

# **Country Report Austria**

## **IEA Bioenergy Task 42**

Gerfried Jungmeier  
Vanja Subotić

JOANNEUM RESEARCH  
Forschungsgesellschaft mbH  
Leonhardstrasse 59  
8010 Graz  
Austria

Web: [www.joanneum.at](http://www.joanneum.at)

## List of content

1	Country introduction .....	2
2	Energy production and consumption based on biomass .....	3
2.1	Current energy production and consumption .....	3
2.2	Current production renewable energy and energy from biomass .....	5
2.3	Import and export of biomass for bioenergy .....	7
2.4	Historical trends for energy consumption and use of biomass .....	8
2.5	Current bioenergy production a breakdown in areas .....	12
2.6	Biomass used for non-energy purpose.....	15
2.6.1	Current use of biomass for non-energy purpose .....	15
2.6.2	Examples of the production of specific materials or chemicals .....	15
2.6.3	Current trends .....	16
3	Policy issues related to biomass, bioenergy and biorefineries .....	17
3.1	Policy targets for energy – renewable energy, bioenergy, biofuels.....	17
3.2	Policies regarding biomass production and use for bioenergy .....	17
3.3	Policies regarding biorefineries or biomass derived products .....	19
4	Biorefinery related funding programs .....	19
4.1	Current situation regarding funding programs for bioenergy and biorefineries.....	19
4.2	Specific programs for biorefineries .....	19
5	Running commercial biorefineries .....	21
6	Demo and pilot plants .....	21
7	Major RTD activities.....	22
8	Stakeholders .....	24
9	Table of figures .....	27
10	List of tables .....	27
11	References .....	27

Annex: Figures and Tables

## **1 Country introduction**

The Republic of Austria is a landlocked federal country comprising nine states. It has a total area of 83,850 km<sup>2</sup> with a population of about 8.4 million. Utilized agricultural area takes about 38% (31.8·10<sup>3</sup> km<sup>2</sup>) and forest land takes about 40% (33.5·10<sup>3</sup> km<sup>2</sup>) of the total land area. That means a large potential for production of biomass, that might be used for heat, electricity, and products related biorefineries and bioenergy industries.

The energy sector is mainly based on fossil resources (38% oil, 11% coal and 23% natural gas). On the second place is renewable energy with 28 %, which makes the use of large scale hydropower and biomass in Austria one among the highest in Europe. The fossil fuels are also used for the non-energy use and it takes a part on the gross inland production together with the fossil fuels for the energy-use. If this part was subtracted, the percentage of the renewable energy was 31.7%.

The current government program forces an increase of the share of renewable energy in primary energy supply to 45% until 2020. One main element of this strategy is an offensive biomass strategy. The activities for the energy use of biomass are based on the National Biomass Action Plan for Austria. The National Biomass Action Plan shows that an increase of 256 PJ (6,144 Mtoe) is possible, which is 2.5 higher compared with 2004.

## 2 Energy production and consumption based on biomass

### 2.1 Current energy production and consumption

In [Table A1](#) is shown the energy balance in 2009. The [Figure A1](#) shows the energy flow chart for Austria in 2009.

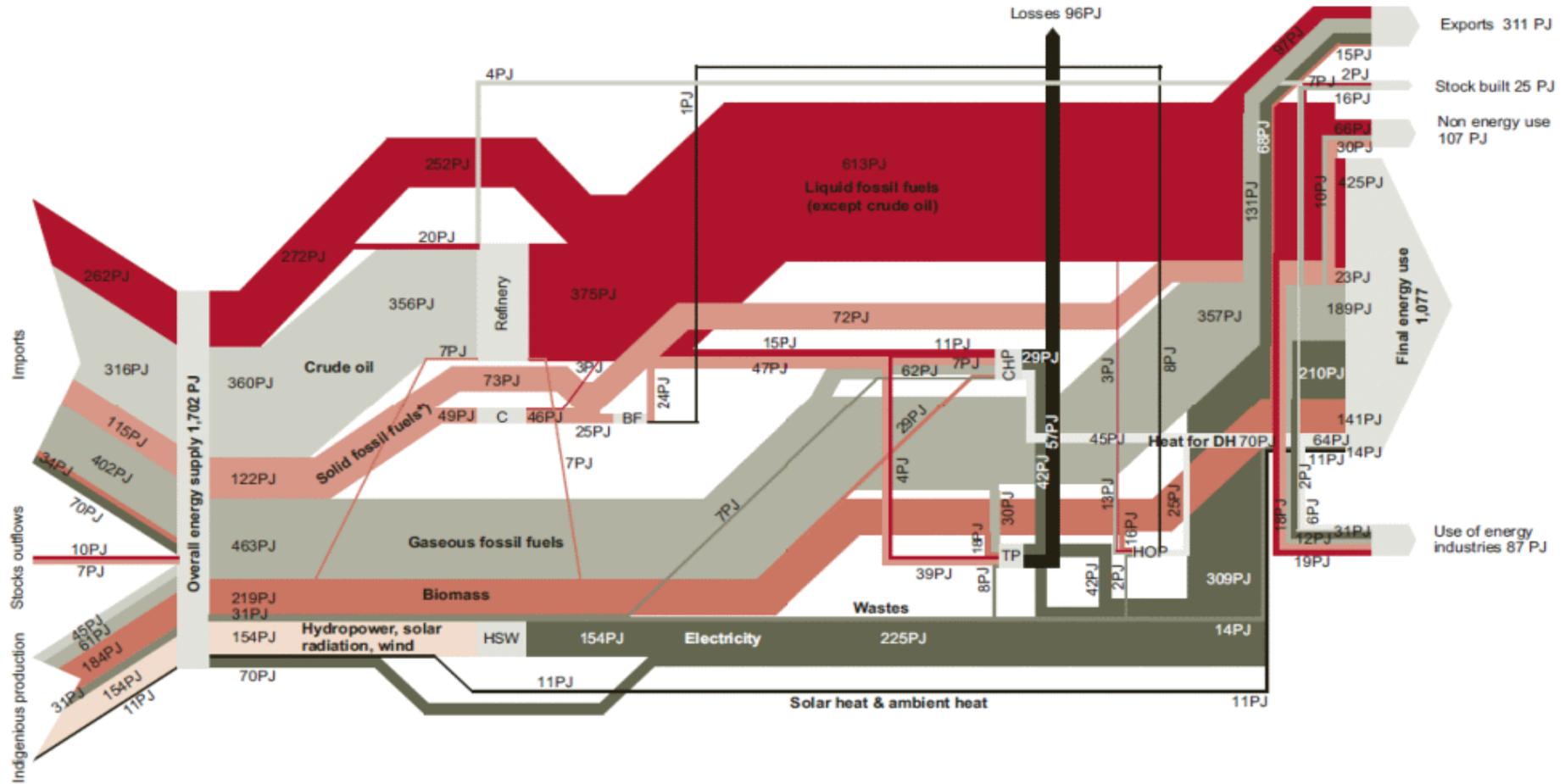
Total gross inland energy consumption increased from 19.1 Mtoe (797 PJ) in 1970 to 36.5 Mtoe (1,073 PJ) in 2009.

**Table A1 : Energy balances in 2009 (STATISTIK AUSTRIA, 2010)**

Fuels	Gross inland consumption	Final energy consumption	Imports	Indigenous production
	PJ			
Hard coal	94.4	8.3	90.6	0
Lignite	1.7	1.7	2	0
BKB and Peat	0.8	0.8	0.8	0
Coke oven coke	25.1	8.4	23.6	0
Crude Oil	358.3	0	315.5	44.9
Refinery Feedstock	25.1	0	20.5	0
Gasoline	1.8	75.7	31.8	0
Kerosene	13.9	27.6	10	0
Diesel	107.6	237.4	142.7	0
Gas oil	28	63.3	30.2	0
Fuel oil	-4.024	11	4.4	0
LPG	4.2	6.6	4.5	0
Other Oil Products	-5.2	1	17.7	0
Refinery Gas	0	0	0	0
Natural gas	303.1	175.2	402.1	60.6
Blast Furnace Gas	0	0	0	0
Coke oven gas	0	2.7	0	0
Waste*	30.6	14	0	0
Fuel wood	63	63.8	7.2	56.7
Biofuels	140	78.8	27.3	127.1
Ambient heat and solar heat	9.9	9.9	0	9.9
Heat for district heating	0	63.6	0	0
Hydro power	145	0	0	145.1
Wind and Photovoltaic	7.2	0	0	7.2
Electricity	2.9	208.4	70.4	0
<b>Total</b>	<b>1,353.4</b>	<b>1,058.2</b>	<b>1,201.3</b>	<b>451.5</b>

\*includes industrial waste, municipal waste non-renewable, municipal waste renewable and other waste

### Energy flow chart for Austria 2009



Rounding differences not equalized.  
 C ... Coke oven; BF ... Blast furnace; HSW ... Hydropower, PV, Windpower plant; TP ... Thermal power plants; HOP ... Heat only production; CHP ... Combined heat and power; Production of charcoal is not shown because of the low energy flows (< 0,5PJ).  
 \*) including coke oven gas and blast furnace gas, DH ... District heating  
 S: STATISTICS AUSTRIA, Energy statistics. Compiled on 28. January 2011.

Figure A1 : Energy flow chart for Austria in 2009 (STATISTIK AUSTRIA, 2010)

## **2.2 Current production renewable energy and energy from biomass**

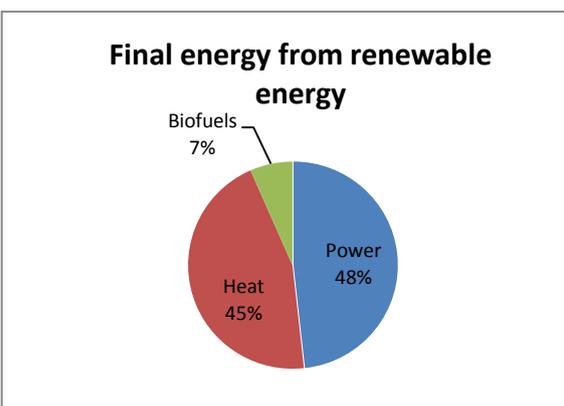
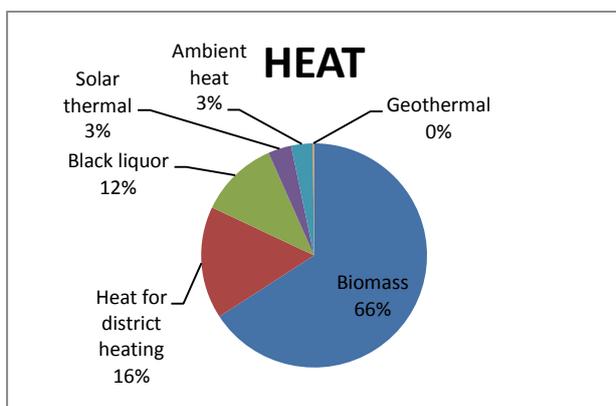
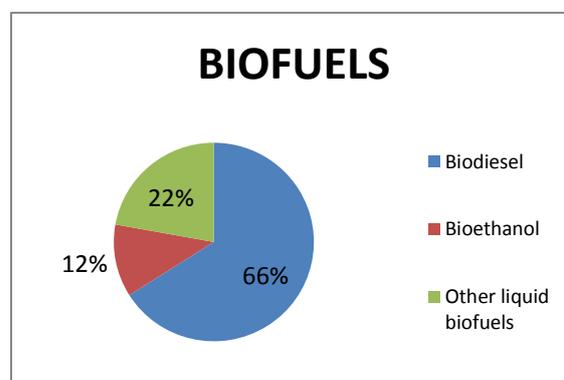
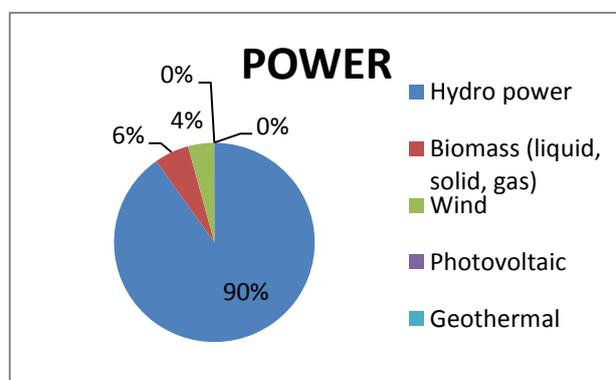
The share of renewables in gross inland consumption in 2009 was 31.7%. Gross inland consumption of renewable energy (mainly bioenergy and hydropower) has more than tripled since 1970 - from 3.0 Mtoe (124 PJ) to 9.5 Mtoe (397 PJ) in 2009. Of the total amount of renewables, bioenergy had the share of 58.9%. The bioenergy with 58.9% has a leader position among the renewable energy. That means there is a higher consumption on the bioenergy (biomass – solid, liquid and gas) than all other renewables together (wind, geothermal, solar thermal, photovoltaic, hydro power). The hydro power represented in 2009 about 37 %, but depends year to year on the water supply of the rivers. In recent years, there were relatively high increases in the range of solar thermal, photovoltaic and geothermal.

According to recent data, the amount of total final energy produced from renewable energy is 2.277 Mtoe (94,871 TJ) and the share of the biomass (solid, liquid, gas), without biofuels, in it is 32%. The share of biomass in power generation is 5% and in the heat generation about 65%.

This share of the biomass in final energy supply from renewables is shown in TableA2 and also in Figure A2.

**TableA2 : Final energy supply from renewables (EEG, 2011)**

	2010	2010	Percentage on the total final energy
<b>POWER</b>	<b>GWh</b>	<b>PJ</b>	<b>%</b>
Hydro power	41,267	148.6	43.5
Biomass (liquid, solid, gas)	2,566	9.2	2.7
Wind	1,915	6.9	2.0
Photovoltaic	21	0.1	0.02
Geothermal	2	0.01	0.002
<b>Total power</b>	<b>45,771</b>	<b>164.8</b>	<b>48.2</b>
<b>HEAT</b>			
Biomass	28,206	101.5	29.7
Heat for district heating	6,946	25.0	7.3
Black liquor	4,866	17.5	5.1
Solar thermal	1,429	5.1	1.5
Ambient heat	1,324	4.8	1.4
Geothermal	78	0.3	0.1
<b>Total heat</b>	<b>42,849</b>	<b>154.3</b>	<b>45.2</b>
<b>BIOFUELS</b>			
Biodiesel	4,127	14.9	4.4
Bioethanol	738	2.7	0.8
Other liquid biofuels	1,386	5.0	1.5
<b>Total Biofuels</b>	<b>6,251</b>	<b>22.5</b>	<b>6.6</b>
<b>Total final energy from renewable energy</b>	<b>94,871</b>	<b>341.5</b>	<b>100</b>



**Figure A2 : Final energy supply from renewables (EEG, 2011)**

The biomass in Austria is mostly used for the heat. The share of biomass in the total heat production in 2008 was 37.6%, actually 0.61 Mtoe (25,489 TJ) and the share of the waste was 6%. In comparison with gas (41%), coal (4%), oil (8%) and all other energy sources the biomass was with 37.6% on the second place.

In 2009, total 2.858 Mtoe (119.1 PJ) of bioheat were produced from single furnaces, 0.588 Mtoe (24.5 PJ) of bioheat district heating were used, what amounts to a total 3.444 Mtoe (143.5 PJ) of the bioheat. These values could increase in 2015 to 3.934 Mtoe (163.9 PJ), or in 2020 to 4,342 Mtoe (180.9 PJ).

Biomass takes the share of 4,264 GWh, actually 0.367 Mtoe or 6.35% in total electricity generation and waste takes 1.12% or 0.06 Mtoe (753 GWh). In 2009 was consumed 0.372 Mtoe (15.5 PJ) of electricity generated from biomass. The share of biomass in primary energy used for electricity production can rise from 0.058 Mtoe (2.4 PJ) in 2004 to 0.46 Mtoe (19 PJ) in 2020.

The Number of plants for the production of green electricity, or electricity from biomass is 719, including 362 plants using biomass gas, 195 using biomass solid including waste, 94 using biomass liquid and 68 using landfill and sewage gas.

Total bioenergy share in 2009 was 4.356 Mtoe (181.5 PJ), and it is expected to be 5.062 Mtoe

## **2.3 Import and export of biomass for bioenergy**

### Solid biomass

The import and export of biomass for bioenergy in 2009 was the following (EEG, 2009):

- Fuelwood: import 0.173 Mtoe (7.2 PJ), export 0.2 Mtoe (1 PJ)
- Pellets and wood briquettes: import 0.28 Mtoe (11.8 PJ), export 0.23 Mtoe (9.6 PJ)
- Bioethanol: import 0.03 Mtoe (1.4 PJ), export 0.02 Mtoe (1 PJ)
- Biodiesel: import 0.28 Mtoe (11.7 PJ), export 0.04 Mtoe (1.5 PJ)
- Biofuels: import 0.65 Mtoe (27.3 PJ), export 0.34 Mtoe (14.2 PJ)
- Other biofuels liquid: import 0.05 Mtoe (2 PJ), export 0.05 Mtoe (2.2 PJ)

The trade with cereals, wood, oilseed and vegetable and animal oils and fats in Austria depends mostly on Europe countries. America and Asia takes the share of about 5% in imports of oilseed and oleaginous fruits and in export of cork and wood has the Asia the share of 8.5%.

In 2009 there were 503,726 t of fuelwood imported and the main countries for import were the Czech Republic, Slovakia, Hungary, Russia and Germany. 95% were exported to Italy. From importance is that the biggest part of the demand for fuel wood is covered by domestic forests. In relation to the overall consumption of fuel wood, the volume of international trade is very low.

Wood chips have been imported, mainly from Germany (80%) and the Czech Republic (12%). (EEG, 2009)

### Transportation biofuels

With a production of 449,033 t in 2009, Austria is one of the most important pellet exporters in Europe. The most important import countries are Germany, Czech Republic and Romania. In 2009 Austria imported 680,563 t and exported 552,532 t of pellets, and it is actually net import 128,031 t.

Austria has one bioethanol plant where bioethanol is produced from wheat, corn and sugar beet syrup from mainly Austrian production.

Austria is net importer of biodiesel; In 2009 318,182 tonnes of biodiesel were imported, and 40,076 tonnes were exported. The main feedstock for the production of biodiesel in Austria is rapeseed oil. In the last years, there was a strong increase in the import of rapeseed from the following most important countries: Hungary, Slovakia and the Czech Republic. Until 2005 Austria has been an exporter of rapeseed oil, but since 2005 the situation has completely changed. 50% is imported from Germany, 8% from Slovenia, 7.5% from Serbia, 6% from Romania, 5.5% from the Czech Republic and 5.5% from Poland. (EEG, 2009)

#### **2.4 Historical trends for energy consumption and use of biomass**

In Figure A3 is shown the wood flow diagramm in Austria. The number of biomass plants is shown in Table A3.



**Table A3 : Number of biomass plants (BiomasseVerband, 2011)**

Fuels	MW <sub>el</sub>	Number
Biomass gas	104.1	362
Biomass solid incl. Waste	436.4	195
Biomass liquid	25.4	94
Landfill- and Sewage Sludge gas	29.8	68
Subtotal Bioenergy	585.7	719

### Solid biomass for heating

In the period 1997-2008 there were 62,393 pellets furnaces installed. Between 2004 and 2008, 61,554 biomass plants (around 3.716 MW) were rebuilt, of which 58,246 were small plants. In 2008, 15,197 small plants (wood chip and pellet central heating furnaces (boilers) up to 100 kW) with a capacity of 411,478 kW were installed. Because of that, after a slump of 51% in 2007, sales of small plants (wood chip and pellet central heating furnaces (boiler) up to 100 kW) reached a record high. The share of the heat generation from biomass (single furnace, central heating, biomass heating plants and green power CHP) in primary energy consumption should increase from 2.3064 Mtoe (96.1 PJ) to 3.96 Mtoe (165 PJ) by 2020. 20.74% of households used fuelwood and wood pellets for heating in 2008.

### CHP plants

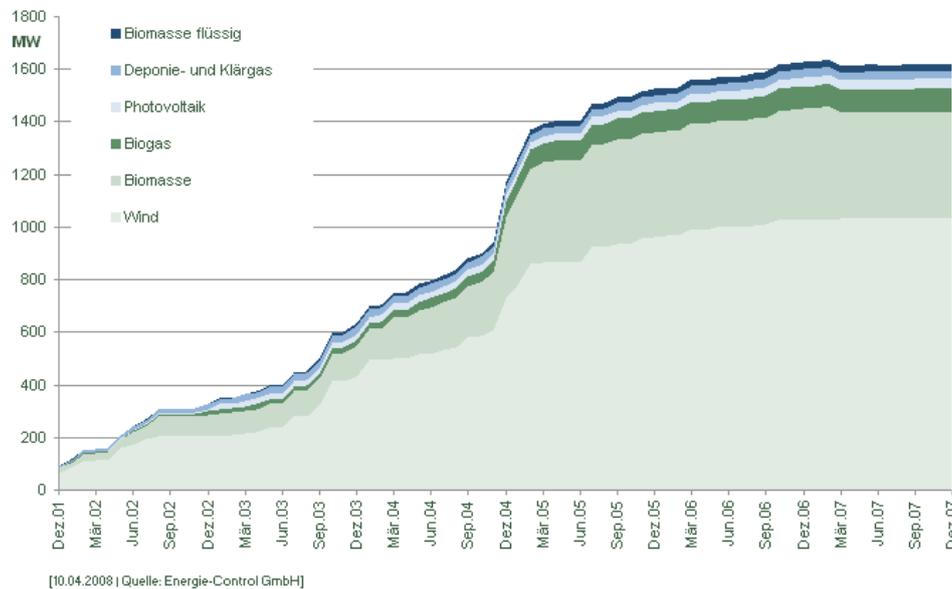
The number of biomass CHPs increased in recent years, and according to data from 2009 there are 9 big biomass CHPs (> 30 MW) in Austria. The biggest biomass CHP in Austria is located in Vienna and has a capacity of 50 MW. It produces the heat for 12,000 households and the electricity for 48,000 households. Particularly of the importance is that this CHP reduces CO<sub>2</sub> emissions by 14,000 tons per year. There are also about 10 medium size CHPs with 10-30 MW of capacity and about 50 smaller CHPs (<10 MW). The amount of heat generated from CHPs increases each year.

The total production of the green electricity from biomass was 3.2 TWh in 2010 and in the same year was generated 5.6 TWh of useful heat from biomass. It can be assumed that about 20% or 1.1 TWh was used for the district heating sector, actually 6% for the total district heating demand in 2010. For the 2020, it was assumed that biomass plants, which are established after the end of the funding period 2006-2011 and under the new framework, must have annual efficiency of 70%. Heat efficiency should increase from about 40% in 2010 up to 47% in 2020.

### Biogas

Before 2002 in Austria there were about 120 small biogas plants, which mainly used liquid manure and wastes. Stimulated by the “Ökostromgesetz” (Green Electricity Act) in 2002, the number of biogas plants increased significantly up to 341 biogas plants in 2009 with a total capacity of 94.5 MW. In the first quarter of 2011, 362 biogas plants with a capacity of 104.1 MW were in operation. The average size of a biogas plant is 277 kW. The majority (90%) of biogas plants has a capacity of less than 500 kW, but they produce with about 67% of the total biogas energy. Only three plants are larger than 1 MW. The average capacity of newly

constructed biogas plants increased between 2004 and 2008 from 30 kWel to 250 kWel. In 2009 in Austria about 0.1419 Mtoe (5,913 TJ) of biogas were produced. The trend of installation of biogas plants is shown in Figure A4.



**Figure A4 : Trends of installation of biogas plants (E-Control, 2010)**

### Transportation biofuels

The largest increase is visible by biofuels: from 0.03 Mtoe (1.2 PJ) in 2004 to 0.82 Mtoe (34 PJ) in 2010, and probably 1.73 Mtoe (72 PJ) by 2020.

Biodiesel is mainly made from (used) vegetable oils and animal fats. Biodiesel has been produced industrially since 1990s. In 1991 one of the first industrial biodiesel production plants became operative in Aschach/Upper Austria.

In Austria 2010 there are 14 biodiesel production facilities which have produced around 650,500 t/a. The production strongly increased in the period 2005 to 2008. The Austrian producer of biodiesel "ARGE biofuels" produced totally 336,654 tons of biodiesel in 2010. In 2006 there were 121,665 t – and it is an increase of 177 percent. (BioKraft, 2010). At all Austrian filling stations, around 96% of the diesel fuel contains a biodiesel additive of approximately 7 vol-%.

In Austria, bioethanol has been added to petrol since 1 October 2007. Bioethanol has been 100% imported till 2008. The production of bioethanol in Pischelsdorf started in 2008 with an annual production capacity of nearly 200,000 t, so the the total national demand for bioethanol can be satisfied. (Basisdaten, 2011). In 2010 the bioethanol production was 156,860 t.

## 2.5 Current bioenergy production a breakdown in areas

Table A4 shows the current bioenergy production.

**Table A4 : Current bioenergy production breakdown in areas (E-Control, 2010)**

Use	Year	Unit	Amount	% of total bioenergy	Feedstock(s)	Number of plants
Power	2010	Mtoe (GWh)	0.22 (2,599)	n.p.	Biomass	719 ** (31.03.2011)
Heat	2010	Mtoe (GWh)	2.43 (28,206)	n.p.	Biomass	
CHP*		Mtoe	n.p.	n.p.		70
Bioethanol	2010 2011	Mtoe (GWh) (t)	0.10 (738) (156,860)	n.p.	Sugar beet, starch, wheat, corn	1
Biodiesel	2010 2011	Mtoe (GWh) (t)	0.30 Mtoe (4,127) (336,654)	n.p.	Waste, animal fat and plant oil	14 (2010)
Biogas	2009	Mtoe (TJ)	0.14 (5913)	n.p.	Manure, corn	362 (2011)
Other	2011	Mtoe (GWh)	0.12 (1,368)	n.p.	Other liquid biofuels	-

\* If no figures for separate heat and power report the combined use as CHP

\*\* Details see Table A3

n.p. ....not possible to quantify

Table A5 shows the breakdown of national biomass energy uses on feedstock.

**Table A5 : Breakdown of national biomass energy use on feedstock – gross inland consumption (STATISTIK AUSTRIA, 2010)**

Source	Year	Unit (Mm <sup>3</sup> or kton)	Amount	% of biomass energy reported above
Round wood	2009	kton	4,396	n.p.
Forest wood chips	2009	kton	other	n.p.
Wood industry residues	2009	kton	6,820	n.p.
Wood pellets/briquettes	2009	kton	577	n.p.
Black liquor and sludge	2009	kton	2,943	n.p.
Wastes (organic fraction)	2009	kton	719	n.p.
Straw/agricultural residues	2009	kton	n.p.	n.p.
Sugar beet/sugar cane	2009	kton	3,000	n.p.
Cereals (grain, corn)	2009	kton	600	n.p.
Other	2009	kton	6,315	n.p.

\*Other: woodchips, woodwaste, bark, black liquor, biogas, landfill gas, sludge gas, sewage sludge, oil biodiesel, animal flour and –fat

n.p. ....not possible to quantify

Wood is, with a share of 27% in bioenergy, the most important biogenic source of energy. In 2009, there was provided the first time more primary energy by wood chips, bark and wood

waste. Woodchips and woodwaste are mainly used by the saw/wood manufacturing (in the wood processing industry), in CHPs and district heating plants, while wood pellets, in an increasing amount, by household heating systems. Black liquor and sludge from paper industry and also bark are used by the paper and pulp industry for the generation of electricity and process heat. In 2009, there was 503,726 tons (7.209 PJ = 0.173 Mtoe) imported fuelwood, which represents 11% of the gross inland consumption and 3,961,449 tons (56.692 PJ = 1.361 Mtoe) was produced in the country. 680,563 tons (11.763 PJ = 0.2823 Mtoe) of pellets and wood briquettes were imported, while Austrian production was 449,033 tons (7.761 PJ = 0.1863 Mtoe). An amount of 552,532 tons (9.550 PJ = 0.2292 Mtoe) was exported. Consumption of wood waste and black liquor was 100% based on inland production. Municipal renewable waste with 718,572 tons (7.219 TJ = 0.1733 Mtoe) and combustible waste with 2,440,878 tons (30.508 PJ = 0.7322 Mtoe) were neither imported nor exported.

There are 13 pellets production units in Austria, 13 small-scale (< 30,000 tons/year), 8 medium-scale (about 40,000 - 50,000 tons/year) and 4 large-scale (> 50,000 tons/year).

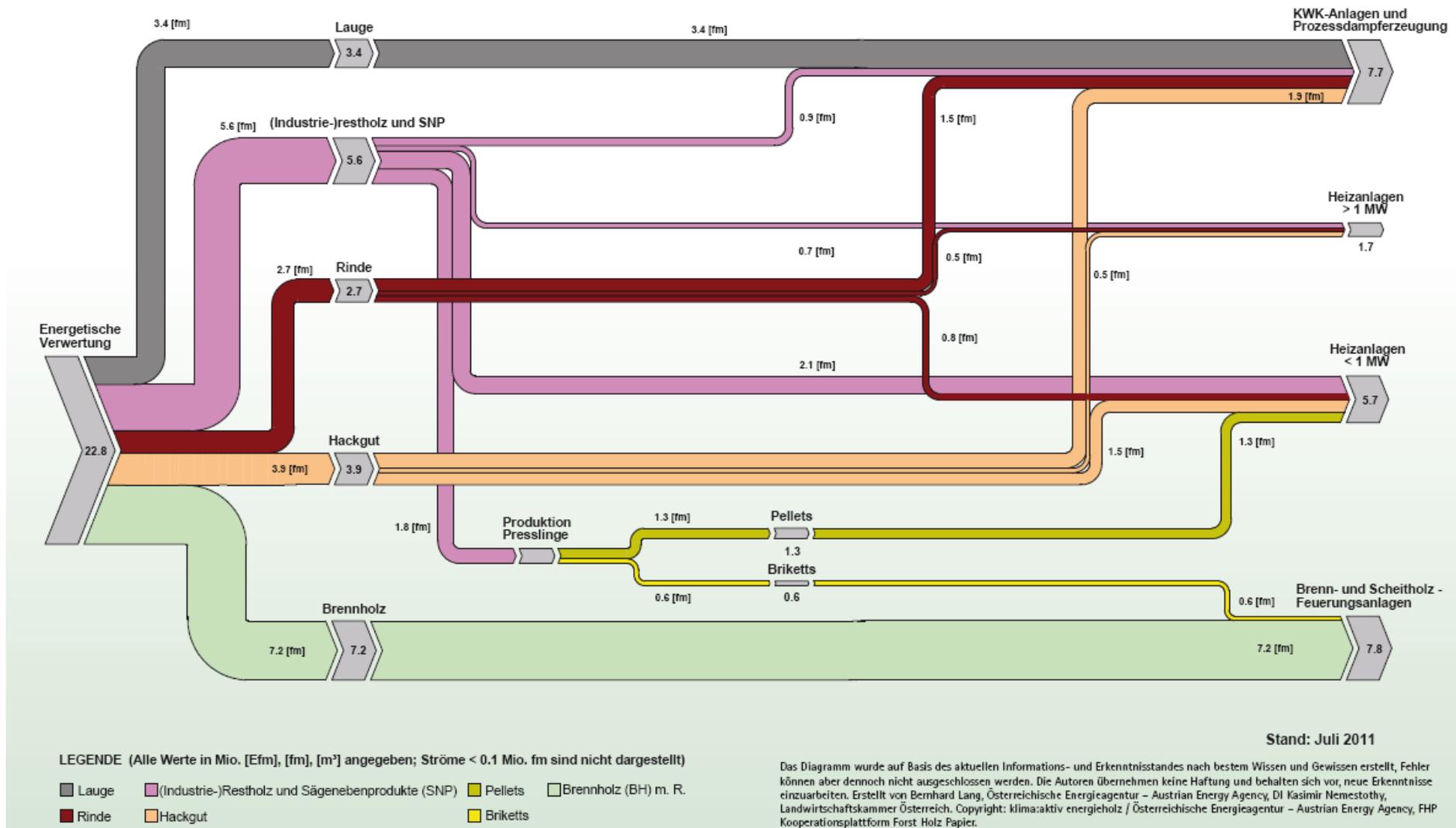


Figure A5 : Wood flows in Austria (BioKraft, 2010)

## 2.6 Biomass used for non-energy purpose

### 2.6.1 Current use of biomass for non-energy purpose

The following table shows the use of biomass for non-energy purpose.

**Table A6 : Use of biomass for non-energy purpose (AGRANA, 2009) (Lebensministerium, 2009) (STATISTIK AUSTRIA, 2010) (Trading Economics, 2010) (UNdata, 2009)**

Use*	Year	Unit	Amount
Wood for particle boards	2009	10 <sup>6</sup> ton	1.2
Wood for pulp and paper	2009	10 <sup>6</sup> ton	2.3
Wastes from pulp and paper	2008	10 <sup>3</sup> ton	1.5
Chemicals from biomass	2009	10 <sup>6</sup> ton	0.78
Cereal production	2009 / 2010	10 <sup>6</sup> ton	5.1 / 4.5
Sugar production	2009	10 <sup>6</sup> ton	0.44
Starch production	2009	10 <sup>6</sup> ton	0.3
Oilseed production	2009	10 <sup>6</sup> ton	0.3
Algae production	2009	10 <sup>6</sup> ton	-

The cereal production in Austria was reported at 5,756,843 t in 2008, according to the World Bank. In 2010 was produced around 4,485,000 tons of cereal.

In 2010 was also produced 3,500 tons of organic sugar from 30,000 tons of organic sugar beet.

Up to now, Austria is a net exporter of wheat. In 2008 the domestic production of wheat was 1,346,124 tons and the domestic demand was 1,023,165 tons. The most important grain in Austria is corn. In 2008 was produced almost 2 million tons of corn. In the same year the domestic demand for corn was almost same like the domestic production.

Domestic production of rapeseed in 2008 was 144,706 t.

### 2.6.2 Examples of the production of specific materials or chemicals

#### Example Green Biorefinery for utilizing grass

The use of grass silage as feedstock for a multi-product utilisation has been developed in Austria over the last years. Key products for this processing are the recovery of high grade amino acids, lactic acid and biogas from liquid and solid residues. The technology is at present implemented and intensively tested in a green biorefinery pilot plant in Utzenaich, Upper Austria. Further valorisation technologies and products applications for the grass press cake are currently in developed and cover a wide range of applications such as insulation materials, fibres for composites, fibre boards, horticulture substrates... and energetic valorisation by combustion . It is expected that the green biorefinery concept will experience a further boost if a linkage to the lignocelluloses biorefinery concepts will be accomplished. This is currently under development and will allow to expand significantly the array of products towards many products generated via fermentation such as most prominently 2nd

generation biofuel or lactic acid at high enantiopurity (e.g. used as PLA precursor or for medical applications).

#### Example of new technology integrations for the sugar and starch industry

The production of sugar and starch is building a stronger cooperation towards other product segments such as energy and biofuels. In Austria the company AGRANA an international player in the sugar and starch sector has also started business in the field of bioethanol (AGRANA bioethanol GmbH, Pischelsdorf). The co-generation of waste streams such as spent fermentation broth is also evaluated and under discussion as appropriate feedstock for anaerobic digestion.

The linkage of the sugar and starch industry with the feed industry for further valorisation of residues streams was already existing (use of beet pulp as feed). A more specialized valorisation concept is the separation of high value food additives such as amino acids out of molasses.

#### Example of using algae as raw material for various process routes

Algae are discussed as future raw materials for various products intensively. Due to very high biomass growing rates they are seen as interesting non food resources for biorefinery set-ups. The production of biofuels out of algae strains containing high amount of lipids is currently under evaluation and development in many RDT projects. However, the separation of PUFA (poly unsaturated fatty acids) such as omega 3 fatty acids mainly for food and feed additives products is able to generate a much higher revenue potential compared to biofuels. In Austria an initiative managed by the company ecoduna is performing a demonstration project for the cultivation of micro-algae in industrial scale photo-bioreactors in order to generate algae biomass for PUFA extractions. All biomass side streams are further valorised for products such as a protein recovery and the co-generation of biogas. The availability of a reliable cheap cultivation technology is seen as a key for establishing algae biorefineries to deliver a wide range of products.

#### Example of co-processing of waste streams of food processing for additional products

Process technologies for the separation of special food compounds from food processing wastes or wine industry such as the separation of polyphenoles have been developed but are at present not implemented at larger scale.

### **2.6.3 Current trends**

There is a trend visible towards lactic acid (LA) as a bulk chemical especially as precursor for PLA.

The industrial player Jungbunzlauer announced to enter the market of lactic acid and its salts for the start of 2012. From the beginning several grades of L (+)-lactic acid, sodium lactate and potassium lactate will be produced in an industrial scale factory in Marckolsheim, France, where also gluconates and the sweetener ERYLITE® are produced. LA-Blends will be introduced soon thereafter. Lactics samples are already available from mid of November 2011.

It is expected that lactic acid fermentation is to build on lignocelluloses feedstock in the future due to the high volatility of prices for starch and sugar they two main currently used raw materials for lactic acid fermentation.

### 3 Policy issues related to biomass, bioenergy and biorefineries

#### 3.1 Policy targets for energy – renewable energy, bioenergy, biofuels

Austria has committed under the EU to a 13% reduction of its greenhouse gas emissions by 2010. As emissions have risen in the 90s, the use of fossil fuels had to decrease by 2010 by more than 3 Mtoe to 18.5 million t. An increase in the share of renewable energy in total energy consumption from 25% in 2002 to 33% by 2010 should provide the compensation. The share of agriculturally important bioenergy should increase from 11.4% (2000) up to this point to 18%.

The marketing of biofuels has been in Austria since October 2005, primarily through the blending of biodiesel to diesel, and since October 2007 also by blending bioethanol to gasoline. Until the beginning of 2009, approx. 4.7 vol% biodiesel and bioethanol were blended. In January 2009 increased the possibility of the addition of biodiesel to a maximum of 7% by volume.

The structure of the heating of the Austrian households between 2003/04 and 2009/10 shows an obvious decline in coal-heated households from 67,831 to 24,048. A significant decline was registered by oil and LPG-heated households, whose number was reduced in the same period by almost 170,000 to 738,666, natural gas and electric power remained in this period almost unchanged. The number of fossil heated households (natural gas, fuel oil, liquefied petroleum gas, coal, cokeoven coke) was reduced from 55% to 47%.

The following table shows the future bioenergy targets.

**Table A7 : Bioenergy targets**

	2005	Estimate 2010	Estimate 2020
Bioenergy	125 PJ <sup>a</sup>	Double	
Biofuels	2,50%	10% (5,75% from 2008)	20% (EU:10%)
Electricity from biomass	2,8%	10% <sup>b</sup>	85% from renewable
Renewable energy	22%	Double from 6% (1990) to 12%	45% (EU: 20%)

<sup>a</sup> Without waste and sludges from paper industries

<sup>b</sup> Moreover: 78,1% from renewable, ÖSG (basis = 56,1 TWh); 80% from renewable, ÖBR

#### 3.2 Policies regarding biomass production and use for bioenergy

"According to estimates by the Austrian Energy Agency greenhouse gas emissions can be reduced in 2020 by 12 million tons and with a full utilization of biomass potential. There could be managed in the period from 2005 until 2020 € 8.6 billion capital and 32,000 new jobs per year. A key challenge in implementing of a national biomass action plan is to mobilize the untapped potential of biomass from agriculture and forestry and help to ensure a regional supply. At the same time, ambitious and demand-side measures should be set. The increased use of biomass is towards the steady growth of energy consumption. Therefore, as part of a biomass action plan, some actions should be appropriate. Even klima:aktiv, climate protection initiative of the Lebensministerium, is trying to increase efficiency on the supply- and demand-side." (Nationaler Biomasseaktionsplan , 2010)

The Austrian government entered an energy agreement in the Government Program. The purpose of the agreement was to reduce the dependence of fossil fuel and reduce the emission of carbon dioxide, or actually the share of the energetic use of biomass to increase by 75% until 2010. There is also a long-term plan for 2020: The share of renewable energy sources in total energy consumption in Austria should increase from 23% in 2004 to 45% in 2020.

The main challenge is to mobilize untapped biomass potential, especially in agriculture and forestry. This requires cooperation of actors in the different sectors like energy, agriculture, forestry and environmental technology. To support such cooperative, there is for example, the klima: aktiv program "Wood energy" from the Federal Ministry of Agriculture, Forestry, Environment and Water Management.

By the sustainable use of biomass potential, the Austrian biomass use could theoretically increase to 256 PJ until 2020. In relation to possible applications, the expected situation:

- The highest increase is for biofuels from 1.2 PJ in 2004 to 34 PJ in 2010 and 72 PJ in 2020.
- The primary energy use of biomass for power generation increases from 2.4 PJ in 2004 to 17 PJ by 2010 and 19 PJ in 2020
- By the heat generation from biomass (single ovens, central heating, biomass heating plants and eco-CHP) is predicted an increase of primary energy use of 96.1 PJ to 142 PJ by 2010 and 165 PJ by 2020

Through the shown use of biomass from 2004 to 2020 following effects are expected:

- Reduction of greenhouse gas emissions by 7 million tons in 2010 and 12 million tons in 2020
- Investments of around 3.2 billion € (2005-2010) and 8.6 billion € (2005-2020)
- 32,000 new jobs per year (average 2005-2020)
- Added value of € 7 billion (2005-2010) and 20 billion € (2005-2020)

A key challenge in implementing of a national biomass action plan is to secure sufficient quantities of domestic biomass. For example, in 2020 should be used 23 million fm of wood for the production of power, heat and biofuels. In the sector biofuels production should be available enough agricultural raw materials (rapeseed, corn, grass, etc.) and the corresponding secure sources of supply at home and abroad for biofuel production.

### **3.3 Policies regarding biorefineries or biomass derived products**

In Austria there are no policies currently existing or in the pipeline which target on the integrated production of materials and chemicals in a biorefinery context. However, this issue is important since more attractive incentives for multi-products setups – such as biorefineries – could make quite some difference in stimulating implementation.

In that concern the “green power remuneration system” in Austria, especially concerning the “feed in tariffs” for power generated from CHP from biogas could make a real boost in implementing biorefineries in Austria. Up to now discussion on that topic has not yet started.

## **4 Biorefinery related funding programs**

### **4.1 Current situation regarding funding programs for bioenergy and biorefineries**

#### **4.2 Specific programs for biorefineries**

"Factory of the Future".

The most important program in the field of biorefineries in Austria is "Factory of the Future". The program "Factory of the Future" by the Federal Ministry for Transport, Innovation and Technology (bmvit) has the target within the next five years to develop demo and pilot projects in sustainable technology development. Examples could be innovative production processes, future-oriented examples etc. The basic principle is to create a sustainable resource base for the manufacture of innovative products through innovative technology concepts for the utilization of surplus grassland biomass. The aim is to enable a continuous operation during the year. Therefore, not only fresh meadow grass is processed, but also of silage, which is preparing in the growing season and stored in the silo. As part of the program "Factory of Tomorrow" should be developed an economically viable model of a Green Biorefinery in Austria.

FTI Initiative Intelligent Production

The Federal Ministry for Transport, Innovation and Technology has launched the new FTI initiative "Intelligent Production". This initiative complements the recent areas of bmvit in the fields environmental / energy, information and communication technology and mobility. The Budget for 2011 is 14 million € and for specific topics are 7 million EURO for every topic available.

Neue Energien 2020 (New energies 2020)

The program has focus on three basic approaches: more efficient use of energy, renewable energy and intelligent energy systems. Ambitious ideas and concepts with long-term perspective should be realized through fundamental research, technological research and development work and with the pilot and demonstration projects aimed at market. Social issues and knowledge for long-term planning processes should be acquired. The budget of this program for 2011 amounts € 30 million.

[Nachhaltigwirtschaften.at](http://Nachhaltigwirtschaften.at)

The Research Forum is a quarterly free publication series of the Federal Ministry for Transport, Innovation and Technology (bmvit), which provides information on selected projects in research, development and implementation projects. This media is devoted to recent results from technology priorities and programs of the pulse energy and environmental technologies sector. With particular reference to the orientation of sustainable development selected areas should be promoted.

#### Österreichische Forschungsförderungsgesellschaft mbH (FFG)

The FFG is the central institution for research funding in Austria. It has more than 30 different funding programs and supports research and development projects, as well as international cooperation projects and utilized the research results.

Austrian Energy Agency - The Austrian Energy Agency is a national competence center for energy with a focus on energy efficiency and renewable energies. The Austrian Energy Agency is involved together with the FFG, the BMVIT and also organizations (sponsors, energy agencies) and government departments from seven other countries in the project ERA NET Bioenergy. The project started in autumn 2004. The 11 projects were funded with over € 5.3 million. Current projects include micro CHP - through the use of micro-CHP and mini-CHP available energy as efficient and environmentally friendly as possible to use.

#### Bundesministerium für Wirtschaft, Familie und Jugend (Federal Ministry of Economy, Family and Youth)

demands increasing the share of renewable energies in electricity consumption and tries to increase the share of 68% to around 85% by 2020. Federal Ministry invests annually 10 million € to biomass and biogas.

Other programs are forced from the Federal Ministry of Agriculture, Forestry, Environment and Water Management.

## 5 Running commercial biorefineries

Table A8 shows the examples of the most representative existing biorefineries.

**Table A8 : Examples of the most representative existinf biorefineries**

Company	Feedstock	Products	Description	Size
Lenzing AG	Fibre and pulp	Furfural, acetic acid, sodium sulfate, potassium-lignin-sulfate	Separation of chemicals as a co-product of fibre and pulp processes. CHP from lignin	
Danisco	Wastewater of pulp and paper industry	Xylose	Separation of xylose out of wastewater	

## 6 Demo and pilot plants

Table A9 shows the examples of the most representative demo and pilot plants in Austria.

**Table A9 : Examples of the most representative demo and pilot plants**

Company	Feedstock	Products	Description	Status (demo/pilot)
Güssing	Lignocellulose	SNG and FT-fuels	Gasification of forest wood chips and conversion to FT-fuels	Pilot
Utzenaich	Grass silage	Amino acids, lactic acid, biogas	Green biorefinery: production of amino acids, lactic acid and biogas from gasses	Pilot
Bruck a d Leitha	CO <sub>2</sub> , nutrients	Omega 3 fatty acids, protein and biogas as co-product	Algae biorefinery: Production of algae at industrial scale for the recovery of high value products such as omega 3 fatty acids; side products: proteins and biogas	Demo plant under construction

## 7 Major RTD activities

The following table shows the list of the major RTD activities.

**Table A10 : Major RTD activities**

Name of project	Type of project	National coordinator	Description	Duration	Size (€s, US\$)
Biosynergy	EU	Joanneum Research	Biomass for the market competitive and environmental friendly synthesis of bioproducts and secondary energy carriers through the biorefinery approach. <a href="http://www.biosynergy.eu">www.biosynergy.eu</a>	2006 - 2010	n.p.
Bioenergy NOE – Network of Excellence	EU	Joanneum Research	The network aims at growing its joint research activities into a Virtual R&D Bioenergy Centre that can spearhead bioenergy research in Europe. <a href="http://www.bioenergy-noe.com">www.bioenergy-noe.com</a>	2005 - 2009	n.p.
Austrian Green Biorefinery Initiative; various thematic sub-projects	National	Joanneum Research, Biorefinery Systems	Primary processing and utilization of fibres from green biomass. Development of downstream processing for separation technology for lactic acid and amino acids from silage juice at technical scale; research on utilizing grass fibres for various product applications	-2009	n.p.
Pilot plant Green Biorefinery	National	Oö Bioraffinerie Forschung und Entwicklung GmbH	Engineering, construction and operation of a pilot plant for separation of high grade amino acids and food grade lactic acid from silage grass and valorisation of grass lignocelluloses for anaerobic digestion in Utzenaich, Upper Austria	2009-2011	3,3 Mio€
Green Biorefinery	EU- SUSPRISE	Joanneum Research	Technical, economic and ecological optimization of value chains by the introduction and efficient use of sustainable raw materials. Evaluated feedstock: maize silage , fresh grass, agricultural residues	2009-2011	n.p.
Cross Border Bioenergy	EU	Österreichischer Biomasse-Verband	The Cross Border Bioenergy project develops a practicable tool for bioenergy companies to assess the attractiveness of European markets for cross-border investments, thereby making them less dependent on fluctuating domestic market conditions and strengthening the whole bioenergy industry. <a href="http://www.crossborderbioenergy.eu">www.crossborderbioenergy.eu</a>	2011-2013	n.p.

Bioethanol from wood and straw	national	Joanneum Research	Perspectives for the production of bioethanol from wood and straw in Austria	2008 - 2011	n.p.
Integration of Bioethanol production in the pulp and paper industry	national	Joanneum Research	Perspectives for the production of bioethanol in the Austrian pulp and paper industry	2008 - 2011	n.p.
Algae for Energy in Austria	national	Joanneum Research	Perspectives for the production and energetic use of algae in Austria	2020 - 2012	n.p.
Agri for Energy I und II	EU	Österreichischer Biomasse-Verband	Aims at connecting stakeholders from the supply & demand sides and fostering new bioenergy businesses in three specific sectors: bioheat, pure vegetable oil and biogas/bio-methane. Project activities are going on in the regions of Austria, Italy, Slovenia, Germany, Bulgaria, Finland and Sweden. <a href="http://www.agriforenergy.com">www.agriforenergy.com</a>		n.p.
Strawhydrolyses	national	FH Oberösterreich	Integrated concept to utilize straw and other annual lignified plants to different energy products (Ethanol, Biodiesel, Biogas) as well as other products produced via fermentation	-2008 – 2013	np
PHOBIOR	EU- Eco Innovation	Ecoduna productions GmbH	Engineering, construction and operation of an industrial scale photo-bioreactor for the production of omega 3 fatty acids, and side products	2010-13	np
Photochem	national	ARENA	Micro algae for the production of chemicals- breeding and downstream processing	2009-12	np
Biogas and cogeneration	National/ international	various stakeholders	Optimization of CHP integration at biogas plants; purification of biogas (e.g. via membranes) for BioCNG, integration of access heat; pretreatment of feedstock for biogas yield enhancement ....	ongoing	np
In the pipeline					
100% yield green refinery	national	OÖ Biorafinerie Forschung und Entwicklung GmbH	Development of a processing technologies for utilising silage grass press cake as feedstock for hydrolysis and consequently fermentation of lactic acid (LA); further processing of LA for ethyl lactate in separation and purification technology	2012-2015	np
High grade additive	national	Joanneum Research	Developing a separation and purification technology for of single amino acids out of mixtures	2012-2014	Np

np...not public

## 8 Stakeholders

The list of the major stakeholders in Austria is shown in the following table.

**Table A11 : Major stakeholders in Austria**

Name	Short Description
<b>Industry</b>	
Lenzing AG	Producer of pulp and paper. Provides the global textile and nonwovens industry with high-quality cellulose fibers. Business units : pulp, textile fibers, nonwoven fibers, energy, engineering, plastics, filaments <a href="http://www.lenzing.com">www.lenzing.com</a>
OMV	Oil refinery company and the oil sector's largest commercial player in Austria. It produces nearly 90% of domestic crude oil, owns and operates the country's only refinery and has a 20% market share in retail filling stations. <a href="http://www.omv.at">www.omv.at</a>
AGRANA	Producer of bioethanol <a href="http://www.agrana.at">www.agrana.at</a>
Energie AG Oberösterreich	Power company <a href="http://www.energieag.at">www.energieag.at</a>
New Energy Capital Investment	Investment company <a href="http://www.energyinvest.at">www.energyinvest.at</a>
BDI BioEnergy-International AG	Engineering and construction of biodiesel and biogas plants; <a href="http://www.bdi-bioenergy.com/">http://www.bdi-bioenergy.com/</a>
Biodiesel Mureck - Seeg reg. Gen.m.b.H.	
Biodiesel Kärnten GmbH	<a href="http://www.biodiesel-kaernten.com">www.biodiesel-kaernten.com</a>
Die Südsteirische Energie- und Eiweiß-erzeugungsgenossenschaft (SEEG reg.Gen.m.b.H.)	<a href="http://www.seeg.at/seeg.php">http://www.seeg.at/seeg.php</a>
EuroBioFuels AG	<a href="http://www.eurobiofuels.ag">www.eurobiofuels.ag</a>
Energy Holding	<a href="http://www.energyholding.at/cms/website.php">http://www.energyholding.at/cms/website.php</a>
HPF Biokraft Hirtl GmbH	<a href="http://www.hpf-biokraft.at/">http://www.hpf-biokraft.at/</a>
Biodiesel Enns GmbH	<a href="http://www.biodiesel-enns.at">http://www.biodiesel-enns.at</a>
PPM-Energie aus nachwachsenden Rohstoffen GmbH	<a href="http://www.ppm-biodiesel.com/kontakt_de.php">http://www.ppm-biodiesel.com/kontakt_de.php</a>
BIO-Diesel Krems GmbH	<a href="http://www.biodieselskrams.at/">http://www.biodieselskrams.at/</a>
Bio Oil Development GmbH	<a href="http://www.bio-oil.biz/de/">http://www.bio-oil.biz/de/</a>
Münzer Bioindustrie- Division Biodiesel	<a href="http://www.muenzer-gruppe.at/bdv/">http://www.muenzer-gruppe.at/bdv/</a>
RME-Alternativtreibstoff Starrein	<a href="http://blt.josephinum.at/index.php?id=541">http://blt.josephinum.at/index.php?id=541</a>

<b>Research Institutes</b>	
Joanneum Research	<a href="http://www.joanneum.at">www.joanneum.at</a>
Institute of Industrial Ecology	<a href="http://www.indoek.noe-lak.at">www.indoek.noe-lak.at</a>
Bioenergy 2020+	The purpose of the Competence Centre is the research, development and demonstration in the “Energetic use of Biomass” sector. <a href="http://www.bioenergy2020.eu">www.bioenergy2020.eu</a>
Energieinstitut an der Johannes Kepler Universität Linz	<a href="http://www.energieinstitut-linz.at">www.energieinstitut-linz.at</a>
<b>Universities</b>	
University of Technology Vienna	<a href="http://www.tuwien.ac.at">www.tuwien.ac.at</a>
University of Technology Graz	<a href="http://www.tugraz.at">www.tugraz.at</a>
University of Graz	<a href="http://www.uni-graz.at">www.uni-graz.at</a>
University of Linz	<a href="http://www.jku.at">www.jku.at</a>
University of Natural Resources and Life Sciences, Vienna	<a href="http://www.boku.at">www.boku.at</a>
Department of Agrobiotechnology, IFA Tulln	<a href="http://www.ifa-tulln.ac.at/">http://www.ifa-tulln.ac.at/</a>
University of Applied Sciences (FH) Wels	<a href="http://www.fh-ooe.at/campus-wels/">http://www.fh-ooe.at/campus-wels/</a>
<b>Governmental Organisations</b>	
FJ-BLT Wieselburg	<a href="http://blt.josephinum.a">blt.josephinum.a</a>
Ministry of Innovation and Technology	<a href="http://www.bmvit.gv.at">www.bmvit.gv.at</a>
Ministry of Forestry, Agriculture, Water and Environment	<a href="http://www.lebensministerium.at">www.lebensministerium.at</a>
Ministries for Economic Affairs	<a href="http://www.bmwfj.gv.at">www.bmwfj.gv.at</a>
National and Regional Energy Agencies	<a href="http://www.energyagency.at">www.energyagency.at</a>
<b>Non-governmental Organisations (NGOs)</b>	
ARGE Kompost und Biogas	<a href="http://www.kompost-biogas.info/">http://www.kompost-biogas.info/</a>
Landwirtschaftskammer Österreich	<a href="http://www.pklwk.at/">http://www.pklwk.at/</a>
Austrian National Support Group Forest based Sector Technology Platform	<a href="http://www.forstholzpapier.at">http://www.forstholzpapier.at</a>
<b>Others</b>	
Andritz AG	Producer of pulp and paper. <a href="http://www.andritz.com">www.andritz.com</a>
Repotec	Company for the biomass gasification, CHP <a href="http://www.repotec.at">www.repotec.at</a>
Vogelbusch	Producer of sugar and starch bioethanol <a href="http://www.vogelbusch.com">www.vogelbusch.com</a>
BDI (biodiesel)	Producer of biodiesel <a href="http://www.bdi-bioenergy.com">www.bdi-bioenergy.com</a>
VTU (biotechnology)	Company developing biotechnologies <a href="http://www.vtu.com">www.vtu.com</a>
Bioenergie Mureck	Producer of biodiesel, bioheat and bioelectricity <a href="http://www.seeg.at">www.seeg.at</a>
ARGE Biokraft	<a href="http://www.biokraft-austria.a">www.biokraft-austria.a</a>

ecoduna	<a href="http://www.ecoduna.com">www.ecoduna.com</a> ; Producer of photobioreactors for industrial algae production
OÖ Bioraffinerie Forschung & Entwicklung GmbH	Operator of the Green Biorefinery for Grass in Utzenaich, Upper Austria;

## 9 Table of figures

Figure A1 : Energy flow chart for Austria in 2009 (STATISTIK AUSTRIA, 2010).....	4
Figure A2 : Final energy supply from renewables (EEG, 2011) .....	6
Figure A3 : Wood flow diagram in Austria (BiomasseVerband, 2011) .....	9
Figure A4 : Trends of installation of biogas plants (E-Control, 2010) .....	11
Figure A5 : Wood flows in Austria (BioKraft, 2010) .....	14

## 10 List of tables

Table A1 : Energy balances in 2009 (STATISTIK AUSTRIA, 2010) .....	3
Table A2 : Final energy supply from renewables (EEG, 2011) .....	6
Table A3 : Number of biomass plants (BiomasseVerband, 2011).....	10
Table A4 : Current bioenergy production breakdown in areas (E-Control, 2010).....	12
Table A5 : Breakdown of national biomass energy use on feedstock – gross inland consumption (STATISTIK AUSTRIA, 2010) .....	12
Table A6 : Use of biomass for non-energy purpose (AGRANA, 2009) (Lebensministerium, 2009) (STATISTIK AUSTRIA, 2010) (Trading Economics, 2010) (UNdata, 2009) .....	15
Table A7 : Bioenergy targets .....	17
Table A8 : Examples of the most representative existinf biorefineries .....	21
Table A9 : Examples of the most representative demo and pilot plants .....	21
Table A10 : Major RTD activities.....	22
Table A11 : Major stakeholders in Austria .....	24

## 11 References

- AGRANA. (2009).  
[http://www.aquagris.org/docs/workshop/vienna/07\\_Residues\\_from\\_sugar\\_and\\_starch  
\\_production\\_19\\_06\\_09\\_01.pdf](http://www.aquagris.org/docs/workshop/vienna/07_Residues_from_sugar_and_starch_production_19_06_09_01.pdf)
- Lebensministerium. (2009). [www.lebensministerium.at](http://www.lebensministerium.at)
- UNdata. (2009). <http://data.un.org>
- BioKraft. (2010). [www.biokraft-austria.at](http://www.biokraft-austria.at)
- Bundesministerium für Wirtschaft, Jugend und Familie. (2010). [www.bmwfj.gv.at](http://www.bmwfj.gv.at)
- E-Control. (2010). [/www.e-control.at](http://www.e-control.at)
- E-Control. (2010). [/www.e-control.at](http://www.e-control.at)
- IEA. (2010). [www.iea.org](http://www.iea.org)  
(2010). *Nationaler Biomasseaktionsplan* .
- Oil surveys. (2010). <http://www.iea.org/stats/surveys/oil surv.pdf>
- OMV. (2010). [www.omv.at](http://www.omv.at)
- STATISTIK AUSTRIA. (2010). <http://www.statistik.at/>
- STATISTIK AUSTRIA. (2010). <http://www.statistik.at/>
- Trading Economics. (2010). [www.tradingeconomics.com](http://www.tradingeconomics.com)
- Algenproduktion. (2011). <http://www.see-o-2.com/article6.htm>
- Austrian Energy Agency. (2011). [www.energyagency.at](http://www.energyagency.at)
- Basisdaten. (2011). [www.biomasseverband.at](http://www.biomasseverband.at)
- Biogas. (2011). <http://www.kompost-biogas.info>
- BiomasseVerband. (2011). [www.biomasseverband.at](http://www.biomasseverband.at)

*Bundesministerium für Verkehr, Innovation und Technologie.* (2011). [www.bmvit.gv.at](http://www.bmvit.gv.at)  
(2011). EEG. Erneuerbare Energien Gesetz, .  
*Fabrik der Zukunft.* (2011). <http://www.fabrikderzukunft.at/highlights/bioraffinerie/>  
*Getreideproduktion.* (2011). [http://www.risk.boku.ac.at/OPAL/WP/?page\\_id=7](http://www.risk.boku.ac.at/OPAL/WP/?page_id=7)  
*Nachhaltigwirtschaften.* (2011). [www.nachhaltigwirtschaften.at](http://www.nachhaltigwirtschaften.at)  
Biomasseaktionsplan. (2009).  
EEG, T. (2009). *IEA Bioenergy Task 40.*