Romania's promising market segments for heating with solid biomass (> 100 kW)

Horizon 2020 Coordination and Support Action number 646495: Bioenergy for Business „Uptake of Solid Bioenergy in European Commercial Sectors"

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Task 2.4 REPORT

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1 Executive Summary

The purpose of the present document is to analyze the situation of Romania with regard to the most promising market segments for the use of bioenergy, namely for heating with solid biomass, for over 100 kW heat load.

The actual situation shows that 74% of Romania's gross energy consumption is covered by the usage of fossil fuels – coal, oil, natural gas and combustible waste, while the renewables cover only 17% - (mainly wind and photovoltaic).

In terms of solid biomass usage, in 2015 there are a number of 8 operational cogeneration, biomass based plants in Romania, with a total installed capacity of 134.28 MW, while the primary energy product of Romania estimated for the period 2015-2020 targets 8,373 GWh forest wood per year, 9,762.2 GWh by products of wood-based industry per year and 18,445.18 GWh agriculture and fisheries by-products per year.

In order to identify the market segments where the switch from the use of fossils to biomass is the most likely, for both "in-house" usage and district heating sector, ARBIO has performed a number of 3 interviews with relevant associations and sector actors.

According to the experts' opinion, these most promising market segments are DH and services sector – especially public buildings like schools and hospitals, resorts and hotels and commercial/shopping sector.

The evaluation mainly took into account the current situation of Romania where a number of legislative documents are under preparation, of which the most relevant to the present Report are:

- the New Heat Law (with regard to DH, which debates to set a 50% share of the energy produced (heat) to be obtained from bioenergy sources)

- the Biomass Law, whose main purpose is the creation of a transparent and stable framework for investors.

The exact timeframe for the laws to come to force hasn't been yet set.

However, considering the prospect of a generous share of 50% of the DH sector to be obtained from bioenergy sources as a result of the upcoming legislation and taking into account Romania's great potential for Biomass, Biomass heating sector is expected to experience a significant development in the years to come, especially with regard to the DH sector.

Contents

2 Introduction

The Horizon 2020 project **Bioenergy4Business** aims to increase the usage of bioenergy through an (at least partial) fuel-switch from coal, oil or natural gas, which are used in "in-house" boilers in commercial sectors for heat purposes or in district heating, to solid biomass sources. The erection of completely new biomass heat applications is considered as an option as well. **Bioenergy4Business** focuses on solid biomass sources and on medium and large heat-only boilers (> 100 kW heat load) providing low temperature and process heat for commercial usage.

Bioenergy4Business builds bridges between policies and markets to support the creation of an enabling environment, the use of sound business and financing models and the careful assessment and implementation of bioenergy heat in local and district heating and in "in-house" applications. These aspects are considered for the most promising market segments among industry and commerce, residential buildings, agriculture and commercial and public services.

Bioenergy4Business involves partners from 12 EU Member States and Ukraine. 11 of these project partners (AT, DE, BG, CR, FI, GR, NL, PL, RO, SK and UA, except BE and DK) are target countries, where tailor-made activities for the most promising market segments will take place from January 2015 until August 2017.

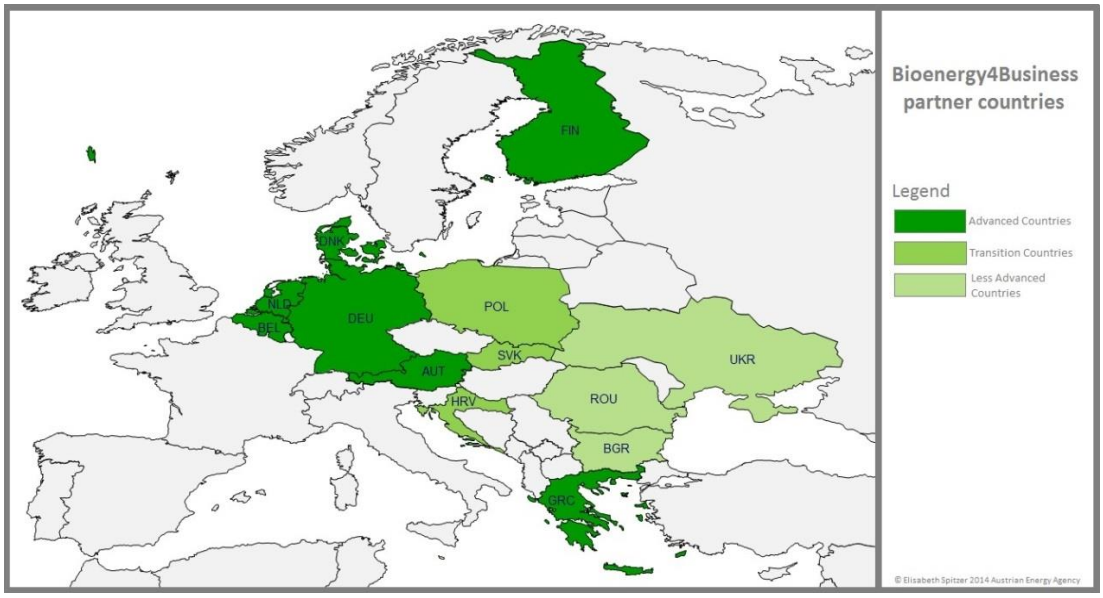

Figure 1: Countries where Bioenergy4Business is implemented.

Bioenergy4Business helps exploiting the considerable economic and sustainable potential of European bioenergy sources for heating, which are locally available at reasonable prices. These can offer a viable alternative to vulnerable European businesses currently depending on fossil resources, which are often imported from politically unstable regions.

Bioenergy4Business makes new market segments for solid biomass usage accessible and enhances the use of both more solid biomass sources and so far not used ones (e.g. pellets, straw etc.) in European heat markets.

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3 Fossil fuel usage in Romania

3.1 Share of fossil fuels in gross inland energy consumption

Error! Reference source not found. shows the gross inland primary energy consumption divided in fossil and non-fossil energy, in absolute numbers (GWh) and in relative numbers (%). In 2013, the fossil fuels coal, oil, gas and combustible waste made up to 74% of total gross energy consumption, while 17% of gross inland energy consumption was supplied by renewable energy sources (mainly wind and photovoltaic).

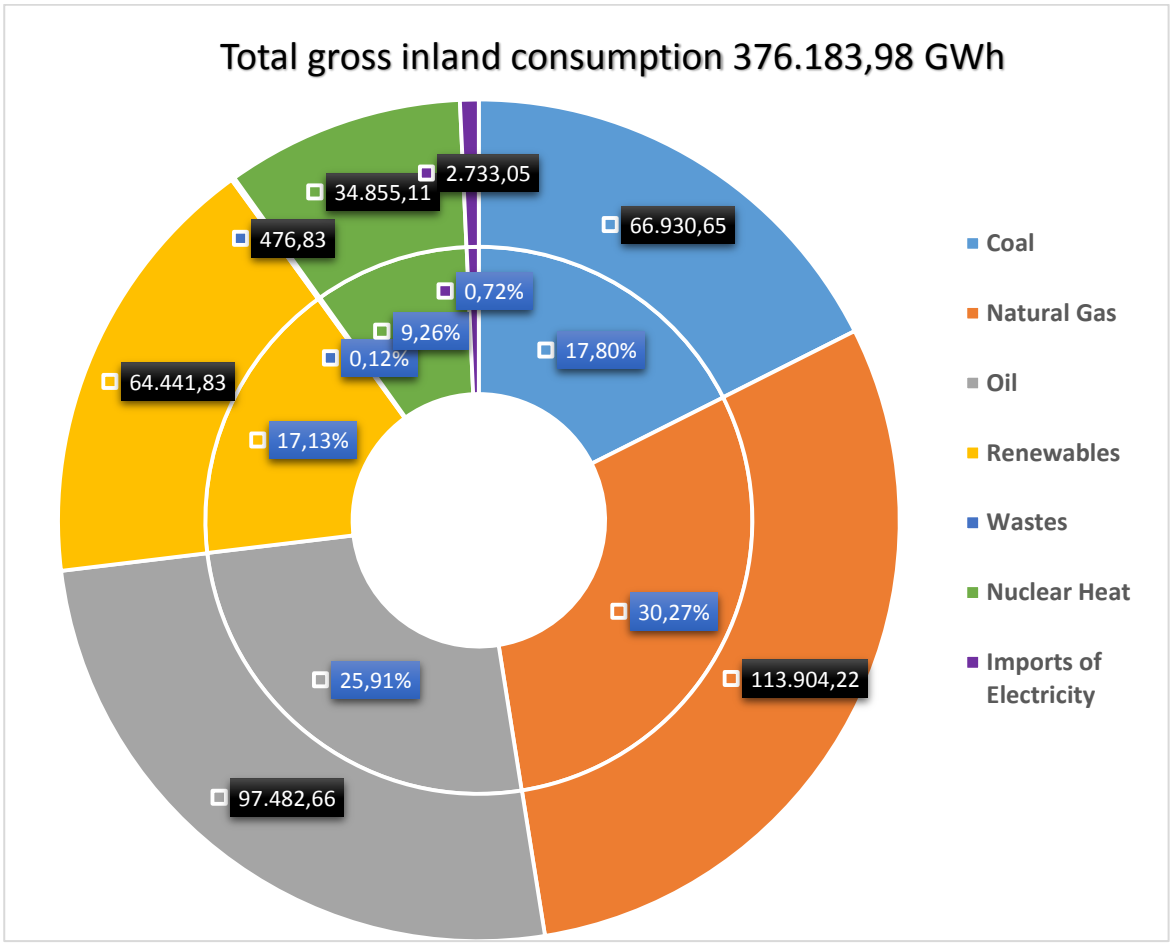

Fig. 2 Gross inland primary energy consumption in Romania. Source: Eurostat.

3.2 Domestic usage of fossil fuels

This chapter shows pie charts for coal, oil and gas, showing for every of these three energy carriers, the share of energy used for different usage categories.

2.2.1 Division of coal consumption in Romania, in 2013

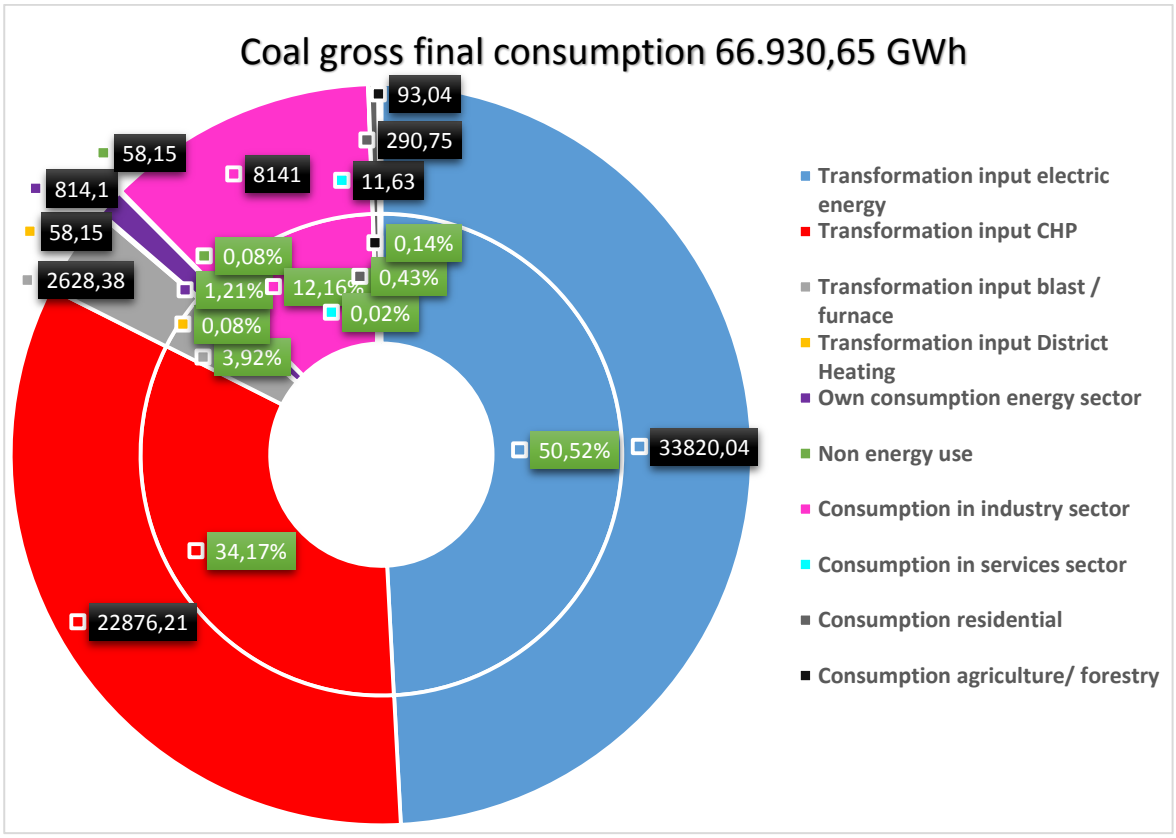

Fig. 3 Division of total coal consumption in Romania in 2013. Source: Eurostat.

2.2.2 Division of oil consumption in Romania, in 2013

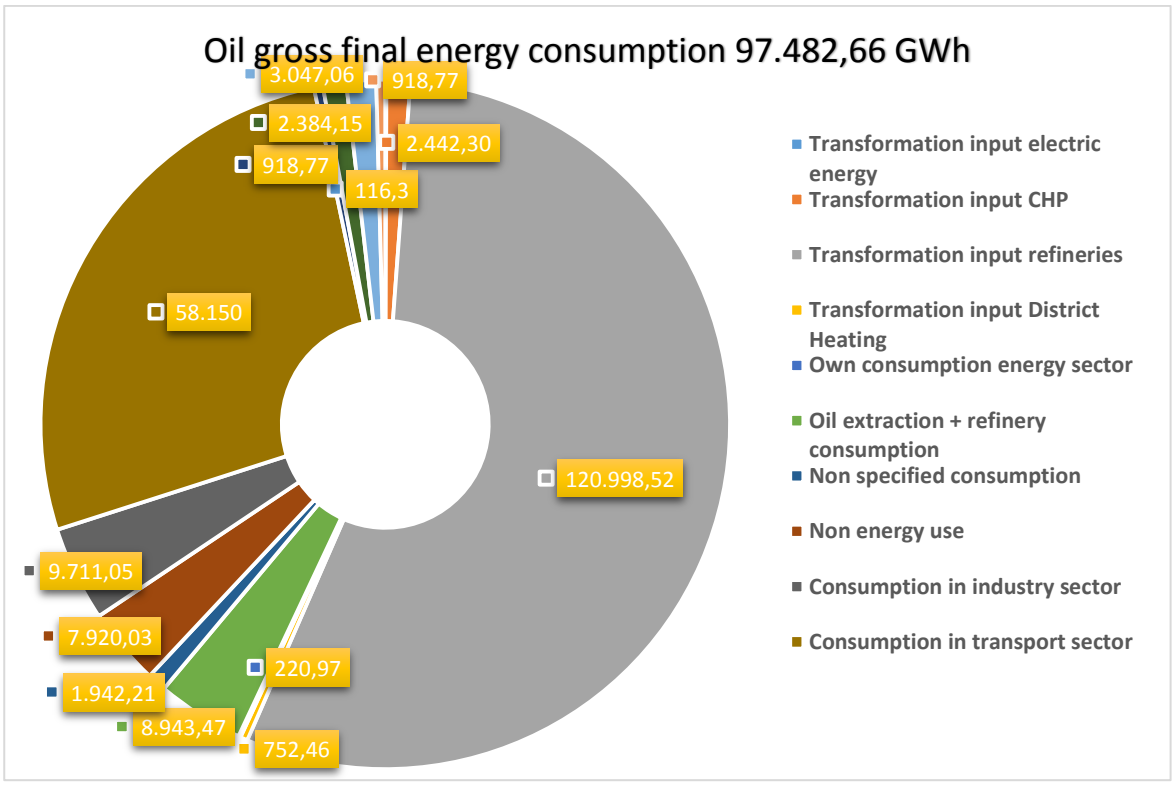

Fig. 4 Division of total oil consumption in Romania, in 2013. Source: Eurostat

.2.3 Division of natural gas consumption in Romania, in 2013

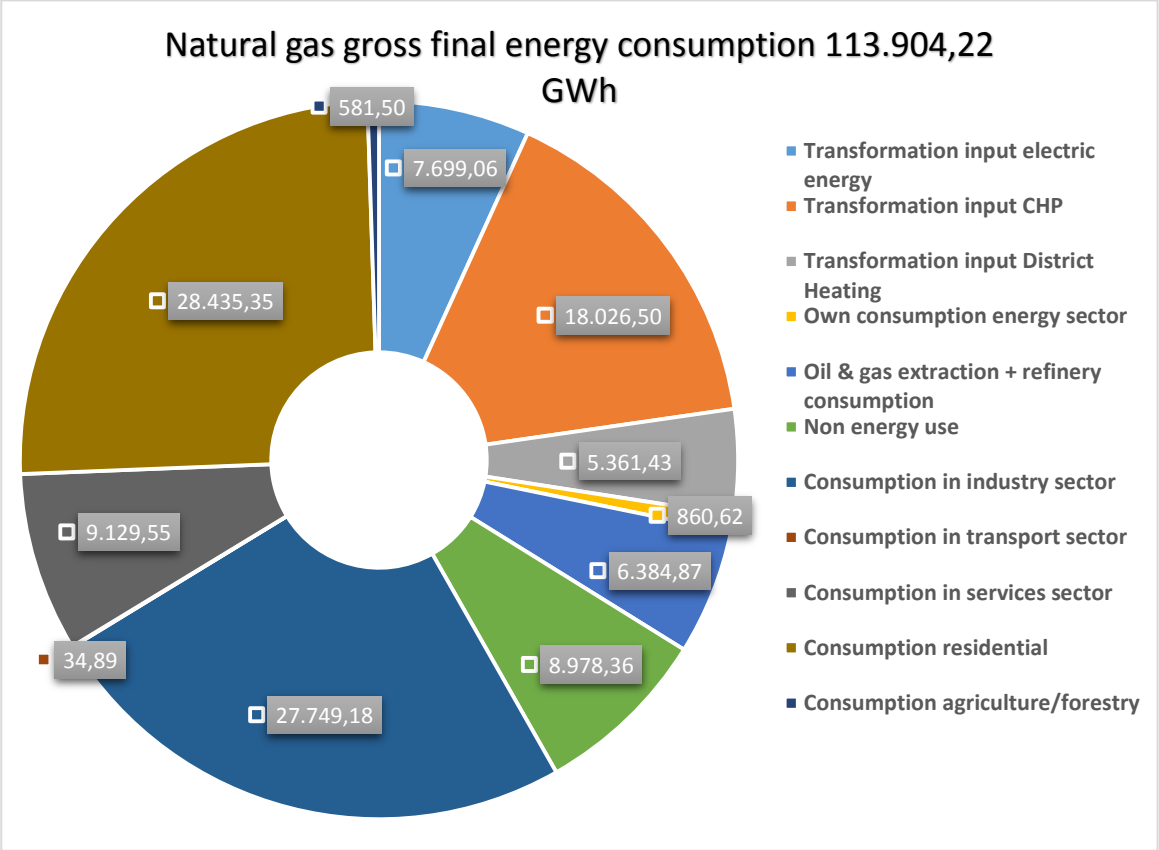

Fig. 5 Division of total primary consumption of natural gas in Romania in 2013. Source: Eurostat.

3.3 Origin of fossil fuels

According to the National Statistical Institute (INS), in 2013, Romania has imported 3.098 kt. of coal, and 5.299 kt. of oil. The statistical data regarding the countries of origin is not available.

3.4 Import prices of fossil fuels

Information not available for Romania.

4 Romania's supply situation of solid biomass for energy purposes

The purpose of the Chapter 3 of this report is to give an overview of the current situation of energy production from solid biomasses e.g. firewood, wood residues or straw the expected development of this sector, as well as biomass supply costs.

4.1 Technical and economical domestic supply potential and current usage

Romania has a surface of 6.3 Mio. ha of forests, and it exploits annually approx. 16,78 Mio. m3 of wood (statistical data at the level of 2013). According to the National Statistical Institute, the production of fire wood in Romania, in 2013, was of 5.06 million m3.

Source: INS (http://statistici.insse.ro/shop/?lang=ro)

The estimated biomass domestic supply for 2015 to 2020 is, according to the NREAP, as follows:

2015	2020
Forest wood 3,000,000 m3 per year	Forest wood 3,500,000 m3 per year
By-products of wood-based industry 3,500,000 m3 per year	By-products of wood-based industry 4,000,000 m3 per year
Agriculture and fisheries (by-products) 3,718,000 ton per year	Agriculture and fisheries (by-products) 3,762,000 ton per year

The Primary energy product of Romania is estimated in the NREAP, for the period 2015 – 2020 to the following figures:

Forest wood 8,373.6 GWh per year

By-products of wood-based industry 9,769.2 GWh per year

Agriculture and fisheries (by-products) 18,445.18 GWh per year

Source: https://www.ecn.nl/projects/nreap/2010/data/

4.2 Domestic biomass procurement costs

The figures for domestic biomass procurement costs are not available for Romania.

5 Romania's solid biomass boiler market beyond 100 kW heat load

5.1 Number of domestic installations of solid biomass boilers

According to ANRE (Romanian Energy Regulator) currently there are 8 operational cogeneration, biomass based, plants in Romania (www.anre.ro). The data for heat only boilers is not available at present.

5.2 Capacity of domestic installations of solid biomass boilers

According to Transelectrica website (www.transelectrica.ro) the capacities of the 8 operational cogeneration, biomass based plants in Romania, are the following:

1. Holzindustrie Schweighofer, Sebes I: 2.4 MW electricity and 8.6 MW heat
2. Holzindustrie Schweighofer, Sebes II: 8.5 MW electricity and 27.5 MW heat
3. Holzindustrie Schweighofer, Radauti II: 5 MW electricity and 17 MW heat
4. Bioelectrica Transilvania, Radauti: 4.9 MW installed capacity
5. General Electric: 6.5 MW installed capacity
6. A6 Impex: 9.73 MW installed capacity
7. Egger: 14.5 MW installed capacity
8. Bioenergy Suceava: 29.65 MW installed capacity.

6 Result of Stakeholder Interviews

The main objective of the stakeholder interviews performed was to identify at least 3-4 market segments in total, where a business case for commercial "in-house" or district heating with solid biomass seems to be most likely. In every country 2-3 biomass boiler manufacturers and 2-3 district heating developers/operators were interviewed for this purpose. Where those target groups were not existing domestic representatives of foreign biomass boiler manufacturers or domestic biomass associations and biomass experts were interviewed instead.

6.1 List of interviewees

Table 11: Overview of interviewed key stakeholders to identify promising market segments for Bioenergy4Business activities.

Name	Function	Company	Type of business	Interview details	Website
Dorin Sfaca	President	Romanian Association of Pellet Producers	Representative Association for Biomass Sector	Personal	www.peletibrichete.ro
Iulian Hornet	Owner	ECO Hornet	Boiler Producer	Personal	www.ecohornet.ro
Ilias Papageorgiadis	President	The Romanian Association of Biomass and Biogas	Representative Association for Biomass Sector	Personal	www.arbio.ro

Source: ARBIO

All interviewees were asked the same following four questions.

- What are the most promising bioenergy sources being available in larger quantities locally (at reasonable prices) in Romania?
- What are promising market-segments (where a business case seems to be most likely) in Romania?
- Due to which technical, economic etc. criteria did you select these promising market segments and which influence do these criteria have regarding market penetration?
- In case you sell biomass boilers abroad: To which countries do you export and what are the promising market segments there?

The interview guide that was used for all interviews can be seen at ANNEX xx of deliverable D2.2 "Summary overview of promising market segments for bioenergy.

The identified market segments are those on which national project activities will be focused on throughout project lifetime. The market segments identified may vary from partner country to partner country.

Preliminary considerations:

Currently, Romania is preparing a number of 4 important legislative documents:
- The Heat Law
- The Biomass Law
- The Feed in Tariff for Renewable Energy projects under 500 KW
- The modifications to the Law 220/ 2008 on the promotion of energy from renewable sources, which aim to resolve the situation that was created on the market by the abundance of photovoltaic and wind projects, detrimental to other technologies, mostly Biomass.

One other important aspect is the interest of Romania related to the transposition of the EU regulations.

The Romanian authorities have stated their intention to support Biomass, which has been declared a priority for Romania. This also results from the fact of introducing so many modifications and legislative initiatives, which supports the idea that the authorities have finally taken over the responsibility for the clarification and structuring of the main frame that shapes the way the sector of Biomass develops, for both, electricity and heat production.

With regard to the production of heat, currently, the drafting of the Heat Law is under debate and it is expected to be inaugurated within the following 18 months. If it will be approved based on the current draft, in the following years, 50% of the heat produced shall come from Biomass, Biogas and Geothermal, which gives Biomass a great potential in Romania. However, the exact timeframe for the law to come to force hasn't been yet set.

6.2 The most promising bioenergy sources

Romania's findings from interviews:

In Romania the sources of bioenergy are generous, and the most promising, available in large quantities are: by products from wood-based industries, forest woodchips, pellets and straw.

6.3 The most promising market segments

6.3.1.1 District heating markets

Romania's findings from interviews:

The most promising market segments identified based on the answers we have received from the stakeholders, are **the existing DH** (which are most likely to go to a fuel switch) and **new small DH** that are most likely to attract new investments.
In terms of new larger DH, the perspective is not really appealing for the fuel switch but we consider there are chances to see new smaller plants coming on the market as it is under discussion to give motives for projects with a smaller size.

On a scale from 1 (worst case) to 10 (best case) we estimate the potential of DH being 9, industrial to 6, agricultural to 3 and commercial sector, to 7.

Beginning with <u>what boiler size</u> would a <u>fuel switch</u> be a viable option (due to economies of scale) currently?

The fuel switch is a viable option for projects between 8 kW and 500 kW, as the projects of up to the capacity of 500 kW are concerned by the feed in tariff support scheme currently in debate.

M<u>arket segments for installing new district heating schemes</u>, where biomass would be viable in Romania: E.g. business parks, shopping centres, housing developments etc.

1**. Plants producing heat for cities** (especially after the pass of the new Heating Law this will be viable and also a priority)
2**. Business parks**
3. **Other industrial plants**
4. **Shopping sector**

Beginning with what boiler size, would a new biomass district heating scheme be a viable option (due to economies of scale) currently?

Currently, there's no law enforcing biomass heating, or the heating support scheme in Romania. The draft of the new Heat Law is under preparation within the working group of the Services and Industries Commission of the Parliament and, provided it will be approved according to the current discussion, the support scheme that the authorities have in view will foster the construction of plants with capacities of up to 500 kW, which is viable for DH.

6.3.1.2 "In-house" boiler markets (auto-production of low temperature heat only)

The market segments indicated in the Questionnaire generally promising with regard to "in-house" boiler markets are:

1 Residential: especially if the new law will introduce the obligation of developers to propose one heating solution for the whole block, with the same fuel.
2. Commercial and service buildings: Yes
3. Public buildings: Yes
4. **Agriculture. Forestry:** Yes
5. **Industry**: only dairy factories. Breweries, wood and wood products (sawmills and furniture producers).

6.3.2 Criteria for selection of promising market segments and their influence regarding market penetration

6.3.2.1 State Risk and –support

Romania findings from interviews:

In Romania, the state has a crucial role in the clarification of the national energy strategy and the creation of a solid legislative framework for Biomass and Heating, which are currently under construction.

All the other elements: corruption, state structure, etc. are partially influencing some domains, but not in a decisive manner.

6.3.2.2 Technical questions

Romania findings from interviews:

There are some problems in Romania regarding fuel quality, which is not fitting the standards of quality in other European countries. The infrastructure of the existing district heating networks (both boilers and pipes) is currently under development. A quality management system will follow the international standards. Based on the replies we have received, technical trainings are needed to create more experts in the field of Biomass, along with the adoption of specific legal stipulations. Nevertheless, we appreciate (experts´ opinion) that all these matters cannot decisively influence the market development.

6.3.2.3 Economic questions

Romania findings from interviews:

The main idea for the Biomass projects is that subventions and financial incentives are needed in order for them to be profitable. Currently, there's no specific support scheme for heat from biomass. There are EU funds available for Biomass and Biogas projects of electricity with cogeneration and the importance of them is considered as high.

Below, there are listed a series of economic factors that influence the market based on the experts replies:

a. Investment costs: The costs are about 30% higher than for the fossil competitors
b. Organisation and maintenance costs: Important influence, as the higher maintenance costs versus fossil fuels increases the need for subsidies.
c. Feed in tariff and other incentives: The investors prefer a feed in tariff system, for both electricity and heat, which is not yet adopted, but under debate.
d. Price stability costs: The cost for the total investment (planning and building) has been relatively stable. The same applies for the cost of raw material.
e. Administrative efforts: * High importance (decisive influence) as there is no legislative framework for heat. The existing provisions apply to all technologies and it is more electricity production oriented. The new legislation for Heat is under debate and there is an expressed political will that it will be concluded in 2015.
f. Banks involvement in financing projects: Not very high. The banks are not interested in financing Biomass projects because of the lack of specific legislation, and the situation with the Green certificates – namely the decision of the Government to postpone the granting of a number of certificates depending on the technology used (biomass, wind, etc.).

6.3.2.4 Organisational questions

Romania findings from interviews:

The main factor that is influencing the market is the in-stability of frame conditions.

In **2014**, the situation of the energy installed for Biomass, electricity and CHP, as compared to the targets set in the NREAP, and in relation to the two main technologies that generated significant number of RES projects, PV and wind, was the following:

Installed	**Projected**
Wind: 2,966.55 MW	2,880 MW
PV: 1,168.38 MW	113 MW
Biomass: 100.3 MW	340 MW

PV projects surpassed the target by 10 times, while wind is also slightly exceeded. The share of Biomass projects is far from being met, as the projects require more time in order to be concluded and it is not a passive investment compared with the other technologies (we have in view here the maintenance costs).

Biomass is declared as a priority for Romania. This is why the relevant authorities are preparing the new legislation with regard to the change of promotion system for the RES, the new legislation specifically dedicated to Biomass, plus the Heat law. The feed in tariff scheme for projects of less than 500 kW is also under discussion. However, before the adoption of the said laws, the situation of the sector is unlikely to change significantly.

6.3.2.5 Motivation of investors

Romania findings from interviews:

Investors are aware of the potential of Romania, and the most important factor that influences the market development is the security and availability of the fuel supply. ARBIO, as the national association for Biomass, is organizing or participates in major events for RES in Romania and Europe in order to inform the potential investors

about Romania. Also, as a member of AEBIOM, all the latest news regarding the Biomass sector are spread by ARBIO to the market leaders. There are no other issues that could influence the sector significantly.

6.3.3 Summary of the most important factors that influence the success of market introduction at the most promising market segments

Romania findings from interviews:

In summary, the most important factors that influence the success of the market development are:

1. Clear and tangible legislation in favour of biomass and heat production
2. Structuring of the fuel supply chains
In Romania, the key stages along the supply chain (production, processing, conversion, and the final consumption) remain individual enterprise, and we cannot speak about an integrated process.
The connection to other biomass markets and the supply logistics - transport, storage and handling – are in the same situation, and are expected to get organized and develop in the following years.
3. The necessity of information campaigns
ARBIO is advocating, and also working on ways to organize large scale awareness campaigns, at national and local level, addressed to: potential investors, local authorities, economic actors from sectors such as agriculture, services, and industry, with regard to the economic and environmental advantages of Biomass.
4. The economic and environmental advantages of Biomass, such as:
a. reduction of the costs generated by the imports of fossil fuels
b. local energy independence
c. reduction of costs for the end user
d. protection of the environment by transforming waste into energy
e. reduction of emissions
f. utilization of unproductive agricultural lands

As a conclusion, the most promising sectors for the production of heat from Biomass are:

1. District Heating
2. Public buildings, especially schools and hospitals
3. Resorts and hotels
4. Commercial / Shopping sector

6.4 Most promising market segments abroad – view from Romanian market actors

Romania findings from interviews:

In Romania, the market of boiler producers that reach the criteria of this report is currently underdeveloped, either for industrial or for residential use.

During the market analysis, we have identified only one producer of boilers who covers the above mentioned criteria, and it is exporting to the following countries: Austria, Hungary, Moldova and Ukraine.

We appreciate that the future of the market could be promising as there is interest expressed by European producers to move their production to Romania, but this remains at the phase of future plans for the moment.

7 Characterization of promising market segments (facts & figures)

7.1 Summary – selection of most promising market segments

Based on the conclusions of the interviews performed by ARBIO, in Romania, the most promising sectors for the production of heat from Biomass, where a switch from fossil fuels is the most likely, are the following:

1. District Heating
2. Public buildings
3. Hotels
4. Commercial / Shopping sector

At the moment of the present report, the Biomass heating sector is not yet developed in our country; the criteria used in experts' opinion for selecting the most promising sectors above mentioned regards the **perspective** given by the new relevant legislation which is currently being under preparation or debate.

Biomass is officially declared a priority in Romania. It is our understanding that in the course of the following 18 months, Romania will have a new legislation with regard to: Biomass, Energy Crops and Heating,

In experts' opinion, **the new laws**, one general, regarding the Biomass sector in its entirety: the Biomass Law, one special, concerning DH and probably public buildings sector (which is not yet clarified at this stage of the debates): the Heat Law, and one specific: the Energy Crops Law, will have in the following period a major impact in the development of the abovementioned market segments.

The new Heating Law, which is currently under debate in the Parliament of Romania (Parliamentary Group for Energy) primarily regards the **DH sector** but will impact other market segments as well, for the reasons exposed below.

One of the main scopes of the law is the implementation of the European legislation on heat production into the national legislation (Directive no. DEE2012/27/EU, amending Directives 2009/125/EC and 2010/30/EC, which repeal Directives 2004/8/EC and 2006/32/EC).

There are four important aspects envisioned by the new Heating Law with a major impact on the production of heat from Biomass:

1. The distribution and the production will be distinctly regulated, **and all producers will have access to the distribution network** (currently, there's no obligation of the operators to take over the heat produced from renewable sources). We appreciate that the possibility to fructify the energy produced constitutes a very important factor that will encourage investors to develop Biomass heating projects in the near future.

2. There will be an express stipulation of the law that **50% of the energy produced (heat) shall be obtained from bioenergy sources**. This provision has a direct impact on the renewable energy sector, especially Biomass (and Biogas and Geothermal). The fact that everywhere in Europe the heat is mainly obtained from the fore mentioned sources (about 87%), and Romania is willing to follow this success path, combined with the fact that Romania has a great potential for Biomass which it is willing to fructify, entitles us to appreciate that the Biomass heating sector will experience a significant boost in the coming years.

3. The production of heat will be **subsidized** by a formula which is being currently at the proposal phase.
4. The establishment of a more coherent and **integrated option system for the end consumer** with regard to its heating needs. Currently, the end consumer is free to choose the heating method it prefers, individually, which disturbed and unbalanced the DH sector, or even contributed to its disappearance in many cities.

We appreciate that all the reasons above mentioned will greatly contribute to the reviving of the DH sector in Romania, and will encourage investors to develop heating projects, especially Biomass. In addition, the fact that all producers will have guaranteed the access to the distribution network, will stimulate investments in all the other most promising sectors as well.

In the current debate phase, there is one aspect with is not being yet clarified, namely whether the public buildings sector will be expressly regulated by the new Heating Law, which we appreciate would have a bigger impact on the development of the sector.

Regardless of the outcome of the issue, from the aggregation of the provisions of the Heating Law and the new Biomass Law, all the sectors above mentioned: DH, public buildings (especially schools and hospitals), resorts and hotels and commercial / shopping will benefit in a relevant manner.

The new Biomass Law, currently under debate by the joint effort of 4 ministries (Energy, Environment, Agriculture and Development), the National Energy Regulation Authority (ANRE) and ARBIO, is mainly addressing the sectors that produce or generate biomass feedstock; among the most important provisions of the law, we mention the following:

1. The establishment of a stable and transparent framework for the investors, to guarantee their revenues (which will be calculated on both the investment and operational costs).

2. The prioritization of the high efficiency heating energy production.

Another law that is expected to significantly impact the development of the heating sector in Romania, namely the production of heat from Biomass, is the Law on Energy Crops, which is also under preparation at the present moment; the new law aims at the clarification of the legal status of agricultural and non-agricultural lands, enabling the use of third category lands for the cultivation of energetic plants.

Basically, the law will regulate a subsidies-system and will stimulate the creation of a cycle in which the investor produces its own raw material for the energy it produces. By encouraging own biomass feedstock production, combined with the fact that the producer will benefit from subsidies while its access to the distribution network will be guaranteed, we appreciate that the proper conditions are created for the boost of Biomass heating sector in the coming years.

In addition, it is also important to mention two initiatives of the Romanian Government that support the above mentioned conclusion: the proposal for public debate of the National Strategy for Climate Change and of the National Action Plan for the Waste Management, conducted by the Ministry of Environment.

7.2 District Heating Sector

In the new Heating Law there will be an express stipulation that **50% of the energy produced (heat) shall be obtained from bioenergy sources**.

Assuming that this will be the final form of the legal provision, and considering that biomass is the most used renewable resource for the heat production at European level, we may estimate that the share of biomass used in the DH sector in the coming years will cover about 40%.

Considering Romania's great potential for Biomass, plus the orientation towards the encouragement of renewable sources of energy usage in the production of heat, we appreciate that the Biomass heating sector will experience a significant development in the years to come, and especially for the DH sector.

7.2.1 Estimation of the GHG-mitigation potential

Traditionally, Romania is using natural gas for heating purposes. According to the official data available on the Eurostat website, at the level of 2013, the transformation input in Romania's DH plants, the fuel input was of 5,361 GWh natural gas.

Assuming the 40% biomass would substitute the natural gas in the natural gas–fired DH plants, and taking into account the average emission factor of the natural gas of 202 t CO2/GWh (see Table 20 below), the CO2-savings potential in the DH sector would be of **433,203 t/a CO2**.

Table 20 - Default GHG-emission factors for different final energy carriers in Romania. Average values

GHG emission factors in t/ GWh	
Energy carrier	**CO_2**
Coal	341
Residual fuel oil	279
Liquid petroleum gas	231
Natural gas	202

Source: IPCC methodology

7.3 Public and Private Service Sector

As it results from the addregation of the provisions of the new Heating and Biomass Law, the Services Sector, namely Public buildings, especially schools and hospitals, Resorts and hotels and Commercial / Shopping sector has a great potential for the fuel switch to renewable sources of energy usage, especially biomass.

7.3.1 Estimation of the GHG-mitigation potential

According to the official data available on the Eurostat website, at the level of 2013, final energy consumption in the services sector for oil (918.7 GWh) and natural gas (9,129.6 GWh) was, in total, of 10,048.3 GWh, used for both electricity and heat purposes. However, data is not available on the quantities specifically used for heat purposes.

Assuming that biomass would substitute 10% of the oil (only) used in the services sector consumption, and taking into account the average emission factor of oil of 279 t CO2/GWh (see Table 20), the CO2-savings potential in the services sector of biomass instead of oil would be of approximately 25,668 t/a CO2.

Similarly, for an assumed 10% natural gas switch to biomass, for an emission factor of 202 t CO2/GWh (see Table 20) the CO2-savings potential in the services sector of biomass instead of natural gas would be of approximately 184,416 t/a CO2.