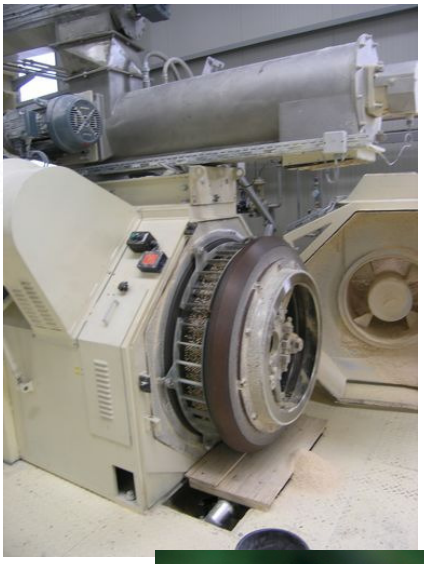

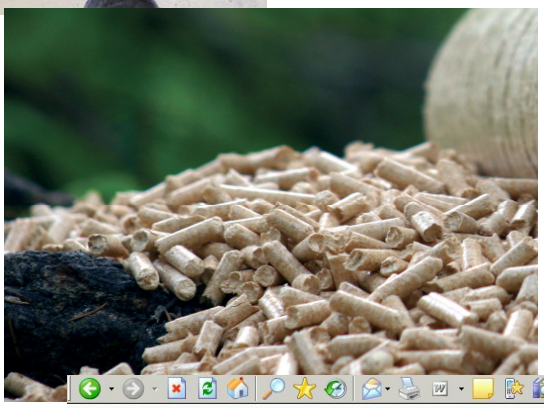

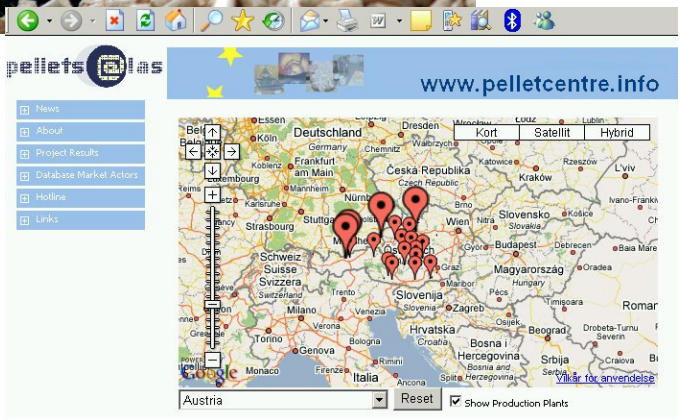

Development and promotion of a transparent European Pellets Market
Creation of a European real-time Pellets Atlas

Intelligent Energy Europe

MBP

(Mixed Biomass Pellets WP 5)

GENERAL FRAMEWORK

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1. INTRODUCTION

The growing consumption of wood pellets in Europe, especially in developed pellet markets such as Austria, raises the question of raw material supply for the pellet producing industry. The availability of the widely used sawdust and other wood wastes is limited. One option discussed is the production of pellets from whole trees, which might be unfavourable in means of sustainability, energy balance and a higher consumer price.
Furthermore, countries without large forestry industries and therefore a lack of sawdust sources will, with growing demands, be forced to serve their domestic markets with pellets imported from countries with a better wood raw material base. Again, the energy and cost balances of the necessary supply and logistic chains are disadvantageous compared to the consumption of locally produced biomass fuels distributed over short distances.

One way to face these problems is the broadening of the raw material base for the pellet production. Technically, a wide range of agricultural wastes and herbaceous crops are suitable as raw materials for the pelletizing process. Namely agricultural residues such as straw, wastes of the food industries, dedicated biomass fuel crops (e.g. *Miscanthus* grass) and even wastes from other bio-energy processes (e.g. bio-gasification) have been used successfully for the production of mixed biomass pellets (MBP).
The use of other raw materials than wood for the pellet production seems to become inevitable in the long run. It will be necessary in order to meet growing demands for pellets in the pan-European market and to allow for the establishment of local pellet supply systems in countries without sufficient wood waste emergence.
The availability of straw alone is enormous even when it can vary significantly between regions and the harvest seasons. Other biomass wastes are produced continuously and in constant amounts and could serve as more reliable raw materials. The use of biomass wastes of course would also allow keeping the pellet prices at low levels since most of the materials mentioned can be acquired at low costs.

The major drawback coming with the utilisation of MBP as fuel is the unfavourable chemical composition of most of the potential herbaceous MBP raw materials. Straw shows, compared to wood, high contents of e.g. chlorine and ash, posing technological problems during the combustion process. Corrosion of burner equipment, slagging and fouling are damaging and cost-intensive processes documented often during MBP combustion trials.
In addition to that high contents of certain elements lead to high emission values for related pollutants. For example high ash contents can result in elevated dust emissions while high HCl emissions are caused by high chlorine contents in the fuel.

Today there are efficient ways to face both these problems. Harmful effects on the burner equipment and the production of highly polluted emissions can be prevented by the application of filters and other gas cleaning technologies and a burner designed to suit the special properties of MBP fuels.
However, the application of such technologies is highly cost intensive and is no option for the small scale. Therefore the use of MBP as fuel in small boilers for heating purposes in the residential sector is hardly possible, even if there is a small community of innovative private

persons experimenting with their own equipment and the combustion of MBP. Many boiler producers at the same time state that they are working on the development of boilers especially designed to fire MBP.
Until the addressed problems with the use of MBP in the small scale are solved the combustion of MBP is limited to large scale applications where the investment in gas cleaning technologies can be cost-effective. MBP seem to be an interesting alternative to wood pellets for co-firing, ideally in CHP plants.

The markets for MBP are just emerging, logistic and trade routes are not established and the amount of traded and used MBP is very limited. In this situation the legal framework for the use of MBP is of great interest to investors and other stakeholders since it is one factor defining trade and investment opportunities. However, due to the infancy of the MBP markets, facts on national legislation regulating the use of MBP are not known to a wider public and the lack of a Europe wide consistent framework hinders market actors in acquiring the overview that is necessary as a basis for the decision on investments. This is a major barrier to the development of the MBP market.

Furthermore, quality standards do not exist for MBP. In fact, the nature of the respective plant materials makes it difficult to give general information on the quality of these fuels. Not only large differences between different plant species but also significant fluctuations in the quality depending on regional and climate factors complicate the situation.

This report tries to inform the reader about general requirements on herbaceous biomass to be used as fuel and relates this information to the ongoing European biomass standardisation process. In addition, eleven project partners of the pellets@las consortium analysed their national legislation concerning the use of MBP. This report summarises the findings and describes the legal framework for the MBP utilisation in eleven European countries.

2. QUALITY REQUIREMENTS ON MBP

The currently applied boiler and large scale firing plant technologies are perfectly suited for the combustion of wood and wood pellets. Especially pellet boilers for the residential heating sector are optimised for the use of wood pellets only.

Wood pellets in general are classified by CEN TS 14961 (Classification by origin and source) as “woody biomass” (1). Sawdust would then be classified as “wood processing industry, by-products and residues” (1.2), usually chemically untreated (1.2.1), with or without bark. MBP on the other hand can be derived from “herbaceous biomass” (2) including agricultural and horticultural herbs (e.g. cereals and grasses) and residues and by-products of the herb processing industries (e.g. rapeseed or sunflower press cake). They can also be classified as “fruit biomass”, (3) including orchard and horticulture fruits (e.g. shells from almond and different nuts) and residues and by-products from the fruit processing industries (e.g. olive

press cake or olive kernels). MBP in the truest sense of the term are classified as "blends and mixtures" (4) if wood, herbs and fruits are used as raw materials in mixture.[1]

The most widely spread quality standards on wood pellets for small scale applications today are the Austrian ÖNORM M 7135 and the German DINplus. Both require ash contents below 0.5 %, a sulphur content below 0.04 %, a nitrogen content below 0.3 % and a chlorine content below 0.02 %. The German DIN 51731 in contrast is less demanding with higher maximum values for ash (1.5 %), sulphur (0.08 %) and chlorine (0.03 %).[2] These less strict requirements still guarantee an unproblematic combustion in modern burner equipment.

Accordingly, these quality standards correspond to CEN TS 14961 (Specification based on fuel characteristics) as follows: The high quality wood pellets (ÖNORM M 7135 and DINplus) are described as A0.7 (ash < 0.7 %), S0.05 (sulphur < 0.05 %), N0.3 (nitrogen < 0.3 %) and Cl0.03 (chlorine < 0.03 %). Wood pellets of DIN 51731 quality are classified as A1.5 and S0.08.[1]

According to CEN/TC 335-WG 2 N94 straw from wheat, rye and barley, straw from oilseed rape and *Miscanthus* was tested. These materials have, in comparison to wood, significantly higher ash contents of 5 w-% (dry basis; 4 % for *Miscanthus*), elevated nitrogen contents (0.5 – 0.8 w-%), elevated sulphur contents (0.1 – 0.3 w-%) and very high chlorine contents (0.2 – 0.4 w-%). These elevated values are not in favour of an unproblematic combustion with today's burning technologies.[3]

Element contents that guarantee the unproblematic combustion are, in reference to CEN TS 14961: N0.5 or better, S0.10 or better and Cl0.10 or better. A maximum ash value is hard to determine since the influence of the ashes depend largely on their elemental composition. It might be stated that A1.5 or even A3.0 is sufficient. These requirements cannot be met with most of the discussed herbaceous raw materials.

Nitrogen contents of more than 0.6 % result in the enhanced production of NO_x. Nitrogen contents of 1 % already lead to NO_x emissions of around 600 mg/Nm^3 (during conventional combustion). Measures to meet this problem can be air staging and fuel staging as well as SNCR and SCR processes.[3]
Elevated sulphur contents (> 0.1 w-%) or elevated chlorine contents (> 0.1 w-%) cause corrosion of the burning equipment through the formation of chloride salts, and HCl. Technological counter measures are fuel leaching, automatic cleaning systems or coating of boiler tubes. Higher chlorine and sulphur contents also cause high emission values for HCl, dioxins (PCCD, PCDF) and SO_x.[3]

According to the figures given above, MBP from straw and other herbaceous biomass would be classified as A6.0 or A6.0+, N0.5 or N1.0, S0.10 ore above and Cl0.10+. Of course the

[1] Hartmann, H., *Normierung von Halmgut,* Technologie- und Förderzentrum Straubing, 2008.
[2] Becher, N. et al., *Standards for solid biofuels – Status and prospects,* Institute for Energy and Technology Leipzig, 2007
[3] Obernberger, I. et al., *Chemical properties of solid biofuels – significance and impact,* Graz University of Technology.

content values, e.g. for chlorine can vary significantly depending on the cultivar, climate and soil factors and the agricultural techniques applied. Furthermore, the pelletizing process or measures applied during the pelletizing process could influence the contents of certain elements. Therefore, other analyses of e.g. straw pellets state other values than the given ones. Some straw pellets producers for example specify the chlorine contents in their products as 0.1 %. This would improve the combustion characteristics significantly.

Given these characteristics of alternative raw materials, MBP from these biomass types cannot be used in the small scale with today's technology. But the use in large scale is possible when technological counter measures are taken to minimise emissions and to prevent harmful corrosion of equipment parts. The use of MBP in the residential sector depends on two necessary developments. First, boiler manufacturers need to design especially optimised equipment that can cope with the unfavourable characteristics of non-wooden biomass. Secondly, the national regulations on emission thresholds must allow for higher values for certain pollutants. This will be discussed later.

Since 2007.11.01 there exists the Austrian standard "ÖNORM C 4000: Compressed miscanthus - Requirements and test methods (National supplement referring to Prestandard CEN/TS 14961)", in which Miscanthus is classified as A 4.0 / A 6.0 (ash content <= 6%), N 0.5 (nitrogen <=0,5%), Cl 0.07 (chlorine <=0,07%) and S 0.05 (sulphur <=0,05%).

Besides this, the only known national quality standard on MBP in Europe is applied in France ("NF Granules Biocombustibles"; FCBA). Two qualities of "agropellets" are defined: The quality "AGRO" is dedicated to the pellet use in automated larger boilers, while the category "AGRO+" defines pellets for the domestic use. The detailed specifications are given in Table 1.

Table 1: Specification for French „agropellet" quality standards.

Specifications	AGRO+	AGRO
Dimensions	D = 6 to 8 mm ± 1mm L = 10 to 30 mm	D = 6 to 16 mm ± 1mm L = 10 to 30 mm
Moisture content	≤ 11%	≤ 15%
Net caloric value (MJ/kg)	≥ 15.5	≥ 14.7
Net caloric value (kWh/kg)	≥ 4.3	≥ 4.1
Bulk density (Kg/m3)	≥ 650	≥ 650
Mechanical durability	≥ 95%	≥ 92%
Amount of fines (after production)	≤ 2%	≤ 3%
Ash Content	≤ 5%	≤ 7%
Cl Content (on dry matter)	≤ 0.2%	≤ 0.3%
N Content (on dry matter)	≤ 1.5%	≤ 2%
S Content (on dry matter)	≤ 0.2%	≤ 0.2%
Ash temperature	Agro+ ≥ 1000°C	Agro ≥ 800°C
Heavy metals (mg/kg)		
As	≤ 1	
Cu	≤ 40	
Cr	≤ 10	
Cd	≤ 0.5	
Hg	≤ 0.1	
Ni	≤ 15	
Pb	≤ 10	
Zn	≤ 60	

As can be seen in Table 1 these standards respect the differences between wood pellets and MBP raw materials. However, it is not known, whether the category "AGRO+" is of any value since the defined maximum values seem to be opposed to the application in small scale domestic heating systems. This is probably not the case for the MBP utilisation in pellet stoves, which are the predominant pellet application in France.

In summary, it can be said that MBP can be burnt without serious problems in large scale plants provided that the necessary additional gas cleaning and other equipment is installed. To promote the use of MBP in this sector governmental aids or fiscal incentives provided to plant operators for investments in these additional equipments might be useful.

In order to allow for the wide spread use of MBP in the residential heating sector the boiler technologies need to be adapted and national environmental laws need to favour the use of alternative biomass fuels by applying especially adapted emission thresholds. Both processes will need political support.

3. NATIONAL LEGAL FRAMEWORKS FOR MBP UTILISATION

11 project partners of the pellets@las consortium analyzed the legal framework in their respective national markets. Where relevant regulations are in force, the configuration of the respective laws is described. This was done for Germany (WIP), Denmark (FORCE), Austria (HFA), the Netherlands (UU), Italy (ETA), Poland (BAPE), Estonia (LETEK), Hungary (GEONARDO), France (ADEME), Greece (AUA) and the United Kingdom (NEF).

3.1. Germany

The permission and operation of combustion units is regulated by the German Law for the protection against harmful effects on the environment (BImSchG). This law distinguishes large combustion units which are subject to approval from smaller units which do not need approval according to § 4 BImSchG.
If units are operated with regular fuels, including wood pellets, approval is not necessary for units up to 1000 kW. In case other fuels (e.g. straw) are used, units need approval above the size of 100 kW.

The operation of small units without the need of approval is regulated in BImSchV1. This order describes all fuels that may be used in small units. Amongst wood pellets and fossil fuels, this list also contains "straw and similar plant materials". This includes, according to most commentaries, *Miscanthus*, hay and reed but excludes grain, husks and rape cake.
BImSchV1 is under amendment at the moment. It is expected that the list of allowed fuels might be extended, but emission restrictions might also be tightened.
Until then, BImSchV1 sets maximum emission values for the use of straw to 0.15 g dust per m^3 and 4 g CO per m^3.

The operation of combustion units which are subject to approval (> 100 kW for straw; >1000 kW for other fuels) is regulated in the technical guidance for air pollution control (TA Luft).
These large-scale units may be operated with a broader fuel range, even pellets made of raw materials like dry manure or remains from biogas production can be burnt with a special permit from local authorities.
The "TA Luft" sets the following maximum emission values for units burning straw (and similar plant materials) – list incomplete:

Table 2: German emission thresholds for combustion that are subject to approval according to TA Luft.

Pollutant	Max. concentration	Pollutant	Max. concentration
Total Dust	< 1 MW: 50 mg/m^3 > 1 MW: 20 mg/m^3	NO_x	< 1 MW: 0.5 g/m^3 > 1 MW: 0.4 g/m^3
Total C	50 mg/m^3	CO	0.25 g/m^3
SO_x	0.35 g/m^3	HCl	30 mg/m^3

Straw and similar plant materials show, compared to woody biomass, significantly higher contents of sulphur, nitrogen, chlorine and ash, resulting in higher emissions of the above mentioned pollutants. Correspondingly, some of the maximum emission values are stricter for wood than for straw materials.
Requirements for larger combustion units (> 50 MV) are stricter with growing unit size (BImSchV13).

Barriers and solutions
BImSchV1 regulates the operation of small-scale combustion units and permits, besides regular fuels, only the combustion of straw and similar plant materials. Although this law already promotes the use of straw by setting higher CO emission threshold values especially for straw combustion, the exclusion of other materials (e.g. grains and husks) is a legal barrier preventing broader use of alternative biomass.
The "TA Luft" allows the use of a broad range of plant materials for the combustion in larger units (> 100 kW). Again, the use of alternative biomass is promoted by, in some cases, higher emission threshold values. Technical problems resulting from unfavourable characteristics of some plant materials can be solved by the application of technical solutions.

3.2. Denmark

In Denmark biomass is defined according to the Danish Act no. 638 of July 3 1997 on biomass waste. (Danish: Bekendtgørelse om biomasseaffald). It defines which types of solid biomass can be combusted in ordinary combustion plants. This includes waste from agriculture, forestry and industries working with biomass such as sawmills and furniture manufacturers. Any type of biomass or mix of biomass that is not mentioned in the annex to the act is defined as waste and must be handled accordingly in terms of temperature and retention time in an incineration plant. Furthermore, a waste tax is due.
Table 3 gives details on how biomass is defined in Act no. 638.

Table 3: Appendix to the Danish Act. No 638 on biomass waste.

1	**Raw wood**, including bark, forest wood chips and untreated milled chips	9	**Untreated grain and seeds**
2	**Clean wood**, including shavings and saw dust, not containing adhesives, lacquer, paint, varnish, impregnants (besides any mill stamps etc.), foil, laminates, nails, screws, fittings, etc.	10	**Untreated cotton and flax**
3	**Wood waste** from the production and treatment of clean, laminated wood, with an adhesive content (phenol-resorcinolresin, polyvinyl acetate resin, urea-formaldehyde resin, poly-urethane resin, and melamine-urea-formaldehyde resin) not exceeding 1% on dry weight basis.	11	**Lolly sticks** with a content of paraffin approved for use in foods not exceeding 1% on dry weight basis.
4	**Straw** (including baling cord from straw bales)	12	**Green pellets** (dried grass, clover etc.)
5	**Kernels** and **seeds** from fruits and berries.	13	**Malt**
6	**Fruit residues** (dry parts of fruits)	14	**Thatched roofing**
7	**Nut** and **seed shells** (including grain and seed screenings)	15	**Tobacco waste** in the form of whole or broken tobacco leaves, tobacco stalks, etc.
8	**Untreated cork**	16	**Fuel pellets** or **fuel briquettes** produced exclusively from wastes in this attachment.

The emission thresholds that apply to the combustion of MBP in Denmark are the same as for other biomass defined in the above mentioned ministerial order. The thresholds are defined in a number of different ministerial orders and a guide from the EPA. The thresholds have been compiled in a comprehensive table covering all thresholds for all sizes of conversion plants (Table 4).

Barriers and solutions

Poor combustion quality and possible operation problems are the main barriers to the development of small scale MBP combustion in Denmark. Furthermore, Denmark has very good and long experience with using straw locally in small district heating plants as well as regionally in medium sized CHP plants and centrally in large CHP blocks. All these plants are dedicated loose straw combustion plants ranging up to very advanced steam data and high efficiency. There is simply no need to introduce pellets in these plants. However, in the coming year where co-firing will be more relevant it cannot be ruled out that MBP might play a role.

Table 4:

Danish emission thresholds for energy plants **February 2009**

Input capacity		Fuel/plant type	Emission thresholds mg/m^3(n,t)				
			Particles	SO_2	NO_x	CO	UHC
MW	approx. kg/h						
Above **0,120** and less than **0,3**	8 - 20	LPG-gas			140	80	
	9 - 23	Natural gas			65/125[4]	75	
	10 - 25	Gas oil			110/250[4]	100	
		Fuel oil					
	30 - 75	Wood and biofuels	150			2500/1200[3]	100
	17 - 43	Coal	125			2500/1200[3]	100/80[3]
	30 - 75	Straw	150[2]			2500/1200[3]	
	9 – 23	Gas engines[6]			550	500	1.500
	9 – 23	Gas turbines[6]			200	150	
Above **0,3** and less than **1**	20 - 65	LPG-gas			140	80	
	23 - 70	Natural gas			65/125[4]	75	
	25 – 80	Gas oil			110/250[4]	100	
		Fuel oil					
	75 -260	Wood and biofuels	300			500	
		Coal					
	75 - 260	Straw					
	23 – 70	Gas engines[6]			550	500	1.500
	23 – 70	Gas turbines[6]			200	150	
Above **1** and less than **2**	65 - 130	LPG-gas			140	80	
	70 – 140	Natural gas			65	75	
	80 – 160	Gas oil			110	100	
		Fuel oil		-			
	260 -520	Wood and biofuels	40/(100)[1]			625	
	260 -520	Coal	40			625	
		Straw					
	70 -140	Gas engines[6]			550	500	1.500
	70 -140	Gas turbines[6]			200	150	
Above **2** and less than **5**	130 -325	LPG-gas			140	80	
	140 - 360	Natural gas			65	75	
	160 - 400	Gas oil			110	100	
	175 - 440	Fuel oil	100		300	100	
	520 - 1300	Wood and biofuels	40/(100)[1]			625	
	520 - 1300	Coal	40			625	
		Straw					
	140 -360	Gas engines[6]			550	500	1.500
	140 -360	Gas turbines[6]			200	150	
Above **5** and less than **25**	325 - 1600	LPG-gas			140	80	
	360 - 1800	Natural gas			65	75	
	400 - 2000	Gas oil	30		110	100	
	440 - 2200	Fuel oil	100		300	100	
	1300 - 6500	Wood and biofuels	40/(100)[1]		300	625	
	1300 - 6500	Coal	40		300	625	
	720 - 3600	Straw	25		200	100	
	360 - 1800	Gas engines[6]			550	500	1.500
	360 - 1800	Gas turbines[6]			200	150	
Above **25** and less than **50** * For power generating companies quotas apply	1600 -3200	LPG-gas			140*	80	
	1800 – 3600	Natural gas			65 *	75	
	2000 – 4000	Gas oil	30		110*	100	
	2200 – 4400	Fuel oil	100		300*	100	
	6500 – 13000	Wood and biofuels	40/(100)[1]	*	300	625	
	6500 – 13000	Coal	40	*	300*	625	
	3600 - 7200	Straw	25	*	200*	100	
	1800 - 3600	Gas engines[6]		*	550*	500	1.500
	1800 - 3600	Gas turbines[6]		*	200*	150	
Above **50** [7] Biomass is calculated as solid fuel	> 3200	LPG-gas	5	5	100-150		
	> 3600	Natural gas	5	5	100-150		
	> 4000	Gas oil	30 –50	200 –1700	200- 450		
	> 4400	Fuel oil	30 –50	200 –1700	200- 450		
	> 13000[7]	Wood and biofuels	30 –50	200	200-650		
	>7200	Coal	30 –50	200 –2000	200-650		
	> 3600	Gas engines[6]		*	550*	500	1.500
	> 3600	Gas turbines[6]		*	50 –120	150	

Reference is 10% O_2 according to the EPA guidelines no. 2/2001 and the Ministry of the Environment Order no. 1432 of 2007-12-11 — No threshold value applies

Reference 5% O_2 according to the Ministry of the Environment Order no. 621 of 2005-06-23 — These fuels can not be used in these plants according to EPA guidelines no. 2/2001

Reference 3% O_2 according to the Ministry of the Environment Order no. 808 of 2003-09-25 — Is governed by the Ministry of the Environment Order no. 1663 of 2006-12-14

Reference 6% O_2 according to the Ministry of the Environment Order no. 808 of 2003-09-25 — Reference 15 % O2 according to EU directive

[1] Figures in parenthesis apply for condensing plants and ny teknologi [2] Does not apply to straw fired plants in rural zones * The higher value applies for plants older than 2001

Reference: FORCE Technology - Telephone 7215 77 00 - info@force.dk

3.3. Austria

To fire something legally in Austria you need a heating system and combustible materials which are both tested and meet the legal requirements.
The "BGBl. 331/1997: Decree on heating systems (FAV)" deals with industrial heating systems with a nominal heat output of 50 kW and higher. This decree sets the maximum emission values for different kinds of fuels including wood, bark and logging residues (seeTable 5).

Table 5:
Maximum emission values [mg/m³] of heating systems for wood, based on nominal heat output [MW]

	<=0,1 [MW]	>0,1-0,35 [MW]	>0,35-2 [MW]	>2-5 [MW]	>5-10 [MW]	>10 [MW]
Dust	150	150	150	50	50	50
CO	800	800	250	250	100	100
NOx *)	250-500	250-500	250-500	250-500	250-350	200-350
HC	50	50	20	20	20	20

***) Depending on the kind of material (wood species, bark, wood based composites, …)**
Biomass, apart from wood, is not mentioned and must be handled individually by the authority (approval procedure) as "Special Fuel".

Since 1995 the "Art. 15 a B-VG agreement: Precautionary measures regarding small-scale heating systems" controls the implementation of heating systems with a nominal heat output up to 400 kW for residential heating or warm water supply. Table 6 shows the maximum emission values for such units for the combustion of solid biofuels.

Table 6: Maximum emission values [mg/MJ] for small-scale heating systems (< 400 kW) fired with solid fuels.

Combustion of solid biofuels	CO	NO_x	OGC	Dust
Hand stocked	1100	150 *)	80	60
Automatically stocked	500	150 *)	40	60

***) The NO_x-limit is valid only for the combustion of wood.**

This existing legal agreement on limiting values of emissions for heating systems had to be redrafted within the last three years because the emissions of non-wood biomass fuels did not succeed to meet the strict requirements on wood. Still the quick implementation of this new agreement fails because of the slow process of acceptation by all 9 Austrian provinces ("Bundesländer"). In the meantime the footnote for the NO_x-limit provides a loophole for the combustion of non-wood biomass.
Table 7 shows the proposed maximum emission values in the revised "Art. 15 a B-VG agreement" [datasource: Lasselsberger L. 2006: Energie aus fester Biomasse, BLT Wieselburg].

Table 7: Proposed maximum emission values [mg/MJ] for heating systems for combustion of solid biofuels (automatically stocked).

	Woodfuels	Other Standardized Biofuels
CO	500	500
NOx	150	300
OGC	30	30
Dust	50	60

Heating systems for "Other Standardized Biofuels" are going to be tested referring to ÖNORM EN 303-5: Heating boilers – Part 5: Heating boilers for solid fuels, hand and automatically stocked, nominal heat output of up to 300 kW – Terminology, requirements, testing and marking.

Barriers and solutions
In Upper Austria *Miscanthus* is cultivated on an area of nearly 400 hectare already. A project group called "ARGE Elefantenwärme" was formed to promote their product. It is sold as horse bedding, burned directly or worked to briquettes. The pelletizing process was too expensive.
Another company produces straw pellets with a production capacity of 4000-5000 tonnes/year but cannot sell them because of the still missing legal regulations to burn them. The straw pellets are granulated again and sold as horse bedding.
In the course of a project hay pellets were produced and their quality was investigated. Costs were high throughout the production chain and it was impossible to fire the hay pellets in standard commercial wood pellets firings due to higher ash contents and a lower ash softening point of the agricultural biomass. Boiler firms are working on new developments to control these properties [data source: Rathbauer J. 2006: Nutzungsalternative Gras als Brennstoff, FJ-BLT Wieselburg].
Some heating system manufacturers already offer special boilers for agropellets with which it would be possible to meet the proposed requirements for the maximum emission values (Table 7). So the main barrier for the use of MBPs is the current legal situation in Austria.
Apart from that a development of logistic systems for the production of agropellets would be necessary.

3.4. The Netherlands

MBP pellets currently are only used for co-firing in a single large-scale coal power plant, the Amer power plant, owned by the Utility Essent. However, also other coal-power plants co-fire agricultural residues, such as wheat husks and palm kernel shells, but not in pelletized form. In general, these plants have to meet the general local, national and international laws setting emission thresholds for coal-power plants. On a national level, this is regulated by the so-called Bees-A, setting emission thresholds for (amongst others) power plants with a

thermal installed capacity greater than 20 MW for emissions of SO_x, NO_x, fine dust particles etc.[4] For example, the emission threshold for plants with a capacity of more than 300 MW, commissioned after 1992, is 200 mg/m^3 for SO_x and NO_x and 50 mg/m^3 for dust. The Bees-A law is also valid for non-wooden biomass, which is explicitly included in the law. Biomass is defined in the law. Next to the inclusion of residues from the food –processing industries and the pulp & paper industries, biomass is defined as 'plant material derived from agricultural or forestry activities'. If mixed biomass pellets were to be used in either large-scale stand-alone plants or co-fired in waste incineration plants, other relevant Dutch laws are the Netherlands Emission Guidelines for Air [5] and the law on the combustion of waste. [6] Especially in the latter, also emission thresholds are defined for contaminated metals (e.g. with heavy metals or halogens).

Next to the national laws, local municipalities have in special situations (e.g. when the plant is located close to residential areas) the right to set more stringent emission levels for specific emission (e.g. dioxins, mercury). However, as levels of halogens and mercury are typically very low in mixed agricultural biomass, this is deemed of less relevance in this frame.

Finally, next to the national laws, international laws relevant for emission from MBP combustion include the national emission ceilings directive [NEC], setting maximum total emission amounts for SO_2, NO_x, volatile organic compounds (VOC) and ammonia (NH_3).[7]

Utilization of MBP for medium-to-small-scale heating is to our knowledge currently not occurring in the Netherlands. If this were to occur in the near-by future, the emissions would be regulated under the Bees-B law,[8] which typically regulates all emission from small-scale industrial installations with thermal capacities lower than 20 MW. Finally, in the (unlikely) application in small-scale residential wood boilers, the Netherlands Emission Guidelines for Air would generally apply. A more detailed overview of all emission rules for biomass use is provided by SenterNovem.[9]

Barriers and solutions

The prices of regular fossil fuels for power production, like coal and natural gas, are more than competitive. For the residential sector biomass including wood pellets is not considered

[4] [Bees-A] Besluit emissie-eisen stookinstallaties milieubeheer-A. Available at: http://wetten.overheid.nl/BWBR0004147/geldigheidsdatum_18-02-2009#Hoofdstuk2

[5] [NER] Netherlands Emission Guidelines for Air, available at: http://www.infomil.nl/aspx/get.aspx?xdl=/views/infomil/xdl/page&ItmIdt=164452&SitIdt=111&VarIdt=82

[6] [BVA] Afvalverbranding: Besluit verbranden afvalstoffen. http://www.infomil.nl/aspx/get.aspx?xdl=/views/infomil/xdl/page&ItmIdt=28786&SitIdt=111&VarIdt=82

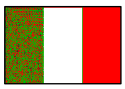
[7] [NEC] national emission ceilings directive, available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2001:309:0022:0030:NL:PDF

[8] [Bees-B] Besluit emissie-eisen stookinstallaties milieubeheer-B. Available at: http://wetten.overheid.nl/BWBR0004833/geldigheidsdatum_18-02-2009

[9] [SenterNovem] Toelichting luchtkwaliteit, available at: http://www.senternovem.nl/duurzameenergie/aan_de_slag/aan_de_slag_bio-energie/vergunningverlening/vergunningverlening_biomassa/c16c08.asp

to be a promising option for the generation of heat by official organisations. The national subsidy scheme "Duurzame Warmte" does promote the use of solar thermal or heat pump technologies in the residential sector, but explicitly not heating technologies using biomass of any kind. On the other hand, the use of biomass for co-generation is promoted

3.5. Italy



The position of the Italian legislation concerning the utilisation of agricultural residues for heat and power production is not very well defined. The effective co-firing Normative lacks clear statements. Several laws were issued by various Governments during the last six years, but none of them was able to stimulate the market.

In reference to the co-firing normative, the most important laws of the Italian legislation are:

- D.lgs16 marzo 1999, n 79 (decreto Bersani) for the liberalisation of the electricity market;
- D.M. 2002 for the rapid development of power (Decreto Marzano);
- DPCM 2002; Characteristics of bio fuels.

The last law mentioned defines the kinds of biofuels that can be used for co-firing in Italy. Namely it declares that agri-products must derive from:

- Dedicated cultivations;
- Forestry (management of forest residues, pruning);
- The industry sector (wood residues which were treated only in a mechanical way, without adding any other products, chemicals, etc)

Following to the trials that were done in the existing power plant fuelled with coal, it was confirmed that bio-residues can be used in a portion of 5-15% of total load of coal, without modifying any part of the plant.[10] In Table 8 the main emission values of a coal power plant and co-firing power plants are compared.[11]

Table 8: Typical emission values of coal power plants, co-firing power plants and emission limits as foreseen by the Normative.

Compound	Average of concentration in coal power plants (mg/Nm^3).	Average of concentration in co-firing power plants (mg/Nm^3).	Limits foreseen by the Normative (mg/Nm^3).
SO2	1224,3	1126,0	1700,0
NOX	502,6	492,0	650,0
CO	5,5	9,0	250
PM10	4,7	3,7	50,0

[10] http://www.latermotecnica.net/articolo.asp?id=20060915003
[11] Source: CESI; http://www.cesi.it/

The Laws which define limits for the emissions of power plants in Italy are the following:

- DPR 203 del 24.05.88, Decreto del MATT 12.07.90 "Linee Guida per il contenimento delle Emissioni";
- Decreto del MATT 25.09.1992 "Disciplina delle emissioni di nichel";
- Decreto del MATT 21.12.95 "Disciplina dei metodi di controllo delle emissioni in atmosfera degli impianti industriali";
- Decreto del MATT 25.08.2000 "Aggiornamento dei metodi di campionamento, analisi e valutazione degli inquinanti, ai sensi del DPR 203 24.05.88";
- DPCM 08.03.2002 "Disciplina delle caratteristiche merceologiche dei combustibili aventi rilevanza ai fini dell'inquinamento atmosferico, nonché delle caratteristiche tecnologiche degli impianti di combustione".

Barriers and solutions

The Italian legislation concerning co-firing in general and the use of MBP for co-firing and the according administration should be simplified. The right to decide on the construction of new power plants is claimed both by the administrative regions (20 in Italy) and the Ministry of production activities, the central institution in Italy. This unclear classification of powers seriously slows down decision processes and market development.

At the same time all phases of the supply chain of agri-residues should be studied in detail. The lack of information and positive experiences in Italy slows the development of this market. This includes the intensified monitoring of the quality of agri-fuels.

The Government should also further enhance the liberalization of the energy market in Italy.

3.6. Poland

For installations < 1 MW emission limits are given by the Polish Standard PN-EN 303-5 (which corresponds to the European Standard EN 303-5:1999):

Table 9: Emission limits < 1 MW

Type of fuel	Power output kW	Emission limits								
		Mg/m^3 at 10% of O2								
		CO			OGC*			dust		
		Class of device			Class of device			Class of device		
		1	2	3	1	2	3	1	2	3
Boilers loaded manually										
biofuel	< 50	25000	8000	5000	2000	300	150	200	180	150
	50- 150	12500	5000	2500	1500	200	100	200	180	150
	150-300	12500	2000	1200	1500	200	100	200	180	150
Boilers loaded automatically										
biofuel	< 50	15000	5000	3000	1750	200	100	200	180	150
	50- 150	12500	4500	2500	1250	150	80	200	180	150
	150-300	12500	2000	1200	1250	150	80	200	180	150

For installations above 1 MW there exists a regulation issued by Ministry of Environment on 4th August 2003:

Table 10: Emission limts > 1 MW

Power output [MW]	Emission limits for dust in mg/m^3					
	For installations put into operation before 29.03.1990		For installations put into operation after 29.03.1990			
	Until 31.12.2015	Since 01.01.2016	Building permit issued before 07.10.1998		Building permit issued after 07.10.1998	
			Until 31.12.2015	Since 01.01.2016	Until 31.12.2015	Since 01.01.2016
< 5	700	200	630	200	630	200
≥ 5 & < 50	400	100	400	100	400	100
≥ 50 & < 500	100	100	100	100	50	50
≥ 500	50	50	50	50	50	50

Power output [MW]	Emission limits for SO_2 in mg/m^3
< 100	800
≥ 100 & < 500	800-400
≥ 500	400

Power output [MW]	Emission limits for NOx in mg/m3	
	01.01.2008 – 31.12.2015	since 01.01.2016
≤ 500	400	400
> 500	400	200

There exists also a certificate issued by the Institute of Chemical Processing of Coal - the "Environmental Safety Certificate". The certificate is non-obligatory; however it is often necessary when applying for European funds. It became very popular among manufacturers, who voluntarily try to get one. The certificate is issued for small solid fuel boilers, and its requirements are stricter than those of the standard PN-EN 303-5. For example, contrary to the standard, the certificate sets limits for NO_x, TOCs or aromatic hydrocarbons emissions.

Boiler type	Boiler's class	Efficiency	Emission limits					
			CO [mg/m^3]	NO_2 [mg/m^3]	Dust [mg/m^3]	TOC [mg/m^3]	Aromatic hydro-carbons [mg/m^3]	Benzoa-pyrene [µg/m^3]
Boilers loaded manually	B	≥ 75	≤ 5000	≤ 400	≤ 200	≤ 150	≤ 15	≤ 150
	A	≥ 80	≤ 1200	≤ 400	≤ 125	≤ 75	≤ 5	≤ 75
Boilers loaded automatically	B	≥ 78	≤ 3000	≤ 600	≤ 150	≤ 100	≤ 5	≤ 100
	A	≥ 80	≤ 1200	≤ 400	≤ 125	≤ 75	≤ 5	≤ 75

Barriers and solutions
Raw material resource potentials are difficult to estimate, however straw surpluses that can be used by the energy sector in Poland are estimated at 10 million tonnes. Supply terms may change over time, as long-term contracts are not preferred by the farmers.

Despite the aforementioned market obstacles, more and more companies see their chances in this market branch. Among other factors, incentives in form of "green and red certificates" contribute to this situation. Green certificates stand for electricity produced from RES – their value is approximately 250 zl/MWh, red certificates stand for CHP – reaching value of 120 zl/MWh for small plants < 1MW.

Another factor leading to the increased interest in MBP are recent changes in legal regulations, which promote the use of herbaceous biomass (energy crops, agricultural residues and residues coming from food processing industry) and no longer respect residues from forestry and their processing.
The new regulation issued by the Ministry of Economy (dated 14 August 2008, Dz.U. 156, Poz. 969) states that energy producing units with power outputs exceeding 5MW and claiming to produce renewable energy with a biomass share among other fuels, have to assure that herbaceous biomass (energy crops, agricultural residues and residues coming from food processing industry) weight ratio is at least 10 % (2009). This obligatory share will increase every year up to 100 % in 2915. For energy producing units with power outputs exceeding 20 MW, the share will rise to a maximum of 60 % in 2017.
The above means that heating plants will strive for the increase of the use of herbaceous biomass and MBP constitute an interesting option for this.

3.7. France

The French legislation does not determine between wood and other biomass fuels. Wooden and herbaceous biomass is equally treated as biomass fuels. This means that all kinds of biomass are potential fuels for combustion processes as long as emission standards are met.

Installations with outputs below 2 MW are not subject to the national legislation. If these small-scale applications are regulated at all in terms of emission thresholds this is done by regional health regulations ("règlement sanitaire departmental").

Installations with power outputs above 2 MW and below 20 MW are regulated by an order issued in July 1997.[12] For these installations the emission thresholds are set at 200 mg SO_x / m^3, 500 mg NO_x / m^3, 150 mg dust / m^3 (< 4 MW) and 100 mg dust / m^3 (> 4 MW). The order includes thresholds that are less strict for some pollutants for plants existing before the order was issued.

[12] Arrêté du 25 juillet 1997 modifié relatif aux petites installations de combustion.

Larger combustion plants (> 20 MW) are regulated by an order issued in June 2002.[13] Related emission thresholds are shown inTable 11:

Table 11: Emission limits > 20 MW

	SO_2 [mg / Nm^3]	NO_x [mg / Nm^3]	Dust [mg / Nm^3]	CO [mg / Nm^3]
20 – 50 MW	200	400	50	200
50 – 100 MW	200	400	50	200
100 – 300 MW	200	300	30	150
> 300 MW	200	200	30	150

Barriers and solutions

The French regulations for medium- and large-scale combustion plants set clear rules for the use of MBP. This promotes their further use in the industrial sector by providing a secure legal framework. Furthermore, the thresholds themselves do promote the use of MBP by allowing their use without demanding too challenging emission values. Compared to the German legislation the values set by the French law can be met without serious problems.

3.8. United Kingdom

Regulatory authorities are involved in controlling heating installations (whether biomass or otherwise) if the rated output of the plant is greater than 0.4 MW. Between 0.4 MW and 3 MW the local authority (i.e. Local Government) is the regulatory authority. If the plant is over 3MW the Environment Agency is the regulatory authority under the Pollution Prevention and Control Act 1999 (IPCC). This is best illustrated by the following chart published by the Carbon Trust (Figure 1). MBP will fall into 2, Waste or Waste Derived Biomass. Part A1 of the Pollution Prevention and Control (PPC) Act relates to Energy Industry Combustion Activities. Emissions to all environmental media must be controlled from Part A1 and A2 installations and such installations are also required to account for energy efficiency and to control against Noise Pollution.

[13] Arrêté du 2 juin 2002 (modifié par l´arrêté du 13 juillet 2004) relatif aux chaudières présentes dans une installation nouvelle ou modifiée dúne puissance supérieure à 20 MW..

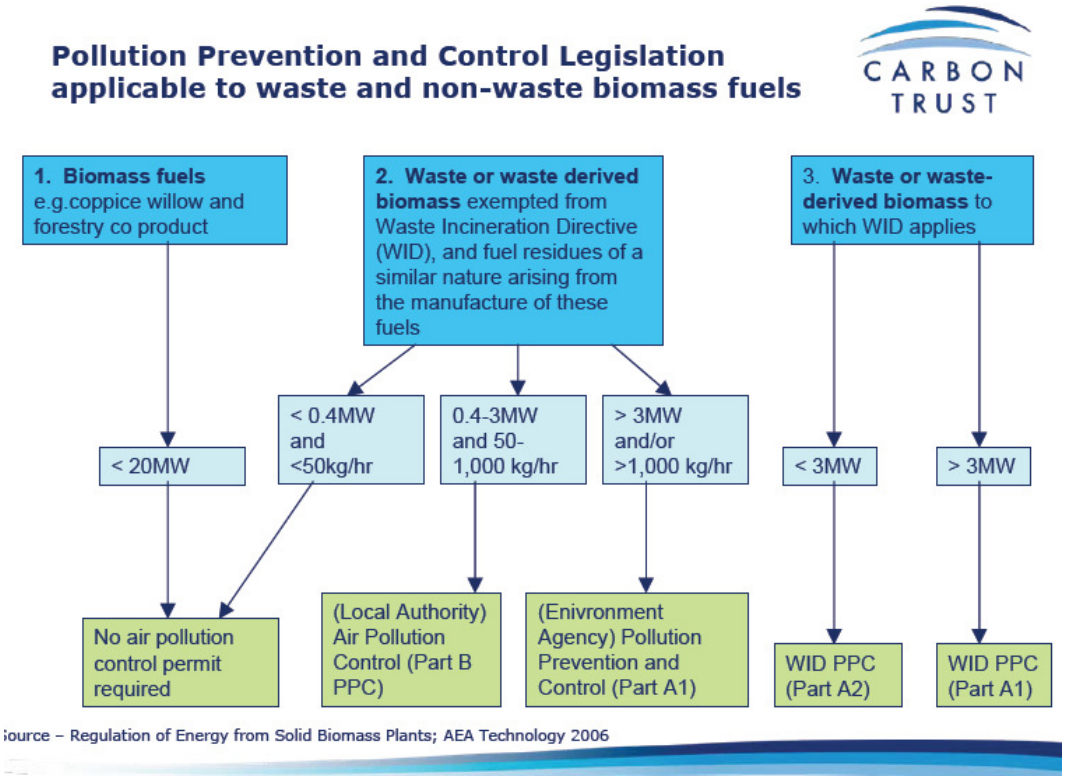


Figure 1

PPC the companies regulated are required to measure emissions from their chimney-stacks. This permission from either the Local Authority or Environment Agency usually comes in the form of a permit, which usually requires the monitoring of emissions. Businesses either monitor their emissions all the time, known as continuous monitoring, or at times defined in their permit, known as spot tests or periodic monitoring. In both cases they must meet our quality requirements.

The revised Large Combustion Plant Directive (LCPD) is also important since this establishes emission limit values (ELVs) for new and existing plant, in addition to making further provisions for pollution inventory reporting in support of the European Pollutant Emission Register (EPER) requirements. Under this legislation, existing combustion plant must either observe lower emission limits, or achieve equivalent emission reductions via a national emissions reduction plan, by 2008, unless it is intended to close the plant after a further 20,000 operating hours between 2008 and the end of 2015. Plant that is upgraded to meet the Part A Emission Limit Values, defined in the Annexes of the Directive, is 'opted in'. Plant that is designate for eventual closure is 'opted out'. It is anticipated that many of the existing coal fired stations will opt out rather than invest in the technology that would enable them to meet the ELVs which will consequently have the effect of reducing the quantity of pellets co-fired in the UK.

The UK's Environment Agency control emissions of sulphur dioxide, nitrogen oxides and particulates from the UK's 17 large coal and oil fired power stations. These controls are implemented by environmental permits – issued under the IPPC. These permits include the

requirements of the LCPD. The emissions limits for each of these power stations can be found at:
http://www.environment-agency.gov.uk/static/documents/Business/2009_SO2_NOx_return_jan09.xls

As can be seen from the diagram above under 0.4 MW (or 20 MW in the case of Biomass Fuels) no regulatory authority is involved unless the plant is in a smokeless zone. It is an offence to emit smoke from a chimney of a building, from a furnace or from any fixed boiler if located in a designated smoke control area. It is also an offence to acquire an "unauthorised fuel" for use within a smoke control area unless it is used in an "exempt" appliance ("exempted" from the controls which generally apply in the smoke control area).

Exempt appliances are appliances (ovens, wood burners and stoves) which have been exempted by Statutory Instruments (Orders) under the Clean Air Act 1993 or Clean Air (Northern Ireland) Order 1981. These have passed tests to confirm that they are capable of burning an unauthorised or inherently smoky solid fuel without emitting smoke. For a list of exempt appliances please go to http://www.uksmokecontrolareas.co.uk/appliances.php . A list of authorised fuels can be found at http://www.uksmokecontrolareas.co.uk/fuels.php. Authorised fuels can be used in a non exempt appliance in smoke control zone, however pellets (MBP or otherwise) are not an authorised fuel – most of the authorised fuels are coke, briquettes for fire logs made by one of a number of manufacturers.

Barriers and solutions
The MBP market in the UK is very small and until the pellets themselves and the equipment to burn them in becomes more widely available, the use of MBP in the UK is unlikely to develop. For the foreseeable future it is anticipated that the main use of MBP pellets in the UK will be for co-firing. From 2009 the availability of ROCS at a higher rate for pellets produced from energy crops such as *Miscanthus* should stimulate the market for MBP from this source. However, the *Miscanthus* be used in a form other than a pellet prior to co-firing. It is anticipate that the use of non-energy crop pellets, whether wood or MBP might decline after 2009 and/or 2015 as some of the existing coal fired power stations in the UK close down rather than opting in to the Large Combustion Plant Directive.

3.9. Hungary

The 23/2001. (IX. 13.) KöM (Környezetvédelmi Minisztérium – Ministry of Environment) resolution contains the rules for combustion equipment with capacities between 140 kWth and 50 MWth. It defines the different energy sources such as coal, other solid fuels (solid biofuels without any pollution and without any chemical treatment), petroleum and gases. In case of CHP facilities the emission thresholds are defined in the ratio of the input heat amount of all used materials.

Table 12: Appendix I: Emission thresholds in Hungary for applications between 140 kW and 50 MW

Pollutant	Emission threshold (mg/ m^3)
Solid material	150
CO	250
NOx (in NO_2)	650
SOx (in SO_2)	2000 *
Total carbon content	50

The thresholds apply to flue-gas that is dry (non-wet), 273° K, 1013 kPa, in case of coal burning 7% in case of wood, wood chips and solid biofuel burning 11% O_2 content.
* In case of wood or wood chips or solid bio fuels the threshold is 1000 mg/ m^3.

The 10/2003 (VII. 11.) KvVM (Környezetvédelmi és Vízügyi Minisztérium – Ministry of Environmental and Water) resolution contains the rules for combustion unit capacity above 50 MWth. The resolution defines biomass and agricultural residues as a possible material to combust.

Table 13: Appendix II A (applies to combustion units above 50 MW that were active at the time this resolution came into force)

Pollutant	Emission threshold (mg/m^3) 50 MWth<combustion unit capacity<100 MWth	Emission threshold (mg/m^3) 100 MWth<combustion unit capacity<500 MWth	Emission threshold (mg/m^3) 500 MWth<combustion unit capacity
Solid material	100	50	50
CO	250	250	250
NO_x (in NO_2)	600	600	500
SO_x (in SO_2)	2000	2000-400	400
Chlorines (in HCl)	200	100	100
Fluorides (in HF)	30	15	15

In case of other material than coal, like biomass (solid biofuel) there is also a threshold (1 mg/Nm^3) for the aggregated emission of Cadmium, Cobalt, Chrome, Nickel, Vanadium, Lead and Arsenic.

Table 14: Appendix II B (applies to combustion units above 50 MW that became active after this resolution came into force)

Pollutant	Emission threshold (mg/m^3) 50 MWth<combustion unit capacity<100 MWth	Emission threshold (mg/m^3) 100 MWth<combustion unit capacity
Solid material	50	30
CO	250	250
NO_x (in NO_2)	400	200 *
SO_x (in SO_2)	850 **	200
Chlorines (in HCl)	200	100
Fluorides (in HF)	30	15

* In case of biomass burning the emission threshold for 100 MWth<combustion unit capacity<300 MWth is 300 mg/Nm^3.
** In case of biomass burning the threshold is 200 mg/Nm3

In case of other material than coal like biomass (solid biofuel) there is also a threshold (1 mg/Nm^3) for the aggregated emission of Cadmium, Cobalt, Chrome, Nickel, Vanadium, Lead and Arsenic. The thresholds apply to dry, 6 v/v % flue-gas.

Barriers and solutions
In Hungary the portion of households supplied by natural gas is extremely high. Also significant state aid applies to natural gas and district heating. Currently, only semi-processed forms of biomass (e.g. fire wood and straw) are used in power plants producing heat and electricity.
The sales of pellet boiler shows increasing tendency in the last few year that can be considered as a potential for the future for pellet producers and traders.

References:

http://www.kvvm.hu/cimg/documents/23_2001_K_M_rendelet_a_140_kWth__s_az_enn_l_nagyobb__de_50_MWth_n_l_kisebb_n_vleges_bemen__h_teljes_tm_ny__t_zel_berendez_sek_l_gszennyez__anyagainak_technol_giai_kibocs_t_si_hat_r_rt_keir_l.doc

http://www.kvvm.hu/cimg/documents/10_2003_KvVM_rendelet_az_50_MWth__s_ann_l_nagyobb_n_vleges_bemen__h_teljes_tm_ny__t_zel_berendez_sek_m_k_d_si_felt_teleir_l__s_l_gszennyez__anyagainak_kibocs_t_si_hat_r_rt_keir_l.doc

3.10. Greece and Estonia


In Greece and Estonia the generation of power and / or heat is not regulated. Namely, the national laws do not provide emission thresholds for any kind of pollutant or for specific boiler sizes. In principle every kind of fuel including all kinds of biomass fuels can be burnt

both in small-scale heating installations in the residential sector and in medium- and large-scale combustion units.

This means that the legal framework does not pose any problem to an enhanced use of alternative biomass fuels or alternative biomass fuel pellets. Especially the exclusion of MBP as irregular fuel and the unfavourable impact of MBP utilisation on emission values cannot be seen as a barrier in these countries.

Of course, technological problems that occur when herbaceous biomass is used as fuel remain. Harmful effects of alternative biomass fuels on parts of the burner equipment must be met with additional and cost-intensive technological upgrades. These barriers related to unfavourable fuel characteristics are, as they are everywhere, the main factor hampering MBP market development that can be eliminated by additional investments.

While this can be done easily in most of the European countries the markets in Greece and Estonia face the additional problem of lacking political support by the national governments. In these three countries subsidy schemes, tax incentives or regulatory promotion programmes are hardly developed and applied. Therefore, the necessary investments in additional technologies necessary for MBP utilisation is neither demanded nor encouraged. Currently this seems to be the main barrier for the development of MBP markets in Greece and Estonia.

4. SUMMARY & CONCLUSIONS

The European pellet market is new and at development stage. This is true for the national wood pellet markets and even more for the MBP markets. The MBP production capacities in Europe are a fractional amount compared to those for wood pellet production and only minor amounts of MBP are produced and consumed in Europe.

As it is the case for other young markets, the MBP market is characterised by a lack of standardisation, of international connectivity and of established trade and logistic regimes. Slower processes as the formulation and implementation of related legislative frameworks are even lagging behind and their harmonisation on a European level is far from realisation.

Accordingly, the national legal frameworks in the eleven countries analysed differ largely. Next to countries without a legislative regulation of combustion processes (Estonia and Greece) there are highly developed legal frameworks in force in other countries (e.g. Germany, Austria and Denmark).

Another difference between the existing legal frameworks is how they handle different fuels. The legislation in Italy, Hungary, the UK and Poland does not discriminate between fossil, wood and alternative biomass fuels. The set emission thresholds apply to all fuels in the same way. In Germany, Denmark, the Netherlands, France and Austria the law sets specific emission thresholds for different fuels. However, in e.g. Germany the accuracy of

discrimination is higher and the German law treats wood and other biomass in a different way, while the French legislation handles all kinds of biomass equally.

The thresholds applied in France, Poland, Hungary and Italy are not too strict and can be met by wood as well as by non-wooden biomass fuels (see Figure 2). In countries like Germany, Austria and Denmark the allowed emissions for wood fuels are too strict and cannot be achieved with other biomass fuels. Therefore these countries have set (or will have to set in the case of Austria) adjusted thresholds in order to allow for the use of e.g. straw as fuel. In the UK the use of waste and biomass derived waste is not restricted by emission limits for applications below 0.4 MW, while the use in medium-scale applications is regulated by regional authorities and power stations are given individual emission permits by the Environment Agency.

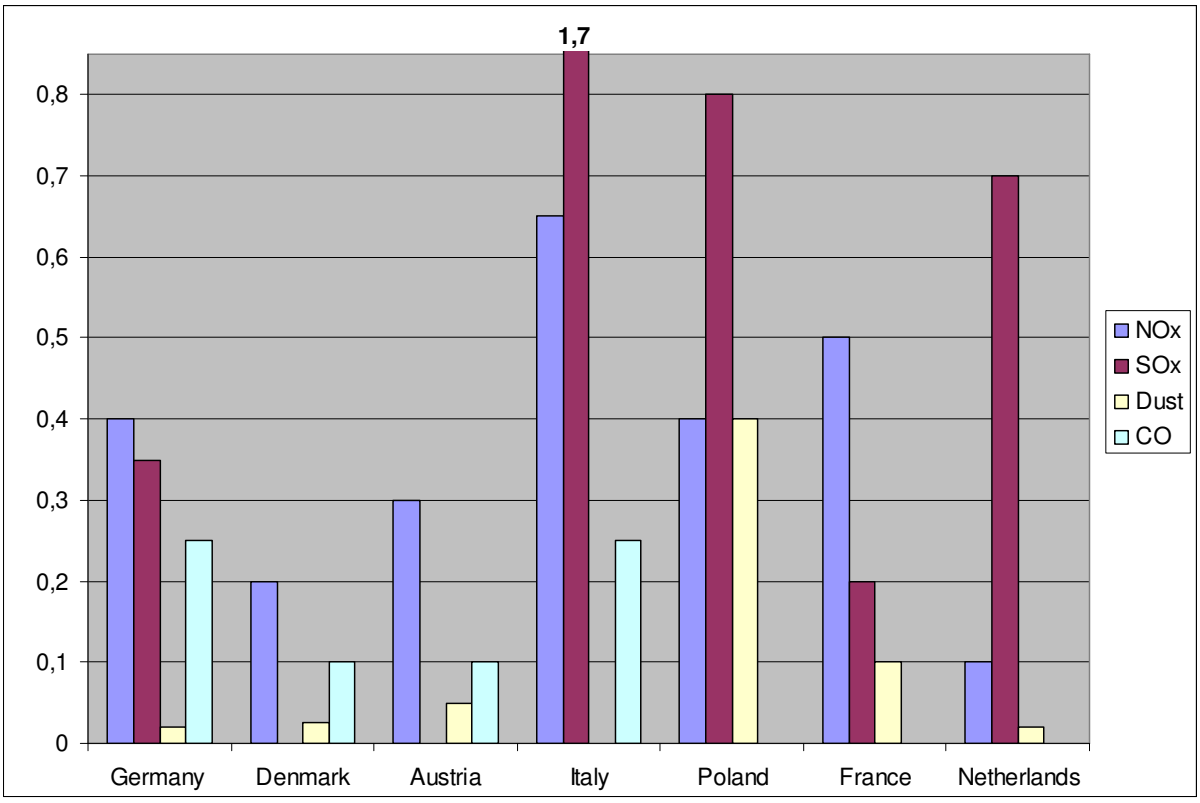


Figure 2: Emission thresholds [g / Nm^3] for selected pollutants in selected countries.
For pollutants without value, no threshold is set or mentioned in this report.
Germany: Combustion of straw, 0.1 – 50 MW
Denmark: Combustion of straw, 5 – 25 MW
Austria: Combustion of wood, > 5 MW
Italy: General limit values
Poland: General limit values, 5 – 50 MW
France: General limit values, > 20 MW
Netherlands: General limit values, < 20 MW

In summary, the analyzed countries fall into three categories:

- Countries without set emission thresholds (Estonia, Greece),
- Countries with loose emission thresholds that apply to a variety of fuels and can be met by MBP,
- Countries with strict emission thresholds, where special thresholds are set for alternative biomass fuels.

In all countries the legal framework does not pose the main barrier to an enhanced MBP utilization since it is basically allowed to burn alternative biomass in all countries, at least in a medium and large scale. Furthermore, where emission thresholds are set they are either generally loose enough or specifically modified in order to allow for the utilization of MBP.

However, the stricter emission thresholds in some countries require the additional application of e.g. gas cleaning technologies. As a result additional investment costs incur when a combustion plant is operated with other biomass fuels than wood.

Additional investment costs are also the result of occurring harmful effects of MBP utilization on the burning equipment, which remains the main barrier to an enhanced MBP utilization in the residential sector. Concerning the use of MBP in small-scale appliances a further technological development of small boilers is crucial in order to develop a MBP market in this sector.

In the medium and large scale sector technological problems can be solved today but political support in terms of financial incentives or regulatory instruments might be necessary for priming market development in this sector.

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