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Portuguese pellets market: Analysis of the production and utilization constrains

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ABSTRACT

As opposite in Portugal, the wood pellets market is booming in Europe. In this work, possible reasons for this market behavior are foreseen according to the key indicators of biomass availability, costs and legal framework. Two major constrains are found in the Portuguese pellets market: the first one is the lack of an internal consumption, being the market based on exportations. The second one is the shortage of raw material mainly due to the competition with the biomass power plants. Therefore, the combination of the biomass power plants with pellet production plants seems to be the best option for the pellets production in the actual Portuguese scenario. The main constrains for pellets market has been to convince small-scale customers that pellets are a good alternative fuel, mainly due to the investment needed and the strong competition with natural gas. Besides some benefits in the acquisition of new equipment for renewable energy, they are insufficient to cover the huge discrepancy of the investment in pellets heating. However, pellets are already economic interesting for large utilizations. In order cover a large amount of households, additional public support is needed to cover the supplementary costs of the pellets heating systems.

1. Introduction

During the last years, an increasing interest for sustainable energy production has been seen globally. A major contribution to this is expected to come from biomass, as a renewable and CO_2-neutral energy source. Biomass has low energy density and low yield per unit area (Kumar et al., 2003). These two key factors result in a high cost of biomass delivery, which increases the total biomass-processing cost. Densified biomass, especially pellets has drawn attention due to its superiority over raw biomass in terms of its physical and combustion characteristics (Obernberger and Thek, 2004). Moreover, pellets have other value-added advantages over raw biomass. Pelletization reduces moisture content, increases energy content, enhances combustion efficiency and produces greater homogeneity of composition as compared to raw biomass (Obernberger and Thek, 2004). The bulk density of biomass pellet is 4–10 times that of 'as received biomass' (Karwandy, 2007). This makes for easier handling and transport. All these factors make pellets one attractive form of biomass-based energy.

The wood pellet market is booming in Europe (Sikkema et al., 2011). The EU 2020 policy targets for renewable energy sources and greenhouse gas emissions reduction and the worsening situation of strong energy dependence on oil (Hedenus et al., 2010) are among the main drivers.

Nowadays, wood pellets are one of the largest internationally traded solid biomass commodities used specifically for energy purposes. In terms of traded volume – about 4 million tones – they can be compared to biodiesel or bioethanol (Heinimö and Junginger, 2009). In Portugal, significant pellet production capacities have been installed since 2005. Several major production plants have been commissioned in 2008, increasing the total capacity to around 400,000 tones. Besides some smaller producers, mainly large-scale plants are in operation. Currently, more than 90% of the produced pellets are exported, mainly to Northern Europe. The domestic pellet consumption in Portugal is very limited. The annual consumption in 2008 is estimated at 10,000 tones (Vivarelli, 2009).

The use of bioenergy depends on supply and demand. The sources of supply vary across countries. It could be residues from forests, from arable land or wood that has already been used as products. It could also be virgin material like energy crops. The demand is mainly dependent on the cost for using it. The cost is partly a result of political decisions like environmental taxes, trade with emission quotas, etc. The production of pellets represents the possibility of using different of these residues in an uniform fuel. Boilers using pellets as fuel allow for an automated

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operation suitable for residential and service buildings in contrast with wood logs boilers. Moreover, pellets allow the use of left-over wood while maintaining boiler emissions within acceptable limits (Kroplin, 1998).

In this work possible reasons for this market behavior are advanced based on biomass residues availability, costs and the policy framework is analyzed in the Portuguese scenario.

2. Biomass potential resources for pellets production

Biomass is the non-fossilized and biodegradable organic material originating from plants, animals and micro-organisms (European Commission, 2004). This definition includes products, by-products, residues and waste from agriculture, forestry and related industries as well as the non-fossilized and biodegradable organic fractions of industrial and municipal wastes.

The biomass wastes in Portugal have a great capacity to contribute to energy production and are partially exploited for this purpose. In the context of pellets production the biomass sources comes from the forestry, wood processing industry and agricultural wastes.

2.1. Forest residues

The share of the forest residues in the total above ground biomass in forests depends on the age of the tree, the species, and the wood assortment harvested (Hoyne, 1999). The Portuguese mainland is very rich in raw materials that can be used as sources of bio-solid. Nearly one third of the territory is forests, about 2.05 Mha or 31.3% of Portugal land area. Waste forest cut down and cleaning of bushes, can serve as a source of biomass for the production of pellets. Wood as fuel is used directly or in processed form (briquettes, pellets and chips). The evolution and quantification for nine types of forest vegetation of the dominant tree species in Portugal are shown in Fig. 1.

In the last 30 years the global forest area does not changed too much with a significant reduction in the pinus pinaster area. In opposite there is a significant increase in the eucalyptus area. This behavior has to do with the shorter rotation of the eucalyptus.

Such as forest area allows the definition of a technical potential of forest residues in Portugal shown in Table 1.

The technical potential is very considerable and mainly from pinus pinaster, eucalyptus and cork-oak. However, there are some factors that could limit the feasible potential of forest residues in Portugal as compared to the technical potential of Table 1.

There are some factors that could limit the feasible potential of forest residues in Portugal as compared to the technical potential as pointed out in the previous section. The first factor is the fact that the extraction of forest residues removes nutrients from the

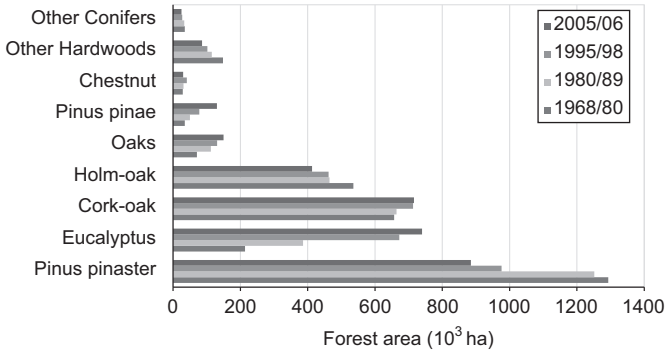

Fig. 1. Evolution and quantification of forest stands in mainland Portugal (Autoridade Florestal Nacional, 2010).

Table 1
Quantification of forest stands in mainland Portugal (Autoridade Florestal Nacional, 2010).

Specie	Biomass (kton)
Pinus pinaster	49,690
Eucalyptus	36,252
Cork-oak	34,925
Holm-oak	10,671
Oaks	6527
Pinus pinae	5325
Chestnut	2407
Acacia	716
Other Hardwoods	4989
Other Conifers	963
Total	152,465

site. Although forest residues compose about 30% of the tree weight, they may contain up to 75% of the above ground main tree nutrients (Hoyne, 1999). Removing these nutrients from the forest soils could lead to reduction in forest productivity in the long term. Evidence for this is difficult to obtain, because of the long term character of this type of primary production (one rotation can take up to 45 years). Since about half of the nutrients in forest residues are concentrated in the needles, the problem could partly be solved by not harvesting the needles. This could be achieved by leaving the forest residues in the forest for a couple of months, so that the needles can be shed. In addition to these two factors, removal of forest residues may influence biodiversity in forests, since dead wood serves as a food base for micro-organisms (Kuiper et al., 1998). However, such processes are mainly facilitated by dead large-diameter stems and to a lesser extent by the quickly decomposing small diameter forest residues.

Clearing of forests is a factor in fire prevention and the obtained product is a valuable energy resource. Within this logic, was defined by the Cabinet Resolution no. 63/2003 the target of 150 MW of installed power originating from forest biomass by 2010. In order to accomplish this goal, the Government launched in February 2006, a competition for power injection (100 MW) in the network for electricity produced in biomass power plants. The Cabinet Resolution no. 169/2005 details the Government targets for the energy sector. The electricity production based on renewable energy sources increased from 39% to 45% of the 2010 final consumption being the target of installed power for forest biomass of 250 MW in 2010 distributed by 15 new biomass power plants. This target was failed since at the end of 2010 the installed power was only of 106 MW, hence the national strategy for energy (Cabinet Resolution no. 29/2010) keeps the same target for 2020.

Taking into account the forest biomass potential in Portugal and considering an average low heating value of 15 MJ/kg, an electrical efficiency of 25%, typical in a combustion power plant, the maximum power that can be installed is 264 MW (Mateus, 2007). The Portuguese target is then very close to the maximum amount of available forest residues.

2.2. Wood industry residues

The wood industry includes a series of activities such as: production of furniture, carpentry, veneer panels, parquet, sawmills and impregnation. Wastes from these operations are mainly wood waste, mostly sawdust, wood dust and wood chips. A feature of this manufacturing sector is the small and medium enterprises. Table 2 shows the amount of wood wastes produced by each sub-sector in Portugal. Since 2001 there is an evolution of