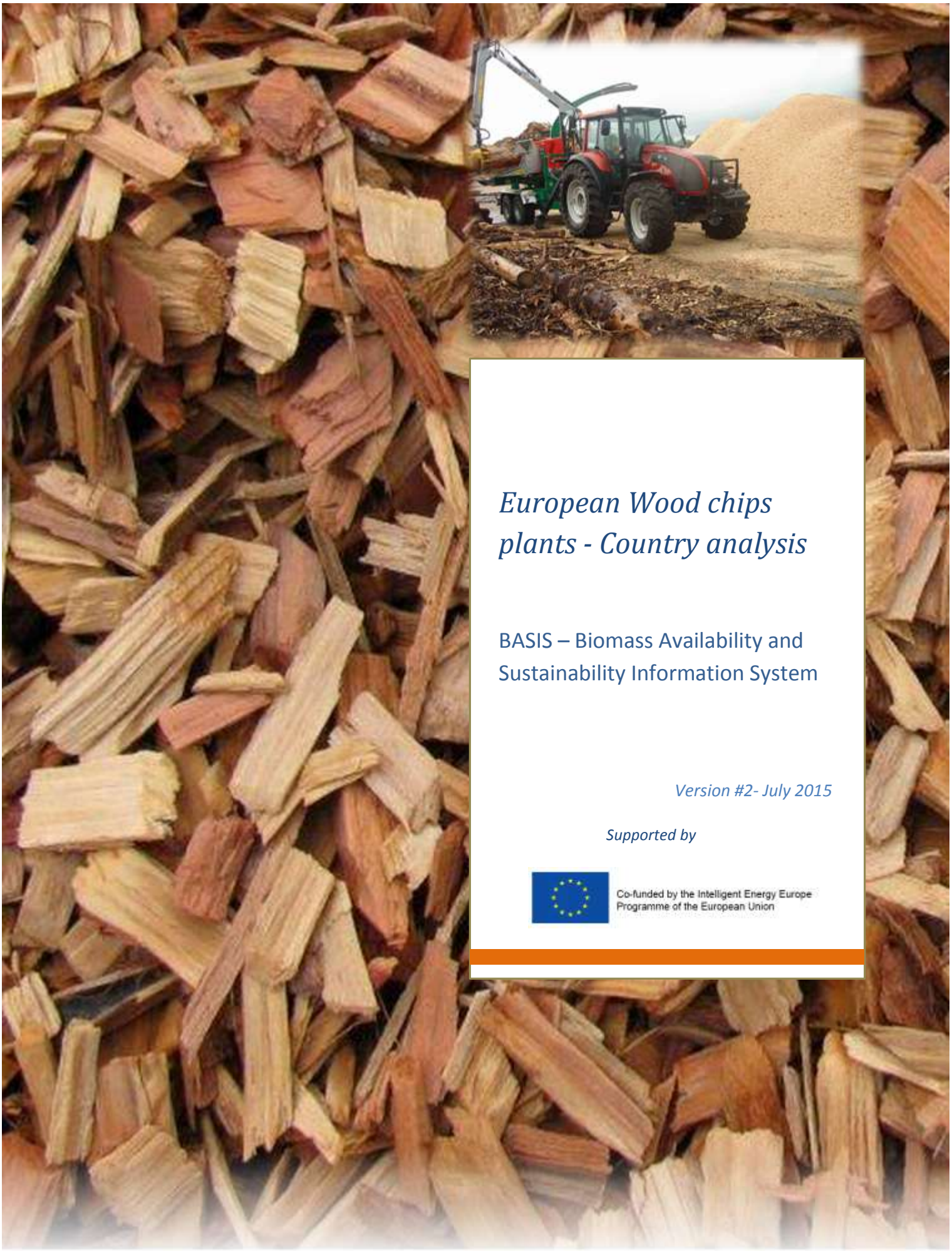

European Wood chips plants - Country analysis

BASIS – Biomass Availability and Sustainability Information System

Version #2- July 2015

Supported by

Co-funded by the Intelligent Energy Europe Programme of the European Union

- **Interested in BASIS Project?**

This project aims at building a platform to assess wood chip supply. It has been designed to support project developers, feedstock suppliers and investors to evaluate the actual availability of wood chips biomass on a regional level in the EU28. There is absolutely no cost associated with the use of the platform.

http://www.basisbioenergy.eu/

BASIS project is supported by the Intelligent Energy Europe program (IEE/12/830/S12.645698)

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Table of Contents

INTRODUCTION

1.1 BASIS Abstract

BASIS is a project by the European Biomass Association, Imperial College London, a consultancy (Eclareon) and a total of 7 national bioenergy associations from the following countries: Austria, Denmark, France, Italy, Germany, Spain and Sweden.

BASIS aims at interacting with bioenergy project developers and investors, providing them a comprehensive view on the sustainable supply and competition for wood for wood chips boilers.
The core idea of this project is to provide in-depth information on the regional supply and demand situation of wood chips by combining the estimated potentially available quantities with actual consumption data based on the identification of bioenergy plants (above 1 MW) using wood chips and other wood chips consumers in the same region. This information collected will be condensed in a comprehensive and easy to use GIS tool. http://www.basisbioenergy.eu/

Why wood for wood chips boilers?

BASIS addresses wood supply for wood chips boilers for two main reasons:

1. it is by far the main form of wood used for medium and large scale projects
2. Wood for wood chips are mainly traded on a local and regional basis

As a result *BASIS* will increase market transparency in the wood chips markets:

- **Project developers** would be able to use *BASIS* in combination with the results of Cross Border Bioenergy (http://www.crossborderbioenergy.eu/) to find attractive locations for new projects.
- **Investors** would be able to use *BASIS* for the risk assessment of projects in pre-development stage to assess whether a region has enough feedstock potential for a sustainable supply of wood chips over the investment period.
- **Feedstock suppliers** will use it to find new customers and develop their biomass supply.
- **Stakeholders** are provided with a comprehensive overview of biomass use in plants above 1 MW capacity, bioenergy conversion efficiency as well as a detailed insight on sustainability aspects from a market perspective.

1.2 BASIS Country Analysis Report: Overview and Methodology

Country Analysis Report aims at presenting initial main outcomes resulting from data collection led at EU28 level during 2014 under AEBIOM guidance. In order to provide an increasingly accurate perception of different national situations concerning the use of wood chips by bioenergy plants, it has been asked to BASIS partners (AT, DK, DE, IT, SE, ES, FR) to comment statistics obtained from data collection. Situation of remaining countries has been reported in the general European overview presented in conclusion of this report.
In order to build a simple and comprehensive grid of analysis, this country Report follows a common structure: a short introduction with the current situation of wood chips uses in the country (1), a statement of the number and characteristics of plants using wood chips as fuel (2), their overall and specific consumption of

wood (3) compared with other use of the same resource (4). As a conclusion perspectives on national developments and markets opportunities were highlighted (5).

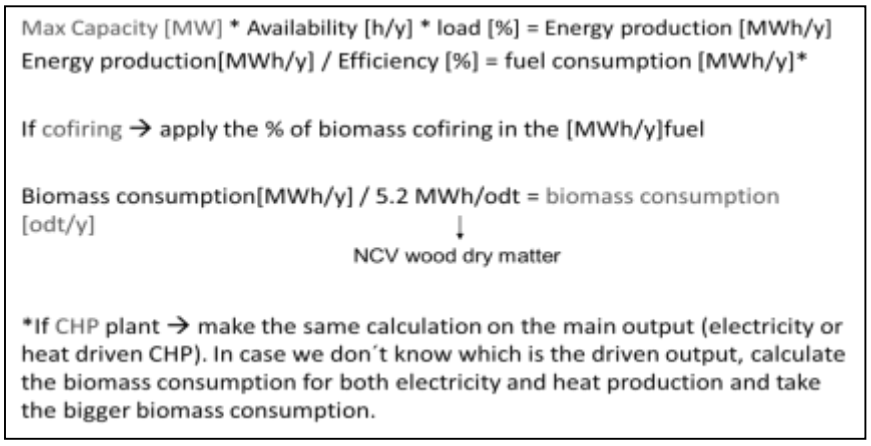
This structure reflects the methodology used in BASIS data collection process. In fact, as briefly explained previously, aside from mapping all bioenergy plants, one of BASIS secondary objective was to have a better understanding of woodchip uses by having an accurate insight of national markets specificities. In this context, apart from plants location data, questions were asked on installation specificities and about regional activities that affect the supply of wood for woodchip. In this context the following information have been collected:

- **Woodchip energy production**: Contributors were asked to collect figures for all plants bigger than 1 MW by providing at least their location, their plant output type (Electricity, CHP, Heat), their size and general characteristics as well as quantity and quality of wood use to produce bioenergy.
- **Particle board**: data collection contained basic information such as name and location of plants in addition to data on either wood input or product output.
- **Pulp mills**: In addition to data on wood input or product output, data collection contained basic information such as name and location of plants that produce pulp for the paper industry.
- **Pellet manufacturing**: In addition to data on wood input or product output, data collection contained basic information such as name and location of plants that produce wood pellets.
- **Wood log use**: Data collection for woodlog use in partner countries was realized with country level data on the use of wood logs at NUTS2 region level.
- **Harbours**: In addition to data on cargo throughput and other logistical capabilities, this final data collection contains basic information such as name and location of ports.

Regarding the general methodology used to collect data on these various wood chips uses, one central objective was to collect a maximum of raw data from plants by a direct contact and by using very few assumptions. However, especially in the case of the smallest appliances, requested data mostly wood consumption and plant size (MW biomass fuel input) were hard to collect directly. The data collection was also not as smooth as presumed as companies were not willing to share all the requested information. With these in mind, in some cases, calculations have been realized following the methodology presented below:

- **Plant size:** Usually plants don´t provide this data, but it can be calculated knowing the energy output and the efficiency. E.g. For an electricity plant with an output of 293 GWh/year and efficiency of 0.3, its plant size would be: 293000 MWh/y ÷ (0.3 * 7750h) = 126.02 MWbiomass

- **Wood demand:** For the calculation of the wood demand knowing the capacity, efficiency, load factor and availability; the following method has been used:



Note from Authors: Statistics presented in this report are resulting from an original data collection at EU level. This document try to be as comprehensive and exhaustive as possible, however some data could be missing. In this context, national comparison needs to be done with great care as well as comparison between wood chips used for energy and other used for instance. The data collection had not been completed when this report was published and hence final data of the project is slightly different.

Country analysis Presentation

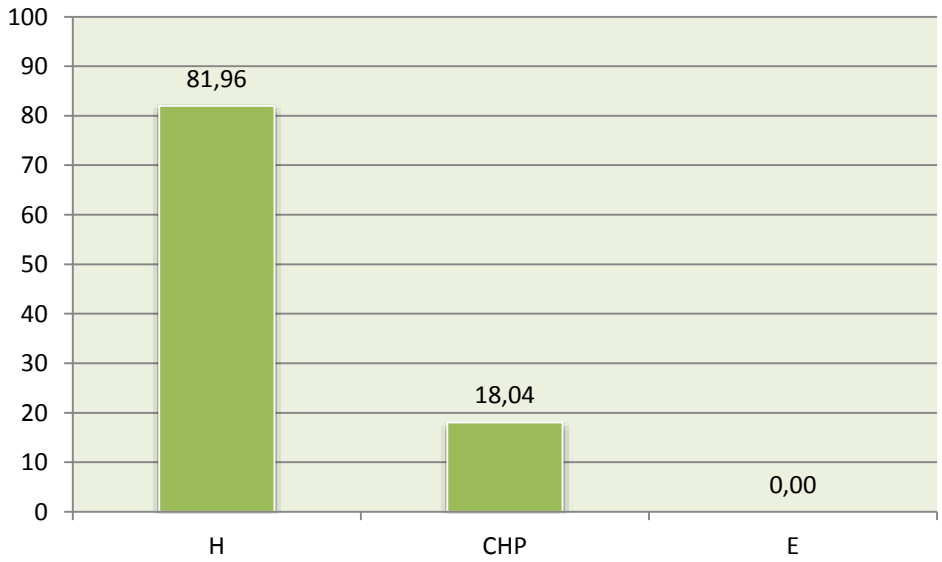
1. Austria

1.1 Introduction:

The final energy consumption of bioenergy has increased by 51 percent from 3.3 Million Toe in 2005 to 5,0 Million Toe in 2012. In 2012 the heat market was dominant for the bioenergy with a share of 82%, followed by biofuels, with a market share of 10 percent and the green electricity generation from biomass and biogas with 8%. About half of the Austrian district heating supply, which supplies 25% of households with heat, is based on biomass resources. In addition, the proportion of individual small-scale heating by the usage of biomass in households amounts to 20 percent. The share of electricity from biomass in electricity consumption is 7 percent, without electricity generation from biogas it is 6 percent. The raw material mainly consists of solid biomass, which is obtained in sawmill by products, in the Austrian timber industry or at forest tending measures. By 2020, the final energy consumption could be increased to about 250 PJ.

1.2 Austrian biomass plants characteristics:

Distribution of biomass plants in Austria:



In Austria the first biomass heating plants were built in the 1990s. At the turn of the millennium there was a boom in Austria. Currently, about 2000 plants of different sizes are in operation, there are about 560 plants over a megawatt. There is a biomass heating plant in almost every major city. Expansion potential lies mainly in

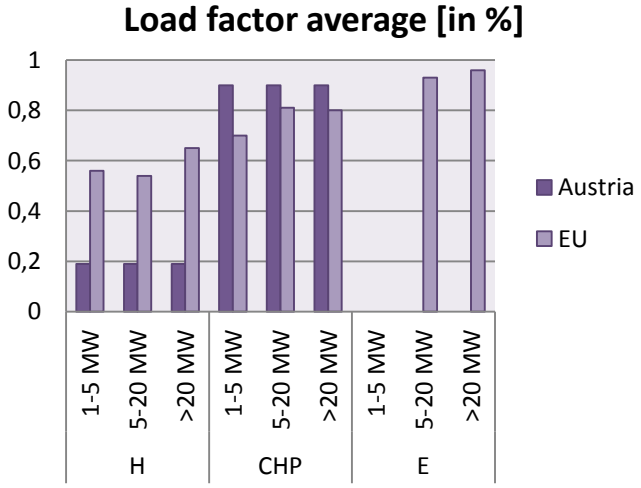
small and medium-sized plants for the supply of public buildings, multi-storey, terraced houses, and commercial buildings and in the integration of biomass burners in existing heat networks. For new successful projects there are short supply lines and high heat sales needed. The combined heat and power plant park was built mainly between 2003 and 2009. After that, the feed-in tariffs for new plants were reduced and only a few new plants were built. With the amendment of the Austrian Green Electricity Act 2012, there was an own funding quota with higher feed-in tariffs set for Biomass CHP plants under 500 kW of electric power. Since this amendment, a few plants were built of this size.

Biomass plant characteristics per type in Austria:

Austria			
Plant type	H	CHP	E
Number of plants >1 MW *(in number)*	459	101	-
Plant size *(MW biomass fuel input)*	2,95	21,03	-
Average rated electrical capacity *(MWe)*	0	3,3	-
Average rated heat capacity *(MWth)*	2,95	17,9	-

In Austria there are 459 biomass heating plants and about 101 biomass CHP plants. The average power, based on the energy content of the used fuel, is 2.95 MW at biomass heating plants, at CHP plants at 21.03 MW.
Biomass heating plants were built by operator communities of farmers who recover their wood chips. This results in an optimal plant size, which is orientated to the offer of regional wood chips and regional heat demand. Biomass CHP plants in contrast to the pure combustion achieve the highest possible system efficiency only in a power range of several MW. Amounts of heat, which are generated in CHP plans, need plant locations with a high heat demand for an efficient resource use.
Usually biomass-CHP plants have been implemented near timber companies (large heat demand and large amounts of biogenic residues) or district heating networks (large heat demand). With the progress of wood gasification technology, which is characterized by high electrical efficiencies in the low power range, the current production of electricity would be possible under the appropriate conditions. This technology is currently in the launch.

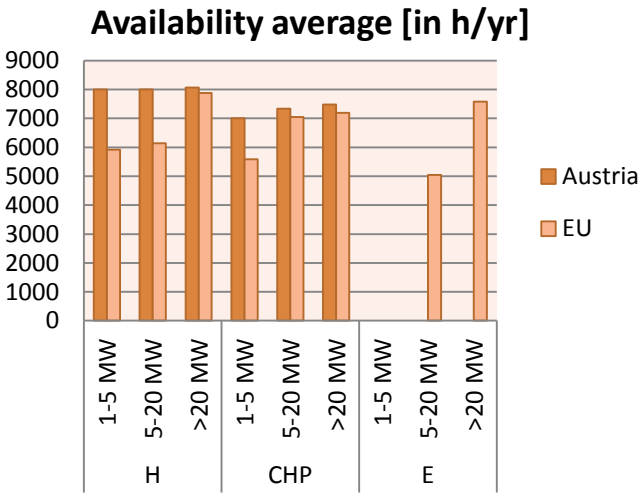
Load factor, Availability, Efficiency of plant in Austria:



In Austria the majority of biomass heating plants is running in a year-round operation. In summer and in the transitional months, the heat production has to be adjusted to the reduced demand. The installed boiler capacity is therefore higher than the retrieved average performance. The reason is that the plants have

to be conceptualized to cover the peak demand during cold winter months.

To ensure efficient use of raw materials under these conditions, multi-boiler systems are installed, and some plants are provided with a buffer memory and clocked.
The differences to the European average appear because of the different conception of Austrian biomass heating plants. The load factor is not an index to analyse efficiency and make statements about the efficiency of fuel use.
Biomass CHP plants are primarily optimized for electricity production and many full load hours with maximum utilization of the plant. The installed capacity and the retrieved average performance are therefore much higher than those of biomass heating plants.



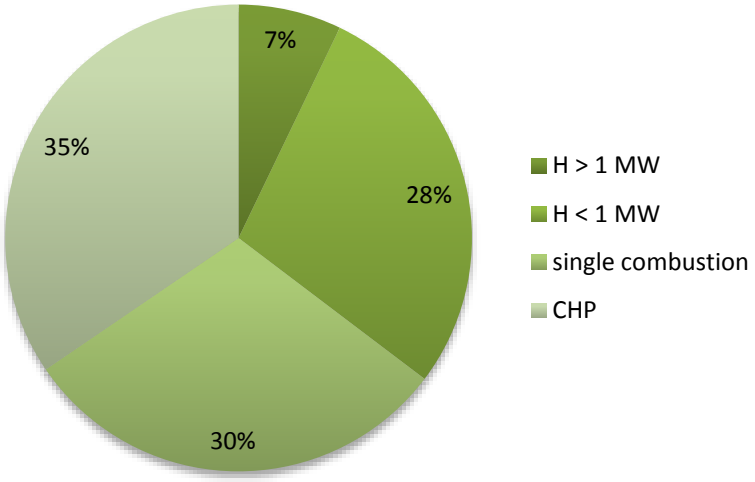
Austrian bioenergy systems have a higher plant availability compared to the European average. The high reliability of the boiler-system is absolutely necessary especially for smaller systems. Many heating plants have a failover fossil-fuelled emergency boiler or have access to an emergency mobile boiler. However, this is connected to high costs, which can lead to an enormous financial strain for small plants. Therefore, the plant operator tries his best to maintain the high quality of the technology and well-trained staff. Many years of experience and comprehensive know-how in plant operation are other important factors.

1.3 Austrian actual use of woodchip:

Annual wood consumption per plant type in Austria [in Odt/yr]:

Austria (Overall national wood consumption = 3.479.092,8 Odt/y)					
Plant type	H > 1MW	H < 1 MW	single combustion	CHP	E
Plant Type per country (*in units*)	459	-	-	101	-
National wood consumption per type (*in odt/yr*)	900.000* Incl. SCP, bark, wood chips	3.550.000* Incl. SCP, bark, wood chips, Pellets	3.800.000* Incl. Firewood, Briquettes	4.350.000* Incl. Black Liquor, bark, SCP, wood chips	-
National Average of annual wood input per type (*in odt/yr*)	1.960	-	-	43.069	-

National woodchip consumption per plant type [in %]:



In Austria 25.2 million m³ wood are recycled per year by the wood industry itself, by biomass heating plants, CHP plants and by individual small-scale heating. The term « wood chips » takes too short, because solid biomass in form of industrial wood waste or sawmill by-products, bark, wood chips, firewood, pellets, briquettes and liquor (residues from paper production) are used for energy production as well. Forestry and wood industry have developed a detailed flowchart of wood that serves as the base for further considerations and provides the most accurate overview of the energetically recycled wood quantities in Austria.

1.4 Energetic use of wood chips compared to other uses:

Woodchip consumption compared to other industry wood uses [in Million odt/y]

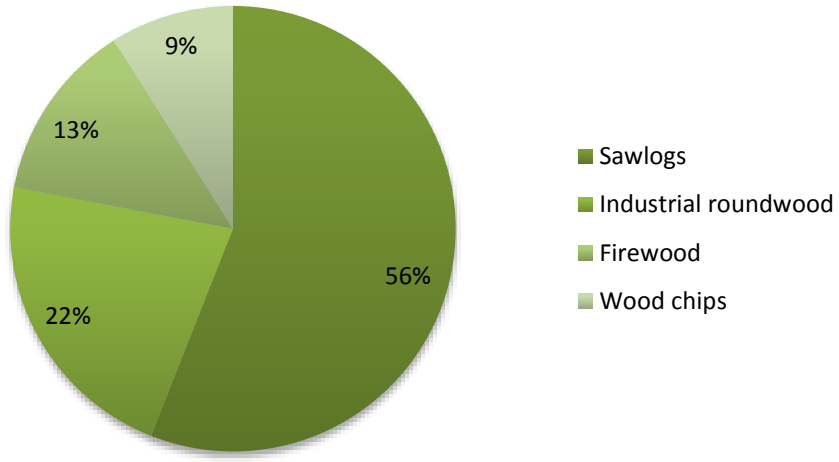
Austria			
	Quantity of wood use	*Primary and semi-finished products (lumber, furniture, paper, ...)*	*By-product (SNP, bark, base, ...)*
Sawmill industry	8.9	4.5	8.8
Other wood industry	3.9	2.2	4.45
Panel industry	1.55	1.4	0.15
Paper industry	4.1	2	2.1
Pellet manufacturers	1	1	-
Direct energy use	7.05	-	-
Indirect energy use	5.75	-	-
Total	33.05	11.1	-

** The cascading use increases the amount of used wood from 46.4 million cubic meters to 66.1 million cubic meters. This is because the same raw material is used several times by the cascading use. Conversion factor 1 cubic meter = 0.5 odt*

The demand for saw logs, which is further processed in the sawmill-industry, is the engine of the value chain of wood. Wood-use is achieved as a cascading use of wood in Austria. This means, that wood – if it is economically possible - is used repeatedly. Concerning the wood industry and as well as the harvesting there are residues for energy recovery. The energy recovery takes place in the wood industry itself, in biomass heating plants, biomass CHP plants or in individual small-scale heating. Many industrial companies also operate biomass heating (power) plants. In addition, the highly export-oriented Austrian wood industry imported quantities of wood, primarily from neighbouring countries. In its usage, there are also large quantities of waste, which are used for energy production. The table shows the data of the value chain of wood from wood products.

In Austria 46.4 million m³ wood are used, that originate from the use of wood in the forest, from other wood supply and from imports of fresh wood, semi-finished and by-products. 5.2 million m³ are exported in form of lumber, 1.1 million m³ in the form of sawmill products. 4.4 million m³ become solid wood products, 2.8 million m³ become products of the panel industry, 4 million m³ become products in the paper industry. In the processing and harvesting of wood, there are large amounts of by-products for energy recovery - all in all 25.2 million m³. 14.1 million m³ - mainly low-quality firewood, wood chips and bark are directly utilized energetically in agriculture and forestry enterprises, heating (power) plants and commercial or individual small-scale heating. 11.1 million m³ get in the energy market by industry. In Austria 78.3 % of the amount of fresh wood provided by harvesting and imports get used materially and cascade. The proportion of directly energetically used wood from forest and imports is 14 percent.

Roundwood supply in Austria 2012 – imports and forest use based on TFR[1]



1.5 Conclusion

In Austria, the wood production, wood industry and energetic use of biomass has a great tradition for centuries and is closely interlinked. The possible potential for biomass is closely connected with the development of the

[1] Source : based on TFR (BMLFUW), BFW, FHP, Statistik Austria, LKO, Austrian Energy Agency. Import and forest use represents a total of 30,4 million m³ (direct energetic use 6.6 million m³ (21,7%) / pathway materials use 23.8 million m³ (78,3%))

material use of wood, especially in the field of solid wood. Sales of wood and sawmill products is the base of a working value-added chain in the wood industry. Only if this value-added chain works, there are residues in the wood and wood industry, which can be used energetically. The wood resources in the Austrian woods have reached an all-time record. At the same time, the traditionally paper industry expects a market slump of over 50 percent. Due to the rising average of annual temperatures (plus 2 degrees Celsius in Austria since the pre-industrial era) the amount of damaged wood is increasing. In addition to the rebuilding of stocks in more resistant mix forests, there will be more low-quality wood for energetically usage available. The appraisal and thinning in the forest could mobilize large quantities of wood and could also have a positive effect on the increment. In general, if environmental conditions fit, the forced use of solid wood is also the best program for promoting bioenergy.

2° Denmark

2.1 Introduction:

Bioenergy is an important energy source in Denmark. In 2012, biomass accounted for 3,2 Million Toe. This is more than 70% of the renewable energy consumption and almost 18% of the total energy consumption in Denmark in 2012.
74% of the bioenergy originated from Danish production of biomass while the remaining 36% of the biomass was imported. While Danish production of biomass is expected to increase, an even stronger growth in the import of biomass is expected in the years to come.
It is estimated that approximately 1/3 of the Danish straw resource from agriculture is used for energy purposes. Wood and biodegradable waste are also important sources of bioenergy. Biogas is, with a contribution of only 4.000 TJ in 2012, still only a small supplier to bioenergy and is not taken into account in this report.
The Danish bioenergy consumption quadrupled in the period 1980 to 2005 and is expected to further increase significantly in the coming years, especially in the combined heat and power production. Some of the largest energy providers (e.g. DONG Energy and HOFOR) are in the process of converting large fossil fuel-driven CHP plants into biomass. These plants include the following major plants: Nordjylland, Studstrup, Skærbæk, Avedøre, and Amager.
The strong and growing use of biomass in the Danish energy consumption can be attributed to the legislative agreement on biomass in 1993 which obliged CHP plants to use 1,4 Mt of straw and wood in their energy production. Recently, the energy agreement from 2012 sets new and ambitious targets for reductions in CO2-emissions and use of biomass.

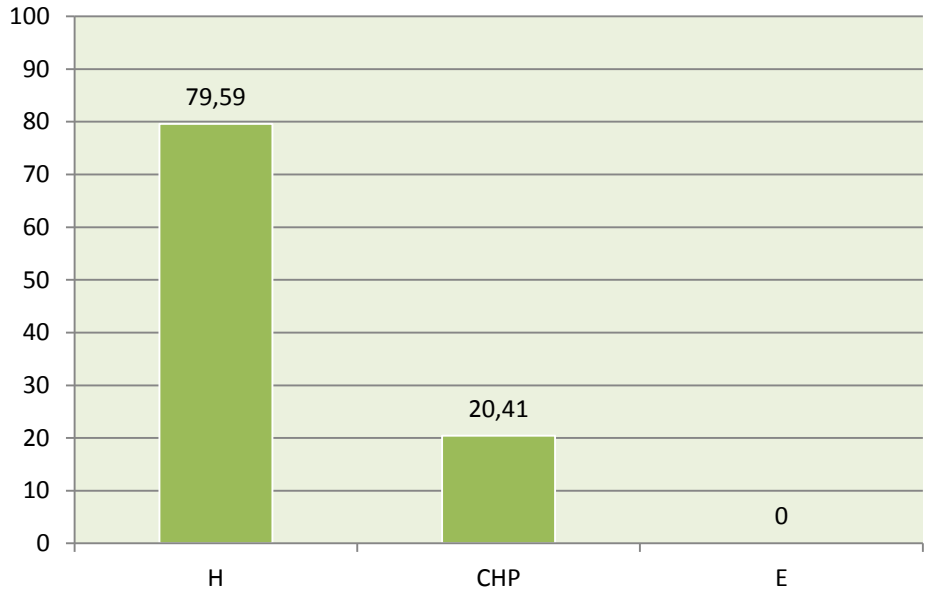
Biomass in Danish energy production, 1.000 TJ (2012)

Type of biomass	Danish	Imported	Total
Straw	17	-	17
Wood chips	12	6	18
Wood	20	3	24
Wood pellets	2	32	33
Wood waste	10	-	10
Biodegradable waste	21	-	21
Biofuels	4	7	11
Total bioenergy	**86**	**48**	**134**
Total renewable energy			**184**
Total energy			**760**

Source: Danish Energy Agency. Energy Statistics 2012.

2.2 Danish biomass plants characteristics:

Distribution of biomass plants in Denmark:



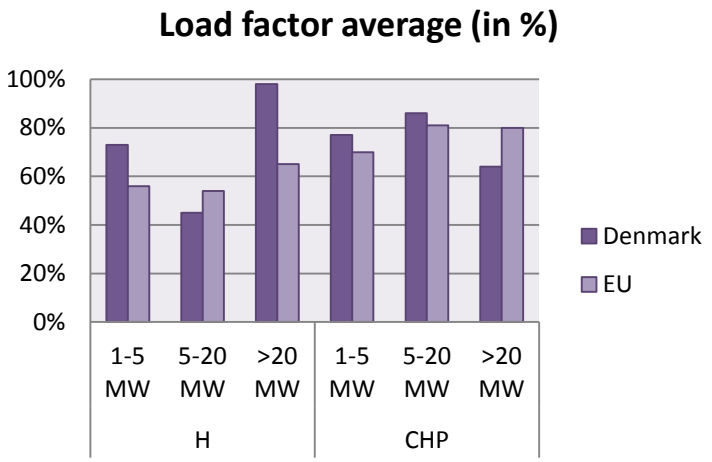
Denmark has no big pure electricity plants, but rather heat plants and CHP plants. More plants will be converted from fossil fuels to biomass in the coming years as a consequence of Denmark's energy policy agreement from 2012 to reduce CO2-emissions from the energy sector by 34 per cent by 2020 compared to 1990.

Biomass plants characteristics per type:

Denmark			
Plant type	H	CHP	E
Number of plants >1MW *(in number)*	78	20	-
Plant size *(MW biomass fuel input)*	5,8	56,0	-
Rated electrical capacity *(MWe)*	-	17,9	-
Rated heat capacity *(MWth)*	6,1	36,3	-

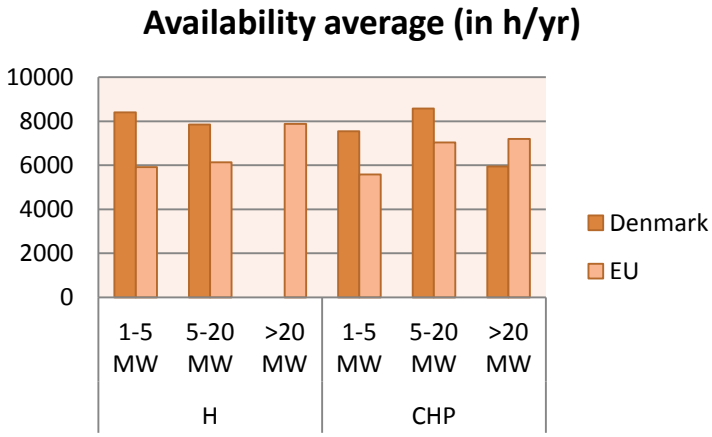
The table indicates that Denmark has 78 heat plants and 20 CHP plants. The heat plants are usually relatively small and serve local communities with heat. It is not profitable to establish small scale CHP plants. The CHP plants are therefore bigger, and although their number is limited, their capacity is much bigger than the heat-only plants.

Load factor, Availability, Efficiency of plant:

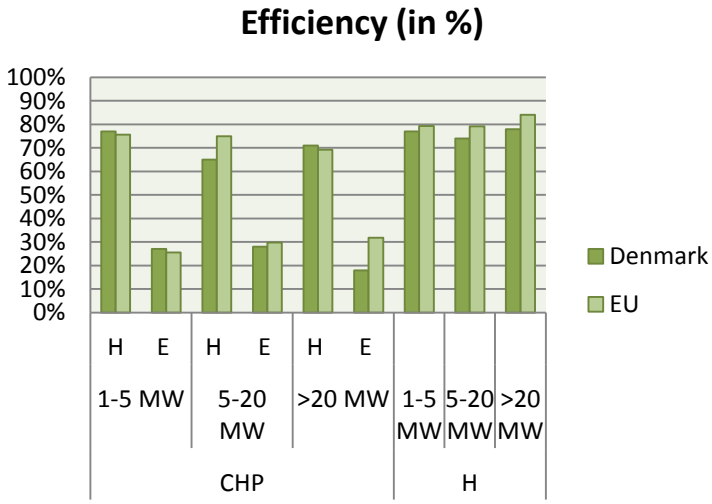


The graph shows that the load capacity is, on average, higher in Denmark than the EU average.

The bar for heat >20MW is not fully representative as it only contains only one observation, being from a heat plant with an especially high load factor.



The average availability in Denmark is higher than the rest of EU.
Biomass constitutes a large part of Danish energy consumption and is increasingly a main stream fuel. Therefore, the biomass plants need to have a high availability as they are a fully integrated part of the energy supply which is relied on.



The efficiency of heat plants is marginally lower than the EU averages. As the averages are constructed from only a few observations, it is not necessarily fully representative. However, one possible explanation for this slightly lower efficiency may be that Denmark being among the first-movers in the field of bioenergy, today has a number of plants that are on average older than the EU-average.

2.3 Danish actual Use of woodchip:

Annual wood consumption per plant type:

Denmark (Overall national woodchip consumption = 2.147.039 Odt/y)			
Plant type	H	C	E
Plant Type per country (*in units*)	78	20	0
National wood consumption per type (*in odt/yr*)	979.145	1.167.894	0
National Average of annual wood input per type (*in odt/yr*)	12.716	58.394	0

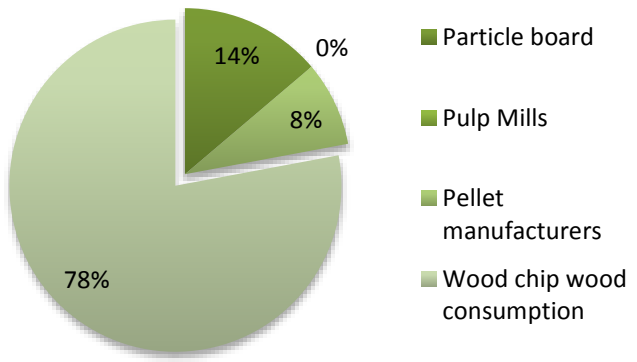
The average of annual wood input is higher for Denmark than the rest of EU. The reason for this are: 1° higher load factor, 2° larger availability average and 3° marginally lower efficiency in heat plants

2.4 Energetic use of wood chips compared to other uses:

Woodchip consumption compared to other industry wood uses in Denmark (in odt/y):

Denmark	
Particle board *(in odt/y)*	380.000
Pulp Mills *(in odt/y)*	0
Pellet manufacturers *(in odt/y)*	227.778
Wood log use *(in odt/y)*	2.753.114
Total woodchip consumption of industrial sector working with wood *(in odt/y)*	3.360.892

Comparison between woodchip uses for energy production and other industrial uses (in %):



The energy sector dominates the use of wood chips by 78 % while other industrial uses only constitute 22 %. It is, however important to note that a significant share of the wood chip consumed in the energy sector is imported.

2.5 Conclusion

There is a further investment potential in bioenergy in Denmark. The technical potential for locally produced biomass is approximately 100 PJ of energy, i.e. unused biomass that could be used in the energy production. But increasingly relying on imported biomass, there is no national boundary for the development in this field.
The primary determinants, as to whether or not the potential in bioenergy can be exploited, are the future price of fossil fuels and biomass, as well as advancements, and energy policy motivated incentives.
At present, the conversion of large CHP plants to biomass use is the dominant area of investment in the sector in Denmark planned to take place before 2020.
Further, the many smaller decentralized heat plants continuously invest and may switch towards more bioenergy, from local or imported sources. An acceleration in this type of conversion hinges on Danish policy incentives.

3° France

3.1 Introduction:

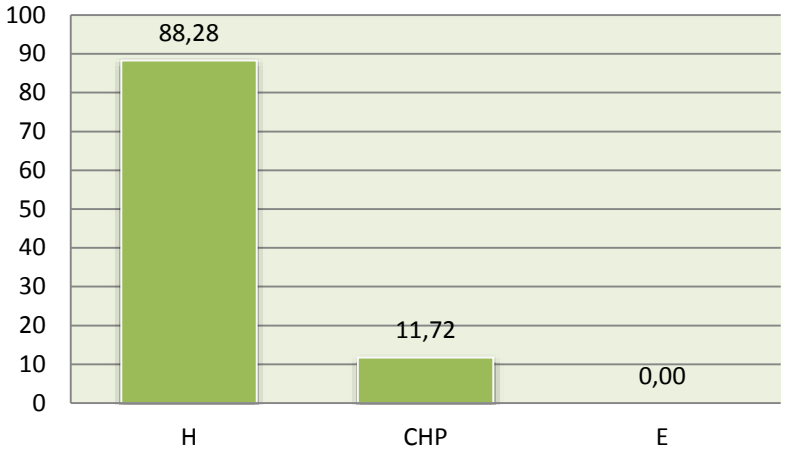
In France, biomass is the main driver for renewable energy with 65% of the national production (46% for wood energy, 11% for biofuels, 1,8% for biogas and other as for example : household waste). This general trend will keep on in the coming years thanks to the action of public authorities which are currently implementing lots of targets for biomass. In 2009 and 2014, Ministry of ecology presented the French targets for renewable energy:

- In the “Grenelle de l’environnement” : 23% share of energy from renewable sources in gross final consumption of energy in 2020 with 58% of biomass which will produce :
    - 11% share of renewable electricity ;
    - 83% share of renewable heat ;
    - More than 90% share of the renewables in the transport.
- Discussions are currently at works in order to agree on news targets for 2030: “Projet de Loi relative à la transition énergétique pour la croissance verte”. The part of wood energy will still be important including for heat efficiency.

In 2014, Ministry of economy and finances and Ministry of agriculture and the forest organized a consultation between the key players of the whole wood industry sector to discuss about the uses of wood. Indeed, currently there are difficulties to mobilize the wood and to provision all of the wood industries. French forest is one of the most important of Europe: 25% public forest and 75% private forest. Lots of actions are carried out to approach and involve foresters to manage their forests; others actions to improve the competitiveness of wood sectors and to have a better organization for the industry.

3.2 French biomass plants characteristics:

Distribution of biomass plants in France:



French government support heat plants under a support fund for heating called “Fonds chaleur” which exist since 2009. On the first period 2009-2013, this “fonds chaleur” allowed a real acceleration of projects to produce renewable heat. It concerns wood biomass, gasification, geothermal, district heating, solar thermal and fatal heat recovery. The budget was 1,112 billion of euros for the 5 years (around 200 million of euros each year). Between 2000 and 2012, the average heat production from biomass was tripled : 1,4 million toe/year. Government appreciate “Fonds chaleur” because device performance has been proven in public funding.

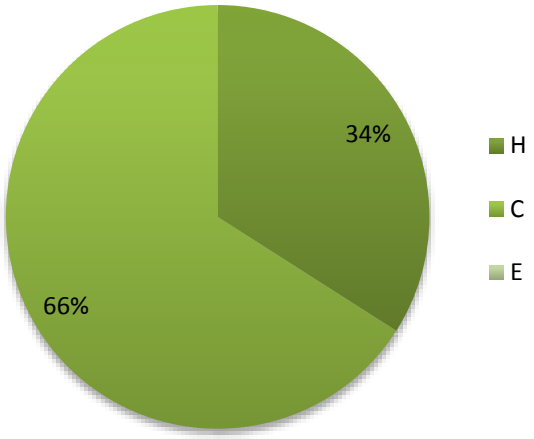
CHP has been less supported by French government because main target is to improve in priority heat renewable energy development. The supports for CHP are not adapted : tariffs are too low and tenders are not adapted. Currently, government is thinking about calling for a new tender in 2015. Discussions are underway with all actors of the sector.

3.3 French Actual Use of woodchip:

Annual wood consumption per plant type in France:

France			
(Overall national wood consumption = 5.603.058 Odt/y)			
Plant type	H	C	E
Plant Type per country (*in number*)	324	43	-
National wood consumption per type (*in odt/yr*)	1.905.403	3.697.655	0
National Average of annual wood input per type (*in odt/yr*)	6.437	85.991	0

National woodchip consumption per plant type (in %):

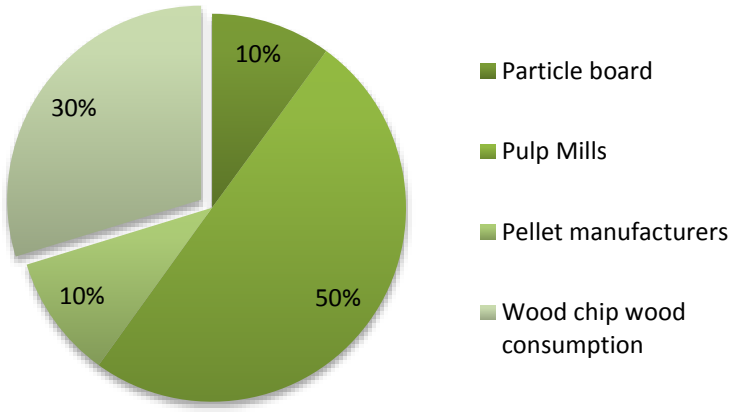


3.4 Energetic use of wood chips compared to other uses:

Woodchip consumption compared to other industry wood uses in France (in odt/y):

France	
Particle board *(in odt/y)*	1.889.759
Pulp Mills *(in odt/y)*	9.402.889
Pellet manufacturers *(in odt/y)*	1.945.250
Wood log use *(in odt/y)*	21.574.500
Total wood consumption of wood chip producers competitors *(in odt/y)*	34.812.398

Comparison between woodchip uses for energy production and other industrial uses (in %):



3.5 Conclusion - Actual availability of wood chips biomass

In France, there are still opportunities for new investments regarding biomass potential. There is lot of actions to improve the mobilization of wood resources. There is lot of targets for wood energy and currently, we don't achieved the objectives. All actors of wood sector have to discuss and work to improve the mobilization, to be more competitive on the others industries as lumber and industrial wood for example because all sectors are supplementary.

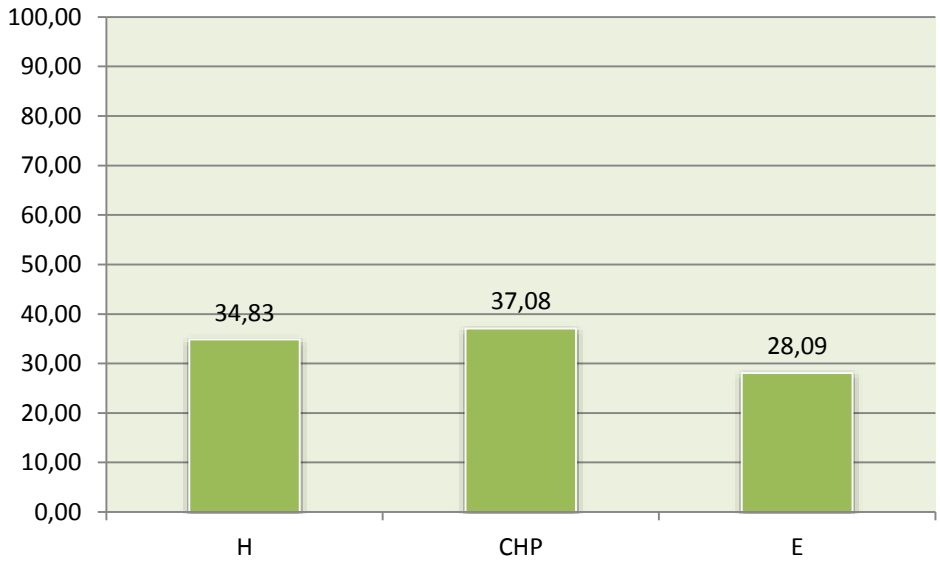
4° Italy

4.1 Introduction:

In Italy there are nearly a hundred biomass plants with a rated capacity greater than 1MW. The use of wood chips to produce renewable energy grew significantly since 2009, due to national incentives.

4.2 Italian biomass plants characteristics:

Distribution of biomass plants in Italy (in %):



As shown in the figure above, there are some differences between EU and Italian distribution of biomass plants. First of all, most of plants are CHP, followed by heating ones.
CHP plants usually have a rated heat capacity between 1 to 6 MW and an electricity capacity of 5 to 10 MW. Average rated capacity is lower than EU one. The diffusion of CHP plants is related to specific schemes, aimed to incentive the production of electricity with FER and giving an extra bonus in case of cogeneration. As far as

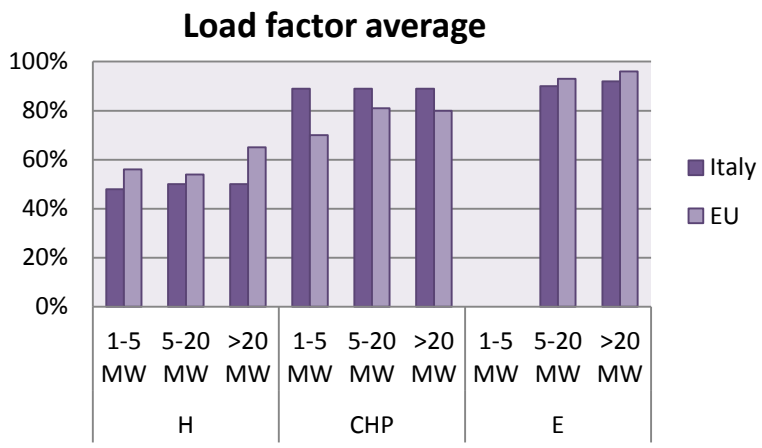
the scheme will be granted in a medium term, new investments will be planned. New plants will probably have a rated heat capacity of 3-5 MW, not more.
Public schemes are affecting positively also heating plants. In the last 5 years many district heating plants were built, most of them under 1 MW. Small heating plants are becoming even more common, especially in the regions of Tuscany and Trentino Alto Adige. Focusing on plants bigger than 1MW, they are mainly located in the north regions and along the Apennines. In 2013 a new scheme was approved (scheda 40E): it supports the production of heat in greenhouses by burning wood chips and wood pellet. Sales of wood chips fueled boilers with a power >100kW already increased significantly. They are expected to grow in the next future years, but new plants will rarely be bigger than 1 MW.
Contrary to the most EU Countries, in Italy there are wood chips plants producing electricity only (less than 30) and no electric plant is running with wood pellet. In south regions, some plants may use Mediterranean solid biomass (e.g. olive pomace, pits and grapes residues) to integrate wood chips. Electric plants are mainly located in the nearby of harbours or in areas where imported wood chips can easily supply the plant. It is foreseen that new plants will not be built in the coming years and that the existing ones will continue to operate as far as they will be supported by incentive schemes.

Biomass plants characteristics per type in Italy:

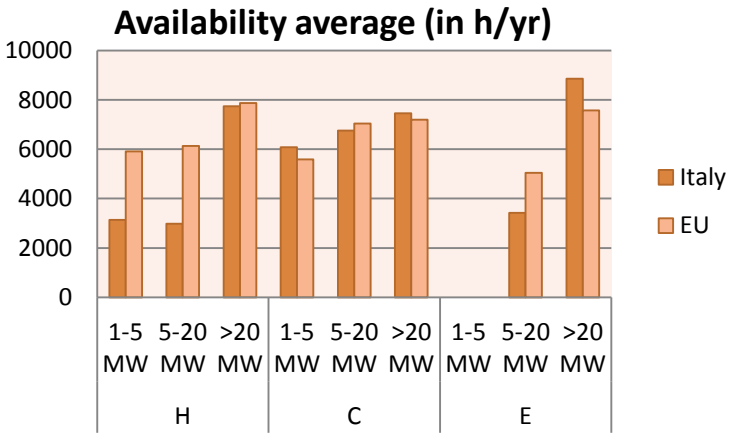
Italy			
Plant type	H	CHP	E
Number of plants *(in number)*	31	33	25
Plant size *(MW biomass fuel input)*	4,3	13,1	48
Rated electrical capacity *(MWe)*	-	3,1	13,8
Rated heat capacity *(MWth)*	6,7	12,4	-

Italian heating plants have a size and a rated heat capacity similar to the other EU Countries, but a lower annual heating output. Running hours per year are clearly under average (3.000 hours/year).
CHP plants are definitely smaller than EU ones. Electricity and heating production is lower as well. Comparison between electric plants actually relies to Spain and Italy comparison. As reported in the table 1.2.2, Italian and Spanish electric plants have similar characteristics and performance.

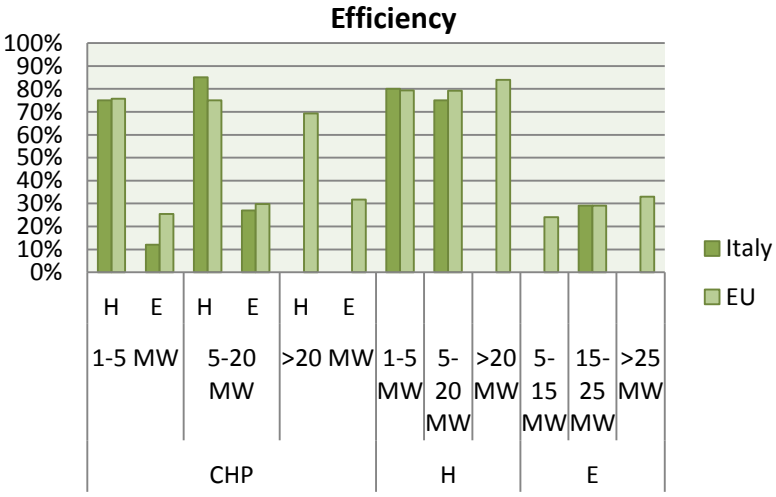
Load factor, Availability, Efficiency of plant in Italy:



National biomass plants have a load factor nearly equal to the other EU Countries. The rate is greater than average in small CHP plants.



The figure shows that the main differences between Italian and EU plants rely on Heating plants with a rated capacity below 20MW. Average running hours is 3.000 per year. This is probably due to the national climate zone, meaning warmer winters than the majority of EU Countries.



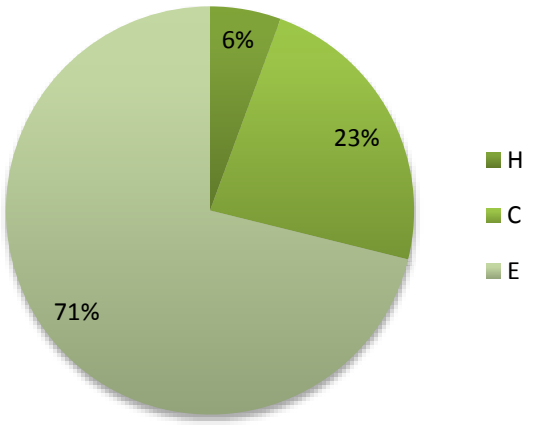
Italian biomass plants have an efficiency rate that is quite in line with EU average rate.

4.3 Italian actual Use of woodchip:

Annual wood consumption per plant type in Italy:

Italy			
(Overall national wood consumption = 2453691,5 Odt/y)			
Plant type	H	C	E
Plant Type per country (*in number*)	31	33	25
National wood consumption per type (*in odt/yr*)	138.881	571.689	1.743.120
National Average of annual wood input per type (*in odt/yr*)	4.480	17.323	69.724

National woodchip consumption per plant type (in %):



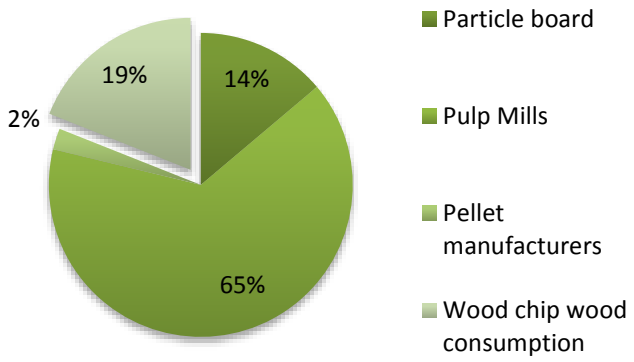
Most of the woodchip is used to fuel electric plants. This is related to the rated power of the plants and not to their numerosity. Incidence of Heating and CHP plants is expected to grow in the coming years.

4.4 Energetic use of wood chips compared to other uses:

Woodchip consumption compared to other wood uses in Italy (in odt/y):

Italy	
Particle board *(in odt/y)*	1.789.474
Pulp Mills *(in odt/y)*	8.391.111
Pellet manufacturers *(in odt/y)*	289.667
Wood log use *(in odt/y)*	1.136.640
Total wood consumption of woodchip producers competitors *(in odt/y)*	11.606.891

Woodchip wood consumption compared with direct competitors (in %):



The chart shows that the main competitor for wood chips use is the pulp mill industry. Biomass plants is the second destination of wood chips, followed by particle board, which is suffering the crisis of the wooden furniture and building sectors. Pellets production represent a marginal destination, as 90% of the national consumption is imported.

4.5 Conclusion:

Italy is actually a country with great biomass potentials. Some factors are currently limiting the domestic production of wood chips:

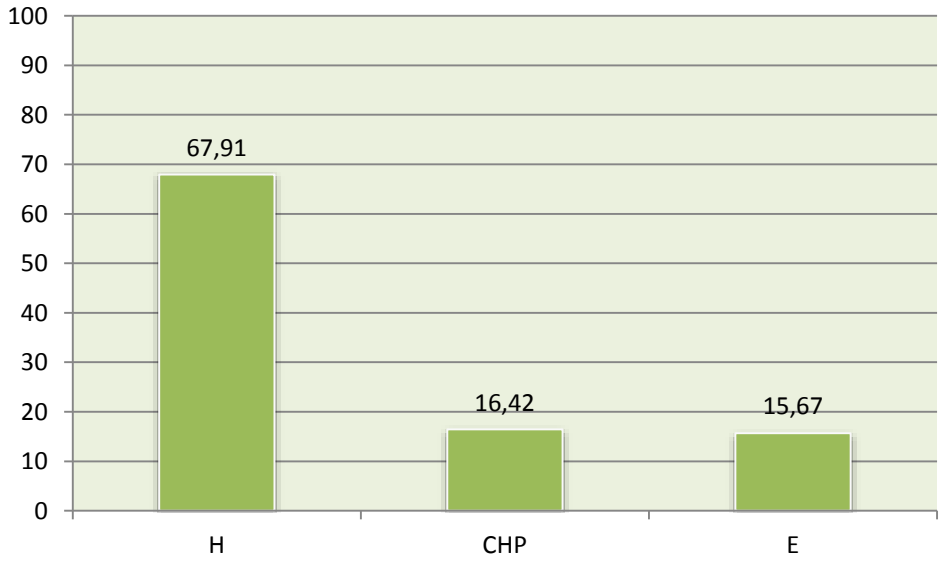
- Forest areas orography, that make it difficult and expensive harvesting activities
- Logistics and supply chain, which are currently improving

By now relevant tones of wood chips are imported by vessel from South America and by road from East Europe Countries. Nevertheless many national players are investing to improve their harvesting equipment to optimize the supply chain (e.g. biomass trade centers).

5° Spain

5.1 Spanish biomass plants characteristics:

Distribution of biomass plants in Spain (in %):



In Spain there were a quite favourable schemes of feed in tariff for electric generation and, about all, in Andalucía there is a huge quantity of olive cake so some years ago the sector developed and many plants were installed. Nowadays the law changed and the feed-in tariff is quite low so many projects were abandoned and there are no new projects coming. So the trend is that the heat share will be much bigger in the following years and not a single plant will be constructed unless the legislation changes. Also the CHP was affected by the legislation and nowadays is much less interesting so its share will also go down.

Biomass plants characteristics per type in Spain:

Spain			
Plant type	H	CHP	E
Number of plants *(in number)*	91	22	21
Plant size *(MW biomass fuel input)*	4,6	15,9	17,6
Average rated electrical capacity *(MWe)*	-	5,1	14,3
Average rated heat capacity *(MWth)*	2,5	13,4	-

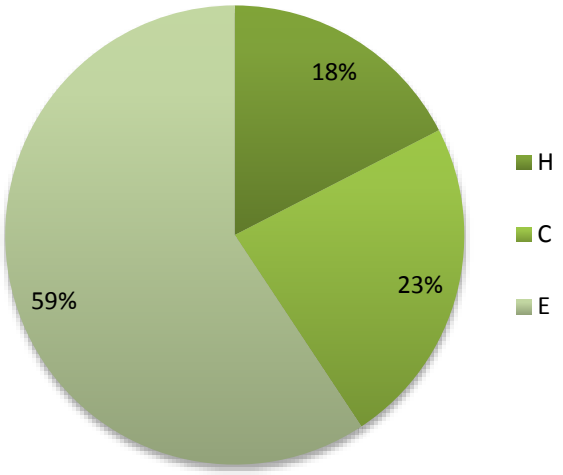
The number of heat plants will increase as fuel prices are very competitive. There are also many pellet plants being installed and most of them include a big biomass boiler in order to dry the raw material.

5.2 Spanish Actual Use of woodchip:

Annual wood consumption per plant type in Spain:

Spain (Overall national wood consumption = 2.535.288,8 Odt/y)			
Plant type	H	C	E
Plant Type per country (*in number*)	91	22	21
National wood consumption per type (*in odt/yr*)	442.536	589.277	1.503.474
National Average of annual wood input per type (*in odt/yr*)	34.980	28.060	68.339

National woodchip consumption per plant type (in %):

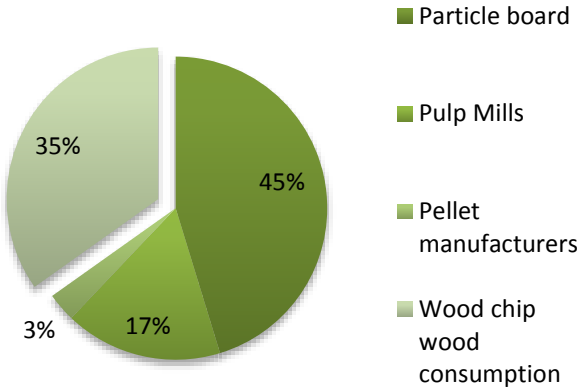


5.3 Energetic use of wood chips compared to other uses:

Woodchip consumption compared to other wood uses in Spain (in odt/y):

Spain	
Particle board *(in odt/y)*	3.295.297
Pulp Mills *(in odt/y)*	1.225.000
Pellet manufacturers *(in odt/y)*	223.865
Wood log use *(in odt/y)*	1.182.959
Total wood consumption of woodchip producers competitors *(in odt/y)*	5.927.121

Woodchip wood consumption compared with direct competitors (in %):



Particle board was a very strong sector in Spain which suffered a big crisis until last year. Nowadays they started to work again and there are using big quantity of wood.

The pellet sector is still small in comparison with huge pulp mills industries and big particle board industries. The trend is that the pellet share will be increase in the near future and will increase its share against all the rest.

5.4 Conclusion:

Spain is a country with big forest resources where there is a quite well developed Wood panel and pulp industry. The Electric generation is frozen in Spain due to the recent legislation so no more new plants will be constructed in the following years. In the other hand the pellet sector is growing very fast consuming still a relative small quantity of woodchip for the pellets and the dryers.
In the near future, the wood panel and pulp industries will maintain the capacity. In the bioenergy sector the heat sector is growing very fast so there will be an increase of pellet manufacturers (there are 43 plants now working and there are around 22 new projects) and wood chip consumers for bigger boilers (industry and residential).

6° Sweden

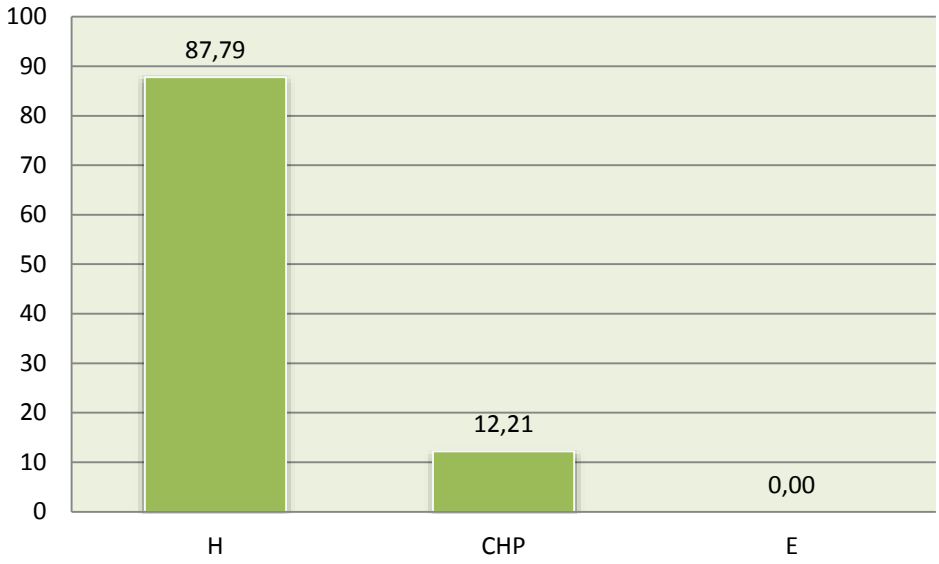
6.1 Introduction:

Swedish bioenergy use has grown from 40 TWh/year in the 1970s to around 140 TWh in 2012. Bioenergy past oil in 2009 to become the leading energy source for the nation. And since 2009 bioenergy has made up more of Sweden's energy mix than hydropower and nuclear power combined. Bioenergy was the leading factor in Sweden's 9 percent decrease in greenhouse gases between 1990 and 2010, while GNP increased by 50 percent.

The main reasons for the Swedish bioenergy sector's phenomenal growth are broad political support and strong incentives such as the CO2 tax introduced in 1991, the green electricity certificates introduced in 2003, and tax exemptions for transport biofuels.
Sweden has a long-standing tradition of using its natural forest resources – the nation has more forests than any other EU member state – while also protecting and developing these resources. Sweden's total forest stock has increased each year despite the rapid expansion in biomass use for energy.
The history of Sweden's biomass development can be seen in terms of two significant factors: rising prices for imported oil and the nation's debate over nuclear power. From the 1973 oil crisis, which coincided with an unusually cold Swedish winter, to 1979 when imported oil prices jumped again and the Three Mile Island nuclear accident happened in the U.S., to a 1980 Swedish referendum on nuclear power calling for a phase-out by 2010, the nation has been seeking new and safe energy sources. National research into renewable energy was initiated in the late 1970s.

6.2 Swedish biomass plants characteristics:

Distribution of biomass plants in Sweden:



The district heating net in Sweden is well developed and therefore is it profitable to make both electricity and heat. This is probably the reason for having a higher share of CHP plants in Sweden compared to the rest of Europe.

Biomass plants characteristics per type in Sweden:

Sweden			
Plant type	H	CHP	E
Number of plants *(in number)*	266	37	0
Average Plant size *(MW biomass fuel input)*	7,5	60,1	-
Average rated electrical capacity *(MWe)*	0	28,6	-
Average rated heat capacity *(MWth)*	17,8	114,7	-

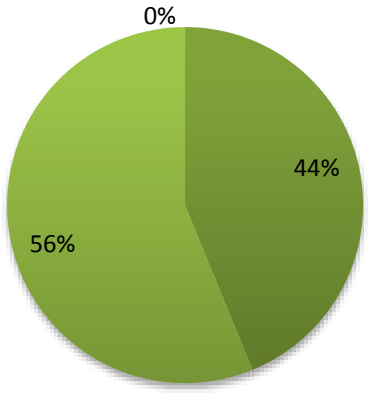
The climate and district heating net is probably the reason for Sweden having higher rated electric/heat figures compared to other countries.

6.3 Swedish actual Use of woodchip:

Annual wood consumption per plant type in Sweden:

Sweden			
(Overall national wood consumption = 6.848.343 Odt/y)			
Plant type	H	C	E
Plant Type per country (*in number*)	459	101	-
National wood consumption per type (*in odt/yr*)	2.999.770	3.848.573	-
National Average of annual wood input per type (*in odt/yr*)	12.144	104.043	-

National woodchip consumption per plant type (in %):



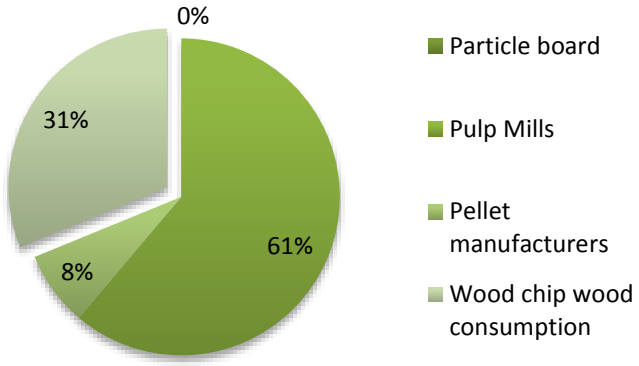
The CHP plants are with a few exceptions all over 21 MW and therefore they consume more than half of the total wood chip consumption although the number of heating plants is four times more.

6.4 Energetic use of wood chips compared to other uses:

Woodchip consumption compared to other industry wood uses in Sweden (in odt/y):

Sweden	
Particle board *(in odt/y)*	0
Pulp Mills *(in odt/y)*	13.435.500
Pellet manufacturers *(in odt/y)*	1.677.000
Wood log use *(in odt/y)*	52.575.000
Total wood consumption from other industry in Sweden *(in odt/y)*	67.687.500

Comparison between woodchip uses for energy production and other industrial uses (in %):



The particle board industry is in principle not existing in Sweden as the all saw dust, wood chips etc and that is not burned used for pellet production. The pulp industry is big in Sweden but is decreasing. In the future this can affect the wood chip market.

6.5 Conclusion:

There is a surplus of wood chips in Sweden today. The reason for this is increasing forest growth, decreasing demand for pulp industry and increasing import of waste and waste wood. Several big CHP investments the last years have waste as fuel input. However, several new large CHP using wood chips are under construction. They will use both imported and Swedish wood chips to have a steady supply and reasonable prices.

7° Germany

7.1 Introduction

With the introduction of the Renewable Energy Sources Act (EEG) in 2000, Germany was able to significantly increase the electricity generation through biomass. The highest annual growth was achieved in 2011 with about 1,300 newly installed plants. Several amendments to the Renewable Energy Sources Act and the following Biomass Ordinance (BiomasseV) allowed managing the expansion in a more targeted way over the past years. In 2013, wood-fired (co-generation) plants contributed about 2.5 % of Germany's total electricity demand.

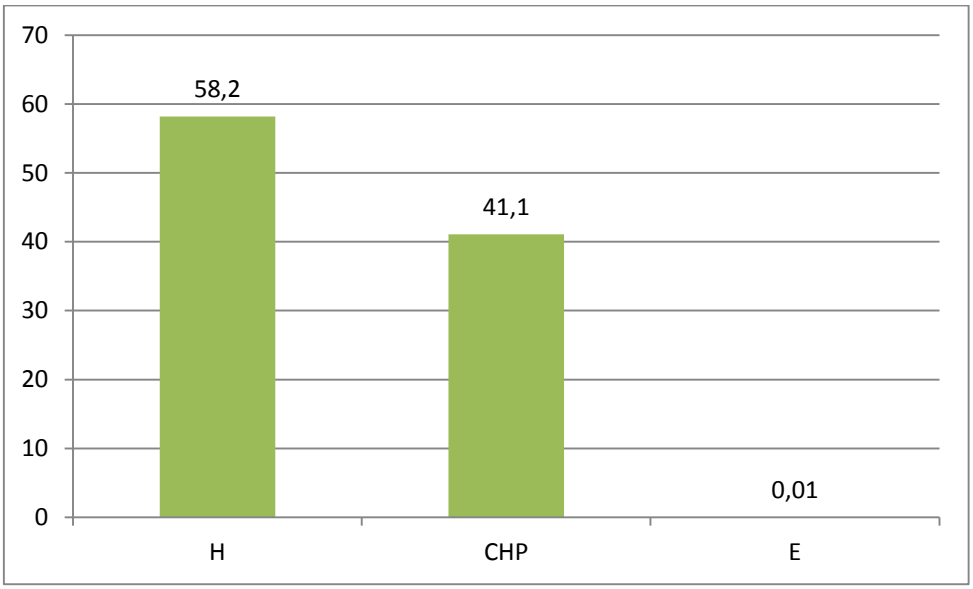
Heat generation from biogenic solid fuels accounts for the largest share of energy produced from renewable sources in Germany. According to the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (2013), the following data was determined for heat generation from biogenic solid fuels in 2012, of which almost all are classified as wood biomass:

- Households: 74.4 million MWh, 5.4% of heat - 22.2 million t of GHG emissions saved
- Industry: 21.8 million MWh, 1.6% of heat - 6.06 million t of GHG emissions saved
- Heating (power) plants: 6.5 million MWh, 0.5% of heat - 1.5 million t GHG emissions saved

With 102.7 billion kWh of heat, Germany covered 7.4% of its heating demand through wood in 2013.

7.2 Germany biomass plants characteristics:

Distribution of biomass plants in Germany (%):



In Germany the first biomass plants were built in the 1990s. Currently, about 1700 plants of different sizes for the production of heat and power are in operation, there are about 150 plants over one megawatt.

In 2014, around 640 plants produced electricity and heat on the basis of CHP, including thermo-chemical wood gasification with a cumulative electric capacity of about 1,537 MWel. After significant growth in terms of newly installed capacities from 2000 to 2009, this trend has been abating over recent years. At the same time, there has been a particular dynamic in the construction of new plants in the lower power segment (<1 MWel) since 2009. Especially over the last three years (since 2011), the number of plants in this segment has increased noticeably. This trend is driven primarily by the technological innovation in thermo-chemical wood gasification.

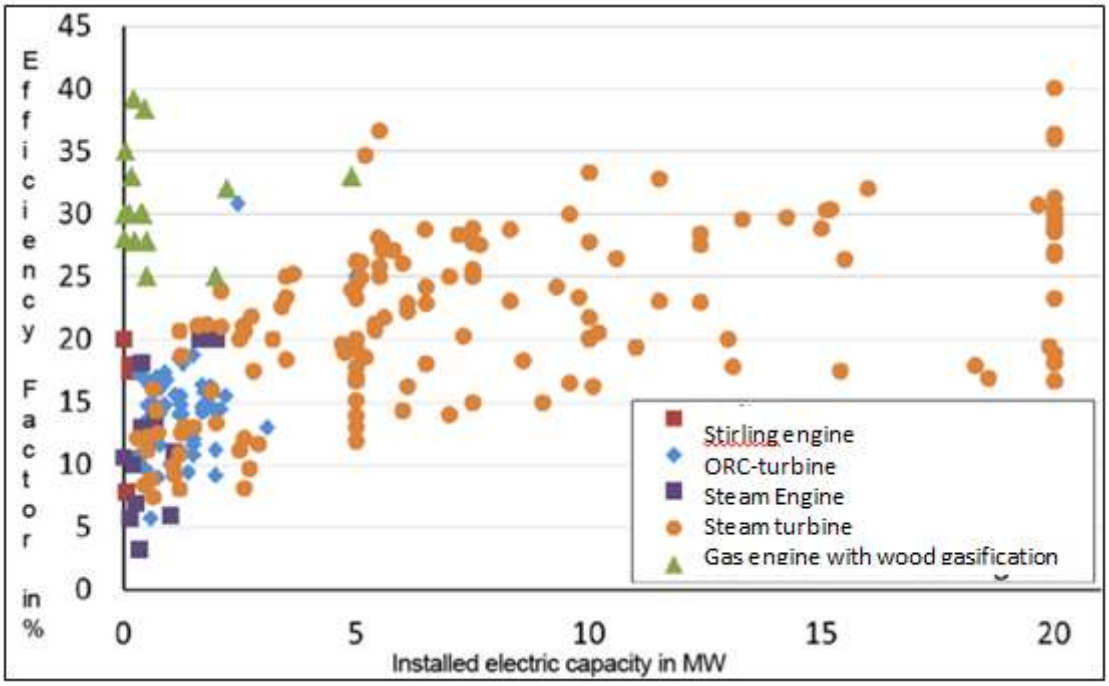
There are about 1,000 other plants that produce heat only. In connection with the development of combined district heat networks and heating plants, these installations fall under the Renewable Energies Heat Act for municipalities, private households and the industry, which provides support for wood chip heating systems as well as pellet stoves and boilers.

With rising prices for energy wood, the growth shifted increasingly towards the lower power classes. While the number of wood (heating) plants continued to go up, the growth in terms of newly installed capacities and electricity generation started to decrease. There is a biomass heating plant in almost every major city. Expansion potential lies mainly in small and medium-sized plants for the supply of public buildings, multi-storey, terraced houses, and commercial buildings and in the integration of biomass burners in existing heat networks.

Biomass plant characteristics in Germany – Raw material use and efficiency

In Germany the majority of biomass heating plants is running in a year-round operation. In summer and in the transitional months, the heat production has to be adjusted to the reduced demand. The installed boiler capacity is therefore higher than the retrieved average performance. The reason is that the plants have to be conceptualized to cover the peak demand during cold winter months. To ensure efficient use of raw materials under these conditions, multi-boiler systems are installed, and some plants are provided with a buffer memory and clocked.

Biomass CHP plants are primarily optimized for electricity production and many full load hours with maximum utilization of the plant. The installed capacity and the retrieved average performance are therefore much higher than those of biomass heating plants.



At the current state of development, three technologies for the cogeneration of electricity and heat on the basis of biomass firing have meanwhile reached market maturity. These include the steam power process using a steam turbine or, in some places, also a steam engine, the ORC20 process as well as thermochemical biomass gasification. Particularly since 2011 and 2012, the thermochemical gasification technology has continuously gained in importance.
The first biomass cogeneration plants promoted under the Renewable Energy Sources Act made almost completely use of steam turbines, which still come to use today, preferably in large-scale plants. With the trend going towards small-scale plants, the number of newly installed turbines is rather low in Germany. In 2012, only three steam turbines were newly installed, which had a cumulative electric capacity of about 16 MW. Over the first ten years of the Renewable Energy Sources Act, wood gasification plants with gas engines saw several phases in which the capacities increased but also decreased again. Since 2011, however, the capacities have been following a continuous upwards trend. In 2012, about 80 plants with a cumulative electric capacity of 6 MW were put into operation. Given that the installed electric capacities are, for most part, rather small,

the wood gasification plants with gas engine have a comparatively high electrical gross efficiency of about 30%. The majority of these plants belong to the smallest segment of the Renewable Energy Sources Act, i.e. the power class with less than 0.15 MWel.
Between the years 2005 and 2008, different suppliers provided products for the power class of > 0.5 kW to 5 MW on the basis of different technologies, including updraft co-current gasifiers, two-stage gasifiers and double-fire gasifiers. These plants, however, make regular maintenance necessary. The dynamics in this power class result from technological innovation.
With regard to the raw materials, a range of different products comes to use:

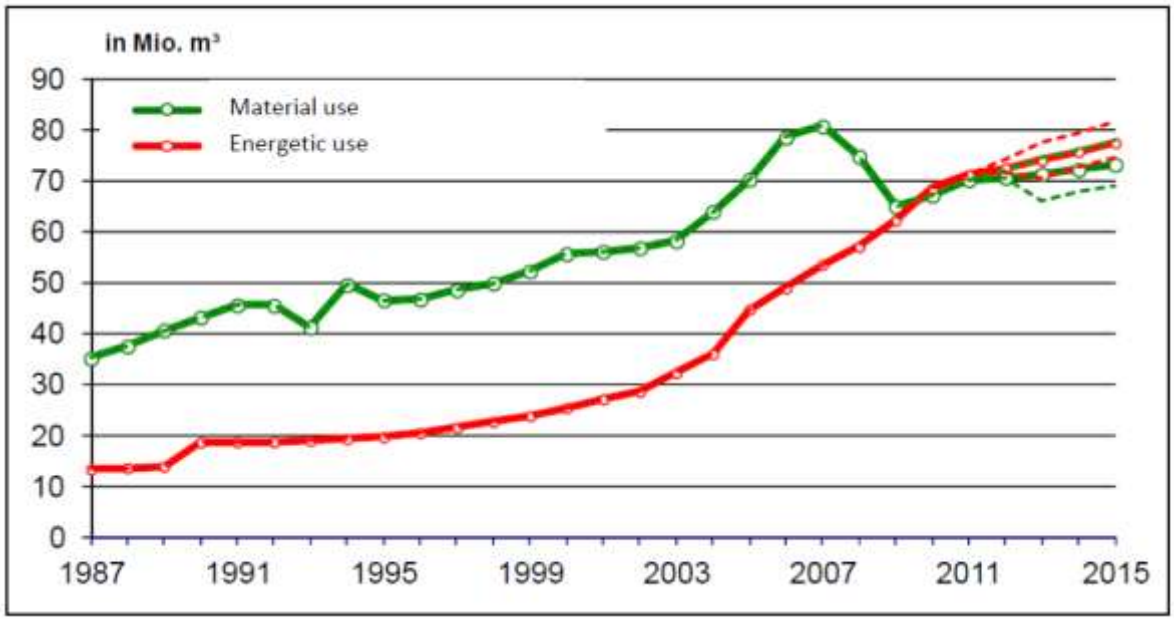
In the sawmill industry, **sawmill by-products** (sawdust, wood chips, rind and strips) and bark, off-cuts and wood shavings are obtained as part of the timber production from round wood, which are important raw materials for the wood-based and paper industry as well as for the production of heat and electricity (also through the use of pellets or briquettes).
While the **waste wood potentials** for energy use were quickly developed after the Renewable Energy Sources Act entered into force in 2000, the introduction of a bonus for renewable materials (NaWaRo bonus) under the Renewable Energy Sources Act of 2004 lead also to the use of **residual forest wood** for the generation of electricity. The availability of residual forest wood for energy wood supply is directly affected by the provision of solid and non-solid wood, in particular through the processing of tree top wood.
For the collection of **landscape conservation wood** from municipalities, there already exist sufficient collection structures across Germany (so-called green wood waste disposals). There is data on the respective amounts (approx. 80 kg/inhabitant x a, about 800,000 t/a) and quality during the year as well as the share of wood suitable for energetic use after processing (approx. 25%, about 200,000 t/a). This landscape conservation wood is already largely used for energy and eligible for the bonus for renewable raw materials under the Renewable Energy Sources Act as of 2004 and 2009, as long as it is used exclusively or together with other renewable raw materials.
Short rotation plantations are another suitable raw material source. In Germany, such short rotation plantations currently cover approximately 5,000 hectares. In the future, the use of these plantations will be expanded also with the help of regional support mechanisms. As mentioned, the relatively new type of agricultural cultivation SRP offers opportunities for a long-term and stable income, particularly for low-yield agricultural production areas. A key characteristic of short rotation plantations is that the planting of tree species is associated with relatively high costs and thus requires a continuation of the agricultural culture for about 20 years to recoup the high costs of planting. The fixed use of the land over 20 years is a novelty in agriculture and will take time to adjust in many places. Once established, however, the plantation can be operated successfully over a period of 20 years with very little effort. Especially the poplar uses hardly any mineral fertilization and harvesting in each three-year cycle is the only remaining workload.

7.3 Actual use of woodchip compared to biomass potential:

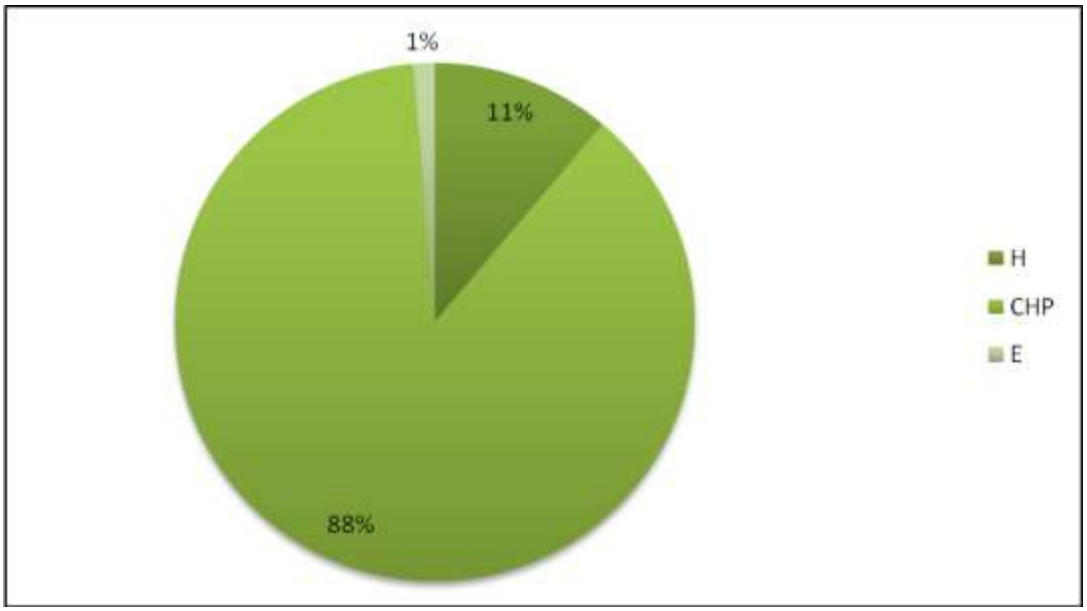
Between 2008 and 2010, the demand for the energetic use of wood was highly subject to weather-related influences. The long and cold winters of 2009 and 2010 have driven the demand for energy wood, particularly by private households. This was one of the reasons why the consumption of wood for energetic uses saw an increase to more than 50%. In the year 2010, the energetic use (50.6%), for

the first time, exceeded the material use of wood in Germany. This development is expected to continue in the future, even though with slightly less vigour. In Germany, the consumption of wood for material and energetic use was about 150 million m³ in 2013.

The material use of wood reached a consumption level of around 70 million m³. The demand for wood for energetic use started at the same level in 2010 and is expected to increase to a consumption of nearly 80 million m³ by 2015. The energetic use of wood is less subject to economic fluctuations, meaning that the corridor of economic deviation is smaller.



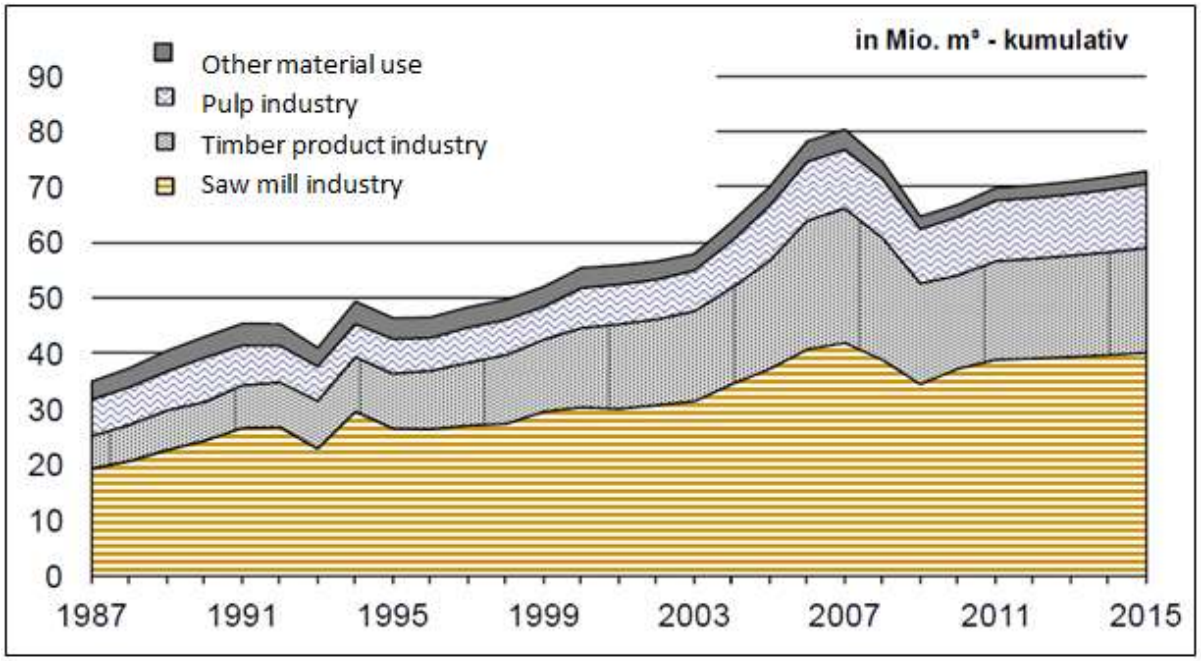
National woodchip consumption per plant type [in %]:



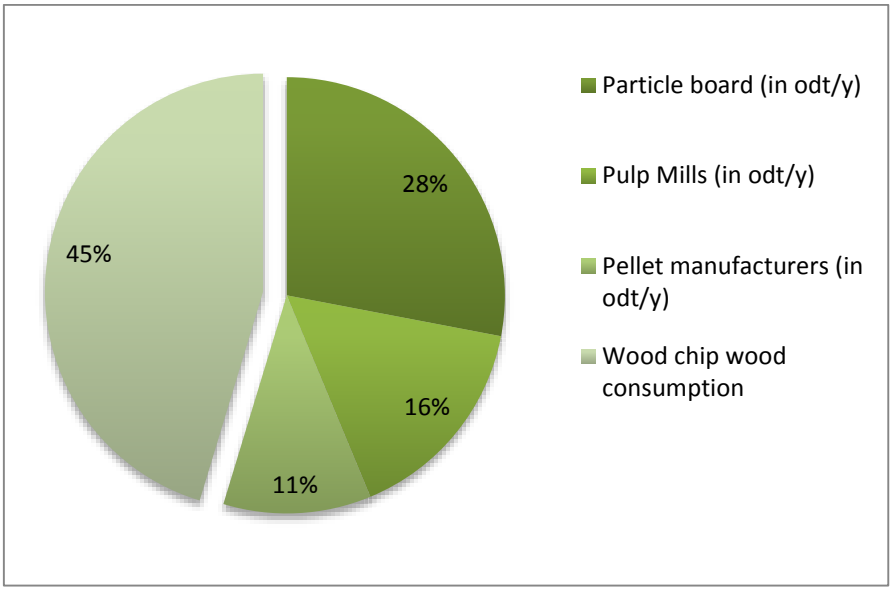
In Germany around 75 million cubic meters of wood are used energetically per year by the timber industry itself, by biomass heating plants, CHP plants and by individual small-scale heating. The term “woodchips” takes too short, because solid biomass in form of industrial wood waste or sawmill by-products, bark, wood chips, firewood, pellets, briquettes and liquor (residues from paper production) are used for energy production as well. Forestry and wood industry have developed a detailed flowchart of wood that serves as the base for further considerations and provides the most accurate overview of the energetically recycled wood quantities in Germany.

7.4 Energetic Wood consumption compared with other uses:
Woodchip consumption compared to other industry wood uses [in Million odt/y]

In Germany, the material and energetic use of wood reached about 150 million m^3 in 2013. The material use amounts to about 73 million m^3 and concerns the following areas: pulp industry, timber product industry, saw mill industry and other material uses.

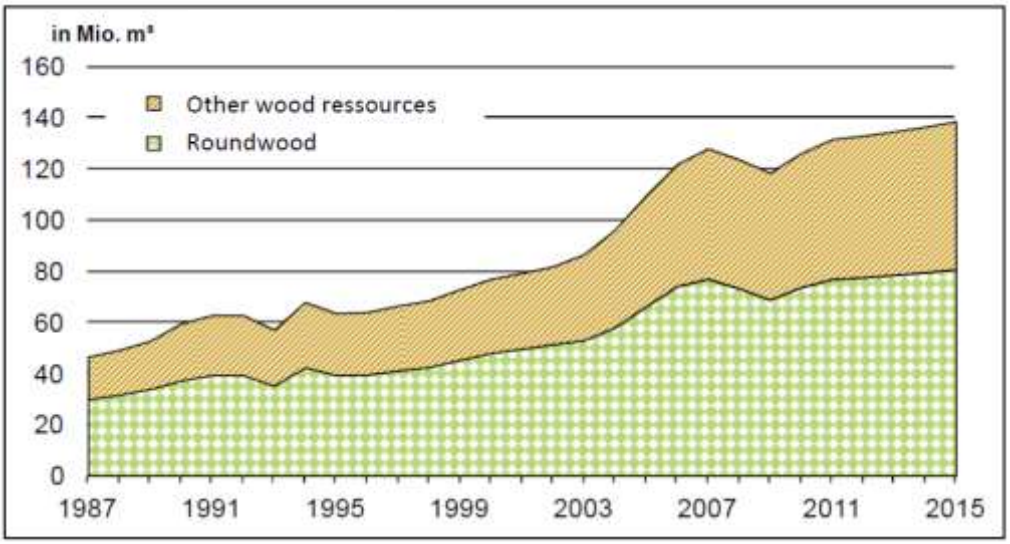


In general, the energetic use of wood exceeded the material use in 2014 (see diagram below). More than 55% of the existing timber volume is used for the production of energy. Only about 45% of the timber volume is used as a material.



The demand for saw logs, which is further processed in the sawmill-industry, is the engine of the value chain for wood. Wood-use is achieved as a cascading use of wood in Germany.
In general, the wood market has been under the influence of considerable economical and structural changes over the past decade. Between 2003 and 2007, the energy policy and prices had an increasing effect on the demand for wood. At the same time, the timber industry continued its growth course on the domestic and the international markets. As a result, the consumption of wood went up greatly. With the financial and economic crisis of 2009, the demand dropped dramatically and only very slowly has been able to come close to the pre-crisis level. Although the demand has taken up rather modestly, the situation of the raw material supplies remains fairly tense and the market currently faces economic turmoil again. The situation is made worse by the fact that the funding policy conditions have deteriorated significantly with the amendment of the Renewable Energy Sources Act in 2014, especially for energetic use of wood.

Roundwood supply in Germany



With 1.4 million hectares, one third of Germany's national area is forested. The third National Forest Inventory (BWI) has encouraging news: The national forest area has remained constant. The amount of new wood growing is exceeding the wood use in Germany. Despite high usage, the stock in the forests has gone up to 3.7 billion cubic meters. In 2013, the supply of round wood for material and energetic uses was about 80 million m³ in Germany.

7.5 Conclusion

In Germany, especially in the southern states of Bavaria and Baden-Württemberg, the wood production, wood industry and energetic use of biomass has a great tradition for centuries and is closely interlinked. The possible potential for biomass is closely connected with the development of the material use of wood, especially in the field of solid wood. Sales of wood and sawmill products is the base of a working value-added chain in the wood industry.
Meanwhile, the growth in the wood gasifier segment accounts for a large part of the newly installed plants for the energetic use of solid biomass. The reason for this is the technological progress in the plant development of thermochemical wood gasification. Growth in the area of biomass heating power plants with an installed capacity of over 1 MWel has again decreased in 2014 as against the previous years. In total, around 100 plants have been built since 2012. For plants > 1 MW, it will be decisive to what degree these plants are also able to produce balancing energy as greater flexibility is demanded. Political support for such systems is closely li

8° United-Kingdom

8.1 Introduction

The installed electric power from dedicated solid biomass plants (including energy crops and imported woody biomass fuels) increased 65% in 2013, with a total value of 1,992 MWe against 1,203 MWe of 2012. At the same time, the biomass cofiring capacity decreased from 200 to 32 MWe due to the recently introduced policy caps on ROCs (Renewables Obligation Certificates) issued for cofiring electricity and the EU air quality regulations for large combustion plants, which strongly affects biomass combustion plants. In particular, this evolution of biomass generation was due mainly to the conversions at Drax and Ironbridge, which have started burning sustainable biomass fuel (pellets) instead of coal, as well as increased generation from the Tilbury conversion (despite its closure under the Large Combustion Plant Directive in August 2013), following the fire in 2012. The conversion of the Drax unit, as well as Ironbridge, resulted in a further reduction (1,474 GWh) in the co-firing of biomass with fossil fuels. Total generation from bioenergy sources as a whole was 24 per cent higher in 2013 than in 2012.

In particular, in second quarter of 2014, bioenergy accounted for a 5.6 TWh (7%) of electricity generation, with an increase of 8.8% compared with a year earlier. The total electricity generation from dedicated biomass plants increased from 4 to 9 TWh from 2012 to 2013, with a load factor rising from 40% to 64%. As regards cofiring plants, the electricity generated decreased in the same years from 1.8 to 0.3 TWh, for the previously mentioned reasons.

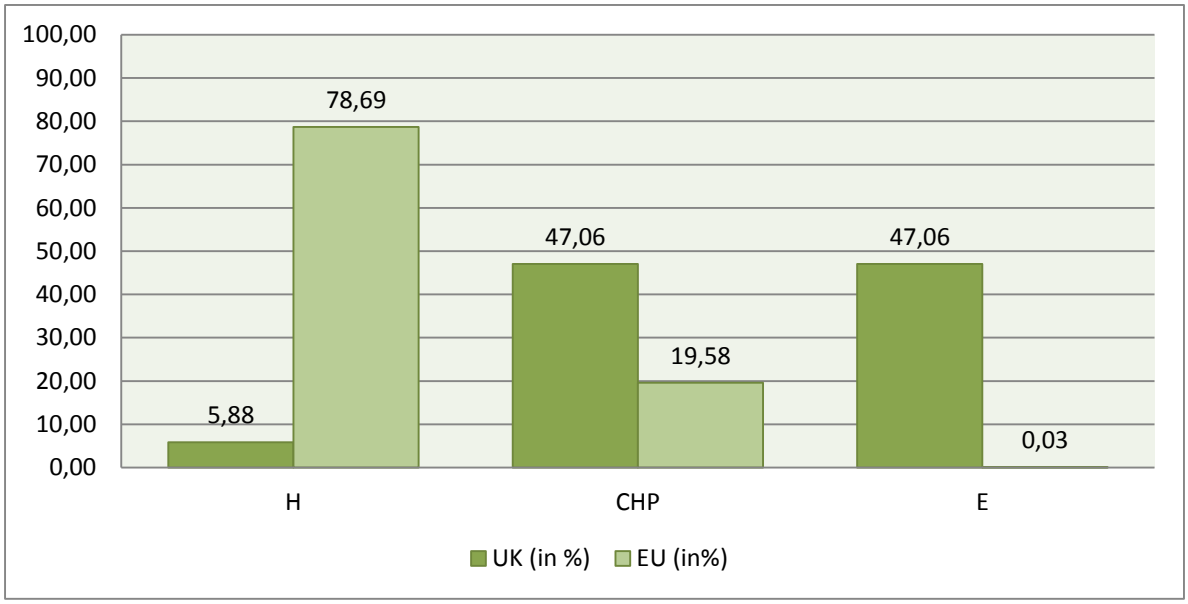
The Department of Energy (DECC) in the UK supports biomass based electricity through Renewable Obligation scheme and biomass heating through the renewable heat incentive, and most of the woody biomass consumption in the UK is used for heating and electricity in dedicated plants. However, in particular in the second typology of energy conversion, biomass supply is mainly based on import of wood pellet from North America and Latin America, and this biomass fuel is used to feed large power plants (repowering of coal power stations), whose perspectives of operation over the next years are strongly related to the options to attract supports in the form of ROCS from Government.

8.2 United-Kingdom biomass plants characteristics:

8.2.1 Distribution of wood chip biomass plants in the United-Kingdom – compared with the situation of the rest of Europe:

As can be seen from the graph below, the types of plants are rather different in the UK compared to the EU average. CHP and electricity plants are more common in UK compared to other EU countries.

The spread (in %) of H/CHP/E plant in the UK compared with European average situation



8.2.2 Biomass plants characteristics per type in the United-Kingdom:

United-Kingdom			
Plant type	H	CHP	E
Number of plants *(in number)*	8	17	16
Plant size *(MW biomass fuel input)*	2 *(5,6)**	52,5 *(26,7)**	45 (32,9)*
Rated electrical capacity *(MWe)*	0 *(0,0)**	17,5 *(10,5)**	14,5 (14,1)*
Rated heat capacity *(MWth)*	1,5 *(6,6)**	35,7 *(26,7)**	0 (0)*

- based on the results obtained in 1500 plants presented throughout Europe (provisional figure based on the state of BASIS data collection)
- large scale cofiring plants (900 MWe and 650 MWe) have been not considered to estimate the average size of dedicated biomass plants

Most of heating plants in the UK have size below 1 MW and are dedicated to residential and tertiary energy demand, hence have not been here monitored (only woody biomass plants larger than 1 MWth have been considered). According to DECCs data, dedicated biomass power plants have commonly size in the range 15-20 MWe, excluding large scale cofiring plants or reconversion of old coal fired plants, such as Drax and Ironbridge, where the plant size is very large (2 units of 650 and one unit of 900 MWe respectively for Drax and Ironbridge). As previously mentioned, the perspectives of operation of these large scale power plants, mostly feed by imported biomasses, and are strongly based on their eligibility for ROCs incentives issued to biomass electricity.

8.2.3 Load factor, Availability, Efficiency of plant in United-Kingdom:

Average figures of plant availability for dedicated biomass plants (both CHP and only electricity generation) and load factor are in the range of 7000-7500 h/year and 0.85-0.9 %. Highest values are registered in the case of dedicated large scale plants that do not present biomass supply constraints and/or seasonality issues, while on the contrary large cofiring plants are often not able to operate at full load for scarcity of biomass fuel. Most of CHP plants operates base load and not in electric or heat driven mode, since the high plant investment costs are faster recovered when the electric generation is maximized.

8.3 Actual Use of woodchip compare to biomass potential:

8.3.1. Annual wood consumption per plant type in the United-Kingdom:

United-Kingdom			
(Overall national wood consumption = 1975029 Odt/y)			
Plant type	H	C	E
Plant Type per country (*in number*)	8	17	16
National wood consumption per type (*in odt/yr*)	5844 *0*	1.516.735 *0*	1.104.308 *0*
National Average of annual wood input per type (*in odt/yr*)	730 *0*	89.220 *0*	69.000 *0*

*based on the results obtained in 1248 plants presented throughout Europe (provisional figure based on the state of BASIS data collection)

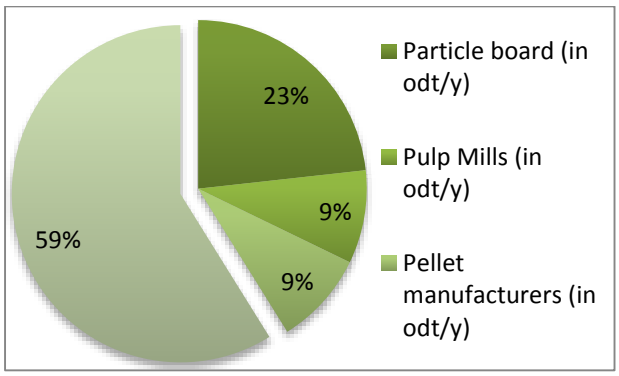
- large scale cofiring plants (900 MWe and 650 MWe) have been not considered to estimate the average biomass consumption

8.4 Woodchip consumption compared with competitors uses:

8.4.1 Woodchip consumption compared to other industry wood uses in the United Kingdom (in odt/y):

United-Kingdom	
Particle board *(in odt/y)*	780.000
Pulp Mills *(in odt/y)*	300.000
Pellet manufacturers *(in odt/y)*	300.000
Wood log use *(in odt/y)*	-
Total wood consumption of wood chip producers competitors *(in odt/y)*	1.380.000

8.4.2 Comparison between woodchip uses for energy production and other industrial uses (in %):



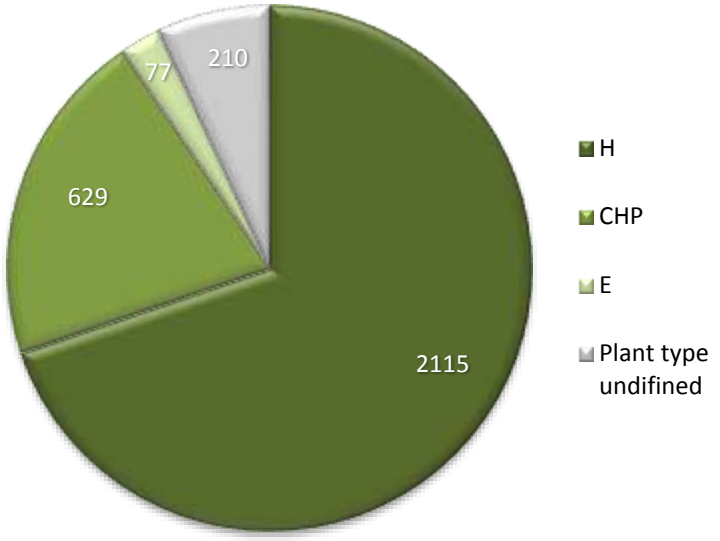
Comment: energy production, in the form of heat and power, still dominates the market of biomass end uses

8.5 Conclusion - Actual availability of wood chips biomass

The use of biomass for energy in the UK has increased consistently in the last years, the main reason being the incentives available in the form of ROCs for electricity and RHI (Renewable Heat Incentive) for heat. The overall woody biomass consumption for heat and power generation in the UK results in the range of 2.5 M odt/year excluding the biomass consumption to feed the two units in Drax and the one in Ironbridge, accounting for 4.5 M odt/year. This last biomass supply is almost completely based on imports of wood pellet from British Columbia and Latin America, and the perspectives of this business are strongly based on the presence of policy support measures for biomass electricity produced in these old coal power plants repowered to use biomass. The sustainability of this imported biomass is one of the main concerns in this case, while potential for new investments based on domestic resources and locally available wood for energy generation still exists, mostly in the case of high quality cogeneration plants (HQ CHP) where the availability of biomass resources (agro-forestry by products, residues from wood processing and, at some extent, energy crops in the form of short rotation forestry and perennial herbaceous crops) is coupled to the presence of energy demand (both thermal and electrical), infrastructures for district heating and logistics for biomass processing-pretreatment, and space availability for biomass storage and conversion.

CONCLUSION - EU28 GENERAL OVERVIEW

Total number of Bioenergy plants (>1MW) using wood chips as fuel in EU-28 [in number]

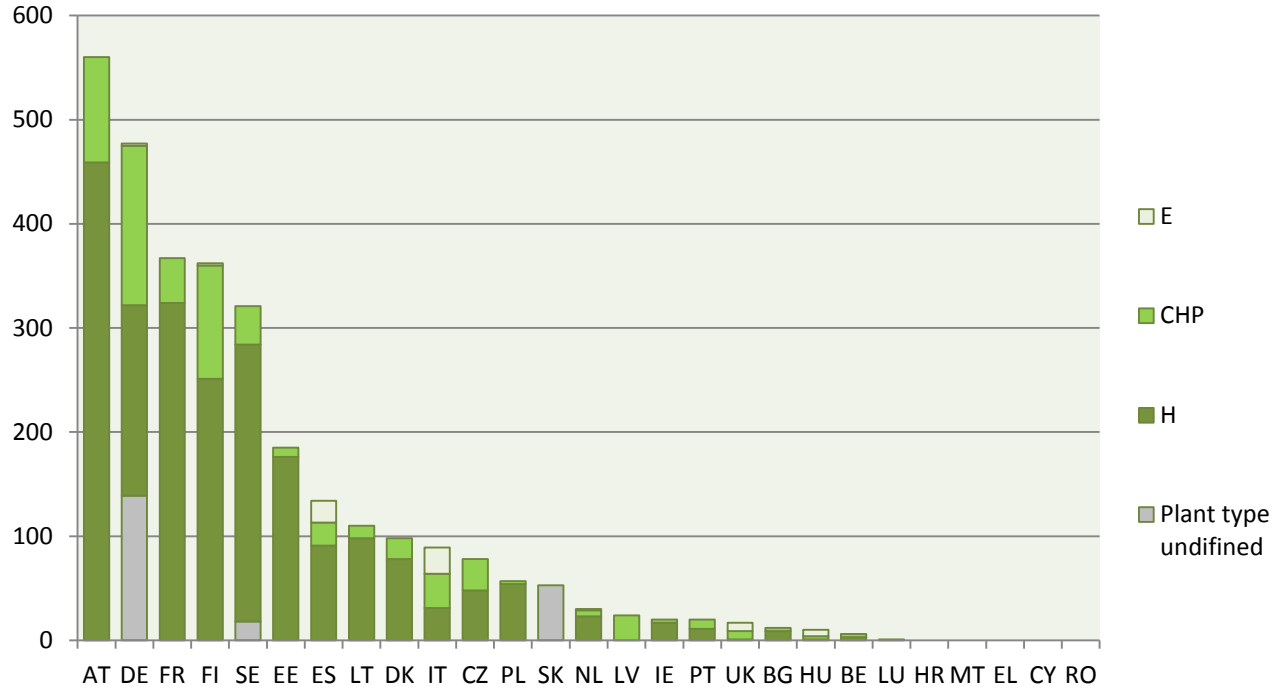


BASIS aggregated data for 24 countries among Europe as presented above. Apart from Romania, in the three last remaining countries (CY, EL, MT) benchmarks have been realized and no significant installations (>1 MW) were found.

The following results are based on an original data collection lead by national contributors which try to cover at least 100% of plants above 20 MW, 75% for plants above 5 MW and at least 50% of plants above 1 MW.

As presented above, BASIS partners collected data for 3019 bioenergy plants at EU level. Among these data only 210 plants remains not fully defined regarding their output type. As it could be expected Heat plants are currently representing around 2/3 of all bioenergy installations. At the opposite, one major BASIS learning was that the total number of Electric plants which represented less than 1% of all installations. Moreover Electric plants seem to be concentrated in few European countries and are responding to specific local needs.

Distribution of Bioenergy plants (>1MW) using wood chips as fuel by type in EU-28 [in number]



Regarding the number of installation, it can be noticed that the 5 biggest countries (AT, DE, FR, FI, SE) are representing more than 60 % of all installations at the EU level. However as it was shown afterwards, this first information must be compared by plant average size. In fact if Austria appears as the first country in Europe in term of total installed plants mostly for heat appliances, the general size of Austrian installations remain one of the smallest in Europe.
Regarding plants type, some national trends clearly raised that could be gathered in three major groups:

- A dominant heating model, mostly in the case of Austria, France, Sweden, Estonia, Lithuania and Poland.
- A balance CHP/heating model, mostly in Germany, Finland, Czech Republic and Portugal
- A specific model for Spain Italy and the United Kingdom which can be characterized by a certain proportion of electric installations.

Bioenergy plants size (>1MW) using wood chips as fuel in EU-28 [in MW]

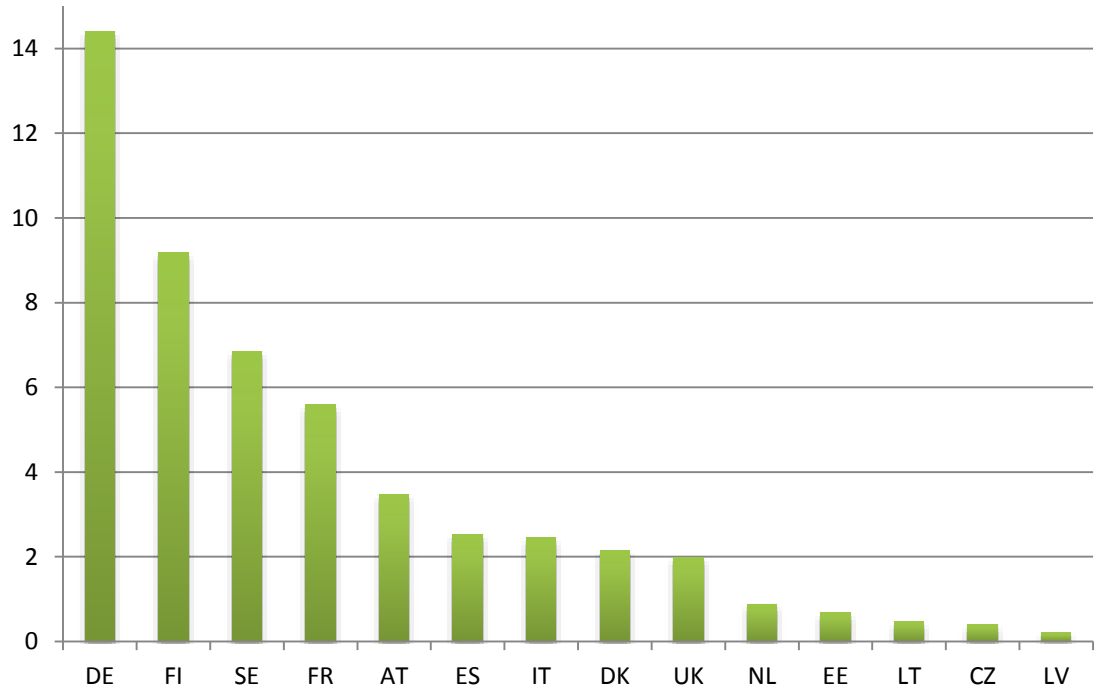
EU-28 Average						
Plant type	H		CHP		E	
EU28 Average Plant size by input *(MW biomass fuel)*	5,7		30,5		32,3	
Minimum and Maximum national values for input	3,4 (AT)	8,9 (LT)	6,7 (LV)	56 (DK)	17 (ES)	47 (IT)
EU28 Rated electrical capacity output *(MWe)*	-		13,5		15,2	
Minimum and Maximum average national values for electric capacity	-		2,3 (LV)	48,7 (FI)	-	20,6 (UK)
EU28 Rated heat capacity output *(MWth)*	5,3		35,3		-	
Minimum and Maximum national values for heat capacity	2,2 (PL)	17,3 (SE)	4,4 (LV)	114,6 (SE)	-	

This graph has been designed to present EU28 plant size average both for their input of wood chips expressed in MW and their Heat/Electric output (in MW). To provide a better understanding extreme national values have been added to provide an insight of the European scope.

Several lessons can be learned from this graph. By establishing a first direct comparison among plant types regarding their wood chip input, Electric plants appears as the biggest installations with an average size around 32,3 MW of biomass fuel compared to CHP (30,5 MW) and Heat plants (5,7 MW). However by comparing the scope of national situations a great heterogeneity of situation can be compared at the European level. This could be reflected for instance by the input size of CHP in Denmark (56 MW) which exceed from almost 10MW the highest value of Electric plants located in Italy (47 MW). At the opposite, the situation for Heat plants appears more homogenous with a smaller scope of values turning around 5MW biomass fuel.

In this context, country with a dominant heating model will naturally have more similar situations but also relatively smaller wood chip consumption as presented in next graph.

Major European wood chips consuming countries for Bioenergy production in plants >1MW [in million odt/yr]



The overall wood chips consumption for Bioenergy production at the European level in 2013 ranged around 51 million of tonnes a year. As it could be expected regarding the installed number of appliances per country, the 5 main wood chips bioenergy producers are representing around 70% of the general consumption.
However it can be noticed that the ranking slightly change if one compared this graph with the distribution of Bioenergy plants. In fact, whereas Finland and Sweden appeared after France or Austria in term of installations, due to higher plant capacity their wood consumption reached higher values.
By crossing these graphs real differential models of development emerged showing certain heterogeneity of situation in Bioenergy production using wood chips.
These differences could be confirmed by the National Average wood chips consumption per output type presented in the graph bellow. When the average wood chips consumption of Heat plants in Austria for instance ranged around 3500 tonnes a year, in Germany and Finland their consumptions is two to three times more important. Differences are even more impressive in the case of CHP plants were installations based in Finland and the United Kingdom consumed in general more than a hundred thousand tonnes of wood a year.

Major European wood chips consuming countries for Bioenergy production in plants >1MW: National Average and global wood input per type [in odt/yr]

EU-28 Country	Plant type	National Average wood chips consumption per output type (in odt/yr)	Overall National wood consumption per type (in odt/yr)
ES	H	34.981	442.537
	C	28.061	589.277
	E	68.340	1.503.475
IT	H	4.480	138.882
	C	17.324	571.689
	E	69.725	1.743.120
FR	H	6.437	1.905.403
	C	85.992	3.697.655
	E	-	-
DK	H	12.716	979.145
	C	58.395	1.167.894
	E	-	-
AT	H	3.460	1.587.968
	C	18.724	1.891.125
	E	-	-
EE	H	2.266	398.830
	C	31.744	285.693
	E	-	-
FI	H	6.161	2.137.743
	C	128.254	7.053.956
	E	-	-
LV	H	-	-
	C	8.503	204.069
	E	-	-
LT	H	3.884	268.015
	C	25.799	206.391
	E	-	-
DE	H	8.821	1.614.144
	C	82.330	12.596.523
	E	94.200	188.400
UK	H	-	-
	C	170.562	1.364.500
	E	87.218	610.529
CZ	H	3549,7	95.843
	C	24.599	295.189
	E	-	-
NL	H	44.800	537.600
	C	44.200	221.000
	E	-	130.000