Wood energy use in the European Union and in Germany

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Abstract: For about 10 years in the European Union and especially in Germany, Austria, France and Scandinavia wood is being used more and more as an energy source. This development is driven by the climate protection policy as well as by aspects of rural development and a safer energy supply. Rapid developments in harvesting and burning technologies and the increase of oil prices are making the use of wood energy more competitive compared to fossil fuels. This process is also being boosted by subsidies for the switch to wood energy heating systems and especially for the generation of electric power.

1. Introduction

In 1977 when the author started dealing with questions of energy supply in Germany, wood energy was not a topic in Germany at all. Other renewable forms of energy like wind and solar power, geothermal energy and even biogas had been discussed as alternatives to nuclear power at this time, but no one spoke about fuelwood. Attendent to the doubling of crude oil prices in 1979 (from $ 15 to $ 30 US per barrel)[1] the first congress on "Heating with Wood" was held in Göttingen in 1980. Several conferences and discussions followed, but fter the oil price had fallen again in the mid-eighties a more intensive use of wood energy did not become economically viable.

In the nineties there was a big progress. The growing awareness of environmental problems, especially climate change led to strong technical and political developments that made the use of wood energy in Germany and Europe a very interesting option as an energy supply. One of the latest results of this development is the so called "Bioenergy Village" Jühnde near Göttingen. After three years of discussion and planning on November 19, 2004 the ground-breaking ceremony for the first buildings took place with two ministers of the Federal Government in attendance. A model project is now under construction in order to demonstrate that it is technically possible and even economically viable to completely supply a village (of about 750 inhabitants) by the means of bioenergy (agricultural residues and plants, as well as wood).[2]

This paper will explain the background of this rapid development and demonstrate with actual examples from Germany and other European countries what actually is going on in the field of wood energy there.

2. Energy policy of the European Union (EU)

The European Commission White Paper on Renewable Energies (COM (97) 599)[3] from Nov. 26th, 1997 describes the strategy aiming at doubling renewable energy share in the EU energy balance by 2010 from 6 to 12%. The following aspects motivated this[4]:

- Environment (CO_2 reduction, other pollutants (acid rain ...))
- Job creation (domestic market, exports)
- Local and regional development (economic and social cohesion)
- Import reduction (security of supply, trade balance)
- Avoided fuel costs

The long-term benefits shall be bigger than the costs. To reach the goals an Action Plan was set into force with some internal energy market measures:

- Fair access to liberalised electricity market
- Fiscal and finance measures
- Bio-energy initiative for transport (liquid bio-fuels) and heat and electricity (solid biomass, biogas)
- Improve building regulations

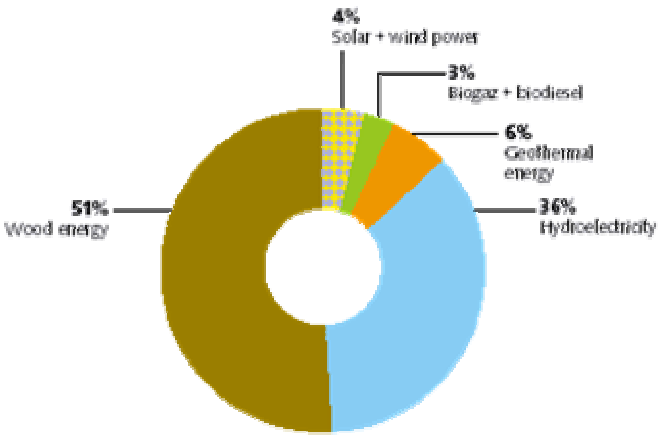

Figure 1: Share of the different renewable energy sectors in European Union primary energy production (2003)

Even though wood energy is obviously only one part of the solution, it is the number one renewable energy in Europe. "During the past decades, the wood energy sector hasn't ceased to progress on technological and industrial levels. The image of this traditional sector has now taken on a new modernity. Out of the 81 million toe[5] of primary energy that resulted from renewable energy sources in 2002, more than half came from the wood energy sector (see Figure 1).

A figure that puts the wood energy sector up at the top of the renewable energies list behind hydraulic power (small and big size installations), and contributing, all the same, from 12% to 14% of the electrical consumption of the countries of the European Union.

In 2002, primary energy production from wood energy amounted to 44.06 million toe for all of the countries of the European Union. This figure marks a progression of 2.7% with respect to 2001. With 8.48 million toe produced in 2002, France is the European leader in this sector.

Germany, which is in second place, had one of the strongest growth rates in the last few years, going from 4.7 million toe in 1999 up to 8 million in 2002. Germany has an estimated 7 million wood energy installations, and if the current rate of progress is maintained, it will very soon become the European leader for the sector.

Two other countries complete this top of the list "foursome": Sweden and Finland, whose common point is the presence of vast wooded areas in their territories (24 respectively 20 million hectares) and a true tradition of exploiting wood for energy.

Several European countries currently have development programs for their wood energy sectors. The case of Denmark can be cited, which has the project to convert all of its wood energy heat networks into cogeneration units, or the case of France, which should continue to be the leading country in the sector due to its national "Wood Energy Plan" program. The White Paper objective for 2010 was set at 100 million toe. On the other hand, the Campaign for Take-Off expressed its goals in terms of new realisations (10 000 MWth of biomass

cogeneration and 1 million homes heated from biomass) which is impossible to translate into toe."[6]

To achieve these objectives the European Union is using a broad variety of measures in its following policy fields:

- Environment
- Growth, Competitiveness and Employment
- Competition and State Aid
- Research, Technology, Development and Demonstration [7]
- Regional Policy
- Common Agricultural Policy and Rural Development Policy
- External Relations

The above mentioned Bioenergy Village Jühnde for example will receive money from differents German sources (Federal Ministry, Federal Agency for Renewable Ressources, State of Lower Saxony, Local County) and from the European Leader+ Programme. "Leader+ is one of four initiatives financed by EU structural funds and is designed to help rural actors consider the long-term potential of their local region. Encouraging the implementation of integrated, high-quality and original strategies for sustainable development, it has a strong focus on partnership and networks of exchange of experience."[8]

The funding of a special wood energy project depends on many special circumstances. It´s always necessary to find out which programme´s intentions may fit to it. Anyway in present day Germany there are some basic funding tools which can by applied in many cases.

3. Funding of wood energy projects in Germany

By instituting an environmental tax reform in 1999, the German government raised the prices of fossil energy sources and thus improved the chances of the renewable energies. In 2003 the European Union took up this idea and created a Council Directive on "restructuring the Community framework for the taxation of energy products and electricity." Member States may apply under fiscal control total for partial exemptions or reductions in the level of taxation for example electricity generated from biomass or from products produced from biomass.[9] The other EU-states may now follow the German example of subsidizing renewable energies on this indirect way.

A very successful means of direct subsidizing wood energy is the German "Renewable Energy Sources Act" (EEG) which has been in force since 2000 and was amended on August 1st, 2004. It basically regulates the payments that producers of electricity based on renewable sources have to receive. "The objective of the Renewable Energy Sources Act is to increase the share of total power supply which is derived from renewables to at least 12.5 per cent by 2010 and at least 20 per cent by 2020. To make this possible, the overall framework for feeding in, transmitting and distributing electricity from renewable energy sources will be considerably improved. This will maintain planning and investment security for manufacturers, plant operators, investors and banks. Drawing on positive experiences with the EEG in its previous version, the renewable basis for producing power can now be expanded with even greater efficiency.

In its amended form, the EEG will also implement the European Union Directive on the promotion of electricity from renewable energy sources of September 2001. To this end all

renewable energy sources have been incorporated into its scope. Payments will, however, continue to be governed in full by the existing principle of exclusive use. This means that, as in the past, fees can only be paid under the Renewable Energy Sources Act if the electricity concerned has been produced exclusively at plant for converting renewable energy sources. Power derived from, for example, co-incinerating the biodegradable fraction of waste will thus be covered by EEG provisions on obligatory purchase and transmission, but it will still not be eligible for EEG payments.

The EEG is one of Germany's most effective and efficient climate protection instruments. In 2003 the use of renewable energy sources (for power, heating and fuel together) delivered CO2 emission savings totalling around 53 million tonnes (44% EEG power!); in 2010 the figure is expected to rise." [10].

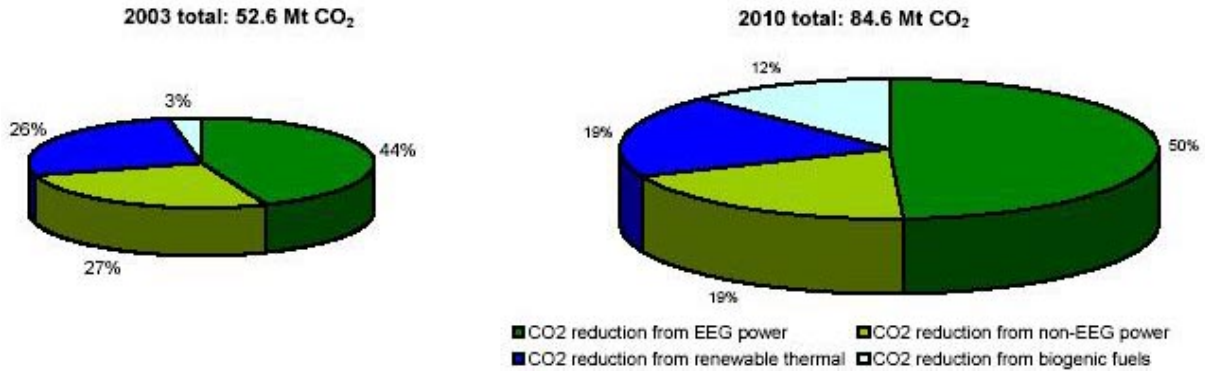

Figure 2: CO_2 reduction from the use of renewable energy sources in Germany[11]

The payments for biomass electricity are actually as follows: power plants up to 150 kW 11,5 Cent/kWh, from 150 kW to 500 kW 9,9 Cent/kWh, from 500 kW to 5 MW 8,9 Cent/kWh and from 5 MW to 20 MW 8,4 Cent/kWh. If electricity is generated exclusively from plant material coming from agricultural, horticultural or forestry operations this payments will be raised by 6,0 Cent/kWh (up to 500 kW), respectively 4,0 Cent/kWh (up to 5 MW plants). In the plant category from 500 kW to 5 MW the payment will be 2,5 Cent/kWh higher if the electricity is made from wood. Another 2,0 Cent/kWh will be added if the electricity is produced in cogeneration with heat and another 2,5 Cent/kWh if the biomass in that case is transformed with innovative technology. The maximal payment can be 21,5 Cent/kWh[12]. The burning of used wood which, actually is very economical will only be remunerated with 3,9 Cent/kWh if the plant will start to operate after July 1st, 2006. All these payments are guaranteed for 20 years. [13]

Wood energy use for heating purposes has also been subsidized during the last years in Germany. In December 2003 the Federal Ministry of the Environment enacted regulations for allowances for the installation of a wood gasification boiler (50 € per kW, at least 1500 €) or for an automatically fed wood heating systems (60 € per kW, at least 1700 €)[14].

An older KfW Housing Modernisation Programme and the KfW CO_2 Reduction Programme will be closed on December 31, 2004, but applications for eligible projects can now be made under the three new programmes as from January 1, 2005. The promotional programmes on "Housing Construction, Modernisation and Energy Conservation" will become more transparent and easier to understand. Generally for new and older houses cheap credits are available if a central biomass heating system or a wood gasification unit will become installed.[15]

4. Actual situation of wood energy use in Germany, demonstrated through examples

Basically wood can be used as an energy source in the following forms

- Split logs
- Briquettes (made from sawdust and shavings)
- Chips (made from logs, branches or used wood)
- Pellets (made from sawdust and shavings)
- Sawdust
- Gasified, liquified or as hydrogen

For all of these forms a lot of technical development work has been performed recently. Chips, pellets and logs are widely used nowadays. Residues from forestry and the wood processing industry as well as used timber are the most common sources.

The traditional form of using split logs for heating has had a recent come back in Germany: Some 26.000 new ovens for this kind of fuel were newly installed just in Lower Saxony in 2003 alone. Thereby there are very different systems ranging from an improved fireplace (with a "window" in front) to a wood gasifying boiler with a very high output efficiency of about 90% and with very low pollutant emissions. This kind of ovens has been developed in the just last century.

Figure 3: Modern wood gasifier boiler (Source: www.koeb-schaefer.com)

A recently finished study at the Institute of Wood Biology and Wood Technology at the University of Göttingen showed that the switch to fuelwood as energy source for private house owners is an economically viable option and harvesting, processing and marketing of fuel wood in many regions offers market niches for entrepreneurs.[16]

The other fast growing market in Germany and some adjacent countries is based on wood pellets for automatically fed ovens or central heating systems (see: Figure 4):

Figure 4: Number of wood pellets heating systems in Germany[17]

The main consumers of wood from the forests are heat plants which use chipped wood. With a capacity of more than 150 kW they often supply schools and district heating systems. One of the oldest examples in Lower Saxony is the Training Centre of the State Forest Service in Seesen-Münchehof which since 1998 completely relies on wood chips from forestry for heating (190 + 145 kW). About 20 buildings in Leese are being supplied by burning wood chips from forestry, used timber and fast growing tree plantations.[18]

Due to the guaranteed high payments for electricity from renewable energy sources, several wood power plants have been built in the last few years. A leading company in that sector is MVV Erneuerbare Energien GmbH. In 2004 they started with three new biomass power stations in Mannheim (20 MW), Königs Wusterhausen (20 MW) and Flörsheim-Wicker (15 MW). The efficiency factor of these plants is more than 35%.[19] Also many wood industry companies make use of this possibility to generate an income. In some cases they supply the electricity companies with currents made from their production waste or even from used timber at a high guaranteed price and buy electric energy for their own production needs at a lower price from the electricity suppliers.

5. Production and standardisation of wood fuel

In Germany the annual increment in the forests is actually around 58 mil. m^3, exceeding the annual harvest by about 18 mil. m^3. Several mil. m^3 of this wood could be used for energy if it is economically feasible to get it out of the forests. Therefore, research is being done how to make efficient use of residues from timber harvesting and small diameter trees especially. Logistic chains and production methods are being developed and optimized:

- Harvesting and skidding
- Chipping of treetops and branches in the forest
- Transportation (by container systems etc.)
- Intermediate storage, eventually screening of the wood chips
- Feeding of the heat plant

Due to the development of high sophisticated burning facilities the effciency of the wood fuel use depends more and more on its properties. Therefore the preparation technology gains importance and standards are being developed to define the quality.

Class	Main fraction > 80 % of weight	Fine fraction < 5 % of weight	Coarse fraction < 1 % of weight
P16	**3,15 mm ≤ P ≤ 16 mm**	**< 1 mm**	**> 45 mm, all < 85 mm**
P45	**3,15 mm ≤ P ≤ 45 mm**	**< 1 mm**	**> 63 mm**
P63	**3,15 mm ≤ P ≤ 63 mm**	**< 1 mm**	**> 100 mm**
P100	**3,15 mm ≤ P ≤ 100 mm**	**< 1 mm**	**> 200 mm**

Table 1. Dimensions of wood chips according to prCEN/TS 14961[20]

A rotary sreening machine was developed to screen the chips according to these requirements. Other classes were defined in the European standard prCEN/TS 14961 based on the moisture content, ash and nitrogen percentage. European standards are also being developed for solid biofuels generally and for wood pellets.

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[2] http://www.bioenergiedorf.de/index_e.html
[3] http://europa.eu.int/comm/energy/library/599fi_en.pdf
[4] http://www.agores.org/Publications/EC%20Presentations/EU%20Strategy%20pp.pdf
[5] toe = tonne of oil equivalent (see: http://www.worldenergy.org/wec-geis/publications/reports/ser/conv.asp)
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