WP3 - Sustainable Exploitation of biomass

Project 4Biomass

Author: Eva Lacher
Kerstin Schilcher
Johannes Schmidl

Vienna, December 2009

AUSTRIAN ENERGY AGENCY

Imprint

Published an produced by: Österreichische Energieagentur – Austrian Energy Agency,
Mariahilfer Straße 136, A-1150 Wien; Tel. +43 (1) 586 15 24, Fax +43 (1) 586 15 24 - 340;
E-Mail: office@energyagency.at, Internet: http://www.energyagency.at

Editor in Chief: Dr. Fritz Unterpertinger

Project management: Johannes Schmidl, Kerstin Schilcher

Reviewing and Layout: Eva Lacher

Manufacturer: Österreichische Energieagentur – Austrian Energy Agency

Produced and published in Vienna

Table of contents

1 Country indicators Austria

Size of country	• Total land area: total: 83,871 km² (land: 82,445 km², water: 1,426 km²) Utilised agricultural area: 3,268,000 ha, of which arable land: 1,377,000 ha (16.4 %) Forest area (utilised): 3,960,000 ha (3,371,000 ha) 47.2 % (40.2 %) Nature protection area: 8 different categories (landscape protection, European protected areas, natural parks, nature conservation areas, protected landscape elements, national parks, nature landscape conservation areas, others), together 27,468 km² (32.8 %)
Population indicators	Inhabitants: 8,210,281 (July 2009 est.) (total) Inhabitants per km²: 97.9
Economic indicators	GDP per capita: $ 39,200 (2008 est.) Growth rate of real GDP per capita: 1.6% (2008 est.)
Energy indicators	Gross inland consumption: 1,421 PJ (2007), of which 1,299 PJ for energetic uses (the remaining for non-energy-uses) Total inland production of primary energy: 458.9 PJ thereof renewable energy: 350.4 PJ or 76 % of energetic uses (excl. imports, incl. stock-exchanges) Primary production of renewable energy: 358.9 PJ or 27.7 % of energetic uses (thereof biomass and waste: 213.1 PJ or 59.3%) Final energy consumption: 1,082.6 PJ RES (biomass) shares of final energy consumption: 152.9 PJ or 15.8% Energy imports: 1,246 PJ (268 PJ exports, 15.9 PJ stock)
Availability of biomass ressources	Theoretical potential: 7.54 Mio. ha Technical potential: 368.3 PJ/a

Source: CIA, The World Factbook, https://www.cia.gov/library/publications/the-world-factbook/geos/au.html

Federal Austrian Ministry of the Environment (edt.) (2007): Facts and Figures 2007

ÖROK (2009): Energie und Raumentwicklung - Räumliche Potentiale erneuerbarer Energieträger

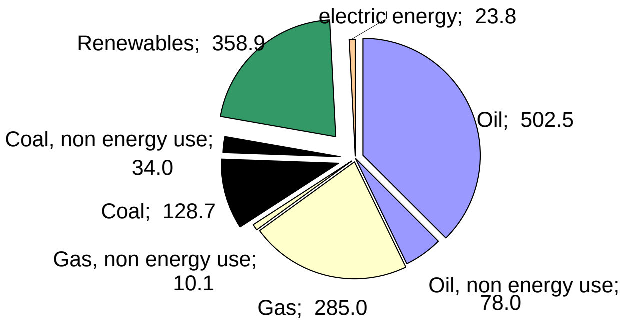


Figure 1: Primary energy Demand in Austria in PJ, as of 2007

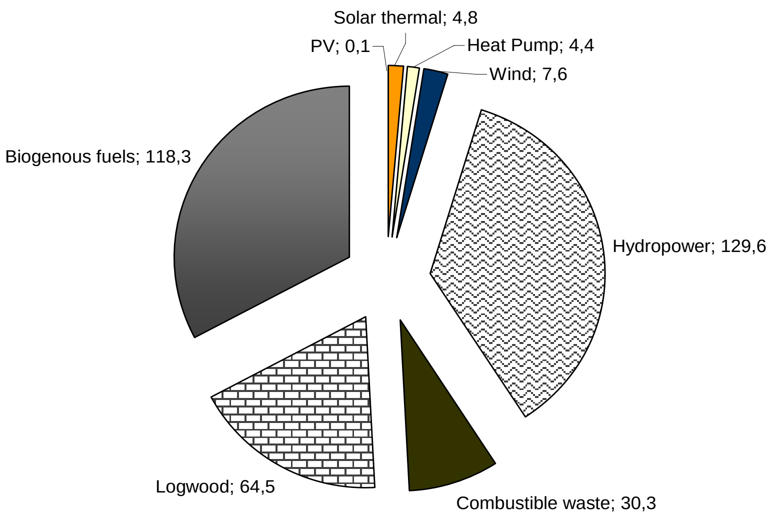


Figure 2: Renewable energy sources in Austria – gross consumption in 2007 (2008 for solar thermal, PV heat pumps, wind); total 358.9 PJ; Sources: Statistik Austria, Austrian Energy Agency

1.1 Renewables besides bioenergy:

1.1.1 (Small scale) Hydroelectric power

In 2007, about 10.0 % of Austrias energy needs resp. 58% of its electricity demand, which accounts for 129.6 PJ (36 TWh), were produced by hydroelectric power plants. Large scale plants (above 10 MW) produced about 31.5 TWh electric energy annually, small scale plants (below 10 MW), produced an additional 5.5 TWh. The Austrian Eco-Electricity Act of 2002 has set strong incentives for the refurbishment of old small hydro power plants and the construction of new ones.

1.1.2 Wind

The electricity produced annually from wind, based on installed capacity as of 2009, will amount to about 2.1 TWh or some 2.9 % of Austrian gross electricity consumption.

1.1.3 Solar energy

Thermal energy: At the end of 2008, 4 million m^2 collectors were installed in Austria, producing some 4.8 PJ of useful heat energy per year. Electrical energy: Some 32 MW of solar electricity were installed in Austria at the end of 2008, 4 MW of it in island mode, the remainder connected to the grid. The production amounted to about 29 GWh of electricity.

1.2 Bio-energy

Bio-energy accounts for some 213.1 PJ of annual production, which is 16.4 % of primary energy demand (if non-energy uses are disregarded). Logwood still dominates. The highest growth rates can be seen for pellets.

There is a common consensus regarding an increased use of bioenergy in the future. There is a working-group installed, which shall develop a strategy to reach 34% of renewable energy by 2020; results gained by this group will be published in 2010.

Table 1: Sources of bioenergy, as used in Austria in 2007; in PJ. (Sources: AEA, Austrian Biomass Association, Landwirtschaftskammer Niederösterreich, Statistik Austria, Propellets Austria)

Source	PJ/year (2007)
Logwood	64.4
Waste wood from Industry and other biogenous sources, woodchips	63,2
Wood pellets, wood- and bark-briquettes	8.6
Straw	2.0
Biodiesel, ethanol	14.8
Bio-, sewage-, landfill gas	5.0
Waste lyes from paper- and pulp industry	25.0
Combustible waste	30.3
Total	213.1

1.2.1 Biogas, Biofuels

In 2008, 340 biogas plants were in operation throughout the country with a total capacity of 91.4 MW, producing about 503 GWh of electricity in addition to heat.

Total traffic-fuel demand in Austria amounts to some 9 Mio. tons. At the end of 2008, the production-capacity of biodiesel plants was about 578,000 tons, which is enough to meet the demand of

5.75% of biodiesel in traffic fuels according to EU-directive 2003/30/EG. The production-capacity of bioethanol amounts to 240,000 tons per year in one plant alone, which is situated at Pischelsdorf, Lower Austria.

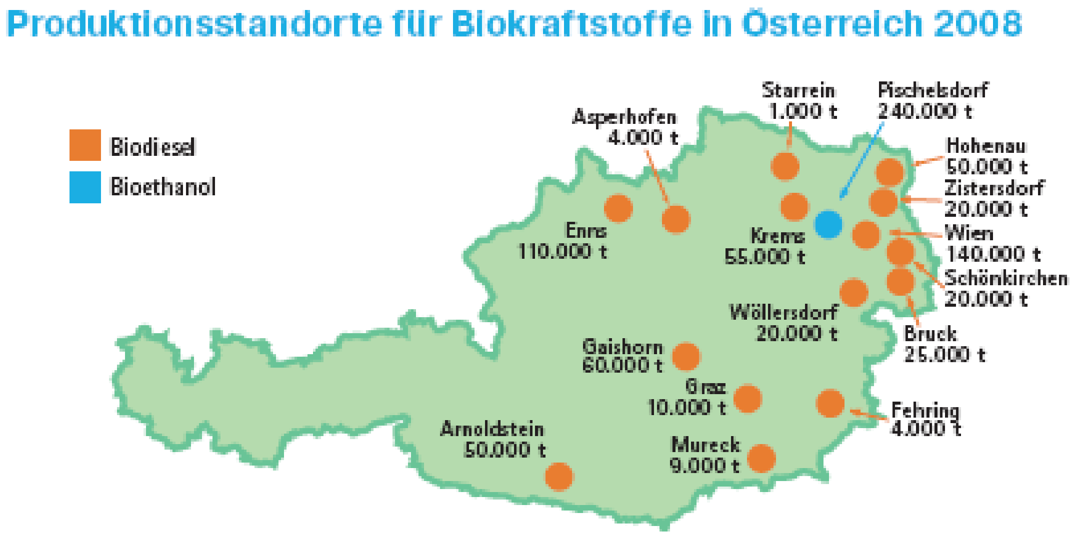


Figure 3: Production sites for biodiesel and ethanol in Austria, 2008 (Source: Austrian Biomass Association, 2009)

1.2.2 Heat from bioenergy (low- and high temperature)

The low-temperature heat market has traditionally been, and remains by far the most important market for biomass in Austria. Small scale heating systems are fuelled by logwood, briquettes, woodchips or pellets, district heating systems are fuelled by woodchips from forestry, from wood-processing industry, and by bark.

The most popular domestic heating systems are tiled stoves, approximately 450,000 are in operation throughout the country : 100,000 are used as main heating system, the rest as support for the central heating system. Biomass heating is especially well developed in rural areas where firewood has been the main source of energy for heating for centuries.

While the share of coal-heated households is disappearing fast and the number of oil- and gas-heated households remains stagnant at high levels, about 20% of Austrian households are heated by biomass. As shown in Table 2, their number increased in the last years. The increase is mainly due to automatic systems such as pellet heating systems.

There are more than 60 enterprises working in the production and the installation of biomass systems.

Table 2: Heating of households in Austria by used heating system and fuel

	2004	2007	% in 2007
Wood, Pellets, Woodchips, wood-briquettes	590.119	740.245	20,73
coal, coke	63.934	37.137	1,04
oil	876.304	822.376	23,03
Electricity	254.550	249.248	6,98
nat. gas	955.098	915.933	25,65
solar, heating pump	26.830	55.706	1,56
District Heat	662.883	750.244	21,01
Total	**3.429.719**	**3.570.889**	**100,00**

High-temperature- and process heat is being used in wood-processing industry and in pulp- and paper industry for industrial purposes.

1.2.3 District Heat and Electricity from Biomass

There are about 1,100 biomass district heating plants in operation in Austria with an installed power of about 1,300 MW in 2008. They convert about 10 PJ of biomass (mostly forest based, a few are fuelled by straw) to heat for heating and for the provision of hot water.

Their power ranges from very small plants (50 kW to 200 kW) for the supply of a group of houses or single big buildings to medium scale plants (200 kW to 2 MW) for the supply of villages, parts of small towns, industrial- and big buildings to big plants in the range of 2 to 20 MW for the supply of towns and cities, or for providing process heat for the wood processing industry.

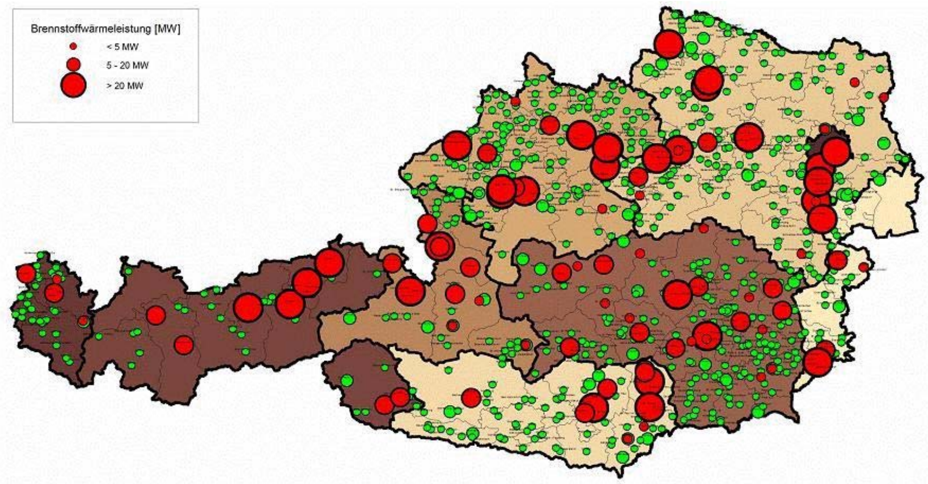


Figure 4: Location of biomass-CHPs in Austria (red circles; as of 2007; green dots= biomass district heating plants).

Some of the big plants are additionally equipped with a CHP (combined heat and power supply system) which produces electricity. Technically, the ORC process is applied for medium scale plants, big plants usually have a steam process (turbine or engine). Financially, CHP is feasible when the electricity is used in industrial processes to substitute for purchased electricity, or when it is supported by special feed-in-tariffs or other incentives, as is the case in Austria and Germany, for example.

Mid 2008, 519,6 MW_{el} based on biomass were connected to the Austrian grid, of that 91.4 from biogas, 26.2 from liquid biofuels, the remaining 402 MW from solid biomass. Electricity-production amounted to 1.9 TWh from solid biomass (incl. waste), 503 GWh from biogases, 36 GWh from liquid biofuels. Additional to that, the paper and pulp-industry produced about 25 PJ of heat and electricity, mainly for their production processes.

2 Demo-Projects

2.1 Fischer production factory, Biomass Combined Heating, Power and Cooling

The company Fischer Sports Gmbh[1] well known for the production of their skis, tennis-rackets, bags, and other sports-equipment, is located in the town of Ried-im-Innkreis (Upper Austria). FACC[2] is a company specializing in the development, design and manufacture of composite components and systems for civil aircraft. Both production sites are situated close to each other, thus one heating-plant for the supply of both sites is technically possible.

Starting point of the project was that the supply of both companies with process-heat and low-temperature-heat had to be renovated, since the old boilers were from the late 1960ies. They burned about 3,000 tons of heavy heating oil, which caused approx. 10,700 tons of CO2-emissions per year.

Since 2000, the Fischer company takes its energy from a bioenergy plant that produces not only heat and power, but also cooling which is used in the ski factory for cooling their presses. The biomass is deliverd by truck and rail from sawmills and forests in nearby regions. This highly innovative project received the prestigeous Austrian Energy Globe Award 2001.

Technical Details:

Country:	Austria
Location:	Ried-im-Innkreis
Project type:	Biomass CHPC (trigeneration)
Supply:	Supply of heat to ski factory
	Supply of cooling to ski factory
	Production of Electricity
Operation:	since 2000
Steam generation:	10t/h

Boiler capacity: 7.700 kW
Electrical capacity of the generator terminal: 605 kW
Heat capacity of heating condensor incl. cooling of the condensor: 6200 kW
Cooling capacity of absorption chiller:
Energy production from biomass 2005:

Heating:	30,000 MWh
Cooling:	1,800 MWh
Eco-electricity:	1,700 MWh
Thermo-oil:	3,200 MWh

---

[1] FISCHER Sports GmbH
A-4910 Ried im Innkreis,
Fischerstraße 8
http://www.fischer-ski.com/de/

2 **FACC AG**
A-4910 Ried im Innkreis
Fischerstraße 9 http://**www.facc.at**

Biomass consumption: approx. 60,000 srm (loose cubic metre), depending on the quality

The plant produces 100 % of the needed heat and cooling demand, the so-called process heat – and cooling, as well as the whole space heating demand of the offices. In addition to that, 20 % of the needed electricity is also covered. This resulted in the closing of the heavy heating oil boilers and a yearly CO_2 reduction of approx. 10,000 tonnes. The total investment amounted to approximately 3.7 Mio EURO. The ownership model which was chosen was energy contracting. The whole plant is in the ownership of Scharoplan, Fischer receives their whole heating and cooling demand for 15 years according to the contract.

Source:

http://www.facc.at/en/start/index.asp

http://www.facc.at/en/start/index.asp

2.2 ORC Heat-Cold-Power (CHCP) production based on old-wood– BIOSTROM, Fussach

2.2.1 Relevant technical data

- Nominal electric capacity: 1.0 MW
- Nominal thermal capacities: 6.2 MW (thermal oil boiler + thermal oil ECO) +1.0 MW (pressurised hot water economiser)
- Nominal chilling capacity - absorption chiller: 2.4 MW
- Start of operation: 2002

2.2.2 Biomass CHP plant with absorption chiller Fussach – acts and facts

Fuel power input (including 20% power reserve)	9,750	kW
Fuel power input (nominal power)	7,800	kW
Nominal power thermal oil boiler and thermal oil ECO	6,200	kW
Nominal power hot water ECO	1,000	kW
Usable thermal power (district and process heat)	5,800	kW
Net electric power ORC	1,100	kW
Thermal driving power of the absorption chiller	3,200	kW
Cooling power of the absorption chiller	2,400	kW
Future expansion potential of district heat and process heat	2,600	kW
Production of heat from biomass	43,500	MWh/a

Production of electricity from biomass	8,250 MWh/a
Production of cold from biomass	18,000 MWh/a

2.2.3 Biomass CHP plant with absorption chiller Fussach – primary energy input and investment costs

Primary energy input

Waste wood - amount (quality classes Q1 – Q4 according to the Austrian wood qualification system)	78,000	m^3/a
Waste wood - primary energy (NCV)	58,500	MWh/a

Investment costs

CHP plant	6.14	Mio €
Cooling station	1.35	Mio €
District heating grid to the cooling station	0.50	Mio €

2.2.4 Biomass CHP plant with absorption chiller Fussach – technological innovations

- First biomass CHP plant based on an ORC cycle combined with an absorp-tion chiller for power production and cooling worldwide
- Waste wood treatment with metal and non-metal separation
- Low-NOx waste wood furnace with CFD optimised geometry
- Thermal oil boiler with separate radiative and convective sections and an automatic cleaning system
- Highly efficient fibrous filter with integrated dry sorption
- Production of electricity from waste wood
- Optimised coupling of the ORC cycle and the absorption chiller

2.2.5 Biomass CHP plant with absorption chiller Fussach – technical data of the absorption chiller

Thermal driving power	3,200 kW
Heating medium	Hot water
Required hot water temperature (feed)	70-83° C
Cooling power	2,400 kW
Cold water temperature (water outlet)	5° C
Cold water temperature (water inlet)	8° C

Cooling medium	Lithiumbromide/water
Performance number	0.75

Source: http://www.bios-bioenergy.at/de/referenzen/alle-projekte/fussach.html

2.3 Biomass-fired CHP-plant based on ORC: STIA-Admont

The biomass-fired combined heat and power production plant is located at the site of STIA Holzindustrie GmbH in Admont, Styria, Austria in a newly built boiler house. From there a district heating system supplies the Benedictine monastery of Admont and the process heat consumers at STIA. The short pipe network (about 470 m only) guarantees low heat losses and a very high installed thermal power per meter pipe network.

Process summary:

The overall plant consists of two combustion units, one with a thermal oil boiler (nominal capacity 3.2 MWth) and the other with a hot-water boiler (nominal capacity 4.0 MWth). Each furnace is followed by a dust precipitator combined with a common flue gas condensation unit. The ORC plant is connected with the thermal oil boiler via a thermal oil cycle and has an electric nomical capacity of 400 kWel. After the successful start-up of the new CHP plant the two oil-fired combustion units at STIA were shut down and are now only used as stand-by units. The three oil-fired furnaces at the Benedictine monastery of Admont were shut down.

The plant supplies STIA-Holzindustrie GmbH with process and space heat and the ORC process covers almost half of the electricity demand (ca. 45%) of STIA. The Benedictine monastery of Admont is supplied with space heat.

Relevant technical data

Nominal electric capacity: 400 kW
Nominal thermal capacities: 3.2 MW (thermal oil boiler) + 4.0 MW (pressurised hot water boiler) + 1.5 MW (flue gas condensation unit)
Investment costs: 3.2 Mio €
Start of operation: 1998/1999

Source:

http://www.bios-bioenergy.at/uploads/media/Report-ORCAdmont-Thermie-2001-03-26.pdf

2.4 European Center for Renewable Energy Güssing

The European Centre for Renewable Energy (Germ. abbr. EEE), headquartered in Güssing (southern Burgenland, close to the Hungarian and Slovenian border), was founded in 1996. With its currently 14 employees the EEE develops lasting regional and community-based concepts for energy conservation and for the generation and use of renewable energy.

As a reliable partner in various national and European networks the EEE has gained an excellent reputation in the fields of research and development and project management, and has long been a sought-after coordinating office. The EEE is also a co-founder of Eco Energy Land and acts as an umbrella organisation for all energy-related activities in the Güssing region. It organises lectures and training in the field of renewable energy and tours through Eco Energy Land.

Güssing as a model for regional economic improvement: The so-called 'Güssing Model' is the strategy of de-centralised, sustainable local energy production with all available renewable resources in a region. Since every region has certain resources in different measures, the model can serve as an example for many communities.

Source: http://www.eee-info.net/cms/

2.4.1 Demo Projects at Güssing:

2.4.1.1 Biomass CHP Plant Güssing – fluidised steam gasifiacation (Thermal)

In order to make the generation of electricity from biomass possible also in small, decentralised power stations, a new type of power station was realised for the first time in Güssing.

For this purpose a gasification procedure is used, which offers particularly as strength-warmth-coupling advantages in comparison with burn procedures. In the biomass power station of Güssing 4,500kW long distance heating and 2,000 kW electricity originate from 2,360 kg of wood per hour. In order to realise this project from the idea to the finished product the partners REPOTEC, as design engineer, scientists from the Technical University Vienna, the EVN and the district Heating Güssing priv.ltd.co. formed the authority network RENET and developed this new, from the economic and technical point well planned system of forth-warmth coupling on the basis of biomass gasification.

Steam gasification

The heart of the power station is the WIRBELSCHICHT (=fluidised bed systems) steam carbureter. It consists of two connencted fluidised bed systems. During gasification the biomass is gasified with approximately 850 degree C under supply of steam. Using water vapor instead of air as medium of gasification results in a nitrogen free, tar-poor product gas, with a high heating value. A part of the remaining coke is transported to combusting over a circulating bed material (sand), which act as heat distribution media. The warmth dissipating to the bed material is needed for the maintenance of the gasification reactions. The flue gas is carried off separately, and the contained heat is used for district heating.

Gas cooling and gas cleaning.

For the function of the gas engine, which is installed subsequently, the product gas must be cooled and cleaned. Naturally the warmth dropping with the cooling is used again for district heating. Afterwards the gas is freed from dust in a woven filter. After this procedure a scrubber reduces the concentrations of tar, ammonia and sour gas components. Due to this special procedure it is possible to lead back all residual substances into the process. As a consequence neither wastes nor waste water result during gas cleaning.

Gas engine

The gas engine converts the chemical energy of the product gas into electricity. Beyond that, the waste heat of the engine is used as well for the production of district heating. For using biomass the efficiency obtained by that way is so far unique. The electrical efficiency is 25-28%, the overall efficiency (electricity and warmth) is even more than 85%.

Contact

For Informations:

Tel.: +43/3322/9010 850-30

E-Mail: biomasse-kraftwerk@eee-info.net

Source: http://www.eee-info.net/cms/netautor/napro4/appl/na_professional/parse.php?mlay_id=2500&mdoc_id=1000558 -popup#popup

2.4.1.2 Biogas facility in Strem – Biogas (Biological gasification)

The „Biogas Strem Errichtungs- und Betriebs GmbH & Co KG“ is the operator of a biogas facility with 500 kWel power that has been built up next to the biomass facility of the „Öko Energie Strem“ agricultural association since November 2004.

This project aims at producing electric and thermal power from locally available, renewable energy sources (the NAWAROs are the re-growing raw materials like grass, clover, mains, sunflower). The produced thermal energy is fed into the local district heating network, while the electric energy goes to the local electric network according to the tariff defined in the eco-power act. The eco-power act prefers such power, which is produced from renewable energy sources. In case of a biogas facility with 500 kWel the tariff rate of 14,5 Cent/kWh is ensured for 13 years.

In several cases the reorganization of agricultural facilities from full-time to part-time operation had resulted in the decreasing of the livestock husbandry to the minimum, consequently due to the reduced livestock production the meadows were not utilized and the plough-land became fallow. This means that enough land is available for renewable energy sources in direct vicinity of the biogas facility. These plants may be grown by environmentally safe agricultural methods and such a way the total required raw material quantity may be available with minimal transport cost.

The biogas facility in Strem has special relevance from the viewpoint of biogas technology development and it becomes a research and demonstration facility by the scientific support of the RENET-program in the following fields:

- Running-in facility, optimization, dry fermentation
- Optimization of process technique and reactor load
- Partial reformation
- Expert system for process control.

Short description of dry fermentation process

Green silage is fed into a heated and continuously mixed fermenting tank made of steel concrete. In order to reach the proper dry substance concentration and digestion chamber load, the substrate should be diluted with fresh water and/or by feeding back of fermented substrate. The created substrate mixture is fermented by micro bacteria. Then, following the separation of solid materials from the bio-gas it is pumped into an interim storage tank (post fermentation tank) equipped with gas storage tank. The bio-gas is converted to electrical and thermal energy in a block thermal power plant. The minor part of the produced electrical and thermal energy is fed back into the cycle of the equipment, while the major part of the produced power is fed into the public network on the advantageous tariff according to the eco-power regulation. The liquid fermentation residue and the separated solid materials, which mean clearly biological and very valuable manure are stored in two lagoons and fed back to the agricultural material cycle at manuring.

Technical data: Bio-gas facility in Strem

Power:

500 kW electrical

600 kW thermal

Annual energy production:

4,350 MWh electrical

5,220 MWh thermal

Annual required plant quantity: 11,000 t (250 ha)

The total investment cost: 2.25 Mio. €

This amount of energy means electrical power supply of 1,200 houses and thermal supply of 40 houses .

Contact
Tel.: +43/3322/9010 850-30
E-Mail: biogas-strem@eee-info.net

Source: http://www.eee-info.net/cms/netautor/napro4/appl/na_professional/parse.php?mlay_id=2500&mdoc_id=1000051

2.4.1.3 Biomass District Heating Plant Güssing (Firing)

In order to decrease drastically the emissions of carbon dioxide, the biomass district heating was opened in 1996 in Güssing, in a township belonging to the “climatic alliance” (“Klimabündnis”).

In contrast to fossil fuels, biomass is a domestic and sustainable source of energy, which is plenty available. Wood in the form of wood chips, wood shavings, bark and pellets is used for the firing in the biomass heating plant. The biomass for the long distance heating comes without exception from regional and local wood owners. This ensures, apart from a high regional value added, the maintenance of our woods.

By controlling the firing of biomass and cleaning the emissions, the biomass heating plant in Güssing, shows only a fraction of waste gas emissions, compared to a multitude of already existing single heating systems. The objects which are connected to the long distance heating, e.g. detached houses, schools and firms are provided with energy from one heating centre only. By firing biomass, water is heated in the boiler of the heating centre and then transported to the customers in well isolated pipelines. A heat exchanger takes over the energy needed in the central heating of the customer. The cooled water is transported back to the heating centre in separate pipelines.

The production, distribution, release and the consumption of energy is regulated and monitored electronically in the biomass long distance heating plant. The perfect technical standard allows an optimal running of the system by minimising personal and production costs. Apart from many advantages for the customers, the biomass long distance heating in Güssing represents a positive example for the whole region.

Advantages for the customer

- high comfort
- energy at a favourable price
- sponsored connection
- the payments for the consumed energy can be controlled easily
- heating with optimal efficiency
- small local wants
- no payments for fuels in advance
- production of electricity and heat on-site

Contact

Tel.: +43/3322/9010 850-30
E-Mail: fernwaerme@eee-info.net

-

2.5 Biomass CHP-Plant Vienna

In 2003, the three companies WIEN ENERGIE, the Austrian Federal Forest Association (ÖBf) and District Heating Vienna founded together the 'Wien Energie Bundesforste Biomasse Kraftwerk GmbH & Co KG' and constructed the Biomass Power Plant Simmering, which started its operation in October 2006. This plant is one of the world's biggest biomass power plants exclusively fed with fresh wood from forestry.

The plant is located in Simmering within the city of Vienna, where already two fossil fuel fired power plants are in operation. Thus, parts of the existing infrastructure could be used, e.g. the heat delivery system for district heating, the connection to the power grid and the feed water preparation system. The pretreatment of biomass (i.e. chipping) takes place at a nearby Danube port.

The plant is designed as a biomass fired power station with fluidised bed combustion or grate firing and power generation by means of a steam turbine and district heating supply. The plant is able to produce 23.4 MWel electricity in summer and 15.06 MWe plus 37 MWth for district heating in winter. It has a fuel consumption of approx. 600,000 m³/a (approx. 23.4 t/h) forest residual wood chips. The plant provides electricity to approx. 45,000 households and heat to approx. 12,000 households. The investment amounted to approximately 52 Mio. EURO. The plant has the potential to reduce Vienna's CO_2 emissions by 144,000 tonnes p.a., which also translates in saving approximately 60,000 t/a coal-equivalent.

In winter, when there is high demand for heat, the plant (rated thermal input: 65.7 MW) achieves a total efficiency of almost 80 % with an electrical gross efficiency of 23 %. However, during summer and in transient periods the power plant is operated in the condensing mode only, with an electrical gross efficiency of 37 %. That means, that from total 8,000 operating hours per year the plant will be operated in the combined-heat-and-power mode for only 2,500 hours per year. Thus, the annual fuel use efficiency is well below 50 % and the plant provides for only 2 % of district heat in Vienna, while it could theoretically deliver three times more.

In sum, this biomass plant is designed as a highly efficient power plant as regards emissions control and energy efficiency. However, due to the limited demand of heat during summer, this potential cannot be fully used; in Vienna, the supply of heat outweighs the demand in transient periods and during summer.

The **lesson** that can be taken for bioenergy in general is, that efficient CHP operation will be restricted to sites where there is – in the ideal case – a round-the-year-demand of (process- or district-) heat, because biomass-combustion will always produce heat as the major outcome of the conversion process.

2.6 Market-introduction of small-scale pellets heating systems: support-System of the Residential Building Sector – Example of Salzburg

In Austria, some 2 billion euros per year are distributed via the support system of the residential building sector. The implementation of this system is carried out by the nine Federal states of Austria, resulting in nine different systems. The special shaping of this support system in the Federal state of Salzburg results in significantly enhanced implementation of solar thermal- and pellets systems.

15 years after implementation, almost all newly build houses in Salzburg are equipped with heating systems based on renewable energy. In 2009, 79% of newly built area of houses are being heated by wood-based systems (biomass-based district heat, woodchips, pellets, logwood,…). Houses built by co-operative societies almos exclusively use pellets or district heat. 62% of of newly built houses additionally use solar thermal energy.

Background behind this success is a system of eco-points. The amount of public subsidies for a project is based on the amount of eco-points. Eco-points depend on the performance of the buildings, on their heating demand, thermal insulation, on the amount of energy which is supplied by renewable sources: the more solar thermal energy, the higher the share of wood-heating etc, the more eco-points are granted, the higher the public subsidy for the project.

Source: proPellets Austria http://www.propellets.at/cms/cms.php

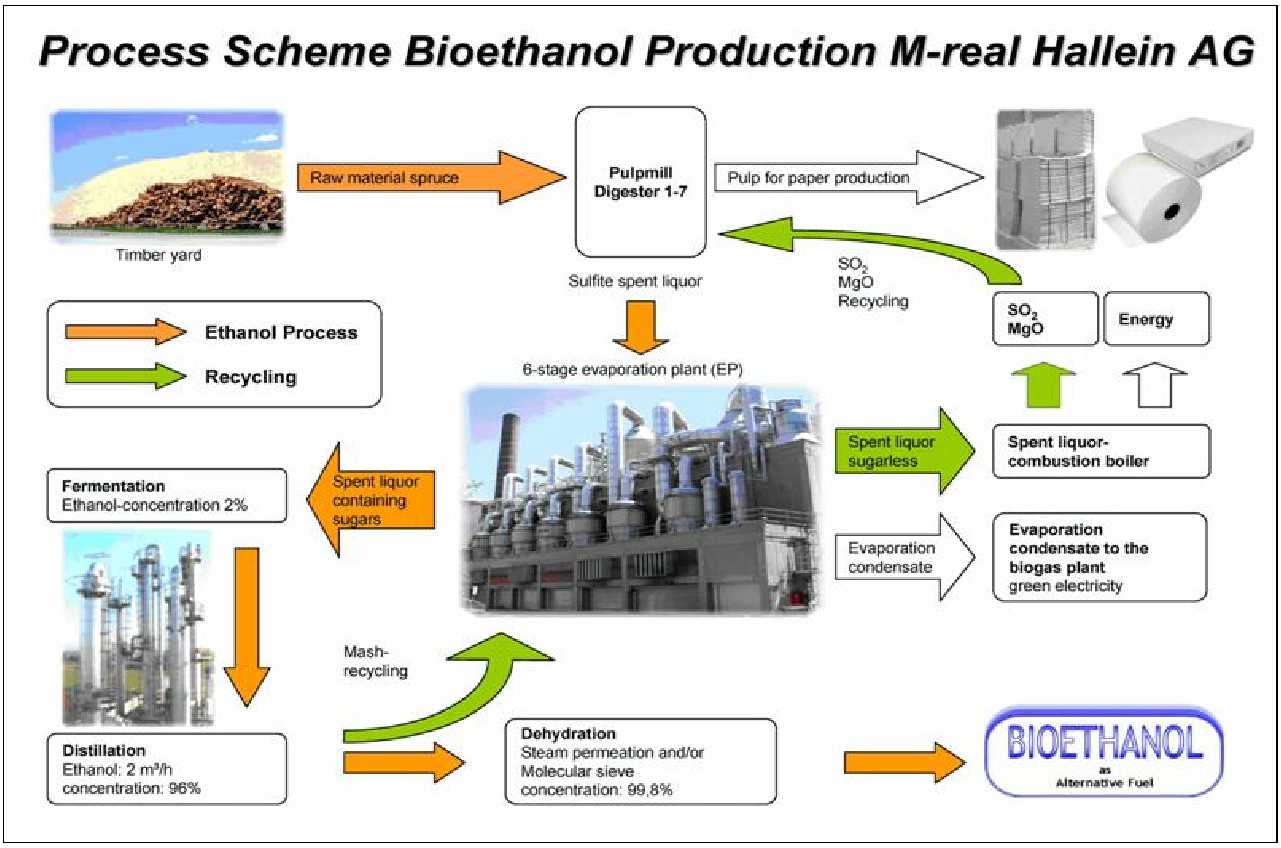
2.7 M-real Hallein AG – Biorefinery: Biochemical conversion of lignocellulosics into ethanol

The Company M-real Hallein AG is planning a demo project for biochemical conversion of lignocellulosics into ethanol. Pulp for the paper mill is produced by cooking spruce chips with acidic magnesium bisulfite cooking liquor. After concentration of the sulfite spent liquor (SSL) in the evaporation plant it is incinerated in the combustion boiler to produce steam and electricity, whereas magnesium oxide and sulfur dioxide are recycled to produce new cooking liquor. The concept for the production of ethanol is to ferment the wood sugars from SSL and to distil off the ethanol in the distillation plant. Afterwards the 96% ethanol is dehydrated by molecular sieves to get water free absolute ethanol. The mash will be recycled as described above.

Ethanol from SSL is a by-product of pulp production from wood and therefore reneweable and sustainable. Hence the ethanol is from high quality according European Pharmacopeia it can be used for technical and speciality purposes in industry or can be used as a 2nd generation fuel after blending with petrol to E85 “Bioethanol”. Studies showed that an ethanol plant would perfectly supplement the pulp and paper mill in Hallein – a future biorefinery.

Further technical details:

Technology	biochemical conversion
Raw Material	lignocellulosics; sulfite spent liquor (SSL) from spruce wood pulping
Input	600 000 SSL (33% dry content) t/a
Product	ethanol
Output	12 000 t/a; 15 Ml/a
Type	demo project
Status	planned



Source and Contact person:

Dr. Fritz Struber, M-real Hallein AG, Salzachtalstrasse 88, A-5400 Hallein, Austria.

Tel: +43 (0) 6245 890 432, fax: +43 (0) 6245 890 558, Mobile: +43 (0) 664 6208 432

fritz.struber@m-real.com ; web: www.m-real.com

M-real, Hallein AG (Austria)

3 Administrative procedures of authorization necessary in the lead up to project realisation. Austria's rules in force

Prior to actual project realisation numerous bureaucratic steps have to be taken. Depending on the type of plant and raw materials and on its utilization different laws and regulations have to considered. However, when designing and developing a biomass fuelled plant some steps can be generalized.

- **Site selection**
  The selection of site is a very important strategic decision in the planning process. A pilot study provides inter alia information on whether there is a demand for electricity/heat/gas and whether there is appropriate infrastructure available to feed-in in the specific area.
- **Raw material supply**
  Sufficient and continuous raw material supply is crucial to operate a biomass plant efficiently, and has to be secured. The logistics to transport, stock and process these raw materials have to be provided.
- **Management**
  The owner/s has/have to decide which type of business ownership they will choose to share responsibilities and spread risks. (e.g. limited liability company, cooperative, etc.
- **Connection with the grid**
  In order to feed-in into the public grid a contract has to be signed with the respective utilities.

3.1 Milestones in the project realization and authorization process

Pilot Study

↓

Draft Planning/Calculation/Funding/Financing

↓

Registration of business (Political district)

↓

Application for Funding (different funding source on different political levels)

↓

Submission

↓

Authorization Procedure (Municipality)

↓

Issuance of Building License

↓

Detailed Planning

↓

Issuance of Green Electricity Certification (Federal Province)

↓

Tender Procedure + Award of Contract

↓

Realization + Final Acceptance

↓

Operation

↓

Regular Inspections

3.2 Permit procedure

There is a hierarchical structure of local responsibility for Austria's administrative units. The highest regional administrative units are the federal provinces (Länder), the second highest are the political districts (districts and towns with charters) and the third and lowest administrative level are the municipalities.

- Regional planning procedures and the designation of areas (or re-designation respectively) lie with the municipalities (supervised by the federal provinces). A biomass plant can for example be build on land that is designated as land for development, a re-designation is only possible if a majority of two thirds accepts in the municipal council.
- According to the Building Acts of the Federal Provinces biomass plants are subject to disclosure and authorization procedures (depending on type and size of plant). The municipality as building authority or the mayor respectively is the person in charge of authorization.
- The registration of business (type of business) is carried out on the political district level. They also issue licenses on behalf of the Trade, Commerce And Industry Regulation Act that are necessary to operate the plant.
- Depending on the type and size of the plant, the type of raw material and residues the authorization procedure might be accompanied by an environmental impact assessment.
- The table below lists a number of laws that have to be taken into consideration when planning and designing a biomass plant. However due to the hierarchical structure of competencies and thus high number of laws and decrees within Austria the list is not complete.

Table 3 : List of National Acts/Decrees

Act/Decree	**Level of competency**
Green Electricity Act	Federal Government
Regional Planning Act	Federal Government
Environmental Impact Assessment Act	Federal Government
Waste Management Act	Federal Government

Air Immission Control Act	Federal Government
Waste Air Purification Act	Federal Government
Water Management Act	Federal Government
Forest Management Act	Federal Government
Clean Air Act	Federal Government
Clean Air Decree for Boiler Plants	Federal Government
Trade, Commerce and Industry Regulation Act	Federal Government
Waste Incineration Decree	Federal Government
Building Act	Federal Province
Air Pollution Control Act	Federal Province
…..	

4 Glossary

Anaerobic: life or biological processes that occur in the absence of oxygen.

Anaerobic digestion: a biochemical process by which organic matter is decomposed by bacteria in the absence of oxygen, producing methane and other by products.

Biodiesel: a biofuel produced through trans-esterification, a process in which organically-derived oils are combined with alcohol(methanol) in the presence of a catalyst to form methyl ester.

Biodiversity: the relative abundance and variety of plant and animal species and ecosystems within particular habitats.

Bioenergy: useful, renewable energy produced from organic matter. The conversion of the complex carbohydrates in organic matter to energy. Organic matter may either be used directly as a fuel or processed into liquids and gases.

Biofuel: fuels made from cellulosic biomass resources. Biofuels include ethanol and biodiesel.

Biogas: a combustible gas derived from decomposing biological waste. Biogas normally consists of 50 to 60 percent methane.

Biomass: organic matter available on a renewable basis. Biomass includes forest and mill residues, agricultural crops and wastes, wood and wood wastes, animal wastes, livestock operation residues, aquatic plants, fast-growing trees and plants, and municipal and industrial waste (biodegradable fraction).

Capacity: the maximum power that a machine or system can produce or carry safely.

Capacity factor: the amount of energy that the system produces at a particular site as a percentage of the total amount that it would produce if it operated at rated capacity during the entire year.

Capital cost: the total investment needed to complete a project and bring it to a commercially operable status.

Chips: Woody material cut into short, thin wafers. Chips are used as raw material for pulping and fibreboard or as biomass fuel.

Cogeneration: the sequential production of electricity and useful thermal energy from a common fuel source.

Combined cycle: two or more generation processes in series or in parallel, configured to optimise the energy output of the system.

Combined heat and power (CHP): an older term for what is now generally called cogeneration.

Combustion: burning. The transformation of biomass fuel into heat, chemicals, and gases through chemical combination of hydrogen and carbon in the fuel with oxygen in the air.

Combustion efficiency: ratio between the actual heat produced by combustion and the total heat potential of the fuel consumed.

Cost-effective: a term describing a resource that is available within the time it is needed and is able to meet or reduce electric power demand at an estimated incremental system cost no greater than that of the least-costly, similarly reliable and available alternative.

Demonstration: for this project, any plant or system that are considered as demo, not in the sense of size, but as devices that represent all the criteria regarding ecological, social and economic sustainability beyond the foreseen criteria of innovations, energy production, efficiency, etc.

District heating or cooling: a system that involves the central production of hot water, steam, or chilled water and the distribution of these transfer media to feat or cooling buildings.

Energy crops: crops grown specifically for their fuel value. These include food crops such as corn and sugarcane, and non-food crops such as poplar trees and switchgrass. Currently two energy crops are under development: short rotation woody crops, and herbaceous energy crops.

Externality: a cost or benefit non accounted for in the price of goods or services. Often externality refers to the cost of pollution and other environmental impacts.

Feedstock: any material which is converted to another form or product.

Fossil fuel: solid, liquid, or gaseous fuels formed in the ground after millions of years by chemical and physical changes in plant and animal residues under high temperature and pressure. Oil, natural gas, and coal are fossil fuels.

Gas engine: a piston engine that uses gaseous fuel rather than gasoline. Fuel and air are mixed before they enter cylinders; ignition occurs with a spark.

Gas turbine: a turbine that converts the energy of hot compressed gases (produced by burning fuel in compressed air) into mechanical power. Often fired by natural gas or fuel oil.

Gasification: a chemical or heat process to convert a solid biofuel to a gaseous form.

Geothermal energy: energy derived from the natural heat of the Earth contained in hot rock, hot water, hot brines or steam.

Greenhouse gases: gases that trap the heat of the sun in the Earth’s atmosphere, producing the greenhouse effect. GHG include carbon dioxide, methane, ozone, chlorofluorocarbons, and nitrous oxide.

Grid: an electric utility’s system for distributing power.

Grid connection: joining a plant that generates electric power to a utility system so that electricity can flow in either direction between the utility system and the plant.

Habitat: the area where a plant or animal lives and grows under natural conditions.

Heat rate: the amount of fuel energy required by a power plant to produce on kWh of electric output.

Heating value: the maximum amount of energy that is available from burning a substance.

Hectare: an area equal to 2.47 acres or 10,000 m^2. there are 100 hectares in 1 km^2.

Hog fuel: wood residues processed through a chipper or mill to produce coarse chips normally used for fuel. Bark, sawdust, planer shavings, wood chunks, and fines may be included.

Hydroelectric power: the generation of electricity using falling water.

Hydrolysis: decomposition of a chemical compound by reaction with water.

Incinerator: any device used to burn solid or liquid residues or wastes as a method of disposal and recovering the heat produced for energy production.

Investment stimulation: direct and indirect financial incentives have the most immediate influence on pro-investment behaviour

Kilowatt: a measure of electrical power equal to 1,000 Watts. 1 kW = 3,413 Btu/h = 1.341 horsepower.

Kilowatt hour: a measure of energy equivalent to the expenditure of one kilowatt for one hour.

Landfill gas: gas that is generated by decomposition of organic material at landfill disposal sites. Landfill gas is approximately 50% methane.

Mesophilic: an optimum temperature for bacterial growth in an enclosed digester (25 – 45 °C)

Methane: an odourless, colourless, flammable gas with the formula CH4 that is the primary constituent of natural gas.

Microalgae: unicellular, photosynthetic aquatic plants.

Moisture content wet basis: moisture content expressed as a percentage of the weight of wood as received.

Moisture content: the weight of the water contained in wood, usually expressed as a percentage of weight, either oven-dry or as received.

Moisture content, dry basis: moisture content expressed as a percentage of the weight of oven-dry wood.

Municipal solid waste: garbage. Refuse offering the potential for energy recovery; includes residential, commercial, and institutional wastes.

Organic compounds: chemical compounds based on carbon chains or rings and also containing hydrogen, with or without oxygen, nitrogen, and other elements.

Particulate: a small, mass of solid or liquid matter that remains individually dispersed in gas or liquid emissions. Particulates take the form of aerosol, dust, fume, mist, smoke, or spray. Each of these forms has different properties.

Pilot scale: the size of a system between the small laboratory model size (bench scale) and a full-size system.

Process heat: heat used in an industrial process rather than for space heating or other housekeeping purposes.

Projects: in a broader sense meaning that not only plants are considered, but also integrated approaches such as "*regional bioenergy systems*". These are especially important since they tend to produce the most value added for regional economies and rural areas (which of course should be verified during the project work).

Relevant: could be defined by criteria regarding ecological, social and economic sustainability. Thus projects should be selected that pay special attention to the latter named criteria.

Renewable energy resource: an energy resource replenished continuously or that is replaced after use through natural means. Renewable energy resources include Bioenergy, solar energy, wind energy, geothermal power, and hydropower.

Sustainable: an ecosystem condition in which biodiversity, renewability, and resource productivity are maintained over time.

Site visit: site visit is when an external team goes to an institution to evaluate verbal, written and visual evidence. Site visits, which often last day/days, are part of the quality evaluation process. The purposes of site visits includes observing facilities and interacting with staff.

Study tour: a study tour is a travel experience with specific learning goals. Study tours emphasize experiential learning and offer both group and self-directed activities that enable learners to explore new facilities, systems, etc. in other countries.

5 List of figures

6 List of tables

Versorgungssicherheit
Wettbewerbsfähigkeit
Nachhaltigkeit
Perspektiven

ÖSTERREICHISCHE ENERGIEAGENTUR – AUSTRIAN ENERGY AGENCY
A-1150 Vienna, Mariahilferstraße 136 | Phone +43-1-586 15 24 | Fax +43-1-5861524-340
office