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BIOMASS PRODUCTION FOR ENERGETIC ISSUES IN THE CZECH REPUBLIC AND AUSTRIA

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1 INTRODUCTION[1]

1.1 General information about biomass

Biomass is a renewable energy source because the energy it contains, comes originally from the sun. Through the process of photosynthesis, chlorophyll in plants captures the sun's energy by converting carbon dioxide from the air and water from the ground into carbohydrates, complex compounds composed of carbon, hydrogen, and oxygen. When these carbohydrates are burned, they turn back into carbon dioxide and water and release the sun's energy they contain. In this way, biomass functions as a sort of natural battery for storing solar energy. As long as biomass is produced sustainably the “battery” will last indefinitely.

Since many centuries the most common way to capture the energy from biomass was to burn it, to make heat, steam and electricity. But advances in recent years have shown that there are more efficient and cleaner ways to use biomass. It can be converted into liquid fuels, for example, or cooked in a process called "gasification" to produce combustible gases. And certain crops such as switch grass and willow trees are especially suited as "energy crops," plants grown specifically for energy generation.

1.2 Types of Biomass

There are many types of plants in the world, and many ways they can be used for energy production. In general there are two approaches: **growing plants** specifically for energetic use, and using the **residues from plants** that are used for other things. The best approaches vary from region to region according to climate, soils, geography, population, and many other factors.

1.2.1 Energy Crops

Energy crops, also called "power crops," could be grown on farms in potentially very large quantities, just like food crops. Trees and grasses, particularly those that are native to a region, are the best crops for energy, but other, less agriculturally sustainable crops such as corn tend to be used for energy purposes at present.

Trees

In addition to growing very fast, some trees will grow back after being cut off close to the ground, a feature called "coppicing." Coppicing allows trees to be harvested every three to eight years for 20 or 30 years before replanting.

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[1] Energy Efficiency and Renewable Energy at your fingertips, available on WWW: http://www.caddet.org/index.php;
Union of Concerned Scientists, available on WWW: http://www.ucsusa.org/clean_energy/renewable_energy_basics/offmen-how-biomass-energy-works.html#Types_of_Biomass

Grasses

Thin-stemmed perennial grasses used to blanket the prairies of the United States before the settlers replaced them with corn and beans. Switch grass, big bluestem, and other native varieties grow quickly and can be harvested for up to 10 years before replanting.

Other crops

A third type of grass includes annuals commonly grown for food, such as corn and sorghum. Since these must be replanted every year, they require much closer management and greater use of fertilizers, pesticides, and energy.

Oil plants

Plants such as soybeans and sunflowers produce oil, which can be used to make fuels. Like corn, though, these crops require intensive management and may not be sustain-able in the longer term. A rather different type of oil crop with great promise for the future is a micro alga. These tiny aquatic plants have the potential to grow extremely fast in the hot, shallow, saline water found in some lakes.

1.2.2 Biomass Residues

After plants have been used for other purposes, the leftover wastes can be used for energy. The forestry, agricultural, and manufacturing industries generate plant and animal wastes in large quantities. City waste, in the form of garbage and sewage, is also a source for biomass energy.

Forestry

Forestry wastes are the largest source of heat and electricity now, since lumber, pulp, and paper mills use them to power their factories. One large source of wood waste is treetops and branches normally left behind in the forest after timber-harvesting operations. Some of these must be left behind to recycle necessary nutrients to the forest and to provide habitat for birds and mammals, but some could be collected for energy production. Other sources of wood waste are sawdust and bark from sawmills, shavings produced during the manufacture of furniture, and organic sludge from pulp and paper mills.

Agriculture

As with the forestry industry, most crop residues are left in the field. Some should be left there to maintain cover against erosion and to recycle nutrients, but some could be collected for fuel. Animal farms produce many "wet wastes" in the form of manure. These wastes are commonly spread on fields, not just for their nutrient value, but also for disposal. Runoff from over fertilization threatens rural lakes and streams and can contaminate drinking water. Processing crops into food also produces many usable wastes.

Municipal Waste

People generate biomass wastes in many forms, including "urban wood waste" (such as shipping pallets and leftover construction wood), the biodegradable portion of garbage (pa-per, food, leather, yard waste, etc.) and the gas given off by landfills when waste decomposes. Even our sewage can be used as energy; some sewage treatment plants capture the methane given off by sewage and burn it for heat and power, reducing air pollution and emissions of global warming gases.

1.3 Converting Biomass to Energy

The old way of converting biomass to energy, practiced for thousands of years, is simply to **burn** it to produce heat. This is still how most biomass is put to use, in the United States and elsewhere. The heat can be used directly, for heating, cooking, and industrial processes, or indirectly, to produce electricity. The problems with burning biomass are that much of the energy is wasted and that it can cause some pollution if it is not carefully controlled.

An approach that may increase the use of biomass energy in the short term is to burn it mixed with coal in power plants—a process known as "co-firing." Biomass feedstock can substitute up to 20 percent of the coal used in a boiler. The benefits associated with biomass co-firing include lower operating costs, reductions of harmful emissions, and greater energy security. Co-firing is also one of the more economically viable ways to increase biomass power generation today.

A number of **noncombustion methods** are available for converting biomass to energy. These processes convert raw biomass into a variety of gaseous, liquid, or solid fuels that can then be used directly in a power plant for energy generation. The carbohydrates in biomass, which are comprised of oxygen, carbon, and hydrogen, can be broken down into a variety of chemicals, some of which are useful fuels. This conversion can be done in three ways: thermochemical, chemical and biochemical.

One persistent myth about biomass is that it takes more energy to produce fuels from biomass than the fuels themselves contain. In other words, that it is a net energy loser. In fact, most of the studies done over the past 10 years confirm that the production of ethanol has a positive energy balance.

1.4 Benefits of biomass

Biomass offers many environmental, economic and energy security benefits. Renewables should always be used in combination with energy efficiency measures. This approach increases the advantages of using renewables:

- Lowering of emissions
- Impact on climate protection
- Reduction of fuel costs
- Employment
- Energy supply security, self-reliance
- High value for rural areas (decentralized applications)
- RES as a requirement for sustainable development

Biomass plays a dominant role in current RES (Renewable Energy Sources) utilization – it covers about 65% of the whole RES.

1.5 Potential for Energy from Biomass

1.5.1 Czech Republic

The energy potential of grown biomass in the Czech Republic has been separately deter-mined for all Czech districts as a sum of different productivities of currently grown energy plants at different ratios of land use. The same has been conducted for the production of food-stuffs and industrial crops. The biomass potential consists of its direct energy use as well as of the production of biofuels. Czech Republic has around 4 264 000 hectares (hereinafter "ha") farmland, which forms 54% total area of the Czech Republic. Approximately 0,42 hectare (hereinafter "ha") farmland (0,3 arable land) accrue to one inhabitant, which comes up to European average. More than one third of land resources in the Czech Republic forms wood areas. There is the change of 15 000 less farm-land from the year 1995, on the other hand forest land area grown by 16 000 ha.

Figure 1: Landuse in the Czech Republic (2006)[2]

	Total land area	Agricultural land	Forest land	Watersurface areas	Built up areas	Other areas
CR (ha)	7 886 699	4 254 403	2 649 147	161 421	130 194	691 534
CR (%)	100	53.94	33.59	2.05	1.65	8.77

1.5.2 Austria[3]

The agricultural used area includes a total of approximately 3.26 million hectares. Of these, around 1.38 million hectares are farmland and approximately 1.81 million hectares are grass-land. If you have a detailed look at the biomass potential of the grassland there is only the "economic grassland" relevant, which covers 0.9 million hectares.

In Austria the area covered by forestry is about 3.96 million hectares, which forms 47.2% of the total area.

Since the beginning of the Austrian forest inventory 1961, a permanent increase in area the Austrian forests was noted. At the moment the annual area increase is about 5100 hectares.

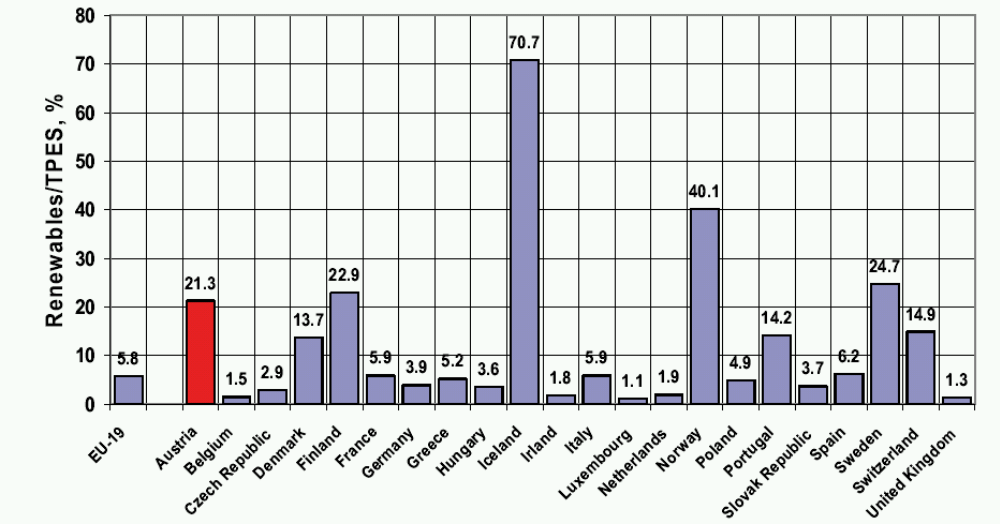
The external trade in timber and wood products accounts for years positive. Approximately 2 / 3 of the Austrian production in quantities of timber, paper, cardboard, fiberboard and other wood products are exported and generate more than 10% of the total Austrian export revenue[4].

[2] Czech Statistical Office, available on WWW: http://www.czso.cz/csu/2007edicniplan.nsf/p/2002-07
[3] Statistics Austria, available on WWW: http://www.statistik.at/;
Biomasse-Ressourcenpotenzial in Österreich; Studie im Auftrag der RENERGIE Raiffeisen Managementgesellschaft für erneuerbare Energie GmbH; Endbericht, 07.05.2007
[4] Waldverband Steiermark, available on WWW: http://www.waldverband-stmk.at

2 OVERALL ENERGY CONSUMPTION IN AUSTRIA AND THE CZECH REPUBLIC

Now we are going to have a look at the overall energy consumption of our 2 countries and the share renewables and especially biomass contribute at the moment.[5]

Figure 2: Contribution of Renewable Energy Sources to Total Primary Energy Supply (TPES) in Europe (2004)



The figure above shows that the amount of RES is very high in Austria compared to the Czech Republic. The reason for this can be found in the fact that the major energy source for electricity in Austria is generated by hydropower plants.

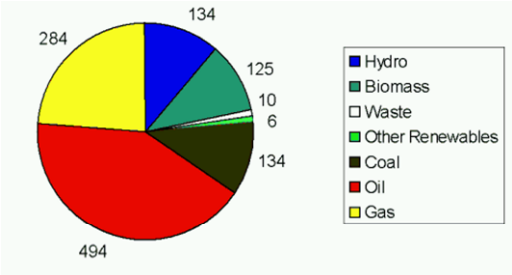
Moreover we are pointing out how the energy is used at the moment with a focus on the energy consumption for domestic heating.

2.1 Austria[6]

Austria's gross domestic energy consumption of 1187 PetaJoul (hereinafter “PJ”) (in 1998) indicates that fossil fuels dominate the scene. However 23 % (273 PJ) of the total consumption come from renewable energy sources.

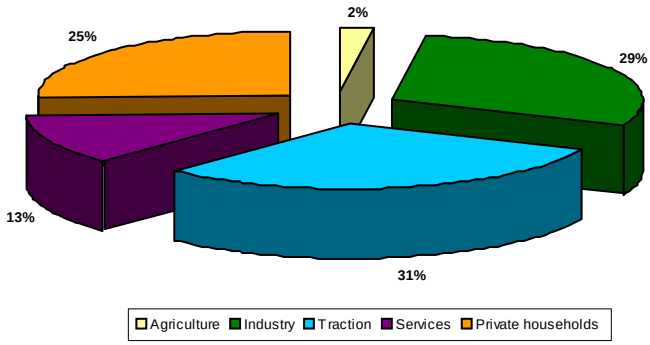
[5] Renewable Energy Sources and Technologies in Austria, G. Faninger, Bericht 26/2006
[6] Austrian Energy Agency, available on WWW: http://www.eva.ac.at

Figure 3: Gross domestic consumption in Austria (1998) - Total 1.187 PJ



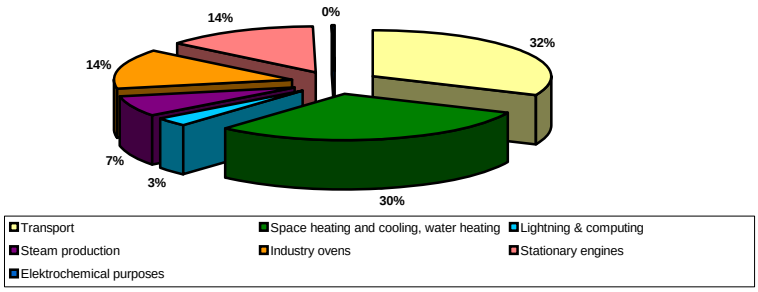
When we have a look at the final energy consumption and compare the different sectors, it is obvious that the private households consume 25% of the total energy[7].

Figure 4: Final Energy Consumption in Austria (2006) – Total 1.093 PJ



The next figure shows the purposes the final energy is used for. After transport, space heating and water heating is the second largest final energy consumer in Austria.

Figure 5: Final Energy Consumption in Austria (2006) – Total 1.093 PJ



The last 2 figures make clear that the energy saving potential at the private households with a focus on the reduction of energy for heating purposes is very high.

[7] Overall energy balances 1970 to 2006, Statistics Austria, available on WWW: http://www.statistik.at/

2.2 Czech republic[8]

Czech gross domestic energy consumption is 1.146,9 PJ. In this pie chart we analyse final energy consumption in the Czech Republic.

The biggest part is covered by industry. Households consume 27% of the total energy, It is the same situation as in Austria.

Figure 6: Final Energy Consumption in the Czech Republic in % (2006) – Total 1.146,9 PJ

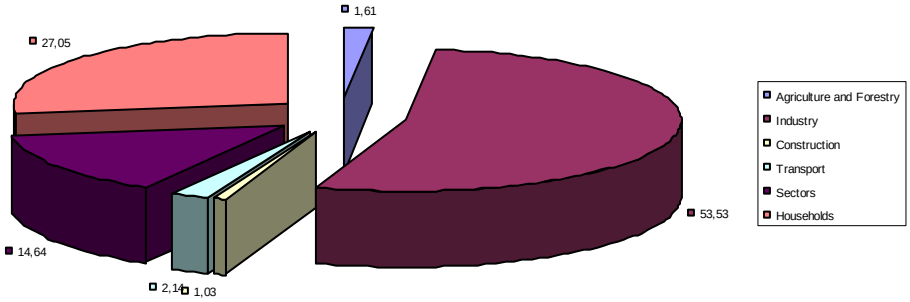
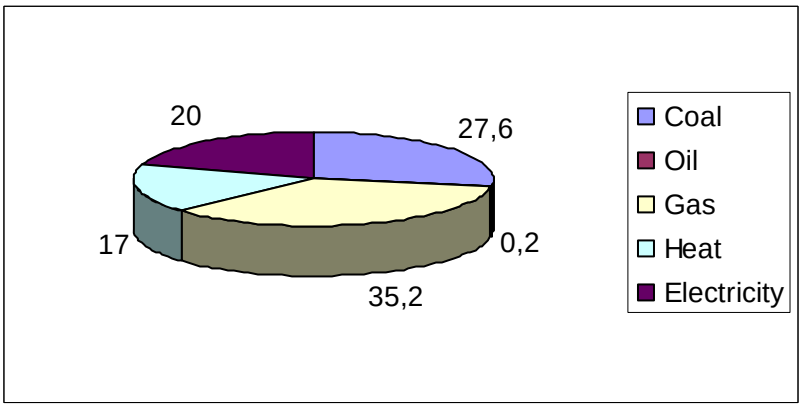


Figure 7: Household's consumption in the Czech Republic (2006) - Total 273,8 PJ



Households consume energy, which comes from gas (32,5%), coal (27,6%), electricity (20%) and heat (17%). Oil makes only imponderable part of consumption.

[8] Czech Statistical Office, available on WWW: http://www.czso.cz/csu/2008edicniplan.nsf/t/27002ADC77/$File/810608kc.DOC

3 THE CURRENT STATE OF BIOMASS USE IN AUSTRIA AND THE CZECH REPUBLIC

3.1 Role of Biomass in a Global Context and in the European Union[9]

The use of Renewable Energy Sources (RES) is the only way of achieving sustainable development. Before the advent of the last 200 years, mankind always solely relied upon renewables. Due to the physical limitations of our planet (scarce natural resources) we have no other choice than to strive for sustainable development.

The main reason for the lack of attraction of renewables is our wasteful treatment of natural resources, including energy. Easy access to non-renewable energy sources in the past 200 years has brought the development of renewables to a standstill in the industrialized world. In that period, world energy consumption rose by 170 times whereas the world population “only” rose by about 10 times. Countries have built their entire infrastructure to suit the requirements of fossil and nuclear energy usage, putting 90 % of all public funding into its development. The energy output of renewables is much lower than that of classical fuels. This is why we need to start thinking differently: Only then might we be able to find a way of making use of the fact that present world energy consumption is only 0,001 % of sun-sourced radiation that falls upon the Earth.

The European Union recognized the importance of tackling the climate change by increasing the share of renewable energies. The first important document issued by the European Commission was the so called RES White Paper in 1997.

The objective was to achieve a share of 12% of total energy consumption by 2010.

After long discussions between the different institutions in 2001 the Directive on the promotion of electricity produced from renewable sources (RES-E directive) was issued.

The aim of this directive was to increase the amount of electricity produced by RES significantly.

The directive set the target that 22.1% of renewable electricity in comparison to the overall electricity consumption should be reached by 2010. In the Annex the European target are transformed into targets for the Member States.

Austria had a share of 70% of renewable electricity in 1997 and has to reach 78,1% in 2010.

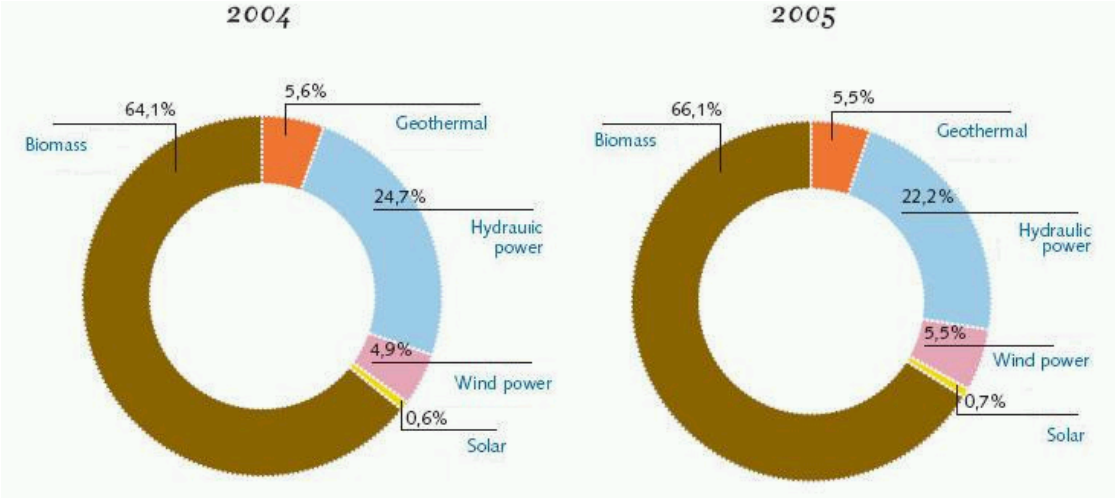
The Czech Republic had 3,8% in 1999 and has to increase this share up to 8 % in 2010.

Moreover this EU document gives a definition of renewable energy, guarantees a free access to the grid connection for green electricity producers, speeds up authorization procedures for potential electricity generators and provides for a system concerning the guarantee of origin or renewable energies.

[9] Innovation and technological development in energy; European Commission / Directorate-General for Energy and Transport; available on WWW: http://ec.europa.eu/energy/res/index_en.htm

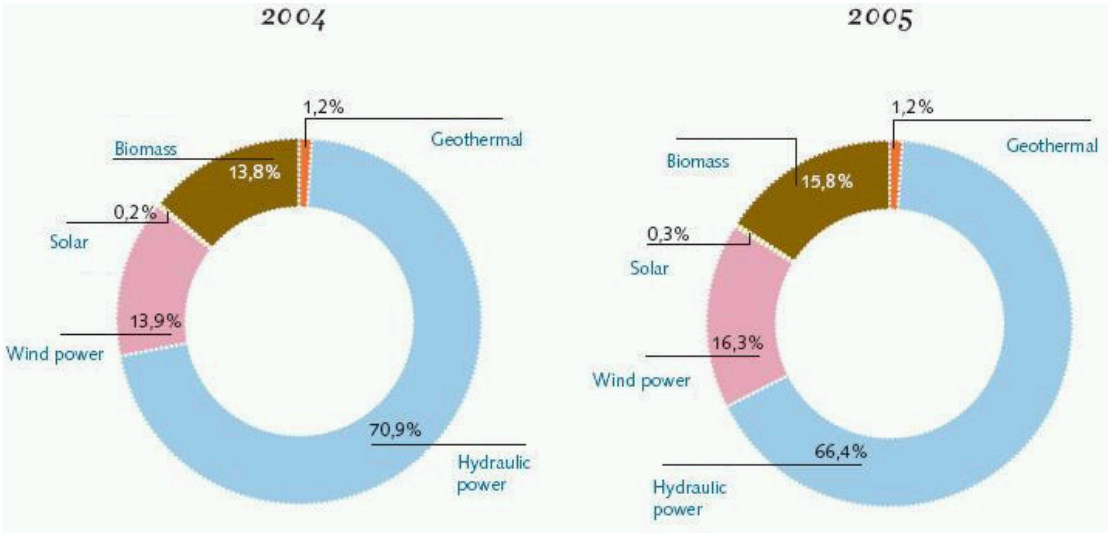
If you have a look at the total renewable primary energy production of the EU you see the dominant role of the biomass.

Figure 8: Share of each resource in the renewable primary energy production (in %)



Regarding just the renewable electricity production of the EU the hydroelectric power plants contribute the largest share. The differences between the two years are mainly depending on the weather like for instance the level of rainfall.

Figure 9: Share of each resource in the renewable electricity generation (in %)



3.2 Role of Biomass in the Czech Republic

The following tables and facts shall give you an overview about the use of this renewable energy source in the Czech Republic:

Table 1: Total energy from renewable sources (2006)

	Energy in fuel used for heat production (GJ)	Energy in fuel used for electricity production (GJ)	Primary energy	Total renewable energy (GJ)	Share of renewable energy on primary energy (%)	Share on the renewable resources (%)
Biomass (without households)	19 920 070.93	5 609 825.23		25 529 896.16	1.34	31.16
Biomass (households)	40 138 138.00			40 138 138.00	2.11	48.99
Water power plant			9 182 520.00	9 182 520.00	0.48	11.21
Biogas	1 163 534.00	1 492 037.77		2 655 572.05	0.14	3.24
Liquid biogas	192.50	94.50	798 319.00	798 606.00	0.04	0.97
Heat pump			676 499.36	676 499.36	0.04	0.83
Solar thermal collector			127 637.91	127 637.91	0.01	0.16
Wind power plant			176 400.00	176 400.00	0.01	0.22
Others	2 589 389.83	52 041.73	1 944.00	2 643 375.28	0.14	3.22
Total	63 811 325.26	7 153 999.23	10 963 320.27	81 928 644.76	4.31	100.00

Table 2: Heat production from renewable resources (2006)[10]

	Gross production	Self-consumption	Delivery	Share on heat from renewable sources
	GJ	GJ	GJ	%
Biomass total	41 759 667.80	40 214 646.40	1 545 021.40	91.19
Biomass without households	16 369 797.10	14 824 775.70	1 545 021.40	35.75
Firewood	556 157.80	555 972.80	185.00	1.21
Wood chips	7 918 201.50	7 032 247.70	885 953.80	17.29
Cellulose material	7 656 367.00	7 100 369.70	555 997.30	16.72
Vegetable material	122 521.80	63 946.20	58 575.60	0.27
Briquet, pellet	116 549.00	72 239.30	44 309.70	0.25
Biomass - households	25 389 870.70	25 389 870.70		55.45
Biogas total	918 510.60	842 624.70	75 885.90	1.48
Solar thermal collector	127 637.90	127 637.90		0.28
Liquid biogas	163.70	163.70	0.00	0.00
Total	45 792 323.30	42 687 434.20	3 104 889.10	100.00

From this table results that the highest proportion on heat production has fixed biomass (91 %). Without households were produced in the Czech republic in 2006 from biomass 16 370 TJ heat energy, which is less than in 2005. Power contribution of other kinds of renewable resources by production of heat energy isn't such important like biomass. There is also still only small meaning of heat production from biomass (919 TJ, it means 2.01 %).

[10] Ministry of Industry and Trade, available on WWW: http://www.mpo.cz/dokument33817.html

There are still not exact amount of gross power production from renewable resources in 2007. But preliminary data say that share of gross power production from renewable resources are[11]:

- Gross power production in the Czech Republic **3,9 %**
- Gross power consumption in the Czech Republic **4,7 %**

Table 3: Total consumption and sources of firewood – tons (2006)[12]

	Total	For a consideration	For free
Purchase	920 891	920 891	0
Self-collection	772 818	74 344	698 474
Purchase and self-collection	959 768	958 328	1 440
Total consumption	2 653 477	1 953 563	699 914

In this context self-collection means, getting wood from own plots or from woods in the charge of forest company. It's really interesting share of self-collection on the total sources. Roughly 700.000 tons of wood are getting without any payment.

Table 4: Number of arrangements burnings biomass (2006)[13]

	Total	Only biomass (tons)	Biomass + coal (tons)
Cook-range	75 500	56 500	19 000
Domestic boiler ÚT	284 000	105 900	178 100
Domestic boiler ÚT and TUV	116 500	47 100	69 400
Local heating device	126 200	66 200	60 000
Domestic boiler TUV	21 600	17 300	4 300
Fireplace	66 900	66 900	-
Total	960 700	359 900	330 800

Table 5: Average annual fuel consumption (2006)[14]

	Only biomass (tons)	Biomass + coal (tons)
Cook-range	2.48	2.26
Domestic boiler ÚT	6.42	3.67
Domestic boiler ÚT and TUV	7.99	4.53
Local heating device	2.22	2.21
Domestic boiler TUV	1.58	
Fireplace	3.01	

[11] Ministry of Industry and Trade, available on WWW: http://www.mpo.cz/dokument43222.html
[12] Ministry of Industry and Trade, available on WWW: http://www.mpo.cz/dokument22793.html
[13] Ministry of Industry and Trade, available on WWW: http://www.mpo.cz/dokument22793.html
[14] Ministry of Industry and Trade, available on WWW: http://www.mpo.cz/dokument22793.html

Table 6: Electricity/Heat in Czech Republic (2005)[15]

	Electricity	**Heat**
	Unit: GWh	*Unit: TJ*
Production from:		
- coal	49782	89430
- oil	326	5668
- gas	3954	37450
- biomass	720	2297
- waste	18	2983
- nuclear	24728	1096
- hydro	3027	
- geothermal	0	0
- solar PV	0	
- solar thermal	0	0
- wind	22	0
- tide	0	0
- other sources	1	312
Total Production	**82578**	**139236**
Imports	12351	0
Exports	-24985	-129
Domestic Supply	**69944**	**139107**
Statistical Differences	0	0

* Transformation sector includes electricity used by heat pumps and electricity used by electric boilers.

** Energy Sector also includes own use by plant and electricity used for pumped storage.

The potential for renewable energy in the Czech Republic has been estimated several times in the past. Only in 2003, however, was research on the potential linked to an economic evaluation in order to provide data for the State Energy Policy and for the preparation of the renew-able energy law expected to promote renewables. The potential has been identified for five different renewable energy sources: solar energy, energy from biomass, wind energy, small hydro and geothermal energy. Each renewable source has its own specific merits and opportunities and therefore the sources potential need to be assessed individually.

[15] International Energy Agency, available on WWW: http://www.iea.org/Textbase/stats/electricitydata.asp?COUNTRY_CODE=CZ

3.3 Role of Biomass in Austria

Energy Policy[16]

Austrian policy supports electricity production from renewable energy sources through feed-in tariffs that are adjusted annually by law. The responsible authority is obliged to buy the electricity and pay a feed-in tariff. The total budget available for this will decrease due to a decision taken in May 2006. Within the new legislation, the annual allocated budget for RES support has been set at EUR 17 million for "new RES electricity generators" up to 2011. This yearly budget is preallocated to different types of RES (30% to biomass, 30% to biogas, 30% to wind, 10% to PV and other RES).

Within these categories, funds will be given on a "first come – first served" basis.

Biofuels are completely exempt from fossil fuel taxes. On 1 October 2007 an Order entered into force regarding a tax rebate for biofuel blends.

A variety of federal programmes for the support of the production of heat and cold from renewable energy sources is being applied. These consist mainly of investment subsidies.

Role of Bioenergy[17]

Hydro power and biomass play the predominant role concerning renewable energy sources in Austria. Considering the role of bioenergic energy carriers 135 PJ were used in 1998.

Accounting for more than 57% of the biomass fuel wood is the main source of biofuel in Austria. Wood chips, bark, straw, and saw mill byproducts are used mainly in the wood-processing industry, the district heating plants and the paper industry. Pellets and briquettes are used in domestic heating systems.

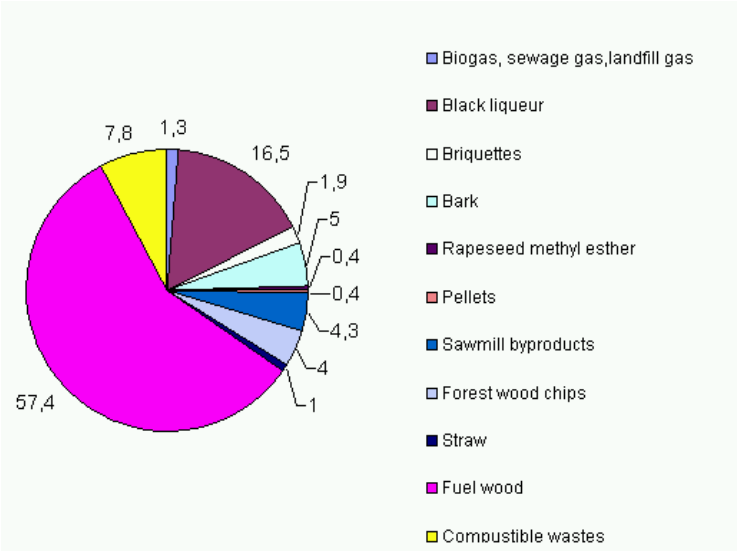
Waste lyes and bark are used in the pulp and paper industry for the production of process heat and electricity. Rapeseed methyl esther is used for automotive applications and to a smaller extend for stationary engines. Biogas, sewage gas and landfill gas are used to produce electricity, heat and to directly drive mechanical applications.

Combustible wastes are mainly burned in district heating systems and to provide process heat.

[16] Green Electricity in Austria with proposals for improvements in energy efficiency; Report by Energie-Control GmbH; August 2007

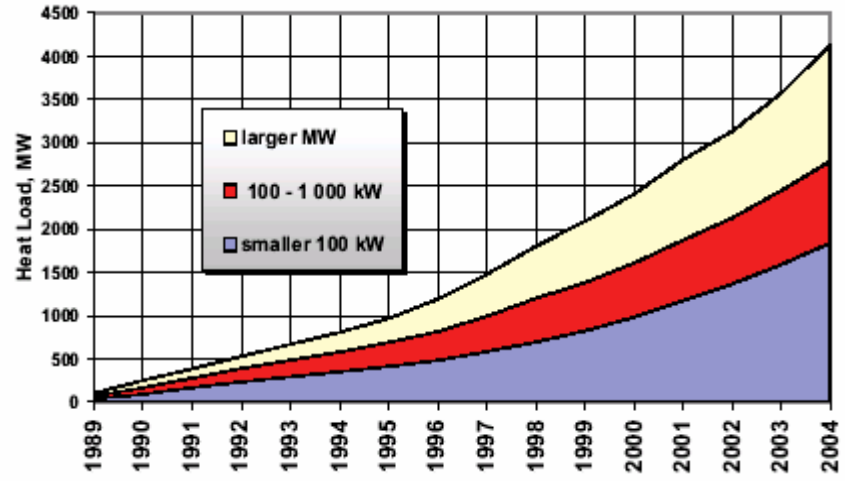
[17] Austrian Energy Agency, available on WWW: http://www.eva.ac.at

Figure10: Bioenergy used in Austria (1998) - Total 135 PJ



The market deployment of biomass-heating systems was actively supported by R&D efforts to improve combustion technology for domestic heating, industrial process heat applications and district heating. Also the operating comfort of biomass boilers could be improved by features of full automatic operation and a similar comfort as oil or gas fired boilers: wood chips and pellets boilers. Since 1989 about 4138 of biomass heating systems were installed in Austria. The annual increasing rate of pellets boilers is since the last three years more than 30% per year.

Figure 11: Market deployment of wood chips and pellets heating systems in Austria: 1989 – 2004[18]



[18] Renewable Energy Sources and Technologies in Austria, G. Faninger, Bericht 26/2006

4 SUMMARY AND OUTLOOK

4.1 Comparative advantage of biomass[19]

The EU is working to reduce the effects of climate change and establish a common energy policy. As part of this policy, European Heads of State or Government agreed in March 2007 on binding targets to increase the share of renewable energy. By 2020 renewable energy should account for 20% of the EU's final energy consumption (8,5% in 2005). To meet this common target, each Member State needs to increase its production and use of renewable energy in electricity, heating and cooling and transport.

Although renewable energies are an integral part of our fight against climate change, they also contribute to growth, job creation and increase our energy security.

Especially biomass will play an important role in several sustainable energy solutions for the future because it:

- Creates jobs
- Protects the climate
- Grows endlessly
- Solves energy problems because it reduces the dependency from fossil fuels
- Is produced regionally
- Opens export opportunities

Nevertheless we have to admit that the production of biomass needs large areas (forestry, agricultural land) and it can only cover a determined amount of the total energy consumption.

So it’s very important to define which sectors could be covered by biomass and which sectors by other RES. The use of bioenergy in households has a lot of advantages, e.g:

- High developed firing technologies already exist
- Easy to handle
- No connection to networks (electricity grid, gas pipelines, district heating network) required

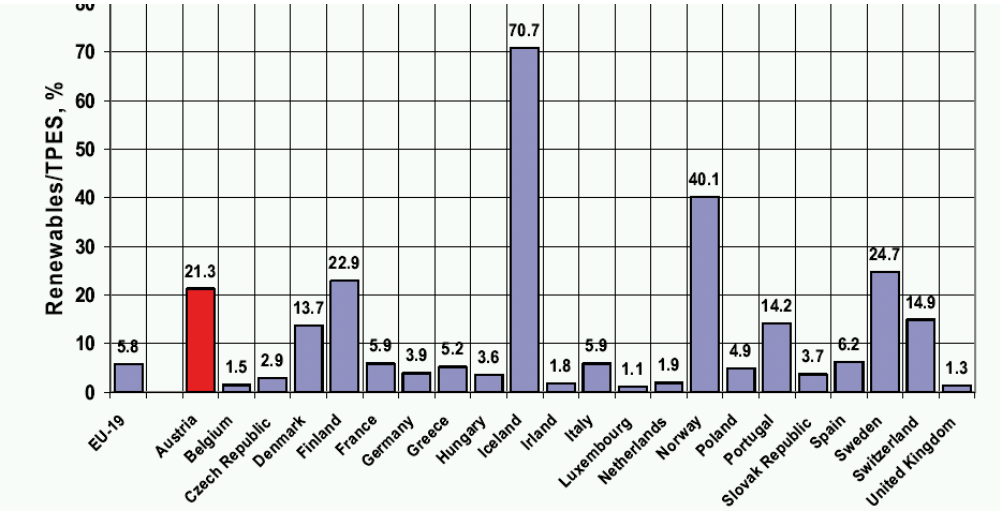
In order to act sustainable and to conserve the biomass resources, we should always try to improve the efficiency of these technologies. As an example innovative solutions like the combination of biomass boilers with solar energy should be forced.

[19] Österreichsicher Biomasseverband, available on WWW: http://www.biomasseverband.at/biomasse

4.2 Comparison of situation in Austria and Czech Republic

When you have a look at the contribution of renewable energy sources to the total energy supply of both countries, you can see that the Czech Republic has still a large potential.[20]

Figure 12: Contribution of Renewable Energy Sources to Total Primary Energy Supply (TPES) in Europe (2004)



Compared to Austria the area covered by forestry is smaller in the Czech Republic. Nevertheless a large amount of wood from the forests is already in use for household heating.

So one focus in future for the Czech Republic could be to cultivate biomass on agricultural areas.

In Austria a large amount of the biomass resources in the forestry and on agricultural areas is already in use. So Austria could for instance focus on the improving of their biomass logistics and the efficiency of their heating systems.

4.3 Conclusion of our work

To sum up the main facts of our work, we noticed that there are at the moment in both countries a lot of political efforts to increase the amount of renewable energy sources.

Nevertheless the target values are not always reached. Responsible for this negative development is on the one hand the absence of strict regulations and continuous monitoring and on the other hand the stable increase of the energy consumption in the Czech Republic and in Austria.

[20] Renewable Energy Sources and Technologies in Austria, G. Faninger, Bericht 26/2006