 [Source: Energy in Croatia, 2014]. There is no known use of olive oil industry residues (olive stones and exhausted olive cake) or nut hulling industry residues.

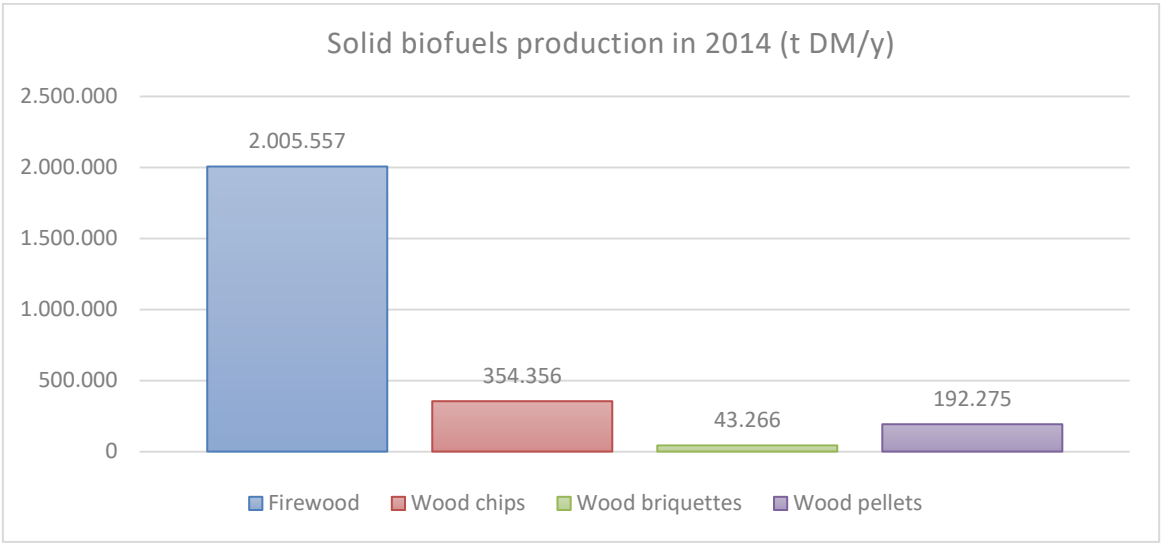

Figure 13 Solid biofuels production [Source: Energy in Croatia, 2014]

Solid biofuels utilized are calculated as production minus export plus imports. For the imports and exports firewood is assumed 15% dry and woodchips 30% dry. Wooden briquettes capacity is estimated to 64 890 t/yr while its actual production is usually done periodically depending on the feedstock availability – waste from wood processing industry. Around 62% of the total briquettes production was exported during 2014. It is assumed that the 38% of pellets produced were utilized domestically. Total installed capacity for the pellet production is 350.400 t/yr, out of which 55% is utilized during 2014. Around 72% of the total pellets production was exported while little was placed on the domestic market. It is assumed that the 28% of pellets produced (table a.3.) were utilized domestically. [Source: Energy in Croatia, 2014]

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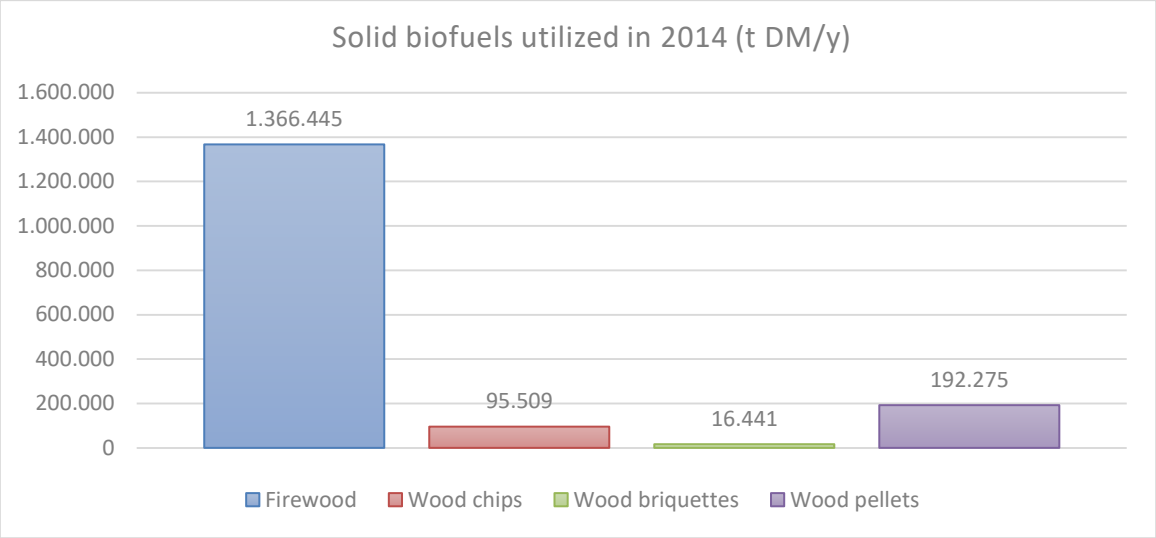

Figure 14 Solid biofuels utilized [Source: Energy in Croatia, 2014]

Following table indicates solid biofuels use by sector in 2014 [Source: Energy in Croatia 2014, Ministry of Economy].

Table 6 Solid biofuels use by sector

Sector	Total amount t/y	Main type of biofuel used	Comments
Biomass power plants (only electricity)	55,838,8	Wood chips	Assumed NCV 12,1 MJ/dm3, density 328 kg/m3, not only DM
CHP and CHPC plants industrial sector	2,837,3	Wood chips	Assumed NCV 12,1 MJ/dm3, density 328 kg/m3, not only DM, additional 1085,6 ktoe for heating and other use in industry
Residential not CHP	2,104,711,3	Firewood	Assumed density NCV 9 MJ/dm3, 445 kg/m3, households 1012,9 ktoe, services 3,8 ktoe, not only DM

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Commercial timber production in 2014 and 2015 [Source: Croatian Bureau of Statistics, 2015]:

Table 7 Commercial timber production

Commercial timber production	Manufactured quantities, '000 m3	
	2014	2015
Round wood (total)	**4.997**	**5.179**
Coniferous	877	838
Non-coniferous	4.120	4.341
Fuel wood, including wood for charcoal	1.653	1.769
Industrial roundwood (wood in the rough)	3.344	3.410
Sawlogs and veneer logs	2.415	2.451
Pulpwood	918	949
Other industrial roundwood	11	10

An estimation of wood structure of commercial timber sales by assortments is as follows: logs 51.3 %, thin round wood 0.9%, pulpwood 17.1 % and fuelwood 30.7 %. A large majority of wood products is sold under pre-set contract/retail arrangements – 90.5 %, by public biddings for domestic market – 4.9 % and by international public biddings (export) – 4.6 % of wood products [Source: Pentek and Poršinsky, 2010].

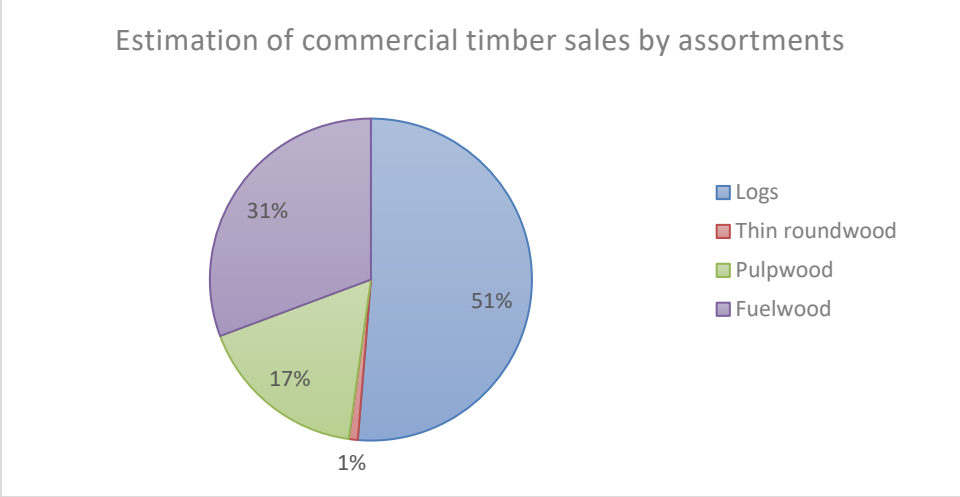

Figure 15 Estimation of commercial timber sales by assortments [Source: Pentek and Poršinsky, 2010]

Value and prices of forestry products sold [Source: Croatian Bureau of Statistics, 2015]:

Table 8 Value and prices of forestry products sold

	Average price, kuna/m3
Total sale value	**315,25**
Fuel wood	164,42
Industrial wood	436,72

Coniferous logs	368,64
Non-coniferous logs	533,62

The table below indicates the average price for customers of the main solid biofuels – commercial customers and domestic customers – in 2016. Typical costs are given in EUR per ton, VAT excluded.

Table 9 average price for customers of the main solid biofuels in 2016

Biofuel	Commercial customers €/t	Domestic customers €/t	Source	Comments
Meter of wood	N/A	90	Njuskalo.hr	25% VAT, delivery included
Bag of pellets (15kg)	N/A	193	Njuskalo.hr	25% VAT
Wood chips	40	N/A	Croatian Forest Ltd.	25% VAT
Wood bricket	110	170	Piljak.hr Njuskalo.hr	25% VAT

BIOMASSES WITH POTENTIAL INTEREST IN CROATIA

Sustainable forest potential (primary forestry production, field residues and secondary agricultural residues) can reach up to 3.8m dry tones/year. Sustainable agriculture potential (primary field residues and tree pruning) can reach up to 2m dry tones/year. Estimated sustainable potential of bio-waste and post-consumer wood can reach up to 0.6m dry tones/year, and potential of dedicated crops can reach up to 70.000 dry tones/year [Source: Croatian Forests Ltd.].

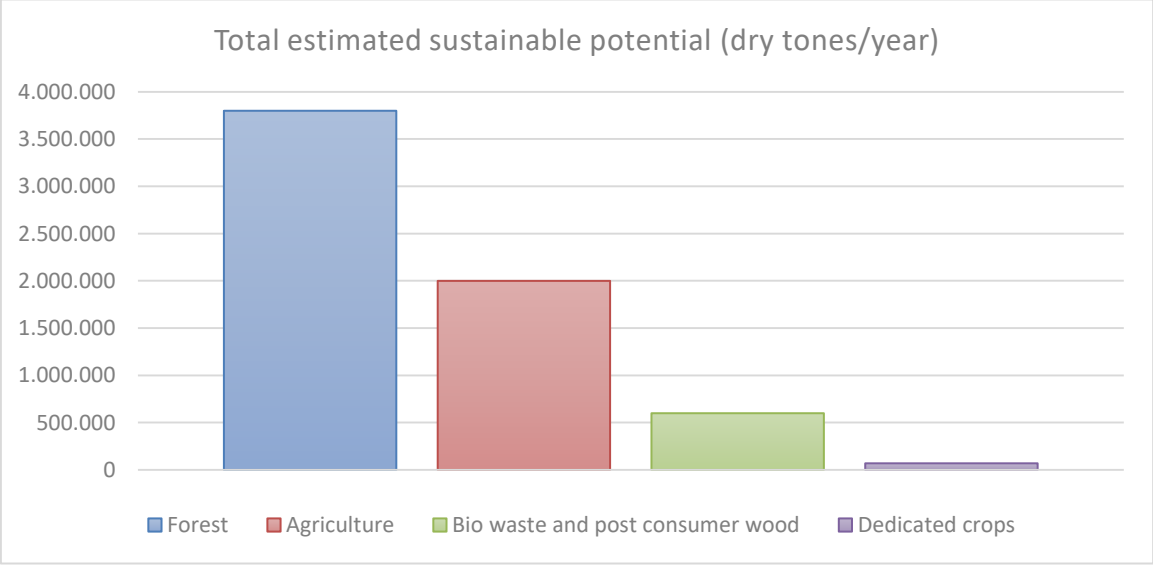

Figure 16 Total estimated sustainable potential of solid bio-fuels [Source: Croatian Forests Ltd.]

Research done under S2Biom FP7 project indicates the biomass resources potential form forests in Croatia – conifers and broadleaves [Source: S2Biom, 2012].

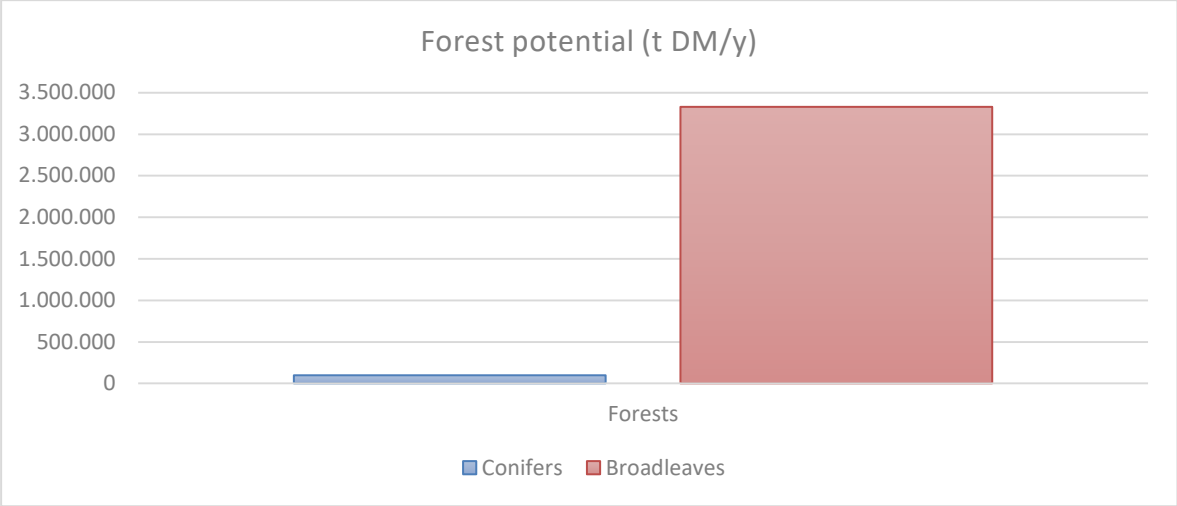

Figure 17 Forest potential [Source: S2Biom, 2012]

Biomass potential from agriculture is illustrated in the following figures from the available data (olive plantations, orchard plantations, vineyards – 2014; cereal straw, sunflower stalks, soybean straw and corn – 2013, based on the assumption that 30% of residues is available for energy use) [Source: Faculty of Agriculture, University of Zagreb].

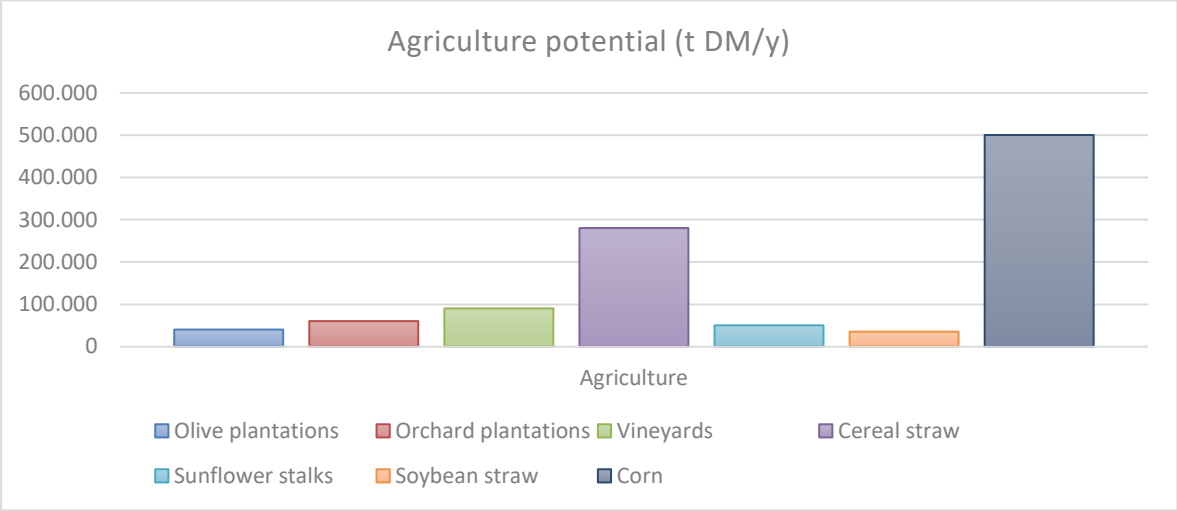

Figure 18 Agriculture potential [Source: Faculty of Agriculture, 2013-2014]

3.627 hectares of agriculture area in Croatia is irrigated, while utilized surface of agricultural area was 1.508.885 hectares in 2014 [Source: Croatian Bureau of Statistics].

The following graphs illustrate the annual quantities of biomass resources potential of Croatia that can be obtained in agro-industry.

Potential of wood industry by type of by-products: (1) Bark (2013: 131.000 m3, assumption density 180 kg/m3, humidity 15%), (2) Clean wood by-products – chips (2013: 400.000 m3, assumption density 328 kg/m3, humidity 30%), (3) Other – wood residues (2013: 530,000 m3, assumption density 160 kg/m3, humidity 15%). [Source: UNECE/FAO Joint Wood Energy Enquiry, 2015]

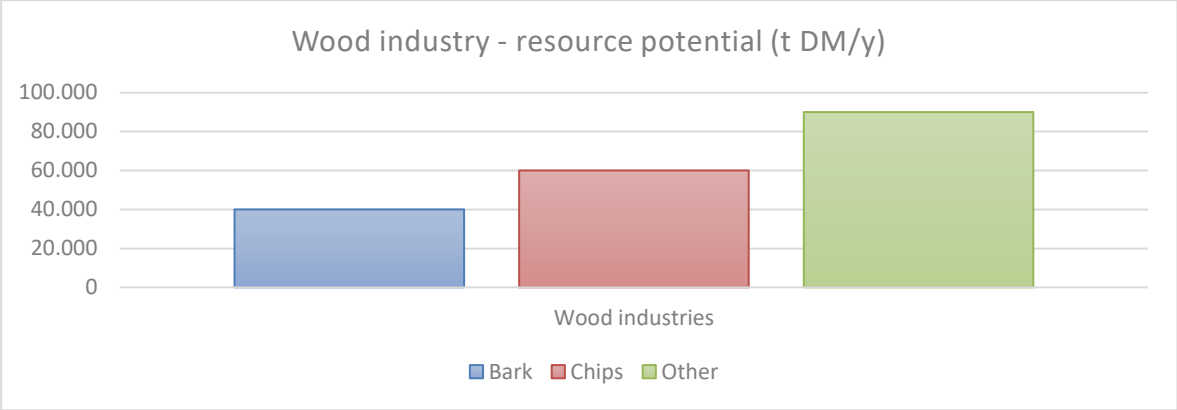

Figure 19 Potential of wood industry [Source: UNECE/FAO Joint Wood Energy Enquiry, 2015]

Potential of nut hulling industry by type of by-products: (1) Hazelnut shell (2014: production 990 t, assumed RPR 0,3), (2) Walnut shell (2014: production 4.015 t, assumed RPR 0,3) [Source: Croatian Bureau of Statistics].

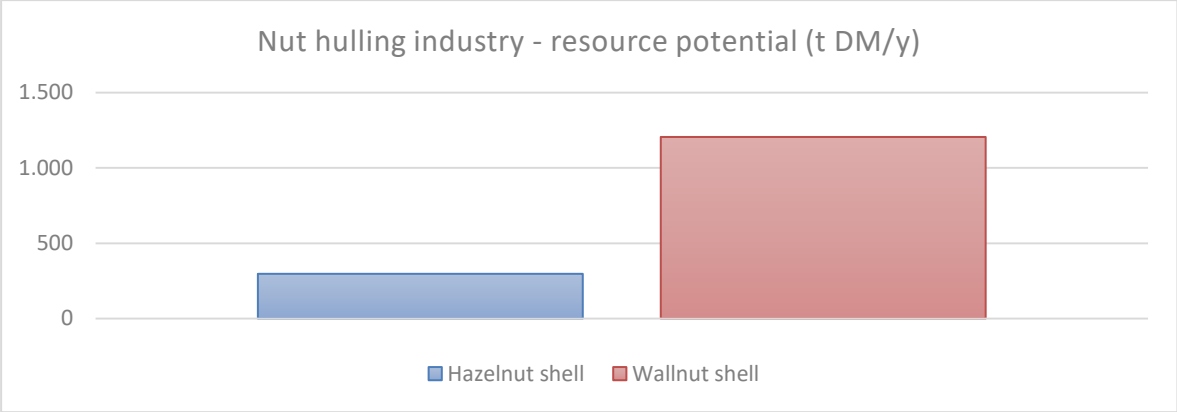

Figure 20 Potential of nut hulling industry [Source: Croatian Bureau of Statistics, 2014]

Potential of olive oil industry by type of by-products: (1) Olive stones (2014: production 8.840 t of olives, assumed RPR 0,3), (2) Exhausted olive cake (2014: production 8.840 t of lives, assumed RPR 0,44) [Source: Croatian Bureau of Statistics].

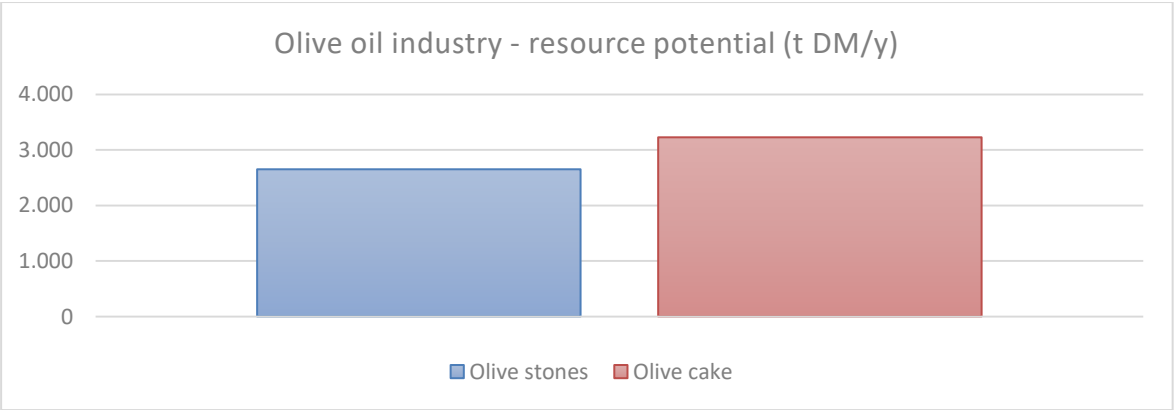

Figure 21 Potential of olive oil industry [Source: Croatian Bureau of Statistics, 2014]

EXPORTATIONS / IMPORTS OF THE SOLID BIOMASSES IN CROATIA

Total energy imports and exports in Croatia in 2014 by energy source [Source: Energy in Croatia, 2014]

are illustrated in the following charts.

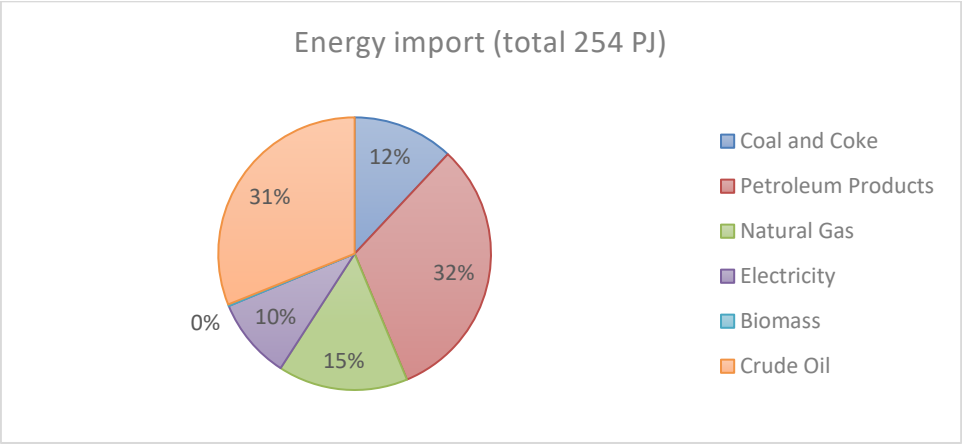

Figure 22 Energy import in 2014 [Source: Energy in Croatia, 2014]

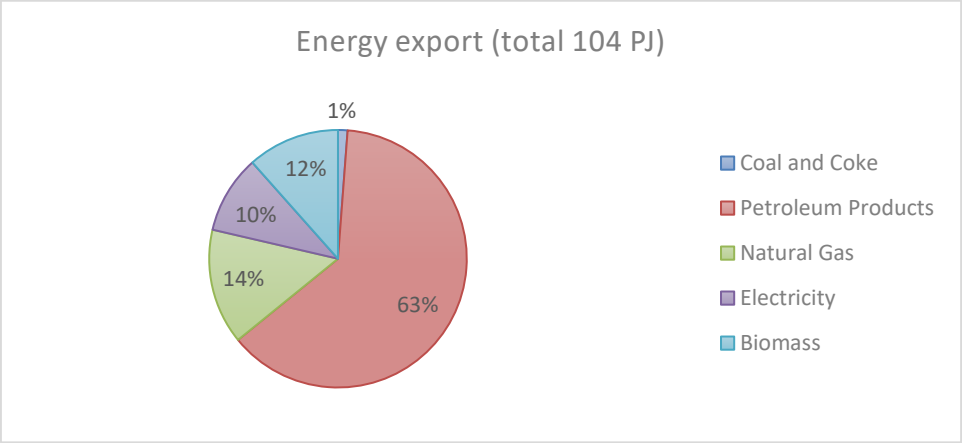

Figure 23 Energy export in 2014 [Source: Energy in Croatia, 2014]

At the moment several biomass district heating plants for buildings in cities and municipalities are in the planning phase. Wood chips are produced with mobile wood chippers at the forest or roadside and are almost always exported to neighbor countries. Production of wood pellets started in 2006/07 as a result of fossil fuels prices growth and increased demand for pellets in EU market. Approximately 95% are exported to EU market mostly in Slovenia, Italy, Germany and Austria.

The Croatian state forests are Forest Stewardship Council (FSC) certified, which is important for the exportation of wood to neighboring EU member states. The annual supply potential for the total wood supply from certified forests is almost 6 million m3 per year. At present quality control and quality assurance standards for processed firewood are not used. The only wood fuel where standards, certification and quality labels are commonly used are wood pellets. This is due to the industrial production process and the market demand for these in export markets, where approximately 95% of the national production is exported. 14 Croatian producers have obtained quality labels (ENPlus) addressing needs for constant assured quality by the EU customers. [Source: ENplus pellets]

Solid biofuels imported and exported in 2014, by biomass source, are illustrated below [Source: Croatian Chamber of Economy].

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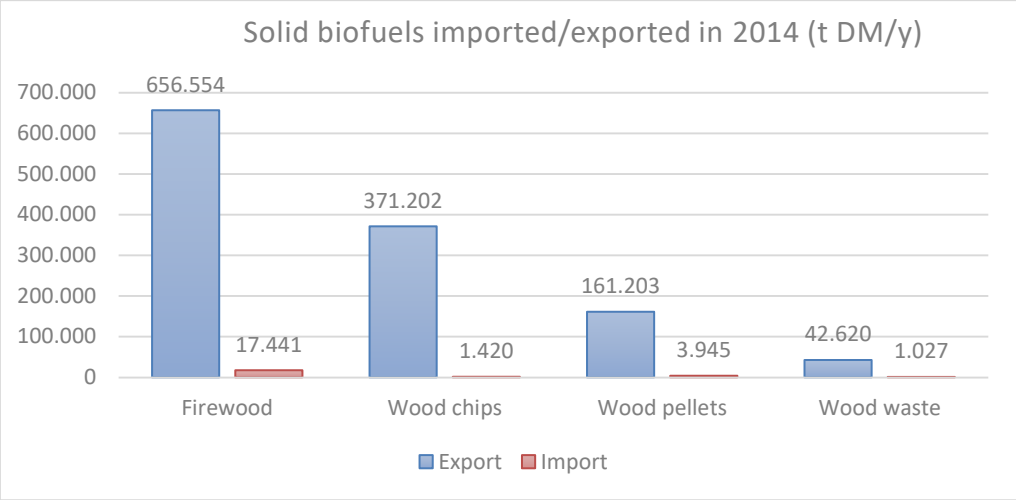

Figure 24 Solid biofuels imported and exported in 2014 [Source: Croatian Chamber of Economy]

(1) Firewood: Main Export in Italy, Slovenia, Hungary, Austria. Main Import from BIH, Slovenia. (2) Wood chips: Main Export in Hungary, Slovenia, Austria. Main Import from Slovenia. (3) Wood pellets: Main Export in Italy, Slovenia, Austria. Main Import from BIH. (4) Wood waste: Main Export in Slovenia, Italy, Germany. Main Import from BIH.

Import prices of fossil fuels and biomass EUR/MWh from 2003 to 2014 are illustrated in the figure bellow [Source: EIHP].

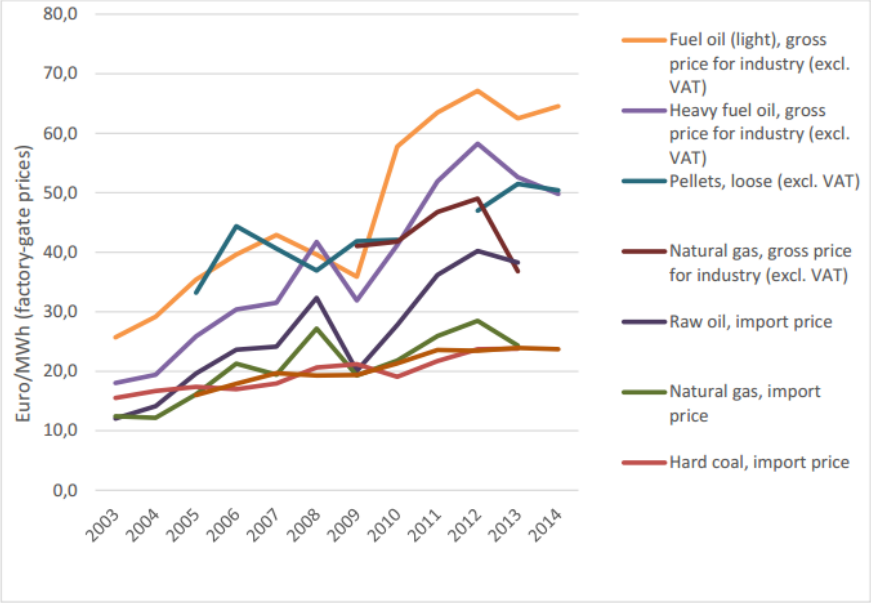

Figure 25 Import prices of fossil fuels and biomass [Source: EIHP]

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MAIN SUPPORTS FOR THE USE OF BIOMASS IN CROATIA

National energy plan recognizes the exploitation of biomass as one of the most important parameters in the sustainable development of rural areas, waste management, agriculture and forestry.

Croatian rural development program (2014 – 2020) has at its disposal 120.000.000 EUR for specific forestry measures, such as conversion of degraded stands. Over 7.000 ha of devastated stands could be transformed into high forests, both in private and state owned areas.

The Environmental Protection and Energy Efficiency Fund (EPEEF) is the central point for collecting and investing extra budgetary resources in the programs and projects of environmental and nature protection, energy efficiency and use of renewable energy sources. The Fund grants financial resources to legal and natural persons for the purpose of financing the activities set out in the Act on the EPEEF through loans, subsidies, financial assistance and donations.

Planned funds for the implementation of the national energy programs in 2015 were 6.000.000 EUR, and 98% was realized.

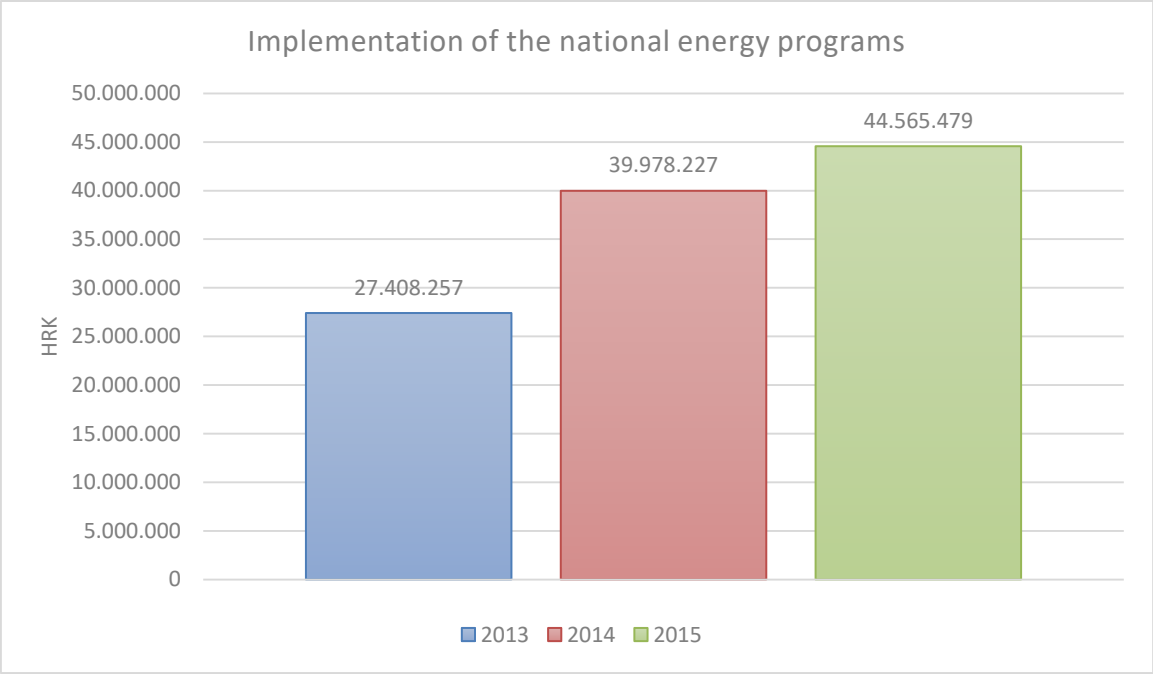

Figure 26 Implementation of the national energy programs [Source: EPEEF, 2015]

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MAIN PROBLAMATIC OF THE USE OF BIOMASS IN CROATIA

The development of a woody biomass market for energy purposes is still in the early stages. The main barriers [Source: BioRES, Biomass EuVET] for further development are listed below:

- Lack of financial incentives for investing in wood pellets heating and biomass district heating;
- Lack of medium and large scale applications of bioenergy production such as district heating, combined heating and power (CHP) utilities;
- Insufficient organizational setting of private forest associations and difficult socio-economic situation of forest owners;
- Lack of knowledge and technologies for domestic market uptake;
- Lack of environmental awareness at all levels (policy makers, businesses, customers, etc.)

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CONCLUSIONS

According to performed interviews of key stakeholders to identify promising biomass market segments in Croatia (in the frame of Bioenergy4Business project), the biggest potential is in the substitution of fossil fuels with biomass energy in Food industry and District heating plants [Source: EIHP, 2014]. Biomass accounts for only around 11% of the total primary energy supply in Croatia, and 95% of produced biomass quantities is exported. Further development of domestic market of solid biofuels, especially from wood industry, is necessary.

Even though Croatia is approaching national energy targets for 2020 and is following EU regulations, import of primary energy (especially crude oil, petroleum products and natural gas) and electricity is high compared to the vast renewable potential that can be unlocked – Croatian coast has on average from 2,400 to 2,800 sunny hours per year and high wind potential, and close to half of land area of Croatia is covered by forests.

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State of the art of the biomass market. Report of Greece

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INTRODUCTION

Solid biofuels are the most important renewable energy source in Greece, accounting for 6.0% of the final energy consumption and 69.3% of the final RES consumption in 2014 [1, 2].

Since 2011, the residential heating market in Greece has seen major changes which have also affected the patterns of biomass consumption as well as its public image. Two main drivers can be identified. The first was the lifting of a long ban on biomass combustion for central heating in the urban centres of Greece, which created a favourable framework for the introduction of biomass heating systems [3]. The second is related to the impact of the financial crisis and the fiscal measures associated with the increase of taxation in the heating oil[1], which still remains the main fuel source for heating in Greece.

As a result, many households have sought alternatives to heating oil, including solid biofuels, and altered their heat consumption patterns, e.g. by switching from central heating to room heating via stoves. In a sense, biomass use for heating has stopped being a rural habit and reappeared in urban areas. However, the extensive use of open fireplaces and low quality wood stoves, in combination with inappropriate fuels such as chemically treated wood, were a major cause of increased PM emissions in the city of Athens and other urban centres [4].

Additionally, the impact of the financial crisis has stimulated interest in the use of biomass in other sectors (industrial, agricultural, services). Several industries, greenhouses, etc. have also switched to biomass use as a means of reducing production costs.

Despite this new interest in biomass, there is still a significant potential of solid biofuels in Greece which remain unexploited. Overall, the solid biomass consumption per capita is only 0.084 toe/inh Compared to the EU28 average of 0.180 toe/inh [5].

The present report intends to present the current state of the art of the biomass market in Greece. The first section is devoted to the main solid biofuels which are already utilized and commercialized in Greece: firewood, wood pellets, exhausted olive cake and olive stones and other agro-industrial residues. The next part discusses other types of biomasses, mostly coming from the forestry and agricultural sectors, which represent a significant potential RES in Greece. The following part discusses the situation regarding imports and exports of biomass in Greece, followed by a discussion on the main types of instruments supporting the use of biomass in the country. Finally, the main issues related to the use of biomass in Greece are discussed and the main conclusions of this study are presented.

MAIN COMMERCIALIZED SOLID BIOFUELS IN GREECE

The main commercialized solid biofuels in Greece can be grouped in the following main categories:

- Firewood
- Wood pellets and briquettes
- Exhausted olive cake and olive stones

[1] The first increase tool place in the fall of 2012: from 60 € to 300 € tax per 1,000 liters. The cost of heating oil for the residential sector thus increased by 40% compared to the previous year.

- Other biomass types, mostly agro-industrial residues such as nut shells, peach kernels, etc.

Since 1/6/2016, the applicable VAT for solid biofuels in Greece is 24% [6].

Firewood

Firewood is by far the most important solid biofuel consumed in Greece, with the main consumption being in the residential sector.

A survey performed by the Hellenic Statistical Authority for the heating period 2011 – 2012 reports that the average thermal energy consumption of a Greek household was 10,244 kWh, while the total number of households in Greece considered for the survey was 4,166,567 [7]. Firewood is by far the most important biomass source for households, contributing to 23.8% of the total thermal energy consumption (876.46 ktoe in total). Alternatively, firewood corresponds to 95.41% of the biomass used for space heating in the residential sector.

Assuming a typical firewood LHV of 3.40 kWh/kg (corresponding to a moisture content of 30%) [8], the amount of firewood consumed by households in Greece is estimated at 2,091 kt DM.

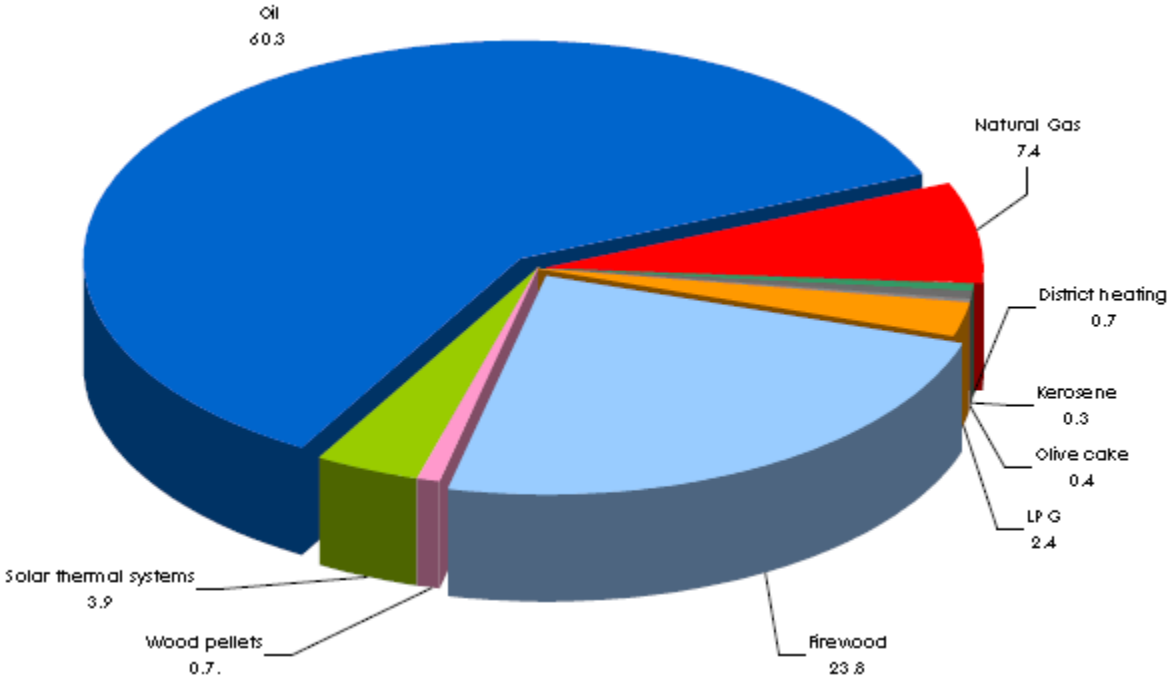

Figure 27: Thermal energy consumption of Greek households per fuel type, 2011 – 2012 (Source: Hellenic Statistical Authority)

In order to understand the origin of firewood consumed in Greece, different statistical sources have to be compared. FAOSTAT [9] reports the following figures for fuelwood production from forests in Greece for the year 2014:

- Coniferous fuel wood: 97,000 m^3 (solid volume, underbark). FAOSTAT suggests a solid density of 625 kg/m^3 for coniferous fuel wood.
- Non-coniferous fuel wood: 968,000 m^3 (solid volume, underbark). FAOSTAT suggests a solid density of 750 kg/m^3 for non-coniferous fuel wood.

In addition to the firewood removed from forests, the Hellenic Statistical Authority indicates that

464,203 t of firewood from agricultural holdings (e.g. large branches of olive trees, uprooted trees, etc) were produced in 2010 [10]. This figure is in the same order of magnitude as those reported in previous years. In all cases, a typical moisture content of 30% can be used to estimate the dry matter content.

Firewood imports and exports are reported in Section 0 of this study.

Based on the previous values, Figure 28 presents an indicative breakdown of the origin of firewood consumed in Greece for 2014. The results indicate that about 42% of the firewood consumption is not reported in the fellings. This result is in line with a study from Germany that only 48% of the fuelwood fellings were reported in the last ten years [11].

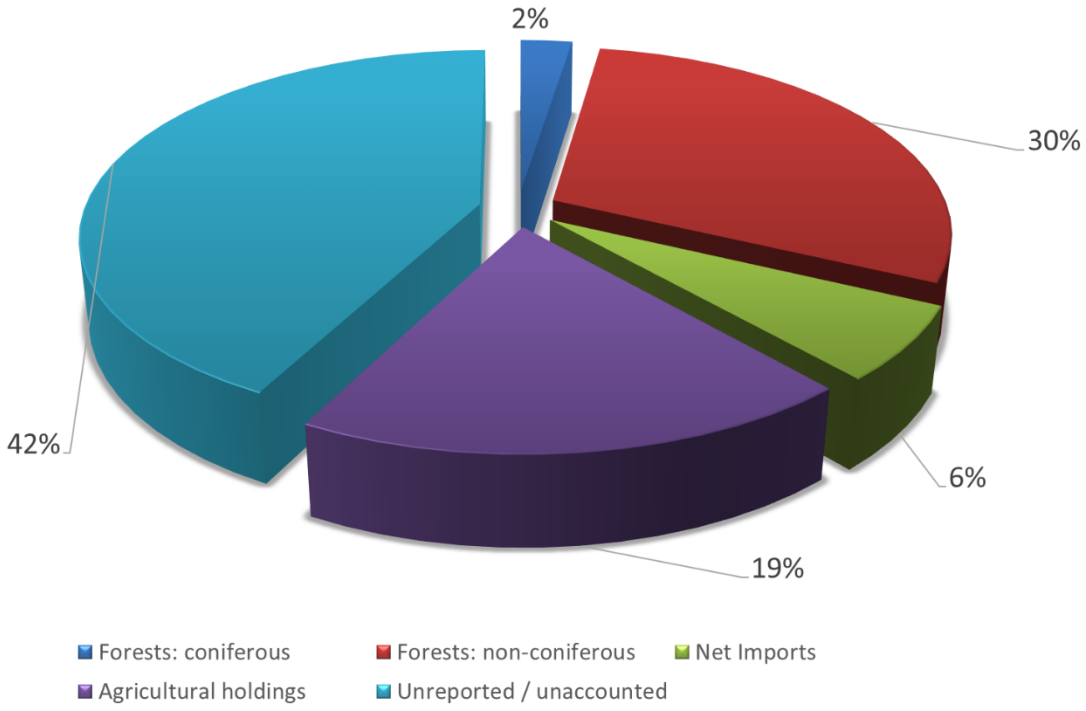

Figure 28: Estimated origin of firewood consumed by the residential sector in Greece for 2014(indicative values)

A market regulation in effect since 2012 requires that for the retail sale of firewood, it is compulsory to use volume units (stacked or bulk cubic meter). Weight units are not allowed [12]. A typical price range is around 60 – 80 €/m^3 (bulk), although prices both higher and lower have been noted. Prices may vary depending on several parameters, such as location of seller and consumer, type of wood, whether the material is solid in bulk or stacked, etc.

Wood pellets & briquettes

The pellets@las project reports that pellet production in Greece started in 2006 [13]. FAOSTAT estimates the national production in 2014 as 36,000 t, with imports amounting to 20,992 t and exports of only 670 t [9].

The Greek Biomass Association, HELLABIOM, reports that the production of wood pellets in Greece amounted to 26,775 t in 2013, while the production capacity is listed as 137,840 t/y [14].

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According to the Hellenic Statistical Authority, wood pellets correspond to 0.7% of the total thermal energy consumed in the Greek residential sector or 3.39% of the biomass consumed for space heating [7]. Assuming typical wood pellet properties (LHV 4.60 kWh/kg and moisture content of 10% [8]), the wood pellet consumption in the residential sector amounted to 64,951 t for the heating period of 2011 – 2012.

Overall, it is estimated that the annual consumption of wood pellets in the residential sector of Greece is in the range of 50,000 – 65,000 t from 2011 onwards. This is fairly low for European standards, however pellet consumption in the residential market exhibits a general upwards trend.

No statistics regarding the wood pellet use in the industrial or other sectors are available. It is expected that wood pellets consumed by such types of heating system would conform to lower quality standards.

There is no concrete information about the number of pellets in the Greek market that conform to quality certification systems such as ENplus or DINplus. It is interesting to note that one Greek producer of wood pellets (Alfa Wood Nevrokopi AEBE, www.alfapellet.gr) has been awarded the ENplus certification [15]. The company has a production capacity of 60,000 t/y.

Again, there is no observatory for the market price of wood pellets in Greece. In the heating period of 2016 – 2017, wood pellets marketed as of A1 quality have a typical price range of 290 – 320 €/t (VAT included). A2 quality pellets are listed with lower prices, around 230 €/t.

Wood briquettes are not as popular as wood pellets; the Hellenic Statistical Authority indicates that only 0.28% of the biomass consumed for space heating in the Greek residential sector is coming from wood briquettes [7].

Exhausted olive cake and olive stones

Greece is the third largest producer of olive oil in the EU (after Spain and Italy) [16]; as a result, agro-industrial biomass residues from the olive oil production process represent a significant potential of renewable energy sources.

According to a mass balance from the BIOMASUD project [17], olive stones amount to 8.3% of the weight of the olive, while the exhausted olive cake is 19.7% of the weight. Both quantities refer to dry basis, since water is given separately in the mass balance. EUROSTAT listed the production of olives for oil production in Greece as 1,570,930 t in 2014 [16]. Therefore, a preliminary assessment of the technical potential of the major solid by-products from olive production is as follows:

- Olive stones: 130 kt DM
- Exhausted olive cake: 309 kt DM

It is worth noting that these numbers may exhibit significant variations from year to year, depending on the actual production volume of olive oil; for example, in 2015 and 2016, the production of olive oil was around 60% compared to the 2014 level [16] and the figures above are expected to be reduced accordingly.

In practice, the separation of olive stones by the Greek olive mills is rare. The standard practice is that

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the olive cake produced by the olive mills is transported to secondary (pomace) mills, where the material is dried and the residual oil (pomace oil) is extracted using hexane and steam; both operations require thermal energy which is typically provided by the combustion of the solid by-product of the process. In most cases, all solid by-products end up in a single fraction, which is marketed as “kernel wood” or “pirinoksilo”, as it is known in Greek.

The self consumption of kernel wood in the pomace mills is a major contributor to the biomass energy consumption in the industrial sector. EUROSTAT reports that the final energy consumption of solid biofuels in the industrial sector was 146.7 ktoe in 2014; of these 73.8% was due to biomass consumption in the food and tobacco sector; this percentage is consistentely high in all years [2]. It is expected that the major share of the biomass consumption in the food and tobacco sector is indeed due to the “kernel wood” self consumption of pomace mills.

The actual level of the self consumption depends on the relative percentage of olive cake from two-phase olive oil mills that is delivered to the pomace mills. The olive cake produced from two phase olive mills has a higher water content compared to the three-phase system equivalent and thus requires higher heat input for drying. The increased penetration of the two-phase olive oil production process in Greece has therefore resulted in the reduction of available “kernel wood” for other uses.

The Association of Olive Kernel Oil Producers of Greece (SPEL) currently estimates that there is a 60/40 split between the two-phase and the three-phase systems currently. For a typical year in which olive oil production reaches 250,000 t, the Association estimates that the kernel wood available for the market is 70,000 and 65,000 t coming from two-phase and three-phase olive mills respectively [18].

(Exhausted) olive cake contributes to 2.34% of the biomass consumption for space heating in the residential sector; its usage is taking place almost exclusively in rural and semi-rural areas [7]. In urban centers, the odours associated with pirinoksilo make it a difficult fuel to use without complains.

In 2016, the market price for the exhausted olive cake was in the range of 70 €/t (VAT included); it’s usually solid either bulk or packed in bags of 20 – 25 kg [18]. Olive stones can be solid for higher prices, in the range of 150 €/t [19].

A specific requirement that legislation impostes to exhausted olive cake and relative fractions used for non-industrial applications in Greece is that their oil content should not exceed 2% wt on a dry basis [20].

Other biomass types

Other types of biomasses amount to the remaining 0.17% of biomass consumption for space heating in the residential sector [7]. There are no published statistics about the exact types of these materials, but it is estimated that most of them are agro-industrial residues.

Nut shells are probably the most important such residues for the domestic sector. From these, almond shells are the most prevalent. In 2013, the production of almonds in Greece amounted to 20,250 t [21]. Of these, almost the whole quantity was processed in crushing plants, where almond shells are produced as a by-product. The shell is between 55 – 70% by weight of the whole nut [22], which means that almond shell production in Greece is a in the range of 11,000 - 14,000 t.

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Walnuts were also produced in significant quantities (21,880 t in 2013). The shell is around 55% of the nut [22]. However, walnuts are mostly processed manually and there is minimal centralized production of walnut shells. It is expected that walnut shells are either disposed or used in stoves and fireplaces.

Other types of nuts, such as pistachios and walnuts, exhibit lower production levels. Pistachio shells are produced by a handful of companies in Greece, but with the current production volumes they are not expected to exceed 500 t on an annual basis [22].

The market price for nut shells ranges from 65 – 120 €/t [22].

Peach kernels are produced by peach canneries and juice production plants. In 2014, the amount of clingstone peaches processed by such plants 381,000 t [23]. Peach kernels are about 8% of the weight of the incoming material, therefore the amount of solid biofuel is estimated to be 30,480 t [24]. Peach kernels were mostly used by the domestic sector and greenhouses until fairly recently; currently they are mostly self-consumed by the peach canneries in order to produce thermal energy. Any leftover quantities that are available on the market are solid in price ranges of 60 – 80 €/t [24].

Cotton ginning residues and rice husk are other types of agro-industrial by-products that are used for thermal energy production in Greece; however, they are mostly self-consumed at their production sites and not available as fuels in the market.

BIOMASSES WITH POTENTIAL INTEREST IN GREECE

In this section, we focus on solid biofuels which represent a significant potential energy source in Greece but which remain currently mostly unexploited. These are divided into the following categories: a) solid biofuels from the forestry sector and b) solid biofuels from the agricultural sector. Solid biofuels originating as agro-industrial residues are already being exploited to a significant degree, as explained in the previous section or represent a potential that is not significant on a national basis (however, it can be a significant resource on a local level).

For the estimation of biomass potential, the main reference is the biomass supply tool developed by the S2Biom project [25]. The methodology used for the calculation of the biomass potential is outlined in detail in a project report [26]. S2Biom considers three main types of potential:

- The technical potential represents the absolute maximum amount of lignocellulosic biomass than is potential available assuming the absolute minimum of technical constraints. These include the recovery rate for forest residues and stumps
- The base potential, which considers also environmental constraints. These take into account the amount of residues needed to keep the soil organic carbon (SOC) content stable for agricultural residues or constraints imposed by site productivity, soil and water protection, biodiversity, etc. for forest biomass.
- The user-defined potential which takes into account restraints imposed by current practices and competing uses.

The S2Biom project provides projections for the year 2020 which come from different models related to land use, crop yields, etc.

Forest Biomass

The forest and other wooded area in Greece accounts for 6,539 thousand ha; of these 55% relate to areas available for wood supply. In contrast, the equivalent EU28 percentage is 73.9% [27]. Generally, the productivity of Greek forests is considered low, in regards to both the standing volume and the annual increment. Equally low is the contribution of the forestry sector to the Greek GDP [28].

The S2Biom project provides estimations about the biomass potential from the forest sector in Greece. The types of biomass considered by the study include the following: a) stemwood from final fellings and thinnings of non-conifer and conifer trees and b) logging residues from final felling and thinnings of non-conifer and conifer trees. The methodology for the calculation is based on biomass resource assessment handbook developed in the Biomass Energy Europe project [29]. Figure 29 and Figure 30 present the potential of stemwood and logging residues in Greece for the year 2020 [25].

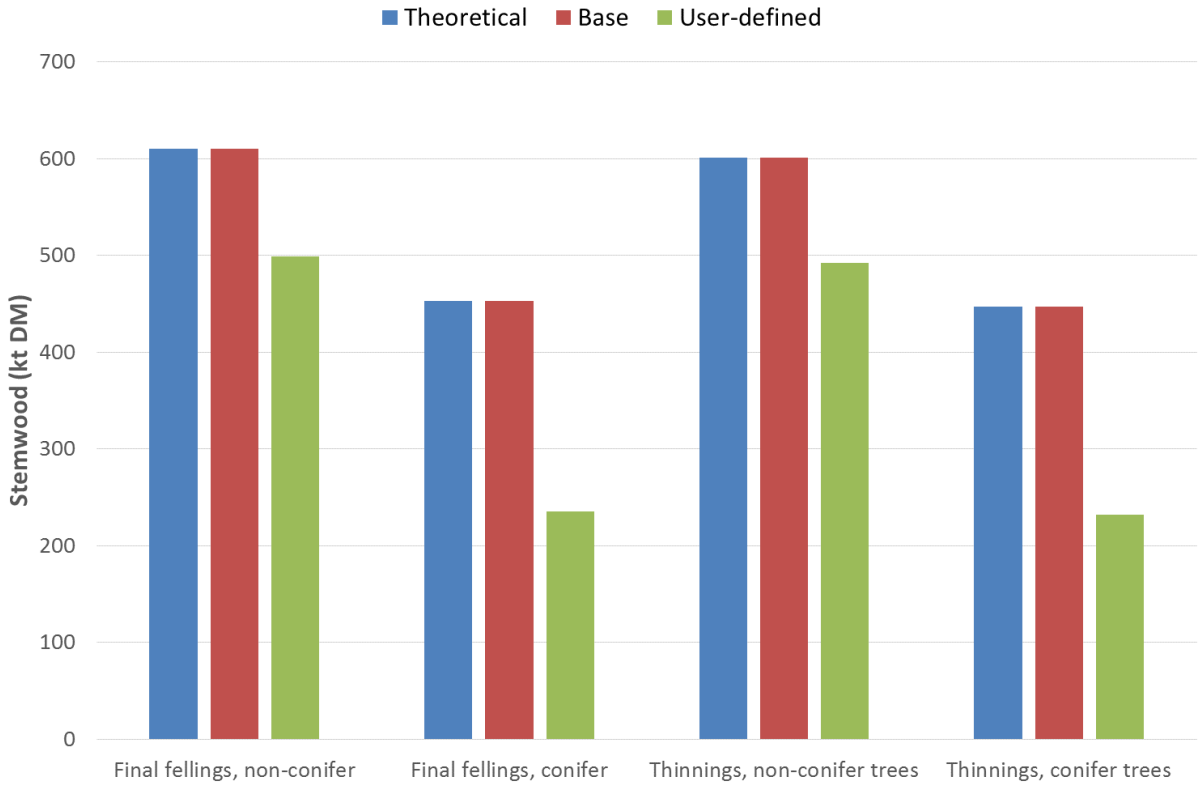

Figure 29: Biomass potential from stemwood removal in Greece reported by S2Biom, 2020

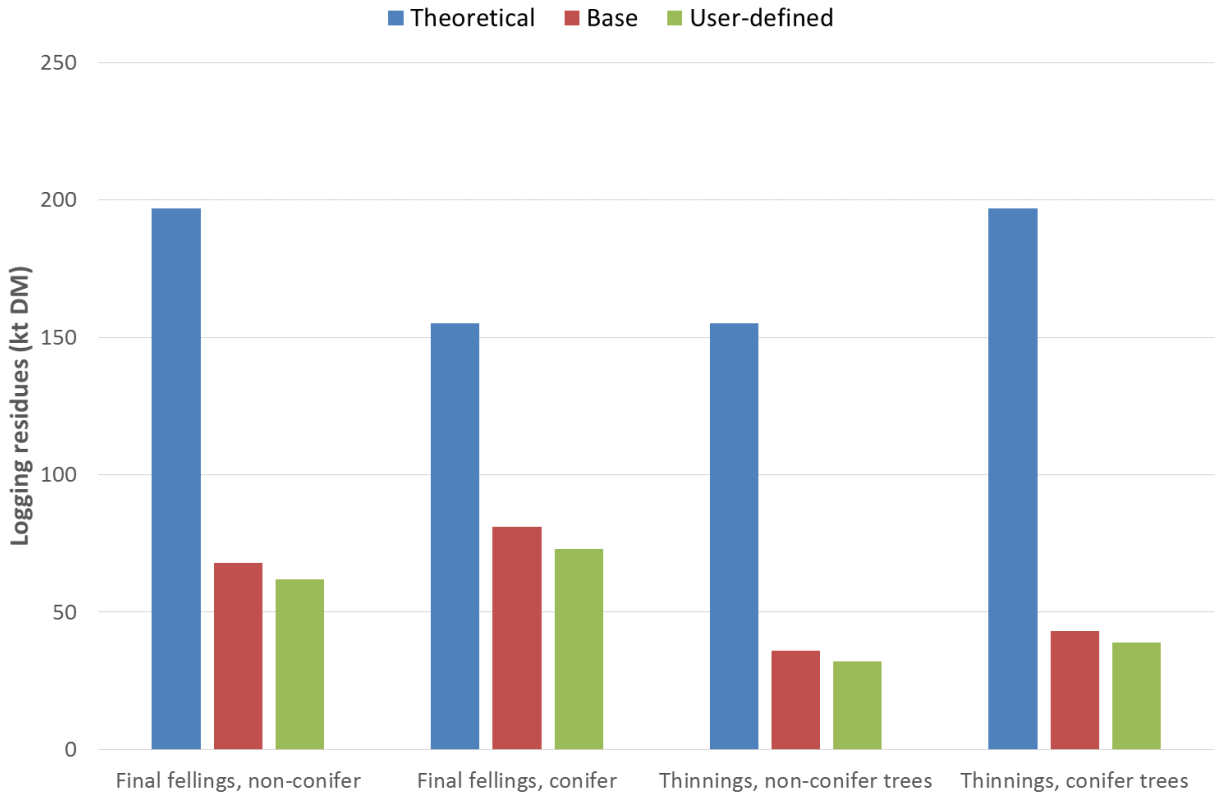

Figure 30: Biomass potential from logging residues in Greece reported by S2Biom, 2020

The total used-defined potential of stemwood, as estimated by S2Biom as 991 and 467 kt DM for non-conifers and conifer trees respectively. In comparison, it's interesting to note that using data from national sources [30] the average roundwood production for the years 2000 – 2010 is 983 and 295 kt DM for non-conifers and conifers respectively. This indicates that potential for further expansion of the forest biomass use is mostly related to the utilization of conifer wood. Logging residues can contribute in total to another 206 kt DM of sustainable biomass potential available for energy production.

Agricultural Biomass

Utilized Agricultural Land (UAA) in Greece corresponded to 4,856.8 thousand ha, or about 36.8% of the total land area. From this area, 37.4% corresponds to arable land, mostly used for cereal production and 19.1% to permanent crops [31].

In the following paragraphs, an estimation of the biomass potential from the agricultural sector is presented for three main types of biomass: a) herbaceous biomass residues, b) prunings from permanent plantations and c) energy crops.

Herbaceous biomass residues

Herbaceous biomass residues include straw from cereals, maize stover, sunflower straw and cotton residues[2]. The S2Biom project provides estimates for the potential of all types of straw and maize

[2] Cotton residues are actually stalks with a wooden texture, but for convenience they are studied along with the herbaceous biomass residues.

stover [26]. The approach is based on the use of Residue to Product Ratios (RPRs) from the literature; for the base potential, restrictions imposed by the need to maintain the soil organic carbon content are applied, while for the user-defined potential competing uses of straw for animal feeding and bedding are imposed.

For the calculation of cotton residues a RPR equal to 2 and a typical moisture content of 45% is considered [32]. For the base potential, a sustainable extraction rate of 50% is considered, while no competing uses for his material are reported. Cotton production for the year 2014 is taken from EUROSTAT [16].

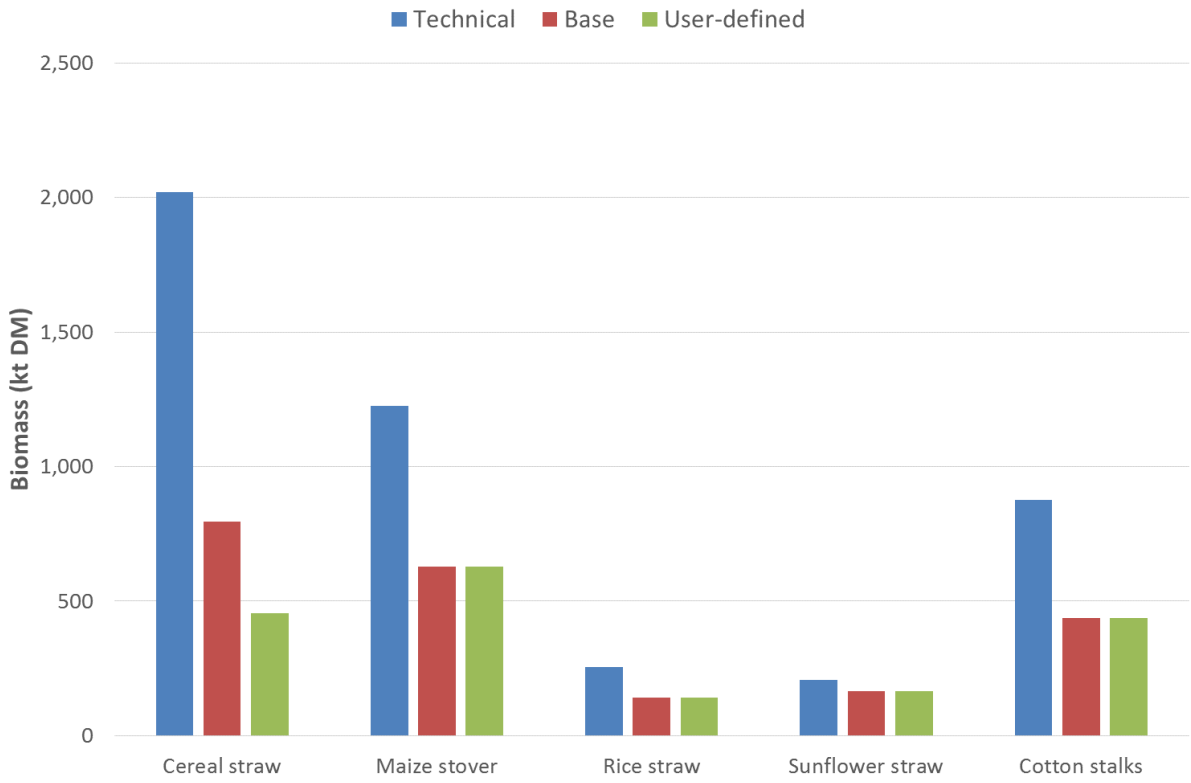

Figure 31: Biomass potential from straw and maize stover reported by S2Biom, 2020 and calculated for cotton residues, 2014

Figure 31 summarizes the main results of the biomass potential for straw, maize stover and cotton stalks. As can be seen, there is a big reduction of the biomass potential for these residues when considering the need to maintain SOC content. Additional limitations are imposed in cereal straw production from the competing uses.

Overall through, around 1.4 million tons DM of straw and maize stover can be sustainably mobilized, while another 0.4 million tons DM of cotton stalks residues can be considered available for bioenergy production.

Prunings from permanent crops

Prunings from permanent crops are a major potential source of woody biomass in Greece.

The S2Biom project calculates the technical potential of prunings using a Residue to Surface Ratio (RSR) that was estimated from the EuroPruning project [33]. The RSR differs depending on the tree

type and whether irrigation is applied.

Another method to calculate the technical potential is the use of Residue to Product Ratios (RPR). In order to compare the S2Biom results, RPRs values for several characteristics Greek tree types as reported in the literature [32] are used along with the fruit yield for the year 2014, as provided by EUROSTAT [16]. Figure 32 compares the results between the two approaches.

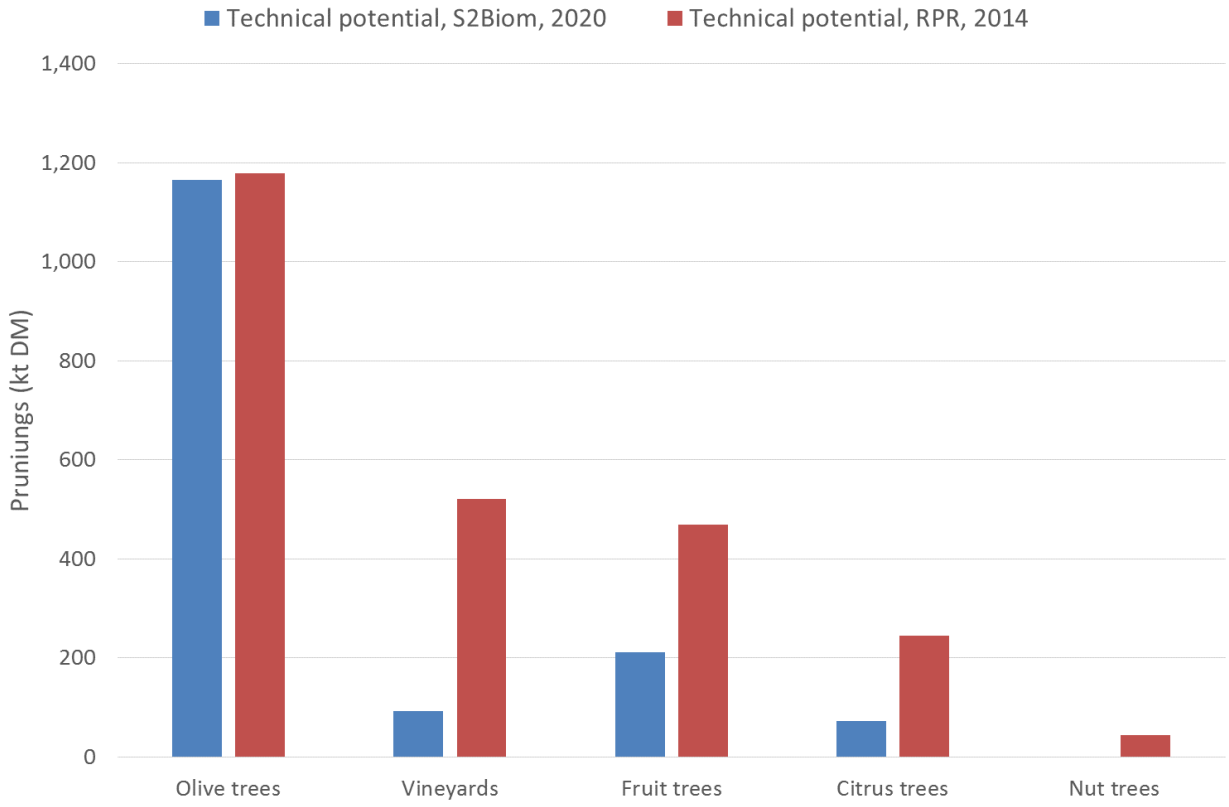

Figure 32: Technical potential from tree prunings in Greece reported by S2Biom, 2020 and calculated using RPRs for 2014

As can be seen, the two methods are in good agreement for olive tree prunings, while the S2Biom results are much lower for the other permanent crop types. **In any case, prunings are a major biomass resource for Greece, with estimations of their technical potential ranging from 1.5 to 2.5 million tons DM.** This potential is currently mostly underutilized; only larger branches[3], mostly from olive trees, are used as firewood (see also Section 0 of this report). The standard practice for the rest is either burning in open field fires or mulching and integration in the soil.

The Horizon 2020 uP_running project [34] intends to promote the sustainable use of prunings from the agricultural sector in several EU countries, including Greece. More information about the potential of prunings for energy production are expected to be generated within the project.

Energy crops

Unused land in Greece can be considered for the cultivation of energy crops for solid biofuels production. The S2Biom project reports this potential taking into account the land available for energy crops cultivation without antagonizing food and feed production as well as projects about the yields

[3] Usually, branches with diameter larger than 6-7 cm are used as firewood.

that can be reached by such crops [26]. The calculation of the base and user-defined potential takes into account several restrictions, such as the non-use of protected areas, areas with high biodiversity value and high carbon stock, ban on irrigation water use, etc. Figure 33 presents the potential estimations of the S2Biom project.

The S2Biom project considers that three herbaceous energy crops are appropriate for the Greek conditions: miscanthus, switchgrass and giant reed. Overall, there is little difference between the base and user-defined potential of energy crop. **In total, the energy crop potential in Greece is in the range of 1.1 million tons DM.**

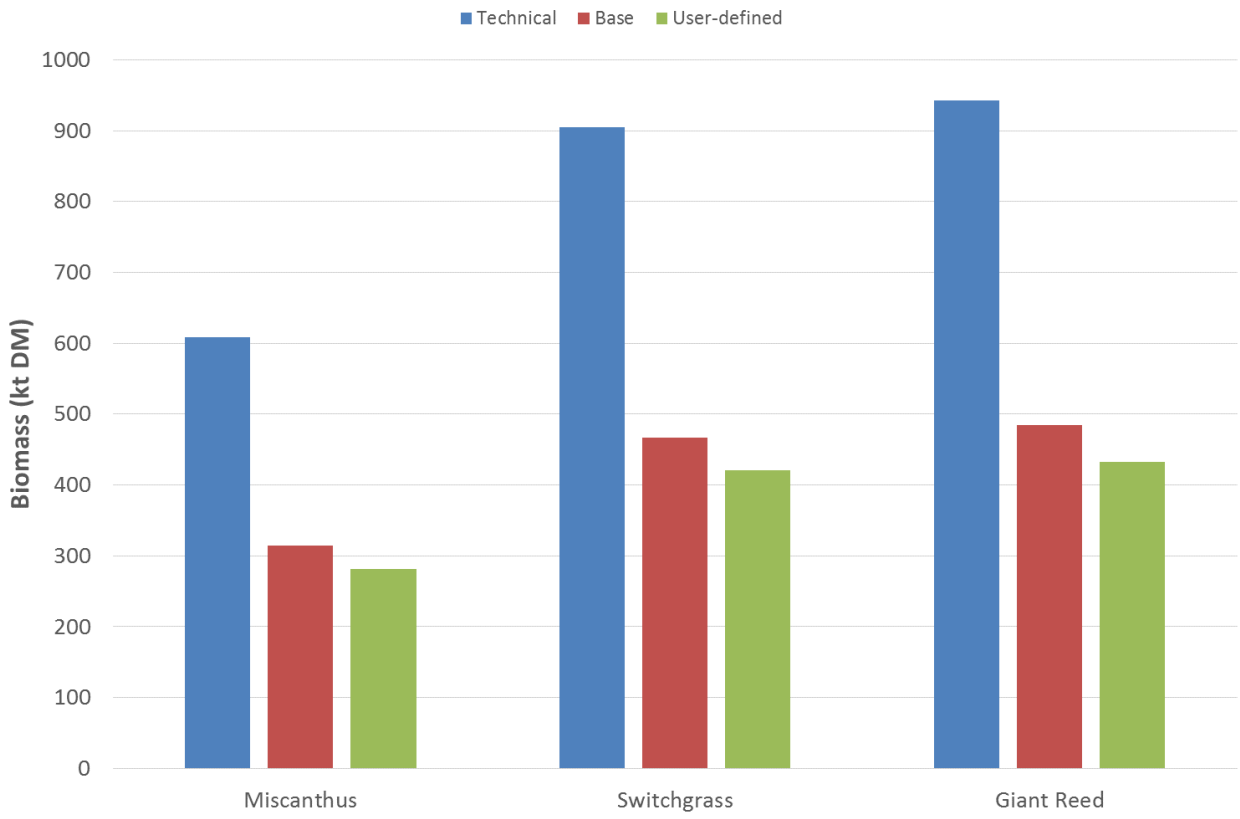

Figure 33: Biomass potential from energy crops in Greece reported by S2Biom, 2020

EXPORTS / IMPORTS OF THE SOLID BIOMASSES IN GREECE

The exports and imports of energy in Greece are dominated by petroleum products, which amount to 99.5% and 89.1% of the total amount respectively [1]. EUROSTAT reports imports of solid biofuels from 2010 onwards [2], however according to FAOSTAT data imports of fuelwood to Greece are recorded even before that year [9].

According to EUROSTAT, the imports of solid biofuels in Greece amounted to 62.1 ktoe in 2014 [2]. For the same year, FAOSTAT [9] reported wood fuel imports of 219,643 m^3 (solid volume, underbark). Additionally, wood pellet imported amounted to 20,992 t, with the main import countries being Austria, Romania, Bulgaria, Albania, Serbia and FYROM [14]. By converting the FAOSTAT values to

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ktoe[4], the calculated breakdown of solid biofuels imports per fuel type are presented in the following figure. The percentage referring to other can be attributed to imports of wood briquettes or sunflower husk pellets for use in industrial applications, greenhouses, etc.

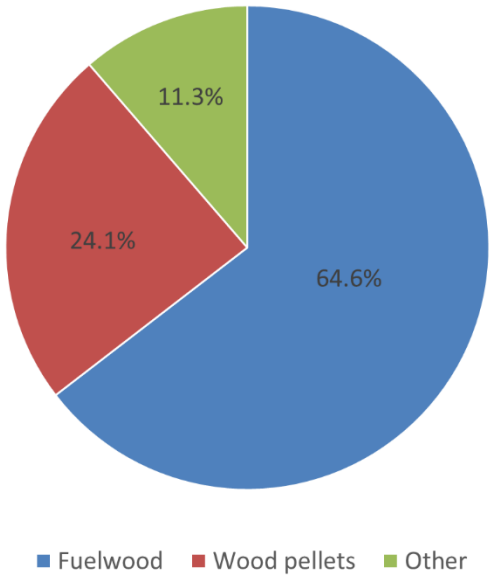

Figure 34: Estimated breakdown of solid biofuels imports to Greece for 2014

The export of solid biofuels from Greece is much more reduced. EUROSTAT reports total exports amounting to 1.1 ktoe in 2014 [2]. For the same year, FAOSTAT [9] reports the imports of 3,351 m^3 (solid volume, underbark) wood fuel and only 670 t of wood pellets, which mostly go to three neighboring countries: Italy, Bulgaria and Albania [14]. Exports of exhausted olive cake to biomass power or CHP plants in other European countries are sporadically reported on the news, but no comprehensive statistical data are available.

[4] A solid density of 725 kg/m^3 (as suggested by FAOSTAT) can be applied in order to estimate the wood fuel import and export quantities in tons. A value of 3.40 and 4.60 kWh/kg is assumed for the LHV of woodfuel and wood pellets respectively.

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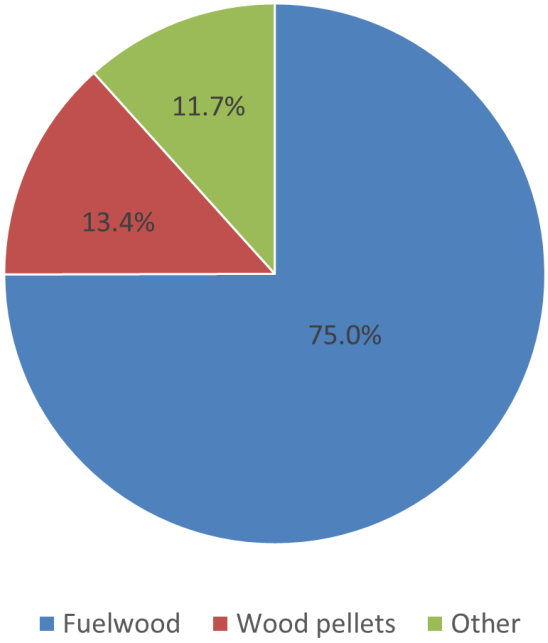

Figure 35: Estimated breakdown of solid biofuels exports from Greece for 2014

Overall, it can be concluded that Greece is a net importing country for solid biofuels.

MAIN SUPPORTS FOR THE USE OF BIOMASS IN GREECE

Support for thermal energy production from biomass

The Programme "Saving at Home" ("Eksoikonomo Kat' Oikon") is co-funded by the Greek State and the European Union through the National Strategic Reference Framework 2007-2013 [35]. The Programme intends to promote energy efficiency in the residential sector by providing incentives for the implementation of energy saving measures.

Eligible homes were all houses, apartment buildings and individual apartments that exclusively satisfy the following criteria:

- They were located in areas with a price zone lower than or equal to 2,100 € / sq.m (as of 31.12.2009).
- They were classified under the Energy Performance Certificate (EPC) in a category less than or equal to D.

The target for savings achieved from program interventions was to increase the Class by at least one category or to achieve primary energy savings of at least 30% of the energy consumption of the reference building. The total eligible budget per application is 15,000 € (VAT included), including also energy audits before and after the implementation of the energy efficiency measures and costs for consultants.

Beneficiaries of the Programme received incentives for the implementation of the actions depending on their income, as indicated in the following table.

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Beneficiaries category	A1	A2	B
Personal Income	≤ 12,000 €	12,000 € - 40,000 €	40,000 € - 60,000 €
Family Income	≤ 20,000 €	20,000 € - 60,000 €	60,000 € - 80,000 €
Incentive	70% Grant 30% Interest-free Loan (interest rate subsidy 100% up to 31.12.2015)	35% Grant 65% Interest-free Loan (interest rate subsidy 100% up to 31.12.2015)	15% Grant 85% Interest-free Loan (interest rate subsidy 100% up to 31.12.2015)

Table 10: Incentives offered by the "Saving at Home" Programme

Eligible actions are grouped in three main categories:

1. Replacement of frames and installation of shading systems;
2. Installing thermal insulation in the building envelope, including roof and pilotis;
3. Upgrading of the heating and hot water production system(s).

Installing a new RES heating system, e.g. a biomass boiler, can be supported in the framework of the third action, with a maximum eligible cost up to 15,000 €.

It is interesting to note that due to the provisions of the Regulation for the Energy Performance of Buildings, the replacement of the heating system alone is usually not sufficient to meet the targets of the Programme, so this intervention has to be combined with other eligible measures, e.g. installation of a solar system for hot water production.

The Programme has currently used up all its allocated funds and is on hold; it is expected that it will open again in the first months of 2017 and will target around 40,000 residences.

Other programmes included in the National Strategic Reference Framework may also include the support of enterprises, public sector, etc. for the installation of biomass heating systems. For example, the Operational Programme "Environment and Sustainable Development" allocated a budget of 2 mil. € for the installation of biomass systems in municipal buildings [36].

Support for electricity production from biomass

Greece used a feed-in tariff (FiT) system for the financial support of different RESe technologies since 2006 [37]. Since that time, the law underwent several revisions, the most important implemented in 2010 [38], which updated the feed-in tariff system in line with the German EEG model.

Generally, the FiT system employed in Greece distinguished the level of the feed-in tariff received by a RES producers based on several parameters, the most important being a) the type of technology and installed capacity of the RES plant, b) whether electricity was supplied to the interconnected mainland grid or to non-interconnected islands and c) whether the investment was supported by public funds or

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not.

RES producers were paid the FiT through the RES Special Account, managed by the Electricity Market Operator (LAGIE). Until the end of 2013, the RES special account reached a deficit surpassing 500 mil. EUR which the Greek government attempted to reduce through several measures, including a revision of the FiT for RES plants already in operation implemented in 2014 [39] (commonly referred to as the "New Deal").

The current support framework for RES electricity in Greece is formed by Law 4414/2016 [40] and is based on a combination of feed-in premiums (FiPs) and tenders. The Law attempts to further control fiscal expenses associated with RES support, while also being in line with European Commission's Energy and Environmental State Aid Guidelines for the period 2014-2020 (EEAG) and promoting the national targets for RES production [41].

A major feature of the new support scheme is that RES producers will participate directly in the wholesale electricity market, while their electricity production will be remunerated at the level of the Reference Tariffs (RTs), which were calculated so that each RES investors is able to achieve a reasonable IRR taking into account the levelised cost of electricity (based on typical CAPEX, OPEX, capacity factors), weighted average cost of capital and accounting rules. The FiP is calculated as the difference between the reference market price RMP and the RT for each technology and is guaranteed for a period of 20 years for most RES types [41].

Table 11 compares the level of financial support enjoyed by electricity producers from different types of biomasses in Greece under the two latest support schemes as well as the installed capacity of biomass power plants [42].

Type of installation	**Capacity**	**Law 4254/2014**	**Law 4414/2016**		**Installed capacity (MWe) as of Nov. 2016**
		Feed-in tariff (€/MWh)	**Reference Tariff for 2016 (€/MWh)**	**IRR**	
Gases released from landfills	≤ 2 MW	131	129	9%	2.250
	> 2 MW	108	106	9%	42.008
Biogas from anaerobic digestion	≤ 3 MW	230	225	10%	10.452
	> 3 MW	209	204	9%	---
Biomass for thermal processes	≤ 1 MW	198	184 (combustion or pyrolysis) 193 (gasification)	9%	2.173
	> 1 MW & ≤ 5 MW	170	162	9%	---
	> 5 MW	148	140	9%	---

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Note: financial support levels indicated are without any type of public support for the investment

Table 11: Comparison of the feed-in and reference tariffs for electricity produced from various biomass types and installed capacity for biomass power plants.

MAIN PROBLEMS FOR THE USE OF BIOMASS IN GREECE

Despite the significant potential of biomass resources in Greece, the per capita consumption of solid biofuels in one of the lowest in the EU-28 [5]. The benefits of the Mediterranean climate and the lower thermal energy demands compared to Central Europe are only part of the reasons why this happens. There are also significant issues associated with the use and mobilization of biomass for energy production.

One issue that affects the use of biomass in Greece is related to public acceptance. Indeed, the use of biomass for heating is often associated with the impact of the financial crisis, energy poverty and the re-appearance of smog in the urban centres of Greece. It should be noted that emissions from biomass use have indeed been a problem, but they are mostly associated with the combustion of inappropriate types of biomasses, such as waste wood, in poorly designed heating systems, such as open fireplaces. In any case, public attitude towards biomass combustion can sometimes be negative.

Market monitoring and certification mechanisms for solid biofuels and related combustion devices are inadequately implemented. Although the most recent law related to biomass heating in Greece requires that biomass central heating boilers should conform at least to the emission limits and efficiency requirements of EN 303-5:2012 Class 3 standard [3], in practice there is no monitoring of the types of combustion devices that are available on the market. Additionally, although national law requires that solid biofuels marketed should conform to the quality requirements of the European Standard EN 15234 [20], in practice many solid biofuels marketed for the domestic or other sectors are not accompanied by product declaration forms.

Public policies have not succeeded in promoting the use of biomass in Greece; despite the feed-in tariff regime, the installation of biomass power plants has not gone through and only small-scale systems (< 1 MW) have been installed. One reason is that the policies in effect target the end-user of the biomass and fail to take into account the complexities and issues associated with the organization of biomass supply chains.

Another issue associated with the mobilization of currently unused agricultural biomass in Greece is the low average size of holdings. Greece was one of the six member states to report an average surface area per farm below 10 ha for 2013, when the EU-28 average was 16.1 ha [31]. This means that the amount of biomass an individual farmer can mobilize is quite low, which in turn makes it more difficult to set-up effective biomass supply chains.

For forest biomass, several issues are reported, such as the lack of investments, distribution of responsibilities over many different public authorities, lack of funding for the forest service, low productivity and problematic and inadequate management plants, etc. [28].

CONCLUSIONS

Despite the fact that biomass is the most important RES in terms of primary energy consumption in Greece, the per capita consumption of solid biofuels is one of the lowest in the EU-28. The main solid

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biofuel used is firewood for the residential sector. Wood pellets have started a quick growth since 2011 but still lag behind the consumption levels of other Mediterranean countries such as Spain and Italy. Exhausted olive cake is another well-known biomass source especially in the areas associated with olive oil production, while other biomass types such as nut shells have mostly local importance.

There are several bottlenecks in the growth of the biomass sector; for already utilized solid biofuels there is a need to promote awareness regarding fuel quality specifications and best practices for their utilization not only among the general public but also for fuel producers. Regarding the significant potential in unutilized biomass resources, such as tree prunings, there is a need to promote concepts for their effective utilization. The activities of the Biomasud Plus project can play a positive role in mitigating all of these issues.

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State of the art of the biomass market. Report of Italy

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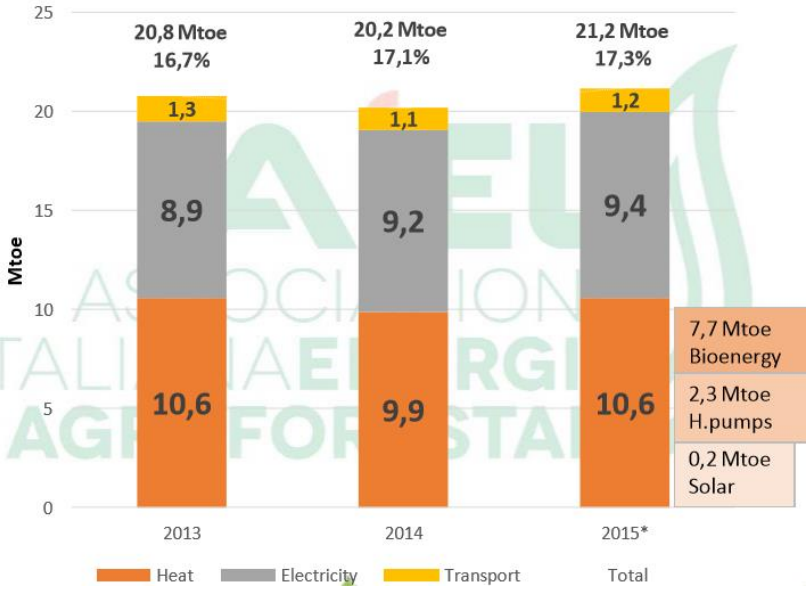
INTRODUCTION

The Gross Final Energy Consumption in Italy is around 120 Mtoes [Figure 1]. The drop in consumption that has occurred in the last year is related both to the mild winters and the efficiency improvements.

Figure 1: Gross Final Energy Consumption in Italy

In 2015, renewable heat counted more than 21 Mtons, 50% of which was used to produce thermal energy. As shown in Figure 2, bioenergy is the main source to produce renewable thermal energy.

Figure 2: Bioenergy for heating consumption



The relevance of biomass in the Italian market is also shown in the figure below. Italy is the 4th bioheat consumer by using biomass within the EU28 area, representing the 9% of the total consumption.

Figure 3: EU28 countries in bioheat consumption

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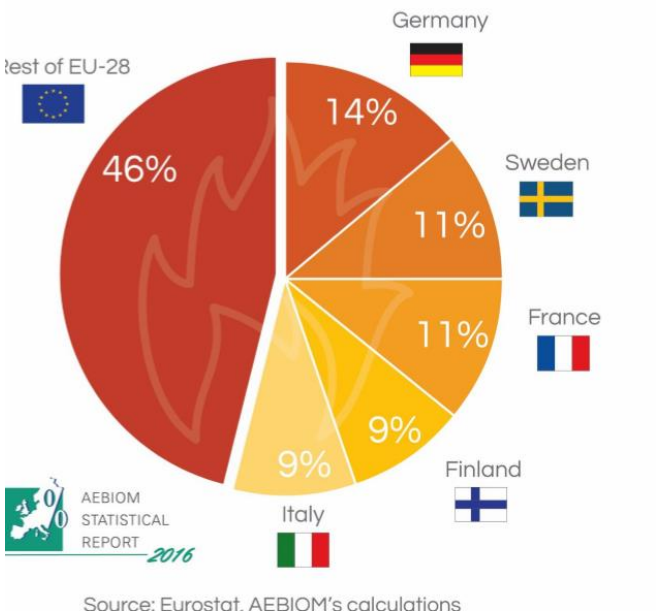

As previously discussed thermal energy counts more than 50% of the Italian total energy consumption. The table below goes deeper in details showing which are the main targets of bioenergy consumption in the Italian market (GSE, 2015). In 2014 273.000 TJ were consumed, corresponding to 6,52 Mtep.

Figure 4: bioheat consumption in the Italian market (GSE, 2015)

	2010 (TJ)	2011 (TJ)	2012 (TJ	2013 (TJ)	2014 (TJ)
Direct Consumes:	**301.131**	**194.726**	**279.829**	**281.558**	**244.494**
Residential	299.895	192.664	277.893	277.698	237.623
Industry	308	1.104	980	2.300	3.489
Commercial and service	*863*	*891*	*888*	*1.485*	*2.488*
Agriculture	65	67	67	75	894
Derived heat productior	**8.739**	**13.878**	**17.423**	**25.151**	**28.388**
From CHP plants	6.502	11.211	14.345	22.059	25.672
	2.237	2.667	3.078	3.092	2.716
	309.870	**208.604**	**297.252**	**306.709**	**272.882**

In 2014, 97% of solid biomass used for thermal energy purposes was delivered to residential users.

Italy is the EU most important residential market for the biomass sector. The main drivers are the installed biomass stoves (more than 5 million) and new installations, that are revamping the current market and increasing the share of biomass by replacing the fossil fuelled devices.

Figure 5: energy sources share within independent heating systems (REF-E, 2016)

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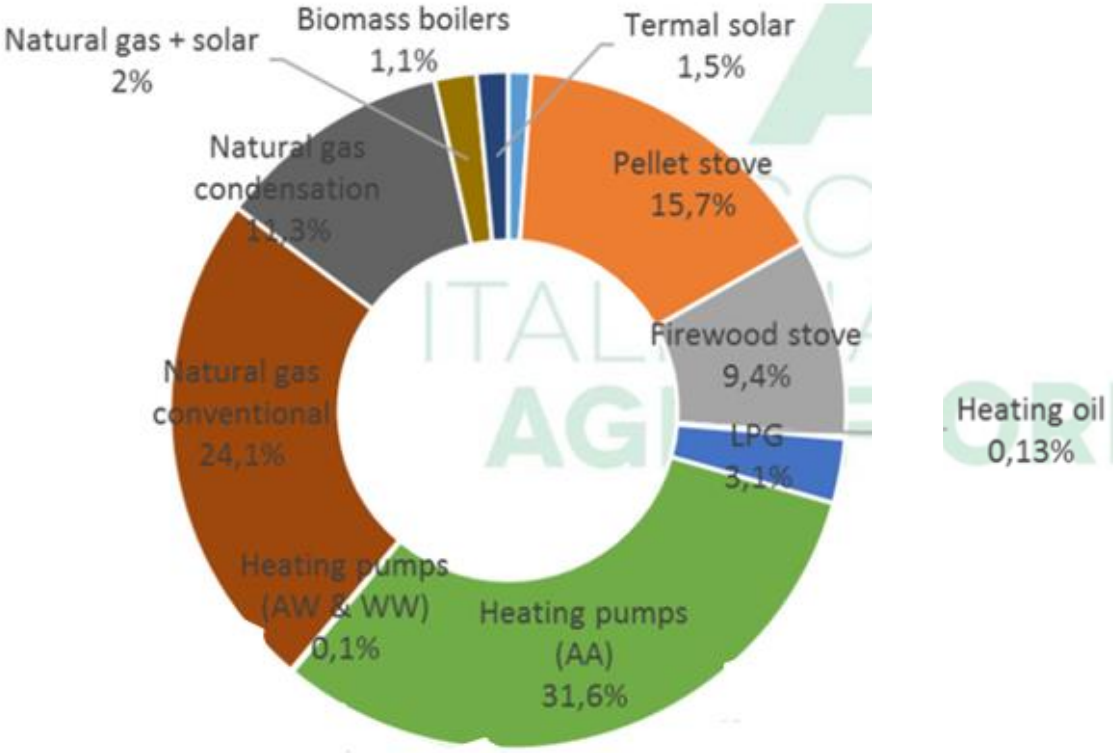


MAIN COMMERCIALIZED SOLID BIOFUELS IN ITALY

Wood biomass represents most of solid biofuels commercialized in Italy, counting over 20.000.000 tones/year.

The most common one is wood logs, whose consumption reaches 18.000.000. One over five families use it as a prevalent fuel to heat its house. Their mean consumption is 3,36 tons per year. Most of the consumption is in the mountain areas near the Alps and Apennines, besides the north-east area (Figure 6).

Another common wood biofuel is of course pellet, being Italy the biggest residential market in Europe. Its annual consumption, related to temperatures and fossil fuels prices, goes from 2.700.000 to 3.200.000 tons per year. It is mainly used in flat regions and islands (Figure 7). Over 4% of Italian families use wood pellets as main fuel to produce residential heat.

Figure 6: penetration rate of wood logs within Italian families (ISTAT, 2013)

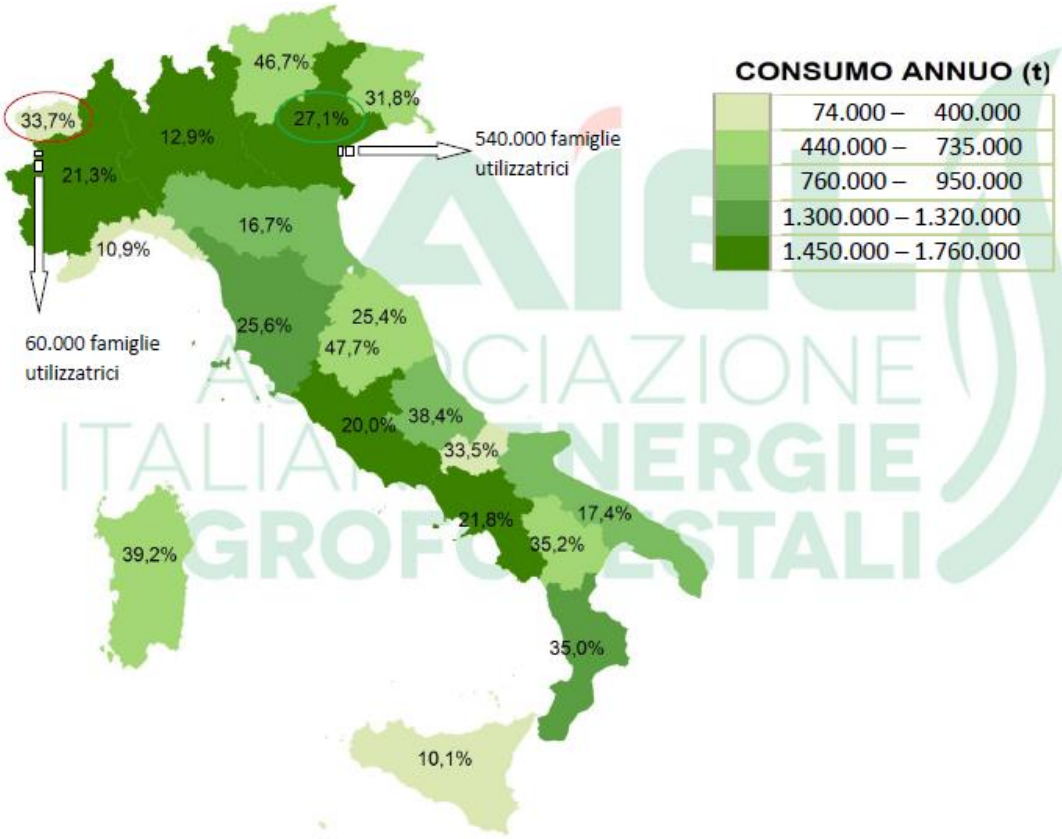
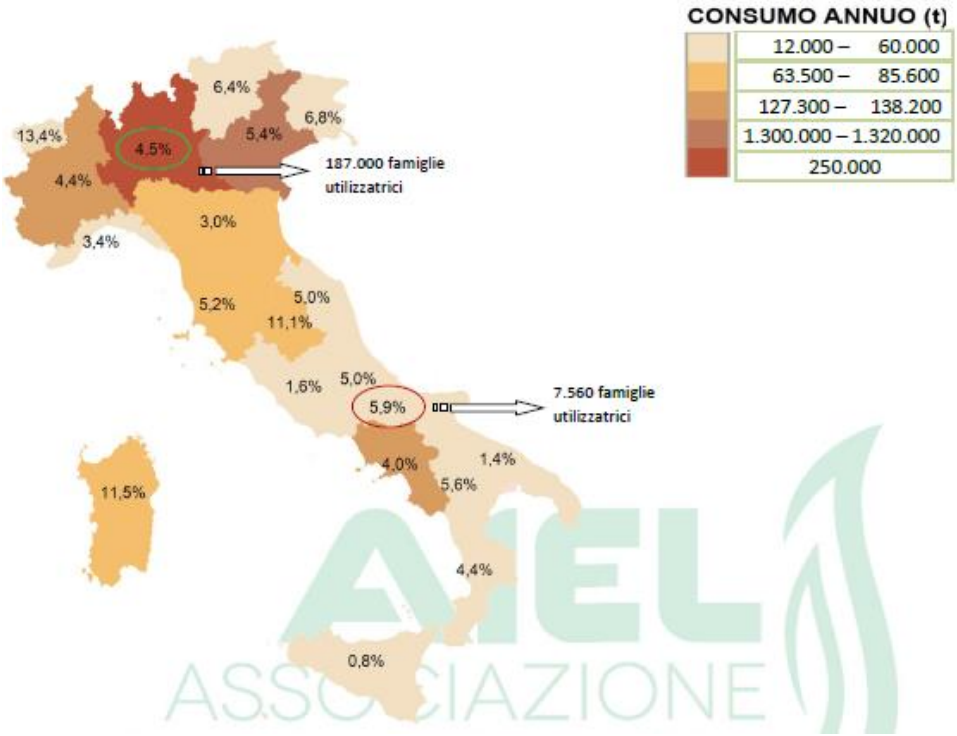


Figure 7: penetration rate of wood pellets within Italian families (ISTAT, 2013)



Woodchips, whose total consumption does not reach 1 mln tones per year, are still not common in the residential market.

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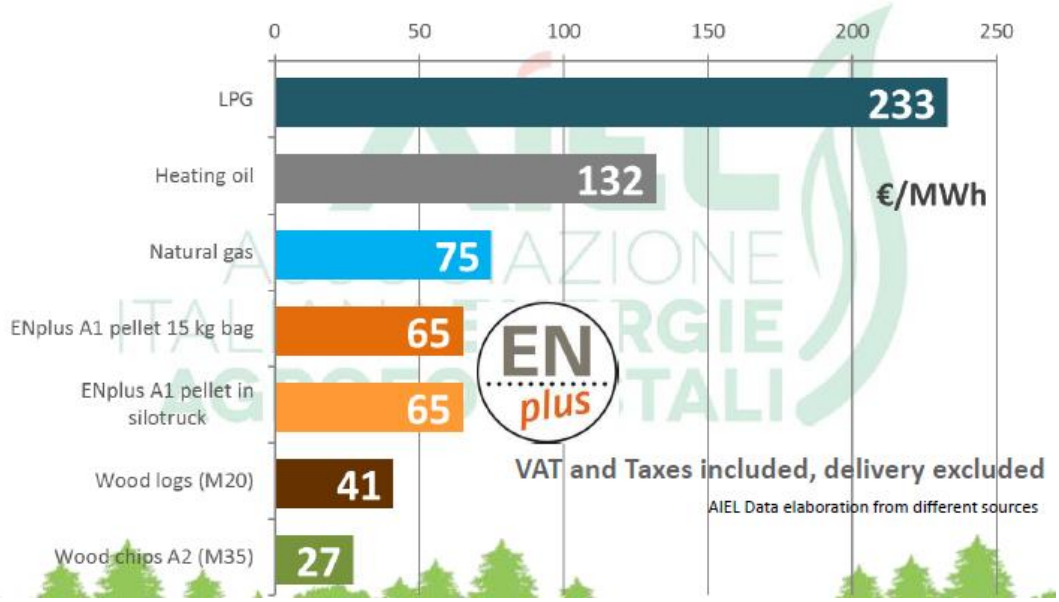
BIOMASSES WITH POTENTIAL INTEREST IN ITALY

Biomasses have high potential interest for two main reasons:

- as shown in the first paragraph, they give the main contribution to the RES rate in the heat sector
- their primary energy price is lower than fossil fuels ones (Figure 8) and the national government is giving interesting incentives to install new high performing biomass devices

Figure 8: Prices comparison between fossil fuels and biomass, Jan. 2017 (www.aiel.cia.it)



Besides wood logs and wood pellets, there are some agricultural biomasses that are rising interest in the market. The most promising ones are: olive stones, nutshells, olive tree pruning and vineyard prunings. It is still hard to estimate their current consumption. Most updated estimations are:

- agricultural chips: 90.000 tDM /y
- olive stones and exhausted olive cakes: 40.000 and 140.000 tDM /y
- nutshells: 90.000 tDM /y

Figure 9: SWOT analysis of the biomasses with highest potential interest (AIEL)

BIOFUELS	STRENGHTS	score	WEAKNESSES	score	OPPORTUNITIES	score	THREATS	score
Olive Stones	Presence of productive districts	3	Lack of biofuel standard and certification scheme	5	Energy independence of farmers and processing sites	3	Inability to use in the next future (Ecodesign enters in force in 2020 and 2022)	3
	The residue has to be processed anymore	4	The standardisation is difficult for small oil mill	4	Availability of solid biomass for energy in agricultural areas	3	Lack of manufacturers' interest for the implementation of suitable stoves and boilers	5
	Logistic of harvesting, treatments, and supply consolidate	4	Poor presence of suitable stoves and boilers (emissions)	3	Consolidate market of this biofuel although uneven	4		
	High energy density of biofuel	4	Divergence between offer and demand for meteorological reasons	4				
	Standard product, in the case of industrial oil mill	4						
	Consolidate processing industry across Italy	4						
Total		**23**		**16**		**10**		**8**
Wood Chips	High availability of forest wood chips	4	Still very low number of plants installed per years	5	A certification scheme for wood chips already existing	5	Natural disasters make very high the availability of logs and decreasing the chips price	3
	The forest wood chips chain is mature, both for the biosuels as well as for chip boilers	5	Increasly availability of chips class B (thanks to meccanization and development of forest enterpreneurs), but still low number of plants interested to buy this low-quality wood chips	4	High government incentives for the next 10 years	5	Social acceptability of pubblic plants	4
	It is a virtuous "short-chain" with important socio-economics benefits and high added value for local communities	5	Falling sales of small-medium size chips plants, decreasing demand of chips class A1 and A2	4	High market potential: areas still not covered by natural gas grid, industrial processes	5	High volatility of fossil fuels price	4
	Low primary energy price (20-30 €/MWh) relative to fossil fuels (> 90 €/MWh), high competitiveness	5	High costs of chips plants (expecially the small-medium size ones)	4			Lowering of Heating Degree Days (HDD)	4
			Logistic of storing and transportation expensive	4				
			Still poor information for the potential market on the actual reliability of wood chips (Biomass Logistic and Trade Centres)	4				
			Some areas are still not cover by the network of professional chips producers	3				
			Still low number of professional chips producers (about 100 in Italy, the majority is in the North)	4				
Total		**19**		**32**		**15**		**15**
Nut shells	Presence of productive districts	3	Lack of biofuel standard and certification scheme	5	Energy independence of farmers and processing sites	3	Inability to use in the next future (Ecodesign enters in force in 2020 and 2022)	3
	Costant and planable production	4	Poor presence of suitable stoves and boilers (emissions)	4	Availability of solid biomass for energy in agricultural areas	3	Lack of manufacturers' interest for the implementation of suitable stoves and boilers	5
	The residue has to be processed anymore	5			Consolidate market of this biofuel although uneven	4	Social acceptability of pubblic plants	4
	Logistic of harvesting, treatments, and supply consolidate	5						
	High energy density of biofuel	4						
	The quality of biofuels is already quite well standardised	4						
	Consolidate processing industry across Italy (i.e. Ferrero)	5						
Total		**30**		**9**		**10**		**12**
Olive tree prunings	High yearly availability	4	Ash content relative high	3	Energy independence of farmers and processing sites	3	Inability to use in the next future (Ecodesign enters in force in 2020 and 2022)	3
	Presence of productive districts	5	Lack of biofuel standard and certification scheme	5	Added income for farmers	2	Lack of manufacturers' interest for the implementation of suitable stoves and boilers	5
	Costant and planable production	4	Expensive logistic (harvesting, treatments, supply of plants)	3	Self-consumption chains environmental and energy friendly	4	Social acceptability of pubblic plants	4
	The residue has to be processed anymore	5	Poor presence of suitable stoves and boilers (emissions)	3	The controlled combustion of prunings (industrial plants) make better the air quality of productive districts	5		
	The energetic valorisation avoids the outdoor burning of prunings (air quality)	5			Availability of solid biomass for energy in agricultural areas	4		
Total		**23**		**14**		**18**		**12**
Vineyard prunings	High yearly availability, which is increasing durings last years	4	Ash content very high	5	Energy independence of farmers and processing sites	3	Inability to use in the next future (Ecodesign enters in force in 2020 and 2022)	5
	Presence of productive districts	4	Lack of biofuel standard and certification scheme	5	Added income for farmers	3	Lack of manufacturers' interest for the implementation of suitable stoves and boilers	5
	Costant and planable production	5	Expensive logistic (harvesting, treatments, supply of plants)	4	Self-consumption chains environmental and energy friendly	4	Social acceptability of pubblic plants	4
	The residue has to be processed anymore	5	Lack of suitable stoves and small-medium boilers, which permits to burn this biofuels respecting the emissions limits	5	The controlled combustion of prunings (industrial plants) make better the air quality of productive districts	5		
	The energetic valorisation avoids the outdoor burning of prunings (air quality)	5			Availability of solid biomass for energy in agricultural areas	4		
Total		**23**		**19**		**19**		**14**

EXPORTATIONS / IMPORTS OF THE SOLID BIOMASSES IN ITALY

In Italy, the total forest area is 10.600.000 ha. Since the forest removal is lower than the growth, the

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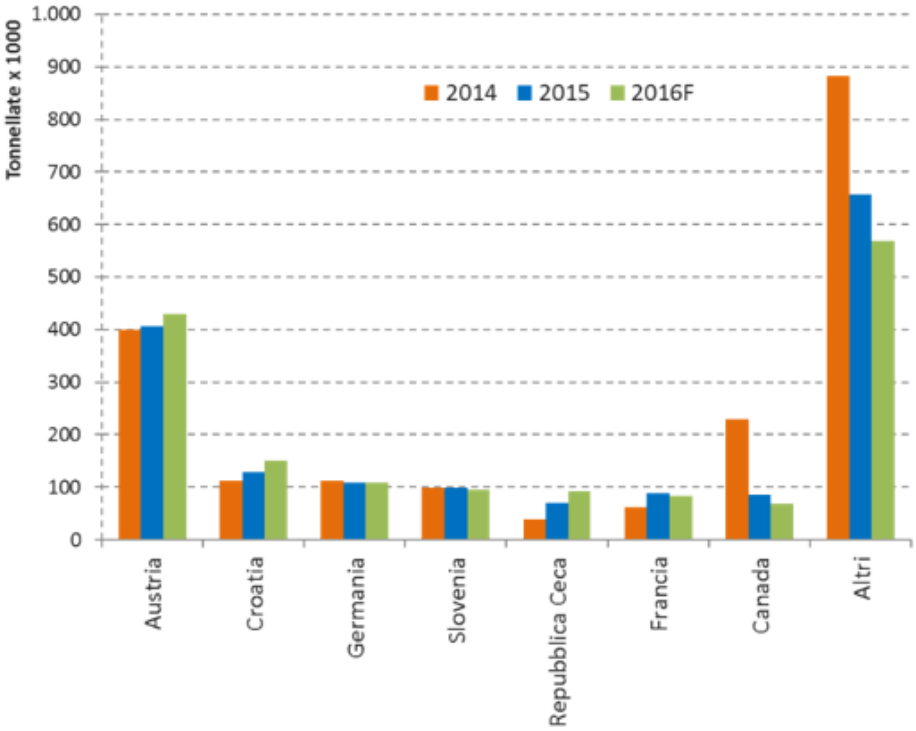
forest area is annually increasing at a rate of 0.6%.
Nevertheless, most of the forest biomass used for energy purposes comes from importations.
All the following figures about biomass availability are to be considered per year.
Starting from wood pellets, at least 80% of the national consumption comes from importations (Figure 10). Historically, the main Italian commercial partner is Austria. Then, the share within North America, Balcans, Baltics and central Europe changes depending on: euro/dollar exchange rate, freight costs, trucks availability and gasoline prices, stocks levels, etc.

Figure 10: Pellet suppliers' countries (EUROSTAT)



Big quantities of wood logs are imported as well. Anyway, it comes hard to make a similar analysis since traceability of importations is still a big issue in our market. Buy the way, about 20% of our consumption comes from Balkans and eastern countries, that are our main suppliers. Another issue is the self-consumption of wood logs, which can represent 30-50% of the total consumption.
We don't have precise data on agricultural biomass, except for olive cakes: at least 100.000 tones are imported every year. Currently, Spain is one of the main partners.

MAIN SUPPORTS FOR THE USE OF BIOMASS IN ITALY

Italy is probably the EU Country with the major support schemes for biomass, giving to the sector great opportunities to keep growing.

The Italian legal framework on ThE can be subdivided in two main group of laws and technical regulations and procedures:

I. White certificates (or "Energy Efficiency Certificates", EEC)
II. Renewable Energy for Heating & Cooling Support Scheme (or "Thermal Account")

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As concerns the White Certificates (or “Energy Efficiency Certificates” - EEC), these are tradable instruments giving proof of the achievement of end-use energy savings through energy efficiency improvement initiatives and projects.

The White Certificates scheme was introduced into the Italian legislation by the Ministerial Decrees of 20 July 2004, as subsequently amended and supplemented. Under the scheme, EE and natural-gas distributors are required to achieve yearly quantitative primary-energy saving targets, expressed in Tonnes of Oil Equivalent (TOE) saved.

Each certificate is worth 1 TOE saved. EE and gas distributors may fulfill their obligation by implementing energy efficiency projects entitling to White Certificates or by buying White Certificates from other parties in the Energy Efficiency Certificates Market that is organized by GME.

High-Efficiency Cogeneration (HEC) units may access the White Certificate scheme under the terms, conditions and procedures established by the Ministerial Decree of 5 September 2011. This Decree enacted by the Minister of Economic Development of 5 September 2011 established criteria and procedures for supporting high-efficiency combined heat & power (or cogeneration) plants through the issuing of White Certificates of type II (TEE II-HEC) by GSE S.p.A. This point deserves further examination. Combined heat & power generation (CHP) or co-generation provides significant energy savings compared to separate generation. The criteria for qualifying generating units as high-efficiency CHP (HEC) are set out in the Ministerial Decree of 4 August 2011, effective from 1 Jan. 2011. This decree completed the transposition of Directive 2004/8/EC, started with Legislative Decree no. 20 of 2007, into the Italian legislation. CHPu qualified as high-efficiency CHP (HEC) have access to the Energy Efficiency Certificates (EEC, in Italian “TEE” or White Certificates) scheme, on the terms and conditions and under the procedures specified in the Ministerial Decree of 5th September 2011. In the context of the Ministerial Decree of 5th September 2011, GSE carries out the following activities:

- Qualifying HEC plants
- Determining the number of White Certificates to be issued to HEC qualified units whose owners have applied for this form of support
- Buying back White Certificates in response to a request made by a producer - at a price equal to the one applicable on the date of commissioning of the unit (or on the date of entry into force of the Ministerial Decree of 5th Sept. 2011 in the case of units already in operation);
- Carrying out activities of verification and monitoring of the supported plants and notifying the Ministry of Economic Development and the producer of their outcome;
- Issuing the Guarantee of Origin of EE from HEC in compliance with Legislative Decree no. 20 of 2007.

This applicable legislative/regulatory framework was recently changed by the Ministerial Decree 28th December 2012 (the so called "White Certificates" decree, which sets national quantitative energy-saving targets - incremental over time - for EE and gas distributors for the years 2013-2016.

The measures introduced by the "White Certificates" decree aim at strengthening the overall effectiveness of the White Certificates scheme, confirming the priority that the national energy strategy assigns to energy efficiency. Energy efficiency is a vehicle to attain all the targets of cost/competitiveness, security, growth and environmental quality, as well as the EU target of reduction of primary energy consumption by 2020. First of all, the decree sets national quantitative energy-saving targets to be pursued - under the White Certificates scheme - by EE and gas distributors in the above mentioned four year period (2013-2016). The Ministerial Decree also lays down criteria, terms, conditions and procedures for implementing end-use energy efficiency initiatives or projects to be supported through the issuing of White Certificates. Moreover, the Ministerial Decree approves 18

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new technical datasheets to quantify primary energy savings. The datasheets have been prepared by Italian ENEA - National Agency for New Technologies, Energy and Sustainable Economic Development. These datasheets may be used to submit standardized and analytical requests for verification and certification. Additionally, ENEA and Energy SystemRSE Research - RSE may - at the request of GSE - develop additional datasheets for measuring, verifying and quantifying energy savings from projects in the following sectors: IT/ICT and telecommunications, heat recovery, solar thermal Concentrated solar power (CSP), water purification and EE distribution systems.

The Premiums, expressed in terms of multiplicative factors of the White Certificates issued, are also envisaged to support large-scale projects (infrastructure, industry, transport) capable of yielding significant volumes of energy savings.

The role of the GSE in this complex legislative framework consists mainly in managing, evaluating and certificating the savings associated with energy efficiency projects under the White Certificates scheme. This task has been transferred from AAEGSI - Authority for Electric Energy, Gas and Water System to GSE on February 3rd 2013. In carrying out this activity, GSE relies on support from ENEA and RSE, each within the scope of its expertise. Furthermore, with the support of ENEA, GSE also verifies the technical and administrative aspects of the implementation of projects that have obtained White Certificates. To do so, GSE randomly checks whether the implemented project complies with the approved project and conducts site inspections during the implementation or useful lifetime of the project.

GSE will assess the project proposals (PPPM) and the requests for verification and certification (RVC) that eligible parties will submit after February 4th 2013 through the "Energy Efficiency" application. AEEGSI will complete the assessment of the project proposals and metering programs (PPPM) filed by eligible parties and processed by AEEG until January 3rd 2013. Moreover, AEEGSI will retain responsibility for assessing and certifying the requests for verification and certification (RVC) submitted before February 2nd 2013.

On February 2nd 2013, the information system for the management of the scheme was transferred to GSE. Consequently, GSE will use this system to issue White Certificates in respect of the RVC approved by AEEG after 1 Feb. 2013.

As regards the eligible parties, these can be classified as follows:

• “Obliged parties” are subject to the obligation of achieving yearly national quantitative energy efficiency improvement targets. Obliged parties may fulfil their obligations by implementing energy efficiency projects - and receiving White Certificates - or by buying White Certificates from other parties.

A. EE distributors with over 50,000 final customers connected to their distribution grids as of 31st December of two years preceding each year of obligation;

B. Natural-gas distributors with 50,000 final customers connected to their distribution network as of 31st December of two years preceding each year of obligation

• "Voluntary parties” are eligible for the White Certificates scheme and may submit energy efficiency projects:

- Energy service companies (ESCos)
- Companies subject to the obligation of appointing an energy manager
- Companies controlled by obliged distributors
- EE or gas distributors not subject to the obligation
- Companies operating in the industry, services, agriculture, transport and public-service sectors, including government bodies, provided that they have appointed a person in charge

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of conservation and rational use of energy ("energy manager" under art. 19, para. 1, Law no. 10 of 9 Jan. 1991) or are certified under the ISO 50001 standard and that they meet the above requirements throughout the technical lifetime of the project

As regards the energy efficiency obligations, yearly national quantitative targets of energy efficiency improvement in EE and gas end uses are defined in terms of millions of White Certificates. To fulfil the obligation, each EE distributor is held - in the 2013-2016 period - to implement projects involving reductions of primary energy consumption, expressed in terms of number of White Certificates. The number of certificates to be accrued and the related years are reported in the following table [Table 1]

Table 1 - Number of White Certificates per specific year for EE distributor [Ministerial Decree December 28th, 20122]

Year	Number of White Certificates [Million]
2013	3.03
2014	3.71
2015	4.26
2016	5.23

In the same way, natural-gas distributors are required to implement projects reducing primary energy consumption. The number of certificates to be accrued and the related years are reported in the following table [Table 2].

Table 2 - Number of White Certificates per specific year for natural gas distributor [Ministerial Decree December 28th, 20122]

Year	Number of White Certificates [Million]
2013	2.48
2014	3.04
2015	3.49
2016	4.28

As regards the ways to access the White Certificates scheme, project proposals (PPPM) and requests for verification and certification (RVC) must be submitted by using the "Energy Efficiency" application. Before using this application, project proponents must complete an accreditation procedure

Ad regards large-scale projects, under the Ministerial Decree of 28th December 2012, "large-scale projects" are defined as projects in the infrastructure sector (the projects may also be combined with energy-saving systems), transport sector, industry sector, resulting into yearly estimated savings of more than 35,000 toe and having a technical lifetime of over 20 years.

The Ministerial Decree of 28th December 2012 provides that the procedures for quantifying the savings achieved through large-scale projects and for issuing the relevant White Certificates shall be established by a specific inter-ministerial decree. The latter decree shall be issued jointly by the Ministries of Economic Development and of Environment, Land and Sea Protection, after seeking the opinion of the Region involved, based on a technical-economic study to be conducted by GSE with the support of ENEA and RSE.

Finally, the decree establishes that the following large-scale projects shall be eligible for premiums, expressed in terms of multiplicative factors of the number of white certificates to be issued:

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- Projects involving significant technological innovations and sizeable reductions of emissions into the atmosphere (premium of up to 30% of the value of the project);
- Projects implemented in metropolitan areas and yielding yearly energy savings of 35,000-70,000 toe (premium of up to 40% of the value of the project);
- Projects implemented in metropolitan areas and yielding yearly energy savings of more than 70,000 toe (premium of up to 50% of the value of the project).

As regards the cumulability with other forms of support, White Certificates issued in respect of projects filed after the 3rd of January .2013 cannot be cumulated with other forms of support (of whatever name) concerning EE and gas tariffs and with other government incentives, except for guarantee funds, revolving funds, loans, exemption from company tax for the purchase of machinery and equipment.
Update information is always available at the website http://www.gse.it/it/CertificatiBianchi/

As concern the Renewable Energy for Heating & Cooling Support Scheme (or "Thermal Account"), the Ministerial Decree of 28th December 2012 (the so-called “Renewable Energy for Heating & Cooling Support Scheme”) implemented Legislative Decree no. 28 of 3rd March 2011 on a scheme of support for small-scale projects of energy efficiency improvement and production of thermal energy from renewables.
The GSE is the body in charge of implementing and managing the scheme, as well as of awarding financial incentives.
Eligible projects concern:

- energy efficiency improvements in existing building envelopes (thermal insulation of walls, roofs and floors, replacement of doors, windows and shutters, installation of solar screens);
- replacement of existing systems for winter heating with more efficient ones (condensing boilers);
- replacement and, in some cases, construction of, new renewable-energy systems (heat pumps, biomass boilers, heaters and fireplaces, solar thermal systems, including those based on the solar cooling technology).

The new Ministerial Decree of 28th December 2012 also introduces - subject to specific requirements - incentives for energy auditing and energy certification associated with the above projects.
The support is granted on the basis of the type of project and on the improvement of the energy performance of the building which may be achieved and/or on the energy which may be produced by renewable-energy systems.
The incentive (contribution to the costs incurred for the project) will be paid in yearly instalments over a variable support period (1 to 5 years), depending on the projects.
The decree allocates funds for a maximum yearly cumulative disbursement of € 200 million for projects implemented or to be implemented by public administrations and a yearly cumulative disbursement of € 700 million for projects implemented by private parties. 60 days after reaching the above limits, no new applications for support will be accepted. Public administrations may “book” incentives for their projects under a special procedure. The yearly cumulative disbursement allocated for public administrations opting for this procedure will not exceed € 100 million (50% of the € 200 million allocation for public administrations). The incentives will be subject to periodical revision pursuant to Legislative Decree 28/2011.
Two types of parties are eligible for this support scheme:

I. Public administrations

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II. Private parties: individuals, apartment block owners and parties with business or agricultural income

The recipient of the support is defined as "Responsible Party", i.e. the party who/which incurs/has incurred the costs for implementing the projects. The responsible party may also authorize another party to submit the application for the incentive and to handle contractual relations with GSE.

Two categories of projects are eligible for the incentives introduced by the Ministerial Decree of 28th December 2012:

- Energy efficiency improvement projects (public administrations may apply for incentives for this category of projects)
- Small-scale projects concerning systems for production of ThE from renewables and high-efficiency systems (public administrations as well as private parties may apply for incentives for this category of projects).

The incentive will be limited to the portion of the project exceeding the one required for complying with the obligation of integrating renewables into new buildings and existing buildings subject to major renovations (as per Legislative Decree 28/2011) and for obtaining the building license.

In order to apply for support, according to the Legislative Decree 28/2011, the incentive is paid by GSE. To this end, GSE has developed a dedicated Internet portal, through which interested parties may apply for the incentive and upload the required documents.

In particular, the responsible party will have to complete an application form specifying the data of the building where the project is to be implemented and the features of the project. These data will enable GSE to check whether the responsible party meets the technical requirements indicated in the decree and to calculate the incentive.

For projects replacing existing winter heating systems with systems equipped with heat pumps or biomass heaters having an overall nominal thermal capacity of more than 500 kWth and of up to 2 MWth, the responsible party must file an application with GSE in order to be enrolled into the appropriate electronic registries.

As regards the cumulability with other forms of support, the incentives may be granted only for projects which do not benefit from other forms of government support, except for guarantee funds, revolving funds and loans. For publicly-owned buildings for public use, the incentives introduced by the Ministerial Decree of 28th December 2012 may be cumulated with grants, in accordance with national and EU legislation. The incentives may be awarded for projects benefiting from other non-government incentives which may be cumulated, in accordance with the applicable national and EU legislation.

Update information is always available at the website http://www.gse.it/it/ContoTermico/Conto Termico 2.0

Other opportunities are given thanks to tax credits, that can be obtained in case of energy efficiency requalification of the building. Tax credits can be up to 50% or 65% of the total investment. They are provided in a 10 years time, depending on the investor's fiscal capacity declared through the Income tax return. Tax credits are handled by the Tax Revenue Agency and subjected to annual revisions.

A complete overview of the national support schemes for biomass can be found in http://www.energiadallegno.it/incentivi/

MAIN PROBLEMATIC OF THE USE OF BIOMASS IN ITALY

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Current main problems related to biomass use in Italy are:

a. Air quality and local bans

Especially in the Po Valley regions, air pollution and the impact of heating systems has become a big issue. The impact of biomass systems to air quality is mainly related to the heating system age and performances, its installation and maintenance, the quality of the biomass that is used in it.

Some studies carried in Lombardy and Veneto regions show how the improvement of these factors can have a relevant impact to the environment:

- The emissions of PM10 coming from the biomass combustion have been reduced in Italy of almost 6% in the last 15 years (AIEL 2016). It has been particular significant in these two regions: -30% in 5 years in Lombardy and -20% in 8 years in Veneto (ARPAL and ARPAV 2016)
- The use of certified pellet (i.e. ENplus) reduces PM10 emissions of 2-4 times (Politecnico di Milano, Caserini et al., 2014)
- In areas where was promoted and supported the replacement of outdated stoves with new generation heating appliances has been measured a reduction of PM2.5 up to 27% (AIEL 2015)
- The replacement of traditional firewood stoves with advanced pellet stoves may lead to a reduction of PM2.5 between 14-50% in winter (AIEL 2015).

b. Public opinion and fossil fuels lobbies:

Public opinion is of course a strategic factor, with high influence on the market and to politics actions. Especially in the last years, when biomass use has become even more relevant, fossil fuels lobbies had increased their efforts to negatively influence the public opinion.

To cope with this threat, it is important to respond to their arguments by supporting a sustainable use of biomass, increasing the quality of the installations, heating systems and biofuels, showing the positive socio-economic impacts of the biomass sectors.

As a consequence, the role of national associations and quality schemes are becoming even more relevant.

CONCLUSIONS

This report clearly shows the relevance of the biomass use in our country, especially where addressed to the residential market. Expectations say that in the coming 5 years biomass will keep being the most relevant source to maintain the quota of RES for heat production (GSE 2016).

Main drivers will keep being the cost advantage of biomass fuels prices compared to fossil ones and the extension of the support scheme Conto Termico.

A driver that has to be enhanced and valued is quality, that has to be applied along all the supply chain (from fuels to appliances) in order to be effective.

These are the basis of the development of the pellet and wood logs markets in Italy. The same principle should be valuable to support the development of the Mediterranean agricultural fuels supply-chain as well. Anyway, since these are still emerging markets, further studies on quality and market potentials should be carried on.

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State of the art of the biomass market. Report of Portugal

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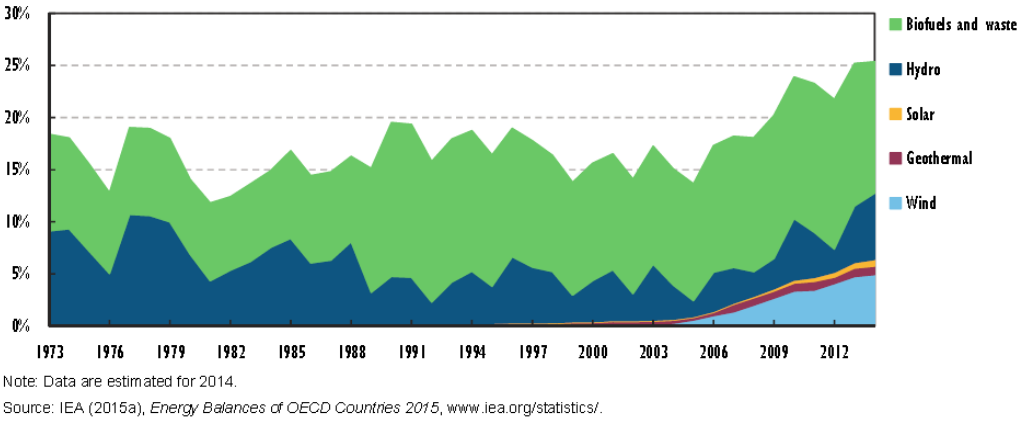
INTRODUCTION

Renewable energy has made strong progress in Portugal over the past decade and the country has become one of Europe's leaders in terms of use of renewable energy sources (RES) such as wind and micro-generation.

Renewable energy accounted for 25.4% of Portugal's total primary energy supply (TPES) in 2014. This share is made up of biofuels and waste (12.6%), hydro (6.4%), wind (4.9%), geothermal (0.8%) and solar (0.6%).

The renewable energy as a percentage of TPES, 1973-2014 is presented in the figure below. [1]



Note: Data are estimated for 2014.

Source: IEA (2015a), *Energy Balances of OECD Countries 2015*, www.iea.org/statistics/.

Figure 1 - Renewable energy as a percentage of total primary energy supply, 1973-2014

Almost 27% of biofuels and waste go into electricity and heat production with the remainder used in industry (36.7%), households and businesses (15%) and transport (10.9%). Electricity from renewable sources amounted to 31.9 terawatt-hours (TWh) in 2014, or 61.3% of total generation. The share of biofuels and waste in electricity generation was 6.4% of RES electricity.

With regard to energy consumption in households (excluding fuels used in vehicles), according to the **2010 Survey on Energy Consumption in Households** (ICESD 2010), Portugal witnessed a change in habits in the last decades. Electricity emerged as the main source of energy consumed in households, representing 42.6% of the total energy consumption. **Firewood was the second main consumed energy source in Portuguese households, with a weight of 24,2% in total energy consumption in homes**, stress being laid on its loss of importance in the past few years (60,3% in 1989 and 41,9% in 1996). [2] [3]

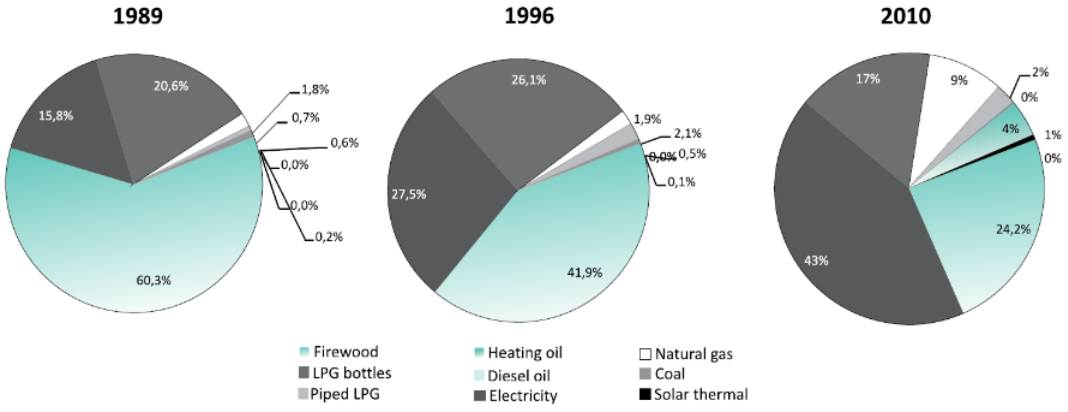


Figure 2 - Distribution of energy consumption in households by source type -Portugal, 1989, 1996 and 2010 [4] [2]

According to the ICESD 2010, the main sources of energy used for space heating were, in descending order of importance (in terms of consumption in toe), biomass, heating oil, electricity and LPG. Biomass, mainly firewood, is the most common fuel, which represents about 68% of total energy consumption for space heating.

A breakdown of the distribution of energy consumption in households for **space heating** by source type is given in the following picture. [2]

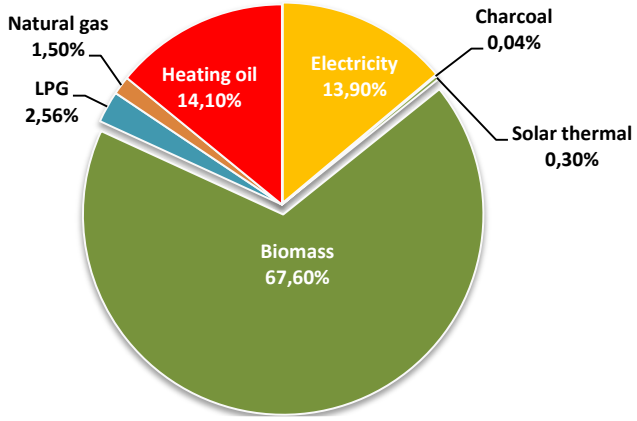


Figure 3 - Energy consumption in households for space heating by source type [2]

Focusing now on the main source of this biomass, according preliminary results of the 6th Nacional Forest Inventory [4], in Portugal Continental the forest occupies about 3,15 million hectares, representing 35,4.8% of the mainland, being the dominant use of soil. This percentage of forest use puts Portugal in the middle of the 27 countries of the European Union (37,6%, SOEF, 2011 [5]).

The bushes and pastures represents the 2nd soil class use (32%), it stands out the bushes areas, that represents about 1,5 millions of hectares.

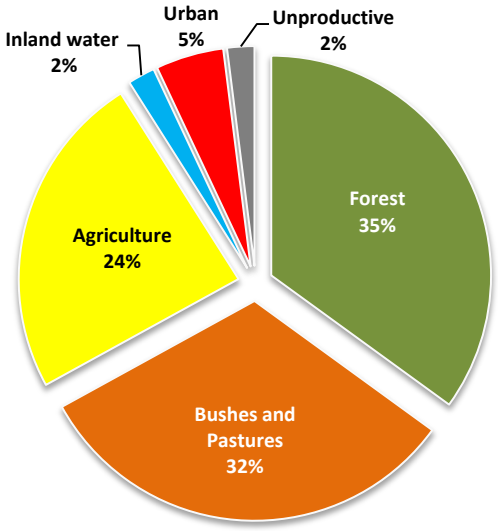


Figure 4 - Soil use distribution in Continental Portugal [6]

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Concerning the national forest cover, the most representative forest species are eucalyptus (*Eucalyptus globulus*), with 812 thousand hectares, the cork oak, with 737 thousand hectares, and the maritime pine (*Pinus pinaster*), with 714 thousand hectares, which together represent 72% of the total forest area.

Other species with significant expression are holm oak (*Quercus ilex*), with 331 thousand hectares, and stone pine (*Pinus pinea*), with 176 thousand hectares.

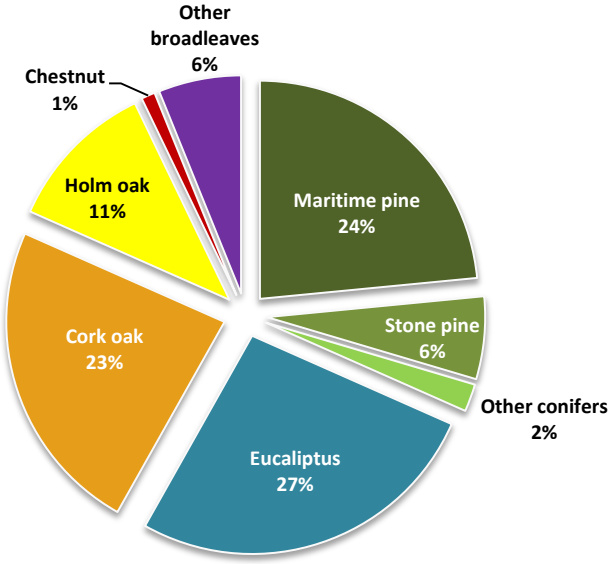

Figure 5 - Forest area by specie/species group [6]

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MAIN COMMERCIALIZED SOLID BIOFUELS IN PORTUGAL

Wood (firewood, wood chips, pellets and briquetes) is the most important solid biofuel source in Portugal. It is traditionally used for heating. According to the data available on solid biofuels produced in the country, wood represents about 94% of the total production.

The following figure indicates the annual quantities of wood utilised in the country and their main destination: domestic-residential or industry and farms.

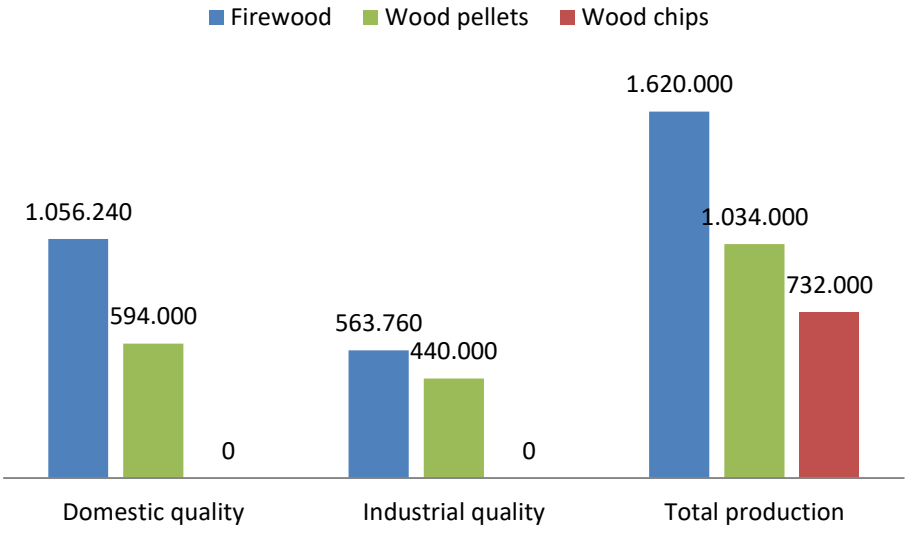

Figure 6 - Annual quantities of wood utilised

Firewood is the most common and known solid biofuel fuel in Portugal. According to the data, the annual production of firewood in Portugal amounts to 1.620.000 tons/year (INE, 2015). The largest consumers of firewood are the residential and service sectors with a total consumption of 1.056.240 tons/year, which represents 65% of the total consumption of this solid biofuel.
However, a significant part of the firewood trade is still in the parallel market and is not quantified.
In recent years, the production and use of pellets had a great development in the country. Presently, according to the Portuguese Pellet Association (ANPEB), Portugal has about 26 pellets plants, and the estimated production capacity is 1.400.000 ton/year, being the effective production of about 1.034.000 ton/year. Only about 20% of the production is destined for domestic consumption, the remaining 80% is exported to several markets such as Spain, the United Kingdom and Benelux, representing a business volume of around 116 million euros. [7]

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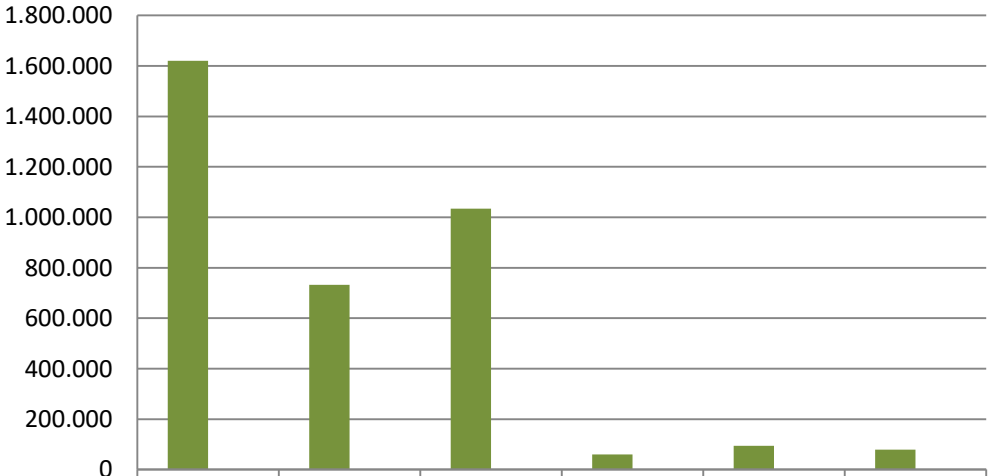
BIOMASSES WITH POTENTIAL INTEREST IN PORTUGAL

The following figure indicates the annual quantities of solid biofuels produced in the country.



	Firewood	Wood chips	Wood pellets	Olive stones	Exhausted olive cake	Nut shells
t (DM/y)	1.620.000	732.000	1.034.000	59.746	94.597	78.626
%	44,8%	20,2%	28,6%	1,7%	2,6%	2,2%

Figure 7 - Annual quantities of solid biofuels produced in the country

As already mentioned before, **wood** (firewood, wood chips, pellets and briquettes) represents about 94% of the total solid biofuels produced in the country, according to the available statistical data.

The **olive stones and olive cake**, once the excess moisture is removed, are used directly as fuel in certain industries for a long time ago. Additionally, the demand for **olive stones** on the residential and services market is increasing. For example, the use of olive stones in small and medium capacity biomass appliances is replacing wood pellets in some cases. Consequently, the consumption of olive stones with controlled quality has a significant potential in Portugal in this sectors.

Concerning the different types of **nut shells**, according to the "BIOMASS INVENTORY ON THE SUDOE SPACE", realized in the previous BIOMASud project [8], in Portugal the quantity of nut shells available from this agro-industry is low compared with the total production of almond, pinion, walnut and hazelnut. Effectively, most of these fruits are exported to other markets without being processed (i.e. with shells). Nut shells available are typically consumed by the crushers, for self-consume in their boilers, or sold in a restrict area. Therefore, a significant potential of this solid biofuel is not being used actually in Portugal.

Concerning **woody agricultural residues**, the vineyard and olive tree are the main biomass producers, although the orchards of oranges, apple and pear also present a significant potential in Portugal. These sub products, namely olive tree pruning's, are being object of several studies related to their energy recovery, and there is relevant technical information in for their conversion into advanced biofuels. [9]

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EXPORTATIONS / IMPORTS OF THE SOLID BIOMASSES IN PORTUGAL

It is difficult to find consistent statistics data of exports / imports of solid biomasses in Portugal.
The most available and reliable information is in the sub sector of pellets. According to the Portuguese Pellet Association (ANPEB) the production of pellets in 2014 was about 1.100.000 tonnes. Only about 20% of the production was for domestic consumption, the remaining 80% were exported to several markets such as Spain, the United Kingdom and Benelux.
The needs of the Portuguese pellet market are almost exclusively granted by the national production, being the imports almost inexistent.

MAIN SUPPORTS FOR THE USE OF BIOMASS IN PORTUGAL

Renewable electricity [1]

In Portugal, the principal instrument for promoting **renewable electricity** is the special production regime, whereby electricity produced from renewable energy benefits from a feed-in tariff (FITs).
Feed-in tariff for electricity produced from renewable sources was until recently treated under the Special Production Regime, established by Decree-Law 312/2001 of 10 December. Until 2012, producers were remunerated on the basis of a formula established by means of separate legislation (Decree-Law 189/88 of 27 May, and updated by Decree-Law 225/2007 of 31 May). The FIT were updated at suitable intervals, for the purpose of reflecting the latest investment and operational costs of each technology, as well as inflation and energy prices.
More recently, a new regulatory (Decree-Law 215- A/2012 and Decree-Law 215-B/2012, of 8 October), allowed anyone producing electricity from renewable sources to sell it in the open market.
For existing and still valid tender procedures (forest biomass, wind, hydro and PV) the previous FIT remains valid until the completion and fulfillment of the established preconditions, i.e., **for electricity produced from forest biomass, there is an indicative average of EUR 119 per MWh for a period of 25 years** (Decree-Law 5/2011, of 10 January revised by the Decree-Law 179/2012 of 3 August, and by Decree-Law 166/2015 of 21 August).

Micro-generation and mini-generation [1]

Micro-generation Law (Decree-Law 363/2007, of 2 November, revised by the Decree-Law 118-A/2010 of 8 October and by the Decree-Law 25/2013 of 8 March) regulates small-scale production of renewable electricity (up to 5.75 kW). The **micro-generation** law defines two regimes:

- The **general regime** is applicable to any type of micro-generation up to a limit of 5.75 kW (25 amperes single-phase).
- The **special regime** is applicable to renewable electricity production up to a limit of 3.68 kW (16 amperes single-phase) where a reference FIT is established and applied to each technology according to a different percentage: 100% for solar, 80% for wind, 40% for hydro, 70% for biomass CHP and 40% for non-renewable CHP. The reference FIT for new producers reduces each year and, once defined, is valid for 15 years divided into two periods , one of eight years and another for the remaining seven years with different values for each. In 2014, the reference FIT was EUR 66/145 per MWh for PV and EUR 218/115 per MWh for other technologies

Mini-generation Law (Decree-Law 34/2011 of 8 March, revised by the Decree-Law 25/2013 of 19

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February) regulates the small-scale renewable energy generation (from 5.75 kW to 250 kW). It also provides for the same simplified licensing procedures for local gridconnected, low- or medium-voltage, small/commercial/industrial energy producers.
The **mini-generation** law defines two regimes:

- The **general regime** is applicable to any type of renewable energy generation technology up to 250 kW.
- The **special regime** is applicable to any type of renewable energy generation technology up to 3.68 kW (16 A single-phase). A reference FIT which is established and applied to each RES according to a different percentage: 100% for solar, 80% for wind, 50% for hydro, 60% for biomass and 60% for biogas. The reference FIT for new producers are reduced each year and, once defined, is valid for 15 years. In 2014, the reference FIT was EUR 105.7 per MWh for PV and EU 158.6 per MWh for other technologies.

The new regulatory framework (Decree-Law 153/2014 of 20 October) is applicable to small-scale RES generation with grid injection and with a FIT (up to 250 kW) and to generation based on any kind of source for own consumption (no capacity limit). It provides for the same simplified licensing procedures as the previous programmes of micro- and mini-generation for local grid-connected energy producers or off-grid using self-consumption, allowing the two regimes:

- The **small generation** is applicable to any type up to a limit of 250 kW, where a reference FIT is established and applied to each RES according to a different percentage: 100% for solar, 90% for biomass and biogas, 70% for wind and 60% for hydro. The reference FIT for new producers in 2015 is valid for 15 years, and has a value of EUR 95 per MWh, to which EUR 5.0 per MWh are added if there is 2 m^2 of solar thermal panels in the consumer's installation or of EUR 10 per MWh if there is an electric vehicle charging power outlet connected to the mobility grid in the consumer facility.
- **Self-consumption** is applicable to any kind of source since it does not benefit from a FIT, and has the possibility of injecting the surplus into the grid, which if paid by the last-resort supplier at 90% of the average monthly market price. Optionally, renewable energy generators in self-consumption (either grid connected or off-grid) can also trade the electricity surplus or the generated electricity by green certificates.

Heating

Concerning the production of thermal energy in the residential and services buildings the existing legislation boils down to the System for Energy **Certification of Buildings (SCE**). The Decree-Law No. 118/2013 of 20 August, that approves SCE, integrates the Regulation on the Energy Performance of Residential Buildings (REH) and the Regulation on the Energy Performance of Services Buildings (RECS). The System constitutes a transposition of the Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010, Energy Performance of Buildings Directive (EPBD), into national law. [10]
This Decree-law is supported through the publication of 6 ordinances and 12 orders that includes the specific calculation methodology, renewable energy account, energy performance certificates (EPC) lay-out, climate data, primary energy conversion factors and others. [4]
SCE establishes the obligation to use solar thermal panels or alternative systems that use renewable energy, such as biomass systems, for space heating and water heating purposes. Boilers and stoves that use biomass as solid fuel must meet the minimum efficiency requirements defined in ordinance

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No. 349-B / 2013 of November 29th (REH solutions requirements for residential buildings), as shown in the following table:

Table 12: Minimum energy efficiency applicable to biomass boilers and stoves [11]

Appliances		Energy Efficiency (%)	Applicable standards
Boilers fired by solid fuel	Wood	≥ 0.75	EN 12809[5]
	Pellets	≥ 0.85	
Stoves fired by solid fuel		≥ 0.75	EN 12809[6] EN 12809[7] EN 12809[8]

MAIN PROBLAMATIC OF THE USE OF BIOMASS IN PORTUGAL]

To overcome the main barriers to increase the use of biomass and to achieve a sustainable market on biomass for energy, some actions are needed; namely: [12]:

- **Increase the forest biomass production.** Can be achieved by increasing forest areas and their productivity, become profitable the abandoned forest areas, promoting forest certification and reducing management costs.
- **Ensure the supply of biomass:** Creating local biomass markets organized such as "Biomass Logistic and Trade Centres". These infrastructures intend to develop and organise the local biomass supply**.**
- **Ensure the quality of the existing biomass on the market**: Becoming mandatory the certification of products such as wood pellets for non-industrial use. Fuel standardization will support consumer confidence.
- **Ensure that new projects use modern and high efficient technologies.** Supporting projects whose equipment meets stringent emissions and quality standards is crucial for market transformation. Biomass heating systems must offer high performances similar to oil and gas systems.
- **Guarantee the quality of the installers of small-scale RES installations.** Develop and mutually recognize accreditation and certification schemes for installers of small-scale renewable energy installations.
- **Facilitate financing and investments**. Promoting energy contracting model, through ESCOs, companies capable of carrying out the design, installation, commissioning, operation, maintenance of facilities and supply biomass. With this model, the consumer pays only the energy it consumes and does not have to make any initial investment.

[5] EN 12809:2001 - Residential independent boilers fired by solid fuel - Nominal heat output up to 50 kW -Requirements and test methods

[6] EN 13229:2001 - Inset appliances including open fires fired by solid fuels - Requirements and test methods

[7] EN 13240:2001 - Room heaters fired by solid fuel – Requirements and test methods

[8] EN 14785:2006 - Residential space heating appliances fired by wood pellets –Requirements and test methods

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- **Promote modern biomass solutions. Promote the integration of biomass with solar thermal system.** Information campaigns and awareness are essential to kick-start markets. Information and awareness is needed for different market stakeholders (biomass producers and distributors, equipment producers and distributers, heating companies, installers) and potential customers (homeowners, housing developers, owners and operators of larger services buildings).

CONCLUSIONS

Nowadays, one of the main challenges is the evolution to a clean and sustainable worldwide economy.
The overall objective of the **BIOMASUD PLUS** project is to develop integrated solutions to promote the **sustainable market for Mediterranean solid biofuels** for residential heating.
This **solid biofuels market**, based on controlled biomass and modern and efficient systems, has a great potential of development in Portugal. However, Portugal still has much to do to reach a state of maturity in this market.
The development of this market creates new jobs, avoids greenhouse gas emissions (GHG) and improves the security of the supply of energy.
The further development of the **biomass market** should comprise some key aspects: **i) sustainability**, **ii) high conversion efficiency**, **iii) information and awareness**.

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State of the art of the biomass market. Report of Slovenia

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INTRODUCTION

Slovenia is one of the most densely afforested countries in Europe. Forests cover 58,5 percent of the surface area, or 1.182.000 ha, and dominates as much as three-quarters of the landscape (Ministry of Agriculture, Forestry and Food, 2016). Most of Slovenia's forests are in the region of beech, beech-fir and beech-oak sites, all of which have a relatively strong productive capacity. According to the data of forest management plans by the Slovenia Forest Service (SFS), the growing stock of Slovenian forests for the year 2015 amounts to 348.203.000 m^3 or 295 m^3 per hectare (SFS, 2015). The share of growing stock of coniferous trees is 45 % and of deciduous trees 55 %. The annual increment of Slovenian forests for the year 2015 amounts to 7,3 m^3 per hectare. In 2014, Slovenian forests was affected by severe ice break and due to sanitation of damaged forests, the annual cut in 2014 and 2015 significantly increased. Furthermore, in 2015 Slovenian forests have been endangered by bark beetles' gradation and the annual cut has totalled 6.031.000 m^3 of biomass (SFS, 2015). In addition to extensive forest cover in Slovenia, there is a lot of tree and bush wood also on the non-forest categories of land, especially on abandoned farm lands which are getting overgrown with forest vegetation. Rich wood resources though are rather badly exploited in Slovenia, yet cutting in forests, as the most important wood resource, does not even reach half of their increment (Wisdom Slovenia, 2011).

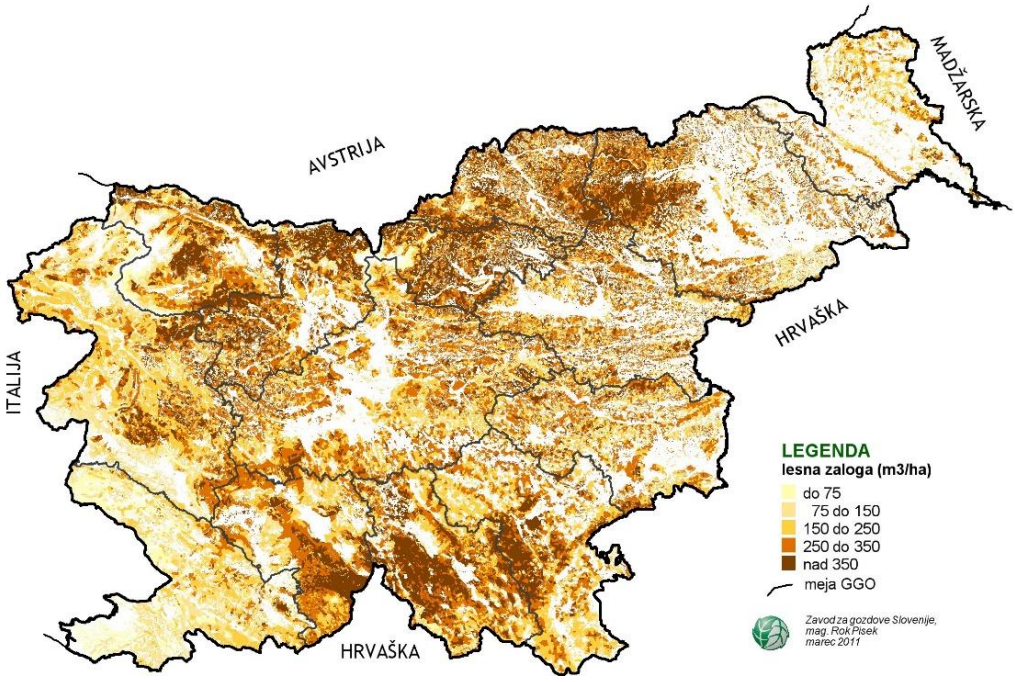

Figure 1: Growing stock (m^3/ha) in Slovenian forests (source: SFS, 2011)

76 % of forests in Slovenia are private property, 24 % of forests are public (owned by the state or communities) (SFS, 2015). Larger and undivided forest estates of state-owned forests enable good professional management. Private forest estates are small, with an average area of only 3 ha and even these are further fragmented into several separate plots. For the great majority of these estates forests are not of economic interest.

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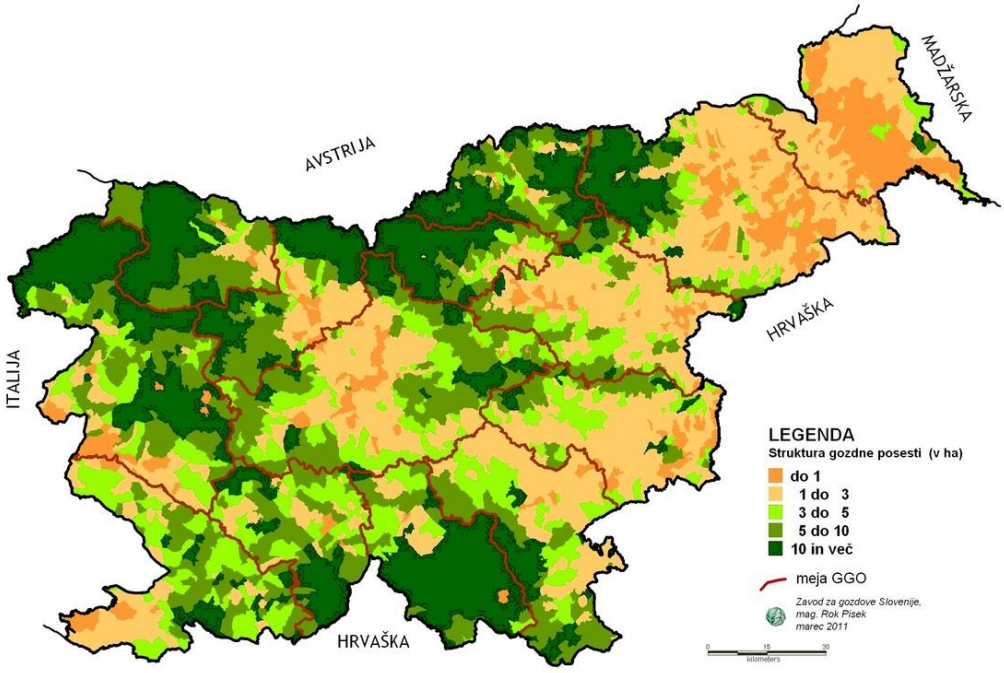

Figure 2: Structure of the forest property by size classes (ha) in Slovenia (source: SFS, 2011)

Most of the wood consumed for heating comes from forests, while up to 20 % of the total energy consumption of roundwood is from short rotation forestry, wood residues, wood wastes etc. (Čebul et al., 2011). It appears that there are two independent wood fuel circuits: one household circuit that uses mainly fuel wood from forests and farmlands and one industrial circuit that uses mainly residues from wood and pulp and paper industries. Not only the forests but also sawmills and furniture making industries are important sources of woody biomass potentially useful (or already used) for energy production. The plantations of fast-growing trees in our country are not very important, because we have a lot of wood suitable for production of wood biomass in our forests, as well as we do not have enough suitable land for the establishment of these plantations. In Slovenia there are two plantations of fast-growing trees, both founded in 2009, with a total area of 6 ha (Čebul et al., 2012).

Most of forest wood assortments (roundwood) is intended for further processing in the wood-processing industry while approximately a quarter of roundwood from forests are used for energy purposes, mostly for heating (Krajnc and Čebul, 2012). At present, the majority of fuel wood in Slovenia is used by household for heating purposes, for which this fuel provides about one third of the national energy demand (Pezdevšek Malovrh et al., 2012).

The information on wood industry primary production and residues production is not directly available. However, several studies and data sources can be used or consulted in order to estimate and map the woody biomass resources of potentially available from this sector (Wisdom Slovenia, 2011). In 2004 the study was done by Slovenian forestry Institute and the results showed, that the quantities of wood residues usable for energy purposes in Slovenia are approximately 1.360.000 tons per year.

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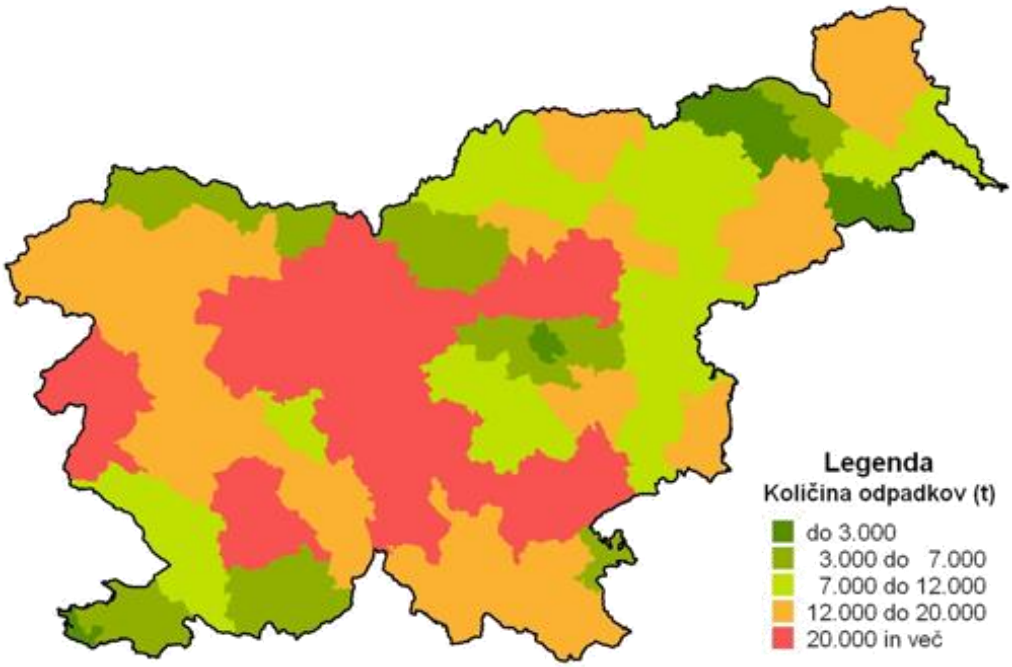

Figure 3: Estimated quantities of wood residues of wood-processing plants (t) at the level of administrative units in Slovenia (source: SFI, 2005)

One of the sources of wood biomass is also wood from shrubs, orchards and vineyards, renovations and maintenance of parks and green areas, cleaning of pastures and other agricultural or urban land. Potential of wood biomass from areas outside the forest is needed to be evaluated and determine their actual potential use. According to the study done by Slovenia Forest Service (SFS, 2004), the potential of wood biomass usable for energy purposes outside the forest is approximately 300.000 m^3 per year.

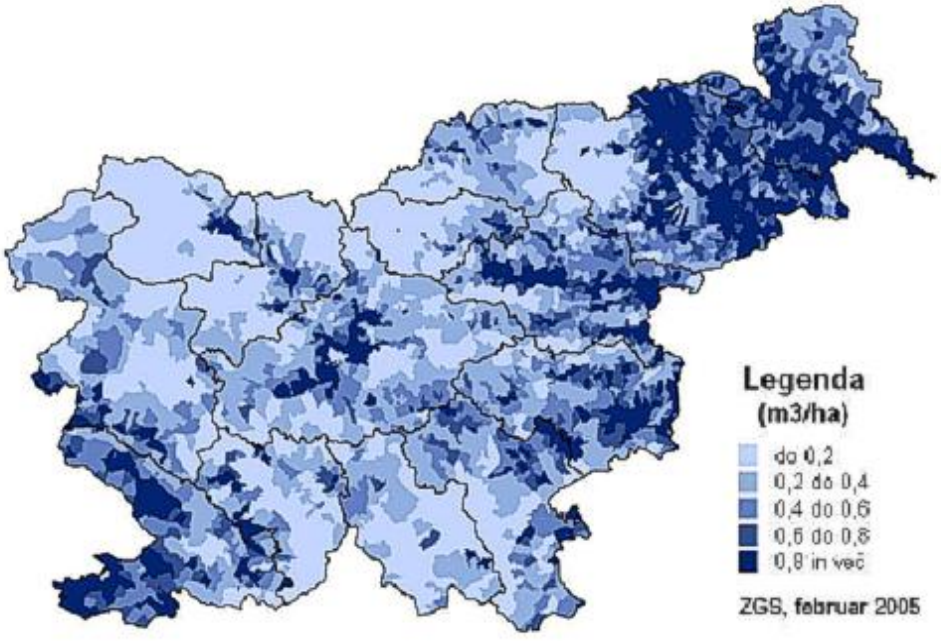

Figure 4: The potential of biomass (m^3/ha) in non-forest land in Slovenia (source: SFS 2005)

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MAIN COMMERCIALIZED SOLID BIOFUELS IN SLOVENIA

Wood is the most important renewable energy source in Slovenia; wood biomass can be divided in three categories: firewood, wood chips and pellets, and wood briquettes. Biomass is mainly used (95 %) for the production of heat, especially in households.

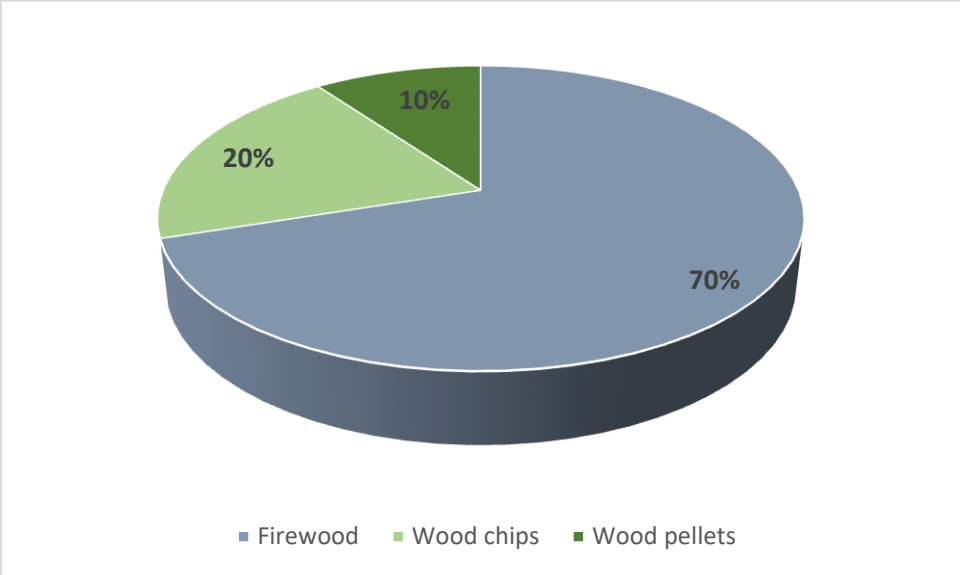

Figure 5: Solid biofuels production (domestic and industrial quality) by biofuel type (in tDM /y)
*data for wood briquettes are not gathered

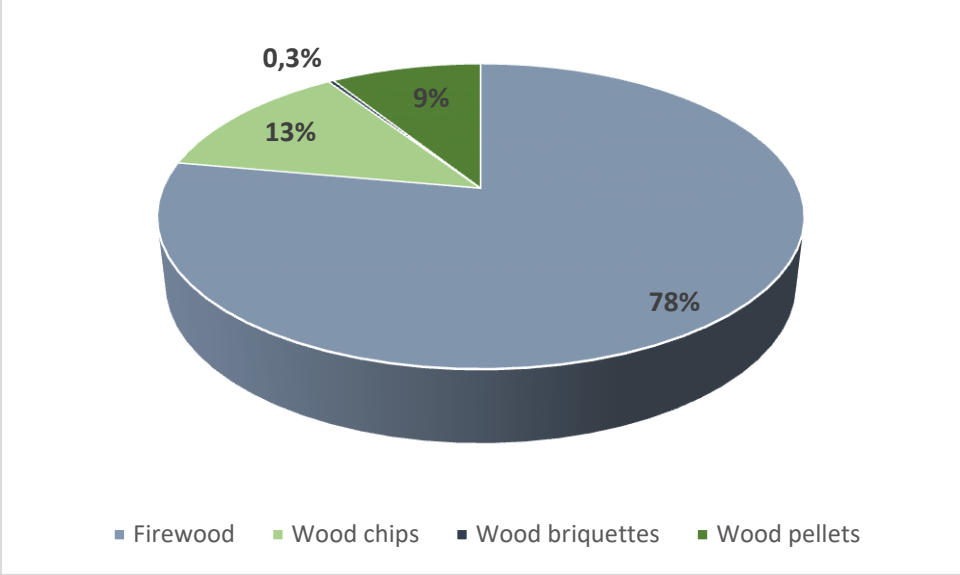

Figure 6: Solid biofuels use (domestic and industrial quality) by biofuel type (in tDM /y)

Firewood is the most common and known form of wood fuel in Slovenia. It is traditionally used for heating, but in recent years also use of wood chips and pellets has grown. According to the data, the annual production of firewood in Slovenia amounts to 1.331.000 net m^3 (SORS, 2015). The largest consumer of firewood are households with a total consumption of 1.212.000 tons which represents 78 % of the total consumption of wood fuels in households (SORS, 2015).
In autumn 2015 study about state of the art of wood chips production was performed (SFI, 2015). The study included 186 wood chippers all around Slovenia (which represents more than 85 % of all wood chips producers in Slovenia in October 2015), where small size chippers prevail (capacity up to 30 loose

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m^3/hour). There are 34 wood chippers (18 %) in Slovenia that can achieve a production capacity of at least 100 loose m^3/hour. Wood chips manufacturers are technologically well equipped; the total production was estimated to more than 1.500.000 loose m^3 of wood chips in 2014. It is estimated that in Slovenia the number of wood chippers is even higher, but their production is negligible and they are mainly used for production of wood fuel for domestic use.

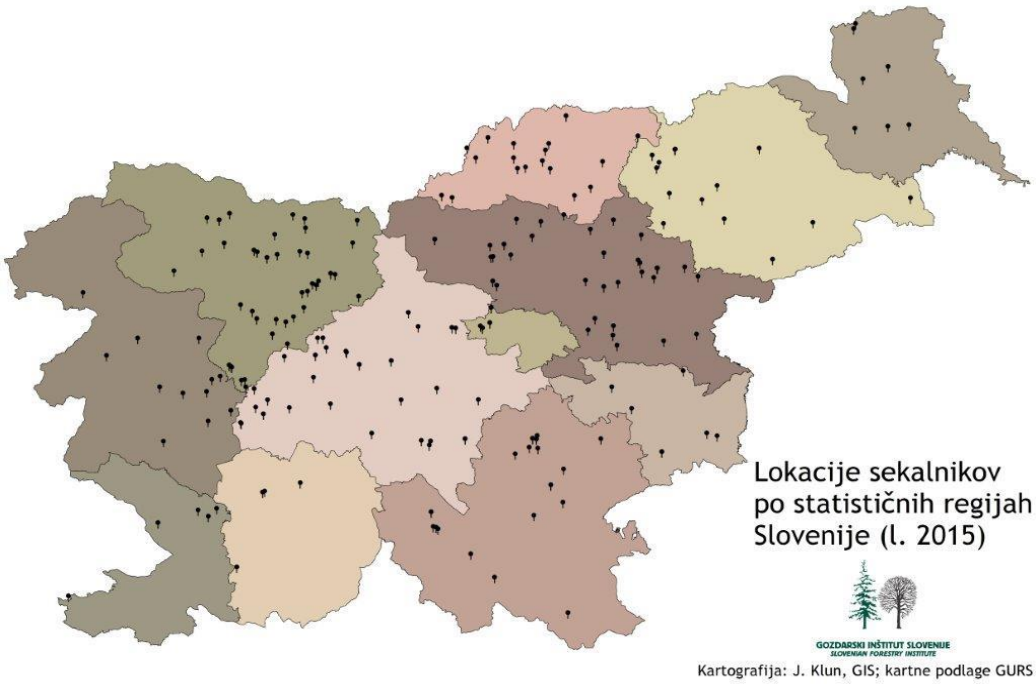

Figure 7: Locations of chippers by statistical regions of Slovenia (source: SFI, 2015)

In Slovenia, the domestic production of pellets is increasing; in 2015 the trend of increasing domestic demand is continuing (+ 6 %) as well (Market statement…, 2016). The main consumers of wood pellets are households, followed by larger public buildings and other users. Last year, the production of pellets recorded a 10 % increase to 110.000 tons (Market statement…, 2016). Among Slovenian pellet manufacturers, smaller manufacturers with a yearly production of under 10.000 tons hold the greatest share. In 2014 Slovenian forestry Institute developed system for assurance of quality wood fuel, called S4Q. S4Q support system is designed for micro and small-scale biomass producers which produce pellets only for domestic market. By the end of 2016, 7 of the total 20 Slovenian pellet manufacturers got right to use a trademark S4Q.

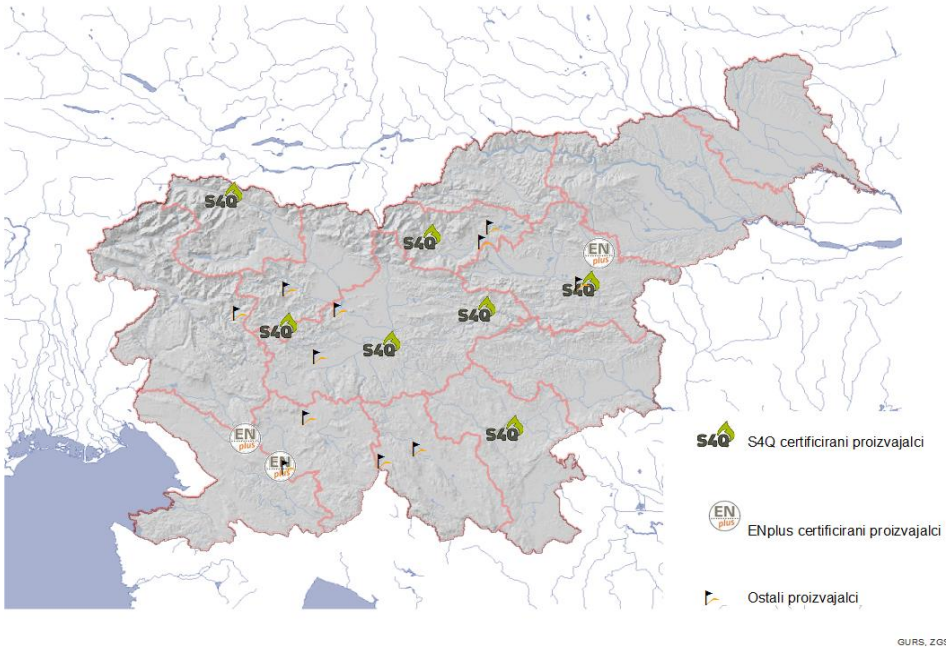

Figure 8: Slovenian pellet manufacturers (source: SFI, 2016)

BIOMASSES WITH POTENTIAL INTEREST IN SLOVENIA

Renewable energy sources supply (excluding hydro energy) amounted to 29.354 TJ in 2015, which is 3 % more compared to 2014 (Market statement…, 2016). The structure of RES is shown in Figure 9. The largest amount of energy from RES is acquired from wood and wood biomass, with a domestic production of 22.832 TJ in 2015, which is 1.7 % less compared to 2014.

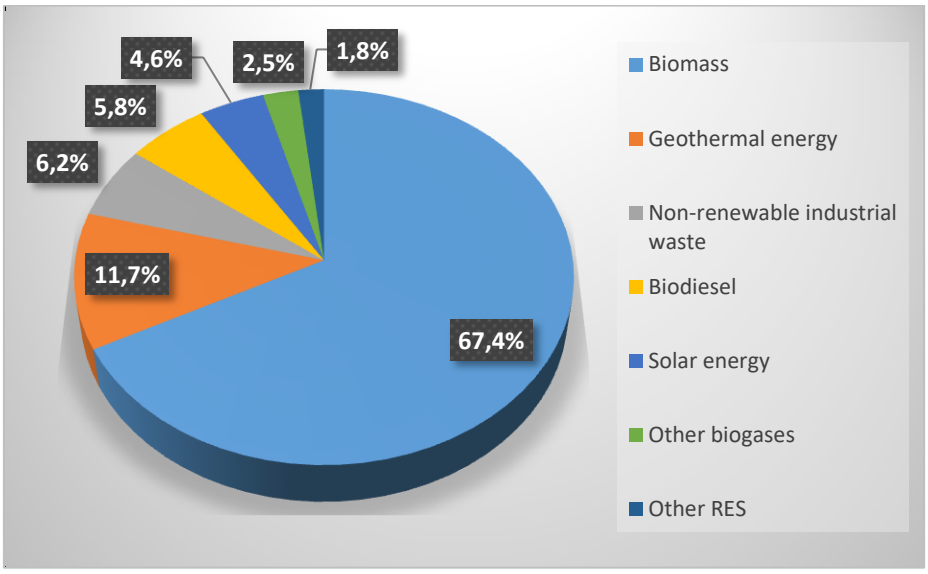

Figure 9: Structure of RES (excluding hydro energy) in gross final energy use in Slovenia in 2015 (source: Ministry of infrastructure, 2015)

The largest consumers of wood fuels are households with a total consumption of 1.6 million tons recorded for 2015 (Market statement…, 2016). The largest single consumer of wood for energy

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purposes is the district heating system in a capital city Ljubljana with an installed capacity of 152 MW. The thermal power plant and the district heating plant recorded a 21 % increase in their consumption of wood fuels (chips) in 2015. Other energy production systems and CHP plants recorded a 27 % increase last year (Market statement…, 2016).

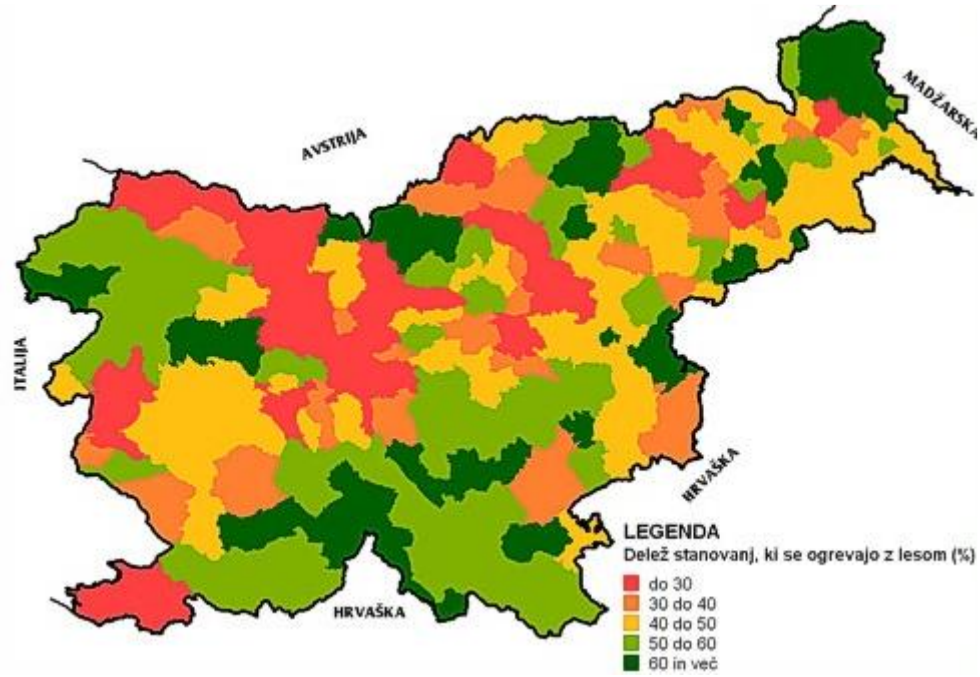

Figure 10: The proportion of dwellings (%) where the wood is the only or the main source of heating (source: SORS, 2002)

At the country level, the overall assessment of the potential of forest biomass by municipalities was made (Figure 11). This estimate covers demographic and economic indicators for each municipality, which affect the wood production. In the process, it was considered as many as nine different factors. From a perspective of assessing the potential and the use of wood biomass from forests, the higher ratings was given to municipalities with lower population density (the more rural parts of Slovenia) and the highest proportion of forests, municipalities with higher average private property, greater proportion of deciduous trees of lower quality and lower realization of annual available cut and municipalities with a greater proportion of dwellings, where the wood is already used as an energy source for heating.

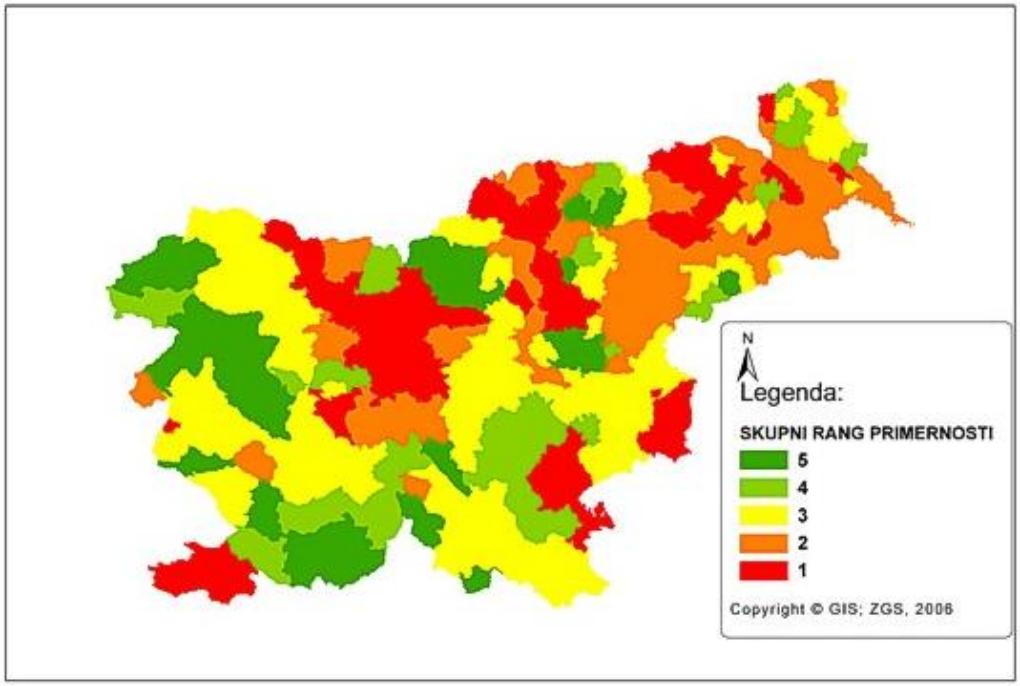

Figure 11: Overall assessment of the potential of forest biomass by municipalities in 5 stages of suitability: rank 1 - the municipalities are less suitable for the use of biomass; rank 5 - the municipalities are highly suitable for the use of biomass (ZGS, 2016)

EXPORT / IMPORT OF THE SOLID BIOMASSES IN SLOVENIA

The statistics on the import and export of timber assortments are monitored by the Statistical Office of Republic of Slovenia but the data on trade inside the EU are collected and reported by companies and the data on trade outside the borders of the EU, reporting is based on customs declarations. Import and export in the EU countries is covered by Intrastat system and the data on imports and exports from non-EU countries is covered by Extrastat system (Krajnc and Piškur, 2006).

In the last ten years, there is an increasing interest in the production and use of various wood fuels. Consequently, by increasing the consumption of wood fuels also the supply increases. Export is considered as it is seen mainly as a threat from the national point of view and as an opportunity from producers' side. The most wood fuels are exported to Italy. Import is considered in terms of raw material import, especially in wood pellets production (Pezdevšek Malovrh et al., 2012). The main import markets for wood fuels are Romania, Bosnia and Herzegovina and Croatia.

Firewood has an important role in the biofuel branch in Slovenia, although the market is of somewhat spontaneous nature. Most of the produced firewood is intended for domestic use and sales on the local market. The majority firewood trade, however, still means uncontrolled buy and sell from individuals (mostly farmers) (Pezdevšek Malovrh et al., 2012). Despite all the facts, some quantities of firewood are also imported and exported; the main import is from Bosnia and Herzegovina and Croatia and the main export market is Italy.

Figure 12: Export and import of fuel wood (firewood, twigs, billets, faggots and similar forms - code 4401 10 00 by nomenclature of the EU) in Slovenia (in m^3) (source: SORS, 2015)

Slovenia is a net exporter of conifer wood chips and a net importer of deciduous wood chips. In wood chips import, deciduous wood chips prevail (a share of 80 – 90 %), and in export, conifer wood chips hold the greatest share (70 – 80 %). Wood chips are mainly imported from Croatia and exported to Austria and Italy (Market statement…, 2016).

Figure 13: Export and import of wood chips (t) in Slovenia (source: SORS, 2016)

The Country Market Statement 2016 reports that the trend of increasing domestic demand of pellets is continuing, which led to increased export, but the import dropped for 4 % compared with the previous year. Despite an increase in the domestic production of pellets, Slovenia remains a net importer of pellets. Romania is the dominant importer of pellets (47 %) and the main export market is Italy (Market statement…, 2016).

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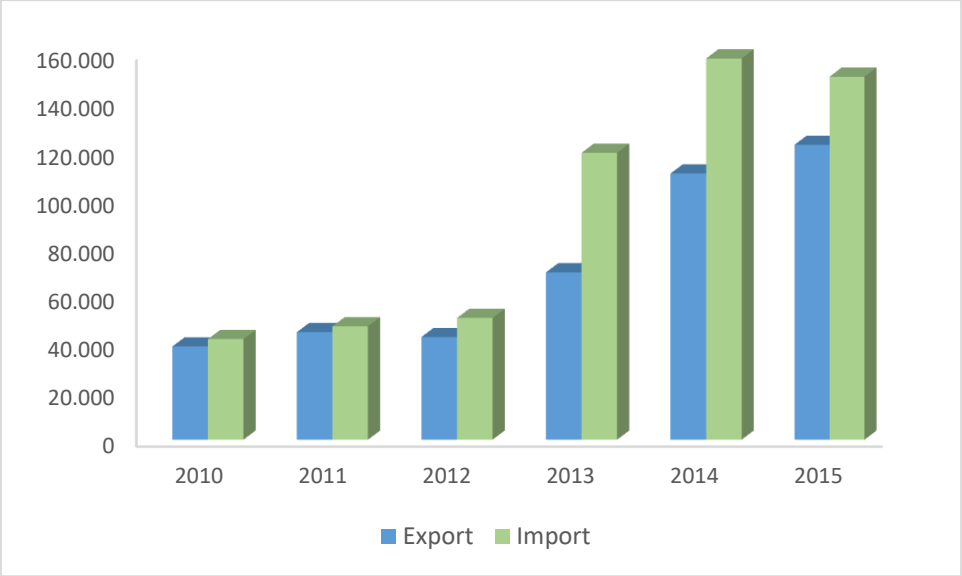

Figure 14: Export and import of wood pellets (t) in Slovenia (source: SORS, 2016)

POLICY SUPPORT FOR THE USE OF BIOMASS IN SLOVENIA

The market for all wood fuels in Slovenia is developing rapidly. This is largely supported by the state with co-financing of investment in modern machinery for the production of wood fuels and boilers for central heating and with the support of promotional projects (Krajnc and Čebul, 2012).

The financial instruments for investments in projects regarding the use of renewable energy sources as well as effective use of RES in energy are:

- Energy Efficiency Action Plan 2008-2016 provide the public funds for the implementation of the promotion of efficient energy use (eg. replacement old heat generation systems with new systems using wood biomass, energy information network for citizens, and green public procurement).
- National Renewable Energy Action Plan 2010-2020 provide adequate support environment for energy rehabilitation of existing buildings, use of renewable energy sources for electricity, increasing the use of RES for energy purposes and introducing biofuels and other renewable energy sources in transport and farming.
- Eco Fund subsidies have had a positive effect on tax revenues, diminishing of grey economy, new green jobs, sustainable development of the construction planning and business, as well as the development of the use of strategic resources, such as wood. The Eco Fund continually implements the following financial programmes (Market statement…, 2016):

- loans to legal entities and sole traders for investments in environmental infrastructure, environmentally sound technologies and products, energy efficiency, energy saving investments, and use of renewable energy sources;
- loans to individuals for conversion from fossil fuels to renewable energy sources, energy saving investments, investments in water consumption reduction, connections to sewage system, small waste water treatment plants, replacement of asbestos roofs;
- grants to individuals for investments in electric cars and for investments in residential buildings (energy efficiency and use of renewable energy sources);

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- grants to legal entities for investments in electric cars and buses for public transport on compressed natural gas or biogas;
- grants to municipalities for investments in buildings where public education takes place, newly constructed as low energy and passive buildings or renovated in passive standard.

- The public tender for co-financing of district heating using renewable energy sources for the period 2016 – 2020, adopted in 2016 by Ministry of infrastructure. The state aid will support the construction of various types of district heating systems on renewable energy sources and the extension of the remote network to an existing district heating system on RES.

- The Rural Development Programme of the Republic of Slovenia 2014 – 2020 is expected to contribute with its priorities and measures to promote the use of renewable energy. In the view of promoting the use of wood biomass, sub-measure M6.4 provides support for investment as follows: M6.4 - Support for investment in the creation and development of non-agricultural activities among others acquisition of electricity and heat from renewable energy sources such as wood biomass, biomass, manure and slurry, water, wind, sun (Rural Development Programme 2014 – 2020).

- Operational Programme for Competitiveness and Cohesion 2014 -2020 foresee providing subsidies for investments in biomass heating plants.
- Regulation on supports for the electricity generated from renewable energy sources; this financial assistance expired by the end of November 2016.

- Feed-in tariff system grants 15 years support in electricity production from combined heat and power on woody biomass with high efficient cogeneration adopted in 2009. This state aid expired by the end of November 2016.

MAIN BARRIERS FOR USE OF BIOMASS IN SLOVENIA

The further development of production and use of wood biomass in Slovenia is affected by different constraints (e.g. Rogelja and Krajnc, 2014; Čebul et al., 2011):

I. Administrative and institutional constraints:
- environmental requirements are vaguely addressed; the absence of regulations, standards and technical regulations with the aim of utilization of wood biomass;
- complex administrative procedures for obtaining various permits and for getting construction documentation to establish biomass plants;
- cross-sectoral coordination in promoting the use of wood biomass is poor. There is a lack of cooperation between different sectors (energy, environment, agriculture, and forestry).

II. Economic constraints:
- investment costs per unit of produced energy compared to fossil fuels are higher;
- uncertain long-term market price of wood biomass and the relationship to other energy products;
- low level of availability of own funds: bad financial status of municipalities and local businesses;
- grants are uncertain; investors are counting on the grants as a reliable hard financial source. Long-term financial mechanisms are not stable to support projects for the utilisation of woody biomass.

III. Technical and market constraints:

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- principles of sustainability, close-to-nature and multipurpose forest management in Slovenia;
- low average private forest holding and very fragmented possession; highly fragmented forest areas (most households have possession of less than 1 ha) and the number of forest owners makes the professional work and optimum use of wood in private forests very difficult. According to study done by Slovenian forestry Institute the majority of small forest owners use wood only to cover their own need for wood biomass (for heating) and don't have any interest to enter the wood market;
- poor equipment and technological skills of private owners of forests;
- low realization of maximum allowable cut especially in private forests; in Slovenia the annual allowable cut is quite conservative, as it represents around 70 % of the estimated annual increment (SFS, 2015). Moreover, the annual actual felling never reach the quantities of the annual allowable cut; except of some years when severe natural disturbances occurred. It is justified to believe that the potential supply of wood fuels could increase today's extracted volumes without limiting the timber industry or affecting the growing stock;
- production of wood chips from forest residues is not a common practice, the main barrier for using forest residues are economics and harvesting technology;
- construction of skid trails in recent years has reached the planned goals, while the construction of forest roads significantly stalled. This is noticeable especially in private forests, where the owners do not have sufficient funds for the construction;
- exports of wood biomass are large. There is an inequality in conditions on the market in neighbouring countries and Slovenia.

IV. Sociological constraints:

- lack of knowledge on efficient use of biomass as fuel;
- lack of training and information of local communities to promote the development of local bioenergy markets;
- lack of confidence in the sustained supply of quality;
- lack of skilled and experienced professionals with relevant knowledge in the field of technologies for wood biomass preparation, production and use.

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CONCLUSIONS

Wood biomass is the most important renewable energy source in Slovenia. It has been and remains an important energy source for covering the heat demand in households, for the production of process heat in industry and for electricity production.

The increase of the use of renewable energy sources is stimulated with different policy instruments and by different institutes. Investments in new devices are encouraged with subsidies and favourable loans. Nevertheless, it is constantly need for investing the energy and knowledge in the promotion of modern technologies for exploitation of wood biomass and especially uses of biomass. In the future, it will be necessary to consider alternative sources of wood biomass such as forest residues and non-forest plantations of fast-growing trees and shrub species.

An important issue is also the further integration of forest owners and farmers in the energy market (for example energy performance contracting) and the promotion of the whole chain from the forest to the final consumer, whether it be an individual, the wood industry or energy plant.

Wood biomass is in Slovenia an important economic, socio-economic and environmental factor. Impacts on the socio-economic position of the country are mainly reflected in the creation of new jobs, increased revenues of the local economy, additional activities on farms, reduction of unemployment, increased energy self-supply and reducing energy dependency.

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State of the art of the biomass market. Report of Spain

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INTRODUCTION

Spain has an enormous potential of biomass resources in both main sources forest and agricultural. Forest is being growing very quickly since last 20 – 30 years because of the movement of population to the cities causing less local use of firewood and also wood industries are decreasing so the result is that less and less wood is being used and there were big plantations since 50-60 of the last century. The annual growth of the stock of wood is 46 million of m3 per year. The official inventory of forest shows the stock of wood has doubled in 13 years. In the IFN2 (National Forestry Inventory 2) made in 1996 there was 594 million of m^3 and in the IFN3 made in 2009 there was 921 million of m^3 which means a 64% increase.

According to CEDER-CIEMAT own data there is a potential of 10.548.261 t DM/y. of forest biomass (forests, scrubs, etc.). From this potential, an available quantity has been estimated of **4.772.650 t DM/y**

Regarding field agricultural biomass (Olive trees, irrigated…), there is in Spain a total potential of 26.220.486 t DM/y that removing the unavailable quantities remains in **12.841.774 t DM/y**

To this potential we shoul dadd the agro-industry biomass resources with a total of **4.202.899 t DM/y** which is composed mainly of:

Clean wood by-products (chips etc) 2.695.962 (t DM/y)

Olive stones: 430.000 (t DM/y)

Olive cake: 800.000 (t DM/y)

Also, AVEBIOM has been collecting data into a database called National Observatory of Biomass Boilers (ONCB) since 2009. Collecting information for this Observatory has not been an easy task. Patience and a high degree of cooperation with manufacturers, equipment and biofuels distributors, installers, public and private institutions and final users have been needed. In spite of that, there are still missing biomass installations in the database, as getting all the data from all the distributors and retailers is not possible.

However, there is enough quantity of data to allow making estimations.

During these 6 years of work in the ONCB's database, AVEBIOM has collected a sample of 48,650 references and 3,875 MW of installed capacity in Spain. Thanks to these references, we were able to estimate that the number of appliances installed in Spain in total is 160,000 until the end of 2015 which corresponds to an installed capacity of 7,275 MW.

Comparing these figures with the previous year, the number of appliances has grown about 25% and around 20% in power.

Although the increases are very satisfactory, distribution companies and installers have the feeling that it could have been a much better season. The demand of biofuels and the installation of new appliances have been less than the expected because the last winters have been very warm and the price of the fossil fuels has been very low, which has delayed the decision of purchasing and installing biomass devices.

Since 2014, there has been a significant growth in the number of installed MW in some Spanish regions (Autonomous Communities). The progress in the regions where the installation of biomass devices is supported with public money is remarkable.

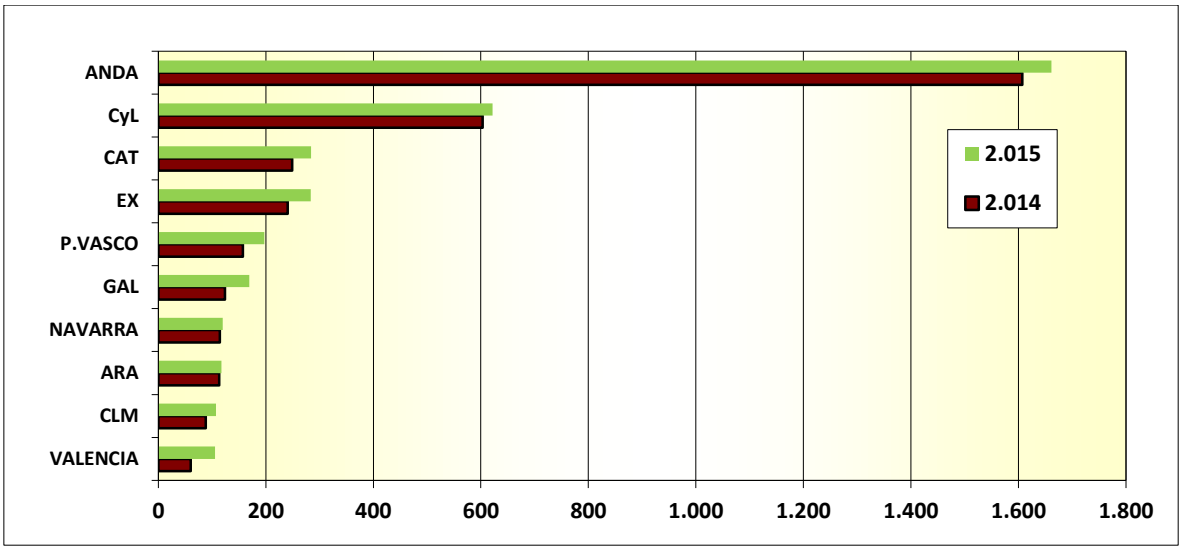

Figure 36: Installed biomass power (MW) in the 10 Regions with the highest values. Source: AVEBIOM

EVOLUTION BY TYPE OF USER

All significant groups which are biomass user grew in number of installations.

The high number of public facilities that have been put into operation in 2015 can be remarked (Table). The evolution of district heatings and the future prospects for this kind of facility are outstanding (Figure 37). There has also been a great response of residences for the elderly and remarkable increases in the number of installations that supply energy from biomass to sports facilities and swimming pools.

Table 1: Evolution of the number of installations and power by user group for the commercial sector, expressed in accumulated values. Source: AVEBIOM

Commercial Sector	Installations registered 2013	Power (kW) 2013	Installations registered 2014	Power (kW) 2014	Installations registered 2015	Power (kW) 2015
Schools	361	53,695	417	64,380	475	71,295
District Heatings	77	67,464	117	139,274	188	200,400
Public buildings	491	45,486	627	50,228	744	57,804
Sport facilities/ swimming pools	188	47,750	258	54,770	306	68,317
Residences for the elderly	142	35,646	187	42,538	235	58,108

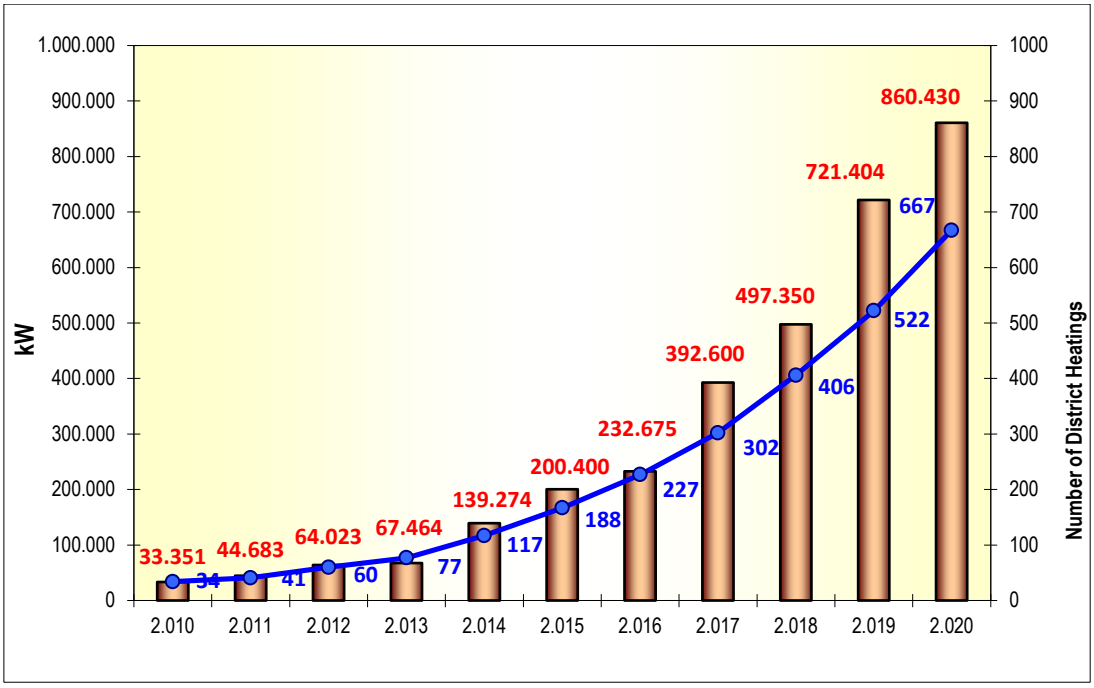

Figure 37: Evolution of the number of district heatings in Spain and its power. Predictions from 2016 to 2020. Source: AVEBIOM

Regarding the use of biomass in the industrial sector, it remains at very high levels in the Agro- farmer sector and in the food industry. In leisure business, including restaurants and hotels, biomass also has an important role.

Table 2: Evolution of the number of installations and power by user group for the industrial sector, expressed in accumulated values. Source: AVEBIOM

Industrial sector	Installations Registered 2013	Power (Kw) 2013	Installations Registered 2014	Power (Kw) 2014	Installations Registered 2015	Power (Kw) 2015
Agro / Farmer	509	327,016	623	362,356	738	417,680
Alimentary	1,230	1,065,955	1,444	1,238,716	1,703	1,461,563
Wood / Furniture	170	510,398	209	562,312	234	615,760
Leisure	431	46,752	625	62,939	851	84,874
Servicies	209	16,198	289	21,648	364	26,122

EVOLUTION IN THE NUMBER OF DISTRIBUTORS AND INSTALLERS

Considering the data recorded in the ONCB it can be verified that the number of equipment distribution and installation companies has increased. There are already 245 different manufacturers that have devices installed in Spain from a total of 28 countries. Likewise, nearly 1,100 installers have recorded at least one data in the DB application, which means an increase of more than 20% over last year.

There is also a notable activity of the biomass ESCOs (Energy Services Co). Some of the most important exceed 50 MWt installed.

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POWER PER INHABITANT RATIO

The average ratio estimated for Spain is 0.15 kW / inhab. From the data (Figure 3), there are 3 regions (Extremadura, Castilla y León and Andalucia) where this ratio exceeds 0.20. This value is still very low compared with the ratio of some Central European territories where biomass has a high level of development (Upper Austria) with a ratio around 1.5 kW / inhab.

The average annual growth for 2015 in Spain is expected to be only 0.012 kW / inhab., which is also a very low figure. It is estimated that this number should not be lower than 0.5 kW / inhab. per year. Thus, the installed capacity each year should always exceed 2,000 MW. Maintaining these average figures, it could be assumed that in 10 years, Spain could reach European average values in the use of biomass.

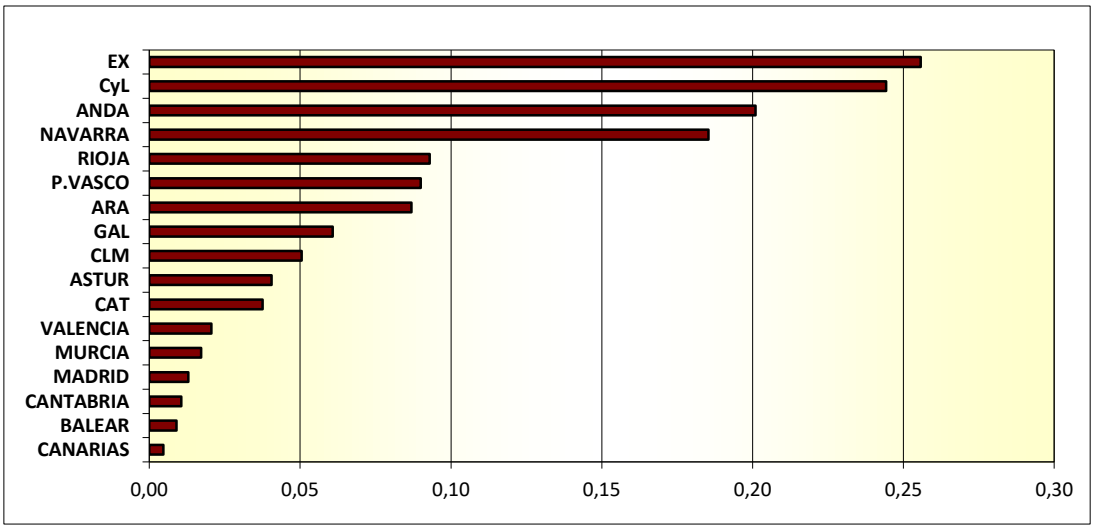

Figure 38: Distribution of the power per inhabitant ratio (kW/inhab.) per Region. Source: AVEBIOM

MAIN COMMERCIALIZED SOLID BIOFUELS IN SPAIN

AVEBIOM as Biomass association is continuously collecting information about the Spanish biomass market. Regarding the solid biofuels AVEBIOM collects data about production and trading and is publishing a map which is included in the magazine Bioenergy International every year. Nevertheless there solid biofuels that we have enough information such as wood pellets or olive stones, and other that we have less and it's more difficult to obtain data.

First of all is very different the industrial market from the domestic market. The focus of the project is in the domestic which is more restrictive in quality due to the requirements of the boilers and also that the small boilers or stove have less tools for reducing from the emissions the particles and other components so they need more quality in the biofuels.

Industrial market

There are two main biofuels which are being used in the industrial market; the most used are the wood chips that are being used for thermal purposes but also in electric generation. The wood chips used in industrial market are around 3 Million DM tonnes. The data (AVEBIOM/CIEMAT) are from 2015 and it may differ from one year to another since the electric generation plants are quite big and if they change it is a very significant consumption shifting from one biofuel to another. Wood chips for industrial use are rather different in quality terms that the ones used in small domestic installations.

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The second biofuel most used in industrial is olive cake, a by-product of the olive oil extraction with around 800.000 tDM/year potential.

There are also other kinds of wood chips coming from olive trees (prunings) or vineyards that may go to industrial use but in smaller quantities, the potential of these biomasses is huge and much more quantities could be destined to energy.

In addition, biomasses such as olive stones, almond shells are being used in the industrial sector without any valorisation (high moisture, no screened) what it's a pity because the quality of these biofuels is quite good and if it would be valorised could be sold with a bigger added value and in form of a biofuel with much more quality which results in less emissions and better performance. Anyway is understandable that they are used like this since the cost of drying and screening is not low, the industrial market cannot pay so much and the domestic market is not so big.

There is a certain production of industrial wood pellets (around 38.000 tons/year) but most of it is destined for exportation to big utilities in Europe.

Other solid biofuels found on the market are: almond shells, pinion nut shells, Chopped pine cones and hazelnut shells.

Table 3: Quantities of industrial solid biofuels present in the market (2015)

BIOFUEL	INDUSTRIAL BIOFUELS (tDM /y)	Source
Wood chips	3.000.000	**AVEBIOM's data / Biomasud Project**
Other chips (e.g. pruning)	51.553	**CIEMAT's data / La biomasa en Andalucía, 2015**
Wood pellets	37.383	**AVEBIOM's data**
Other pellets (e.g. pruning)	4.673	**AVEBIOM's data / CIEMAT's data**
Olive stones	300.000	**La biomasa en Andalucía, 2015 / AVEBIOM's data / CIEMAT's data**
Exhausted olive cake	800.000	**La biomasa en Andalucía, 2015 / AVEBIOM's data / CIEMAT's data**
Almond Shell	140.000	**AVEBIOM's data**
Chopped pine cone	38.250	**AVEBIOM's data**
Pine nut shells	6.588	**AVEBIOM's data**
TOTAL	4.378.447	

Domestic market

Regarding the domestic sector, the most used biomass is still the firewood with 1.500.000 tonnes/year as per official figures from MAGRAMA although actual quantities in the market are believed to be significantly bigger.

Wood pellets are the second biofuel most used for domestic. Nowadays are being consumed 443.925

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tDM /year from which 406.542 are for domestic use (data from AVEBIOM for 2016). The use of this fuel is increasing very quickly and it has more than double in the last 3 -4 years. The number of producers has increased accordingly. Below there are a table and a graph showing the evolution of the marked for the wood pellets (please note that figures are in metric tonnes and not in dry tonnes, i.e. 443.925 tDM are equivalent to 475.000 metric tonnes which including a 7% of water content).

Detailed information (annual production, location,…) about the wood pellet plants and other domestic solid biofuels producers can be found in solid biofuel map that is published together with the Spanish edition of Bionergy International magazine (http://bioenergyinternational.es/). In the next page we can found the last edition available (2016) –figure 4.

Mapa de los Biocombustibles 2016

España, Portugal y América del Sur

BIOENERGY INTERNATIONAL

Pellet
Producción real 2015

Productor CERTIFICADO
sin datos
en construcción
sin producción
< 15 000 t/año
15 000 - 30 000 t/año
> 30 000 t/año

Astilla :: Hueso
Capacidad de producción

Productor CERTIFICADO
sin datos
< 10 000 t/año
10 000 - 30 000 t/año
30 000 - 60 000 t/año
> 60 000 t/año

Briquetas

Pellets - España

Map	Planta, ubicación	Capacidad 2016 (t/año)	Producción 2015 (t/año)	ENplus
1	Acucora. Burgos	30 000	0	
2	AOG Gestión de Biomasa. Jaén (parada)	sin datos	0	
3	Afpurna. Huesca	15 000	4 000	
4	Agropellets de Aragon. Huesca	18 000	2 000	ES029
5	Amatex. Soria	24 000	7 000	
6	Anatar Pellet Málaga	2 000	100	
7	Ángel Fernandez Nieto. Albacete	3 000	sin datos	
8	Aprovechamientos Energéticos del Campo. Jaén	15 000	8 500	ES007
9	Aranguren. Navarra	-	construcción	
10	Arkea Pellets. Navarra	600	sin datos	
11	Aserradero Valsaín. Segovia	-	construcción	
12	Astillas y pellets de Canarias. Tenerife	1 500	1 000	
13	Barroso. Ávila	2 000	200	
14	Bioblue. Tarragona	13 000	200	
15	Biocameros. La Rioja	200	50	
16	Bioganper. Valencia	3 000	1 200	
17	Biomasa Córdoba. Córdoba	12 000	0	
18	Biomasa Forestal. La Coruña	75 000	60 000	ES013
19	Biomasa Montemayor. Valladolid	-	construcción	
20	Biomasa Sostenible de Valdaracete. Madrid	15 000	800	
21	Biomasa del Aneto. Huesca	1 800	800	ES019
22	Biomasas Herrero. Valladolid	1 000	800	
23	Bionercam. Albacete	sin datos	sin datos	
24	Biopar. Navarra	sin datos	sin datos	
25	Biopellet de la Sierra Norte. Guadalajara	7 000	100	
26	Biopellet Energía. Gerona	sin datos	sin datos	
27	Biosagra. Granada	sin datos	sin datos	
28	Biovegamasa. León	20 000	0	
29	Bricopellet. Cuenca	14 000	sin datos	
30	Burpellet. Burgos	70 000	27 000	ES005
31	Calorpel. Navarra	10 000	900	
32	Caryse. Toledo	48 000	sin datos	
33	Combustibles Naturales. Cantabria	47 000	0	
34	Coterram. León	30 000	11 000	ES016
35	Ebapellet. Vizcaya	20 000	18 000	
36	Ebinor. La Rioja	10 000	2 200	ES081
37	Echeverte Hermanos. Navarra	3 000	800	ES025
38	Ecofogo. Orense	14 000	3 700	ES004
39	Ecoforest. Toledo	40 000	15 000	
40	Ecofuego. Navarra	2 000	900	
41	Ecoreto. Cantabria	1 200	600	ES089
42	Ecowarm. La Coruña	20 000	6 600	ES014
43	Ekopellet. Guipuzcoa	8 000	6 000	
44	El Campichuelo. Madrid	1 000	sin datos	
45	Enerbio. Barcelona	20 000	13 000	ES015
46	Energi Pellet Garulo. Lérida (parada)	12 000	0	
47	Energía Sierra Segura. Albacete	10 000	0	ES080
48	Energy Pellets. Castellón	3 000	500	
49	Ertasa. Albacete	32 000	30 000	ES006
50	Eurogan. Zaragoza (madera y purín)	3 500	700	
51	Forestalia Renovables. Zaragoza	13 000	construcción	
52	Fymasa. Cuenca (parada)	500	sin datos	
53	Galpellet. Orense	20 000	13 500	ES012
54	García Varona. Burgos	4 000	sin datos	
55	Gestil. Córdoba	25 000	800	ES041
56	Gestinor. La Coruña	22 000	0	ES087
57	Gesforal. Almería	5 000	0	
58	Goldpellet. Islas Baleares	2 200	sin datos	
59	Green Biorefinery. León	50 000	construcción	
60	Grupo Platero. Guadalajara	5 000	1 500	
61	Iberia Biomasa. Granada	23 000	sin datos	ES020
62	Iderna Generación. Zaragoza (madera y carbón vegetal)	sin datos	sin datos	
63	Lesmar. Valencia	10 500	1 000	ES028
64	Maderas Cuenca. Cuenca	-	construcción	
65	Maderas Doñana. Huelva	10 000	1 700	ES086
66	Maderas Omanda. La Coruña	4 500	4 500	ES088
67	Madridpellets. Madrid (parada)	15 000	2 000	
68	Naparpellets. Navarra	20 000	5 000	ES010
69	Naturpellet. Segovia	40 000	23 000	ES023
70	Netpellets. Islas Baleares	3 000	2 000	
71	Novalia. Barcelona	32 000	20 000	ES024
72	Palets J. Martorell. Gerona	12 000	5 000	ES018
73	Panatec Power Solutions. Cáceres	5 000	sin datos	
74	Palets de La Mancha. Ciudad Real (sarmientos)	20 000	5 000	
75	Pelkam. La Coruña	3 000	1 600	
76	Pellet de Villahermosa. Castellón	15 000	construcción	
77	Pellet del Este. Valencia	2 000	1 000	
78	Pellet Vitoria. Álava	2 000	500	
79	Pellets Asturias. Asturias	32 000	30 000	ES001
80	Piñones Hijos de Luis Sanz. Valladolid	2 000	200	
81	Reciclados Lucena. Córdoba	10 000	4 000	ES084
82	Reciclatges Tamayo. Barcelona	25 000	9 000	ES022
83	Recuperaciones Ortín. Murcia	4 000	2 900	ES085
84	Ribas. Burgos	45 000	23 000	ES008
85	SCA Nuestro Padre Jesús. Jaén	9 500	sin datos	
86	Somacyl. Valladolid	30 000	30 000	
87	Surpellets. Jaén	20 000	2 000	ES040
88	Teruel Pellets. Teruel	20 000	2 700	ES026
89	Tramasa. Salamanca	30 000	25 000	ES027
90	Tubocas. Granada	14 000	2 500	ES083

Pellets - Portugal

Map	Planta, ubicación	Capacidad 2016 (t/año)	ENplus
1	Grupo Visabeira-Pinewells. Arganil	150 000	PT001
2	Enerpellets. Pedrogao Grande	125 000	PT008
3	Grupo Gesfinu-Pellets Power. Mortágua	100 000	PT005
4	Pellets First/Enerpellets. Alcobaça	100 000	PT002
5	Tec Pellets. Famalicão	100 000	
6	Grupo Gesfinu-Pellets Power 2. Setubal	90 000	
7	Enermontijo. Pegões	75 000	PT004
8	Grupo Gesfinu-Jungle Power. Lousada	75 000	
9	JAF Group/Novalenha. Oleiros	75 000	PT003
10	Tec Pellets-Stellep. Chaves	60 000	
11	Palser. Sertã	50 000	PT006
12	Lusoparquete. Oliveira de Azemeis	40 000	
13	Omnipellets. Leiria	25 000	
14	CMC. Alcobaça	20 000	
15	Melpellets. Melgaço	10 000	
16	Vimasol. Celorico Basto	12 000	
17	Nicopellets. Ílhavo	15 000	PT007
18	Glowood. Cercal do Alentejo	60 000	

Astillas - Productores

Map	Empresa, ubicación	Prod. (t/año)	Biomasud
1	Agroforestal Nava. Asturias	30000-60 000	
2	Amatex. Soria	sin datos	
3	Artigal (Forestal). Orense	30000-60 000	
4	ASTISA-Pyrobloc. Salamanca	< 10 000	
5	Biobaen. Palma de Mallorca	< 10 000	
6	Bioenergía Romà Portilla. Lérida	sin datos	
7	Biorcam. Guadalajara	10 000-30 000	
8	Biofor (Biocombustibles Forestales). Soria	10 000-30 000	
9	Biofor Energía. Valencia	< 10 000	
10	Biomasa del Aneto. Huesca	sin datos	
11	Biomasa del Segura. Murcia	10 000-30 000	
12	Biomasa Montemayor. Valladolid	< 10 000	
13	Biomasa Rubio. Salamanca	< 10 000	
14	Biomasa Sostenible de Valdaracete. Madrid	10 000-30 000	
15	Biomasa y calderas Javier. Ávila	< 10 000	
16	Biomaser. Zamora	< 10 000	
17	Biomaspallars. Lérida	< 10 000	
18	Biomassa del Gironès. Gerona	< 10 000	
19	Biomas Renovables. Toledo	< 10 000	
20	Bitalia. La Rioja	10 000-30 000	
21	Bosquenergía (Biozamora). Zamora	10 000-30 000	
22	Caryse. Toledo	sin datos	
23	CLB Lozoyuela. Madrid	< 10 000	
24	Cortiña. Lugo	sin datos	
25	David Velasco. Valladolid	< 10 000	
26	Diforest. Badajoz	10 000-30 000	
27	Ebinor. La Rioja	10 000-30 000	
28	Ecotermik. Lérida	< 10 000	
29	Everod. Lérida	> 60 000	
30	Explotaciones Forestales María. Badajoz	sin datos	
31	Explotacions Forestals Camà. Barcelona	sin datos	
32	Extremadura Verde (Forestal). Cáceres	30000-60 000	
33	Factor Verde. Guadalajara	10 000-30 000	
34	Forega. Orense	sin datos	
35	Forega. Lugo	sin datos	
36	Forest Distribution. Palencia	< 10 000	
37	Forestal del Maestrazgo. Castellón	< 10 000	
38	Forestal Soliva. Gerona	> 60 000	
39	Forestalia. Zaragoza	30000-60 000	
40	Forestar. Zamora	< 10 000	
41	Franc Alou. Lérida	sin datos	
42	Fustes Tomà. Lérida	< 10 000	
43	García Forestal. La Coruña	30 000-60 000	
44	García Varona. Burgos	sin datos	
45	Gestión de Biomasa. Córdoba	30 000-60 000	ES005
46	Goldpellet. Palma de Mallorca	< 10 000	
47	Iderna. Zaragoza	< 10 000	
48	Indústries Forestals d'Argençola. Barcelona	sin datos	
49	Isempa EERR (Biopalas). Lugo	30000-60 000	
50	J. Farnadas. Barcelona	10 000-30 000	
51	Leñas Ricoman. Madrid	sin datos	
52	Madera de Pinares. Zaragoza	< 10 000	
53	Maderas José Sáiz. Cantabria	sin datos	
54	Maderas Soler. Valencia	> 60 000	
55	Maderas y Leñas Trella. Orense	sin datos	
56	Materias Forestals. Gerona	sin datos	
57	Mycsa Mulder. Huelva	> 60 000	
58	Naparpellet. Navarra	10 000-30 000	
59	Panatec Power. Madrid	10 000-30 000	
60	Paletas y Virutas de Galicia ECOFOGO. Orense	10 000-30 000	
61	Pere Garriga Bosch. Barcelona	< 10 000	
62	Quercus Energy. Palma de Mallorca	< 10 000	
63	Serradora Boix. Barcelona	30000-60 000	
64	Serradora de Ca'n Juan. Palma de Mallorca	sin datos	
65	Serrerías y Embalajes Salaberria. Guipuzcoa	10 000-30 000	
66	Solbiom. Valladolid	sin datos	

Briquetas - Productores

Map	Empresa, ubicación
1	Astisa-Pyrobloc. Salamanca
2	Bioenergía Balear. Islas Baleares
3	Bioforestal La Mancha-Brikade. Ciudad Real
4	Bricoenergías Catalanas. Barcelona
5	Briquetas Brither. Soria
6	Briquetas Carvalo. La Coruña
7	Briquetas del Tajo. Toledo
8	Briquetas Lanzarote. Gran Canaria
9	Briquetas XEVE. Pontevedra
10	Carboexpor. Zamora
11	Combustibles Naturales. Cantabria
12	Combustibles Ecofoc. Alicante
13	Ecofogo. Orense
14	Ecoforest. Pontevedra
15	Harimasa. Navarra
16	Iderna. Zaragoza
17	Los Rivera. Badajoz
18	Madera de Pinares. Zaragoza
19	Maderas Lobera. Vizcaya
20	Palets Pla d'Urgell. Lérida
21	Talleres Arimar. Guipuzcoa
22	Valentín Rico. Valladolid
23	Verta Gestion de Residuos. Valladolid

Distribuidores de PELLET certificados

	Empresa, ubicación	ENplus
D001	Aspolberta. Madrid	ES301
D002	Carsan Biocombustibles. Madrid-Granada	ES302
D003	Biomasa Forestal. La Coruña	ES303
D004	Aplicaciones Energéticas de la Fusta-Enerbio. Barcelona	ES304
D005	Probiomasa Producció. Barcelona	ES305
D006	Bitalia Energía Natural. La Rioja	ES306
D007	Gestcalor (Lignum). Pontevedra	ES307
D008	Bolume Enerxía. Orense	ES308
D009	Carbón Verde Energía. León	ES309
D010	Energía Natural del Norte (Ebinor). La Rioja	ES310
D011	Combustibles Ecológicos BioAragón Energía. Zaragoza	ES311
D012	García Forestal. La Coruña	ES312
D013	Ecoloma. Jaén	ES313
D014	Agropellets de Aragón. Huesca	ES314
D015	Energía Sierra Segura. Albacete	ES315
D016	Gestión de Biomasa. Córdoba	ES316

El Mapa de los Biocombustibles sólidos de España, Portugal y América del Sur ha sido confeccionado con información recogida y elaborada por AVEBIOM, la Asociación Española de Valorización Energética de la Biomasa. Gracias a John O'Ryan Surveyors por la información sobre Chile y a HRV por los datos de Portugal.

www.avebiom.org :: www.bioenergyinternational.es

Hueso de aceituna y Otros - Productores

Map	Empresa, ubicación	Prod. (t/año)	Biomasud
1	Aspo. Ciudad Real	30000-60 000	
2	Aspo Linares. Jaén	30000-60 000	
3	Aspo Molina. Málaga	30000-60 000	
4	Aspo Motril. Granada	< 10 000	
5	Aspo Puente Genil. Córdoba	30000-60 000	
6	Aspo. Portugal	< 10 000	
7	Bio Hueso Plus. Jaén	< 10 000	
8	Biomasa Roma Portillas. Lérida	sin datos	
9	Cerealia Agrobroker. Córdoba	< 10 000	
10	Combustibles Caballo. Madrid	30000-60 000	
11	Cotrans Juneda. Lérida	< 10 000	
12	D. Espuny. Jaén	30000-60 000	
13	Ecoenergías Manchegas. Cuenca	< 10 000	
14	Ecoloma. Jaén	30000-60 000	ES008
15	EnerBiomas. Granada	30000-60 000	
16	Energía Sierra Segura. Albacete	30000-60 000	ES001
17	Green Energy. Jaén	30000-60 000	
18	Hueso de Aceituna Sierra de Cazorla. Jaén	< 10 000	
19	Jose Palaez Renovables. Jaén	30000-60 000	
20	Monaleg. Cádiz	< 10 000	
21	Oleícola el Tejar. Córdoba	sin datos	
22	Oleícola Jaén. Jaén	30000-60 000	
23	Oleo Morón. Sevilla	sin datos	
24	Olihueso. Córdoba	< 10 000	
25	Pellets Moreno. Navarra	< 10 000	
26	Probiosur. Jaén	> 60 000	
27	Transoba. Jaén	< 10 000	

Pellets - Chile

Map	Planta, Ubicación	Cap. t/año
1	Andes Bio Pellets. Bio Bio	15 000
2	Ballesti. Bio Bio	300
3	Biopower. Bio Bio	4 560
4	Borde del Río Energy. Bio Bio	480
5	Climandef. Bio Bio	2 400
6	Davidson Trading. Bio Bio	1 800
7	Ecocalor Chile. VI Región	480
8	Forestal Flor del Lago. Araucanía	2 400
9	Forestal Río Calle Calle. Los Ríos	360
10	Forestal y Agrícola Puyehue. Los Lagos	240
11	Maderas Prosperidad. Maule	3 000
12	Maderas Radiata. Bio Bio	3 000
13	Muebles Romero. Araucanía	2 160
14	Patagonia Pellet. Los Ríos	360
15	Pellet Energy. Araucanía	1 200
16	Pro Energy. Bio Bio	9 600
17	Promasa-Ecomas. Bio Bio	36 000
18	Recuperadora de Maderas. Los Lagos	3 000
19	Sur Pellet. Araucanía	1 200
20	Traiguen Energy. Araucanía	5 400
21	3 Volcanes. Maule	2 400

Pellets - Argentina

Map	Planta, Ubicación	Cap. t/año
22	Canale. Córdoba	8 800
23	GP Energy. Misiones	15 000
24	INTI. Chaco	2 000
25	Lare. Entre ríos	75 000
26	Lipsia. Misiones	20 000
27	Maderas Mesopotamia. Misiones	25 000
28	Zeni. Corrientes	18 000
29	Zuamar. Corrientes	2 400

Table 4: Evolution of the wood pellet market. Source: AVEBIOM

	2012	2013	2014	2015	2016	2020
Instaled capacity	950.000	975.000	1.125.000	1.250.000	1.372.000	1.646.400
Nº plants	40	42	45	79	86	95
Production	250.000	350.000	410.000	475.000	550.000	792.000
Consumption	175.000	380.000	350.000	400.000	475.000	665.000

Wood pellet market evolution (Tm/year)

In the next graph, in blue we can see the installed capacity of wood pellet production (real data until 2016 and estimation for 2020); in red the actual production of wood pellets (real data until 2016 and estimation for 2020); in green the consumption of wood pellets in Spain (real data until 2016 and estimation for 2020).

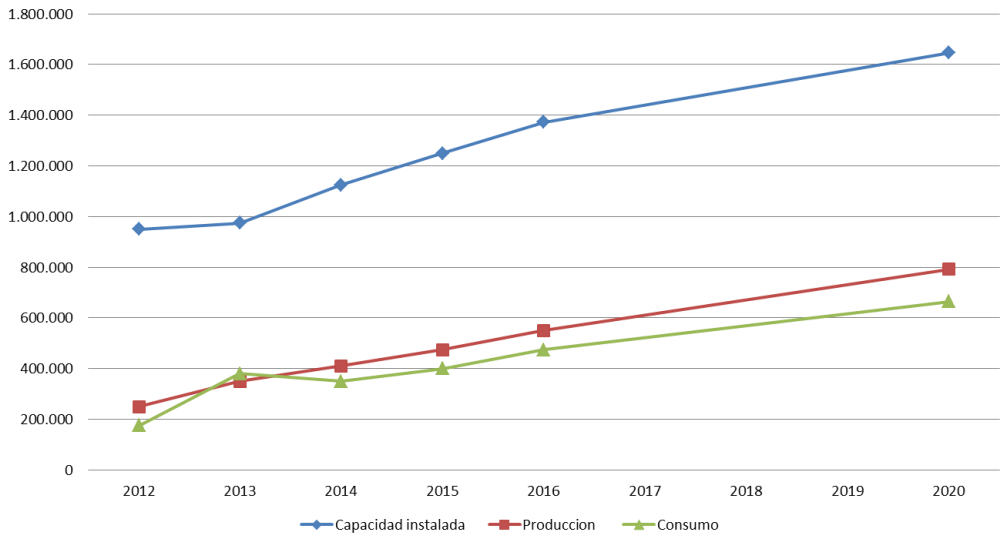

Figure 5: Evolution of the wood pellet market. Source: AVEBIOM

The average production plant has a producing capacity of 17.500 Tm/year so they are clearly oriented to domestic market. The actual average production is 8.200 Tm/year what for the global pellet market is very small and most likely they have scale difference with Portugal producers what is causing difficulties for competing with them. On the other hand the quality of the production is very good as 85% of the production is certified with EN*plus*® A1.

The market has been depressed for the last 3 years until last winter (season end 2016- beginning 2017) because the conjunction of 3 causes: three last winters were rather mild so the consumption was low, price of fossil fuels was very low causing delays in the change of the heating devices and also the big number of plants that has been installed in Spain (between 15-20 in a year and a half 2015 and mid 2016). This situation has caused very low prices and closures of pellet plants just one year after its inauguration.

After wood pellets, the most used biomass for domestic is wood chips (240.000 tDM /year) which are

This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No. 691763

mainly used in mid-size installations (50 – 500 kW). Also the use of this biofuel has been growing in the last years (in Spain there was 5 logistic centres in 2011 and around 16 in 2014). The prices has been more stable and reasonable since the mid-size installations are less affected by the mild winters and being much cheaper it is not so affected by the low price of fossil fuels.

In the case of Olive Stones, about 130.000 tDM /year are used every year in the domestic sector but as previously mentioned there are another 300.000 tDM /year that are now destined to the industrial sector but that could be destined to the domestic if they would be valorised (dried and screened). The quantities mentioned are average because the olive trees don't produce every year the same making cycle of 4 around years. Of course production is also depending on the weather.

Wood briquettes market is about 50.000 tDM /year and its tendency to remain stable since is not growing as the ones from the other solid biofuels.

Other solid biofuels found on the market on less quantities are: almond shells, pinion nut shells, Chopped pine cones and hazelnut shells that are being used mainly in the industrial sector but their quality is very good and could be used perfectly in domestic devices with a minimum valorisation (drying and screening them).

Table 5: Quantities of domestic solid biofuels present in the market (2015)

BIOFUEL	DOMESTIC BIOFUELS (tDM /y)	Source
Firewood	1.500.000	**Statistical yearbook 2014 MAGRAMA**
Wood chips	240.000	**AVEBIOM's data / Biomasud Project**
Other chips (e.g. pruning)	323.021	**CIEMAT's data / La biomasa en Andalucía, 2015**
Wood briquettes	50.000	**AVEBIOM's data**
Wood pellets	406.542	**AVEBIOM's data**
Olive stones	130.000	**La biomasa en Andalucía, 2015 / AVEBIOM's data / CIEMAT's data**
Almond Shell	10.000	**AVEBIOM's data**
TOTAL	2.706.292	

BIOMASSES WITH POTENTIAL INTEREST IN SPAIN

Studying the potential of the forestry derived solid biofuels it's obvious that there is still a big room for increasing the utilisation of these biofuels. Nowadays, as per the IFN (National Forestry Inventory) the wood stock has increased from 594 million of m^3 in 1996 to 921 million of m^3 in 2009 in the Spanish forests. This is due to several reasons (economic crisis, abandon of rural areas, etc.) but the fact is that

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in Spain it's being cut around 16 million of m^3 every year which means a 35% of the annual growth when the European average is 61%. To confirm this data, with the application BIORAISE (http://bioraise.ciemat.es/bioraise/) it has been calculated that there is an available potential of more than 4.700.000 t DM /y of forestry biomass. Special mention has to be done to woody biomass coming from scrubs with a lot of potential (2 million tDM/y from which 937.000 would be available as per the BIORAISE). There is a Life+ project with CIEMAT and AVEBIOM among others entities involved to see how some difficulties in the recollection, use, etc. can be solved (http://enerbioscrub.ciemat.es/).

Regarding agricultural biomasses, Spain as big producer has a lot of potential of agricultural by-products. As per BIORAISE there is a total potential of 26 million tDM/y but applying different restrictions, the available potential would of more than 12 million tDM/y. From these sources, the most interesting biomasses that nowadays are not very used in biomass are olive tree prunnings and vineyards prunnings. Actually they are used for energy uses (industrial, electric generation,…) but in both most of the available quantities (90-95%) remains in the fields and are burned open air in order to eliminate them[9]. Quantities available of these two biomasses are huge (1.455.168 tDM/y potential available for olive trees and 675.000 tDM/y for vineyards as per BIORAISE and estimations from BTCII project are even bigger). Although there are other agricultural biomasses feedstock with interesting quantities usually are not giving enough quality, about all for domestic use or present some other problems that complicates its utilisation or, as it also may happen, have an alternative use where they have a bigger economic value and therefore is not viable its use for energy (i.e. livestock alimentation, food use, etc.).

Another biomass that has potential as solid biofuel would be pistachio shells. Although there is small quantities of this plant in Spain yet, the amount of ha with this feedstock are growing quickly and soon would

EXPORTATIONS / IMPORTS OF THE SOLID BIOMASSES IN SPAIN

Spain is not a country with big exportations or importations of biomass. The most traded solid biofuels out or inside our country are the wood pellets and the wood chips.

In the case of the wood pellets, the imports/exports are somehow balanced for the domestic market; Spain is exporting to France and Italy mainly about 80.000 dTM/year, in these countries, prices of the product are higher and consumption was not so depressed (although the 3 mild winters situation with lower consumption was for the whole Europe). There are also exportations of industrial wood pellet with electric generation as destiny, the quantities exported are 37.383 dTM/year. In the case of industrial exportations the countries of destination change and are mainly England and Belgium.

Imports of wood pellets are coming from Portugal where the pellet plants are bigger, salaries lower and consequently prices are lower. The quantity imported is approximately 80.000 dTM/year.

Regarding there are exportations of around 150.000 dTM/year of Wood Chips to Italy to be used in power plants.

Another solid biofuel frequently exported is the olive stones, usually with Italy as destiny, of which, as per the data available the quantities exported were 30.000 dTM/year. This is happening because there was an surplus of this biofuel in Spain due to a good season, but it may happen that the case is the

[9] Technical backgrounds for advanced techniques and technologies in biomass production for workshops and trainings. Biomass Trade Centre II project. Francescato, Valter; Negrin Massimo; Rodero, Pablo

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opposite, a lack of olive stone may trigger some imports of olive stones from North Africa (Tunisia, Morocco,..)

In all cases of exportations, being big volumes that usually are done by few operators and sold to very few clients, a change of fuel in the power plant, in the country regulations or change of supplier may change the whole panorama from one year to the following. This is the case of the Olive Cake, an industrial solid biofuel of which some years ago there was a lot of exportations for co-firing but in the last years the trend is no exportations as the plants are not co-firing anymore and they prefer wood pellets.

Table 6: Exports / Imports of solid biofuels (2015)

BIOFUEL	EXPORTS (t /y)	IMPORTS (t /y)	MAIN IMPORT-EXPORT COUNTRIES/ FINAL USE	Source
Wood chips	150.000	0	Italy / Electric generation	**AVEBIOM's data**
Wood pellets	86.542 (Domestic)	80.000	Imports from Portugal	
	37.383 (Industrial)		Exports to: France, Italy // Domestic - thermal purposes	
			Exports to England, Belgium // Electric generation	
Olive stones	30.000	0	Italy,	**AVEBIOM's data**
TOTAL	**303.925**	**80.000**		

MAIN SUPPORTS FOR THE USE OF BIOMASS IN SPAIN

At National level there are economic support measures for installing biomass heating facilities in Spain, which are implemented by IDAE (Institute for Energy Diversification and Saving, organism depending on the Ministry of Industry, Energy and Tourism) and there is also a programme called "Proyectos Clima", which buys verified CO_2 emissions reductions, managed by the Ministry of Agriculture, Food and Environment.

Table 7: Subsidy programmes for the installation of biomass facilities at National level in Spain. Source: AVEBIOM

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Programme	Description	Budget for 2016	More information
PAREER-CRECE	Support programme for energy refurbishing of existing buildings. Loans and direct subsidy. For biomass 25% subsidy and 65% loan	174,426,000 € (for all the categories)	http://www.idae.es/index.php/id.858/relmenu.409/mod.pags/mem.detalle
BIOMCASA II	Programme for the implementation of projects of thermal biomass in buildings. Loans for the installation of biomass heating devices in buildings	848,000 €	http://www.idae.es/index.php/idpag.722/relmenu.407/mod.pags/mem.detalle
GIT	Financing to authorised firms of Large Thermal Installations running on renewable energies in the building sector. Loan. The launching of this financing programme responds to the need of boosting the implementation of large installations to produce thermal energy in building from the exploitation of renewable energies such as biomass. The maximum financing limit per project will amount to 80% of the value of the eligible investment (the one devoted to thermal generation), with a maximum absolute financing limit per individual project of €3,000,000.	7,873,000 €	http://www.idae.es/index.php/idpag.638/relcategoria.1160/relmenu.385/mod.pags/mem.detalle
Proyectos Clima	Programme of the Ministry of Agriculture, Food and Environment for buying CO_2 emissions reduction (when changing from a fossil fuel boiler to a biomass boiler, for example). These emissions have to be verified by inspection bodies. In 2016 the price for the CO_2 tonne avoided was 9,70 €/tm	20,000,000 € (for all the categories)	http://www.magrama.gob.es/es/cambio-climatico/temas/proyectos-clima/convocatorias-proyectos-seleccionados/Convocatoria_2016.aspx

At regional level there are some Autonomous Communities with economic support measures, but they are often more limited in time. In Table subsidies in several Regions are shown.

Table 8: Subsidy programmes for the installation of biomass facilities in several Regions of Spain. Source: AVEBIOM

Programme	Description	More information
Subsidies for Renewable Energies in Murcia	Provides subsidies, according to the Operational Programme ERDF (European Regional Development Fund) Murcia 2014/2020, for companies established in the Region of Murcia, for the execution of investments for the following purposes: energy audits, renewal of equipment and energy consuming installations, improving energy efficiency in production processes, energy generation facilities at the consumption point	http://bit.ly/1RvIzhR
Cantabria subsidies for forest biomass	Subsidies for small companies and forest owners to support silvicultural activities	http://dgmontes.org/web/atencion-a-la-ciudadania/detalle/-/journal_content/56_INSTA

extraction		NCE_DETALLE/16401/3674520
Basque Country Biomass Subsidies	Eligible Biomass activities: - Biomass facilities with boilers for thermal energy production by producing hot water, superheated water or steam. - Boilers for producing hot air, although the nominal power must exceed 70 kW. - New connections to existing district heating facilities.	http://www.eve.eus/Programas-de-ayuda/Biomasa-2016.aspx
Subsidies for Renewable Energies in Castilla la Mancha	Subsidies financed by the European Regional Development Fund, for the use of renewable energy in Castilla la Mancha. These Subsidies are related to the measures that support the clean energy production and ensure a reduction in CO_2 emissions. They are also an instrument to promote the use of clean energies favouring a fully sustainable energy development model.	http://docm.castillalamancha.es/portaldocm/descargarArchivo.do?ruta=2016/01/07/pdf/2015_15522.pdf&tipo=rutaDocm
Galicia Biomass Subsidies	Subsidies for thermal biomass Projects to be carried out in Galicia for individuals and groups. Maximum subsidy: 50% or 50,000€ (120,000 € for groups).	http://www.inega.es/subvencions/subvencions/Energiasrenovables/2016/ficha_renovables2016_0002.html

MAIN PROBLAMATIC OF THE USE OF BIOMASS IN SPAIN

There are several barriers that can be classified in different categories

Sociological / training barriers:

- Lack of knowledge on the use of biomass as fuel; In a survey made in 2014, 70% of the people cannot explain what "biomass" is and do not know or mix up the meaning of "energy efficiency"
- There are doubts about certain topics of the biomass:
    - Assurance of the supply. Although in the last years the distribution network has been developed significantly about all for wood pellet, for certain biofuels is possible to find some lacks in the chain of supply.
    - Stability of the price in long term. Sometimes within the final users there are doubts saying that when many people start consuming biomass the prices will rise up. This is quite unlikely since there are lots of potential and it's a global market not depending only from the local sources. Also, in Austria, they have an index price since 2006 and the prices had no significant difference since then.
    - Emissions. Some fossil fuels operators are giving a bad image of the biomass because of its competence with biomass by exaggerating the emissions of the biomass. Although modern boilers fulfil legislation the bad image is arriving at the final users / administrations in some cases.

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- There is a lack of skilled and experienced professionals in the field of technologies for biomass production and boiler / stoves installations.

Economic barriers:

- The investment needed for a biomass installation, although they have decreased in the last years, are still higher than other fossil fuels installation. In the long term it's profitable due to the lower price of the biofuels.
- Competition against fossil fuels. The barrel price has been very low for the last 2-3 years and consequently the prices of the competitors fossil fuels were in some occasion very similar. Also the companies installing natural gas or other competitors have bigger economic resources for marketing, financing installations, etc.
- Most of the companies dealing with biomass are very small and have financial difficulties about all when there are some special conditions in the market (weather, low price of fossil fuels, etc.)
- In the last year there are few financial incentives or grants to change to biomass or install a biomass device.
- In the electric sector, the legislation changed some years ago and nowadays is not affordable to install new power plants. The legislation changed making some projects that were already being built unprofitable so this is causing a legislation insecurity for the investments that will last for years

Administrative barriers:

- Complex administrative procedures for obtaining various permits for construction of biomass plants;
- There is a lack of cooperation between different sectors (ministries of energy, industry, environment, agriculture).
- Burocratic burden for cut permits

Technical barriers:

- Highly fragmented forest areas that make unprofitable some forests.
- High transport cost that could be solved changing the limitation of tonnage transported in the trucks

CONCLUSIONS

Spain has a huge potential of biomass and there is still a big margin to keep on growing in the use of local biomass. Although there has been a big development in the last years in terms of production, consumption and distribution of solid biofuels still there is margin to improve and grow since there are big potentials available about all in forestry sources but also in some agricultural biomasses like olive tree prunnings or vineyards that nowadays are underused. The solid biofuels which grew more were

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wood pellets and wood chips (but wood chips mostly in industrial) but there Spain is only using a 35% of the annual growth of the trees as per the IFN (National Forestry Inventory) when the average in Europe is a 61%. This underuse of the wood has caused that wood stock has doubled in the last years.

The growth in the use of solid biofuels has been important but some external factor have affected to the market making the development slower than foreseen. The low price of the petrol barrel for the last two years have turned some fossil fuel more competitive towards biomass provoking mostly a delay in the replacement of old installations. Also, for 3 heating seasons in a row the temperatures were quite mild and the consumption went down, fortunately for biomass sector, the last season was normal and markets recovered a little.

In the case of wood pellets the growth has been quite important doubling the production from 2012 to 2016 (passing from 250.000 to 550.000 TM/y) and almost tripling the consumption (175.000 Tm in 2012 to 475.000 in 2016) but this fast implementation of production facilities brought some problems to the market making the prices go down as the demand didn't grow accordingly or at least the usage due to mild temperatures in the last 3 winters were smaller than expected.

There is still margin to grow or improve in some solid biofuels like for example olive stones, nut shells (almond, pine nut,…) which are used mostly without valorising them (not drying or screening) in industrial applications

There are other biomasses with a big potential such as Olive tree prunings and vineyard prunings because the quality is fair enough, not for a small boiler or stove but enough for farms or mid-size installations such district heatings and the quantities available in Mediterranean countries and specially in Spain are huge.

Spain is not a country very important in exportations or importations. Only some not very significant quantities of wood pellets, wood chips and olive stones are traded from/to abroad.

Since 2012, the legislation for electric generation from biomass changed and the feed in tariff were derogated and since then is not financially viable to develop a power plant with biomass. Many project went down even with terrains and construction started because of this legislation change and brought an legislation insecurity that will last for years.

Regarding heating purposes there has been more stability in the support for biomass. There are some national schemes promoted by IDAE but there are many from the different Autonomous Communities although they are more variable in the time. Also there is a program buying verified CO2 tonnes saved managed by FES CO2 (MAGRAMA)

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State of the art of the biomass market. Report of Turkey

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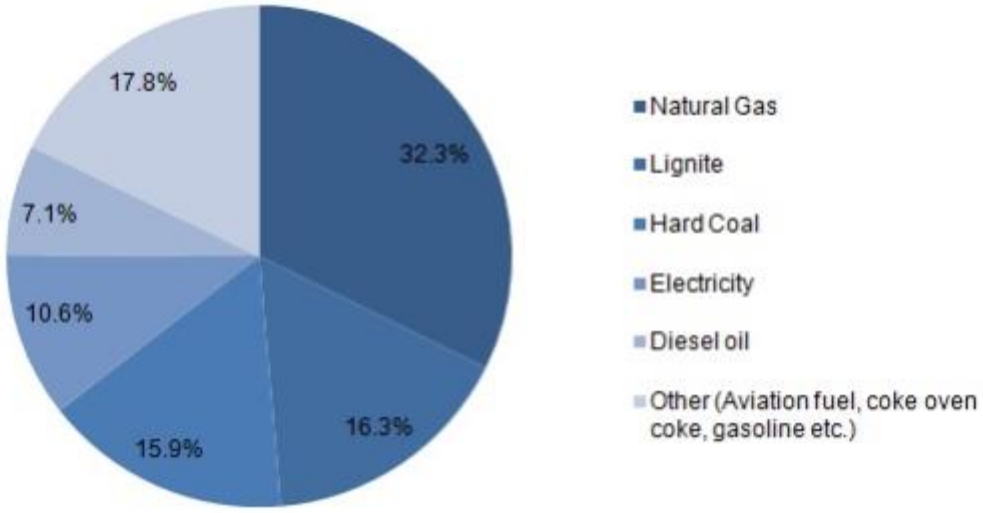
INTRODUCTION

In the year of 2014, 100 million 734 thousand 472 tonne of oil equivalent (TOE) energy consumed in industry and service sectors in Turkiye. The consumption quantity was 86 million 136 thousand 765 TOE in industry while 14 million 597 thousand 707 TOE in service sectors. Electricity production and distribution, manufacturing, and transportation and storage sectors have the highest share sectors with 42.4%, 38.4%, and 9.5%, respectively in total energy consumption. Natural gas was the most consumed fuel with 32 million 498 thousand 888 TOE. According to annual consumptions on the fuel basis, natural gas was mostly consumed fuel in 2014. The second consumed fuel was lignite with 16 million 416 thousand 93 TOE while third fuel was hard coal with 15 million 981 thousand 137 TOE.

Table 1. Breakdown of total energy consumption by fuel type, 2014[1].



MAIN COMMERCIALIZED SOLID BIOFUELS IN TURKIYE

Main commercialized solid biofuels in Turkiye are as follows:

- Hazelnut shell
- Wallnut shell
- Pistachio shell
- Wood pellet
- Olive stone
- Olive oil cake

BIOMASSES WITH POTENTIAL INTEREST IN TURKIYE

Biomass is one of the rising stars of the renewable energy sector. According to the definition in the Renewable Energy Law (REL), biomass is a resource obtained from agricultural and forestry products including vegetable oil waste, agricultural harvesting waste as well as from organic waste, and from the by-products formed after their processing. Biomass sources include agriculture, forests, animals, organic urban waste, etc.

- Waste potential is around 8.6 million tons equivalent of petroleum (TEP), 6 million TEP is used for heating.

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- Installed Power Capacity in Turkey (2013): 241MWe
- Total Amount of Waste from Forests is 4,800,000 Tons (1.5 MTEP) (600 MW)
- From Agriculture 15,000,000 Tons (300 PJ)
- Potential map of biomass energy (BEPA) is prepared by GDRE [2].

Table 1. Global country agro-industry biomass resources [3].

SECTOR OF ACTIVITY	TYPE OF BY-PRODUCTS	POTENTIAL (t DM/y)
Wood industries	Bark	600,000
	Clean wood by-products (wood based panel)	6,500,000
	Other wood by-products (specify)	-
Nut hulling industry	Almond Shell	40,000
	Chopped pine cone	-
	Pistachio shells	72,000
	Hazelnut shell	323,000
	Other(Almond shell)	40,000
Olive oil industry	Olive stones	1,750
	Exhausted olive cake	850,000
TOTAL AGROINDUSTRY		8,426,750

EXPORTATIONS / IMPORTS OF THE SOLID BIOMASSES IN TURKEY

Turkey has tremendous ecosystem richness due to its geographical location. For this reason, olive wastes, hazelnut wastes, pistachio wastes, grape wastes, walnut wastes and more biomass varieties are combined in Turkey.

According to the information from the shell traders, there is an incredible trade in the nut /fruit shell market. Because of the high quality energy and low ash from shells. But, the market is dominated by local bargainers. Bakeries and some people of small towns use nut shells for heating and cooking. But,

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there are no exact statistics about biomass trade except for wood chips.

Turkey's imports of wood chips and scrap (HS 4401) increased significantly due to a surge in demand from local MDF and chipboard producers. Total imports increased from 48,000 MT in 2005 to 544,000 MT in 2006 eventually reaching 974,000 MT in 2008 and 1.6 million MT in 2009. The US is the leading supplier in this category, providing some 500,000 MT, followed by Brazil with 323,000 MT. The Ukraine and Bulgaria were other leading suppliers of wood chip and scrap to Turkey in 2009 with 387,000 MT and 55,000 MT respectively. Canada and Venezuela are also among the leading suppliers of wood chips to Turkey. Due to the way in which imports in this category are recorded, it is virtually impossible to distinguish what percentage of these imports was hardwood or softwood.[4]

MAIN SUPPORTS FOR THE USE OF BIOMASS IN TURKEY

National legislation on biomass heating systems for the domestic sector

According to the Ministerial Decree [5], boilers using solid biofuels in Turkey should meet at least the requirements for emissions of TS EN 303-5-2013-04 standard, identified with the standard as described in paragraph 5. Efficiency and emission limits are shown in Table 1, Table 2 and Table 3 [6].

There is no strict regulation about usage of biomass (wood pellets, hazelnut shell, apricot kernel, peach shell, walnut shell, pistachio shell) in Turkey. However, according to legislation of Ministry of Environment and Urbanization solid biofuel should meet the emission criteria.

Biomass use and heating systems in the domestic heating sector

Energy demand of Turkey is increasing year by year depending on increase of population. From 1985s up to now, while natural gas usage increased remarkably, the use of petroleum liquid products almost depleted. Although the use of coal in industry has been increased, it has been greatly diminished in domestic. Share of renewable energy in residential sector has been increasing from almost 0% to 5% since 2005. Due to lack of its own sufficient natural gas sources, Turkey pays 34.76-23.45 billion $ (2014-2015) for importation of natural gas [7]. There are new studies to abate this energy deficit. Turkey continues to gain new energy perspectives with EU close relationships. Coal has been replaced with biofuels in domestic use. The initiation of governmental support for purchase of biomass heating systems might promote solid biofuel use in Turkiye.

Turkiye has a huge biomass potential. Due to the unawareness of market of biomass in Turkey, there is no support for use of biomass products. However, biomass potential is high enough to build a biomass market system. Subsequently, BIOMASUDPLUS project results may lead certified products and then create a market that supported by legislations by government.

MAIN PROBLEMATIC OF THE USE OF BIOMASS IN TURKEY

-Sustainable biomass products
-Sustainable biomass quality
-No support for use of biomass
-Biomass stove and products are expensive than traditional stoves.

CONCLUSIONS

At present, energy plays a vital role in sustainable social-economical development and raising living quality.Turkey has an abundance of renewable energy sources but has not evaluated them sufficiently for technical and economical reasons. Moreover, meeting energy demand is essential for being able to continue sustainable development in the economy and improving the living conditions of humankind.

Furthermore, Turkey can provide all energy demand from renewable energy sources, especially

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biomass. If native energy sources like biomass are evaluated sufficiently and efficiently, energydependence on foreign countries will decline dramatically. The appearance of energy importation into country will also vanish. Biomass can be used to meet a variety of energy needs, including generating electricity, heating homes, fueling vehicles and providing process heat for industrial facilities. Turkey is a developing country with rich biomass potential. Limited sources of petroleum-based fuel made the subject of producing quality energy and productive usage of itan important point for Turkey. Among the renewable energy sources, fuelwood seems to be the most interesting because its share of the total energy production of Turkey is high, and the techniques for converting it to useful energy are not necessarily sophisticated.

Due to some technological and economical consequences, renewable energy resources have wide applications neither in the world nor in Turkey at present . Biomass can be used to meet a variety of energy needs, including generating electricity, heating homes, fueling vehicles and providing process heat for industrial facilities.

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Market data for Croatia

Biomass availability, quality, costs and use

a. Which are the biomass resources available and how much annually?

Table a.1.- Global country field biomass resources potential and consumption.

FORESTS		Source	Comments
	POTENTIAL (t DM/y)		
Conifers	97,000	Research done under S2Biom FP7 project	Year 2012, http://www.s2biom.eu/en/
Broadleaves	3,328,000	Research done under S2Biom FP7 project	Year 2012, http://www.s2biom.eu/en/
Mixed forests	N/A	N/A	-
Shrubs	N/A	N/A	-
Other (specify)	N/A	N/A	-
TOTAL FORESTS	3,425,000		
AGRICULTURE			
	POTENTIAL (t DM/y)		
Rain-fed crops	N/A	N/A	3,627 hectares of area is irrigated, while utilized surface of agricultural area is 1,508,885 hectares in 2014, Croatian Bureau of Statistics
Irrigated crops	N/A	N/A	3,627 hectares of area is irrigated, while utilized surface of agricultural area is 1,508,885 hectares in 2014, Croatian Bureau of Statistics
Rice crops	N/A	N/A	-
Olive plantations	43,993	Faculty of Agriculture, University of Zagreb	Year 2014
Orchard plantations	63,116	Faculty of Agriculture, University of Zagreb	Year 2014

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Vineyards	90,954	Faculty of Agriculture, University of Zagreb	Year 2014
Cereal straw	274,815 – 296,800	Faculty of Agriculture, University of Zagreb	Year 2013, based on the assumption that 30% of residues is available for energy use
Sunflowers stalks	38,011 – 63,099	Faculty of Agriculture, University of Zagreb	Year 2013, based on the assumption that 30% of residues is available for energy use
Soybean straw	30,659 – 42,309	Faculty of Agriculture, University of Zagreb	Year 2013, based on the assumption that 30% of residues is available for energy use
Corn stover	410,602 – 529,677	Faculty of Agriculture, University of Zagreb	Year 2013, based on the assumption that 30% of residues is available for energy use
TOTAL AGRICULTURE	952,150 - 1,129,948		

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Table a.2.- Global country agro-industry biomass resources

SECTOR OF ACTIVITY	TYPE OF BY-PRODUCTS	POTENTIAL (t DM/y)	Source	Comments
Wood industries	Bark	20,043	UNECE/FAO Joint Wood Energy Enquiry (JWEE) 2015. United Nations, Geneva.	Year 2013, 131,000 m3, assumption density 180 kg/m3, humidity 15%
	Clean wood by-products (chips etc)	91,840	UNECE/FAO Joint Wood Energy Enquiry (JWEE) 2015. United Nations, Geneva.	Year 2013, 400,000 m3, assumption density 328 kg/m3, humidity 30%
	Other wood by-products - wood residues	72,080	UNECE/FAO Joint Wood Energy Enquiry (JWEE) 2015. United Nations, Geneva.	Year 2013, 530,000 m3, assumption density 160 kg/m3, humidity 15%
Nut hulling industry	Almond Shell	N/A	N/A	-
	Chopped pine cone	N/A	N/A	-
	Pine nut shells	N/A	N/A	-
	Hazelnut shell	297	Production 2014: 990 t (Croatian Bureau of statistics)	Assumed RPR 0,3
	Wallnuts shell	1,205	Production 2014: 4,015 t (Croatian Bureau of statistics)	Assumed RPR 0,3
	Other(specify)	N/A	N/A	N/A
Olive oil industry	Olive stones	2,652	Production 2014: 8,840 t olives (Croatian Bureau of statistics)	Assumed RPR 0,3 http://www.fao.org/docrep/003/X6545E/X6545E01.htm
	Exhausted olive cake	3,228	Production 2014: 8,840 t olives (Croatian Bureau of statistics)	Assumed RPR 0,44 (H=17%) http://www.fao.org/docrep/003/X6545E/X6545E01.htm
TOTAL AGROINDUSTRY		191,345		

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Table a.3.- Solid biofuels production

BIOFUEL	DOMESTIC QUALITY (tDM /y)	INDUSTRIAL QUALITY (tDM /y)	TOTAL (tDM /y)	Source	Comments
Firewood	N/A	N/A	2,005,557	Energy in Croatia 2014	Potential is calculated from 5,302,200 m3 firewood, and density of 445 kg/m3, and humidity %
Wood chips	N/A	N/A	354,356	Energy in Croatia 2014	-
Other chips (e.g. pruning)	N/A	N/A	N/A	N/A	-
Wood briquettes	N/A	N/A	43,266	Energy in Croatia 2014	-
Wood pellets	N/A	N/A	192,275	Energy in Croatia 2014	-
Other pellets (e.g. pruning)	N/A	N/A	N/A	N/A	-
Olive stones	N/A	N/A	N/A	N/A	No known use residues, potential as written in Table a.2.
Exhausted olive cake	N/A	N/A	N/A	N/A	No known use residues, potential as written in Table a.2.
Nut shells	N/A	N/A	N/A	N/A	No known use of shells, potential as written in Table a.2.
Almond Shell	N/A	N/A	N/A	N/A	-
Chopped pine cone	N/A	N/A	N/A	N/A	-
Pine nut shells	N/A	N/A	N/A	N/A	-
Hazelnut shell	N/A	N/A	N/A	N/A	-
Other(specify)	N/A	N/A	N/A	N/A	-
Other(specify)	N/A	N/A	N/A	N/A	-
TOTAL			2,595,454		

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Table a.4.- Solid biofuels use by biofuel type

BIOFUEL	DOMESTIC USE (tDM /y)	INDUSTRIAL USE (tDM /y)	TOTAL (tDM /y)	Source	Comments
Firewood	N/A	N/A	1,366,445	Energy in Croatia 2014, Croatian Chamber of Economy	Production (table a.3.) minus exports plus imports (table a.5.) For the imports and exports it is assumed 15% dry
Wood chips	N/A	N/A	95,509	Energy in Croatia 2014, Croatian Chamber of Economy	Production (table a.3.) minus exports plus imports (table a.5.) For the imports and exports it is assumed 30% dry
Other chips (e.g. pruning)	N/A	N/A	N/A	N/A	-
Wood briquettes	N/A	N/A	16,441	Energy in Croatia 2014	Wooden briquettes capacity is estimated to 64 890 t/yr while its actual production is usually done periodically depending on the feedstock availability – waste from wood processing industry. Around 62% of the total briquettes production was exported during 2014. It is assumed that the 38% of pellets produced (table a.3.) were utilised domestically.
Wood pellets	N/A	N/A	53,837	Energy in Croatia 2014	Total installed capacity for the pellet production is 350 400 t/yr, out of which 55% is utilised during 2014. Around 72% of the total pellets production was exported while little was placed on the domestic market. It

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					is assumed that the 28% of pellets produced (table a.3.) were utilised domestically.
Other pellets (e.g. pruning)	N/A	N/A	N/A	N/A	-
Olive stones	N/A	N/A	N/A	N/A	-
Exhausted olive cake	N/A	N/A	N/A	N/A	-
Nut shells	N/A	N/A	N/A	N/A	No known use of shells, potential as written in Table a.2.
Almond Shell	N/A	N/A	N/A	N/A	-
Chopped pine cone	N/A	N/A	N/A	N/A	-
Pine nut shells	N/A	N/A	N/A	N/A	-
Hazelnut shell	N/A	N/A	N/A	N/A	-
Other(specify)	N/A	N/A	N/A	N/A	-
Other(specify)	N/A	N/A	N/A	N/A	-
TOTAL	N/A	N/A	1,532,232	N/A	-

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b. How much is imported and/or exported annually?

Table b.1.- Solid biofuels imports/exports

BIOFUEL	EXPORTS (t /y)	IMPORTS (t /y)	MAIN IMPORT-EXPORT COUNTRIES/ FINAL USE	Source	Comments
Firewood	656,554	17,441	Main Export in Italy, Slovenia, Hungary, Austria Main Import from BIH, Slovenia	Croatian Chamber of Economy	Year: 2014
Wood chips	371,202	1,420	Main Export in Hungary, Slovenia, Austria Main Import from Slovenia	Croatian Chamber of Economy	Year: 2014
Other chips (e.g. pruning)	N/A	N/A	N/A	N/A	-
Wood briquettes	N/A	N/A	N/A	N/A	-
Wood pellets	161,203	3,945	Main Export in Italy, Slovenia, Austria Main Import from BIH	Croatian Chamber of Economy	Year: 2014
Other pellets (e.g. pruning)	N/A	N/A	N/A	N/A	-
Sawdust and wood waste	42,620	1,027	Main Export in Slovenia, Italy, Germany Main Import from BIH	Croatian Chamber of Economy	Year: 2014
Olive stones	N/A	N/A	N/A	N/A	-
Exhausted olive cake	N/A	N/A	N/A	N/A	-
Nut shells	N/A	N/A	N/A	N/A	-
Almond Shell	N/A	N/A	N/A	N/A	-
Chopped pine cone	N/A	N/A	N/A	N/A	-
Pine nut shells	N/A	N/A	N/A	N/A	-
Hazelnut shell	N/A	N/A	N/A	N/A	-
Other(specify)	N/A	N/A	N/A	N/A	-
Other(specify)	N/A	N/A	N/A	N/A	-

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TOTAL	1,231,579	23,833	N/A	N/A	-

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c. What are the typical costs of the biofuels for commercial and private customers?

Table c.1.- Solid biofuels prices

Biofuel	Commercial customers typical cost €/t	Domestic customers typical cost €/t	Source	Comments
Meter of wood	N/A	90	Njuskalo.hr	25% VAT, delivery included
Bag of pellets (15kg)	N/A	193	Njuskalo.hr	25% VAT
Wood chips	40	N/A	Croatian Forest Ltd.	25% VAT
Wood bricket	110	170	Piljak.hr Njuskalo.hr	25% VAT

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d. Where are the biofuels used

This question is to complement the information in table a3.

Table d.1.- Solid biofuels use by sector

Sector	Total Ammount t/y	Main type of biofuel used	Reference	Comments
Agricultural-farm sector	N/A	N/A	Energy in Croatia 2014, Ministry of Economy	-
Biomass power plants (only electricity)	55,838,8	Wood chips	Energy in Croatia 2014, Ministry of Economy	Assumed NCV 12,1 MJ/dm3, density 328 kg/m3, not only DM
Co-firing power plants(only electricity)	N/A	N/A	Energy in Croatia 2014, Ministry of Economy	-
CHP and CHPC plants residential sector	N/A	N/A	Energy in Croatia 2014, Ministry of Economy	-
CHP and CHPC plants industrial sector	2,837,3	Wood chips	Energy in Croatia 2014, Ministry of Economy	Assumed NCV 12,1 MJ/dm3, density 328 kg/m3, not only DM, additional 1085,6 ktoe for heating and other use in indutry
Residential not CHP	2,104,711,3	Firewood	Energy in Croatia 2014, Ministry of Economy	Assumed density NCV 9 MJ/dm3, 445 kg/m3, households 1012,9 ktoe, services 3,8 ktoe, not only DM

e. Are being used certified solid biofuels in the market? Please specify types, certification standards and annual quantities.

Table e.1.- Solid biofuels imports/exports

Biofuel	Certification standard	Annual amount	Source	Comments

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		t/y		
Wood Pellet	EN plus A1	7 200	www.pilana-mrkopalj.hr	The producer is Pilana Mrkopalj, with current production of 1t/hour per year (300 working days).
Wood Pellet	EN plus A1/A2	N/A	www.pellets.hr	The producer is Energy Pellets, and has a production capacity of 30.000 t/y, the actual annual amount is not disclosed.
Wood Pellet	EN plus A1	12 000	www.velpel.hr	The producer is Velpel Ltd.
Wood Pellet	EN plus A2	N/A	www.spacva.hr	The producer is Spacva Ltd and has a max.production capacity of 50 000 t/y, the actual annual amount is not disclosed. Source: Catalogue of forestry companies and wood fuel producers (2012/2013), http://www.biomasstradecentre2.eu/wood-biomass-production/catalogues/
Wood Pellet	EN plus A2	N/A	www.sisarka.com	The producer is Sisarka Ltd. and has a max. production capacity of 50 000 t/y, the actual annual amount is not disclosed. Source: Catalogue of forestry companies and wood fuel producers (2012/2013), http://www.biomasstradecentre2.eu/wood-biomass-production/catalogues/
Wood Pellet	EN plus A1	N/A	www.mundus-viridis.hr	The producer is Mundus Viridis Ldt. and has a max.production capacity of 10 000 t/y. The actual annual amount is not disclosed. Source: Catalogue of forestry companies and wood fuel producers (2012/2013), http://www.biomasstradecentre2.eu/wood-biomass-production/catalogues/
Wood Pellet	EN plus A1	N/A	www.drvenjaca.hr	The producer is Drvenjaca and has a max.production capacity of 7 200 t/y. The actual annual amount is not disclosed. Source:

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				Catalogue of forestry companies and wood fuel producers (2012/2013), http://www.biomasstradecentre2.eu/wood-biomass-production/catalogues/
Wood Pellet	EN plus A2	N/A	www.pelet-gamauf.com	The producer is Gamauf and has a max.production capacity of 21 600 t/y. The actual annual amount is not disclosed. Source: Catalogue of forestry companies and wood fuel producers (2012/2013), http://www.biomasstradecentre2.eu/wood-biomass-production/catalogues/
				In Croatia, there are 14 EN*plus* certified producers (http://www.enplus-pellets.eu/production/certified-producers/). For a few certified producers there are no available information about annual amount or max. production capacity.

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Market data for Greece

Biomass availability, quality, costs and use

a. Which are the biomass resources available and how much annually?

Table a.1.- Global country field biomass resources potential and consumption.

FORESTS		Source	Comments
	POTENTIAL (t DM/y)		
Conifers	1,347,191	FOREST EUROPE, UNECE and FAO 2011, other literature & calculation	
Broadleaves	2,413,254	FOREST EUROPE, UNECE and FAO 2011, other literature & calculation	
Mixed forests	N/A		
Shrubs	N/A		
TOTAL FORESTS	**3,760,445**		
AGRICULTURE			
Herbaceous crops	**4,764,101**	**EUROSTAT (2014) & calculation**	**Sum of potential from herbaceous species listed below.**
Soft wheat straw	614,565	-//-	
Durum wheat straw	1,049,678	-//-	
Rye straw	52,774	-//-	
Oat straw	87,905	-//-	
Barley straw	442,851	-//-	
Maize residues	1,117,665	-//-	
a. Rice straw	237,363	-//-	
b. Sunflower straw	282,958	-//-	
c. Rapeseed straw	1,477		
d. Cotton stalks	876,865		

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e. Orchard plantation prunings	**f. 2,469,225**	**EUROSTAT (2014) & calculation**	**Sum of potential from tree species listed below.**
g. Olive tree prunings	h. 1,178,489	-//-	
i. Vineyard prunings	j. 520,156	-//-	
k. Peach tree prunings	l. 196,721	-//-	
m. Orange tree prunings	n. 175,281	-//-	
o. Apple tree prunings	p. 139,689	-//-	
q. Tangerine tree prunings	r. 54,694	-//-	
s. Almond tree prunings	t. 43,376	-//-	
u. Cherry tree prunings	v. 37,046	-//-	
w. Pear tree prunings	x. 34,739	-//-	
y. Nectarines tree prunings	z. 34,116	-//-	
aa. Apricot tree prunings	bb. 26,252	-//-	
cc. Lemon tree prunings	dd. 15,044	-//-	
ee. Plum tree prunings	ff. 8,127	-//-	
gg. Fig tree prunings	hh. 4,572	-//-	
ii. Hazelnut tree prunings	jj. 923	-//-	
TOTAL AGRICULTURE	**7,233,326**		**Sum of herbaceous crops residues and orchard plantation prunings**

Data sources & calculations

Forests

In 2010, the forest area in Greece was 3,903,000 ha, of which 3,595,000 ha (92%) were available for wood production (Source: *FOREST EUROPE, UNECE and FAO 2011: State of Europe's Forests 2011. Status and Trends in Sustainable Forest Management in Europe*). The growing stock was given as 47 m^3/ha.

The same source indicated that the Net Annual Increment (NAI) in Greece was 3,813,000 m^3 (overbark) or 1.3 m^3/ha. Data for the NAI of broadleaves and conifers were not presented in this report or other statistical sources, e.g. FAO.

In a presentation of the Secretary of the Special Secretariat of Forests (Source: *G. Amorgianiotis, Economy and Forestry. Presentation at workshop "Greek Forestry: A big advantage for the Greek economy", 16th May 2001, in Greek*), the following information is presented regarding the distribution and NAI of the Greek forests:

- 22.2% of the forests are coniferous, with a NAI of 2.82 m^3/ha.
- 29.4% of the forests are broadleaves, with a NAI of 2.12 m^3/ha.
- 48.4% of the forests are evergreen broadleaves, with a NAI of 0.45 m^3/ha

For the conversion of cubic meters overbark to dry matter, Biomass Conversion and Expansion Factors (BCEF) are used. A BCEF of 0.8 for broadleaves and 0.6 for conifers is considered, based on the IPCC Guidelines for the Mediterranean / dry tropical / subtropical climate zones with a stocking of between 41-80 m^3/ha.

The equation giving the forest potential for each main forest species is the following

$$(\boldsymbol{Forest\ potential}, \boldsymbol{tDM}) = (\boldsymbol{Forest\ Area}, \boldsymbol{ha}) \times (\boldsymbol{Availability}, \%) \times (\boldsymbol{Species}\ \%)\ \times \boldsymbol{BCEF}$$

The calculated results are given in Table a.1. The potential presented can be used as industrial wood, firewood, etc.

Agriculture: Herbaceous crop residues

For the herbaceous crop residues in Greece, the following formula is applied:

$$(\boldsymbol{Herbaceous\ residues}, \boldsymbol{tDM}) = (\boldsymbol{Crop\ production}, \boldsymbol{t}) \times \boldsymbol{RPR}\ \times (\boldsymbol{1} - \boldsymbol{W})$$

The main reference for the Residue to Product Ratios (RPRs) and typical moisture contents is the following paper: *Scarlat, N., M. Martinov, and J.-F. Dallemand, Assessment of the availability of agricultural crop residues in the European Union: Potential and limitations for bioenergy use. Waste Management, 2010. 30(10): p. 1889–1897.* For cotton, the reference is *Apostolakis, M. Kyritsis, S., Souter, Ch., The energetic potential of biomass from agricultural and forestry by-products (a study in Greek territory). 1987, ELKEPA, Athens (in Greek)*.

Crop	RPR	Moisture content (W)
Soft and durum wheat	$1.6057 - 0.3629 * \mathrm{Ln}(\mathrm{YLD})$	15%
Rye	$1.5142 - 0.3007 * \mathrm{Ln}(\mathrm{YLD})$	15%

Oat	$1.3002 - 0.1874 * \mathrm{Ln}(\mathrm{YLD})$	15%
Barley	$1.3796 - 0.2751 * \mathrm{Ln}(\mathrm{YLD})$	15%
Maize	$1.3373 - 0.1807 * \mathrm{Ln}(\mathrm{YLD})$	30%
Rice	$3.845 - 1.2256 * \mathrm{Ln}(\mathrm{YLD})$	25%
Sunflower	$3.2189 - 1.1097 * \mathrm{Ln}(\mathrm{YLD})$	40%
Rapeseed	$2.0475 - 0.452 * \mathrm{Ln}(\mathrm{YLD})$	40%
Cotton	2.00	45%
YLD refers to the yield (expressed in t/ha) of the main agricultural product of the crop.		

For crop production, the main source is EUROSTAT, Crop statistics data (*code: apro_acs_a*) for the year 2014.

Orchard plantations

For the orchard plantation prunings in Greece, the following formula is applied:

$$(\boldsymbol{Prunings}, \boldsymbol{tDM}) = (\boldsymbol{Fruit\ production}, \boldsymbol{t}) \times \boldsymbol{RPR} \times (\mathbf{1} - \boldsymbol{W})$$

For fruit production, the main source is EUROSTAT, Crop statistics data (*code: apro_acs_a*) for the year 2014.

Residue to Product Ratios (RPRs) and typical moisture contents have been taken from the following publications:

- For most tree types: *EUBIONET, Biomass survey in Europe / Country Report of Greece (2003). Available online at: http://www.afbnet.vtt.fi/greece_biosurvey.pdf.* Note: this publication uses values from an older Greek source (Apostolakis, 1987). The values quoted are product / ratio, therefore the inverse value was used for the calculations.
- For plum, fig and hazelnut trees: *H. Unal, K. Alibas, Agricultural Residues as Biomass Energy. Energy Sources, Part B, 2:123–140, 2007*. Note: this publication quotes values from Turkey.

The typical moisture content of all prunings was taken as 40% wt, with the exception of olive tree prunings where the value of 35% wt was applied.

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Table a.2.- Global country agro-industry biomass resources

SECTOR OF ACTIVITY	TYPE OF BY-PRODUCTS	POTENTIAL (t DM/y)	Source	Comments
Wood industries	Bark	N/A	----	
	Clean wood by-products (chips etc)	N/A	----	
	Other wood by-products (specify)	N/A	----	
Nut hulling industry	Almond Shell	10,328	EUROSTAT (2014) & calculation	
	Chopped pine cone	----	----	The production is non-existent or negligible
	Pine nut shells	----	----	The production is non-existent or negligible
	Hazelnut shell	< 365	EUROSTAT (2014) & calculation	
	Walnut shell	< 10,229	-//-	Shells may be produced manually and hence not easily collected.
	Pistachio shell	332 - 498	-//-	Only a small percentage (10 – 15%)of the yearly production is treated by crushing plants.
	Other(specify)			
Olive oil industry	Olive stones	130,387	EUROSTAT (2014) & calculation	
	Exhausted olive cake	309,473	EUROSTAT (2014) & calculation	
Rice industry	Rice husk	41,278	EUROSTAT (2014) & calculation	Mostly used as fuel by the rice processing industry.
Cotton industry	Cotton ginning residues	69,352	EUROSTAT (2014) & calculation	Used as fuel in cotton ginning plants for steam production (drying of cotton, wetting of lint, treatment of cotton seeds)
Fruit canneries and juice production plants	Apricot stones	924	EUROSTAT (2014) & company estimations	

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	Peach kernel	24,384	EUROSTAT (2014) & company estimations	
kk. TOTAL AGROINDUSTRY		**< 597,218**	ll.	mm.

Data sources & calculations

Nut hulling industry

For the calculation of the nut shells produced in Greece, the following formula is applied:

$$(\boldsymbol{Nut\ shells, tDM}) = (\boldsymbol{Nut\ production, t}) \times (\%\ \boldsymbol{shell}) \times (\%\ \boldsymbol{nut\ processed}) \times (\boldsymbol{1 - W})$$

The following table summarizes the calculations and data sources for those main quantities for the main types of nuts produced in Greece. In all cases, a typical moisture content of 15% is considered.

Nut type	Nut production (t) [1]	% shell* [2]	% nut processed [2]	Nut shells (tDM)
Almond	20,250	60	100	10,328
Walnut	21,880	55	100	10,229
Pistachio	7,100	55	10 - 15	332 - 498
Hazelnut**	810	53	100	365

[1] For almond, walnut and hazelnuts, the quantities in 2014 are taken from EUROSTAT data (Code: apro_acs_a)

For pistachio, the 2013 production data are used taken from the following publication: *Hellenic Statistical Authority, "2013 ANNUAL AGRICULTURAL STATISTICAL SURVEY", Piraeus, 10 June 2016. Available online at: http://www.statistics.gr/documents/20181/3c4b9b69-c5a5-435a-8a6c-e1913cb446d1*

[2] Estimations based on communications with nut processing companies.

Almonds: the shell ranges from 55 – 70% of the nut. A typical value of 60% is used. Almost the whole of the production is processed by almond crushing plants.

Walnuts: the shell is about 55% of the nut. It is assumed that most of the nuts are opened before they are put in the market. However, walnut processing plants are rare and in many cases, the work is done manually.

Pistachios: the shell is about 55% of the nut. Processing plants treat only the «closed» nuts, which are about 10 – 15% of the yearly production.

Hazelnuts: no data from processing companies are available. A value of 53% for the percentage of the shell was taken from the following publication: *H. Unal, K. Alibas, Agricultural Residues as Biomass*

Energy. Energy Sources, Part B, 2:123–140, 2007. It is also assumed that 100% of the nut is processed.

Olive oil industry calculations

The production of olives that are processed for olive oil production was 1,570,930 t in 2014 Source: *EUROSTAT, Crops statistics, code: apro_acs_a)*.

According to a mass balance from the BIOMASUD project (*Rodero, P., Esteban L., The olive oil industry: Main by-products and their characteristics as fuels*), olive stones amount to 8.3% of the weight of the olive, while the exhausted olive cake is 19.7% of the weight. Both quantities refer to dry basis, since water is given separately in the mass balance. Therefore:

$$(\boldsymbol{Olive\ stones}) = \mathbf{1,570,930}\ \boldsymbol{t} \times \mathbf{8.3\%} = \mathbf{130,387}\ \boldsymbol{tDM}$$

$$(\boldsymbol{Exhausted\ olive\ cake}) = \mathbf{1,570,930}\ \boldsymbol{t} \times \mathbf{19.7\%} = \mathbf{309,473}\ \boldsymbol{tDM}$$

Actual production volumes depend on the production systems employed. In Greece, the separation of olive stones is rare; the stones typically end up in the exhausted olive cake produced by the secondary (pomace) mills. It is also noted that a large percentage of exhausted olive cake is self-consumed by the pomace mills for drying the wet olive cake and producing steam for extraction of residual oil.

Rice industry calculations

The annual rice production for 2014 was 229,320 t (Source: *EUROSTAT, Crops statistics, code: apro_acs_a)*. Rice husk is about 20% of the rice and has a typical moisture content of around 10%. Based on these, the following calculation regarding production of rice husk in 2014 can be made:

$$(\boldsymbol{Rice\ husk}) = \mathbf{229,320}\ \boldsymbol{t} \times \mathbf{20\%} \times (\mathbf{1} - \mathbf{10\%}) = \mathbf{41,278}\ \boldsymbol{tDM}$$

It is noted that rice husk is typically as fuel by rice processing plants for the cooking of rice.

Cotton industry

The annual cotton seed production for 2014 was 797,150 t (Source: *EUROSTAT, Crops statistics, code: apro_acs_a)*. Cotton ginning residues are around 10% of the processed cotton and have a typical moisture content of around 13% (Source: http://biomass.com.gr/gr/examples/ex6). Based on the above, the cotton ginning residues production in 2014 is as follows:

$$(\boldsymbol{Cotton\ ginning\ residues}) = \mathbf{828,233}\ \boldsymbol{tons} \times \mathbf{10\%} \times (\mathbf{1} - \mathbf{13\%}) = \mathbf{69,352}\ \boldsymbol{tDM}$$

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These residues are used as fuel in the cotton ginning plants for steam production for various internal uses (drying of cotton, wetting of lint, treatment of cotton seeds, etc). Recently, a 1 MWel CHP plant burning cotton ginning residues was built in Greece.

Fruit canneries and juice production plants

Apricot Shell

According to data obtained from EUROSTAT, the total production of apricots was 125,010 t in 2014. The percentage of apricots led to fruit canneries and juice production plants (from which the stones are taken out) is estimated at about 20% of the total production. The stone to flesh percentage varies depending on the fruit variety; the average of the extreme measurements (5.8%) from a literature source is used [Source: *T. Milošević, N. Milošević, I. Glišić, I.S. Glišić, Determination of size and shape properties of apricots using multivariate analysis, Acta Sci. Pol., Hortorum Cultus 13(5) 2014, 77-90. Available online at: http://wydawnictwo.up.lublin.pl/acta/hortorum_cultus/2014/5/07.pdf*], therefore the quantity of stones produced are estimated to be around 1,450 t.

Apricot stones have a high resale value; one company in Greece claims to buy around 90% of the total production. In its premises, the stones are crushed and the bitter kernel (around 25%) is sold as a nut (mostly exported). This percentage falls within the reported kernel to stone percentage from the literature [see *Milošević et al., 2014*]. The remaining 75% of the stone is sold as a fuel; a typical moisture content would be around 15%. Therefore, the quantity of apricot stones produced as a fuel is estimated to be around 924 tDM. The company claims that historical production data have never exceeded 1,500 t in any case.

Peach kernel

The clingstone production in Greece amounted to 425,000 t in 2014, of which 381,000 t were processed in canneries and juice production plants (Source: *Ministry of Rural Development and Food, http://www.minagric.gr/images/stories/docs/agrotis/Oporokipeytika/rodakina/stoixeia_ektashs_sybyrino_rodakino241016.pdf*).

The Greek Canneries Association (EKE) estimated that peach kernels are about 8% of the incoming material (Source: *project communication, 2016*). Assuming a typical moisture content of around 20%, the following calculation can be made for peach kernel production in 2014:

$$(\boldsymbol{Peach\ kernel}) = \mathbf{381{,}000}\ \boldsymbol{t} \times \mathbf{8}\% \times (\mathbf{1} - \mathbf{20}\%) = \mathbf{24{,}384}\ \boldsymbol{tDM}$$

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Table a.3.- Solid biofuels production

BIOFUEL	DOMESTIC QUALITY (tDM /y)	INDUSTRIAL QUALITY (tDM /y)	TOTAL (tDM /y)	Source	Comments
Firewood	N/A	N/A	550,638	FAOSTAT (2014) & calculation	ELSTAT indicates that 464,203 t of firewood from agricultural holdings were produced in 2010.
Wood chips	N/A	N/A	N/A		
Other chips (e.g. pruning) Please, ad new files for each additional biofuel	N/A	N/A	N/A		
Wood briquettes	N/A	N/A	N/A		
Wood pellets	N/A	N/A	26,775	HELLABIOM (2013)	The annual production capacity is listed as 137.840 t/y. Mostly targeting the domestic heating market.
Other pellets (e.g. pruning) Please, ad new files for each additional biofuel	N/A	N/A	N/A		
Olive stones	N/A	N/A	5,000 – 7,000	CERTH estimation	
Exhausted olive cake	N/A	N/A	358,268	EUROSTAT (2014) & calculation based on data from Associaton of Olive Kernel Oil Producers	The usual Greek term is ” pyrinoksylo” (translated as kernel wood). About 60% of the production is self-consumed by the secondary olive mills during the production process.
Nut shells	N/A	N/A	21,254 - 21,420	EUROSTAT (2014) & calculation	Same as listed in Table a.2.
Rice husk	N/A	N/A	41,278	EUROSTAT (2014) & calculation	Same as listed in Table a.2.
Peach kernels	N/A	N/A	24,384	EUROSTAT (2014) & calculation	Same as listed in Table a.2.
Cotton ginning residues	N/A	N/A	69,352	EUROSTAT (2014) & calculation	Same as listed in Table a.2.
TOTAL	N/A	N/A			

Data sources & calculations

Firewood

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FAOSTAT reports the following figures for wood fuel production from forests in Greece for the year 2014:

- Coniferous fuel wood: 97,000 m^3 (solid volume, underbark). FAOSTAT suggests a solid density of 625 kg/m^3 for coniferous fuel wood.
- Non-coniferous fuel wood: 968,000 m^3 (solid volume, underbark). FAOSTAT suggests a solid density of 750 kg/m^3 for non-coniferous fuel wood.

A typical moisture content of 30% is used to estimate the dry matter content.

In addition to the firewood removed from forests, the Hellenic Statistical Authority (ELSTAT) indicates that 464,203 t of firewood from agricultural holdings were produced in 2010. This figure is in the same order of magnitude as those reported in previous years.

Olive stones

Only a limited number of companies in Greece perform the separation of olive stones from the olive cake. Based on some initial discussions with such producers, CERTH estimates that the volume of production in Greece is around 5,000 – 7,000 t.

Exhausted olive cake

The starting point for the calculation is the production of olives that are processed for olive oil production, same as in Table a.2.

Through project communication (June 2016), the Association of Olive Kernel Oil Producers of Greece (SPEL) mentioned that the production of exhausted olive cake (refered in Greece as ”kernel wood” or ”pyrinoksylo” depends on several factors, such as the olive oil production and percentage of olive oil produced in three-phase or two-phase olive mills. The Association estimates that there is a 60/40 split between the two-phase and the three-phase systems currently. The olive cake produced by two-phase systems is around 80% of the olives, with a typical moisture around 68%, while the three-phase system produce an olive cake which is 50% of the weight of the incoming olives and with a a lower moisture content of 52%.

Following treatment of the olive cake at the secondary (pomace) mills and extraction of the residual oil, it is estimated that the amount of ”pyrinoksilo” produced is around 358,268 tDM.

Of this quantity, around 60% is self-consumed by the pomace mills in order to dry the incoming olive cake and to produce steam required for the pomace oil extraction process. The rest is used by the domestic and industrial sectors.

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Table a.4.- Solid biofuels use by biofuel type

BIOFUEL	DOMESTIC USE (tDM /y)	INDUSTRIAL USE (tDM /y)	TOTAL (tDM /y)	Source	Comments
Firewood	2,031,678	N/A	N/A	Hellenic Statistical Authority & calculation	
Wood chips	N/A	N/A	N/A		
Other chips (e.g. pruning)	N/A	N/A	N/A		
Wood briquettes	N/A	N/A	N/A		
Wood pellets	58,456	N/A	N/A	Hellenic Statistical Authority & calculation	
Other pellets (e.g. pruning)	N/A	N/A	N/A		
Olive stones	N/A	N/A	N/A		
Exhausted olive cake	35,656	N/A	N/A	Hellenic Statistical Authority & calculation	
Nut shells	N/A	N/A	N/A		
nn. Almond Shell	N/A	N/A	N/A		
oo. Chopped pine cone	N/A	N/A	N/A		
pp. Pine nut shells	N/A	N/A	N/A		
qq. Hazelnut shell	N/A	N/A	N/A		
rr. Other(specify)	N/A	N/A	N/A		
TOTAL	**2,185,546**	**458,814**		Domestic: Hellenic Statistical Authority & calculation Industrial: EUROSTAT (2012) & calculation	

Data sources & calculations

Domestic use

The main source for the statistical data of Table a.4 is a survey conducted by the Hellenic Statistical Authority[10] regarding the energy consumption of households reported that for the heating period of 2011 – 2012. According to the survey, the average thermal energy consumption of a Greek household was 10,244 kWh, while the total number of households in Greece considered for the survey was 4,166,567.

Only three types of biomass fuels are listed in the survey as contribution to the thermal energy consumption of households: firewood 23.8%, wood pellets 0.7% and olive cake 0.4%.

[10] Hellenic Statistical Authority, "Survey on energy consumption in households, 2011-2012", Piraeus, October 2013. Available online at: http://www.statistics.gr/documents/20181/985219/Energy+consumption+in+households/

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The table presents the calculated fuel consumptions for the domestic sector based on the results of the surveys and using the following typical fuel properties:

- Wood pellets, LHV: 4.60 kWh/kg, moisture 10% (Source: Wood fuels handbook)
- Firewood, LHV: 3.40 kWh/kg, average moisture 30% (Source: Wood fuels handbook)
- Olive cake, LHV: 4.07 kWh/kg, average moisture 15% (CERTH estimation)

The overall domestic consumption of biomass based on this survey amounts to **913.83 ktoe**. This figure is in very good agreement with the residential consumption of solid biofuels for the residential sector in Greece provided by EUROSTAT, which is **908.9 ktoe** (Code: nrg_107a).

Industrial use

No similar national survey regarding the biomass consumption of the industrial sector can be found.

EUROSTAT (Code: nrg_107a) reports that the industrial consumption of solid biofuels (excluding charcoal) in the industrial sector was **188.9 ktoe in 2012**. Of this, 85.4% was due to consumpion in the category ”food and tobacco” sector. It is expected that a significant percentage of the industrial consumption of biomass corresponds to the self-consumption of exhausted olive cake by the secondary olive mills.

Therefore, using the same typical fuel properties for olive cake (LHV: 4.07 kWh/kg, moisture 15%) as in the previous case, a rough estimation of the biomass consumption in the industrial sector is calculated.

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b. How much is imported and/or exported annually?

Table b.1.- Solid biofuels imports/exports

BIOFUEL	EXPORTS (t /y)	IMPORTS (t /y)	MAIN IMPORT-EXPORT COUNTRIES/ FINAL USE	Source	Comments
Firewood	2,429	159,241		FAOSTAT (2014) & calculation	Significant quantities of firewood are imported from Bulgaria (mostly) for the domestic market in Northern Greece.
Wood chips	N/A	N/A	N/A		
Other chips (e.g. pruning)	N/A	N/A	N/A		
Wood briquettes	N/A	N/A	N/A		
Wood pellets	670	20,992	Export countries: Italy, Bulgaria, Albania. Main Import countries: Austria, Romania, Bulgaria, Albania, Serbia, FYROM.	FAOSTAT (2014) / HELLABIOM (2013, for import / export countries	
Other pellets (e.g. pruning)	N/A	N/A	N/A		
Olive stones	N/A	N/A	N/A		
Exhausted olive cake	**	N/A	N/A		** The export of olive stones to biomass power and CHP plants for other European countries has been recorded as a practice but no statistical data are available.
Nut shells	N/A	N/A			
ss. Almond Shell	N/A	N/A			

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tt. Chopped pine cone	N/A	N/A			
uu. Pine nut shells	N/A	N/A			
vv. Hazelnut shell	N/A	N/A			
ww. Other(specify)	N/A	N/A			
TOTAL	**3,099**	**180,233**			

Data sources & calculations

FAOSTAT reports the following figures for wood fuel imports / exports in Greece for the year 2014:

- Imports: 219,643 m^3 (solid volume, underbark)
- Exports: 3,351 m^3 (solid volume, underbark)

A solid density of 725 kg/m^3 (as suggested by FAOSTAT) was used to estimate import and export quantities in tons.

Assuming typical fuel LHVs for wood fuel (3.4 kWh/kg for moisture of 30%) and wood pellets (4.6 kWh/kg for moisture of 10%), the energetic value of imports is calculated as 61.0 ktoe, while exports are 1.3 ktoe. These figures correspond very well to the values quoted by EUROSTAT, e.g. 62.1 ktoe and 1.1 ktoe for imports and exports respectively.

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c. What are the typical costs of the biofuels for commercial and private customers?

Table c.1.- Solid biofuels prices

Biofuel	Commercial customers typical cost €/t	Domestic customers typical cost €/t	Source	Comments
Wood pellets Enplus A1 (imported	N/A	241.95	www.karadinos.gr (6/11/2016)	Quoted price for 1000 kg
Wood pellets Enplus A1 (Greek producer)	N/A	225.81	www.praktiker.gr (6/11/2016)	Quoted price for 15 kg bag
Wood pellets Enplus A2 (Greek producer)	N/A	185.48	www.praktiker.gr (6/11/2016)	Quoted price for 15 kg bag
Wood pellets A1 (Greek producer)	N/A	232.14	www.pelletaki.gr (6/11/2016)	Quoted price for 990 kg
Wood pellets A1 (Greek producer)	N/A	219.90	www.pelletaki.gr (6/11/2016)	Quoted price for 990 kg
Olive stones	N/A	150	Project communication with producer	Bagged, 25 kg
Exhausted olive cake	55	55	Chatzelis Group (Facebook announcement, 11/4/2016)	Bulk, purchase from production plant
Olive cake pellets (industrial use)	186.54	N/A	www.pelletaki.gr (6/11/2016)	Transport cost not included, quoted price for 990 kg
Firewood	N/A	64.52 €/m3 (beech, pine) 72.58 €/m3, oak 80.65 €/m3 (olive) (All prices in bulk m3)	http://www.xylopigi.gr/ (6/11/2016)	Listed seller delivers free of charge within Attica (Athens region). Large variations are recorded depending on the seller and time of year.
Peach kernel	60 - 80	60 - 80	Greek Canneries Association (project communication, 2016)	
Nut shells	65 - 120	65 - 120	Various producing companies (project communication, 2016)	

- No price index for solid biofuels is available in Greece. Reported prices come from various sources, e.g. internet search, company announcements, project communications, etc.
- The applicable VAT for solid biofuels in Greece is 24% (since 1/6/2016, ΠΟΛ 1061/2016)
- According to Market Regulation No 4/28.11.2012, for the retail sale of firewood, it is compulsory to use volume units, either cubic meter, stacked or cubic meter, bulk (weight units are not allowed).

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d. Where are the biofuels used

This question is to complement the information in table a3.

Table d.1.- Solid biofuels use by sector

Sector	Total Amount t/y	Main type of biofuel used	Reference	Comments
Agricultural-farm sector	*	Firewood, wood pellets, olive cake, others		*According to EUROSTAT, the agricultural / forest sector consumed 24.7 ktoe of solid biofuels in 2014.
Biomass power plants (only electricity)	0	N/A	EUROSTAT (2014)	The use of solid biofuels for electricity production is minimal. Recently, a 1 MWe ORC plant firing cotton ginning residues was built in Greece.
Co-firing power plants(only electricity)	0*	Cardoon, maize residues and exhausted olive cake	CERTH, FP7 project DEBCO	*Co-firing of biomass in lignite-fired power plants has been performed as demonstration in the framework of EU and nationally-funded research projects in the past. To this day, there is no permanent application.
CHP and CHPC plants residential sector	0	N/A	EUROSTAT (2014)	
CHP and CHPC plants industrial sector	0	N/A	EUROSTAT (2014)	
Residential not CHP	**	Firewood, wood pellets, olive cake, others		*According to EUROSTAT, the residential sector consumed 750 ktoe of solid biofuels in 2014.

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e. Are being used certified solid biofuels in the market? Please specify types, certification standards and annual quantities.

Table e.1.- Solid biofuels imports/exports

Biofuel	Certification standard	Annual amount t/y	Source	Comments
Wood Pellets	ENplus A1 / A2	Not disclosed	ENplus list of certified producers (http://www.enplus-pellets.eu/production/certified-producers/), TUV-Nord press release (http://www.tuv-nord.com/gr/el/press-releases-580-1326.htm)	Only one Greek producer of wood pellets (Alfa Wood Nevrokopi AEBE, www.alfapellet.gr) has been awarded the ENplus certification. The company has a production capacity of 60,000 t/y, the actual produced quantity is not disclosed. Imported wood pellets are often of ENplus A1 quality, no statistics are available though.

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Market data for Italy

Biomass availability, quality, costs and use

a. Which are the biomass resources available and how much annually?

Table a.1.- Global country field biomass resources potential and consumption.

FORESTS		Source	Comments
	POTENTIAL (t DM/y)		
Conifers	126.346	ENEA 2009	
Broadleaves	1.833.972	ENEA 2009	
Mixed forests			
Shrubs	220.264	ENEA 2009	
Other (specify)			
Other (specify			
TOTAL FORESTS			
AGRICULTURE			
	POTENTIAL (t DM/y)		
Rain-fed crops			Not relevant
Irrigated crops	40.000		7.000 ha
Rice crops	N.A.	ENEA 2009	
Olive plantations			
Orchard plantations (Vineyards and olive plantations included)	4.906.405	ENEA 2009	
Vineyards		ENEA 2009	
Agricultural residuals	22.403.610	ENEA 2009	
Other (specify)			
TOTAL AGRICULTURE	**29.530.597**		

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Table a.2.- Global country agro-industry biomass resources

SECTOR OF ACTIVITY	TYPE OF BY-PRODUCTS	POTENTIAL (t DM/y)	Source	Comments
Wood industries	**Bark**	**544.000**	**FEDERLEGNO, elab. AIEL**	
	Clean wood by-products (chips etc)	**34.000.000**	**FEDERLEGNO, elab. AIEL**	**The potential depends on the quantity of wood that is meant to be used for energy purposes**
	Other wood by-products (specify)			
Nut hulling industry	**Almond Shell**			**Not relevant**
	Chopped pine cone			**Not relevant**
	Pine nut shells			**Not relevant**
	Hazelnut shell	**116.557**	**ENEA 2009, University of Neaples**	
	Other(specify)			
Olive oil industry	**Olive stones**	**N.A.**		
	Exhausted olive cake	**690.000**	**ENEA 2009, AIEL**	
Chips. from pruning		**4.900.000**	**ENEA 2009**	
TOTAL AGROINDUSTRY				

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Table a.3.- Solid biofuels production

BIOFUEL	DOMESTIC QUALITY (tDM /y)	INDUSTRIAL QUALITY (tDM /y)	TOTAL (tDM /y)	Source	Comments
Firewood	5.300.000	0	5.300.000	ISTAT 2015, AIEL 2015	Production represents 80% of the national consumption. Half of the production is self-produced by end consumers
Wood chips	90.000	2.310.000	2.400.000	ISTAT 2015, AIEL 2016	Import represents the 20% of the industrial consumption
Other chips (e.g. pruning)	0	90.000	90.000	AIEL 2016	
Wood briquettes					Not relevant
Wood pellets	360.000	0	300.000	AIEL, EPC 2016	
Other pellets (e.g. pruning)					Not relevant
Olive stones	20.000	20.000	40.000	AIPO	Import 50% of the total consumption
Exhausted olive cake	70.000	70.000	140.000	AIEL	
Nut shells	43.700	43.700	87.400	AIEL	
Almond Shell					
Chopped pine cone					
Pine nut shells					
Hazelnut shell	43.700	43.700	87.400	AIEL	
Other(specify)					
Other(specify)					
TOTAL	**5.927.400**	**2.577.400**	**8.444.800**		

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Table a.4.- Solid biofuels use by biofuel type

BIOFUEL	DOMESTIC USE (tDM /y)	INDUSTRIAL USE (tDM /y)	TOTAL (tDM /y)	Source	Comments
Firewood	10.620.000	0	10.620.000	ISTAT 2015, AIEL 2016	0,01% ISO 17225-5
Wood chips	90.000	2.910.000	3.000.000	INEA 2015, AIEL 2016	10% ISO 17225-4
Other chips (e.g. pruning)	0	90.000	90.000	AIEL	0% ISO 17225-4
Wood briquettes					
Wood pellets	2.430.000	270.000	2.700.000	ISTAT 2015, AIEL 2016	65% ISO 17225-2 (Enplus)
Other pellets (e.g. pruning)					
Olive stones	42.500	42.500	85.000	AIPO	
Exhausted olive cake	70.967	70.967	141.933	AIEL	
Nut shells	43.709	43.709	87.418	AIEL	
Almond Shell					
Chopped pine cone					
Pine nut shells					
Hazelnut shell	43.709	43.709	87.418	AIEL	
Other(specify)					
Other(specify)					
TOTAL	**13.297.176**	**3.427.176**	**16.724.351**		

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b. How much is imported and/or exported annually?

Table b.1.- Solid biofuels imports/exports

BIOFUEL	EXPORTS (t /y)	IMPORTS (t /y)	MAIN IMPORT-EXPORT COUNTRIES/ FINAL USE	Source	Comments
Firewood	20.000	5.300.000	East Europe	ISTAT 2015, AIEL 2016	
Wood chips	0	600.000	East Europe	EUROSTAT 2015	
Other chips (e.g. pruning)					
Wood briquettes					
Wood pellets	0	2.400.000	Austria, Canada, USA, East Europe	EPC 2016	
Other pellets (e.g. pruning)			e.g . in Spain. UK, Poland, Belgium/power and thermal plants		
Olive stones		45.000	Spain		
Exhausted olive cake					
Nut shells					
Almond Shell					
Chopped pine cone					
Pine nut shells					
Hazelnut shell					
Other(specify)					
Other(specify)					
TOTAL	**20.000**	**8.345.000**			

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c. What are the typical prices of the biofuels for commercial and private customers?

Table c.1.- Solid biofuels prices (October 2016)

Biofuel	Commercial customers typical price €/t	Domestic customers typical price €/t	Source	Comments
Wood logs M25	110	140	AIEL's members 2016	
Wood pellets ENplus A1	206	238	AIEL's members 2016	
Wood pellets ENPlus A2	180	215	AIEL's members 2016	
Wood chips M25	115		AIEL's members 2016	
Agricultural wood chips M25	100		AIEL's members 2016	Vineyard, olive and orchard potatures,
Agricultural briquettes		160	AIEL's members 2016	
Agricultural pellets		215	AIEL's members 2016	

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d. Where are the biofuels used

This question is to complement the information in table a3.

Table d.1.- Solid biofuels use by sector

Data is available in Mtep. It is not possible to convert to tons considering that it refers to a biomass mix

Sector	Total Ammount t/y	Main type of biofuel used	Reference	Comments
Agricultural-farm sector	75.000	Wood chips, pellet, agricultural residuals	GSE 2015	
Biomass power plants (only electricity)	1.440.000	Wood chips	BASIS 2015, GSE 2014, AIEL 2015	
Co-firing power plants(only electricity)	0			
CHP and CHPC plants residential sector	500.000	Wood chips	BASIS 2015, GSE 2014, AIEL 2015	
CHP and CHPC plants industrial sector	3.300.000	Wood chips	BASIS 2015, GSE 2014, AIEL 2015	
Residential not CHP	35.900.000	Wood logs, wood pellets, Mediterrean biofuels,	BASIS 2015, GSE 2014, AIEL 2015	
Commercial, Industrial not CHP	715.300	Wood chips, wood pellets	BASIS 2015, GSE 2014, AIEL 2015	District heating included

e. Are being used certified solid biofuels in the market? Please specify types, certification standards and annual quantities.

Table e.1.- Solid biofuels imports/exports

Biofuel	Certification standard	Annual amount t/y	Source	Comments
Wood pellet	ENplus	1.500.000	Aiel, EPC 2016	
Wood pellet	DINplus	N.A.		Statistics not available

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Market data for Portugal

Biomass availability, quality, costs and use

a. Which are the biomass resources available and how much annually?

Table a.1.- Global country field biomass resources potential and consumption.

FORESTS		Source	Comments
	POTENTIAL (t DM/y)		
Conifers	1.348798	IFN6, 2013 preliminary results	Total potential calculated with Biorreg-Florestas methodoly (2007) through preliminary results of the last national forest inventory
Broadleaves	2.398.508	IFN6, 2013 preliminary results	Total potential calculated with Biorreg-Florestas methodoly (2007) through preliminary results of the last national forest inventory
Mixed forests			
Shrubs	2.573.292	Biorreg-Florestas (2007)	Potential production of the forest understorey shrubs
Other (specify)			
Other (specify			
TOTAL FORESTS	**6.320.598**		
AGRICULTURE			
	POTENTIAL (t DM/y)		
Rain-fed crops			
Irrigated crops			
Rice crops			
Olive plantations	96.403	INE, 2015. Instituto Nacional de Estatística, Estatísticas Agrícolas 2014	Total olive prunings production in 2014
Orchard plantations			
Vineyards	212.993	INE, 2015. Instituto Nacional de Estatística, Estatísticas Agrícolas 2014	Total vineyards prunings production in 2014
Other (specify)			
Other (specify)			
TOTAL AGRICULTURE	**309.396**		

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Table a.2.- Global country agro-industry biomass resources

SECTOR OF ACTIVITY	TYPE OF BY-PRODUCTS	POTENTIAL (t DM/y)	Source	Comments
Wood industries	**Bark**			
	Clean wood by-products (wood chips)	732.000	INE, 2015. Instituto Nacional de Estatística, Estatísticas Agrícolas 2014	Total production in 2013 High quantity utilised in industry like feedstock
	Other wood by-products (specify)			
Nut hulling industry	**Almond Shell**	6.378	INE, 2015. Instituto Nacional de Estatística, Estatísticas Agrícolas 2014	This data refer the year 2014
	Chopped pine cone	54.847	UNAC, 2010. União das Organizações de Agricultores para o Desenvolvimento da Charneca	This data refer the year 2010 Total production
	Pine nut shells	16.317	UNAC, 2010. União das Organizações de Agricultores para o Desenvolvimento da Charneca	This data refer the year 2011
	Hazelnut shell	86	INE, 2015. Instituto Nacional de Estatística, Estatísticas Agrícolas 2014	This data refer the year 2014 - Total production
	Other(Walnut)	998	INE, 2015. Instituto Nacional de Estatística, Estatísticas Agrícolas 2014	This data refer the year 2014 - Total production
Olive oil industry	**Olive stones**	59.746	GPP, 2016. Gabinete de Planeamento, Políticas e Administração Geral. SIAZ - Sistema de Informação sobre o Azeite e a Azeitona de Mesa	campaign 2015-2016 Total production
	Exhausted olive cake	94.597	GPP, 2016. Gabinete de Planeamento, Políticas e Administração Geral. SIAZ - Sistema de Informação sobre o Azeite e a Azeitona de Mesa	campaign 2015-2016 Total production
TOTAL AGROINDUSTRY		**964.969**		

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Table a.3.- Solid biofuels production

BIOFUEL	DOMESTIC QUALITY (tDM /y)	INDUSTRIAL QUALITY (tDM /y)	TOTAL (tDM /y)	Source	Comments
Firewood	1.056.240	563.760	1.620.000	INE, 2015. Instituto Nacional de Estatística, Estatísticas Agrícolas 2014	This data refer the year 2013
Wood chips	n.a.	n.a.	732.000	INE, 2015. Instituto Nacional de Estatística, Estatísticas Agrícolas 2014	Total production in 2013 High quantity utilised in industry like feedstock
Other chips (e.g. pruning)					
Wood briquettes					
Wood pellets	594.000	440.000	1.034.000	ANPEB, 2016. Associação Nacional de Pellets Energéticos de Biomassa	This data refer the year 2014
Other pellets (e.g. pruning)					
Olive stones	n.a.	n.a.	59.746	GPP, 2016. Gabinete de Planeamento, Políticas e Administração Geral. SIAZ - Sistema de Informação sobre o Azeite e a Azeitona de Mesa	campaign 2015-2016 Total production
Exhausted olive cake	n.a.	n.a.	94.597	GPP, 2016. Gabinete de Planeamento, Políticas e Administração Geral. SIAZ - Sistema de Informação sobre o Azeite e a Azeitona de Mesa	campaign 2015-2016 Total production
Nut shells					
Almond Shell	n.a.	n.a.	6.378	INE, 2015. Instituto Nacional de Estatística, Estatísticas Agrícolas 2014	This data refer the year 2014
Chopped pine cone	n.a.	n.a.	54.847	UNAC, 2010. União das Organizações de Agricultores para o Desenvolvimento da Charneca	This data refer the year 2010 Total production
Pine nut shells	n.a.	16.317	16.317	UNAC, 2010. União das	This data refer the year

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				Organizações de Agricultores para o Desenvolvimento da Charneca	2011
Hazelnut shell	n.a.	n.a.	86	INE, 2015. Instituto Nacional de Estatística, Estatísticas Agrícolas 2014	This data refer the year 2014 - Total production
Pistachio shell	-	-	-	-	-
Other (Walnut)	n.a.	n.a.	998	INE, 2015. Instituto Nacional de Estatística, Estatísticas Agrícolas 2014	This data refer the year 2014 - Total production
Other(specify) Please, ad new files for each additional biofuel					
TOTAL	**1.650.240**	**1.020.077**	**3.618.969**		

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Table a.4.- Solid biofuels use by biofuel type

BIOFUEL	DOMESTIC USE (tDM /y)	INDUSTRIAL USE (tDM /y)	TOTAL (tDM /y)	Source	Comments
Firewood	1.056.240	563.760	1.620.000	INE, 2015. Instituto Nacional de Estatística, Estatísticas Agrícolas 2014	This data refer the year 2013
Wood chips	n.a.	n.a.	732.000	INE, 2015. Instituto Nacional de Estatística, Estatísticas Agrícolas 2014	Total production in 2013 High quantity utilised in industry like feedstock
Other chips (e.g. pruning)					
Wood briquettes					
Wood pellets	594.000	440.000	1.034.000	ANPEB, 2016. Associação Nacional de Pellets Energéticos de Biomassa	This data refer the year 2014
Other pellets (e.g. pruning)					
Olive stones					
Exhausted olive cake					
Nut shells					
Almond Shell					
Chopped pine cone					
Pine nut shells					
Hazelnut shell					
Other(specify)					
Other(specify) Please, ad new files for each additional biofuel					
TOTAL	**1.650.240**	**1.003.760**	**3.386.000**		

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b. How much is imported and/or exported annually?

Table b.1.- Solid biofuels imports/exports

BIOFUEL	EXPORTS (t /y)	IMPORTS (t /y)	MAIN IMPORT-EXPORT COUNTRIES/ FINAL USE	Source	Comments
Firewood					
Wood chips					
Other chips (e.g. pruning)					
Wood briquettes					
Wood pellets	792.000	-	Spain, United Kingdom and Benelux	ANPEB, 2016. Associação Nacional de Pellets Energéticos de Biomassa	This data refer the year 2014
Other pellets (e.g. pruning)			e.g . in Spain. UK, Poland, Belgium/power and thermal plants		
Olive stones					
Exhausted olive cake					
Nut shells					
Almond Shell					
Chopped pine cone					
Pine nut shells					
Hazelnut shell					
Other(specify)					
Other(specify) Please, ad new files for each additional biofuel					
TOTAL	**792.000**				

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c. What are the typical costs of the biofuels for commercial and private customers?

Table c.1.- Solid biofuels prices

Biofuel	Commercial customers typical cost €/t	Domestic customers typical cost €/t	Source	Comments
Wood chips	70		CBE, 2016	23% of VAT
Firewood	60		CBE, 2016	6% of VAT
Wood pellets (bag)	214		CBE, 2016	23% of VAT
Wood pellets (Pallet with 77 bags)	184		CBE, 2016	23% of VAT
Olive stones	120		CBE, 2016	6% of VAT

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d. Where are the biofuels used

This question is to complement the information in table a3.

Table d.1.- Solid biofuels use by sector

Sector	Total Ammount t/y	Main type of biofuel used	Reference	Comments
Agricultural-farm sector				
Biomass power plants (only electricity)				
Co-firing power plants(only electricity)				
CHP and CHPC plants residential sector				
CHP and CHPC plants industrial sector				
Residential not CHP				

e. Are being used certified solid biofuels in the market? Please specify types, certification standards and annual quantities.

Table e.1.- Solid biofuels imports/exports

Biofuel	Certification standard	Annual amount t/y	Source	Comments

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Market data for Slovenia

Biomass availability, quality, costs and use

a. Which are the biomass resources available and how much annually?

Table a.1.- Global country field biomass resources potential and consumption.

FORESTS		Source	Comments
	POTENTIAL (t DM/y)		
Conifers	1.656.000	SFS, Report on Forests for 2014	The allowable cut of assortments of low quality.
Broadleaves			
Mixed forests	No data		
Shrubs	No data		
Residues in the forest	404.000	SFS, Report on Forests for 2014	Forest residues at the realization of allowable cut.
Bark of timber	52.000	SFS, Report on Forests for 2014	The quantity of bark of timber at the realization of allowable cut.
TOTAL FORESTS	**2.112.000**	SFS, Report on Forests for 2014	
AGRICULTURE			
	POTENTIAL (t DM/y)		
Rain-fed crops	No data		
Irrigated crops	/		
Rice crops	/		
Olive plantations	2.534	Agricultural Institute of Slovenia, SORS (2003-2008)	
Orchard plantations	6.485	Agricultural Institute of Slovenia, SORS (2003-2008)	
Vineyards	48.702	Agricultural Institute of Slovenia; SORS (2003-2008)	Wet biomass
TOTAL AGRICULTURE	**197.000 + 151.000**	SFS, Report on Forests for 2014	Wood and non-wood residues from agricultural areas usable for energy + evaluated allowable sustained cut of trees in non-forest land use.

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Table a.2.- Global country agro-industry biomass resources

SECTOR OF ACTIVITY	TYPE OF BY-PRODUCTS	POTENTIAL (t DM/y)	Source	Comments
Wood industries	**Bark**	**No data**		
	Clean wood by-products (chips etc)	**461.000**	**SFS, Report on Forests for 2014**	**The quantity of wood waste in the production of sawn timber at the the realization of allowable cut.**
	Other wood by-products (specify)			
Nut hulling industry	**Almond Shell**	**/**		
	Chopped pine cone	**/**		
	Pine nut shells	**/**		
	Hazelnut shell	**/**		
	Other(specify)			
Olive oil industry	**Olive stones**	**830**	**Project m.o.r.e.**	**Olive residues in 2007.**
	Exhausted olive cake	**No data**		
TOTAL AGROINDUSTRY		462.000		

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Table a.3.- Solid biofuels production

BIOFUEL	DOMESTIC QUALITY (tDM /y)	INDUSTRIAL QUALITY (tDM /y)	TOTAL (tDM /y)	Source	Comments
Firewood	1.331.000 m^3 or approx. 771.980 tDM		1.331.000 m^3 or approx. 771.980 tDM	SORS, 2015	
Wood chips			1.500.000 loose m^3 or approx. 215.000 tDM	Varbiom, 2016. Ogrevanje z lesnimi gorivi, lesni sekanci.	
Other chips (e.g. pruning)					
Wood briquettes			No data		Data are not gathered separately for briquettes.
Wood pellets	110.000		110.000	Market statement for Slovenia, 2016.	Data for year 2015.
Other pellets (e.g. pruning)					
Olive stones			280	Project: m.o.r.e.	Data for year 2007.
Exhausted olive cake			1.100	Project: m.o.r.e.	Data for year 2007.
Nut shells			/		
Almond Shell			/		
Chopped pine cone			/		
Pine nut shells			/		
Hazelnut shell			/		
Other(specify)			/		
Other(specify)					
TOTAL					

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Table a.4.- Solid biofuels use by biofuel type

BIOFUEL	DOMESTIC USE (tDM /y)	INDUSTRIAL USE (tDM /y)	TOTAL (tDM /y)	Source	Comments
Firewood	1.211.805	/	1.211.805	SORS, 2015	Logs are used in households and not in industry.
Wood chips			200.000	Data gathered with questioner in 2016 by Slovenian forestry institute.	It is difficult to divide total use of wood chips to domestic or industrial use. Wood chips for energy production are utilized mainly for residential heating (e.g. district heating plants). For industrial use mostly wood residues are utilized but also wood chips. Data for year 2015.
Other chips (e.g. pruning)				No data	
Wood briquettes			5.000	SFI estimate	Data are not gathered separately for briquettes.
Wood pellets	140.000		140.000	Market statement for Slovenia, 2016.	Data for year 2015.
Other pellets (e.g. pruning)					
Olive stones				Project: m.o.r.e.	In Slovenia olive residue is treated as waste and not as secondary product. We don't use olive residue for energy most of them are thrown away or use like fertilizer in olive fields.
Exhausted olive cake				Project: m.o.r.e.	The end users of olive residues are

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					now mainly olive millers which use olive residues for composting. Two of them use olive residues for their private energy purposes (heating). Both of them have around 60 tons of residues per year. If they would use all of residues, it would be enough energy for heating at least 5 more households. In Slovenia pit separators, which separate olive pits from olive pomace are not used. There are also no drying facilities and refineries to dry wet pomace in order to make them more appropriate for burning.
Nut shells			/		
Almond Shell			/		
Chopped pine cone			/		
Pine nut shells			/		
Hazelnut shell			/		
Other(specify)			/		
Other(specify)					
TOTAL					

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b. How much is imported and/or exported annually?

Table b.1.- Solid biofuels imports/exports

BIOFUEL	EXPORTS (t /y)	IMPORTS (t /y)	MAIN IMPORT-EXPORT COUNTRIES/ FINAL USE	Source	Comments
Firewood	379.500	151.600	Main import from Bosnia and Herzegovina and Croatia. Main export market is Italy.	SORS, 2015.	Data are measured in m^3.
Wood chips	237.000	135.000	Main import from Croatia. Main export market is Austria and Italy.	Market statement for Slovenia, 2016.	Data for year 2015.
Other chips (e.g. pruning)					
Wood briquettes	No data	No data			
Wood pellets	122.000	152.000	Main import from Romania and Bosnia and Herzegovina. Main export market is Italy.	Market statement for Slovenia, 2016.	Data for year 2015.
Other pellets (e.g. pruning)			e.g . in Spain. UK, Poland, Belgium/power and thermal plants		
Olive stones			/		
Exhausted olive cake			/		
Nut shells			/		
Almond Shell			/		
Chopped pine cone			/		
Pine nut shells			/		
Hazelnut shell			/		
Other(specify)			/		
Other(specify)					

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TOTAL					

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c. What are the typical costs of the biofuels for commercial and private customers?

Table c.1.- Solid biofuels prices

Biofuel	Commercial customers typical cost €/t	Domestic customers typical cost €/t	Source	Comments
Firewood	No data available	116	Price trends of wood fuels in Slovenia between 2011 and 2016. 2016. Gozdarski vestnik 74, št.7-8.	Firewood with a moisture content of 20 % and a length of 25-50 cm. Data are valid for the period before the heating season 2015/2016.
Wood chips	No data available	52	Price trends of wood fuels in Slovenia between 2011 and 2016. 2016. Gozdarski vestnik 74, št.7-8.	Wood chips with a moisture content of approx. 30 % and particle size of approx. 36 mm. Data are valid for the period in the heating season 2015/2016.
Wood briquettes (10 kg bag)	No data available	171	Price trends of wood fuels in Slovenia between 2011 and 2016. 2016. Gozdarski vestnik 74, št.7-8.	Wood briquettes with a moisture content of 12-15 %. Data are valid for the period before the heating season 2015/2016.
Wood pellets (loose)	No data available	190	www.s4q.si	The price of pellets obtained in the second half of the year 2015.
Wood pellets (Big-Bag)	No data available	193	www.s4q.si	The price of pellets obtained in the second half of the year 2015.
Wood pellets (15 kg bag)	No data available	204	www.s4q.si	The price of pellets obtained in the second half of the year 2015. The greatest demand is for pellets packed in 15 kg PVC bags and stacked on the pallet

Comment: VAT in Slovenia estimate 22 %.

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d. Where are the biofuels used

This question is to complement the information in table a3.

Table d.1.- Solid biofuels use by sector

Sector	Total Ammount t/y	Main type of biofuel used	Reference	Comments
Agricultural-farm sector	No data			
Biomass power plants (only electricity)	105.000	Only wood and wood waste.	SORS, 2016	Data for year 2015.
Co-firing power plants(only electricity)	/			
CHP and CHPC plants residential sector	/			
CHP and CHPC plants industrial sector	67.000	Only wood and wood waste.	SORS, 2016	Data for year 2015.
Residential not CHP	1.616.000	Only wood and wood waste.	SORS, 2016	The final consumption of wood and wood waste in the households. Data for year 2015.

e. Are being used certified solid biofuels in the market? Please specify types, certification standards and annual quantities.

Table e.1.- Solid biofuels imports/exports

Biofuel	Certification standard	Annual amount t/y	Source	Comments
Pellets	EN-plus	approx. 86.000	Pellet producers in Slovenia – data gathered with questioner in 2016. Slovenian forestry institute.	Production in year 2015.
Pellets	S4Q	approx. 22.000	Pellet producers in Slovenia – data gathered with	Production in year 2015.

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			questioner in 2016. Slovenian forestry institute.	

Comment :
In 2014 Slovenian forestry Institute developed system for assurance of quality wood fuel, called S4Q. S4Q system is designed for micro and small-scale biomass producers which produce pellets only for domestic market.

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Market data for Spain

Biomass availability, quality, costs and use

a. Which are the biomass resources available and how much annually?

Table a.1.- Global country field biomass resources potential and consumption.

FORESTS			Source	Comments
	POTENTIAL (t DM/y)	**AVAILABLE (t DM/y)**		
Conifers	3.031.382	1.438.717	CIEMAT: Bioraise	"Available" is the potential after applying several restrictions (Slope,…)
Broadleaves	3.601.615	1.594.704	CIEMAT: Bioraise	"Available" is the potential after applying several restrictions (Slope,…)
Mixed forests	893.080	549.137	CIEMAT: Bioraise	"Available" is the potential after applying several restrictions (Slope,…)
Shrubs	2.080.482	937.845	CIEMAT: Bioraise	"Available" is the potential after applying several restrictions (Slope,…)
Wooded pasture	941.701	252.248	CIEMAT: Bioraise	"Available" is the potential after applying several restrictions (Slope,…)
Other (specify)				
TOTAL FORESTS	**10.548.261**	**4.772.650**		
AGRICULTURE				
	POTENTIAL (t DM/y)	**AVAILABLE (t DM/y)**		
Rain-fed crops	16.944.193	5.420.661	CIEMAT: Bioraise	Potential available after applying several restrictions (Slope,…)
Irrigated crops	4.682.592	3.746.230	CIEMAT: Bioraise	Potential available after applying several restrictions (Slope,…)
Rice crops	394.983	316.204	CIEMAT: Bioraise	Potential available after applying several restrictions (Slope,…)
Olive plantations	1.819.981	1.455.168	CIEMAT: Bioraise	Potential available after applying several restrictions (Slope,…)
Orchard plantations	1.411.563	1.129.094	CIEMAT: Bioraise	Potential available after applying several restrictions (Slope,…)
Vineyards	843.949	675.000	CIEMAT: Bioraise	Potential available after applying several restrictions (Slope,…)
Crop mixtures	123.225	99.416	CIEMAT: Bioraise	Potential available after applying several restrictions (Slope,…)
Other (specify)				
TOTAL AGRICULTURE	**26.220.486**	**12.841.774**		

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Table a.2.- Global country agro-industry biomass resources

SECTOR OF ACTIVITY	TYPE OF BY-PRODUCTS	POTENTIAL (t DM/y)	Source	Comments
Wood industries	**Bark**	**232.099**	**CIEMAT, BIOMASUD PLUS Study task 2.3**	
	Clean wood by-products (chips etc)	**2.695.962**	**CIEMAT, BIOMASUD PLUS Study task 2.3**	
	Other wood by-products (specify)			
Nut hulling industry	**Almond Shell**	**150.00**	**AVEBIOM's data**	
	Chopped pine cone	**38.250**	**AVEBIOM's data**	
	Pine nut shells	**6.588**	**AVEBIOM's data**	
	Hazelnut shell			
	Other(specify)			
Olive oil industry	**Olive stones**	**430.000**	**La biomasa en Andalucía, 2015 / AVEBIOM's data / CIEMAT's data**	**Average. All years have different figures**
	Exhausted olive cake	**800.000**	**La biomasa en Andalucía, 2015 / AVEBIOM's data / CIEMAT's data**	**Average. All years have different figures**
TOTAL AGROINDUSTRY		4.202.899		

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Table a.3.- Solid biofuels production

BIOFUEL	DOMESTIC QUALITY (tDM /y)	INDUSTRIAL QUALITY (tDM /y)	TOTAL (tDM /y)	Source	Comments
Firewood	1.500.000		1.500.000	Statistical yearbook 2014 MAGRAMA	
Wood chips	240.000	3.000.000	3.240.000	AVEBIOM's data / Biomasud Project	
Other chips (e.g. pruning)	323.021	51.553	374.574	CIEMAT's data / La biomasa en Andalucía, 2015	
Wood briquettes	50.000			AVEBIOM's data	
Wood pellets	406.542	37.383	443.925	AVEBIOM's data	2015
Other pellets (e.g. pruning)		4.673	4.673	AVEBIOM's data / CIEMAT's data	
Olive stones	130.000	300.000	430.000	La biomasa en Andalucía, 2015 / AVEBIOM's data / CIEMAT's data	
Exhausted olive cake		800.000	800.000	La biomasa en Andalucía, 2015 / AVEBIOM's data / CIEMAT's data	
Nut shells					
Almond Shell	10.000	140.000	150.000	AVEBIOM's data	
Chopped pine cone		38.250	38.250	AVEBIOM's data	
Pine nut shells		6.588	6.588	AVEBIOM's	

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				data	
Hazelnut shell					
Other(specify)					
Other(specify)					
TOTAL	**2.706.292**	**4.378.447**	**7.084.739**		

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Table a.4.- Solid biofuels use by biofuel type

BIOFUEL	DOMESTIC USE (tDM /y)	INDUSTRIAL USE (tDM /y)	TOTAL (tDM /y)	Source	Comments
Firewood	1.500.000		1.500.000	Statistical yearbook 2014 MAGRAMA	
Wood chips	240.000	2.850.000	3.090.000	AVEBIOM's data / Biomasud Project	
Other chips (e.g. pruning)	323.021	51.553	374.574		
Wood briquettes	50.000		50.000	AVEBIOM's data	
Wood pellets	400.000		400.000	AVEBIOM's data	2015
Other pellets (e.g. pruning)		4.673	4.673	AVEBIOM's data / CIEMAT's data	
Olive stones	115.000	285.000	400.000	La biomasa en Andalucía, 2015 / AVEBIOM's data / CIEMAT's data	
Exhausted olive cake		800.000	800.000	La biomasa en Andalucía, 2015 / AVEBIOM's data / CIEMAT's data	
Nut shells					
Almond Shell	10.000	140.000	150.000	AVEBIOM's data	
Chopped pine cone		38.250	38.250	AVEBIOM's data	
Pine nut shells		6.588	6.588	AVEBIOM's data	
Hazelnut shell					
Other(specify)					
Other(specify)					

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TOTAL	**2.638.021**	**4.176.064**	**6.814.085**		

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b. How much is imported and/or exported annually?

Table b.1.- Solid biofuels imports/exports

BIOFUEL	EXPORTS (t /y)	IMPORTS (t /y)	MAIN IMPORT-EXPORT COUNTRIES/ FINAL USE	Source	Comments
Firewood	0	0		AVEBIOM's data	
Wood chips	150.000	0	Italy / Electric generation	AVEBIOM's data	
Other chips (e.g. pruning)	0	0		AVEBIOM's data	
Wood briquettes	0	0		AVEBIOM's data	
Wood pellets	86.542 (Domestic) 37.383 (Industrial)	80.000	Imports from Portugal Exports to: France, Italy // Domestic - thermal purposes Exports to England, Belgium // Electric generation		
Other pellets (e.g. pruning)	0	0		AVEBIOM's data	
Olive stones	30.000	0	Italy,	AVEBIOM's data	
Exhausted olive cake	0	0			Some years ago there was a lot of exportations for co-firing but in the last years the trend is no exportations as the plants are not cofiring anymore and they prefer wood pellets
Nut shells					
Almond Shell	0	0		AVEBIOM's	

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				data	
Chopped pine cone	0	0		AVEBIOM's data	
Pine nut shells	0	0		AVEBIOM's data	
Hazelnut shell					
Other(specify)					
Other(specify)					
TOTAL	**303.925**	**80.000**			

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c. What are the typical costs of the biofuels for commercial and private customers?

Table c.1.- Solid biofuels prices

Biofuel	Commercial customers typical cost €/t	Domestic customers typical cost €/t	Source	Comments
Wood pellet (A1/A2) in 15 kgs. bags		216,53	AVEBIOM's price index http://www.avebiom.org/es/ind-precios-biomasa	Average prices for 2016. VAT 21%
Wood pellet (A1/A2) in bags 1 pallet.		210,69	AVEBIOM's price index http://www.avebiom.org/es/ind-precios-biomasa	Average prices for 2016. VAT 21%
Wood pellet (A1/A2) in bulk full's cargo (pneumatic transport)		193,87	AVEBIOM's price index http://www.avebiom.org/es/ind-precios-biomasa	Average prices for 2016. VAT 21% Transport calculated 200 km.
Wood pellet (A1/A2) in bulk full's cargo (non-pneumatic transport)		186,76	AVEBIOM's price index http://www.avebiom.org/es/ind-precios-biomasa	Average prices for 2016. VAT 21% Transport calculated 200 km.
Wood chips (A1/A2) in bulk. Domestic quality (dried <35% P31,5 – P45		91,14	AVEBIOM's price index http://www.avebiom.org/es/ind-precios-biomasa	Average prices for 2016. VAT 21% Transport calculated 100 km.
Olive Stones (A1/A2) In bags		155,01	AVEBIOM's price index http://www.avebiom.org/es/ind-precios-biomasa	Average prices for 2016. VAT 21%
Olive Stones (A1/A2) in bags 1 pallet		153,49	AVEBIOM's price index http://www.avebiom.org/es/ind-precios-biomasa	Average prices for 2016. VAT 21%
Olive Stones (A1/A2)) in bulk full's cargo (pneumatic transport)		130,94	AVEBIOM's price index http://www.avebiom.org/es/ind-precios-biomasa	Average prices for 2016. VAT 21% Transport calculated 200 km.
Olive Stones (A1/A2)) in bulk full's cargo (non-pneumatic transport)		126,31	AVEBIOM's price index http://www.avebiom.org/es/ind-precios-biomasa	Average prices for 2016. VAT 21% Transport calculated 200 km.

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Classes of biofuels as per the following standards:
ISO 17225-2 Wood Pellets
ISO 17225-4 Wood Chips
UNE 164003 Olive Stones

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d. Where are the biofuels used

This question is to complement the information in table a3.

Table d.1.- Solid biofuels use by sector

Sector	Total Ammount t/y	Main type of biofuel used	Reference	Comments
Agricultural-farm sector	No data			
Biomass power plants (only electricity)	4.000.000	Wood chips, Olive Cake, other agriculture	AVEBIOM's data	
Co-firing power plants(only electricity)	0	0	AVEBIOM's data	
CHP and CHPC plants residential sector	0	0	AVEBIOM's data	
CHP and CHPC plants industrial sector				
Residential not CHP	Total: 2.155.000 240.000 Pellets; 240.000 wood chips; 115.000 Olive Stones; 10.000 Shells; 50.000 Briquettes; 1.500.000 firewood		AVEBIOM's data	

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e. Are being used certified solid biofuels in the market? Please specify types, certification standards and annual quantities.

Table e.1.- Solid biofuels imports/exports

Biofuel	Certification standard	Annual amount t/y	Source	Comments
Wood pellet	ENplus	403.000	AVEBIOM	85% of the total production of wood pellet. Estimation for 2016
Wood pellet	Din+	154.000	AVEBIOM	32% Estimation for 2016
Olive Stones	BIOmasud	2.400	AVEBIOM	Estimation for 2016

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Market data for Turkey

Biomass availability, quality, costs and use

a. Which are the biomass resources available and how much annually?

Table a.1.- Global country field biomass resources potential and consumption.

FORESTS		Source	Comments
	POTENTIAL (t DM/y)		
Conifers	2,727,316	www.ogm.gov.tr, 2015	(380 kg/m^3)&(humidity=50%)(2015)
Broadleaves	1,005,344	www.ogm.gov.tr,2015	(380 kg/m^3)&(humidity=50%)(2015)
Mixed forests	1,199,514	www.ogm.gov.tr, 2015	(380 kg/m^3)&(humidity=50%)(2015)
Shrubs	-		
Other (specify)	-		
Other (specify)	-		
TOTAL FORESTS	**4,932,174**		
AGRICULTURE			
	POTENTIAL (t DM/y)		
Rain-fed crops	-	-	
Irrigated crops	-	-	
Rice crops	249,000	2014,Turkstat	It is not calculated, given data directly.
Olive plantations	850,000	2015-2016,Turkstat	It is not calculated, given data directly.
Orchard plantations			It is not calculated, given data directly.
Vineyards	212,000	2015, TurkStat	It is not calculated, given data directly.
Rape and turnip rape	110,000	2014, TurkStat	It is not calculated, given data directly.
Sunflower	685,000	2014,TurkStat	It is not calculated, given data directly.
Soya	150,000	2014,Turkstat	It is not calculated, given data directly.
TOTAL AGRICULTURE	**2,256,000**		

Table a.2.- Global country agro-industry biomass resources

SECTOR OF ACTIVITY	TYPE OF BY-PRODUCTS	POTENTIAL (t DM/y)	Source	Comments
Wood industries	**Bark**	**600,000**	**Hayat Energy**	**8-12% of total potential (6,500,000* 0,09(average)=600,000 t/year)**

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	Clean wood by-products (wood based panel)	**6,500,000**	**Hayat Energy**	**9,200,000m3*0,7 t/m3=6,500,000 ton**
	Other wood by-products (specify)	**-**		
Nut hulling industry	**Almond Shell**	**40,000**	**2015, http://www.tuik.gov.tr/PreTablo.do?alt_id=1001**	**50% of the fruit potential equals to the shell.**
	Chopped pine cone	**-**		
	Pistachio shells	**72,000**	**2015, http://www.tuik.gov.tr/PreTablo.do?alt_id=1001**	50% of the fruit potential equals to the shell.
	Hazelnut shell	**323,000**	**2015, http://www.tuik.gov.tr/PreTablo.do?alt_id=1001**	50% of the fruit potential equals to the shell.
	Other(Almond shell)	**40,000**	**2015, http://www.tuik.gov.tr/PreTablo.do?alt_id=1001**	50% of the fruit potential equals to the shell.
Olive oil industry	**Olive stones**	**1,750**	**Marmarabirlik Marzey, 2015**	**It is not calculated, given data directly.**
	Exhausted olive cake	**850,000**	**2015, http://www.tuik.gov.tr/PreTablo.do?alt_id=1001**	**It is not calculated, given data directly.**
TOTAL AGROINDUSTRY		8,426,750		

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Table a.3.- Solid biofuels production

BIOFUEL	DOMESTIC QUALITY (tDM /y)	INDUSTRIAL QUALITY (tDM /y)	TOTAL (tDM /y)	Source	Comments
Firewood	3,900,000		www.ogm.gov.tr		
Wood chips	3,250,000		www.ogm.gov.tr		
Other chips (e.g. pruning)	-	-	-		
Wood briquettes	-	-	-		
Wood pellets	430,000		http://www.buyuktorbali.com/dogalgazin-pabucunu-dama-atan-yakit-pelet		
Other pellets (e.g. pruning)	-	-	-		
Olive stones	1,750		Marmarabirlik Marzey, 2015		
Exhausted olive cake	850,000		2015, http://www.tuik.gov.tr/PreTablo.do?alt_id=1001		
Nut shells					
Almond Shell	40,000		2015, http://www.tuik.gov.tr/PreTablo.do?alt_id=1001		
Chopped pine cone	-				
Pine nut shells	-				
Hazelnut shell	323,000		2015, http://www.tuik.gov.tr/PreTablo.do?alt_id=1001		
Pistachio shell	72,200		2015, http://www.tuik.gov.tr/PreTablo.do?alt_id=1001		
Walnut shell	85,000		2015, http://www.tuik.gov.tr/PreTablo.do?alt_id=1001		
Other(Almond shell)	40,000		2015, http://www.tuik.gov.tr/PreTablo.do?alt_id=1001		

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Table a.4.- Solid biofuels use by biofuel type

BIOFUEL	DOMESTIC USE (tDM /y)	INDUSTRIAL USE (tDM /y)	TOTAL (tDM /y)	Source	Comments
Firewood					
Wood chips					
Other chips (e.g. pruning)					
Wood briquettes					
Wood pellets					
Other pellets (e.g. pruning)					
Olive stones					
Exhausted olive cake					
Nut shells					
Almond Shell					
Chopped pine cone					
Pine nut shells					
Hazelnut shell					
Pistachio shell					
Walnut shell					
Other(specify) Please, ad new files for each additional biofuel					
Sunflower					
TOTAL					

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b. How much is imported and/or exported annually?

Table b.1.- Solid biofuels imports/exports

BIOFUEL	EXPORTS (t /y)	IMPORTS (t /y)	MAIN IMPORT-EXPORT COUNTRIES/ FINAL USE	Source	Comments
Firewood					
Wood chips					
Other chips (e.g. pruning)					
Wood briquettes					
Wood pellets					
Other pellets (e.g. pruning)					
Olive stones					
Exhausted olive cake					
Nut shells					
Almond Shell					
Chopped pine cone					
Pine nut shells					
Hazelnut shell					
Other(specify)					
Other(specify) Please, ad new files for each additional biofuel					
TOTAL					

Data of biomass trade was not found for Turkey

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c. What are the typical costs of the biofuels for commercial and private customers?

Table c.1.- Solid biofuels prices

Biofuel	Commercial customers typical cost €/t	Domestic customers typical cost €/t	Source	Comments
Hazelnut shell	97	97	https://cevizkabugusatisi.wordpress.com/2015/03/22/ceviz-kabugu-fiyatlari/	
Wallnut shell	97	97	https://cevizkabugusatisi.wordpress.com/2015/03/22/ceviz-kabugu-fiyatlari/	
Pistachio shell	87	87	https://cevizkabugusatisi.wordpress.com/2015/03/22/ceviz-kabugu-fiyatlari/	
Almond shell	97	97	https://cevizkabugusatisi.wordpress.com/2015/03/22/ceviz-kabugu-fiyatlari/	

d. Where are the biofuels used

This question is to complement the information in table a3.

Table d.1.- Solid biofuels use by sector

Sector	Total Amount t/y	Main type of biofuel used	Reference	Comments
Agricultural-farm sector				
Biomass power plants (only electricity)				
Co-firing power plants(only electricity)				
CHP and CHPC plants residential sector				
CHP and CHPC plants industrial sector				
Residential not CHP				

Data of biomass consumption by sectors was not found for Turkey

e. Are being used certified solid biofuels in the market? Please specify types, certification standards

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and annual quantities.

Table e.1.- Solid biofuels imports/exports

Biofuel	Certification standard	Annual amount t/y	Source	Comments

Data of biomass certification was not found for Turkey

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Consolidated SWOT analysis

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Swot analysis for [Olive Stones] in [All]

Please fill at least 3 elements in each category and evaluate the importance of each element from 1 to 5 being 5 the maximum.

Strengths	***Weaknesses***
• Good quality fuel. High net calorific value, high density and low ash content • Feasibility of direct use for energy in small scale combustion may increase acceptance among the users • Large availability some countries (Spain, Greece, Italy, Portugal) • Low price compared with other biomasses, namely wood pellets • Agroindustry by-product. Low GHG emissions	• Variations in the availability annually because of the characteristics of the olive tree and weather conditions • Low quality of the olive stone in the market relative to its potential • The adoption of Standard / certification schemes for these fuels is not widespread • More emissions compared to Pellets due to poor devices and more NO content
Opportunities	***Threats***
• Olive mills interested in producing olive stones as a means to increase and diversify income • Renewable targets and legislation promoting renewable energies could benefit biofuels • Potential market due to substitution of fossil fuels devices • Alternative to pellets easy to use if standardised	• Lack of manufacturers' interest for the implementation of suitable stoves and boilers • Presence of not standardised / bad quality olive stones in the market • Competition with other fuels / biofuels • Lack of Professionals qualified to install biomass heating systems

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Swot analysis for [Wood chips] in [All]

Please fill at least 3 elements in each category and evaluate the importance of each element from 1 to 5 being 5 the maximum.

Strengths	***Weaknesses***
• Very good fuel properties (for forest wood chips), especially ash content, comparable with wood pellets • Low fuel cost, very cheap alternative to fossil fuels • Employment opportunities for local community in the supply chain logistics of biomass • Developed supply side. Infrastructure and technologies for harvest are well established for wood chips • Useful also for larger Systems (micro and district heating systems	• Logistic of storing and transportation expensive • Greater variability in fuel properties which may affect combustion system performance • Expensive technologies for production and use • Low energy content per volume / large storage room • Still very low number of plants installed per year
Opportunities	***Threats***
• Contribute to rural development (create employment) • Large potential in use of wood chips in big users buildings • High market potential: areas still not covered by natural gas grid, industrial processes • Standard product with high acceptance • Renewable targets and legislation promoting renewable energies could benefit biofuels	• Competition with other Fossil fuel low prices • High cost of installation for households • Small producers • Good availability • Competition for the raw material by other biofuels such as wood fire or wood industries

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Swot analysis for [Nuts] in [All]

Please fill at least 3 elements in each category and evaluate the importance of each element from 1 to 5 being 5 the maximum.

Strengths	***Weaknesses***
• Good quality, low ash content, low moisture suitable for combustion in domestic heating appliances • No need to process too much • Agricultural by-product that diversify incomes for industries and have low carbon footprint • Easy storage • Low price compared with wood pellets.	• Small volumes of production, mostly of interest for local consumption • Seasonal biomass availability which is a problem for storage (big quantities in few time) and therefore can be stored open air and getting poor quality (moisture) • High oil content, possible impact on combustion devices • Poor presence of suitable stoves and boilers (emissions)
Opportunities	***Threats***
• Renewable targets and legislation promoting renewable energies could benefit biofuels • Agricultural by-product that diversify incomes for industries and reduce its energy dependence • There is a consolidated market and in some regions new crops are being implementing that can increase availability • Opportunity to valorize a agro-industrial by-product	• The availability of these biofuels depends on the annual production of fruits (very variable) • Market size and organization. Small production volumes means that there is limited interest in further upgrading this resource, e.g. through fuel certification • Lack of manufacturers' interest for the implementation of suitable stoves and boilers • Competition with other biofuels or fossil fuels

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Swot analysis for [Olive tree prunings] in [All]

Please fill at least 3 elements in each category and evaluate the importance of each element from 1 to 5 being 5 the maximum.

Strengths	***Weaknesses***
• Huge availability in Mediterranean regions. • Big potential unused nowadays is burned or chipped and reverted to the soil. • Quality similar to woodchips if recollection is properly done • The energetic valorisation avoids the outdoor burning of prunings (air quality) • Employment opportunities for local community in the supply chain logistics of biomass	• Difficult to collect prunings in a proper way for not taking sand and degrading the quality. Need for specialised machinery • Seasonal biomass availability • Higher ash content compared to forest wood biomass, hence higher expected dust emissions • Lack of biofuel standard and certification scheme • Poor presence of suitable stoves and boilers (emissions) • Logistics (harvesting, pre-treatment, supply) can be expensive
Opportunities	***Threats***
• Legislation trend is to forbid the elimination by fire • Farmers interested in cost reduction or diversifying their sources of income • Availability of solid biomass for energy in agricultural areas • Availability is in rural areas where there can be programs that can finance machinery • Renewable targets and legislation promoting renewable energies could benefit biofuels	• Appliances adapted to the type of biofuel • Professionals qualified to install biomass heating systems • Competition with other biofuels or with mulching • Lack of manufacturers' interest for the implementation of suitable stoves and boilers

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Swot analysis for [vineyard prunings] in [All]

Please fill at least 3 elements in each category and evaluate the importance of each element from 1 to 5 being 5 the maximum.

Strengths	***Weaknesses***
• New/additional source of income for wine producers / farmers • High availability in most of the countries of the project and lots of unused potential of vineyard prunings. • Quite high production per hectare • The energetic valorisation avoids the outdoor burning of prunings (air quality) • Renewable targets and legislation promoting renewable energies could benefit biofuels	• Seasonal biomass availability • Lack of biofuel standard and certification scheme • Logistics (harvesting, pre-treatment, supply) can be expensive • Higher ash content compared to forest wood biomass, hence higher expected dust emissions • Lack of suitable stoves and small-medium boilers, which permits to burn this biofuels respecting the emissions limits
Opportunities	***Threats***
• Legislation trend is to forbid the elimination by fire • Farmers interested in cost reduction or diversifying their sources of income • Contribute to rural development by absorbing and valorising substantial volumes of agricultural waste as feedstock • The controlled combustion of prunings (industrial plants) make better the air quality of productive districts • Renewable targets and legislation promoting renewable energies could benefit biofuels	• No quality standards for vineyards punning's • Uncertain market conditions for placing vineyard pruning as biofuel. • Lack of manufacturers' interest for the implementation of suitable stoves and boilers • Competition with other bifouels / fossil fuels • Competition use of the prunings mulching

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Croatia’s SWOT analysis

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Swot analysis for [Olive stones] in [Croatia]

Please fill at least 3 elements in each category and evaluate the importance of each element from 1 to 5 being 5 the maximum.

Strengths	***Weaknesses***
• Low ash content (5) • In combination with wood pellets very good quality as biofuels (4) • Low emission (5)	• Seasonal availability, there is no continuous stream (5) • Use for self-consumption (4)
Opportunities	***Threats***
• Possibility of joining large numbers of producers in order to improve competitiveness regarding biofuel production (5)	• No market conditions for placing olive stones as biofuel. Olive stones competitiveness is very weak compared to current industry trends (wood pellets, firewood) (5) • Expensive machine for separation olive stones from olive pomace (4) • Still treated as a waste

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Swot analysis for [Wood chips] in [Croatia]

Please fill at least 3 elements in each category and evaluate the importance of each element from 1 to 5 being 5 the maximum.

Strengths	***Weaknesses***
• Available biofuels with low cost (4) • Low percentage of small parts, low ash content (5) • Low emissions (5)	• Low energy density (4) • Due to bulk storage, this biofuel requests twice as much space as the wood logs (5) • Content of water should be less than 30%, otherwise could cause congestion of the system and creation of the carbon soot (5)
Opportunities	***Threats***
• Larger exploitation of wood waste (5) • High availability of sources (5) • Higher awareness of consumers for benefits of using this biofuels (4)	• High cost of installation for households (5) • Wood chips competitiveness is very weak compared firewood (5) • Higher price in the future/undefined price of wood chips (4) • Availability of the annual amount prescribed by the government law (5)

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Swot analysis for [Nut shells] in [Croatia]

Please fill at least 3 elements in each category and evaluate the importance of each element from 1 to 5 being 5 the maximum.

Strengths	***Weaknesses***
• Low ash content (5) • No need for additional drying process, biofuel with low humidity (5) • Easy manipulation and storage (5) • Low emission (5)	• Crops depends on the weather conditions, different yield every year (5) • Small yield per hector, mostly used for personal consumption (4) • Limited offer and high price of cleaning machines (4) • High oil content, can cause damage on combustion devices (5)
Opportunities	***Threats***
• Increased breeding of nuts shells in last couple of years (5) • Higher awareness of consumers for benefits of using this biofuels (4)	• Lower nut shells production volume in comparison with more popular biofuels (wood chips, wood pellets) (4) • Using only for self-consumption (5) • Uncertain market conditions for placing nut shells as biofuels (5)

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Swot analysis for [Olive tree prunings] in [Croatia]

Please fill at least 3 elements in each category and evaluate the importance of each element from 1 to 5 being 5 the maximum.

Strength	***Weaknesses***
• High availability of olive tree prunings (5) • Good heating value (5)	• Most of olive plantations are on the islands so there is higher cost of transportation (4) • Use for self-consumption (4) • Poor management of collecting the prunings (5) • Seasonal availability, there is no continuous stream (5)
Opportunities	***Threats***
• Increasing trends for olive tree growing (4) • Possibility of joining large numbers of producers in order to improve competitiveness regarding biofuel production (reduction of expenses) (5)	• No market conditions for placing olive tree prunings as biofuel (5) • Olive tree prunings competitiveness is very weak compared to current industry trends (wood pellets, firewood, wood chips) (5) • Still treated as a waste (5)

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Swot analysis for [Vineyard prunings] in [Croatia]

Please fill at least 3 elements in each category and evaluate the importance of each element from 1 to 5 being 5 the maximum.

Strengths	***Weaknesses***
• Large areas in Croatia covered in vineyard tree (5) • Vineyard tree has a huge potential for local use since it can be grown from across the entire country (production not centralized (5) • High pruning income in vineyards with intense production (5)	• Although large area in Croatia is covered in vineyard, sizes of individual vineyards are only up to 1 ha (too small for biofuel production) (4) • Trend of reducing production and vineyards size in the last 10 years (4) • Production seasonality (5)
Opportunities	***Threats***
• Ability to be used in the entire country without the additional transport expenses (can be produced and used locally) (4) • Possible combination of biofuel production and wine pomace in order to reduce waste in wine production process (4) • Possibility of joining large numbers of producers in order to improve competitiveness regarding biofuel production (reduction of expenses) (5)	• Uncertain market conditions for placing vineyard pruning as biofuel. Vineyard pruning competitiveness is very weak compared to current industry trends (wood pellets, fire wood, wood chips) (5) • Due to the lack of information and research about quality of vineyard pruning as a fuel, people would likely be more hesitant to use it than to use other fuels (4) • Setting of a biomass supply chain could present additional expense for farmers and producers (4)

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Greece’s SWOT analysis

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Swot analysis for [Olive stones] in [Greece]

Please fill at least 3 elements in each category and evaluate the importance of each element from 1 to 5 being 5 the maximum.

Strengths	***Weaknesses***
• Low ash content, suitable for combustion in domestic heating appliances (5) • Low cost compared to "standard" wood pellets (5) • Lower emissions compared to exhausted olive cake (3) • No odour, contrary to exhausted olive cake (4) • Good country availability based on the annual olive oil production	• Small particle size distribution, can be an issue for the feeding systems of some combustion devices (3) • Variations in annual production due to changes in the volume of olive oil production from weather conditions (3) • Higher nitrogen content compared to wood pellets, can be a cause of NOx emissions (2)
Opportunities	***Threats***
• Olive mills interested in producing olive stones as a means to increase and diversify income (4) • Revision of legislation in favour of cleaner fuels can indirectly help wood chips adoption (3) • Separation of olive stones from exhausted olive cake can also provide opportunities for olive mills to increase income (4)	• Consumers – and in some cases people involved in the olive value chain – are often unaware of the differences between this fuel and exhausted olive cake (4) • Pomace mill operators are often against the separation of the olives stones at the level of the primary olive mills, since it affects the quality of the incoming material for their facilities (5) • Availability of olive stones mostly in southern Greece, in areas with lower heat demand and thus reduced annual fuel consumption (3) • Very low cost of exhausted olive cake, which combines stone and flesh fractions (4)

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Swot analysis for [Wood chips] in [Greece]

Please fill at least 3 elements in each category and evaluate the importance of each element from 1 to 5 being 5 the maximum.

Strengths	***Weaknesses***
• Very good fuel properties (for forest wood chips), especially ash content, comparable with wood pellets (4) • Low fuel cost, very cheap alternative to fossil fuels (5) • Low emissions (3)	• Low energy density, issues with transport and storage. The latter can be a major issue in domestic use in urban areas (5) • Existing feeding systems for small-scale biomass boilers are unable to handle wood chips (5) • Greater variability in fuel properties which may affect combustion system performance (3) • Uncertainties regarding potential of the forest sector to produce wood chips (3)
Opportunities	***Threats***
• Households interested in identifying low cost fuels (3) • Revision of legislation in favour of cleaner fuels can indirectly help wood chips adoption (3) • Communities located near forest areas often have good incentives (e.g. higher heat demand, good availability of resources) to develop wood chips value chains (3)	• Very big market for firewood, which limits the material available for wood chip production (4) • The expanding biomass market is targeting mostly pellets and firewood: only niche markets for wood chips (5) • Consumers unaware of this type of fuel and producers / traders are unwilling to invest (5)

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Swot analysis for [Nut shells] in [Greece]

Please fill at least 3 elements in each category and evaluate the importance of each element from 1 to 5 being 5 the maximum.

Strengths	***Weaknesses***
• Low ash content, suitable for combustion in domestic heating appliances (5) • Low cost compared to "standard" wood pellets (5) • No odours or other issues associated with exhausted olive cake (4)	• Uneven particle size distribution, can be an issue for the feeding systems of some combustion devices (3) • Small volumes of production, mostly of interest for local consumption (5) • High oil content, possible impact on combustion devices (2) • No mechanized cracking for some nut types (e.g. walnuts), hence practically zero centralized production despite the significant potential (5)
Opportunities	*Threats*
• Nut trees are growing in popularity in the farming sector, hence higher production volumes of nut shells expected in the future (4) • Proper handling and energetic utilization of nut shells can help reduce the environmental footprint of nut producers (3)	• Self-consumption of the producer sites may limit the quantities available on the market (3) • Small production volumes means that there is limited interest in further upgrading this resource, e.g. through fuel certification (4)

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Swot analysis for [Olive tree prunings] in [Greece]

Please fill at least 3 elements in each category and evaluate the importance of each element from 1 to 5 being 5 the maximum.

Strengths	***Weaknesses***
• High availability of olive tree prunings in Greece (especially Southern Greece) and quite high production per hectare (4) • Heating value comparable to forest wood biomass (4) • Disposal of olive tree prunings represents a cost to farmers; therefore, energetic utilization can be a cost saver or potential source of income (4)	• Area distributed biomass resource. Collection costs and logistics operations can increase the value of the fuel sold to consumers (5) • Due to the generally small size of agricultural holdings, difficult to mobilize sufficient number of farmers to set-up quite large value chains (4) • Appropriate handling of olive tree leaves requires more complex operations from farmers / operators (3) • Higher ash content compared to forest wood biomass, hence higher expected dust emissions (3)
Opportunities	***Threats***
• Farmers interested in cost reduction or diversifying their sources of income (4) • General interest in biomass and low cost heating solutions (4) • Entrepreneurs interested in investing the potential of this biomass resource (4) • Prohibition or further limits in the open-fire burning of this resource can open up its utilization for energetic purposes (4) • Olive tree wood known for its good fuel properties (2) • Actors that can be involved in olive tree pruning value chains are	• Higher availability of olive tree prunings mostly in southern Greece, in areas with lower heat demand and thus reduced annual fuel consumption (4) • In the same areas, competition with the low cost exhausted olive cake or the higher quality olive stones can be a barrier to the acceptance of this fuel (4) • The spreading of the practice of mulching as a cost effective way to handle olive tree prunings limits the resources available. Mulching may not generate direct profit for the farmers, but it also does not require the setting up of a biomass supply chain (4)

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the same as those involved in the handling of biomass from olives, e.g. olive stones and exhausted olive cake. Hence, synergies can be established (3)	• Setting up an olive tree pruning value chain in the current economic environment is riskier and more difficult than investing in other alternatives (4)

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Swot analysis for [Vineyard prunings] in [Greece]

Please fill at least 3 elements in each category and evaluate the importance of each element from 1 to 5 being 5 the maximum.

Strengths	***Weaknesses***
• High availability of vineyard prunings in Greece and quite high production per hectare (4) • Heating value comparable to forest wood biomass (4) • Disposal of vineyard prunings represents a cost to farmers; therefore, energetic utilization can be a cost saver or potential source of income (4)	• Area distributed biomass resource. Collection costs and logistics operations can increase the value of the fuel sold to consumers (5) • Lower yield per hectare compared to olive tree prunings • Due to the generally small size of agricultural holdings, difficult to mobilize sufficient number of farmers to set-up quite large value chains (4) • Higher ash content compared to forest wood biomass, hence higher expected dust emissions (3)
Opportunities	***Threats***
• Farmers interested in cost reduction or diversifying their sources of income (4) • General interest in biomass and low cost heating solutions (4) • Prohibition or further limits in the open-fire burning of this resource can open up its utilization for energetic purposes (4) • Vineyard wood is known for its good fuel properties, especially regarding heating (2)	• The spreading of the practice of mulching as a cost effective way to handle vineyard prunings limits the resources available. Mulching may not generate direct profit for the farmers, but it also does not require the setting up of a biomass supply chain (4) • Some competition between traditional uses of vineyard prunings (e.g. barbeques, grilling, etc.) may limit availability (4) • Setting up a vineyard pruning value chain in the current economic environment is quite risky (4)

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Italy’s SWOT analysis

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Swot analysis for [Olive Stones] in [Italy]

Please fill at least 3 elements in each category and evaluate the importance of each element from 1 to 5 being 5 the maximum.

Strengths	***Weaknesses***
• Presence of productive districts (3) • The residue has to be processed anymore (4) • Logistic of harvesting, treatments, and supply consolidate (4) • High energy density of biofuel (4) • Standard product, in the case of industrial oil mill (4) • Consolidate processing industry across Italy (4)	• Lack of biofuel standard and certification scheme (5) • The standardisation is difficult for small oil mill (4) • Poor presence of suitable stoves and boilers (emissions) (3) • Divergence between offer and demand for meteorological reasons (4)
Opportunities	***Threats***
• Energy independence of farmers and processing sites (3) • Availability of solid biomass for energy in agricultural areas (3) • Consolidate market of this biofuel although uneven (4)	• Inability to use in the next future (Ecodesign enters in force in 2020 and 2022) (3) • Lack of manufacturers' interest for the implementation of suitable stoves and boilers(5)

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Swot analysis for [Wood Chips] in [Italy]

Please fill at least 3 elements in each category and evaluate the importance of each element from 1 to 5 being 5 the maximum.

Strengths	***Weaknesses***
• High availability of forest wood chips (4) • The forest wood chips chain is mature, both for the biosuels as well as for chip boilers (5) • It is a virtuous "short-chain" with important socio-economics benefits and high added value for local communities (5)	• Still very low number of plants installed per years (5) • Increasly availability of chips class B (thanks to meccanization and development of forest enterpreneurs), but still low number of plants interested to buy this low-quality wood chips (4) • Falling sales of small-medium size chips plants, decreasing demand of chips class A1 and A2 (4) • High costs of chips plants (expecially the small-medium size ones) (4) • Logistic of storing and transportation expensive (4) • Still poor information for the potential market on the actual reliability of wood chips (Biomass Logistic and Trade Centres) (4) • Some areas are still not cover by the network of professional chips producers (3 • Still low number of professional chips producers (about 100 in Italy, the majority is in the North) (4)

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Opportunities	***Threats***
• A certification scheme for wood chips already existing (5) • High government incentives for the next 10 years (5) • High market potential: areas still not covered by natural gas grid, industrial processes	• Natural disasters make very high the availability of logs and decreasing the chips price (3) • Social acceptability of pubblic plants (4) • High volatility of fossil fuels price (4) • Lowering of Heating Degree Days (HDD) (4)

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Swot analysis for [Nut shells] in [Italy]

Please fill at least 3 elements in each category and evaluate the importance of each element from 1 to 5 being 5 the maximum.

Strengths	***Weaknesses***
• Presence of productive districts (3) • Costant and planable production(4) • The residue has to be processed anymore (5) • Logistic of harvesting, treatments, and supply consolidate(5) • High energy density of biofuel (4) • The quality of biofuels is already quite well standardised (4) • Consolidate processing industry across Italy (i.e. Ferrero) (5)	• Lack of biofuel standard and certification scheme (5) • Poor presence of suitable stoves and boilers (emissions) (4)
Opportunities	***Threats***
• Energy independence of farmers and processing sites (3) • Availability of solid biomass for energy in agricultural areas (3) • Consolidate market of this biofuel although uneven (4)	• Inability to use in the next future (Ecodesign enters in force in 2020 and 2022) (3) • Lack of manufacturers' interest for the implementation of suitable stoves and boilers (5) • Social acceptability of pubblic plants (4)

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Swot analysis for [Olive tree prunings] in [Italy]

Please fill at least 3 elements in each category and evaluate the importance of each element from 1 to 5 being 5 the maximum.

Strengths	***Weaknesses***
• High yearly availability (4) • Presence of productive districts (5) • Costant and planable production (4) • The residue has to be processed anymore (5) • The energetic valorisation avoids the outdoor burning of prunings (air quality) (5)	• Ash content relative high (3) • Lack of biofuel standard and certification scheme (5) • Expensive logistic (harvesting, treatments, supply of plants) (3) • Poor presence of suitable stoves and boilers (emissions) (3)
Opportunities	***Threats***
• Energy independence of farmers and processing sites (3) • Added income for farmers (2) • Self-consumption chains environmental and energy friendly (4) • The controlled combustion of prunings (industrial plants) make better the air quality of productive districts (5) • Availability of solid biomass for energy in agricultural areas (4)	• Inability to use in the next future (Ecodesign enters in force in 2020 and 2022) (3) • Lack of manufacturers' interest for the implementation of suitable stoves and boilers (5) • Social acceptability of pubblic plants (4)

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Swot analysis for [Vineyard prunings] in [Italy]

Please fill at least 3 elements in each category and evaluate the importance of each element from 1 to 5 being 5 the maximum.

Strengths	***Weaknesses***
• High yearly availability, which is increasing durings last years (4) • Presence of productive districts (4) • Costant and planable production (5) • The residue has to be processed anymore (5) • The energetic valorisation avoids the outdoor burning of prunings (air quality) (5)	• Ash content very high (5) • Lack of biofuel standard and certification scheme (5) • Expensive logistic (harvesting, treatments, supply of plants) (4) • Lack of suitable stoves and small-medium boilers, which permits to burn this biofuels respecting the emissions limits (5)
Opportunities	***Threats***
• Energy independence of farmers and processing sites (3) • Added income for farmers (3) • Self-consumption chains environmental and energy friendly (4) • The controlled combustion of prunings (industrial plants) make better the air quality of productive districts (5) • Availability of solid biomass for energy in agricultural areas (4)	• Inability to use in the next future (Ecodesign enters in force in 2020 and 2022) (5) • Lack of manufacturers' interest for the implementation of suitable stoves and boilers (5) • Social acceptability of pubblic plants (4)

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Portugal’s SWOT analysis

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Swot analysis for Olive Stones in Portugal

Please fill at least 3 elements in each category and evaluate the importance of each element from 1 to 5 being 5 the maximum.

Strengths	***Weaknesses***
• Biomass with high net calorific value, high density and low ash content • Dry biomass which is easy to store • Feasibility of direct use for energy in small scale combustion may increase acceptance among the users • Low price compared with other biomasses, namely wood pellets • Agroindustry by-product • Increased independency of society from fossil resources • Non-food crop no direct competition for use as food • Large agro-industrial sector that produces significant amounts of residues	• Seasonal biomass availability • Low quality and quantity production rate relative to its potential • The quality of the olive stones depends of the treatment process given to the by-products of olive oil extraction (no standard) • Domestic wood heating is traditional use and this tradition is hard to change • Transport over large distances is expensive
Opportunities	***Threats***
• Large increasing of olive grove area • If it is standardized, it is easy to use, stored and feed the process • Standard product with high acceptance • Can be an alternative to pellets • Opportunity to valorize a agro-industrial by-product • Income opportunity for agroindustry • Lower transport costs due to higher density • Enlarge biomass supply and easing pressure on forests • Integration of biomass heating system with solar thermal system	• Market size and organisation • Quantity and quality availability • Lower acceptance for a non-standard product • Appliances adapted to the type of biofuel • Professionals qualified to install biomass heating systems

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Swot analysis for wood chips in Portugal

Please fill at least 3 elements in each category and evaluate the importance of each element from 1 to 5 being 5 the maximum.

Strengths	***Weaknesses***
• Employment opportunities for local community in the supply chain logistics of biomass • Infrastructure and technologies for harvest are well established for wood chips • Infrastructure (saw mills) well established • Feasibility of direct use for energy in small scale combustion may increase acceptance among the users • Low price compared with other biomasses, namely wood pellets • Promotes forest management, contributing to the reduction of the risk of forest fire • Increased independency of society from fossil resources	• The wood chips quality is irregular • Transport over large distances is expensive • Low density compared with pellets • Competition with wood industries
Opportunities	***Threats***
• If it is standardized, it is easy to use, stored and feed the process • Standard product with high acceptance • Can be an alternative to pellets • Contribute to rural development (create employment) • Income opportunity for forestry sector • Integration of biomass heating system with solar thermal system	• Market size and organisation • Quantity and quality availability • Lower acceptance for a non-standard product • Feedstock for other wood industries • Appliances adapted to the type of biofuel • Professionals qualified to install biomass heating systems

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Swot analysis for Nut shells in Portugal

Please fill at least 3 elements in each category and evaluate the importance of each element from 1 to 5 being 5 the maximum.

Strengths	***Weaknesses***
• Agroindustry by-product • No further processing required • Dry biomass which is easy to store • Low price compared with other biomasses, namely wood pellets • Alternate use of the residue which generates income for the agro-industries • Non-food crop no direct competition for use as food • Increased independency of society from fossil resources	• Seasonal biomass availability • Quantity of nut shells available from agro-industry is low compared with the total production of almond, pinion, walnut and hazelnut • Nut shells available are typically consumed by the crushers, for self-consume in their boilers, or sold in a restrict area • Low feasibility of energy equipment for small-scale combustion • High ash content compared to wood biofuels • Domestic wood heating is traditional use and this tradition is hard to change • Transport over large distances is expensive
Opportunities	***Threats***
• A significant potential of this solid biofuel is not being used actually in Portugal • It is easy to use, stored and feed the process adapted to these biofuels • Can be an alternative to other biofuels or fossil fuels • Opportunity to valorize a agro-industrial by-product • Income opportunity for agroindustry • Enlarge biomass supply and easing pressure on forests	• The availability of these biofuels depends on the annual production of fruits (very variable) • Market size and organization • Appliances adapted to the type of biofuel • Professionals qualified to install biomass heating systems

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Swot analysis for Olive tree prunings in Portugal

Please fill at least 3 elements in each category and evaluate the importance of each element from 1 to 5 being 5 the maximum.

Strengths	***Weaknesses***
• Traditional use for domestic heating • Large agricultural sector that produces significant amounts of residues • Income opportunity for farmers • Agricultural by-product • Employment opportunities for local community in the supply chain logistics of biomass • Technologies for harvest are well established • Possibility of being processed into chips or pellets • Feasibility of use for energy • Increased independency of society from fossil resources	• Seasonal biomass availability • Transport over large distances is expensive
Opportunities	***Threats***

• Large increasing of olive grove area
• Could be converted into chips or pellets
• Pelletised prunnings could be used as alternative
  ○ Lower transport costs due to higher density
  ○ Easier feeding to process (higher standardisation)
• Opportunity to valorize an agricultural by-product
• Enlarge biomass supply and easing pressure on forests
• Contribute to rural development by absorbing and valorising substantial volumes of agricultural waste as feedstock
	• Appliances adapted to the type of biofuel
	• Professionals qualified to install biomass heating systems
	• Parallel market

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Swot analysis for Vineyard prunings in Portugal

Please fill at least 3 elements in each category and evaluate the importance of each element from 1 to 5 being 5 the maximum.

Strengths	***Weaknesses***
• Large agricultural sector that produces significant amounts of residues • Agricultural by-product • Employment opportunities for local community in the supply chain logistics of biomass • Possibility of being processed into pellets • Increased independency of society from fossil resources	• Seasonal biomass availability • High collecting, processing and transporting costs • Usually disposed and burned in piles on the field • Low density, further processing is required, namely baling • High ash content
Opportunities	***Threats***

• Large increasing of vineyard area
• Pelletised vineyard prunings could be used as alternative
  ○ Lower transport costs due to higher density
  ○ Easier feeding to process (higher standardisation)
• Opportunity to valorize an agricultural by-product, i. e., income opportunity for farmers
• Contribute to rural development by absorbing and valorising substantial volumes of agricultural waste as feedstock
• Enlarge biomass supply and easing pressure on forests
	• Market size and organisation
	• Quantity and quality availability
	• Lower acceptance for a non-standard product
	• Appliances adapted to the type of biofuel
	• Professionals qualified to install biomass heating systems

This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No. 691763

Slovenia's SWOT analysis

This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No. 691763

Swot analysis for [Wood Chips] in [Slovenia]

Please fill at least 3 elements in each category and evaluate the importance of each element from 1 to 5 being 5 the maximum.

Strengths	***Weaknesses***
• (4) The cheapest wood fuel (comparing €/MW) • (5) Use of low quality wood • (5) Developed supply side • (2) Useful also for larger systems (micro and district heating systems)	• (5) Expensive technologies for production and use • (3) Low energy content per volume / large storage room • (2) Problems with dust • (4) System of pricing is not known or transparent (buying/selling according to volume, weight, energy)
Opportunities	***Threats***
• (5) System of subsides for modern boilers • (5) Rural development program – support for buying machinery (wood chippers • (4) Large potential in use of wood chips in public buildings	• (5) High number of small producers • (2) No system for QA/QC • (4) More stringent legislation about emissions and ash disposal • (1) No system for trace of origin of row material

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Swot analysis for [Olive tree prunings] in [Slovenia]

Please fill at least 3 elements in each category and evaluate the importance of each element from 1 to 5 being 5 the maximum.

Strengths	***Weaknesses***
• (5) Use of residues from olive plantations • (4) Low price of row material • (3) New/additional source of income for olive oil producers	• (4) Technology for collecting of punning's not available • (5) Small concentration of olive tree prunning's – higher costs of collecting • (3) possibilities of use of punning's are not known well among possible producers and also users • (4) Alternative use of olive tree prunning's – for soil fertiliser in olive tree plantations
Opportunities	***Threats***
• (4) New source of energy available in rural areas particularly suitable for heating individual olive mills and private households • (5) Rural development program – support for buying machinery (machinery for processing) • (3) Development of local market with wood chips (including chips produced from prunning's)	• (5) High number of small olive oil producers - potential of punning's is limited and fragmented • (4) No market for chips from olive tree punning's • (2) More stringent legislation about emissions and ash disposal

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Swot analysis for [Vineyard prunings] in [Slovenia]

Please fill at least 3 elements in each category and evaluate the importance of each element from 1 to 5 being 5 the maximum.

Strengths	***Weaknesses***
• (5) Use of residues from vineyards • (4) Low price of row material • (3) New/additional source of income for wine producers	• (4) Expensive technologies for collecting of punning's • (4) Technology for collecting of punning's not available in majority or regions • (2) Problems with processing of punning's • (5) possibilities of use of punning's are not known well among possible producers and also users • (4) Alternative use of vineyard prunning's – for soil fertiliser in vineyards
Opportunities	***Threats***
• (4) New source of energy available in rural areas • (5) Rural development program – support for buying machinery (machinery for processing) • (2) Large potential in use of punning's in local areas	• (5) High number of small wine producers - potential of punning's is limited and fragmented • (2) No quality standards for vineyards punning's • (4) No market for pellets from vineyard punning's

This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No. 691763

Spain’s SWOT analysis

This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No. 691763

Swot analysis for [Olive Stones] in [Spain]

Please fill at least 3 elements in each category and evaluate the importance of each element from 1 to 5 being 5 the maximum.

Strengths	***Weaknesses***
• Good quality, similar to wood pellets (5) • Lower price than wood pellets (5) • Good availability in Spain (3) • Low GHG as is a "by-product" (3) • Easy adaptation of devices designed for pellets (4)	• Variations in the availability annually because of the characteristics of the olive tree and weather conditions (3) • Bad reputation due to bad quality olive stones sold by some companies (5) • Unawareness to consumers (4)
Opportunities	***Threats***
• Big percentage of the production used as industrial biofuel that could be valorised and give it more added value (4) • Renewable targets and legislation promoting renewable energies could benefit biofuels (3) • A big market is there, changing old fossil fuels boilers / stoves.(4)	• Pellet or other biofuels competition (4) • Low fossil prices (4) • Consumers changing to other biofuel / fuel because of bad experience with bad quality olive stones (5)

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Swot analysis for [Wood Chips] in [Spain]

Please fill at least 3 elements in each category and evaluate the importance of each element from 1 to 5 being 5 the maximum.

Strengths	***Weaknesses***
• Good quality (4) • Low price compared with other biofuels and about all fossil fuels. (5) • Big Availability in Spain (4)	• Expensive logistic (5) • Need for a big storage (4) • Devices more expensive (3) • High moisture content when trees are collected. Need to dry (3)
Opportunities	***Threats***
• Renewable targets and legislation promoting renewable energies could benefit biofuels (3) • A big market available for cheap fuels (4) • Present in rural areas that need to be developed. (3)	• Fossil fuel low prices (4) • Competition with other low cost bifouels (3) • Electric generation legislation in Spain is not promoting new projects. (4)

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Swot analysis for [Nut shells] in [Spain]

Please fill at least 3 elements in each category and evaluate the importance of each element from 1 to 5 being 5 the maximum.

Strengths	***Weaknesses***
• Good quality. Pretty similar to wood pellets (4) • Lower price than wood pellets (4) • Residue of an industrial process. Low GHG (3)	• Need for more expensive boilers / adaptations(5) • Very seasonal products. Need for big storages (4) • Poorer quality if stored outdoors (4) • No such big volumes of production, mostly of interest for local consumption (3)
Opportunities	***Threats***
• Renewable targets and legislation promoting renewable energies could benefit biofuels (3) • A big market available for cheap fuels (4)	• Fossil fuel low prices (4) • Competition with other bifouels (4)

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Swot analysis for [Olive tree prunnnings] in [Spain]

Please fill at least 3 elements in each category and evaluate the importance of each element from 1 to 5 being 5 the maximum.

Strengths	***Weaknesses***
• Huge availability in the south of Spain (mainly Andalusia) (5) • Quality could almost as wood chips if collected properly (3) • Diversification of incomes for farmers (4) • Nowadays, elimination of the prunnings is a expense (4)	• No standardisation of the biofuel (4) • Difficult to collect prunings in a proper way for not taking sand and degrading the quality. Need for specialised machinery (5) • Poorer quality compared to wood chips about all if it's not collected properly (3)
Opportunities	***Threats***
• Legislation trend is to forbid the elimination by fire (5) • Renewable targets and legislation promoting renewable energies could benefit biofuels (3) • A big market available for cheap fuels (4)	• Fossil fuel low prices (4) • Competition with other low cost bifouels (3) • Electric generation legislation in Spain is not promoting new projects. (4) • Competition use of the prunnings mulching (2)

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Swot analysis for [Vineyards prunnings] in [Spain]

Please fill at least 3 elements in each category and evaluate the importance of each element from 1 to 5 being 5 the maximum.

Strengths	***Weaknesses***
• Huge availability of the prunnings (4) • Better quality than other biomasses like olive cake (4) • Nowadays, elimination of the prunnings is a expense (5)	• No standardisation of the biofuel (4) • Expensive logistic (4) • Difficult to collect prunings in a proper way for not taking sand and degrading the quality. Need for specialised machinery (5) • Poorer quality compared to wood chips about all if it's not collected properly (3)
Opportunities	***Threats***
• Legislation trend is to forbid the elimination by fire (5) • Renewable targets and legislation promoting renewable energies could benefit biofuels (3) • A big market available for cheap fuels (4)	• Fossil fuel low prices (4) • Competition with other low cost bifouels (3) • Electric generation legislation in Spain is not promoting new projects. (4) • Competition use of the prunnings mulching (2)

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Turkey’s SWOT analysis

This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No. 691763

Swot analysis for [Olive Stones] in [Turkey]

Please fill at least 3 elements in each category and evaluate the importance of each element from 1 to 5 being 5 the maximum.

Strengths	***Weaknesses***
• Clean fuel (cleaner than olive husk) • Automatic / autonomous operation • High calorific value	• Difficulty in separating olive stone • Only produced from sliced and pickling olive industry
Opportunities	***Threats***
• Decrease environmental pollution by olive waste • Increase of the price of fossil fuels	• Expensive (115 £ / ton) • Lack of government support • Lack of connection in the biomass sector

This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No. 691763

Swot analysis for [Wood chips] in [Turkey]

Please fill at least 3 elements in each category and evaluate the importance of each element from 1 to 5 being 5 the maximum.

Strengths	***Weaknesses***
• Cheaper than pellets • Useful also for larger Systems (micro and district heating systems) • Supply chain management is stronger than the other biomass types • More efficient use of the regional biomass resources	• Lack of manufacturers of biomass systems in the region- most systems imported from • Expensive production technology • Large storage area need • Lower energy content per volume than pellets • EU standards are applied, the standards should be adopted to Turkey • No subsidies for modern boilers
Opportunities	***Threats***
• Large potential in use of wood chips in public buildings • Huge amount of biomass potential	• Confusion of authority (The classification and disposal process not carried out by municipalities) • The foreign approval companies are so expensive and having difficulty in the language • Unclear security of local fuel supply e.g. logs

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Swot analysis for [Nuts] in [Turkey]

Please fill at least 3 elements in each category and evaluate the importance of each element from 1 to 5 being 5 the maximum.

Strengths	***Weaknesses***
• Clean fuel • Automatic / autonomous operation • High calorific value	• Humidity is main problem • Easily decomposed
Opportunities	***Threats***
• Decrease environmental pollution by olive waste • Can be used with coal	• Lack of government support • Bakeries use in BlackSea region

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Swot analysis for [Olive prunnings] in [Turkey]

Please fill at least 3 elements in each category and evaluate the importance of each element from 1 to 5 being 5 the maximum.

Strengths	***Weaknesses***
• Clean fuel • Automatic / autonomous operation • High calorific value	• Humidity is main problem • Easily decomposed • Ash contents may create problems
Opportunities	***Threats***
• Large potential in many regions • Can be used with coal • Easily marketable	• Lack of government support • Lack of commercial attractiveness • No subsidies for modern boilers

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Swot analysis for [Vineyard prunnings] in [Turkey]

Please fill at least 3 elements in each category and evaluate the importance of each element from 1 to 5 being 5 the maximum.

Strengths	***Weaknesses***
• Useful also for larger Systems (micro and district heating systems) • Easily accessible in Eagan and Marmara region • More efficient use of the regional biomass resources • Easily marketable	• Lower energy content per volume than pellets • Easily decomposed • EU standards are applied, the standards should be adopted to Turkey • No subsidies for modern boilers • Lack of commercial attractiveness
Opportunities	***Threats***
• Large potential in Eagean and Marmara region • Population increase resulted in energy demand increase • Can be used with coal	• Confusion of authority (The classification and disposal process not carried out by municipalities) • Rapid decomposition from source of biomass

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Report of the final user survey for Croatia

This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No. 691763

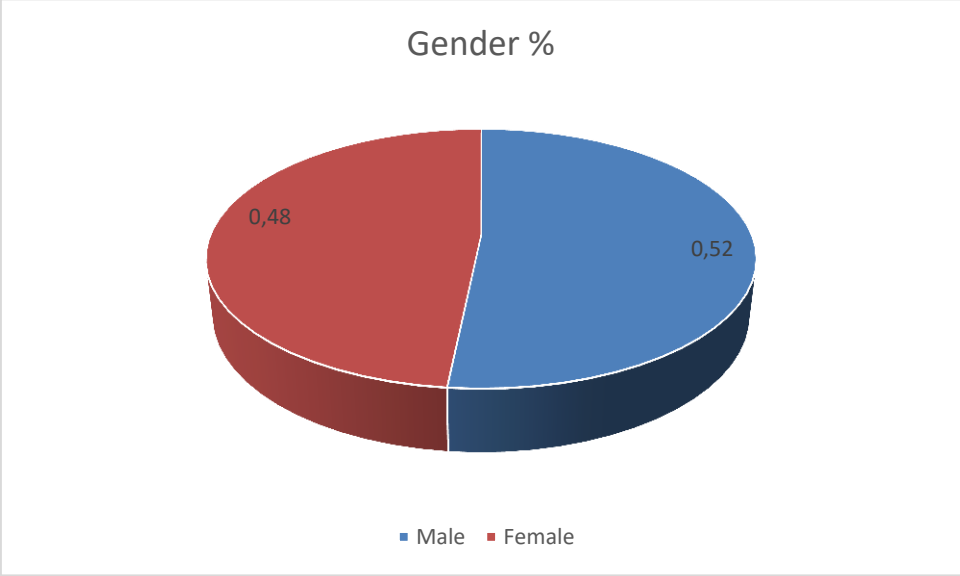
RESULTS DESCRIPTION FOR CROATIA

Please make a small graphic for the following informations an put some lines of interpretation:

- *NUMBER OF RESPONDENTS*

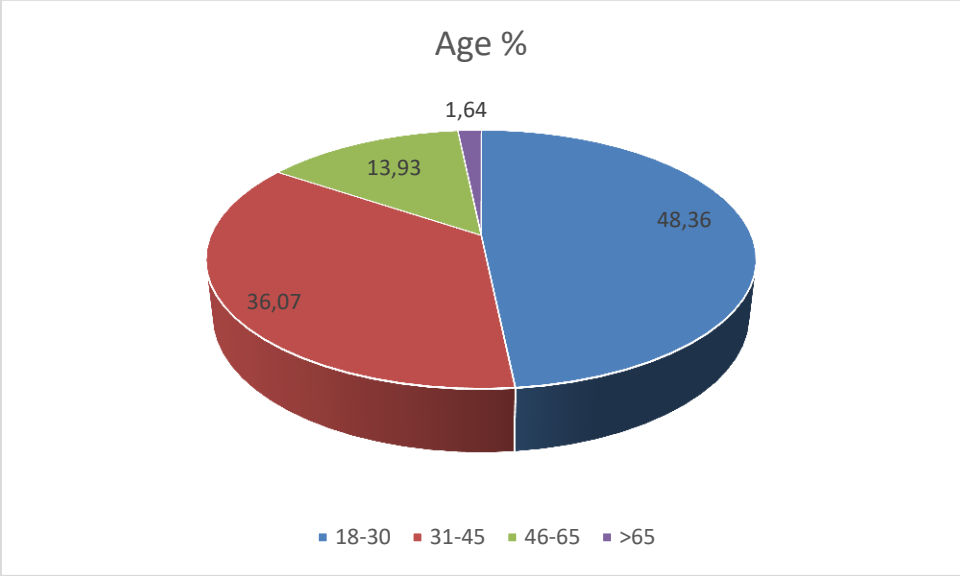
***122** is the number of people that took part in the final user survey.*

- *RESPONDENTS GENDER (%)*



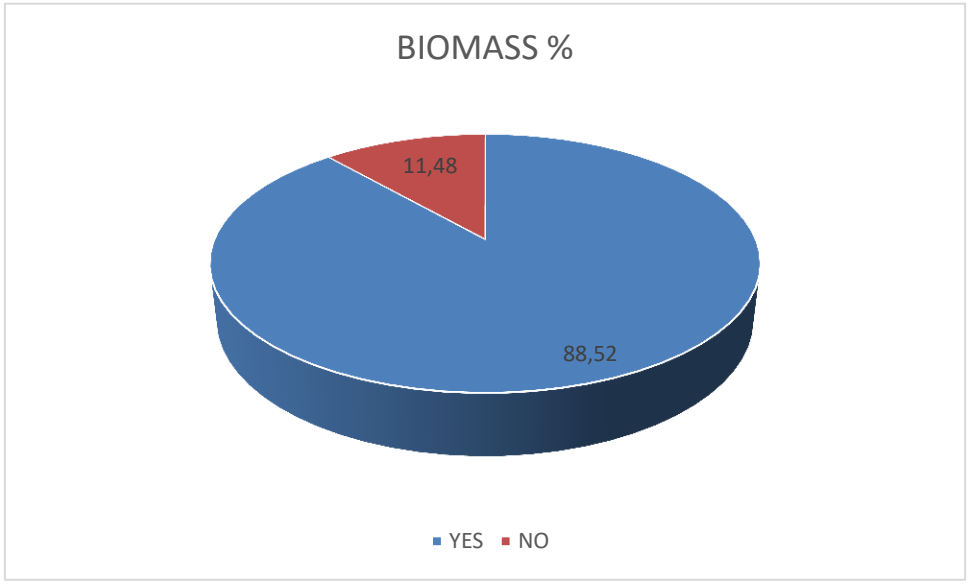
*Out of 122 total respondents, **63** were male and **59** were female, making **52%** and **48% respectively.***

- *RESPONDENTS AGE (%)*



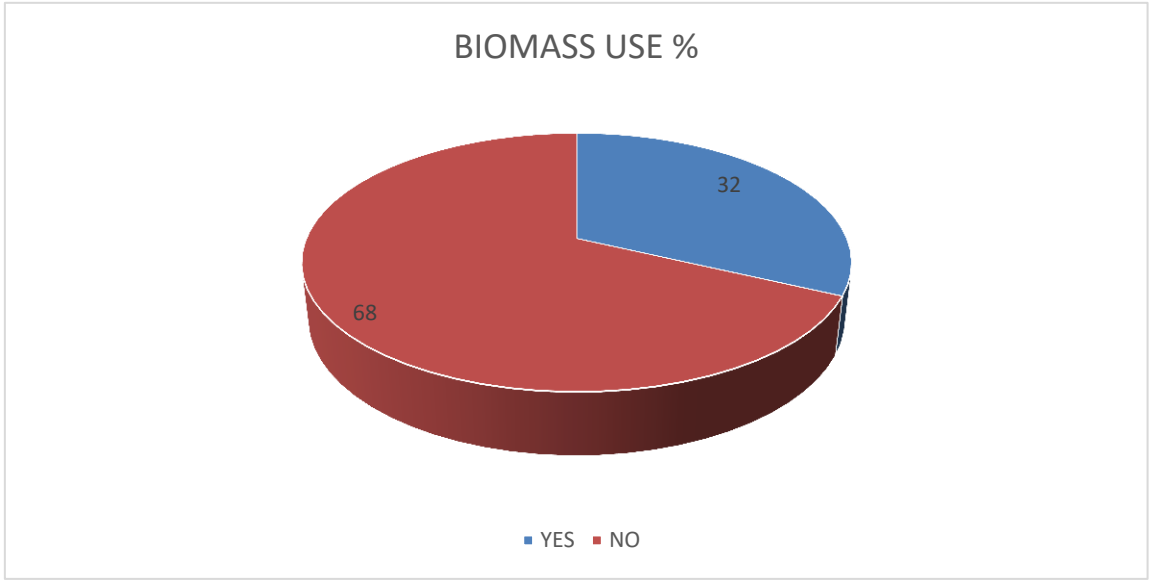
*Out of 122 people that took the survey, **59** respondents were between the ages of 18 and 30, followed by **44** being between 31 and 45 and **17** between 46 and 65 years of age. Only **2** respondents were older than 65. This ratio yielded **48%, 36%, 14% and 2%** for the age groups from the youngest to oldest.*

- *% OF RESPONDENTS WHO KNOW ABOUT BIOMASS*



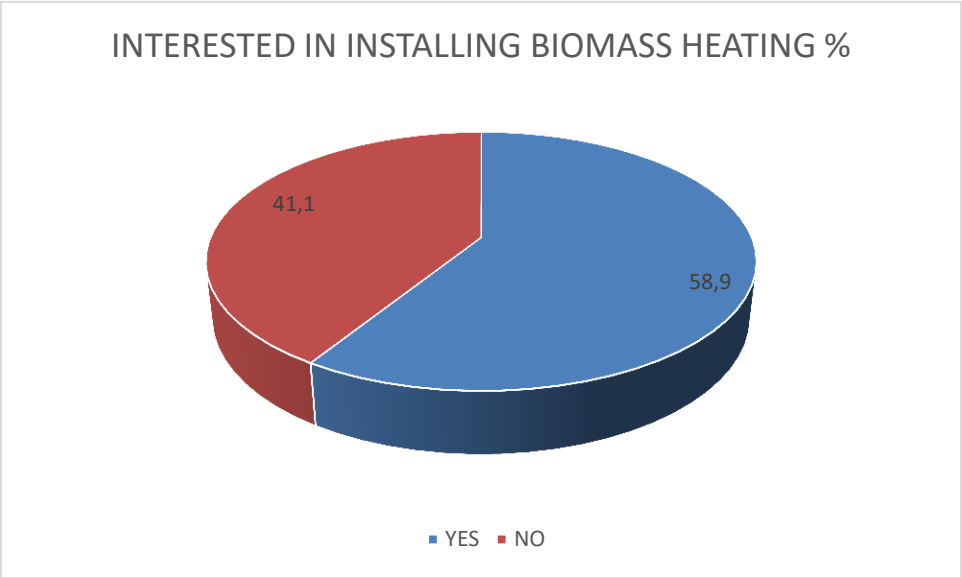
***89%** of respondents were familiar with biomass which corresponds to 108 positive answers out of 122. Only **11%** or 14 respondents admitted they were not familiar with biomass.*

- *% OF RESPONDENTS WHO USE BIOMASS FOR HEATING IN THEIR RESIDENCE*



*Out of 108 respondents which were familiar with biomass, only 35 of them use biomass for heating, which corresponds to **32%.** This accounts for only **29%** of total survey respondents.*

- % OF RESPONDENTS willing to change to a biomass system



43 or **58.9%** of 73 people that said they are not using biomass for heating declared they would be interested in installing a biomass system in the future.

- *MAIN REASON FOR YES*

  Respondents interested in installing a biomass system pointed out that high costs and spatial or building restrictions were the main reasons why they have not done so already.

- *MAIN REASONS FOR NO*

  Most of the people that would not install a biomass system explained their main motivation for this decision are spatial or building restrictions, closely followed by a need for investment.

- *KIND OF PROPERTY OF BIOMASS USERS*

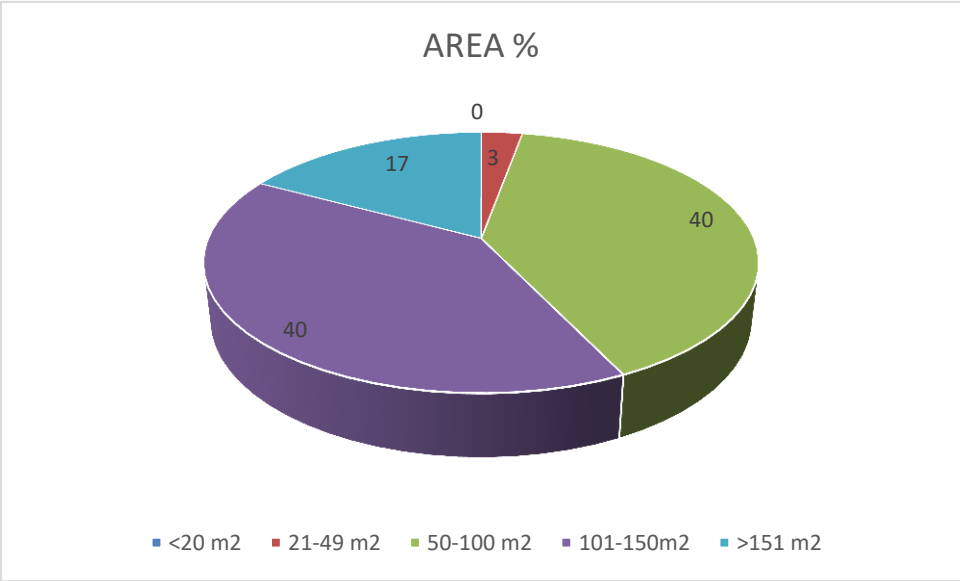
- *TYPE OF BUILDING*

  ***34** out of **35** total users of biomass systems declared they are using the system in their family house, while only **one** person noted they are using the system in an apartment building.*

- *TYPE OF OWNERS*

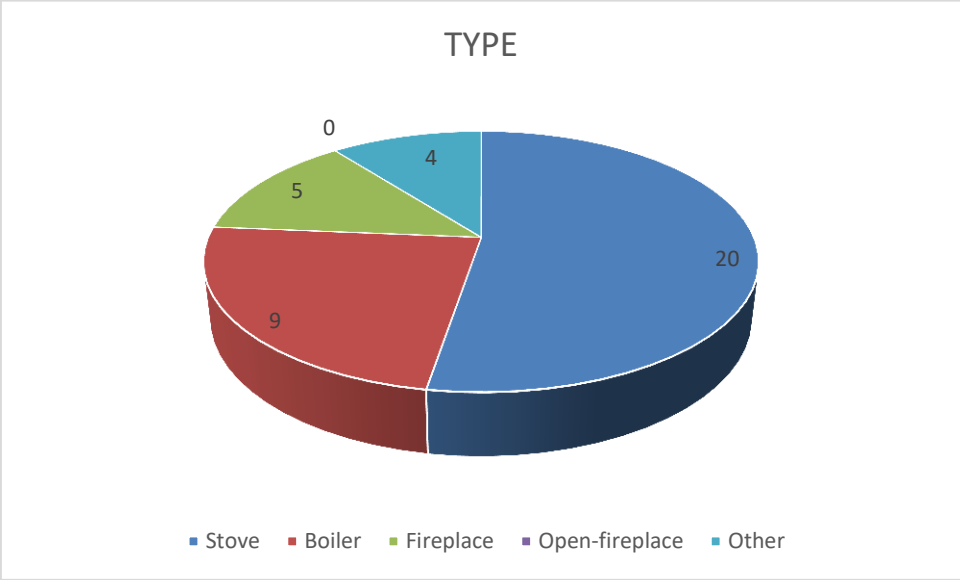
  ***30** out of **35** biomass system users said they are the owners of the building in question, while the rest are subtenants.*

- *SURFACE TO HEAT*



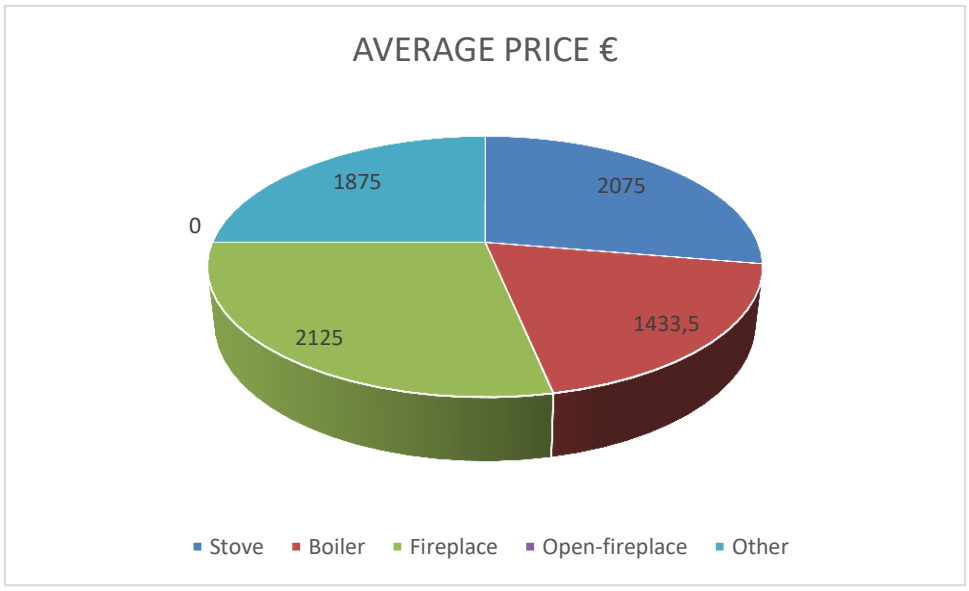
Most of the respondents (80%) stated the heated area is between 50 and 150 m^2. Half of this percentage is in the 50 – 100 m^2 range, while the other half is in the 101 – 150 m^2 range. 17% is heating areas greater than 150 m^2, while only 3% heated areas in the range from 21 to 50 m^2. No respondents stated an area of 20 m^2 or less.

- *TYPE OF HEATING SYSTEM*

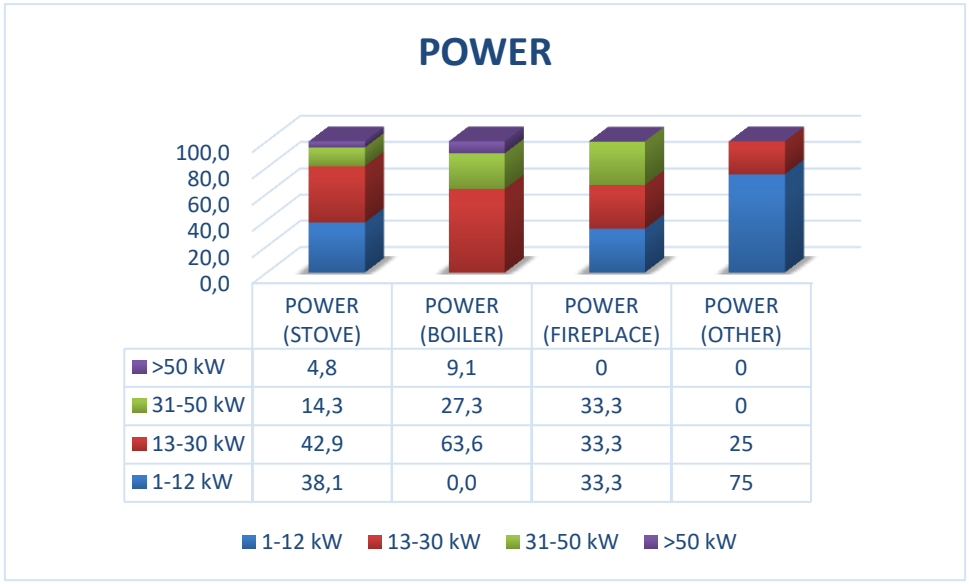


Stove was the most used type of a heating system, while it has to be noted some users chose multiple options, indicating there is more than one type of system being used for heating purposes. In the category "Other", solar collectors and rocket stove heaters were mentioned as heating system options in use.

- *AVERAGE PRICE BY DEVICE*

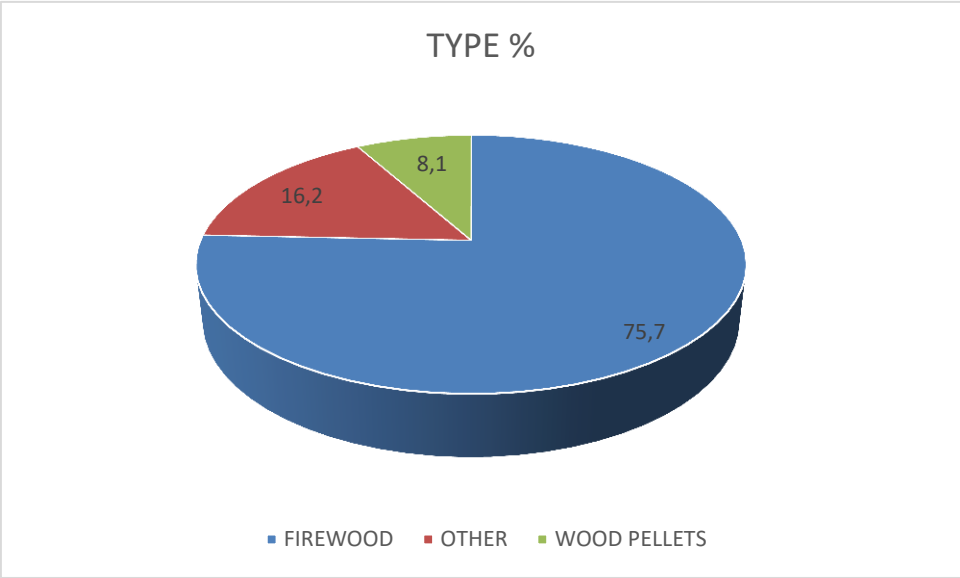


○ *% DEVICE POWER BY CATEGORY AND DEVICE*

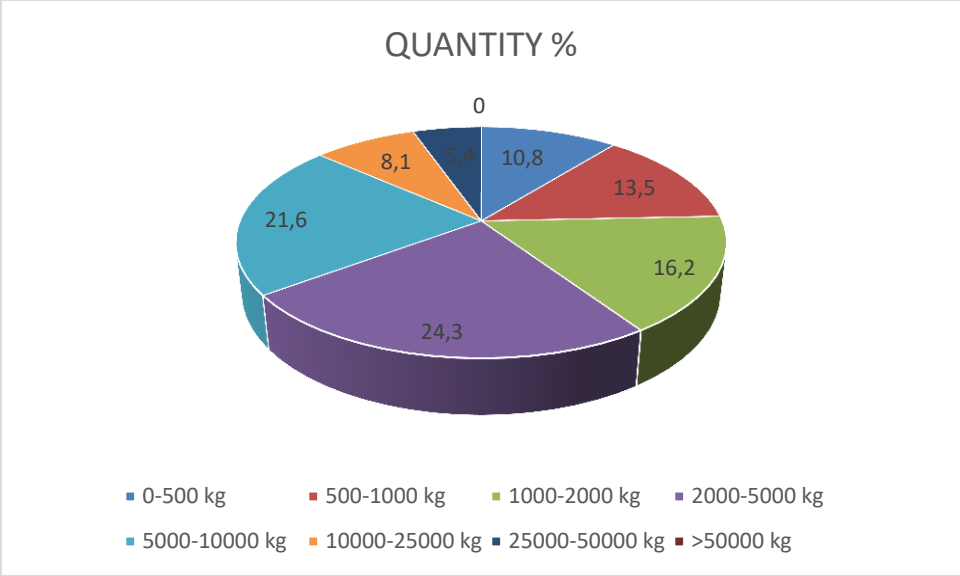


	POWER (STOVE)	POWER (BOILER)	POWER (FIREPLACE)	POWER (OTHER)
>50 kW	4,8	9,1	0	0
31-50 kW	14,3	27,3	33,3	0
13-30 kW	42,9	63,6	33,3	25
1-12 kW	38,1	0,0	33,3	75

○ *% TYPE AND QUANTITY OF BIOFUEL*



Only three types of fuels were used, with over three quarters of respondents using firewood. "Other" was mainly regarding the agricultural residues (mostly corn) and saw dust from local sawmills.



- *What is your feeling as consumer using biomass?*

○ *AVERAGE OF GRADE OF GENERAL SATISFACTION*

***4.43** out of **5** was the average grade of satisfaction using biomass among **35** users in Croatia.*

○ *AVERAGE OF GRADE OF SATISFACTION WITH YOUR INSTALLATION (EFFICIENCY,EMISSIONS, FREQUENCY OF CLEANING, ETC)*

***4.03** out of **5** is the average grade of satisfaction with the installation.*

○ *AVERAGE GRADE OF SATISFACTION WITH THE BIOMASS (QUALITY, PRICE, …)*

***3.97** out of **5** is the average satisfaction with the biomass among respondents.*

○ *AVERAGE OF GRADE OF SATISFACTION WITH THE DISTRIBUTION NETWORK*

3.77 *out of* ***5*** *was the result of overall satisfaction with the distribution network.*

• *Your considerations when you are buying biomass .*

○ *AVERAGE PRICE*

4.06 *out of* ***5.***

○ *AVERAGE QUALITY*

4.46 *out of* ***5.***

○ *AVERAGE CERTIFICATION*

2.17 *out of* ***5.***

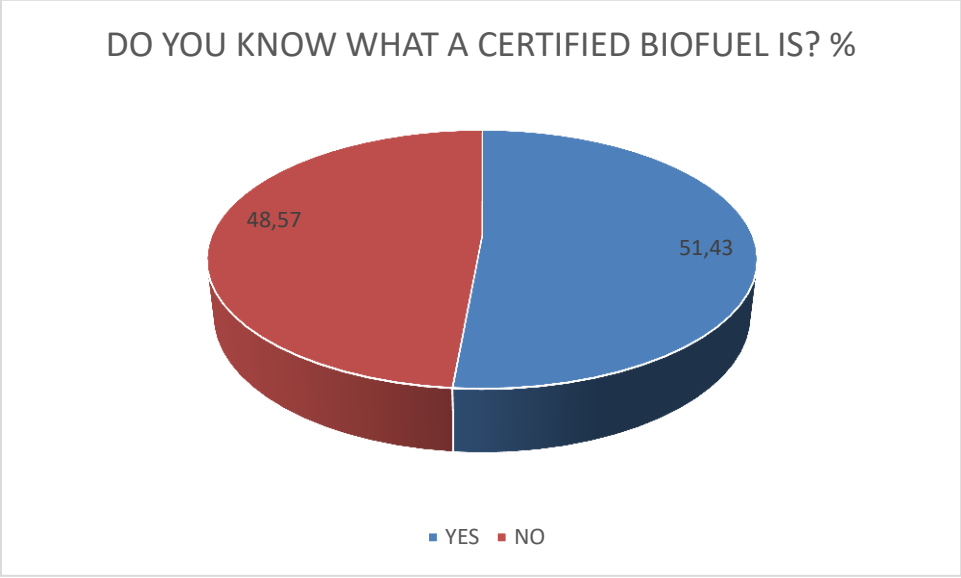
○ *AVERAGE LOCAL PRODUCT*

4.03 *out of* ***5.***

○ *AVERAGE DELIVERY SERVICES*

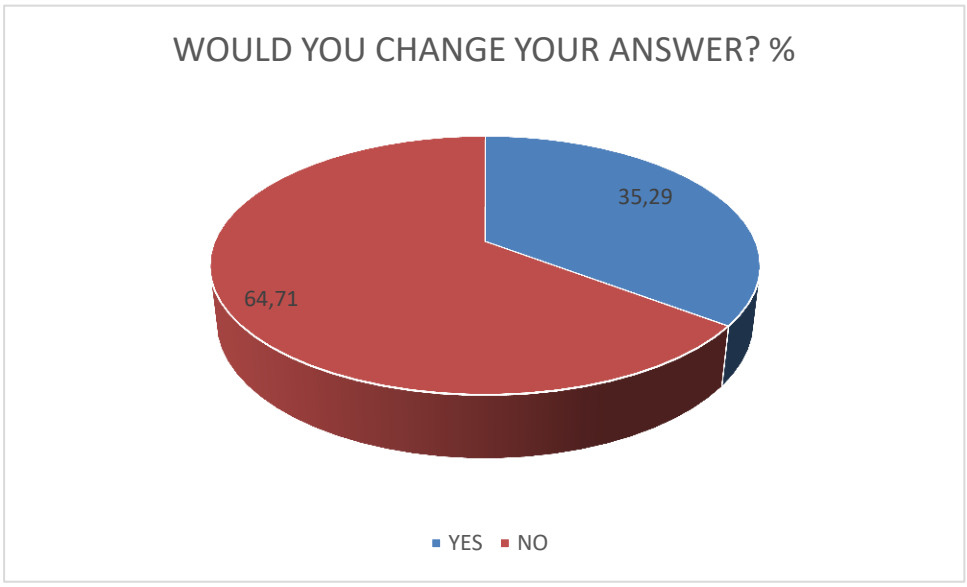
4.19 *out of* ***5.***

• Do you know what a certified biofuel is? %



51, 43% of respondents know what is a certified biofuel, 48,57% don't know what is the certified biofuel.

• Once you understand what is a certified fuel, would you change your answer about your considerations when you are buying biomass? %



64,71% of respondents would not change their answer about their considerations when they are buying biomass.

• *Considerations when you are buying biomass Now you know what implies a certified biofuel .*

○ *AVERAGE PRICE*

3.63** out of **5.

○ *AVERAGE QUALITY*

4.13** out of **5.

○ *AVERAGE CERTIFICATION*

3.43** out of **5.

○ *AVERAGE LOCAL PRODUCT*

4.29** out of **5.

○ *AVERAGE DELIVERY SERVICES*

4.57** out of **5.

This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No. 691763

MAIN CONCLUSIONS FROM THE SURVEY IN CROATIA

- Based on data collected form the survey in Croatia, we can conclude that there is a high interest for using biomass, but mainly high costs and spatial/building restrictions are making it difficult for people to realize their project ideas.
- Overall, around one third of respondents are already using biomass systems and they have reported reasonably high levels of satisfaction with their current installation and its use. This can be seen from the average overall satisfaction grade of 4.43 out of 5.00, which users have reported.
- Given that more than three quarters of biomass users seem to be using standard firewood, the price of the biofuel and its local availability seem to be the primary drivers for consumer's choices.
- At first, the biomass system users rated the importance of biomass certification with an average of mere 2.17 out of 5.00, which is a very low result. An increase to 3.43 after getting to know more details about certification is very encouraging for the future of biomass market in Croatia, as it indicates people would be willing to use a higher quality certified products if given a proper chance to learn about their benefits.
- However, it has to be noted that based on the small sample size and taking into account that most of the respondents have a similar profile, general experiences and preferences regarding biomass use in Croatia might differ significantly.

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Report of the final user survey for Greece

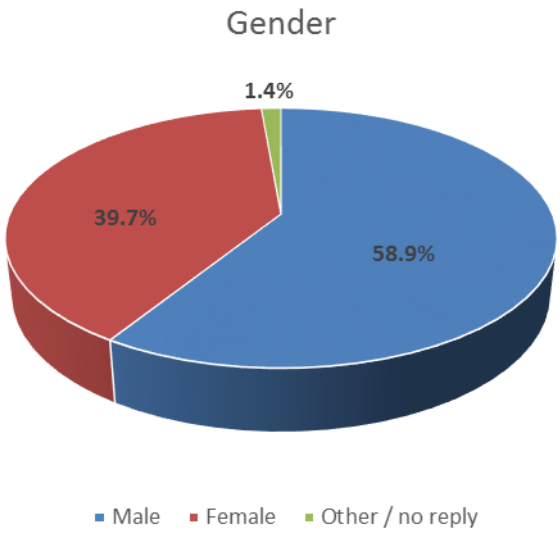
RESULTS DESCRIPTION FOR GREECE

NUMBER OF RESPONDENTS

The final user survey was answered by 73 respondents.

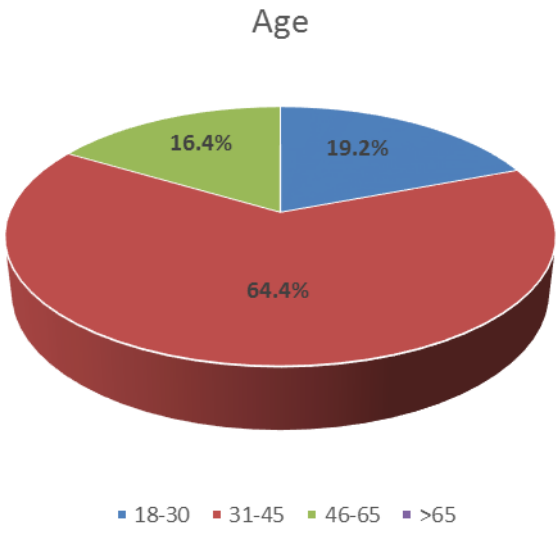
RESPONDENTS GENDER (%)

43 of the respondents identified as "male", 29 as female and 1 identified as "other / no reply". The corresponding percentages are 58.9%, 39.7% and 1.4%.



RESPONDENTS AGE (%)

14 respondents were between the ages of 18 and 30, **47** being between 31 and 45 and **12** between 46 and 65 years of age. None of the respondents were older than 65. The corresponding percentages were 19.2%, 64.4%, 16.4% and 0%.



% OF RESPONDENTS WHO KNOW ABOUT BIOMASS

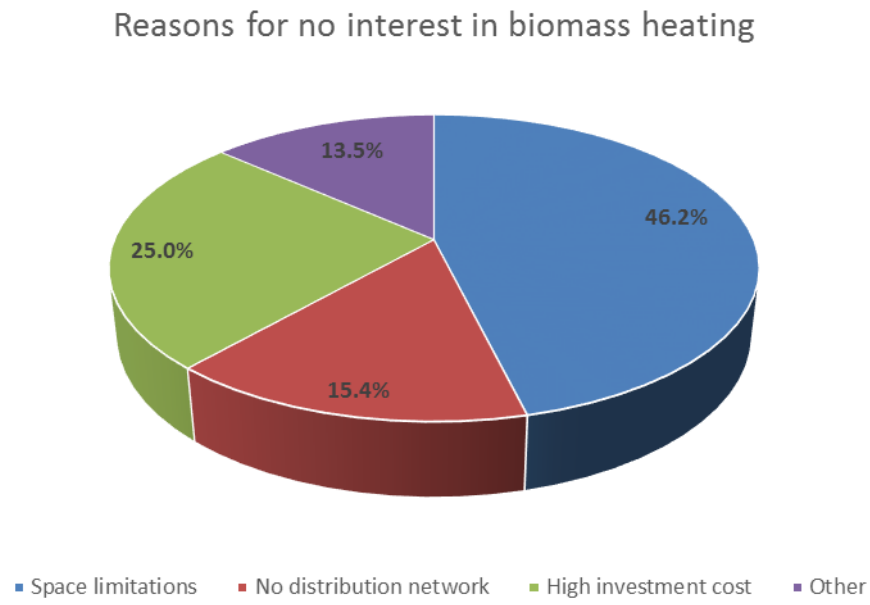
84.9% of the respondents expressed familiarity with biomass (62 positive answers out of 73). The remaining **15.1%** responded that they did not know what biomass is.

% OF RESPONDENTS WHO USE BIOMASS FOR HEATING IN THEIR RESIDENCE

Only 3 respondents answered that they use biomass for heating in their residence. This corresponds to a percentage of **4.8%** out of the respondents knowledgeable about biomass and **4.1%** of the total respondents.

% OF RESPONDENTS UNWILLING TO CHANGE TO BIOMASS HEATING

Out of the 59 correspondents who know what biomass is and do not use biomass for heating, 66.1% (39 responses) have expressed unwillingness or serious issues for a change to a biomass system. The following chart summarizes the responses received regarding the reasons for this lack of interest in biomass heating.



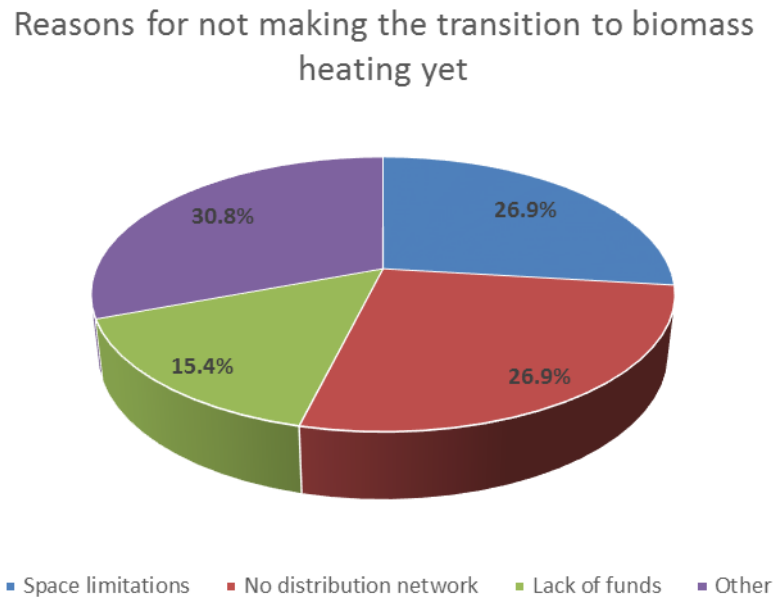
Space limitations was the most important limiting factor, accounting for 46.2% of the responses received. The high investment cost followed with 25.0%, while the lack of a biomass distribution network amounted to 13.5%. Other reasons for no immediate interest in biomass heating accounted to 15.4% of the responses; the more detailed explanations given includes usage of an alternative heating system (e.g. natural gas, district heating), preference for other heating solutions (e.g. geothermal energy, natural gas, insulations) and lack of knowledge on the benefits of biomass heating.

The findings generally agree well with the origin of the respondents, which are mostly coming from urban centres, where lack of space in apartment blocks are indeed a limiting factor. The investment cost is also a limiting factor, especially considering the impact of the financial crisis and the uncertainties associated with the payback time due to the variations in the oil price. The lack of distribution network can partly be explained in urban surroundings, even though there are now many retailers of firewood, pellets and other biomass fuels in Athens, Thessaloniki and other urban centers.

% OF RESPONDENTS INTERESTED TO CHANGE TO BIOMASS HEATING

Out of the 59 correspondents who know what biomass is and do not use biomass for heating, 33.9% (20 responses) have expressed interest to change to a biomass system. The reasons why the change has not taken

place yet were asked and the following chart summarizes the responses received.



Space limitations and lack of a distribution network in the area each amounted to 26.9% of responses received. Lack of funds for the heating system change (or purchase of a new system) corresponded to 15.4% of the questions. Finally, 30.8% of the responses related to other reasons; the most important of these seems to be the lack of more precise information about costs and installation requirements. The requirement for a joint decision of co-owners of an apartment block was also given, while a few respondents claimed that they would make the transition as soon as possible.

The responses received indicate that even among the people interested in switching to biomass heating, there is still uncertainties regarding the actual costs and installation requirements which would have to be overcome by more extensive awareness raising and dissemination campaigns. Space limitations are again prevalent; it is an obstacle that cannot be overcome as easily.

KIND OF PROPERTY OF BIOMASS USERS

As mentioned, only 3 respondents use biomass. The following table summarizes their responses:

	Res. #1	**Res. #2**	**Res. #3**
Type of residence	Apartment	Apartment	Detached house
Type of ownership	Rented	Rented	Owner
Heated surface	101 – 150 m2	50 – 100 m2	50 – 100 m2
Type of heating system	Stove	Fireplace	Boiler
Average price	N/A	N/A	2,000 €
Installed capacity	1 – 12 kW	N/A	N/A
Type and quantity of biofuel used	Wood pellets, 1,000 – 2,000 kg	Firewood, 0 – 500 kg	Wood chips, 1,000 – 2,000 kg

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SATISFACTION WITH BIOMASS INSTALLATION

The following table summarizes the responses of the users of biomass regarding satisfaction.

Satisfaction	**#1**	**#2**	**#3**
General satisfaction	5	4	4
Satisfaction with installation (efficiency, emissions, etc.)	5	3	3
Satisfaction with biomass (quality, price)	5	4	4
Satisfaction with distribution network	5	4	4

CONSIDERATIONS DURING PURCHASE OF BIOMASS

The following table summarizes the responses of the users of biomass regarding satisfaction.

	Res. #1	**Res. #2**		**Res. #3**
Knowledge of certification	**Yes**	**No**	**Yes**	**No**
Price	4	4	4	4
Quality	4	5	5	4
Certification	5	N/A	4	2
Local product	5	1	2	2
Delivery services	3	4	4	3

KNOWLEDGE AND IMPACT OF CERTIFICATION

Respondent #1 replied positively regarding knowledge of certification and had already awarded the highest grade (5) in its considerations when purchasing biomass.

Respondent #2 replied negatively regarding knowledge of certification; after an explanation was offered, it awarded a high priority (4) in certification; the other considerations where not affected other than a slight increase regarding the purchase of local products.

Respondent #3 was not informed about biomass certification; after an explanation was offered, it did not consider the option to re-evaluate its main considerations when purchasing biomass after being information about certification.

MAIN CONCLUSIONS FROM THE SURVEY IN GREECE

The survey in Greece drew a limited number of responses and it is difficult to draw very general conclusions. However, the following points can be made, considering also our expert opinion about the state of the biomass sector in Greece:

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- It seems that the majority of Greeks claim knowledge of biomass; this can be expected considering the fact that – after the financial crisis and increased taxation on heating oil – biomass has received wide publicity as a low-cost heating solution.
- Only 4.1% of the respondents of the survey claimed to use biomass. The figure is much lower than the reported share of biomass in the thermal energy used by households in Greece. This may have to do with the origin of the respondents, which seem to come mostly from the large urban areas of Athens and Thessaloniki. Biomass usage is more widespread in smaller cities, closer to agricultural areas, and rural areas in general.
- Space limitations appear to be the main reason for the limited adoption of biomass heating, especially in urban environments. Indeed, apartment blocks were not designed with biomass heating in mind, lack the storage space required for the fuel and, in cases of multiple ownerships, the decision process for a fuel switch is more complicated. Unfortunately, this limiting factor is not easy to overcome.
- Lack of awareness of different aspects related to biomass heating are another limiting factor. Potential end-users might be unaware of distribution networks in the area (even though it is now easy to get biomass fuels in most places of mainland Greece) or unsure of installation requirements, total costs, etc. This can be solved by comprehensive awareness raising / dissemination campaigns.
- Finally, regarding fuel certification and the benefits thereof, it is not possible to draw any concrete conclusions. The general impression given by the survey is that there is still need to improve the awareness of the customers in this issue, especially considering that other, more visible aspects, such as distribution networks, are still not well known.

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Report of the final user survey for Italy

This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No. 691763

RESULTS DESCRIPTION FOR ITALY

Gathering information about end user habits and use of biomass in the residential sector has not been easy since there are not segmentation researches of end users. Probably, further studies should be carried on by covering longer periods of time.

But this pilot study shows some useful information to address the Biomasudplus project and potential future studies.

The questionnaire was mainly spread through AIEL's FB page and contact persons. In about 20 days we reached 72 valuable responses. The following figures are useful to profile the respondents of the questionnaire.

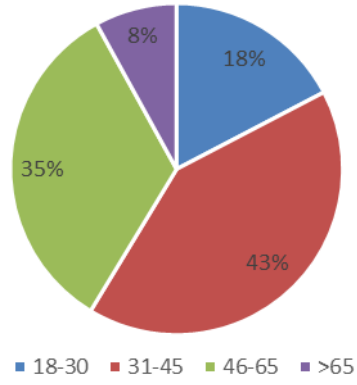
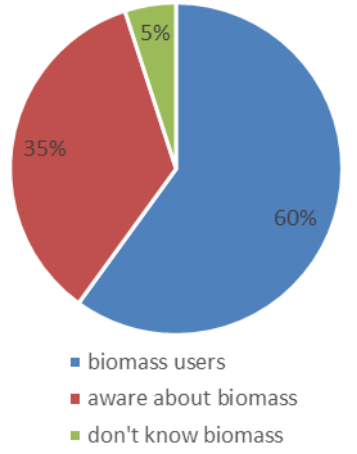
Figure 1: Age of respondents	
	The large majority of them are men (80%) and aged between 31 to 45 years. Communication's channels may have influenced the mean age of respondents.

Figure 2: Biomass consumers and potential users	
	Almost all responders knew about biomass (95%) and about 60% of them are residential biomass users. About 2/3 of respondents that are aware about biomass but still not using it, declared to be inclined to change to a biomass system. The main reason for not having done it yet is a lack of space in their house (55%). The other reasons are related to budget problems or limited time to dedicate to this choice.

The main reason for not changing to biomass is related to the house characteristics: limited space (65% of non-users), living in an apartment building or not being the owner. The second reason is the high investment cost of biomass devices (10%).

Only to respondents report difficult to find suppliers in the nearby of their house. The most satisfying statistics is that only one person refuses to use biomass because considering it pollutant.

The following graphs characterize the type of buildings and devices owned by the interviewed biomass users.

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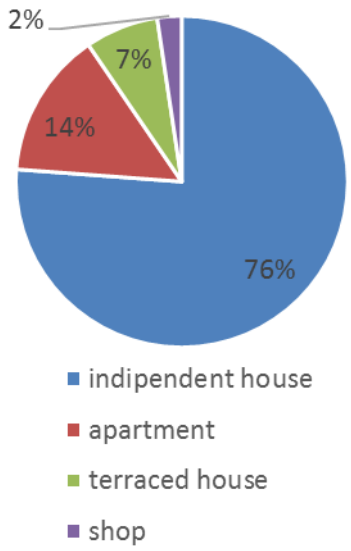
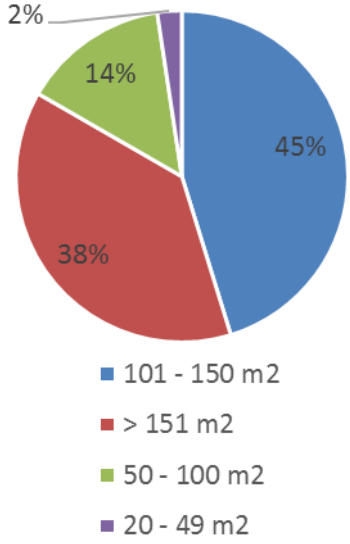
Figure 3: Type of building	Figure 4: Surface to heat
	
2/3 of the interviewed biomass users live in an indipendent house. Proportionally, almost 80% result to be the owner of the house, while the remaining 20% are lessees.	Since most of the users live in independent houses, the surface to heat tend to be higher than 100m2 (83%) even if in the 45% of the cases it is lower than 150m2.

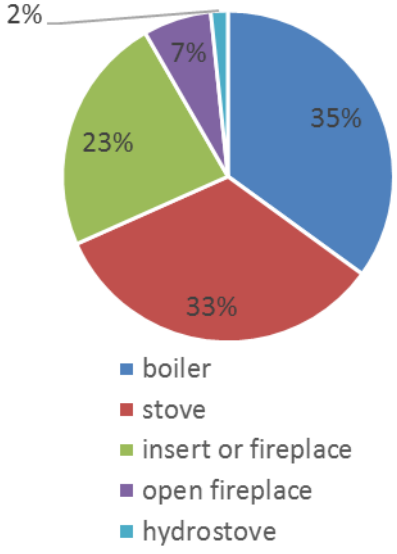
Figure 5: Type of heating system	
	The investigation says that the most common devices are stoves and boilers (70%), followed by inserts and fireplaces (30%). These rates actually look to be not very reliable knowing that 70% of the Italian market is represented by stoves. Anyway, an interesting evidence is that 45% of the users have more than one biomass sysem. The main combinations are boiler+stove and boiler+insert or fireplace. The mean price payed for a boiler is €5.000 (min €2.500, max €6.500). The mean price payed for a boiler is €2.700 (min €500, max €6.000). Answers on stoves look not to be valuable, since the average price result €2.400 (min €800, max €4.500).

Figure 6: boilers power ranges	Figure 7: stoves power ranges	Figure 8: inserts and fireplaces power ranges	Figure 9: open fireplaces power ranges

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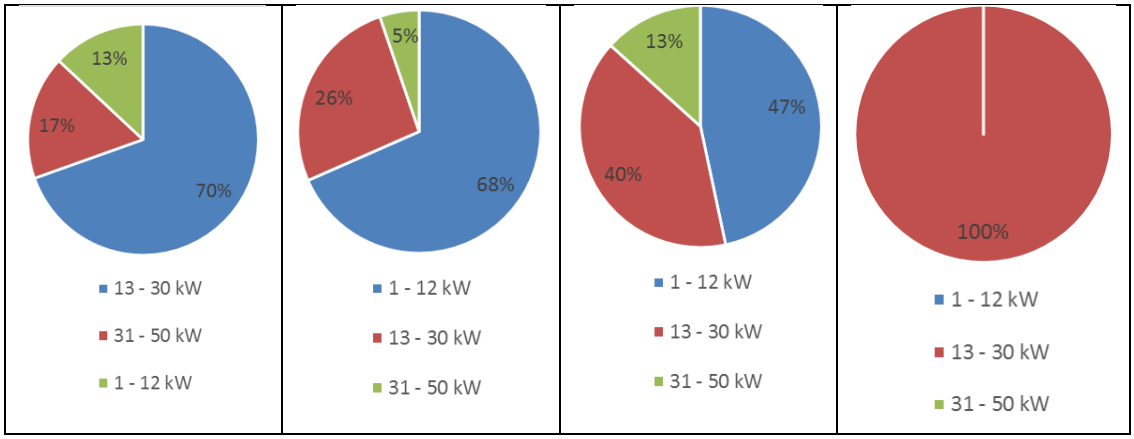
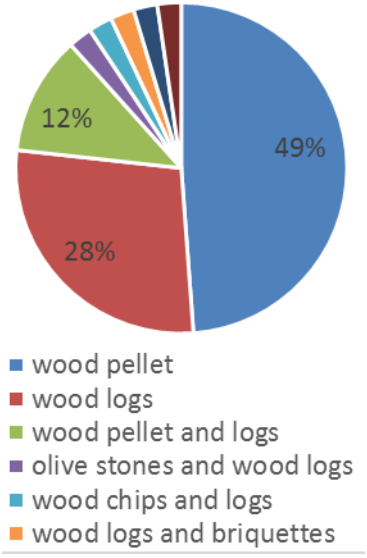


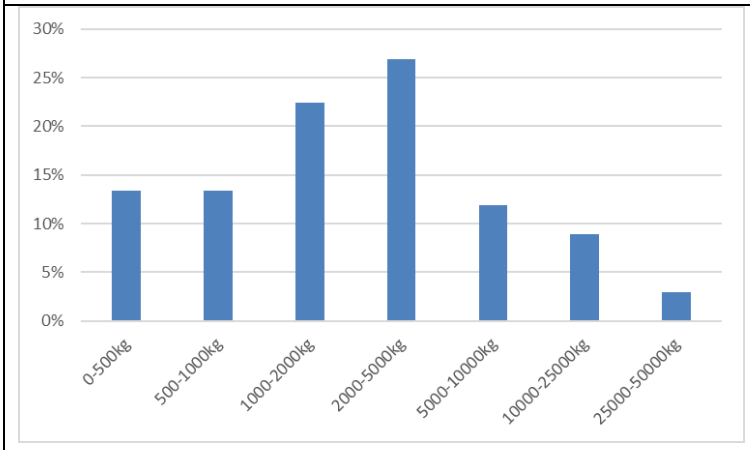
Besides heating systems, the survey aims to gather more information on biofuels consume's habits.

Figure 10: biofuels types



The results confirm that the most common biofuels in Italy are wood pellet and wood logs. Nevertheless, national statistics are more in favour of wood logs rather than wood pellets. Other biofuels are confirmed to be still a side market. Probably, further investigations are needed to go deeper in Mediterranean biofuels use.

Figure 11: quantity of biofuels used



Half of respondents report to use within 1 to 5 tons of biomass per year to heat their house. The other 50% is split within lower than 1 ton and 5 to 50 tons per year.

General speaking, the feeling of consumers as users of biomass is good and rated 4,5 over 5. What makes them satisfied users is mainly quality and what should be improved is price and the suppliers' network.

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Figure 12: grade of satisfaction

To conclude, the attitude of end consumers on quality is confirmed by the last question: “Do you know what a certified biofuel is?”. 92% answered “yes”. This is probably the most positive result of the research.

MAIN CONCLUSIONS FROM THE SURVEY IN ITALY

The survey got a good picture of end users profiles, the way they use biomass and their grade of satisfaction.

One of the most relevant results - on an association point of view - is that where market is not covered it is mainly due to the residential building characteristics, not for biomass biofuels or devices related reasons itself. Even more important is the fact that aversion to biomass (i.e. due to pollution) still looks a marginal problem in the market.

The investigation gave also useful information about which types of heating appliances are more common in each kind of house. Detailed information was also gathered to better understand biomass products mix and their installed power. This is precious information for heating systems manufacturers.

In our case, the investigation among biofuels use was not as successful as the previous part of the survey. This is due to the market composition, which is strongly in favour on common fuels like pellets and wood logs and, consequently, would require greater number of responders to detect statistics on Mediterranean biofuels. We also should say that even ISTAT (National Statistics Institute) was not able to investigate on these fuels due to inconsistent numbers. Probably, a dedicated research is needed.

In conclusion, what is significant to us is the feedback on customer experience on biofuels use. Results sound great, and they underline the role of quality and certifications to grant future market share in the heating market.

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Report of the final user survey for Portugal

This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No. 691763

The main results from the national final user questionnaire "Biomasud Plus Questionnaire for Task 2.1" is presented in the following figures.

NUMBER OF RESPONDENTS and RESPONDENTS GENDER (%)

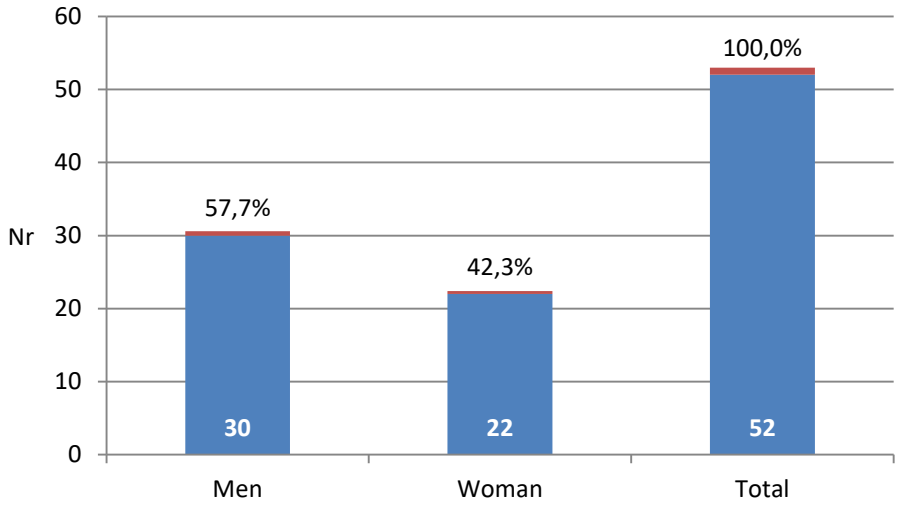

Figure 1 – Number of responders by gender

The Portuguese sample that will be analysed consists of 52 responses, 57.7% of men and 42.3% of women (Figure 1).

RESPONDENTS AGE (%)

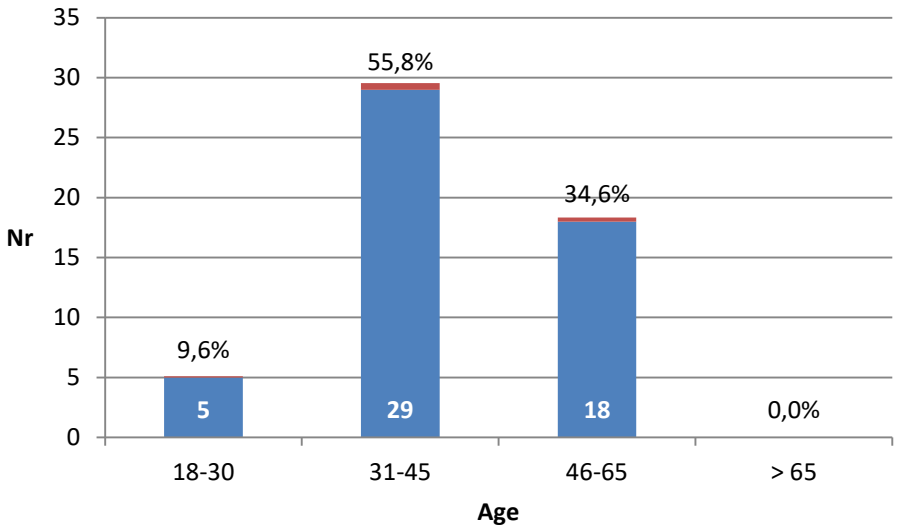

Figure 2 – Number of responders by age group

% OF RESPONDENTS WHO KNOW ABOUT BIOMASS

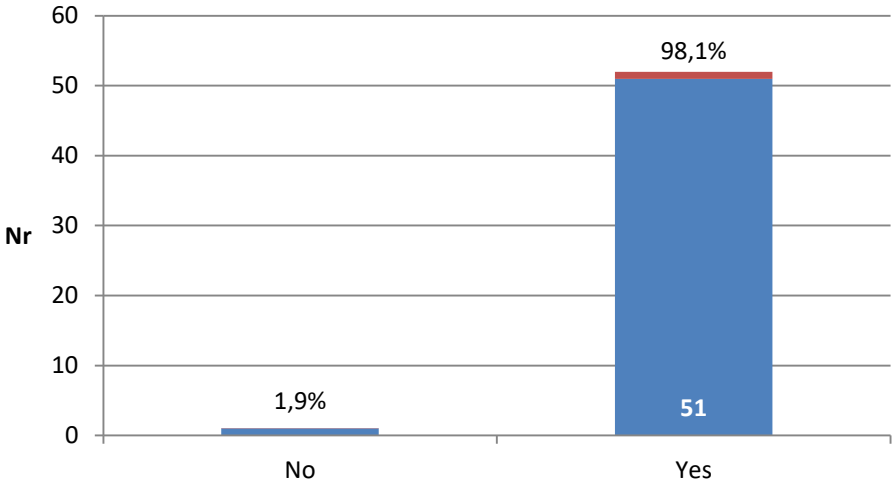

Figure 3 – *% of respondents who know about biomass*

In the sample of 52 responses, only one respondent does not know about biomass, which corresponds to 1.9% of the sample (Figure 2).

% OF RESPONDENTS WHO USE BIOMASS FOR HEATING IN THEIR RESIDENCE

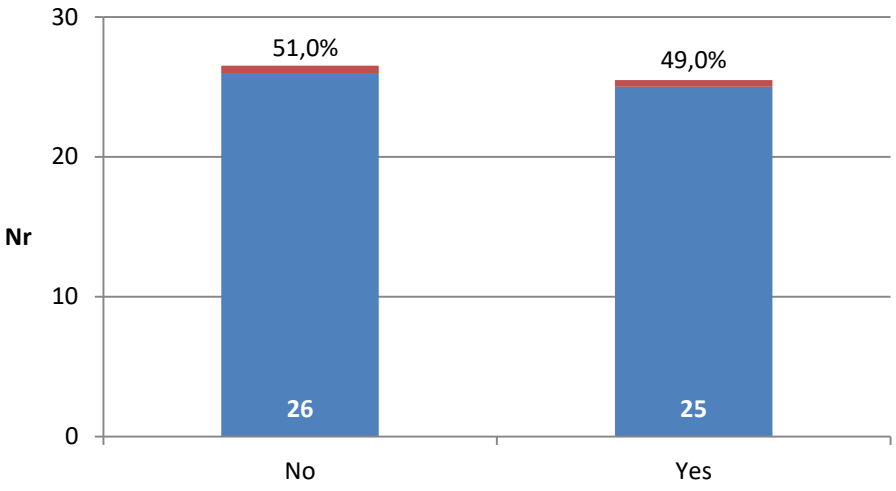

Figure 4 – *% of respondents who use biomass for heating in their residence*

Considering only the 51 interviewed who knows what biomass is, 25 use biomass for heating in their home, representing 49% of them (Figure 4).

% OF RESPONDENTS WILLING TO CHANGE TO A BIOMASS SYSTEM

26 respondents do not use biomass, but 10 (38% of them), willing to switch to a biomass system. The

following figure represents the main reasons why respondents have not yet changed.

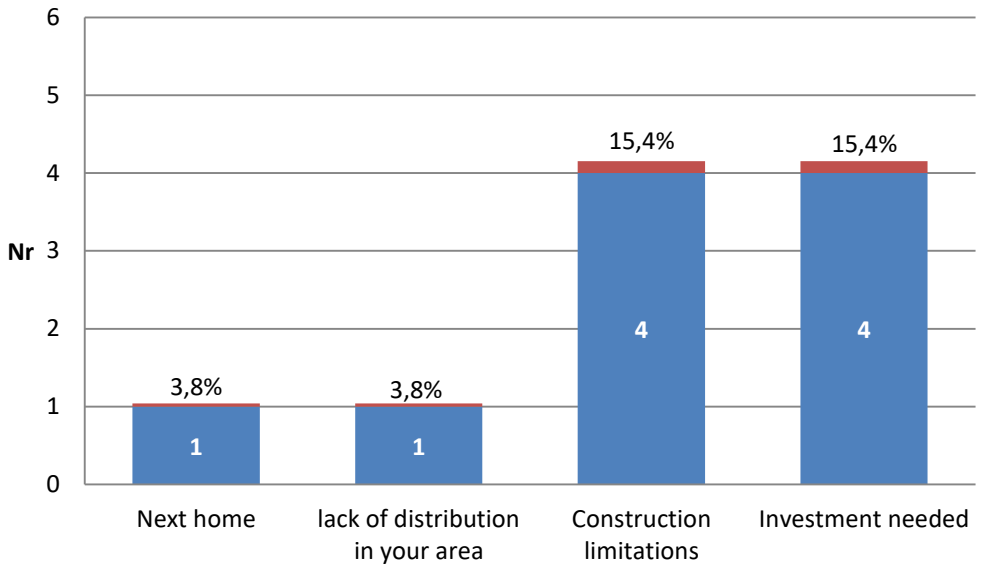

Figure 5 – *Number of respondents willing to switch to a biomass system and why they have not yet done*

The main reasons why the respondents interested to change to biomass systems haven't done it so far are the investment needed and constructions limitations (Figure 5).

62% of the respondents don't use biomass heating systems and don't want to change. The following figure represents the distribution of the main reasons why the respondents do not want to change.

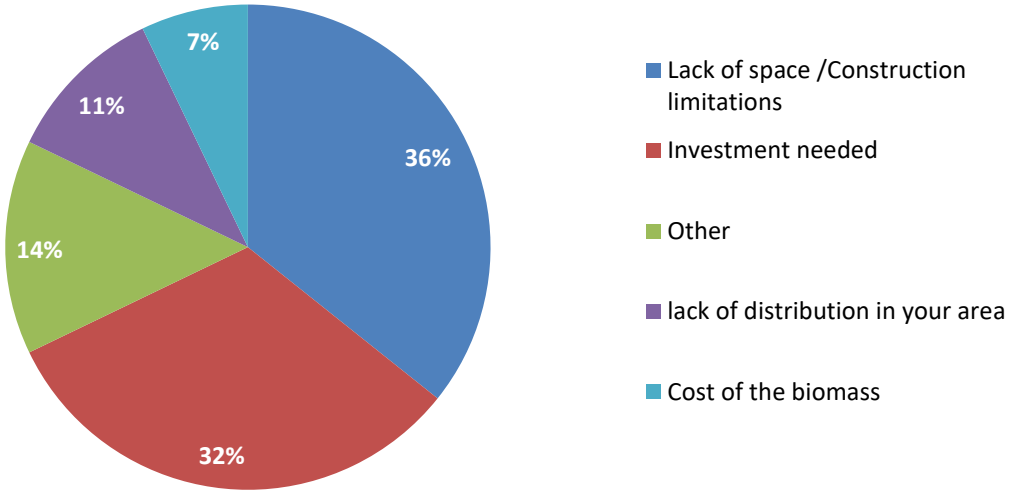

Figure 6 –*Distribution by reason why the respondents don't want to change to a biomass heating system*

Also here, the main reason for don't want to change is lack of space, followed by investment needed.

KIND OF PROPERTY OF BIOMASS USERS

The huge majority of the biomass users live in a single family house and own it (Figures 7 and 8).

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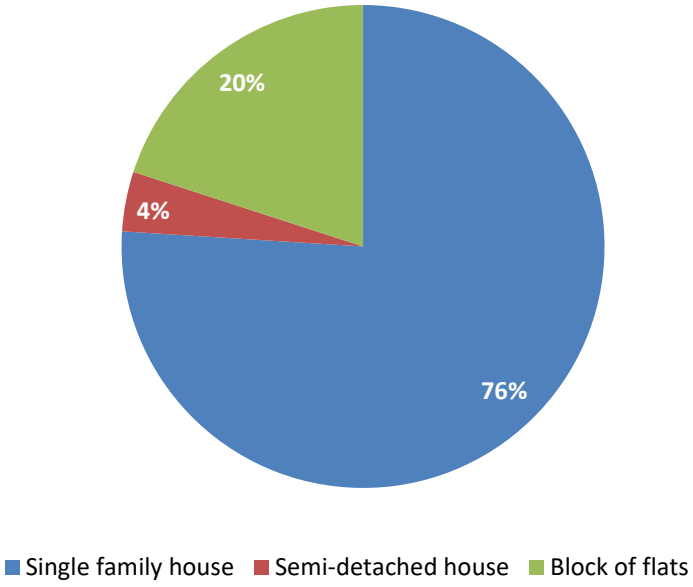

Figure 7 –Type of building

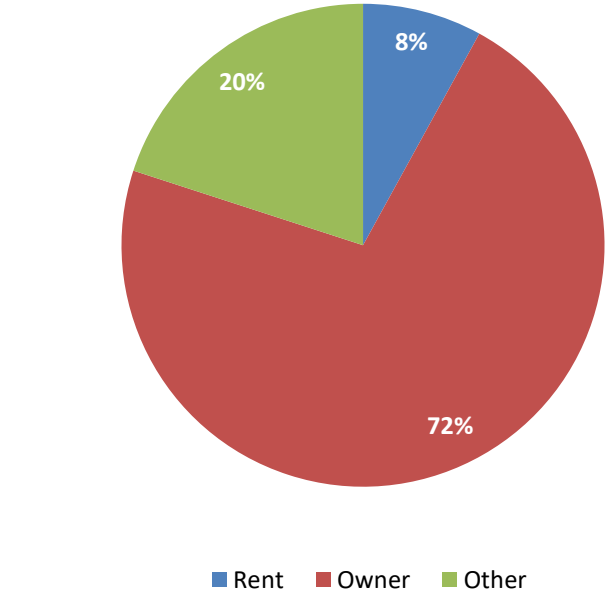

Figure 8 –*Type of owners*

The interviewees had difficulty answering when we asked what is the surface to heat (Figure 9), and even more when we asked the price of the device and its power, so we considered that the answers obtained were not significant for this analyse.

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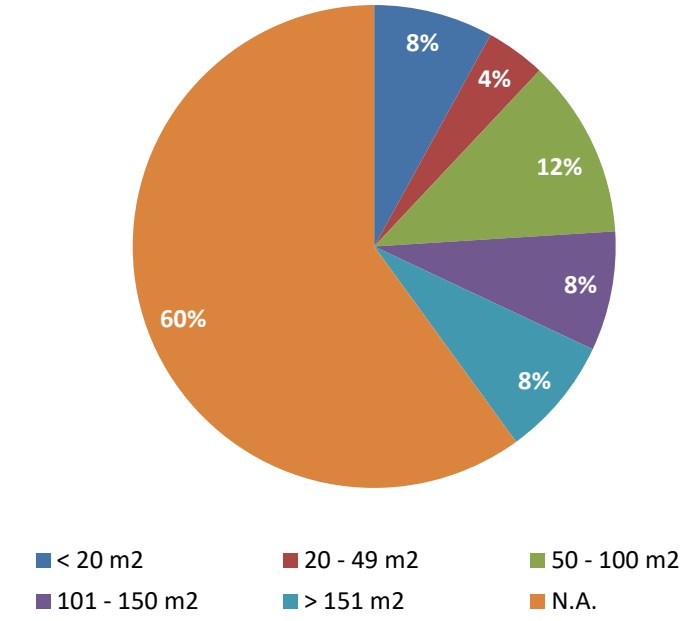

Figure 9 –*Surface to heat*

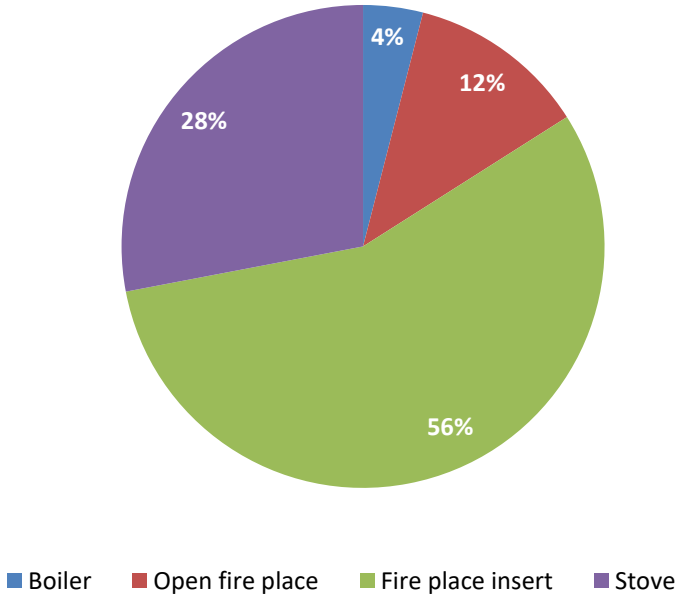

Figure 10 –*Type of heating system*

The type of biomass heating system most used is fire place inserted (56%), followed by stove (28%), open fire place (12%) and boiler (4%) (Figure 10).

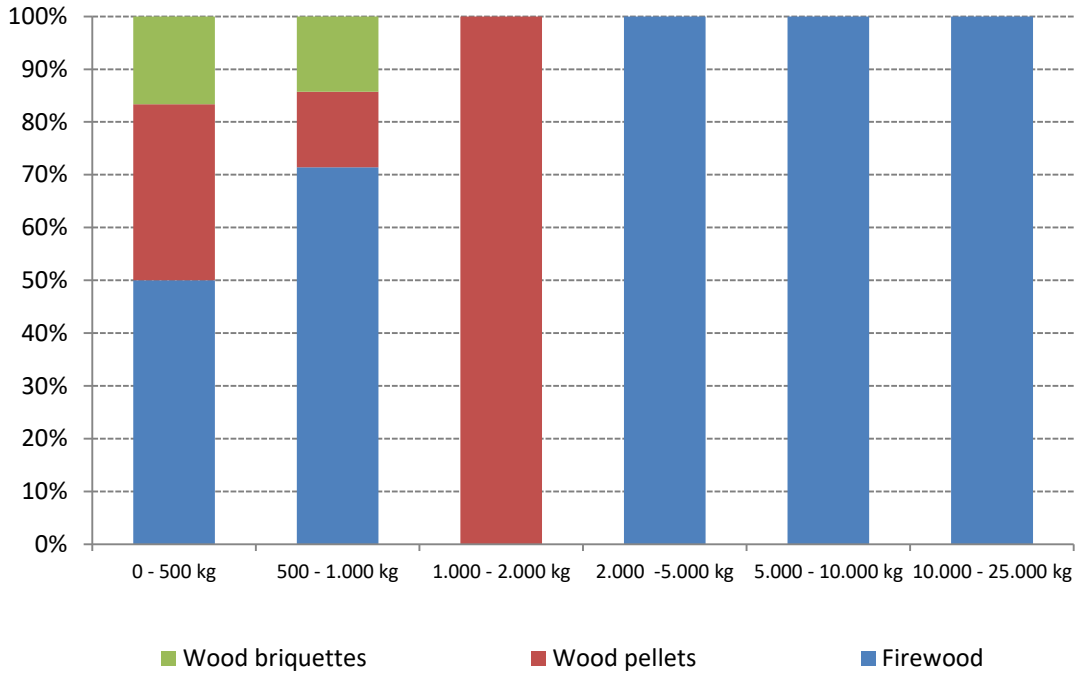

Figure 11 – *% type and quantity of biofuel*

The type of biomass used is mostly firewood, followed by wood pellets and wood briquetts. Only in the class 1000-2000 kg/year pellets appeared as the type of biomass 100% used in this class. (This last conclusion suggests that the sample is not representative) (Figure 11).

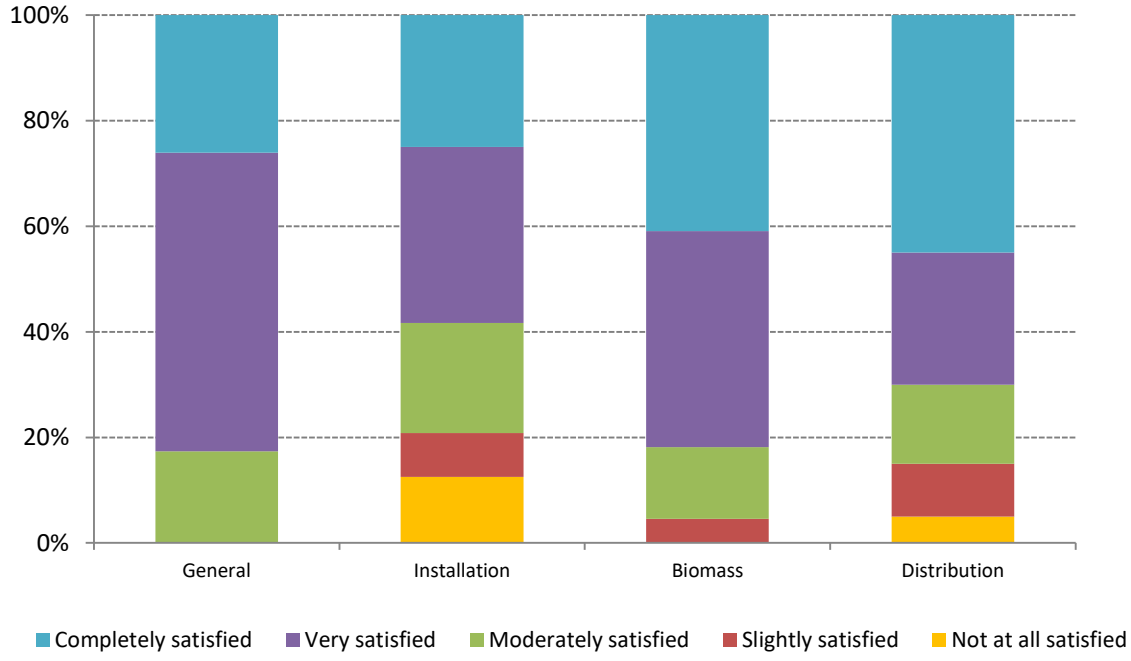

Figure 12 – *Consumer feeling when using biomass*

Concerning the consumer feeling when using biomass (Figure 12), in general most of them are very

satisfied or completely satisfied and only less than 20%of them are moderately satisfied.

In relation with the grade of satisfaction with the installation (efficiency, emissions, frequency of cleaning, etc.), also most of them are very satisfied or completely satisfied, however, about 15% are not at all satisfied.

The consumers average grade of satisfaction with the biomass (quality, price, etc..) is also majority of very or completely satisfaction, as well as the average grade of satisfaction with the distribution network.

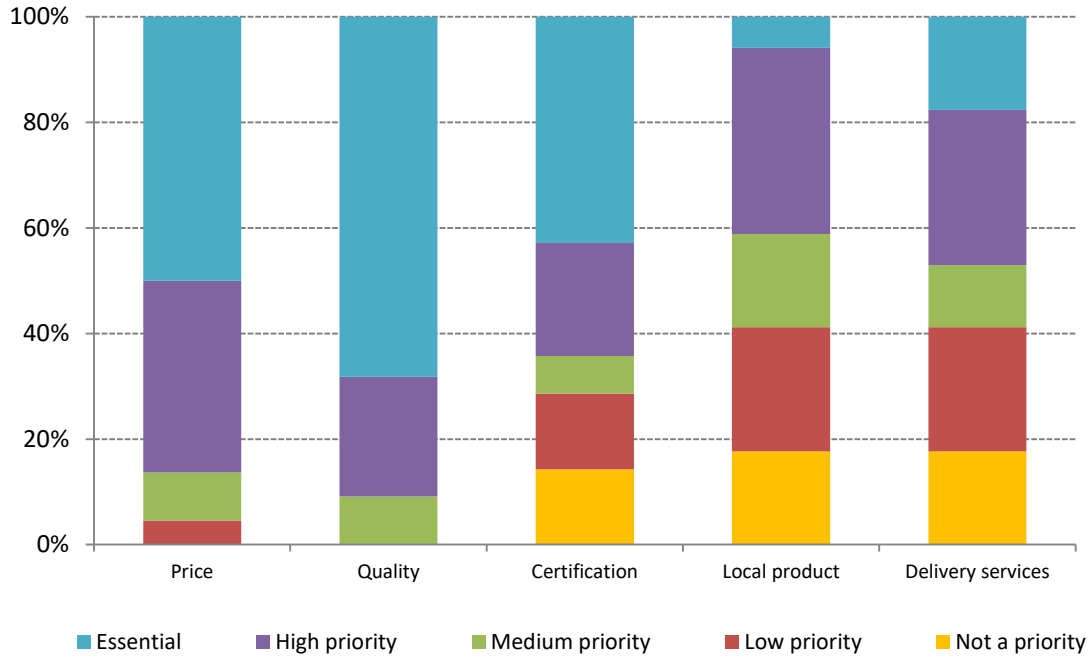

Figure 13 – *Rate of considerations when buying biomass*

Concerning the consumers priorities when buying biomass (Figure 13), it's possible to conclude that quality and price are essential or have a high priority for the majority of the consumers, as well as biomass certification. Biomass as a local product and the delivery services are also an essential or a high priority for a large amount of consumers.

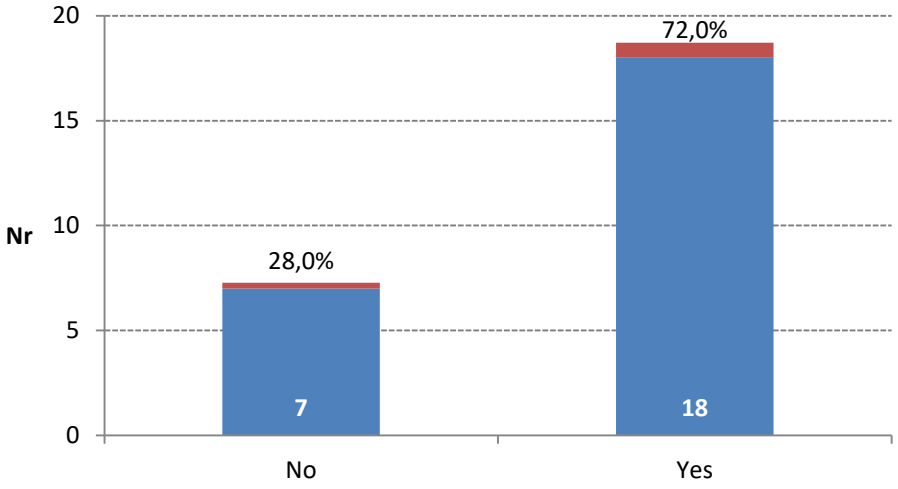

Figure 14 – *% of biomass users who* know what a certified biofuel is

Figure 14 shows that the majority of biomass consumers (72%) know what a certified biofuel is.

The answers obtained when asked if "Once you understand what is a certified fuel, would you change your answer about your considerations when you are buying biomass?" were only 3 and have no statistical significance.

MAIN CONCLUSIONS FROM THE SURVEY IN PORTUGAL

First of all, it's important to underline that this analysis was elaborated from a questionnaire where only 52 answers were obtained (sample size) and it was verified that the majority of respondents live in the same region of Portugal, so it is not representative of the whole country.
Nevertheless, the main conclusions obtained from this survey are:

- Only 1.9% of respondents do not know about biomass.
- 49% of who knows what biomass is use biomass for heating in their home.
- The main reasons why the respondents interested to change to biomass systems haven't done it so far are the investment needed and constructions limitation.
- The main reason for don't want to change is lack of space, followed by investment needed
- The huge majority of the biomass users live in a single family house and own it.
- The type of biomass heating system most used is fire place inserted (56%), followed by stove (28%), open fire place (12%) and boiler (4%).

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- The type of biomass used is mostly firewood, followed by wood pellets and wood briquettes.
- In general most of the biomass consumers are very satisfied or completely satisfied and only less than 20% of them are moderately satisfied. In relation with the grade of satisfaction with the installation (efficiency, emissions, frequency of cleaning, etc.), also most of them are very satisfied or completely satisfied, however, about 15% are not at all satisfied. The consumers average grade of satisfaction with the biomass (quality, price, etc..) is also majority of very or completely satisfaction, as well as the average grade of satisfaction with the distribution network.
- Concerning the consumers priorities when buying biomass it's possible to conclude that quality and price are essential or have a high priority for the majority of the consumers, as well as biomass certification. Biomass as a local product and the delivery services are also an essential or a high priority for a large amount of consumers.
- 72% of biomass consumers know what a certified biofuel is.

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Report of the final user survey for Slovenia

This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No. 691763

RESULTS DESCRIPTION FOR SLOVENIA

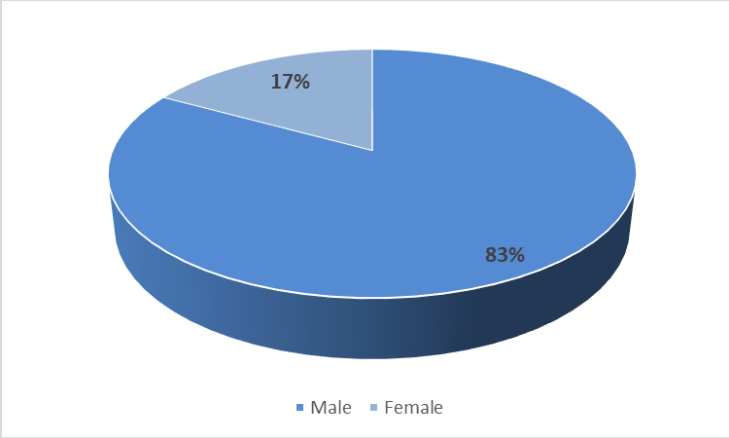
- *NUMBER OF RESPONDENTS:*

The total number of respondents is 138.

- *RESPONDENTS GENDER (%)*

Male: 83 %

Female: 17 %



- *RESPONDENTS AGE (%)*

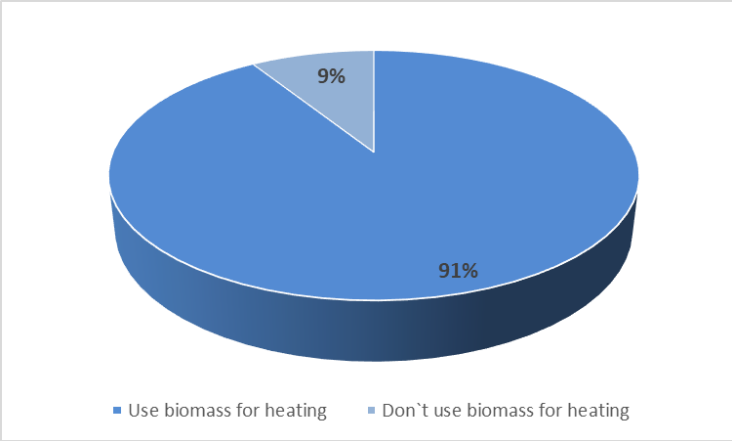
Age class	%
18 – 30	4
31 – 45	28
46 – 65	52
> 65	16

- *% OF RESPONDENTS WHO KNOW ABOUT BIOMASS*

99 % of respondents know what is biomass.

- *% OF RESPONDENTS WHO USE BIOMASS FOR HEATING IN THEIR RESIDENCE*

91 % of respondents use biomass for heating in their residence.



- % OF RESPONDENTS willing to change to a biomass system

55 % of those respondents who don`t use biomass for heating their residence, would be willing to replace the existing heating system with the biomass system.

- *MAIN REASON FOR YES*

- Lack of space / restrictions for construction

- *MAIN REASONS FOR NO*

- The investment is needed
- Lack of space / restrictions for construction

- *KIND OF PROPERTY OF BIOMASS USERS*

- *TYPE OF BUILDING*

	%
Single family house	27
Semi-detached house	2
Block of flats	2
Other	5
No answer	64

- *TYPE OF OWNERS*

	%
I am the owner	29
I rent a building/flat	2
Other	2
No answer	67

- *SURFACE TO HEAT*

m^2	%
20 – 49	1
50 – 100	6
101 – 150	14
> 151	15
No answer	64

- *TYPE OF HEATING SYSTEM*

	% (multiple answers are possible)
Boiler for central heating	30
Oven (stove / furnace room)	7
Indoor fireplace	10
Open fireplace	1
Other	2
No answer	63

- *AVERAGE PRICE BY DEVICE*

	€ (VAT is included)	Comment
Boiler for central heating	8.500	76 % answers about price
Oven (stove / furnace room)	2.600	56 % answers about price
Indoor fireplace	2.700	69 % answers about price
Open fireplace	1.000	100 % answers about price
Other	1.800	50 % answers about price

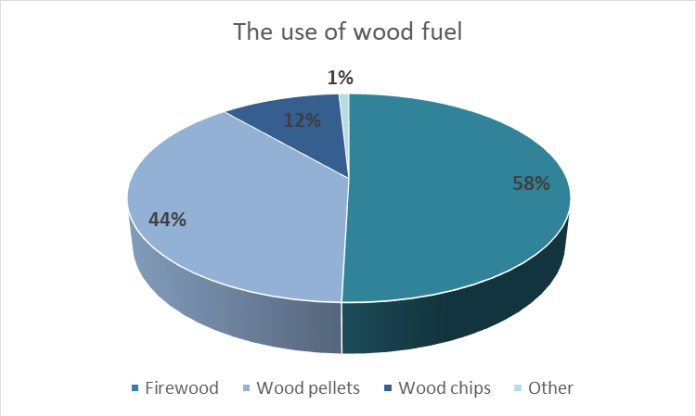
- *% DEVICE POWER BY CATEiGORY AND DEVICE*

	%			
	1 – 12 kW	13 – 30 kW	31 – 50 kW	> 50 kW
Boiler for central heating		55	34	11

Oven (stove / furnace room)	70	30		
Indoor fireplace	77			
Open fireplace	100			
Other				50

- *% TYPE AND QUANTITY OF BIOFUEL*

58 % of respondents who use biomass for heating their residence are using firewood. The next most commonly used biofuel are wood pellets (44 % of respondents), followed by wood chips with 12 %.



13 % of respondents use two types of biofuel for heating their residence - the most commonly is used combination of firewood and wood pellets.

Legend:

(1) 0 – 500 kg
(2) 500 – 1.000 kg
(3) 1.000 – 2.000 kg
(4) 2.000 – 5.000 kg
(5) 5.000 – 10.000 kg
(6) 10.000 – 25.000 kg
(7) 25.000 – 50.000 kg
(8) > 50.000 kg

	%							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Firewood	1	8	6	21	52	12	/	/
Wood chips	7	/	7	/	26	20	20	20
Wood pellets	5	2	13	62	18	/	/	/
Olive stones	/	/	/	/	/	/	/	/
Wood briquettes	/	/	/	/	/	/	/	/
Other	/	/	/	/	/	/	/	100

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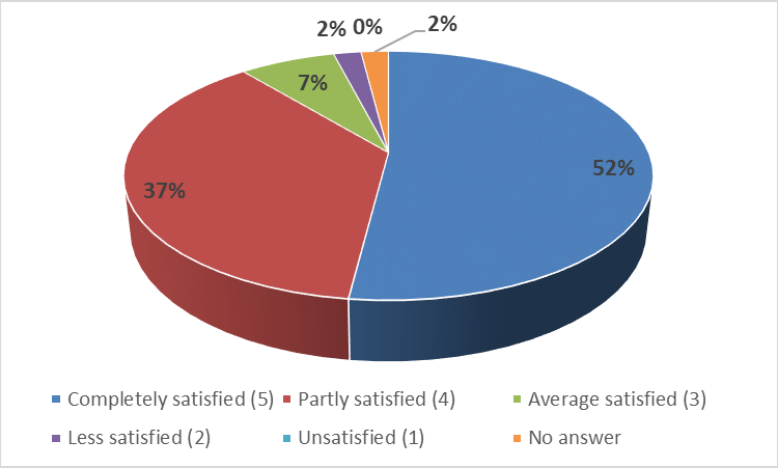
	%					
	Firewood	Wood chips	Wood pellets	Olive stones	Wood briquettes	Other
0 – 500 kg	20	20	60	/	/	/
500 – 1000 kg	83	/	17	/	/	/
1000 – 2000 kg	38	8	54	/	/	/
2000 – 5000 kg	29	/	71	/	/	/
5000 – 10.000 kg	73	8	19	/	/	/
10.000 – 25.000 kg	75	25	/	/	/	/
25.000 – 50.000 kg	/	100	/	/	/	/
> 50.000 kg	/	75	/	/	/	25

- *What is your feeling as consumer using biomass?*
  - *AVERAGE OF GRADE OF GENERAL SATISFACTION*

	%
Completely satisfied (5)	52
Partly satisfied (4)	37
Average satisfied (3)	7
Less satisfied (2)	2
Unsatisfied (1)	0
No answer	2



- *AVERAGE OF GRADE OF SATISFACTION WITH YOUR INSTALLATION (EFFICIENCY,EMISSIONS, FREQUENCY OF CLEANING, ETC)*

	%
Completely satisfied (5)	17
Partly satisfied (4)	12
Average satisfied (3)	3
Less satisfied (2)	3
Unsatisfied (1)	0
No answer	65

- *AVERAGE GRADE OF SATISFACTION WITHTHE BIOMASS (QUALITY, PRICE, …)*

	%
Completely satisfied (5)	21
Partly satisfied (4)	10
Average satisfied (3)	4
Less satisfied (2)	0
Unsatisfied (1)	0
No answer	65

- *AVERAGE OF GRADE OF SATISFACTION WITH THE DISTRIBUTION NETWORK*

	%
Completely satisfied (5)	29
Partly satisfied (4)	4
Average satisfied (3)	2
Less satisfied (2)	0
Unsatisfied (1)	1

No answer	64

- *Your considerations when you are buying biomass.*

  - *AVERAGE PRICE*

	%
Most important (5)	35
Quite important (4)	6
Important (3)	10
Irrelevant (2)	1
Completely irrelevant (1)	2
No answer	46

  - *AVERAGE QUALITY*

	%
Most important (5)	44
Quite important (4)	14
Important (3)	2
Irrelevant (2)	0
Completely irrelevant (1)	0
No answer	40

  - *AVERAGE CERTIFICATION*

	%
Most important (5)	20
Quite important (4)	7
Important (3)	6
Irrelevant (2)	1
Completely irrelevant (1)	10
No answer	56

  - *AVERAGE LOCAL PRODUCT*

	%
Most important (5)	22

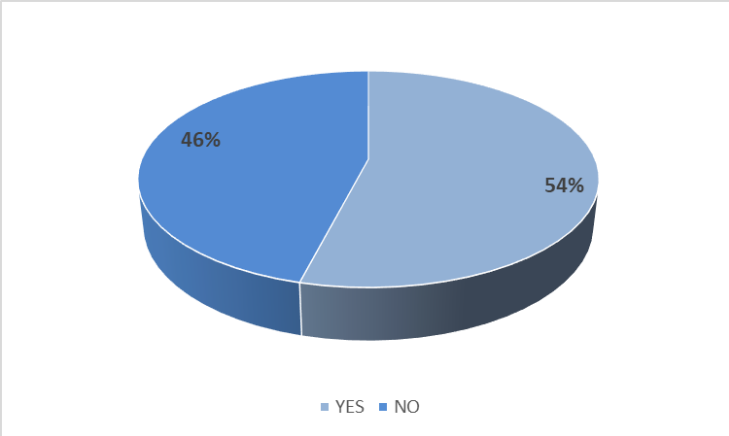
Quite important (4)	6
Important (3)	6
Irrelevant (2)	1
Completely irrelevant (1)	0
No answer	65

- *AVERAGE DELIVERY SERVICES*

	%
Most important (5)	23
Quite important (4)	13
Important (3)	10
Irrelevant (2)	2
Completely irrelevant (1)	0
No answer	52

- Do you know what a certified biofuel is?

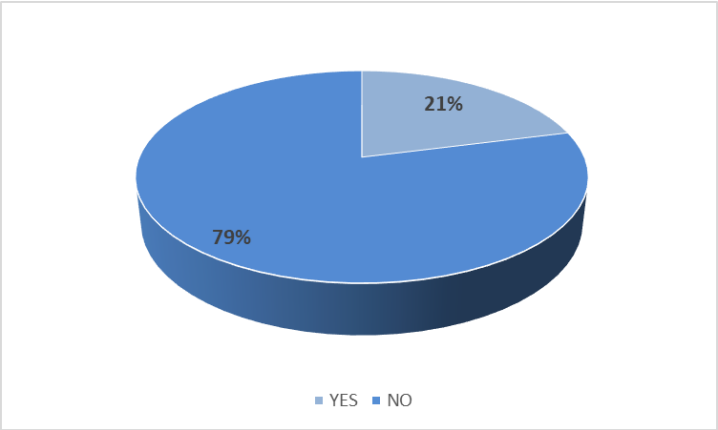
	%
YES	54
NO	46



- Once you understand what is a certified fuel, would you change your answer about your considerations when you are buying biomass?

	%
YES	21

NO	79



- *Considerations when you are buying biomass Now you know what implies a certified biofuel.*

We received very few answers to this question. The only result is that 33 % from those who would change their answer about their considerations when they are buying biomass, would give 5 points to certified biofuels instead of quality biofuels.

MAIN CONCLUSIONS FROM THE SURVEY IN SLOVENIA

The total number of respondents is 138, 83 % of which are male and 17 % female. According to the age structure of the respondents, the age class which prevail is 46 – 65 years (52 %). With 28 % followed by the age class 31 – 45 years, 16 % of respondents are older than 65 years and the lowest share of respondents (4 %) is 18 – 30 years old.

99 % of respondents know what biomass is and 91 % of respondents use biomass for heating in their residence. More than a half of the respondents (55 %) who don`t use biomass for heating their residence, would be willing to replace the existing heating system with the biomass system.

The following set of questions was intended only for users of wood fuels; to questions like type of building, type of owners, surface to heat, type of heating system we received less than 40 % of the answers, and therefore it's difficult to make any conclusions. 30 % of respondents have a heating system boiler for central heating of which average price is 8.500 € (VAT is included). 55 % of those respondents who use boiler for central heating, have device power in class 13 – 30 kW, 34 % of respondents have device power in class 31 – 50 kW and 11 % of respondents have device power more than 50 kW.

58 % of respondents who use biomass for heating their residence are using firewood. The next most commonly used biofuel are wood pellets (44 % of respondents), followed by wood chips with 12 %. One part of the respondents (13 %) use two types of biofuel for heating their residence - the most

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commonly is used combination of firewood and wood pellets.

52 % of respondents who use firewood for heating their residence, placed an average annual consumption of this biofuel to class 5.000 – 10.000 kg. 62 % of respondents who use wood pellets for heating their residence, placed an average annual consumption of this biofuel to class 2.000 – 5.000 kg. Respondents who use wood chips for heating their residence, placed an average annual consumption in the higher classes (from 5 (5.000 – 10.000 kg) to 8 (> 50.000 kg)).

To the question: "What is the overall assessment of the satisfaction with heating on wood fuels?", 52 % of the respondents are completely satisfied, 37 % are partly satisfied, 7 % are on average satisfied, 2 % are less satisfied and 2 % of respondents didn`t answer to the question. To the following questions: "What is the assessment of the satisfaction with installation?", "What is the assessment of the satisfaction with the wood fuels (quality, price)?", "What is the assessment of the satisfaction with the distribution network", we received less than 40 % of the answers, and therefore it's difficult to make any conclusions.

Furthermore, we asked Slovenian users of wood fuels what are their considerations when they are buying biomass and we got the following results: the quality of wood fuels and their price are the most important factors, following by delivery services, local product and last a certified product. Many respondents didn`t answer to all these questions, the main reason for that is that a large part of users of firewood make that fuel at home by themselves – and they don`t buy it on the market.

54 % of respondents who are users of wood fuels know what a certified biofuel is. An interesting result is, that most of those who don`t know what certified biofuel is (79 %), would not change their opinion about their considerations when they are buying biomass. However, 33 % from those who would change their answer about their considerations when they are buying biomass, would give 5 points to certified biofuels instead of quality biofuels.

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Report of the final user survey for Spain

This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No. 691763

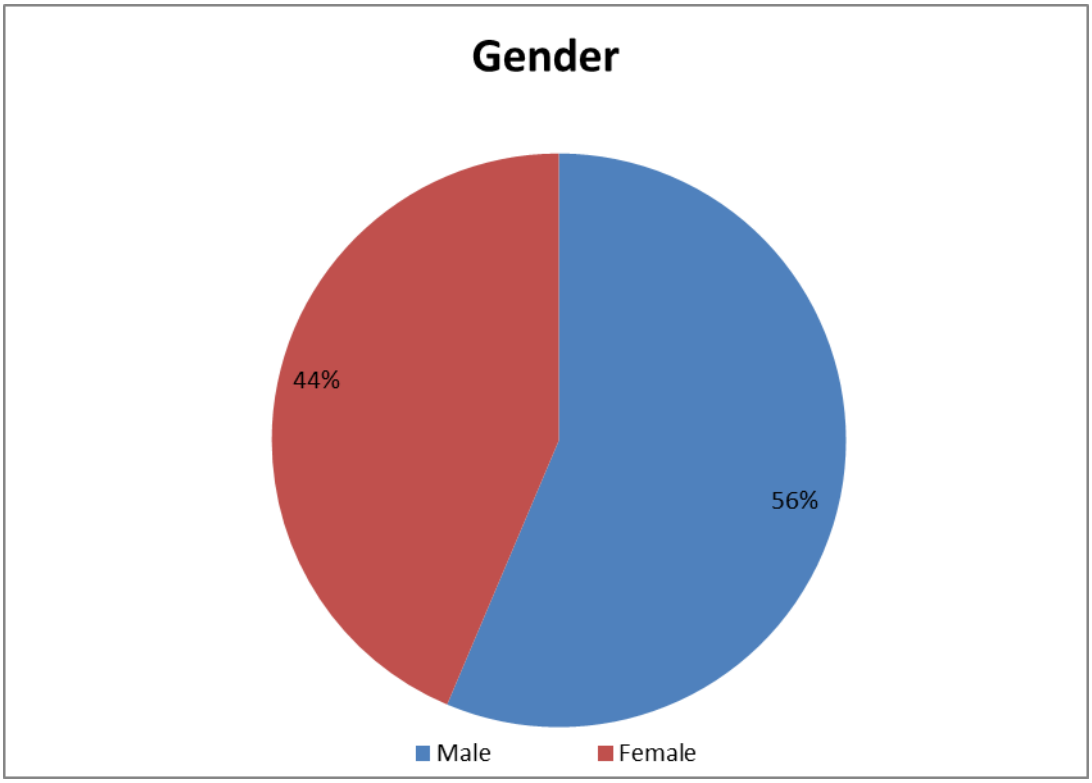
RESULTS DESCRIPTION FOR SPAIN

NUMBER OF RESPONDENTS

The Spanish final user survey was answered by 165 respondents.

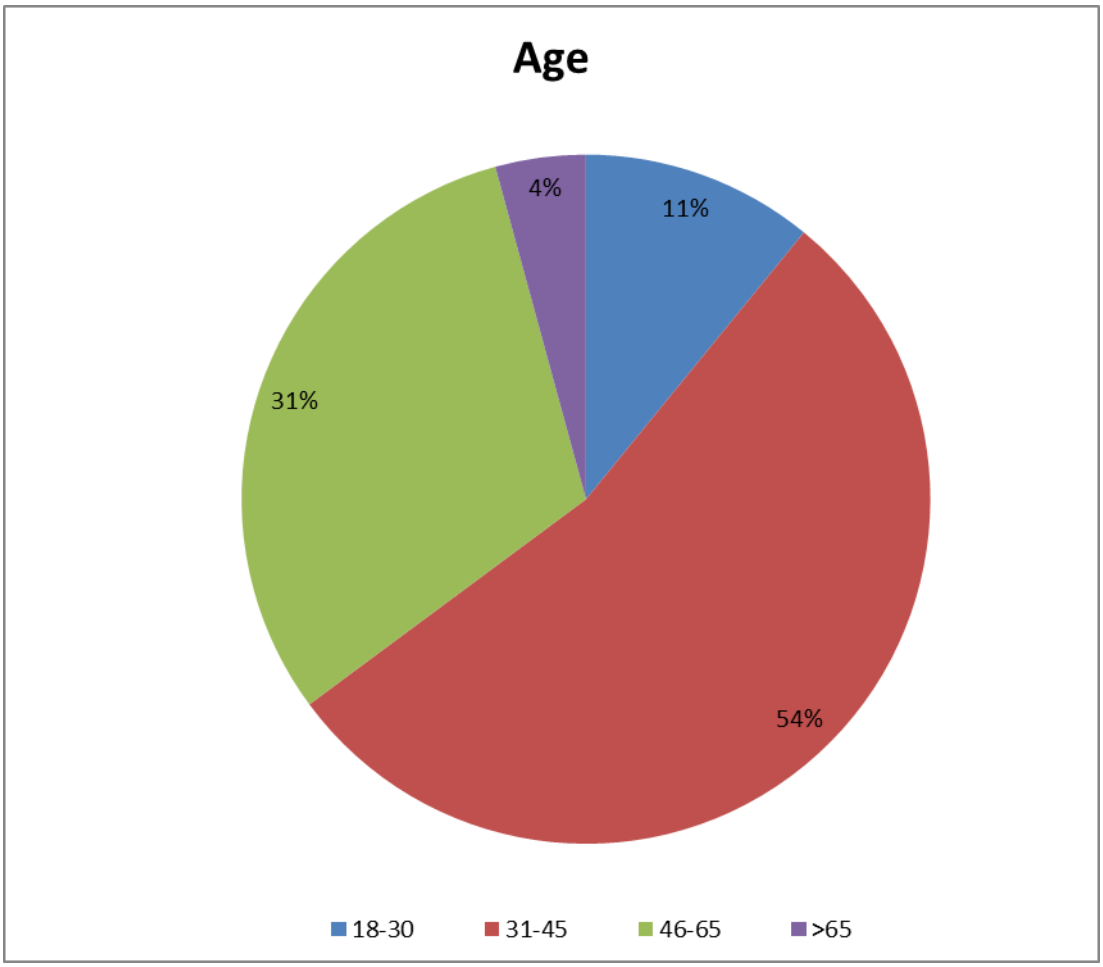
RESPONDENTS GENDER (%)

93 respondents were identified as Male(56%) and the rest, 72 were Female (44%)



RESPONDENTS AGE (%)

18 of the respondents were between the ages of 18 and 30, 89 being between 31 and 45, 51 between 45 and 65 and only 7 were older than 65. The corresponding percentages were 11%, 54%, 31% and 4%.



% OF RESPONDENTS WHO KNOW ABOUT BIOMASS

89% of the respondents answered that they know what biomass is (147 positives answers out of 165). The remaining 11% responded negatively.

% OF RESPONDENTS WHO USE BIOMASS FOR HEATING IN THEIR RESIDENCE

A 21% of the respondents answered that they are using already biomass (35 out of 165). 112 respondents out of 165 corresponding to a 68% answered that they aren't using biomass nowadays. The remaining respondents left the cell empty (18 which corresponds to 11%).

% OF RESPONDENTS willing to change to a biomass system

From the respondents that know what biomass is and don't use biomass for heating, 50% were willing to change to a biomass system (65). The same percentage, 50% was unwilling to change to a biomass system for the heating (64).

MAIN REASON FOR YES

Among the reasons given to haven't shift to biomass yet but they would be interested to change, 17% claim that they will change as soon as possible, 42% was the space limitation, 16% lack of enough budget, 9% No distribution network and 16% other reasons.

It was an important factor for some of the respondents that they were not the owners so they can't choose.

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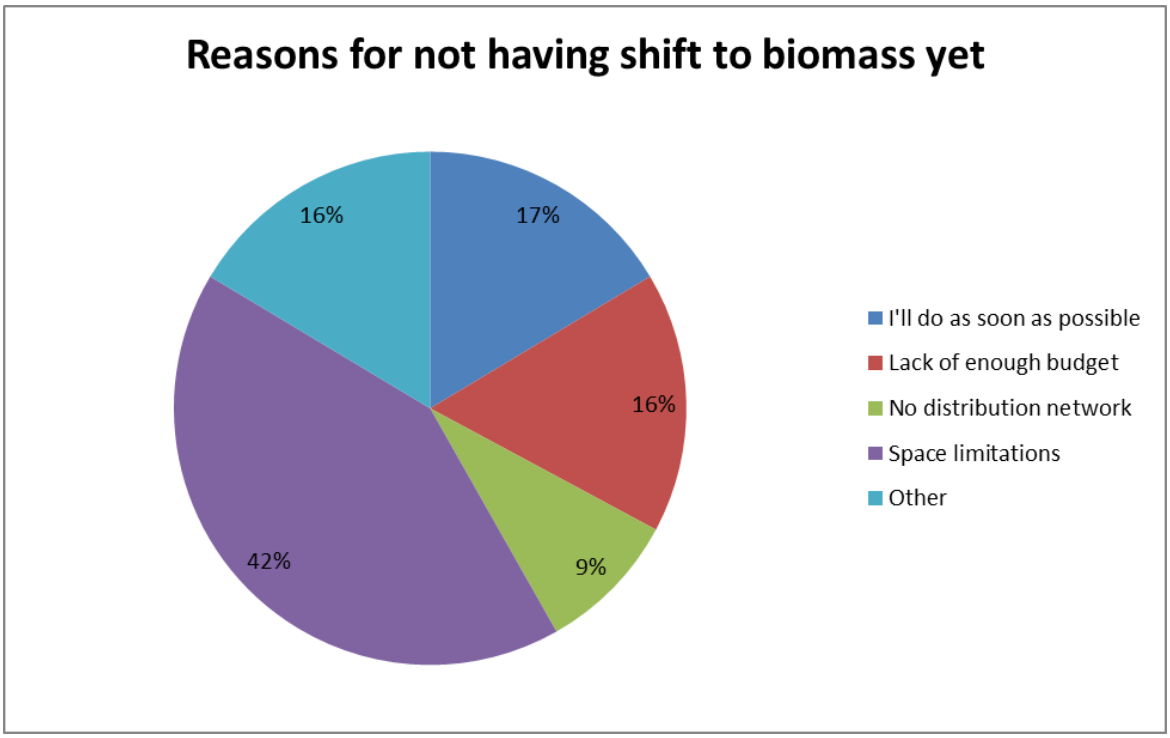
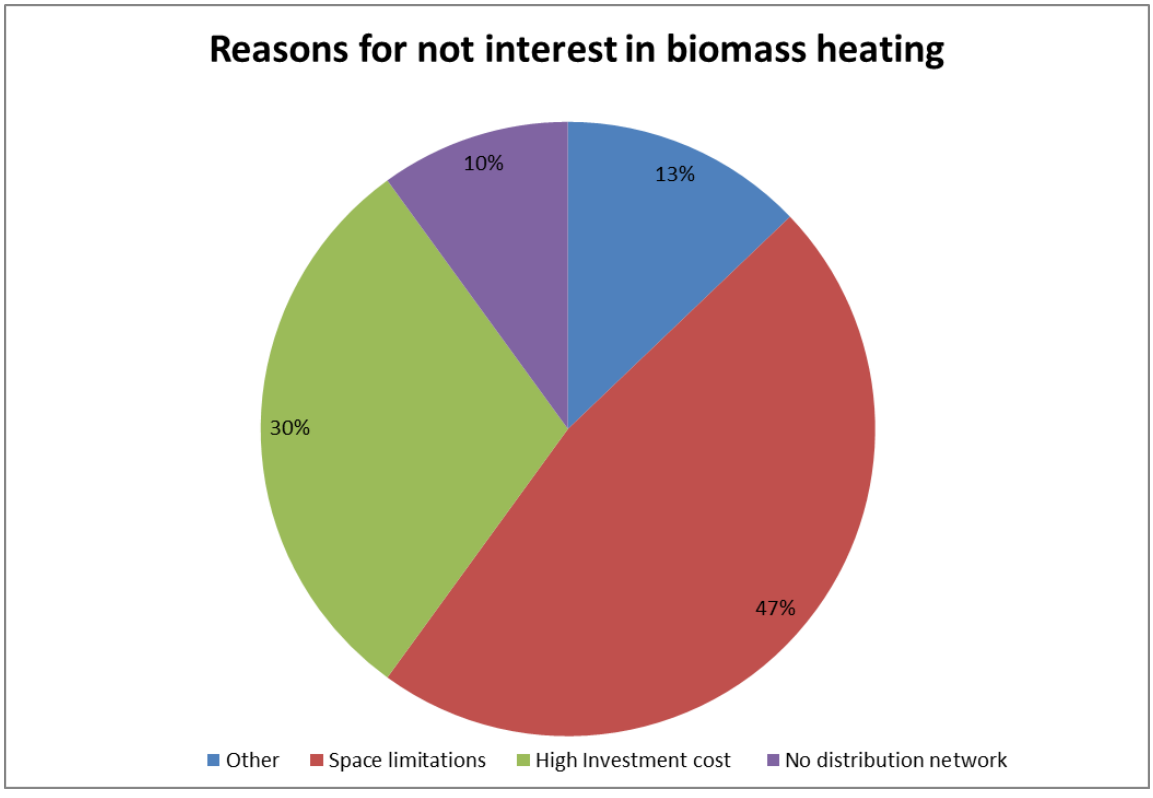


MAIN REASONS FOR NO

Out of the 64 respondents who know what biomass is and do not use biomass for heating, the main reason for being unwilling to change to biomass heating was the space limitation or constructive reasons (47%), also quite notorious was the high inversion cost of the biomass installation (30%). The lack of distribution network seems not to be a big issue in Spain with a 10%. The remaining percentage was other answers.



KIND OF PROPERTY OF BIOMASS USERS

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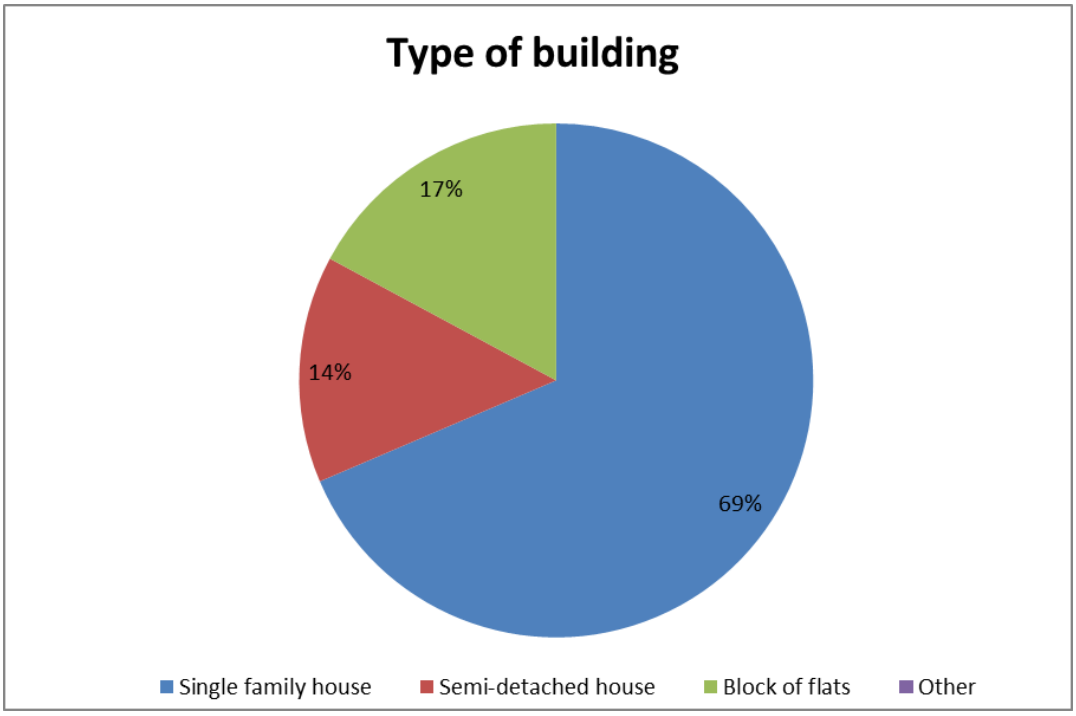
Of the 35 biomass users that answer the survey, a 69% are living in a detached single family house and 14% in a semi-detached house. Only a 17% is using biomass in a block of apartments. We must have in mind that in Spain is not possible to put a fireplace / stove in an apartment except if there is a chimney going to the up roof, it's not possible to put a chimney through the façade. The best option for apartments is to put a boiler for the whole building or a District Heating.



TYPE OF OWNERS

Most of the biomass users who answered the survey (77%) were the owner of the household. This matches to some answers of non-biomass users that claimed that it was difficult to replace the heating system if they were renting the house.

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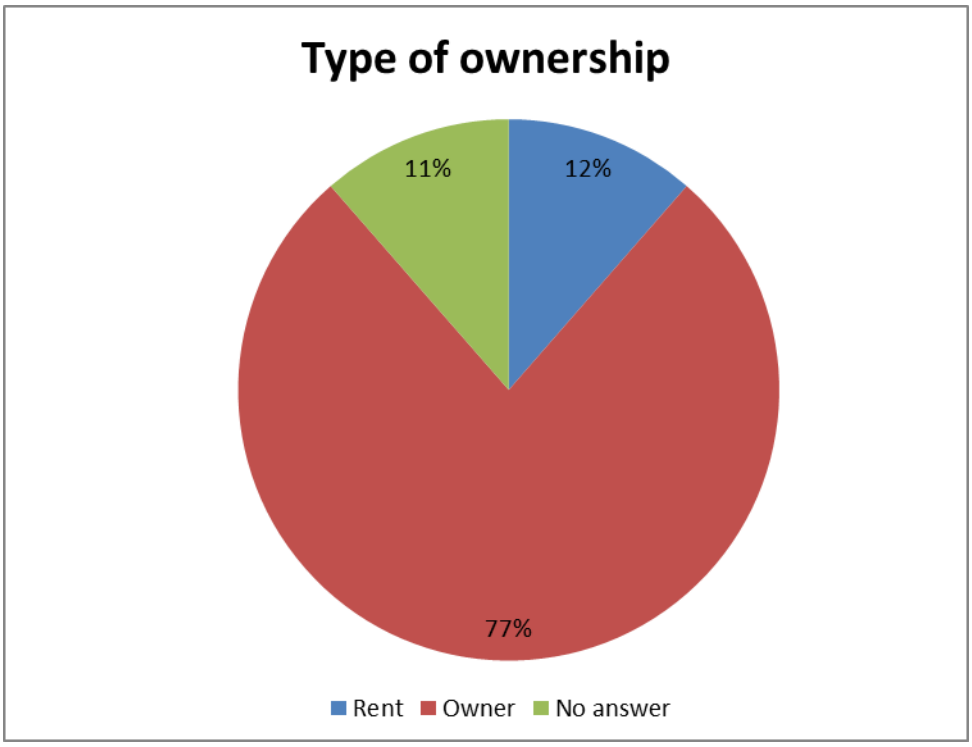
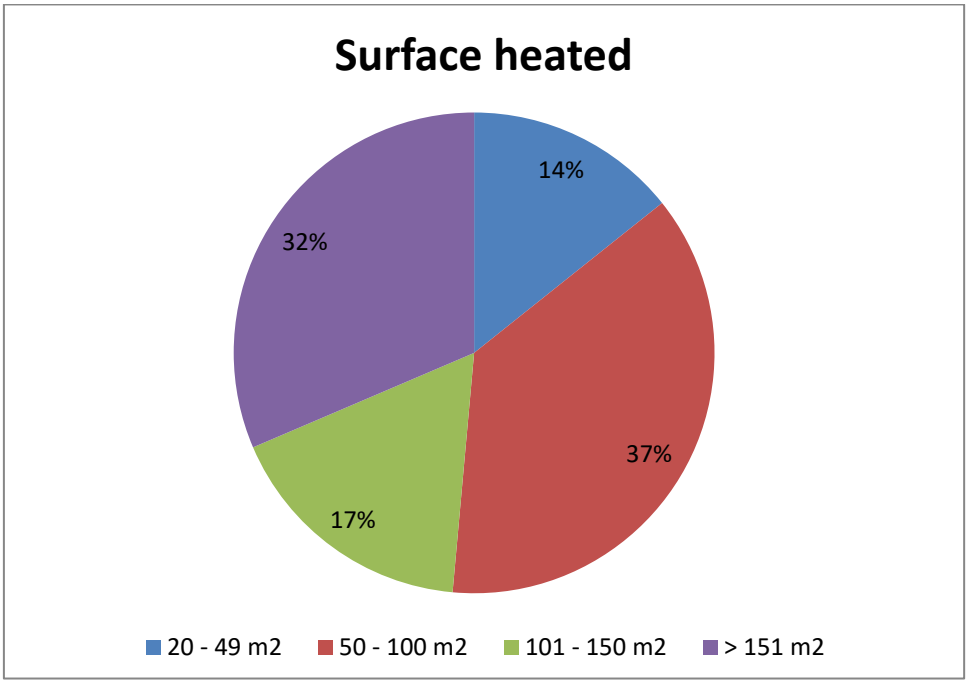


SURFACE TO HEAT

From the 35 biomass users who answered the survey a 37% was living in a household between 50-100 m^2, 32% in with a bigger surface than 151 m^2, 17% from 101-150 m^2 and 14% from 20 to 49 m^2



TYPE OF HEATING SYSTEM

From the 35 biomass users who filled in the questionnaire we go the following results regarding the type of installation (some users had several devices)

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Type of heating system	Number of installations	Average price	Device Power
Boiler	11	4.551 €	25,9 kW
Stove	20	1.734 €	10,3 kW
Insert / fireplace	7	2.333 €	9,75

Some of the respondents had 2 devices installed at home. Stoves are the most used device among the surveyed

TYPE AND QUANTITY OF BIOFUEL

Type of Fuel	# users 0 – 500 kg	# users 500 – 1000 kg	# users 1000 – 2000 kg	# users 2000 - 5000 kg	# users 5000 – 10000 kg	# users 10000 – 25000	# users 25000 - 50000
Wood Pellets	5	4	5	3			
Firewood	1			1		1	1
Wood Briquettes	1						
Wood chips	1						
Olive Stones	1						
Walnut shells	1						
Pine nut shells					1		
Other				1		1	

Most used fuel were wood biofuels and about all wood pellet.

What is your feeling as consumer using biomass?

AVERAGE OF GRADE OF GENERAL SATISFACTION

From the 35 respondents that used biomass, 89% were completely satisfied or partly satisfied so in general users had a good perception about using biomass. Average note was 4,35 over 5.

	%
Completely satisfied (5)	43
Partly satisfied (4)	46
Average satisfied (3)	9
Less satisfied (2)	

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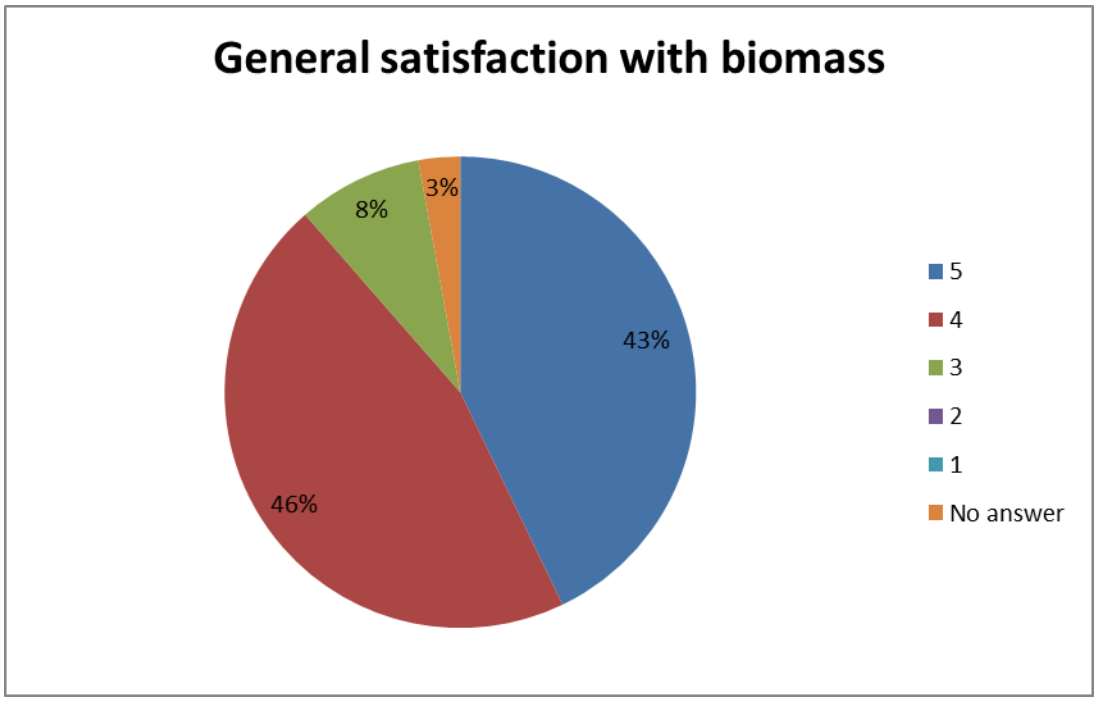
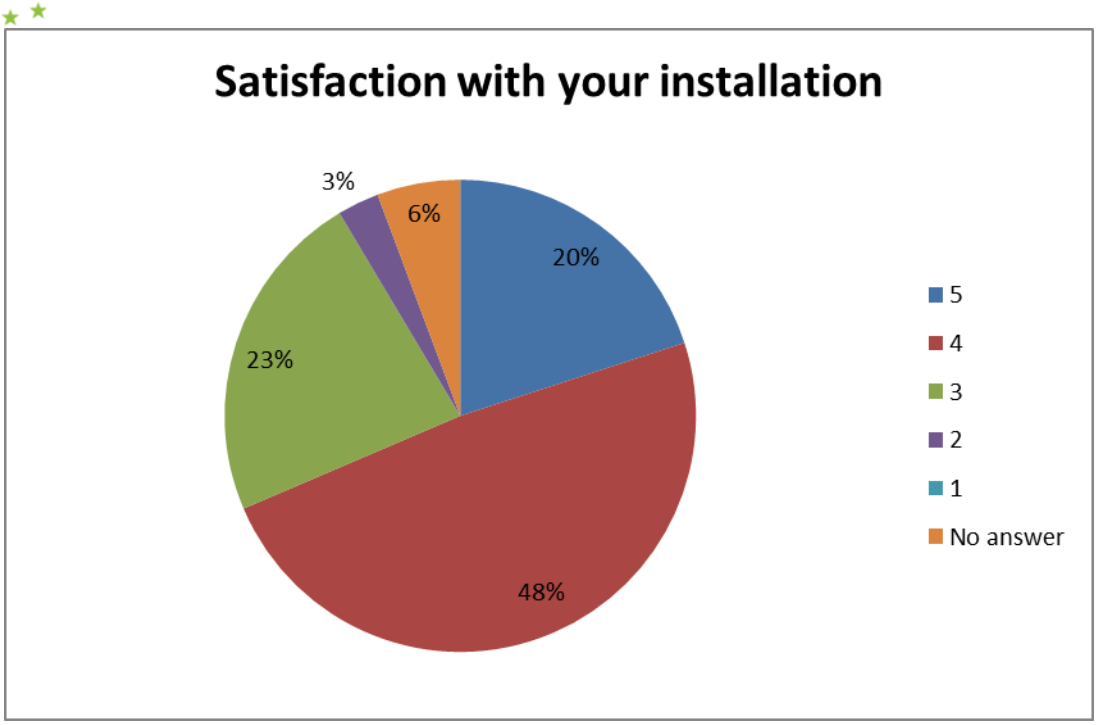
Unsatisfied (1)	
No answer	3



AVERAGE OF GRADE OF SATISFACTION WITH YOUR INSTALLATION (EFFICIENCY,EMISSIONS, FREQUENCY OF CLEANING, ETC)

Cleaning and emissions the installation could be worst part of biomass from the point of view of the users but as it can be deduced from the survey most of the users are satisfied with their devices. Average of the note was 3,91

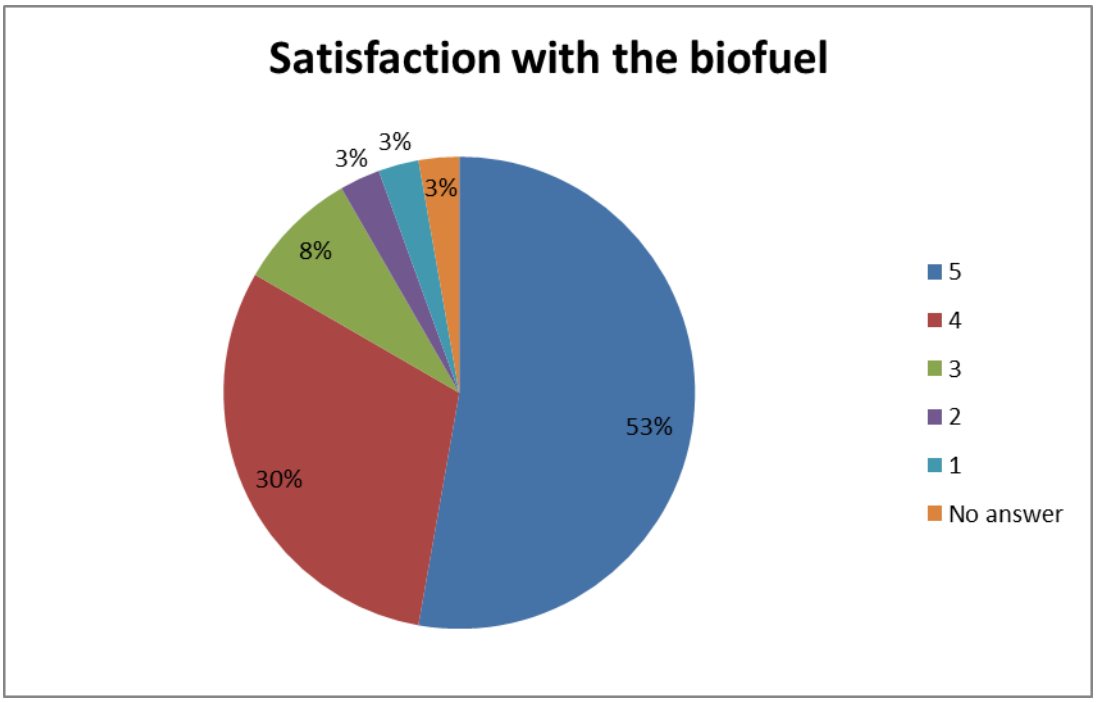
	%
Completely satisfied (5)	20
Partly satisfied (4)	49
Average satisfied (3)	23
Less satisfied (2)	3
Unsatisfied (1)	
No answer	6



AVERAGE GRADE OF SATISFACTION WITHTHE BIOMASS (QUALITY, PRICE, …)

	%
Completely satisfied (5)	53
Partly satisfied (4)	30
Average satisfied (3)	8
Less satisfied (2)	3
Unsatisfied (1)	3
No answer	3

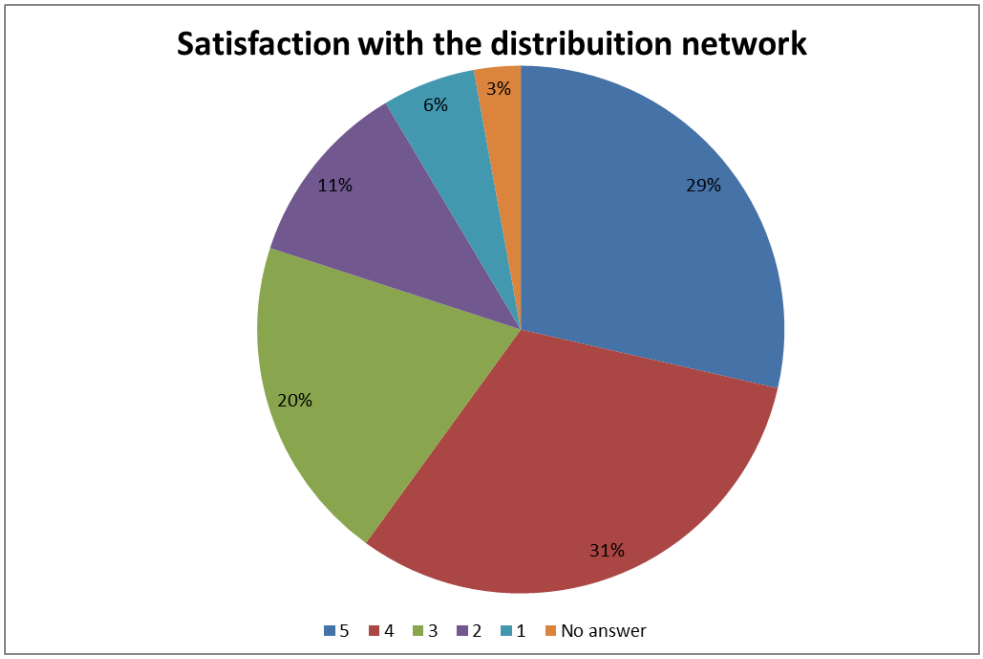
The satisfaction with the biofuel was quite good achieving a 83% between the categories completely satisfied and partly satisfied.. The average was 4,41



AVERAGE OF GRADE OF SATISFACTION WITH THE DISTRIBUTION NETWORK

	%
Completely satisfied (5)	29
Partly satisfied (4)	31
Average satisfied (3)	20
Less satisfied (2)	11
Unsatisfied (1)	6
No answer	3

The worst punctuation of the perception topics for the users was obtained for the distribution network that can accord with the fact that it's relatively a new market and still is not 100% developed. The average note was 3,68

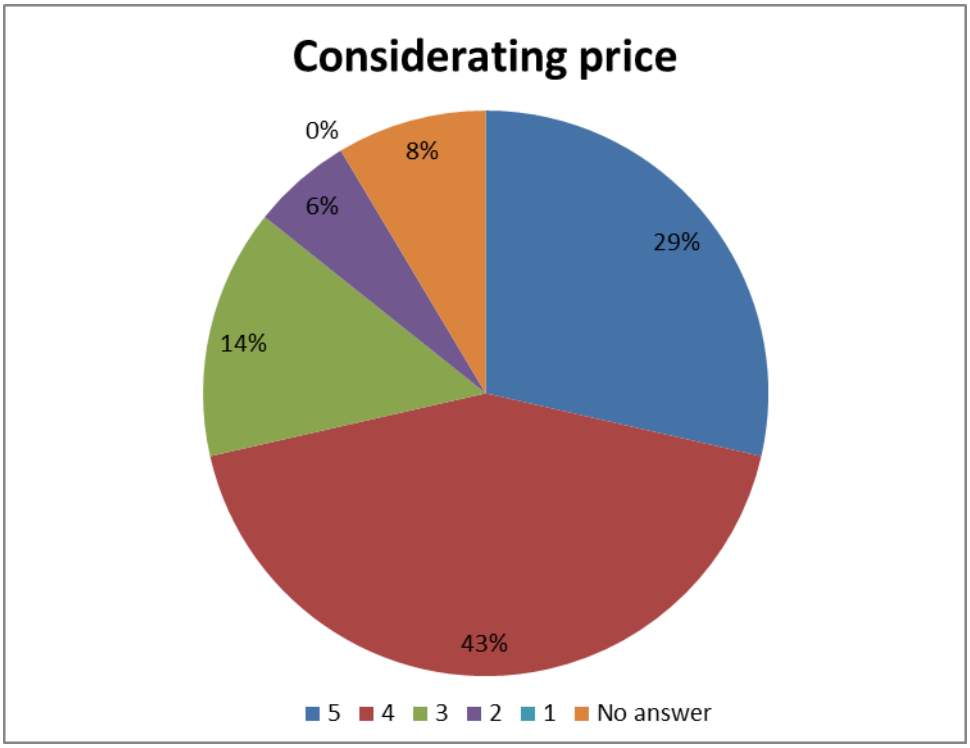


Your considerations when you are buying biomass.

Considerations	Average
Price	4,03
Quality	4,44
Certification	4,06
Local Product	4,03
Distribution Services	4,13

When buying biofuels, the most important consideration among the respondents was the quality with the highest note. After this consideration there were no important differences and the rest of considerations (Quality, Certification, local product, Distribution services) obtained practically the same note.

PRICE



QUALITY

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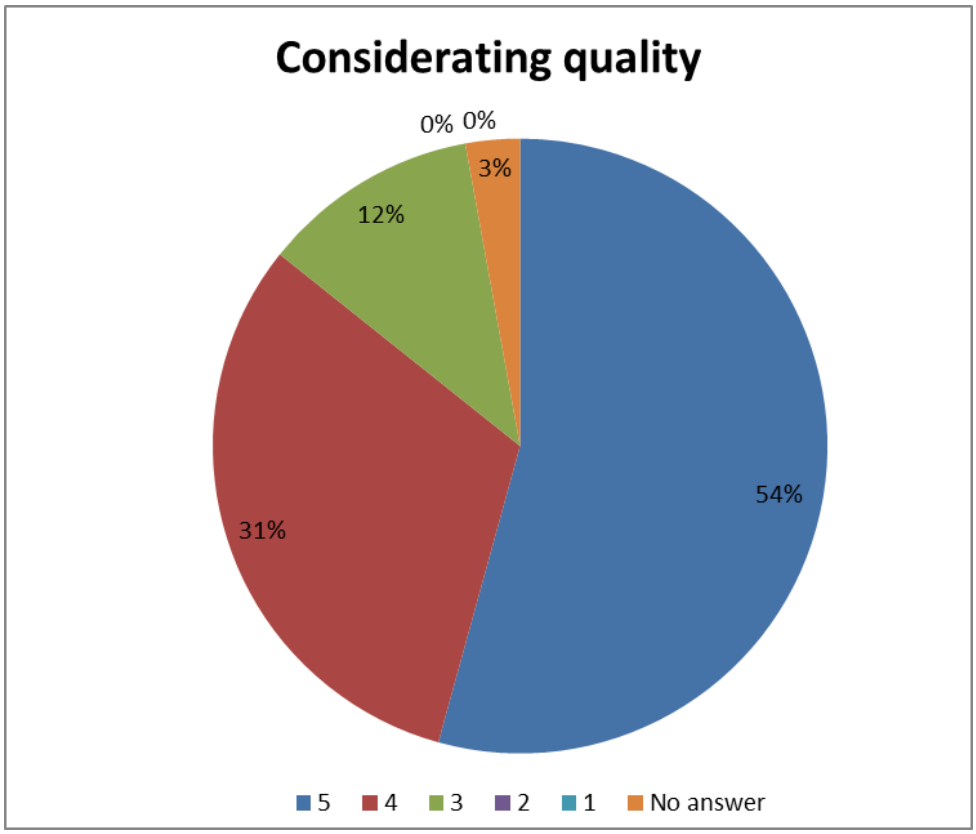
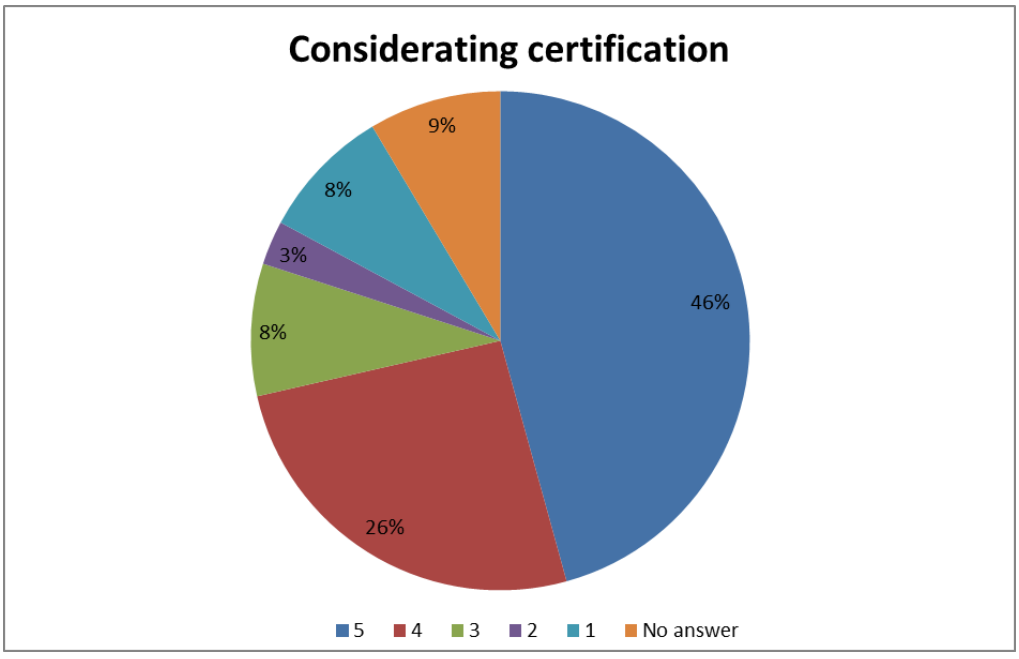
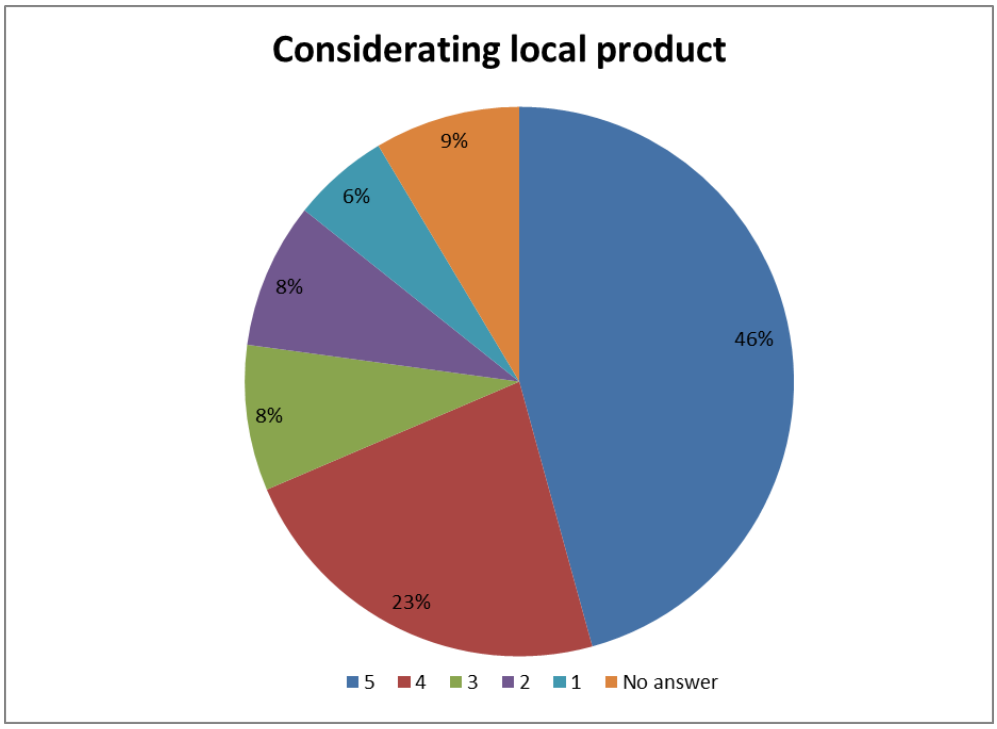


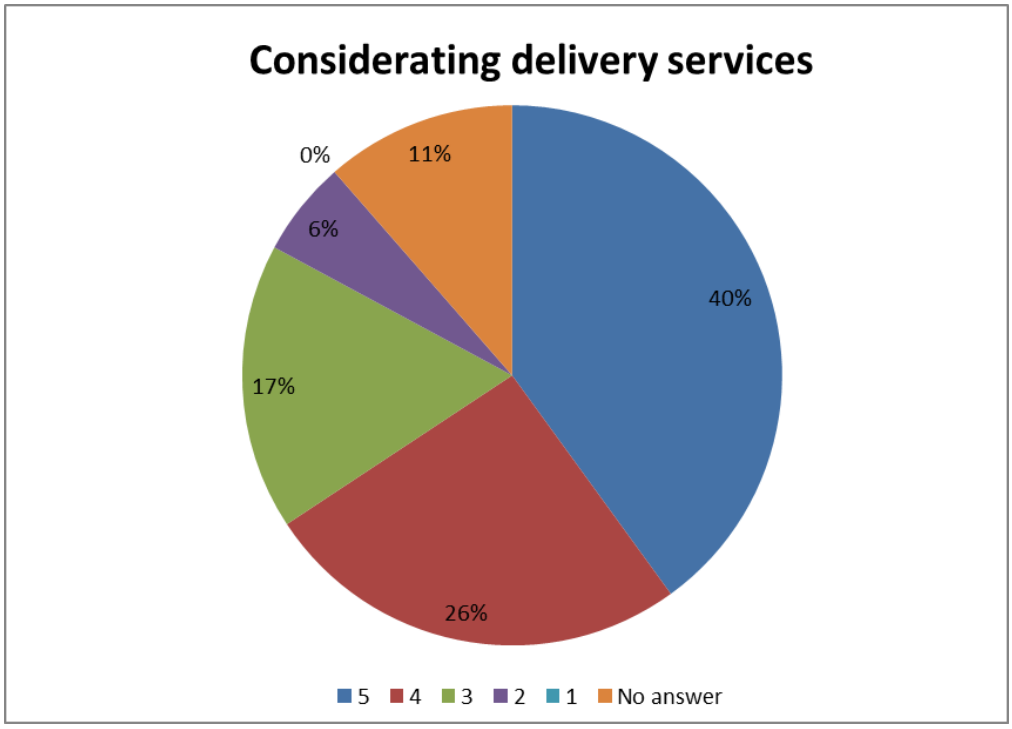
CERTIFICATION



LOCAL PRODUCT

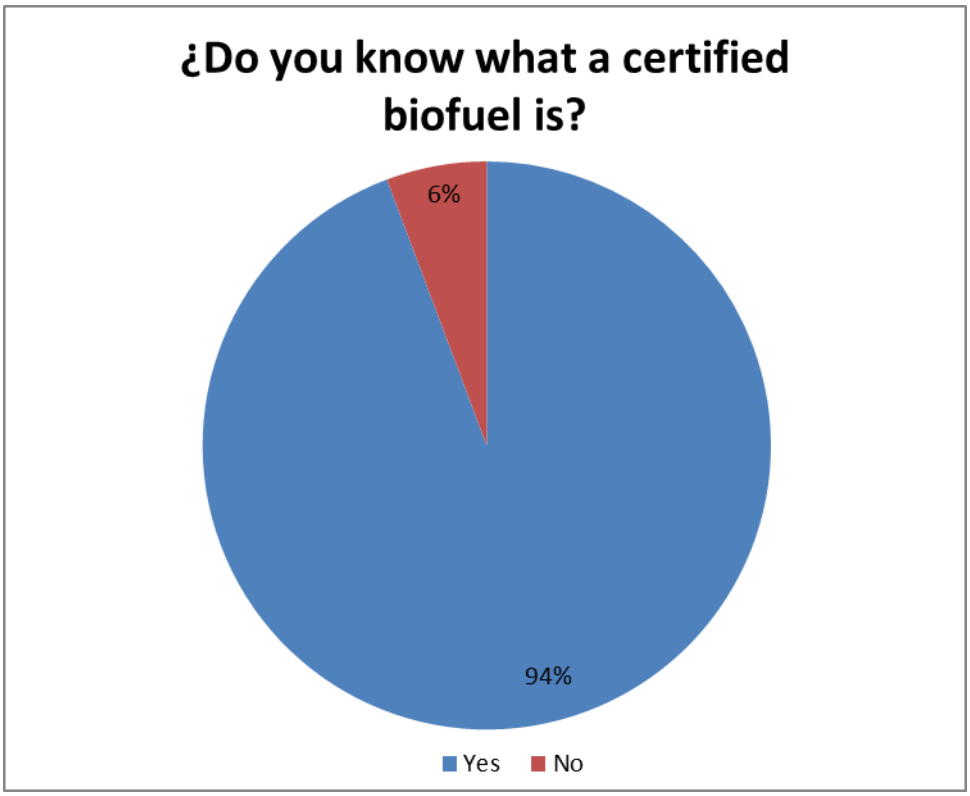


DELIVERY SERVICES



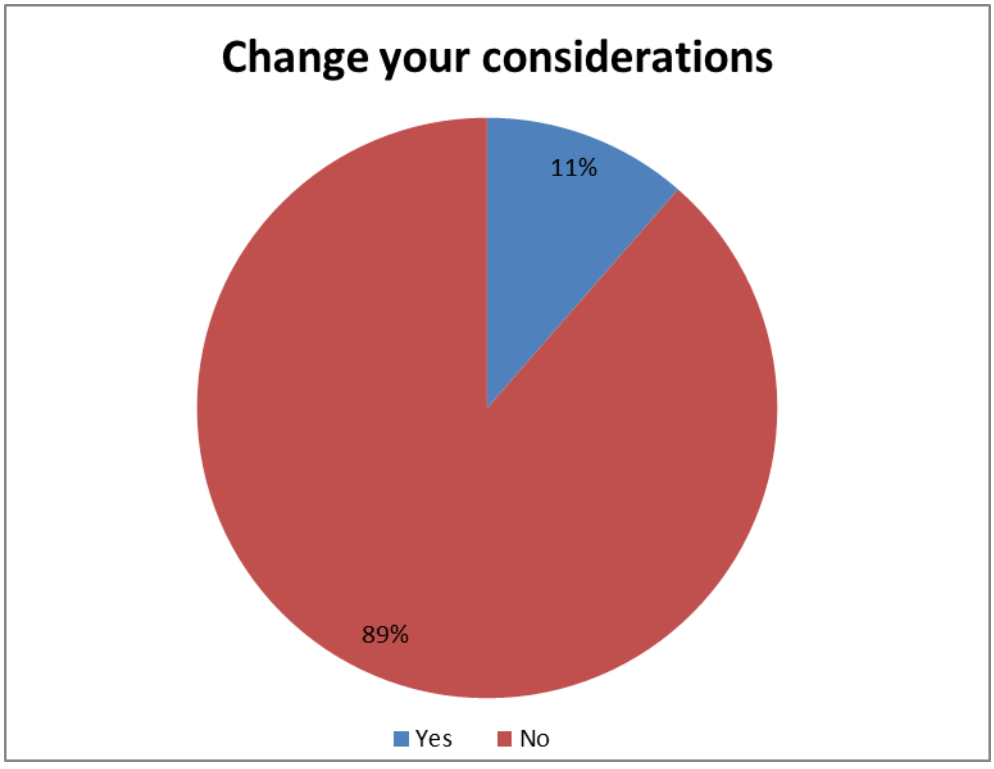
Do you know what a certified biofuel is? %

Most of the respondents knew what a certified biofuel is (94%). Having a so high % about what a certification implies was totally unexpected



Once you understand what a certified fuel is, would you change your answer about your considerations when you are buying biomass? %

A majority of respondents wouldn't change its answers in the considerations when buying biomass once they are informed about what a biomass certification is



Considerations when you are buying biomass Now you know what implies a certified biofuel.

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There were only 4 respondents that answered that they would change its view after knowing what implies a certified fuel. Their answers before and after were as follows:

	Res. # 1		Res. #2		Res. #3		Res. #4	
Knowledge of certification	No	Yes	No	Yes	No	Yes	No	Yes
Price	2	3	2	3	4	3	5	5
Quality	5	5	3	4	4	4	5	1
Certification	5	1	4	3	1	4	5	5
Local	5	2	3	4	2	3	5	5
Delivery services	5	4	4	3	3	3	5	5

There are not many conclusions that can be extracted with only 4 respondents but it seems that since in other columns are lowering the priority the quality and certification remains high

MAIN CONCLUSIONS FROM THE SURVEY IN SPAIN

Although the respondents to the survey were limited certain conclusion can be extracted from it.

- Most of the respondents were between 31 and 45 years (89) and 45-65 (51) what is logical having in account that they are the categories where they are living alone and can decide and afford for a heating system change.
- It was surprising that 89% of the respondents knew about biomass and 21% were already using it but it's possible since from a couple of years biomass is very present in supermarkets and fuel stations and with the crisis and high fossil fuel prices, users has been looking for alternatives. 21% is a very high share for people using biomass.
- Among the respondents also we could notice a lack of information because they express their concern about the results of a biomass heating installation, about its cleanness, where to buy and also where it can be placed. For example some answers claimed that they couldn't put a biomass system because it was building with several households and this is perfectly feasible. So one conclusion is that even if the respondents knew about biomass there is still a lack of knowledge among the potential users.
- There is still a big potential of growth since 50% percent of the respondents were willing to install biomass and 17% of them will do it as soon as possible and most of the reasons for not being interested was the space limitations that might vary if they change of house or new smaller devices are sold.
- The kind of property is very important to be able to install biomass. Many people are living in flats and only devices for the whole building are possible and complicates things since it's not a household decision but from many, although is much more economical having one device, specially if its with biomass than having individual devices for every flat. Also kind of ownership is decisive as rented users are logically more reluctant to make

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changes.

- Stoves are the most popular device and it fits with the expected trend in Spain because it's not an expensive device that can be combined with the existing heating system. Also for not so cold areas like south of Spain it can work very well as unique heating device.
- Most of the users of biomass were satisfied with their devices
- Most used biomass are woody biomass (pellets, firewood, briquettes, etc) and pellets was the most frequent
- Concerning the consumers priorities when buying biomass it's possible to conclude that quality is essential and has a high priority for the majority of the consumers
- Regarding certification it can be concluded that most of the respondents knew what a biomass certification is and that it is an important factor for the customers buying biomass and quality very related too.

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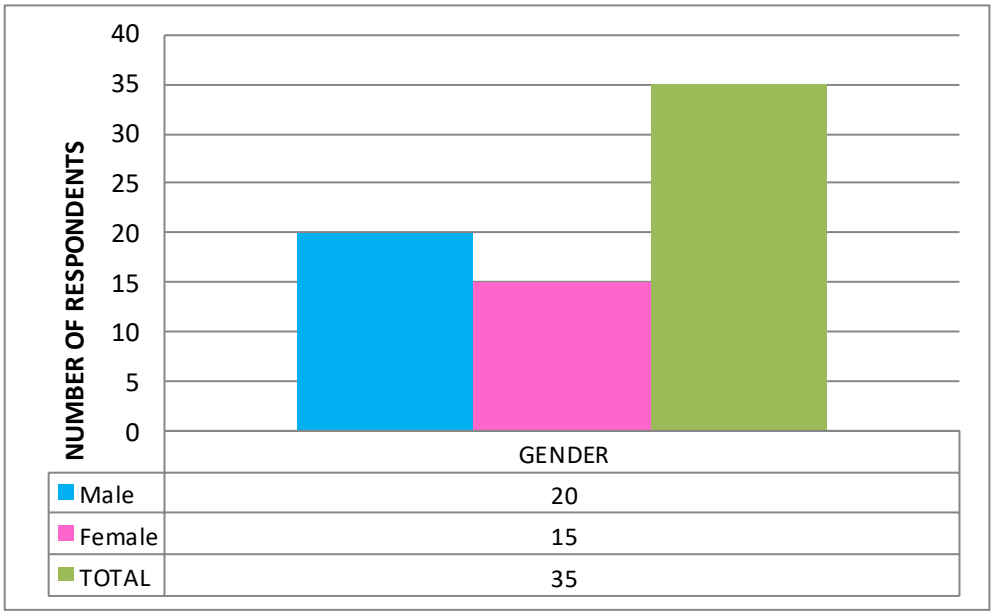
Report of the final user survey for Turkey

This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No. 691763

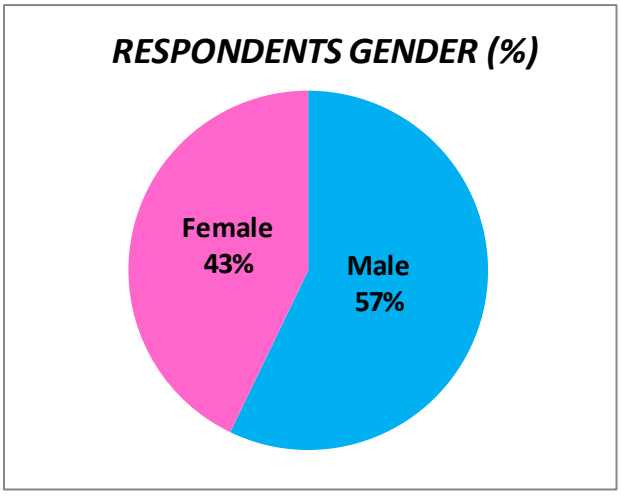
RESULTS DESCRIPTION FOR TURKIYE

Please make a small graphic for the following informations an put some lines of interpretation:

- *NUMBER OF RESPONDENTS: 35*



- *RESPONDENTS GENDER (%)*



- *RESPONDENTS AGE (%)*

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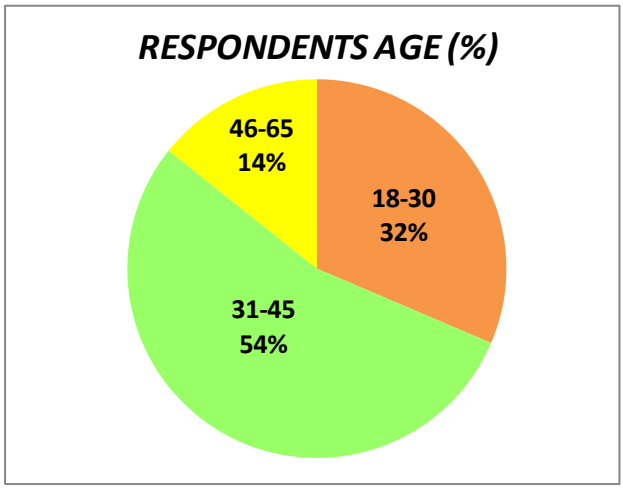
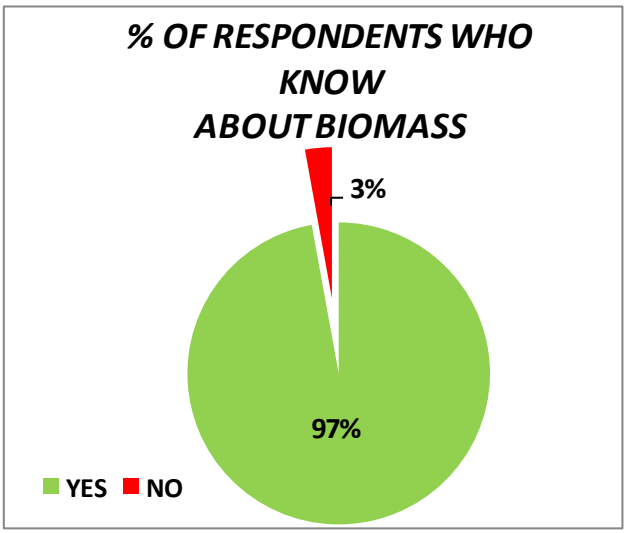
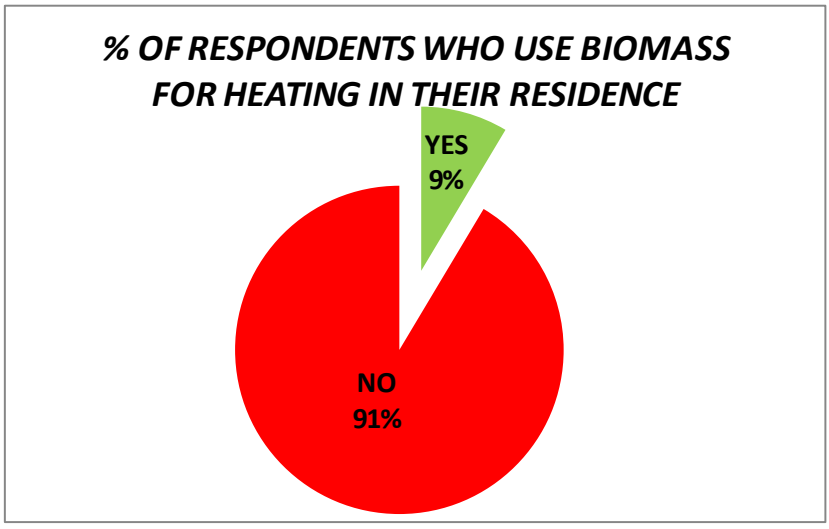


- *% OF RESPONDENTS WHO KNOW ABOUT BIOMASS*



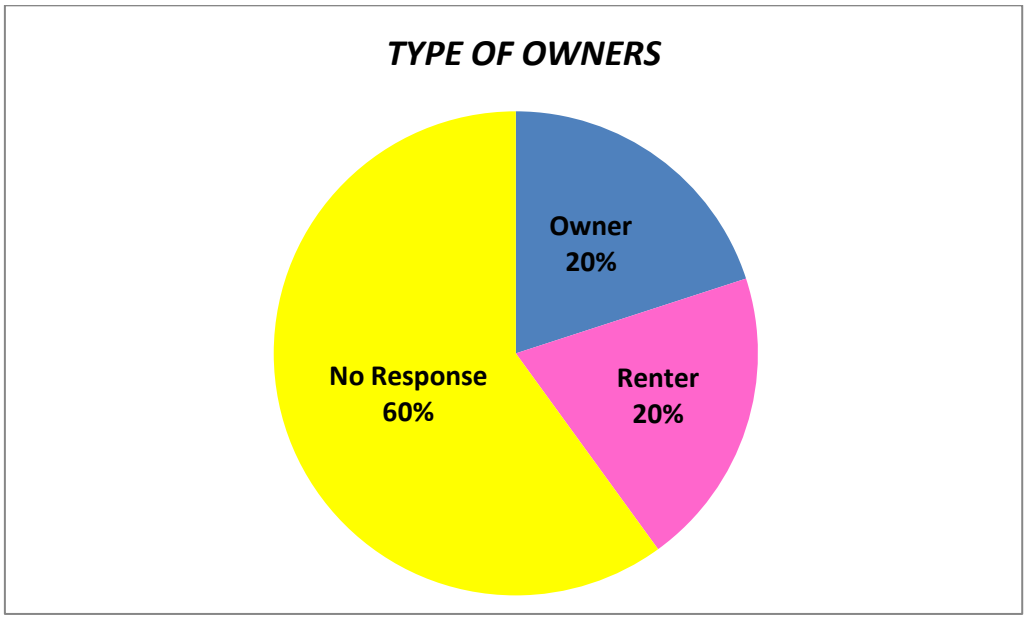
- *% OF RESPONDENTS WHO USE BIOMASS FOR HEATING IN THEIR RESIDENCE*



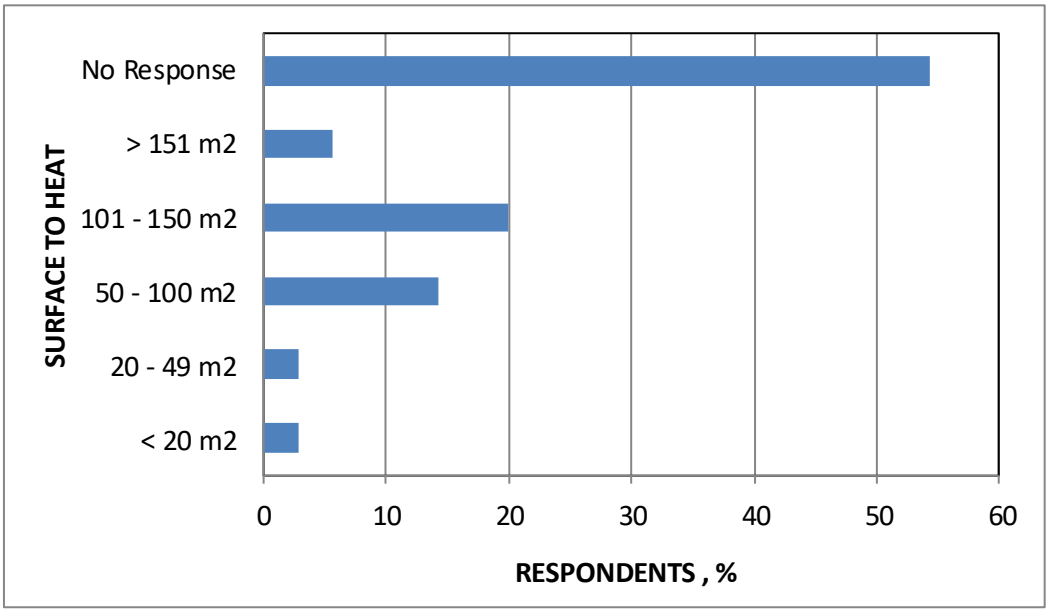
- % OF RESPONDENTS willing to change to a biomass system

- *MAIN REASON FOR YES: 43%*
- *MAIN REASONS FOR NO: 57%*

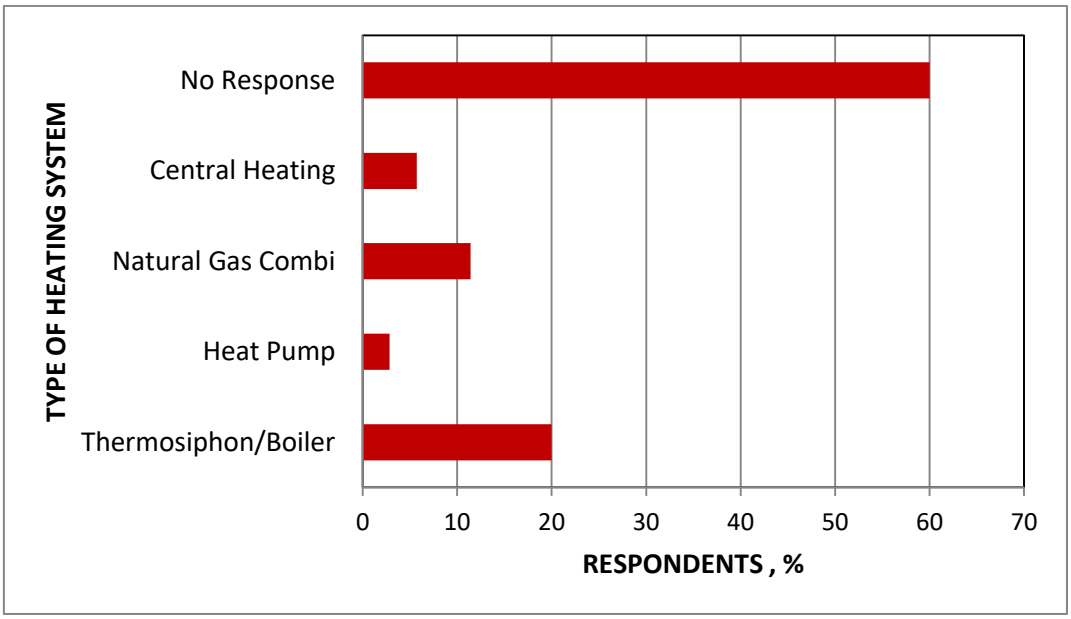
- *KIND OF PROPERTY OF BIOMASS USERS*
- *TYPE OF BUILDING:* ***All are apartment***
- *TYPE OF OWNERS:*



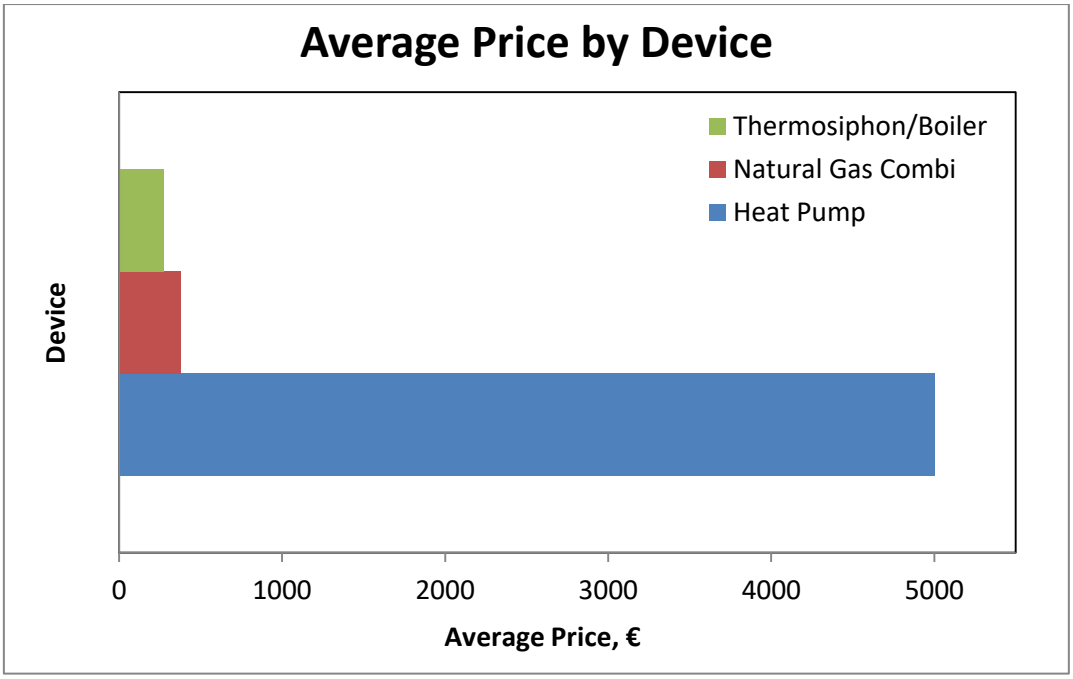
- *SURFACE TO HEAT*



- *TYPE OF HEATING SYSTEM*



- *AVERAGE PRICE BY DEVICE*



- *% DEVICE POWER BY CATEGORY AND DEVICE*

  4 Respondents chose thermosiphon/Boiler and;

- *50% of them 13 - 30 kW*
- *25% of them 31 - 50 kW*
- *25% of them 1 - 12 kW*

  1 Respondent chose Heat Pump; 13-30 kW

  1 Respondent chose Natural Gas Combi; 13-30 kW

- *% TYPE AND QUANTITY OF BIOFUEL*

  1 Respondent chose wood and hazelnutshell (500-1000 kg)

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1 Respondent chose peach shell (0-500 kg)

1 Respondent chose olive stone and hazelnutshell (0-500 kg)

- *What is your feeling as consumer using biomass?*

- *AVERAGE OF GRADE OF GENERAL SATISFACTION*

7 Respondents answered:

- *29% of them 5 points*
- *43% of them 4 points*
- *14% of them 3 points*
- *14% of them 2 points*

- *AVERAGE OF GRADE OF SATISFACTION WITH YOUR INSTALLATION (EFFICIENCY,EMISSIONS, FREQUENCY OF CLEANING, ETC)*

3 Respondents answered:

- *33% of them 4 points*
- *33% of them 3 points*
- *33% of them 1 point*

- *AVERAGE GRADE OF SATISFACTION WITHTHE BIOMASS (QUALITY, PRICE, …)*

3 Respondents answered:

- *66% of them 4 points*
- *33% of them 1 point*

- *AVERAGE OF GRADE OF SATISFACTION WITH THE DISTRIBUTION NETWORK*

3 Respondents answered:

- *33% of them 4 points*
- *66% of them 1 point*

- *Your considerations when you are buying biomass .*

- *AVERAGE PRICE*

4 Respondents answered:

- *50% of them 3 points*
- *25% of them 4 points*
- *25% of them 5 points*

- *AVERAGE QUALITY*

4 Respondents answered:

- *50% of them 3 points*

- *25% of them 4 points*
    - *25% of them 5 points*

- *AVERAGE CERTIFICATION*

  4 Respondents answered:

- *50% of them 3 points*
- *25% of them 4 points*
    - *25% of them 1 point*

- *AVERAGE LOCAL PRODUCT*

  4 Respondents answered:

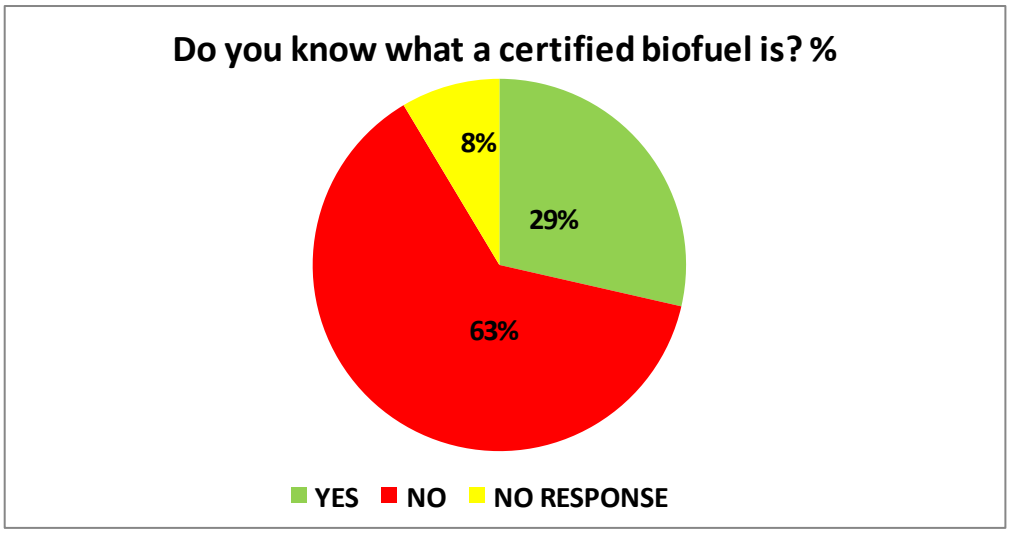
- *50% of them 3 points*
- *25% of them 4 points*
    - *25% of them 1 point*

- *AVERAGE DELIVERY SERVICES*

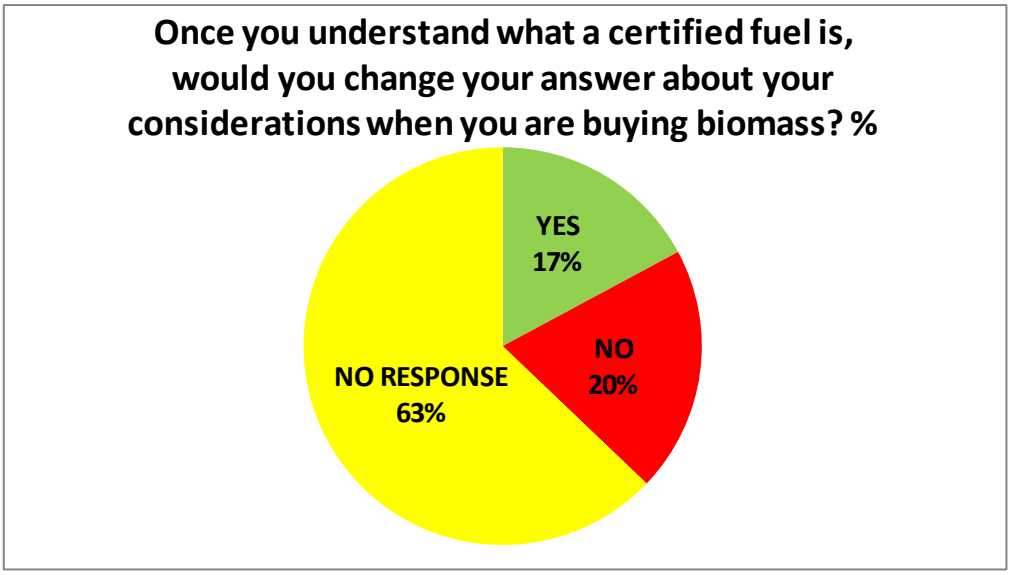
  4 Respondents answered:

- *50% of them 4points*
- *25% of them 3 points*
    - *25% of them 5 points*

- Do you know what a certified biofuel is? %



- Once you understand what a certified fuel is, would you change your answer about your considerations when you are buying biomass? %



- *Considerations when you are buying biomass Now you know what implies a certified biofuel.*
  - *AVERAGE PRICE*

    2 Respondents answered:
- *50% of them 5 points*
- *50% of them 3 points*
  - *AVERAGE QUALITY*

    2 Respondents answered:
- *50% of them 3 points*
- *50% of them 4 points*
  - *AVERAGE CERTIFICATION*

2 Respondents answered:

- *50% of them 3 points*
- *50% of them 4 points*

- *AVERAGE LOCAL PRODUCT*

  2 Respondents answered:

- *50% of them 3 points*
- *50% of them 4 points*

- *AVERAGE DELIVERY SERVICES*

  2 Respondents answered:

- *50% of them 3 points*
- *50% of them 5 points*

MAIN CONCLUSIONS FROM THE SURVEY IN TURKIYE

- 35 people participated in the questionnaire. It is difficult to forward the questionnaire to the biomass users in rural regions who do not have internet access.
- 97% of respondents know biomass, however 3% of them do not know.
- Only 9% of respondents use biomass for heating purpose.
- However, 43% of respondents are willing to change their system to a biomass system.
- On the other hand, the biomass is expensive and the distribution network does not exist.
- Generally, people don't know the definition of certified solid biomass. Only 14% of respondents know the definition of certified solid biomass.