

EFFORTS TO INCREASE ENERGY FROM BIOMASS IN AUSTRIA

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Summary:

This paper deals with the operating context for renewable energy in Austria, presenting the main trends and developments in the past and present use of biomass. Due to its significance for agricultural markets, particular emphasis is placed on biofuels. The paper ends with a description of the support measures underpinning the use of renewable energy sources.

Keywords:

Energy consumption, renewable energy sources, biofuels, support, Austria.

Zusammenfassung:

Dieser Beitrag beschäftigt sich mit den Rahmenbedingungen für die erneuerbaren Energien in Österreich. Vorgestellt werden wesentliche Entwicklungen in der Biomassenutzung in der Vergangenheit und in der Zukunft, insbesondere wird auf die Biotreibstoffe wegen der großen Bedeutung für die Agrarmärkte eingegangen. Abschließend wird die Förderung der Nutzung erneuerbarer Energieträger beschrieben.

Schlagwörter:

Energieverbrauch, Erneuerbare Energieträger, Biotreibstoffe, Förderung, Österreich.

1. Introduction

The white paper published by the European Commission in 1997 states that the European Union's aim is to double the contribution of renewable energy sources to overall gross internal energy consumption from 6% to 12% by 2010. Renewable energy sources are: biomass (including biogas, solid biofuels etc.), wind power, photovoltaic solar power, thermal solar energy (solar heating), hydroelectricity and geothermal energy.

The two most important EU directives promoting renewable energy sources are Directive 2001/77/EC (on the promotion of electricity produced from renewable energy sources in the internal electricity market) and Directive 2003/30/EC (on the promotion of the use of biofuels or other renewable fuels for transport). According to Directive 2001/77/EC, Austria should increase the share of electricity derived from renewable energy sources from 70% of gross inland consumption in 1997 to 78.1% in 2010.

Directive 2003/30/EC defines biofuels as liquid or gaseous fuel produced for transport use and sourced from biomass. Article 2 lists and specifies the following biofuels: bioethanol, biodiesel, biogas, biomethanol, biodimethylether, bio-ETBE (ethyl-tertio-butyl-ether), bio-MTBE (methyl-tertio-butyl-ether), synthetic biofuels, biohydrogen and pure vegetable oil. According to Article 3, member states should ensure a minimum proportion of biofuels and other renewable fuels in their markets. Reference values for national target biofuel use - expressed as biofuel's share of all petrol and diesel sold for transport purposes and calculated based on energy content - are 2% by 31.12.2005 and 5.75% by 31.12.2010.

Using 1990 levels as the base figure, Austria intends to reduce emissions of the six "Kyoto greenhouse gases" by 13% by the target period 2008 to 2012. To reach this ambitious goal, the National Council adopted the "Austrian Climate Strategy 2008/2012". Renewable energy sources, in particular biomass, should contribute to the CO₂ emissions reduction target (see BMWA 2003, p. 4).

The objective of this paper is to detail the efforts undertaken to promote renewable energy sources - in particular biomass - in Austria. First, some figures on energy supply and consumption, and the share taken by renewable energy sources, are presented. Then the

development of the use of biomass as an energy source is documented. The steps taken to implement Directive 2003/30/EC in Austria are described together with some impacts of this implementation. Finally, support measures promoting the use of renewable energy sources are outlined.

2. Energy supply and consumption in Austria

Table 1 details the domestic production of energy (by energy source) from 2001 to 2003. Hydropower and other renewable energy sources contribute the largest share. Natural gas and mineral oil contribute about one quarter of primary energy. The reduced supply from hydropower in 2003 was a consequence of that year's drought.

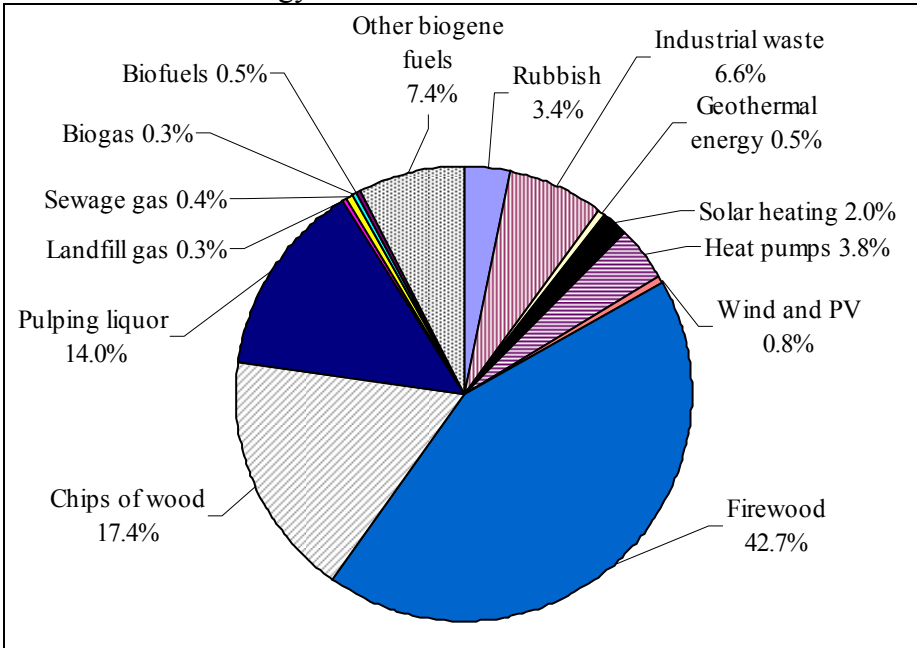
Table 1
Domestic primary energy production in Austria, by source, 2001 to 2003

Primary energy	2001		2002		2003	
	PJ	%	PJ	%	PJ	%
Coal	11.8	2.9	13.9	3.3	11.3	2.6
Mineral oil	43.0	10.4	37.7	9.0	51.4	11.7
Natural gas	62.2	15.0	67.5	16.2	75.1	17.2
Hydropower	144.7	35.0	143.8	34.4	130.8	29.9
Other renewable sources	151.7	36.7	154.3	37.1	169.1	38.6
Total	413.4	100.0	417.2	100.0	437.7	100.0

Source: BMWA 2005

Data regarding the “other renewable energy sources” are available for 2003. Firewood the main source, contributing about 43% of the 169 PJ total (see Figure 1). The share from wood pellets is increasing, as is that from other sources like biogas. The contribution from biofuels is also set to increase in the future.

Figure 1
Other renewable energy sources in Austria in 2003

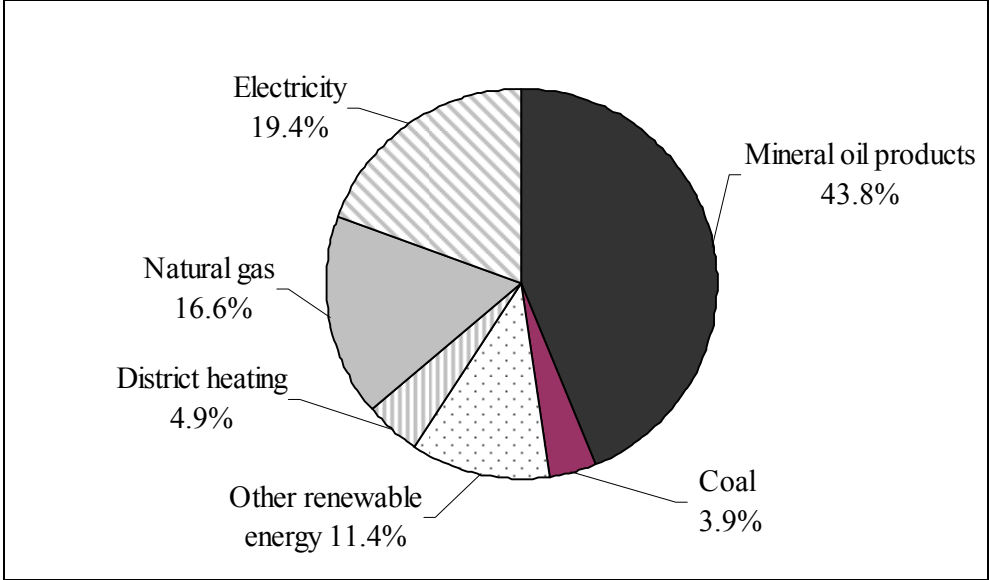


Source: EVA 2005

Austria has to import most of its fossil energy. Imports of mineral oil, natural gas and hydro-power have increased over the past. Total imports in 2003 amounted to 1,118 Peta Joule (PJ).

The sources of the energy consumed in Austria in 2003 are given in Figure 2. Total gross energy consumption was 1,398 PJ, while end user consumption amounted to 1,104 PJ. Electricity had a 19.4% share, other renewable sources accounted for 11.4%.

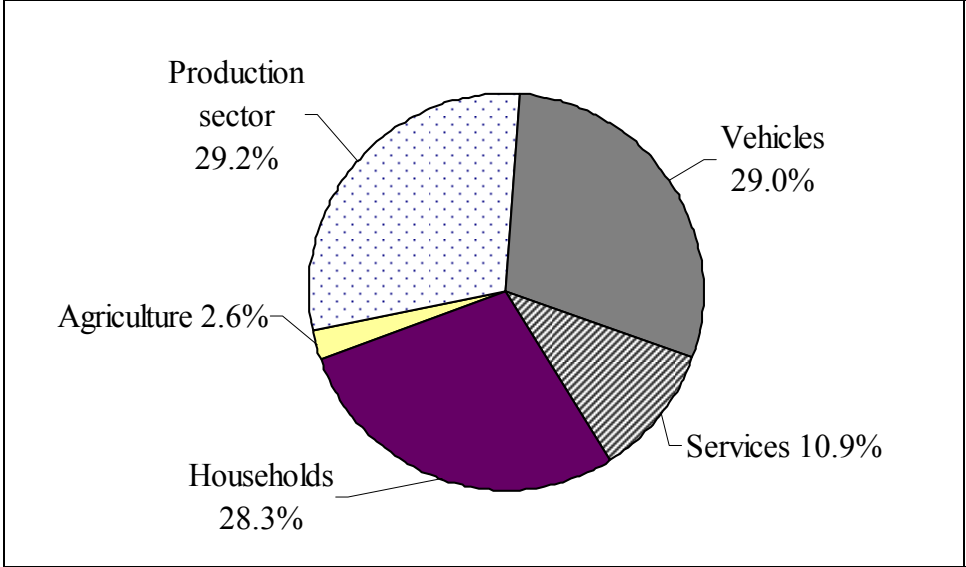
Figure 2
Energy consumption by end users in 2003, by source



Source: BMWA 2005

The use of energy by sector is shown in Figure 3. The production sector, vehicles and private households each consumed close to 30% of the total in 2003. Services consumed about 10%. Agriculture's share was less than 3%.

Figure 3
Energy use by sectors



Source: BMWA 2005

3. Biofuels

The two most common biofuels in Austria will be biodiesel and bioethanol. Biodiesel generally refers to methyl esters (fatty acid methyl esters) produced by transesterification (IEA, 2004, p. 33). The feedstock for this chemical process can be vegetable oil, used cooking oil or animal fat. The co-product is glycerine. In Austria, the feedstocks most commonly used in this context are waste oil and rape oil. Rape is the main oilseed, followed by sunflowers.

Bioethanol can be produced from any biological feedstock that contains appreciable amounts of sugar or materials that can be converted into sugar, such as starch or cellulose (IEA, 2004, p. 34). In Austria, grain crops (primarily maize and wheat) and sugar beet will be the crops produced for bioethanol production. The co-products of the ethanol production process are DDGS (distillers dry grain soluble) from maize and wheat, and bagasse from sugar beet.

The realisation of the EU's Biofuel Directive will have strong impacts on Austrian agriculture and the national economy, as the following sections demonstrate. For a more detailed paper on this subject, see Schultes and Zimmermann (2004).

Substitution targets in Austria

Austria brought Directive 2003/30/EC into force through the Kraftstoffverordnung (BGBl. II Nr. 417/2004), which is based on the Motor Vehicle Act (Kraftfahrgezet 1967 zgd BGBl. I Nr. 175/2004). The new regulation places an obligation on entities selling petrol or diesel on the Austrian market for use as fuel in vehicles or who are importing the same (excepting where it's imported in the fuel tank of a vehicle). This obligation is to substitute a proportion of this petrol or diesel with biofuels. The targets set for the share to be taken by biofuels and other renewable fuels are: 2.5% by 1 October 2005, 4.3% by 1 October 2007 and 5.75% by 1 October 2007. These targets can be reached either by direct substitution with biofuels in their pure form or by use of biofuels blended in mineral oil derivatives (BMLFUW 2005, p. 125).

Estimated biofuel requirements

Biodiesel and bioethanol are considered here as the only two biofuels likely to substitute for petrol and diesel. The estimated biofuel quantities required to achieve the target substitution levels in selected years are given in Table 2. These were calculated by Tretter (2004, p. 173) using the expected sales of diesel and petrol for transport uses in Austria together with the relevant biofuel share in the years specified.

Table 2
Estimated biofuel requirements in selected years

Year	Share %	Biodiesel		Bioethanol	
		million l	1,000 t	million l	1,000 t
2007	2.50	360.0	317.5	151.4	120.2
2008	5.75	507.7	448.3	188.9	150.0
2010	5.75	543.1	479.5	188.9	150.0

Source: Tretter 2004, p. 173

Area needed to produce the estimated biofuel requirements

The area needed in Austria to produce the estimated required quantities of biofuels is calculated under the assumption that only domestic crop supplies are used. Rape only is used for biodiesel production, while wheat, maize or sugar beet is used for bioethanol production.

The average yield per hectare maize for the period 2002 to 2004 (9.1 t) produces about 3 t of ethanol. The equivalent figure for wheat is about 1.5 t of ethanol (average wheat yield 5.2 t/ha) (see Gangl 2004). About 64 t of sugar beet were harvested per hectare in recent

years. Based on output figures used by Bachler (2004), about 5.2 t of ethanol are produced per hectare sugar beet in Austria (see Table 3).

Table 3

Land needed to meet the demand for bioethanol in selected years, calculated for each alternative source crop

Agricultural product	Bioethanol t/ha	Land (ha) needed to meet bioethanol requirements in		
		2007	2008	2010
Wheat	1.5	80,133	100,000	100,000
Maize	3.0	40,067	50,000	50,000
Sugar beet	5.2	23,115	28,846	28,846

Source: Own calculations using data for bioethanol requirements from Table 2

The land requirement differs according to the crop used for producing bioethanol. Wheat requires about three times as much land as sugar beet to meet the demand for bioethanol.

The Agrana Bioethanol GmbH is building a plant with an annual capacity of about 200,000 m³ bioethanol. This capacity would meet the projected future demand for this biofuel. The raw materials will be 388,000 t wheat, 81,000 t maize and 48,000 t sugar beet syrup (*Österreichische BauernZeitung*, 9/22/2005). About 80,000 ha of land will be needed for crop production. In the past, Austria has had a wheat surplus and needed to import maize (see BMLFUW 2005).

Rape seed yields in Austria averaged 2.5 t/ha between 2002 and 2004. Assuming 40% oil content, this gives about 1 t rape oil and 1.45 t rape meal per hectare. According to Peterson and Hustrulid (1998, p. 98) “approximately 10% alcohol is reacted and approximately 10% by weight glycerine is removed, so the amount of ester produced is essentially equivalent to the oil used.” This means that about 1 t of biodiesel is produced in Austria per hectare of rape. Between 317,000 ha (in 2007) and 480,000 ha (in 2010) of rape would be needed to produce the estimated biodiesel required.

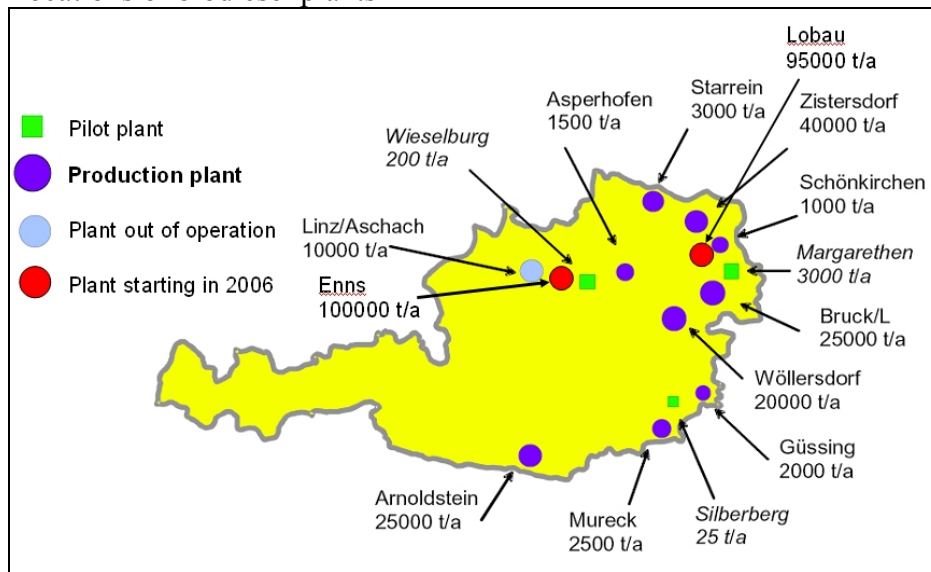
The estimated maximum possible rape area in Austria is about 150,000 ha, given durable rotation practices (about 20 % rape) (see Knoflacher et al. 1991, p. 22). Austria has a total of 1.38 million hectares of arable land, but not all regions offer favourable conditions for growing rape. In 2004, only 35,000 ha of winter rape were cultivated in Austria; the figure for 2000 was about 51,000 ha (BMLFUW, 2005, p. 174). A higher price for rape seed is necessary to allow expansion of rape production. However, most of the rape oil for biofuel production will in fact be imported. One of the planned biodiesel plants will be located in Vienna in the “Ölhafen Lobau” (lit. Lobau Oil Docks), with the oil required for biodiesel production (95,000 t in 2006 and 300,000 t in 2010, see BDV 2005) likely imported via ship. In this case no additional rape meal will be supplied from Austria. The other planned biodiesel plant will be located near Enns, Upper Austria; it will produce about 100,000 t biodiesel in 2006 (see AIZ). The locations of the biodiesel plant are shown in Figure 4.

Biodiesel was produced in Austria mainly from rapeseed oil, used frying oil and animal fat. In 2003 from the production of approximately 55,000 t biodiesel about 10 % were used in Austria, mainly in fleets of cars (Tretter 2004, p. 171 and p. 174). The development of the total capacity of biodiesel plants and the biodiesel productions since 1991 shows Figure 5.

Co-products of ethanol production

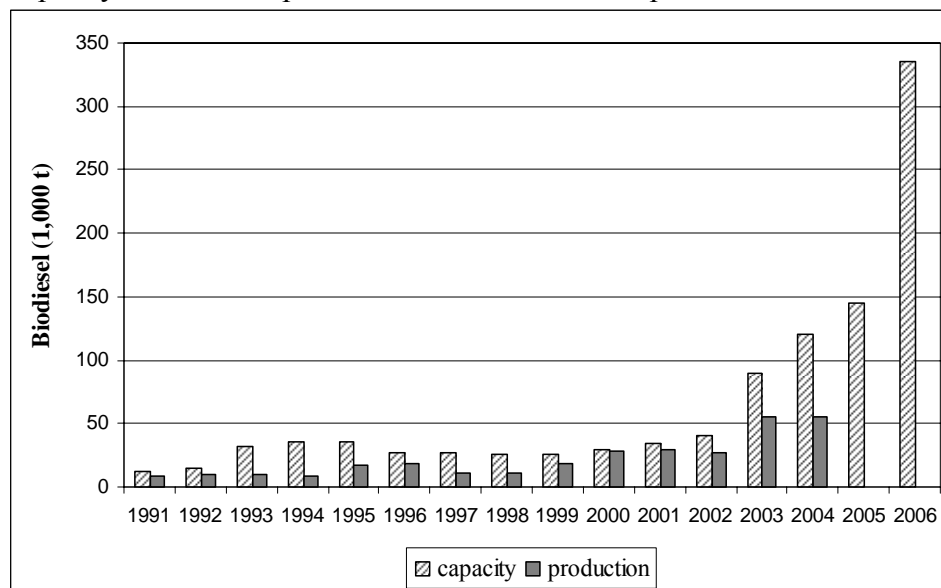
The co-product of ethanol production from the planned plant will be DDGS, in total about 150,000 t. It will replace some of the soybean meal imports. The quality of DDGS is not comparable to soybean meal. Pimentel and Patzek (2005) state: “DDG has value for feeding cattle that are ruminants, but has only limited value for feeding hogs and chickens.”

Figure 4
Locations of biodiesel plants



Source: BLT Wieselburg (plants starting in 2006 added)

Figure 5
Capacity of biodiesel plants in 2006 and biodiesel production from 1991 to 2004



Source: EVA 2004, BMLFUW 2003, Salchenegger 2005, Tretter 2004 (capacity in 2006 and production from 2002 to 2004 added)

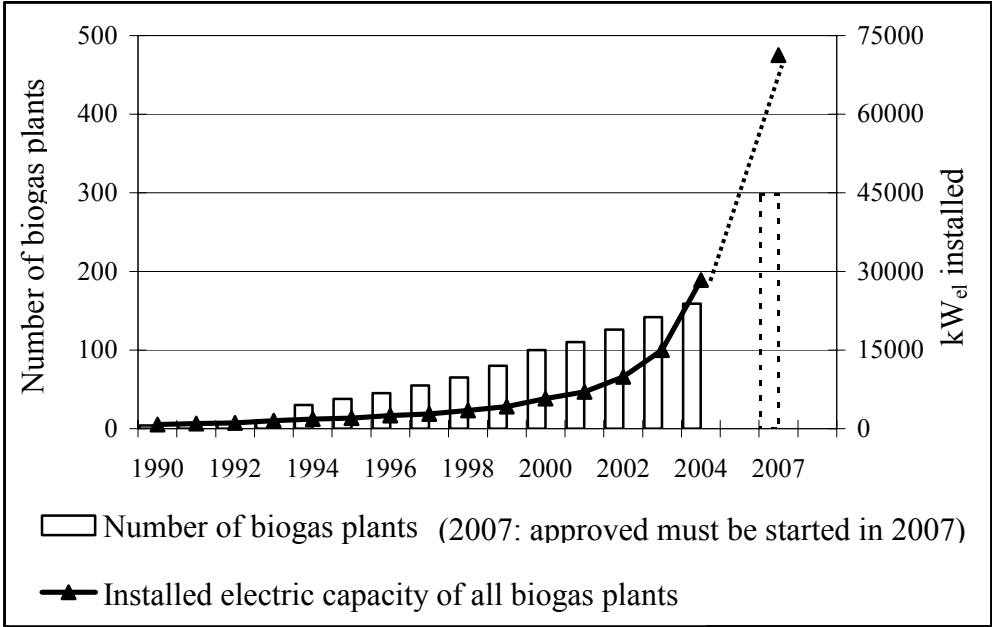
4. Biogas

The number of biogas plants grew rapidly at the beginning of the 1990s (see Figure 6). This development is of considerable importance to agriculture through the latter's role as the supplier of raw materials. Initially, slurry and waste materials were the main sources of feedstock. In more recent years, biogas plants have been built mainly for use with energy crops such as grass and maize silage (Walla et al. 2005, p. 119).

According to E-Control, there were 298 licensed biogas plants in Austria in the first quarter of 2005. Their combined bottleneck capacity was 71.3 MW. To qualify for the "green" electricity tariff, licensed plants must be in operation by 31.12.2007. The total injection volume in 2004 was 102 GWh. This volume increased fivefold between the beginning of 2003 and the beginning of 2005. The equivalent volume figure for 2010 is estimated to reach

approximately 400 GWh, with 24,300 ha of land expected to supply the required raw material (EVA 2004).

Figure 6
Number of biogas plants and the installed capacity in Austria

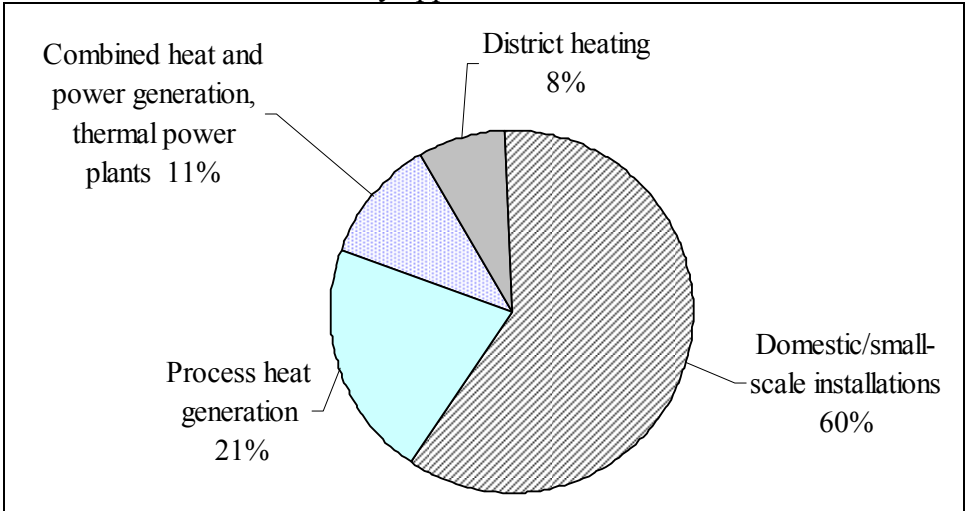


Source: Walla et al. 2005, E-Control 2005

5. Heating

Biomass for heating is very important in rural areas. About 126 PJ of the total consumption of energy (11.4 %) in 2001 came from renewable energy. More than two thirds of the biomass is used in the low temperature range (see Figure 7): wood, wood chips or wood pellets in individual heaters and central heating furnaces; bark, sawmill by-products, wood chips and straw in district heating plants. Almost 500,000 principal domiciles are heated using biomass in individual heaters or central heating systems (BMWA 2003, p. 10).

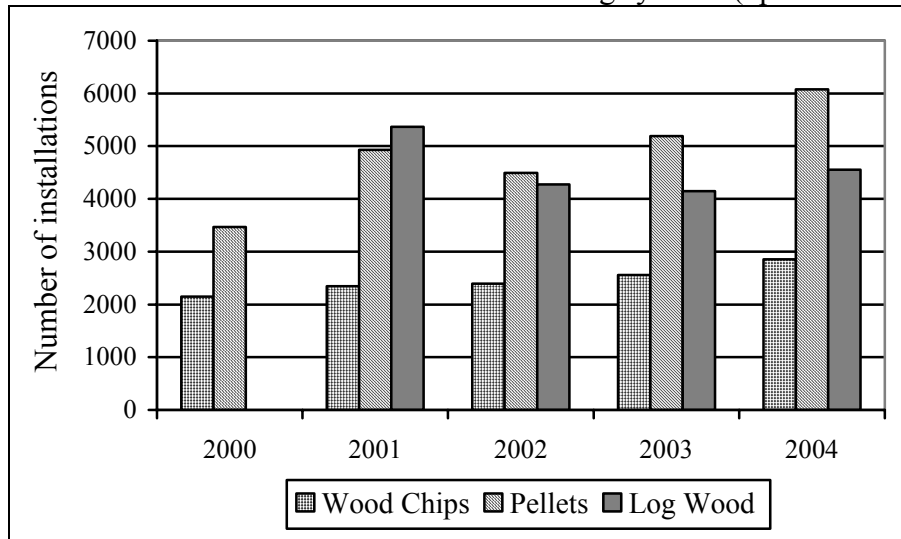
Figure 7
Biomass utilisation in 2001 by application



Source: BMWA 2003

Figure 8 shows the annual increase in small-scale biomass installations from 2000 to 2004. The share of wood chip-fired and pellet-fired installations increased. During this period, about 12,000 wood chip and about 24,000 pellet-fired installations (with a capacity up to 100 kW) were installed. Since 2002, the number of log-fired installations has dropped below the number of pellet-fired installations.

Figure 8
Annual increase in small-scale biomass heating systems (up to 100 kW)



Source: NÖ-LKK 2005

Biomass district networks first appeared in the mid-1980s in rural areas. In the recent past, approximately 50 new plants have been registered each year; their construction was subsidized by the national and provincial authorities. At the end of 2001, a total of 694 plants were operating, with a capacity of 822 MW (see BMWA 2003, p. 11).

6. Support for renewable energy sources

Various economic policy measures are being used to increase the share of renewable energy, including price setting, tax breaks and investment subsidies. These three measures are explained in more detail below.

Price setting

Directive 2001/77/EC regarding support for electricity production from renewable energy sources is implemented in Austrian legislation through the Ökostromgesetz (BGBl. I Nr. 149/2002) and the Ökostromverordnung (BGBl. II Nr. 508/2002) which came into effect on 20.12.2002. Three so-called balance groups were established and obligated to purchase the renewable "green" electricity offered to them and at fixed prices. For those plants approved before the end of 2002, the prices are those determined at the time of their planning approval, and are fixed for a period of ten years from the day on which the plant actually begins operation (unless a longer period of support had already been granted by local provincial authorities).

For those plants approved after 1.1.2003, the prices are defined in the Ökostromverordnung. The price tariffs defined in the Verordnung are fixed for the first thirteen years of a plant's operation. This applies only to new plants whose construction was approved in either 2003 or 2004, and which begin operation before the end of 2007. Table 4 gives an overview of the tariffs set for electricity produced from solid and liquid biomass, biogas and wind. The tariff set for electricity from solid biomass drops by 20% to 35% if

waste wood is used, that for electricity from biogas drops by 25% if the biogas is derived from organic waste (§ 7 and § 9 BGBI. II Nr. 508/2002).

Table 4

Green electricity prices for selected energy sources, in Cents per kWh

Solid Biomass		Liquid biomass		Biogas		Wind	
Output	Tariff	Output	Tariff	Output	Tariff	Output	Tariff
≤2 MW	16.0	≤200 kW	13.0	≤100 kW	16.5	No upper limit	7.8
2-5 MW	15.0	>200 kW	10.0	100-500 kW	14.5		
5-10 MW	13.0			500-1000 kW	12.5		
>10 MW	10.2			>1000 kW	10.3		

Source: BGBI. II Nr. 508/2002

The plants sell all their electricity to one of the three balance groups. These groups distribute this electricity to retailers proportionally, according to each retailer's previous year's consumption, thus ensuring each gets the same percentage of green electricity in its supply.

The tariff for green electricity is financed through the transfer price charged to the retailer and a surcharge collected from the end user. The transfer price for green electricity is fixed by law in the Ökostromgesetz at 4.5 Cent/kWh. Legal amendments can be used to modify this transfer price to match changes in market prices for electricity. The surcharge is determined each year in a piece of legislation (BGBI. II 533/2004) and added to the end users' electricity bills as an explicit supplementary billing item. The size of this charge depends on the nature of the end user, whether a private household or business (see E-Control 2005a, p. 87). Table 5 gives an overview of the surcharges determined to date and the suggested surcharges for 2006.

Table 5

The average surcharge levied on end users as a contribution to green electricity support (in Cents per kWh over the period 2003 to 2006)

Billing period	2003	1.1.04 – 31.3.04	1.4.04 – 31.12.04	2005	2006
Average surcharge	0.450	0.450	0.490	0.510	0.690
Households (Grid level 7)	0.464	0.464	0.514	0.542	0.743
Small/medium business (Grid level 6)	0.445	0.445	0.480	0.508	0.668
Large business (Grid level 3)	0.424	0.424	0.448	0.461	0.595

Source: E-Control 2005a, p. 91/2005

The growth in the number of electricity plants producing green energy brought with it a commensurate increase in demand for support funds. Hence, for example, the 101% increase in the surcharges levied on households (grid level 7) across the period 2003 to 2005. Table 6 shows the total annual cost incurred by a typical household or business through the surcharge requirements defined in the Ökostromgesetz. The financing system for green electricity is summarised in Figure 9 using 2004 as an example.

Table 6

Annual surcharge costs incurred by electricity users from 2003 to 2006 in Euro

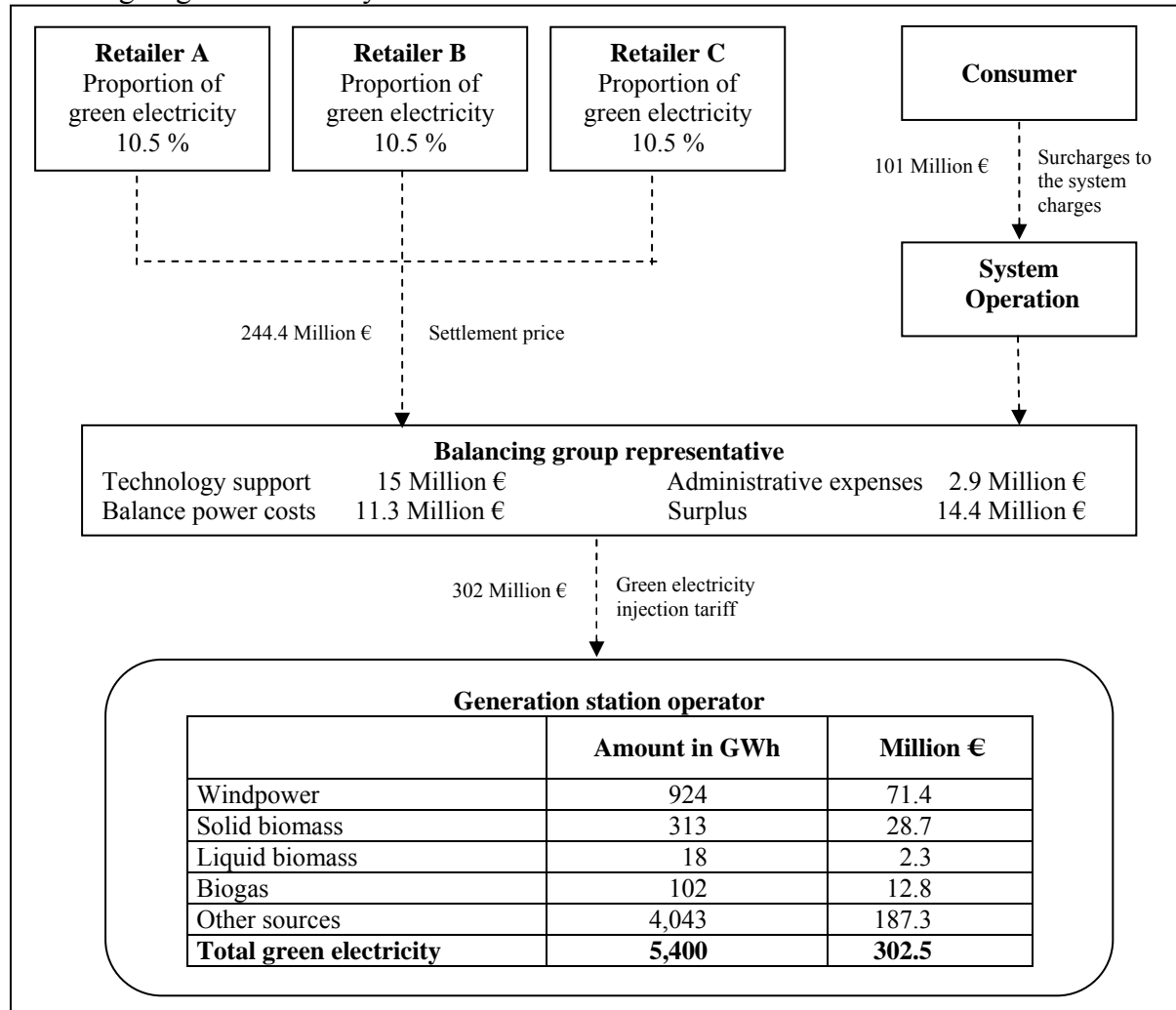
End user	2003	2004*	2005	2006
Household using 3,500 kWh	16	17	19	26
Small business using 100,000 kWh	440	470	503	668
Large business using 150 GWh	628,500	661,000	691,500	892,500

*)Figures weighted according to the breakdown in Table 5

Source: E-Control 2005a, p. 100

Figure 9

Financing of green electricity in 2004



Source: E-Control 2005a, E-Control 2005b

Tax breaks

Tax reform legislation in 2000 (BGBl. I Nr. 160/1999) exempted biofuels from the tax levied on mineral oil, provided the biofuel is used in its pure form. Beforehand, only biofuels produced for own use on a farm were exempt from the tax (BGBl. I Nr. 630/1994). Mineral oil tax legislation - Mineralölsteuergesetz 1995 (BGBl. I Nr. 630/1994) - also exempts natural gas from the oil tax if used for fuel.

Mineral oil tax for petrol is currently dependent on sulphur content and is 417 (< 10 mg/kg S) / 432 € (> 10 mg/kg S) per 1,000 l. A modification to fuel legislation - Kraftstoffverordnung 1999 (BGBl. II Nr. 417/2004) - reduces the mineral oil tax charge for

petrol and diesel containing at least 4.4% biofuel (see Table 7). The tax changes go into effect as of 10/01/2007 for petrol and were implemented for diesel on 10/01/2005.

Table 7

Mineral oil tax charge for petrol and diesel in Euro per 1,000 Litres

Fuel	Without a biofuel component	Containing at least 4.4% biofuel
Petrol from 10/01/2007	445	412
Diesel from 10/01/2005	325	297

Source: BGBl. II Nr. 417/2004

Legislation from 2005 implementing mineral oil tax law (Bioethanolgemischverordnung BGBl II Nr. 378/2005) exempts the bioethanol part of blended petrol from the tax, provided bioethanol makes up at least 85% of the total.

Investment support

The Austrian rural development programme offers support for the construction of biomass heating plants and small-scale district heating systems, biogas plants, and biofuel production facilities. At least 75% of the biomass so used (e.g. sawdust, bark, straw) must come from the local region. A maximum of 55% of the total investment costs for private or community facilities can be subsidised. A precondition for the support is that farmers must own at least 51% of the facility. Administration of the support measures is undertaken by the local provincial government, who may issue their own regulations. In Lower Austria, for example, the investment support for a biogas plant is set at 30% or a maximum of 150,000 € (NÖ-Landesregierung 2003, p. 3). The costs of the subsidies are borne by the EU (50%), the national authorities (30%) and provincial authorities (20%) (BMLFUW 2003, p. 7).

Where a facility for using renewable energy sources is not majority owned by farmers, then investment support is available through domestic environmental support measures. Up to 30% of the investment costs can be covered by subsidies. These support costs are shared by the national authorities (60%) and the provinces (40%) (EVA 2005, p. 223).

7. Final remarks

Austria has always made considerable use of renewable energy sources in the past (e.g. hydropower, firewood). The country began to explore the potential of other renewable energy sources at an early date; the first “Austrian energy research and technology plan” was produced in 1974. The white paper on “Energy for the future: renewable sources of energy” and the EU-Directives 2001/77/EC and 2003/30/EC were therefore welcomed (see BMWA 2003, p. 6 and 7). The increased use of renewable energy sources will contribute to a reduction in CO₂ emissions and the creation of jobs. However, further analysis is required to determine the best future use of available resources in the production of renewable energy, with regard to, for example, the appropriate use of agricultural land (maize, wheat, rape etc.) and the best use of the feedstock produced (heating material, biodiesel, biogas, bioethanol). Biogas, for example, can be used to generate electricity and heat, or for processing into biofuel.

In Austria, a mix of measures is used to substitute fossil energy with renewable energy sources and to reduce CO₂ emissions, and the existing energy saving potential should also be further exploited to help implement a sustainable energy policy.

References

- AIZ (2005): Raiffeisenlandesbank OÖ errichtet Biodieselwerk in Enns. <http://www.aiz.info> 04/15/2005.
- Bachler, A. (2004): Bioethanolproduktion aus Zuckerrüben in Österreich. Diplomarbeit, University of Natural Resources and Applied Life Sciences, Vienna. Vienna.
- BDV (2005): BioDiesel Vienna: Biodiesel-Produktion am Ölhafen Lobau wird schrittweise ausgeweitet. <http://www.biodiesel-vienna.at/presse>. 11/25/2005.
- BMLFUW (2003a): Grüner Bericht 2002. Federal ministry of Agriculture, Forestry, Environment and Water management. Vienna.
- BMLFUW (2003b): Sonderrichtlinie für die Umsetzung der „Sonstigen Maßnahmen“ des österreichischen Programms für die Entwicklung des ländlichen Raums. Federal ministry of Agriculture, Forestry, Environment and Water management. Vienna.
- BMLFUW (2005): Grüner Bericht 2005. Federal ministry of Agriculture, Forestry, Environment and Water management. Vienna.
- BMWA (2003): Renewable Energy in Austria. Federal Ministry of Economics and Labour, 2nd edition. <http://www.bmwa.gv.at>
- BMWA (2005): Stand und Entwicklung der Energieversorgung in Österreich – Ergänzungspapier zum Energiebericht 2003 der österreichischen Bundesregierung. Federal Ministry of Economics and Labour, 2nd edition. <http://www.bmwa.gv.at>
- E-Control (2005a): Bericht über die Ökostrom-Entwicklung und fossile Kraft-Wärme-Kopplung in Österreich. Vienna.
- E-Control (2005b): Gutachten zur Bestimmung der Förderbeiträge für Kleinwasserkraft und „Sonstige“ Ökoanlagen für 2006. Vienna.
- EVA – Austrian Energy Agency (2005): Energiesparförderung und Energieberatung 2005. Vienna.
- Gangl, C. (2004): Ethanolherzeugung aus stärkehaltigen Rohstoffen für Treibstoffzwecke. Diplomarbeit, University of Natural Resources and Applied Life Sciences, Vienna. Vienna.
- IEA-International Energy Agency (2004): Biofuels for transport – An international perspective. Paris.
- Knoflacher, M., Tuschl, P. and Schneeberger, W. (1991): Ökonomische und ökologische Bewertung von alternativen Treibstoffen. Austrian research center. Seibersdorf.
- Kramer, K. and Prankel, H. (2003): Verwendung von Pflanzenölkraftstoffen. <http://www.blb.bmlfuw.gv.at>
- Lehner, H. et al. (2004): Energieeffizienz und Erneuerbare 2010. Austrian Energy Agency. Vienna.
- Niederösterreichische Landesregierung (2003): NÖ Biogasanlagenförderung. Niederösterreichische Landesregierung. St. Pölten.
- NÖ-LKK Lower Austrian Chamber of Agriculture (2005): Biomasse-Heizungserhebung 2004. <http://www.agrarnet.info>
- Österreichische BauernZeitung (2005): Jeder Hektar Ackerland wird wieder gebraucht. 9/22/2005 – Vol. 5/38.
- Peterson, C. L. and Hustrulid, T. (1988): Carbon Cycle for Rapeseed Oil Biodiesel Fuels. Biomass and Bioenergy, Vol. 14, No. 2, pp. 91 – 101.
- Pimentel, D. and Patzek, T. W. (2005): Ethanol Production Using Corn, Switchgrass, and Wood; Biodiesel Production Using Soybean and Sunflower. Natural Resources Research, Vol. 14, No. 1. p. 65 – 76.
- Salchenegger, S. (2005): Biokraftstoffe im Verkehrssektor in Österreich 2005. Zusammenfassung der Daten der Republik Österreich gemäß Art. 4, Abs. 1 der Richtlinie 2003/30/EG für das Berichtsjahr 2004. Bericht 281 Umweltbundesamt, Vienna.

Schultes, H. and Zimmermann, J. (2004): Umsetzung der Biokraftstoff-Richtlinie in Österreich. Agrarische Rundschau, No. 415, 29 – 34.

Tretter, H. (2004): Anhang II: Umsetzung der Bio-Kraftstoff-RL lt. KraftstoffVO in Österreich – Biokraftstoffeinsatz- und Flächen-Szenario. In: Energieeffizienz und Erneuerbare 2010. Austrian Energy Agency. Vienna.

Walla, C. and Schneeberger, W. (2005): Farm biogas plants in Austria - An economic analysis. In: Jahrbuch der Österreichischen Gesellschaft für Agrarökonomie, Vol. 13, Facultas Verlags- und Buchhandels AG. Vienna.

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