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Wood Chips

Modern Heating with Tradition – How It Is Done in Austria

www.biomasseverband.at

Österreichischer Biomasse-Verband
Austrian Biomass Association

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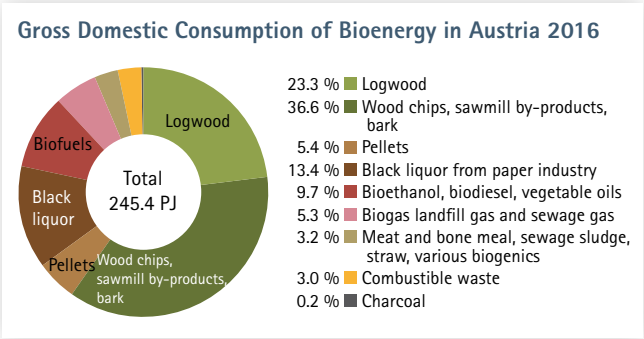
Agriculture, Forestry, Regions and Water Management

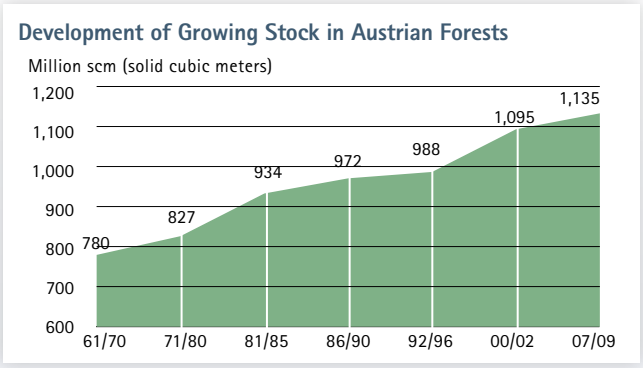
Wood Chips: Renewable and Regional

Wood chips are climate-friendly, domestic and cost-efficient fuel for heat and power production. They are especially well-suited for objects with a high heat requirement and sufficient space for storage. Because of their characteristics, wood chips are the most popular biogenic energy source in Austria.



Source: Statistics Austria, Energy balance 2016

Wood chips along with other by-products from forestry and sawmill industry are the most important biogenic fuel in Austria.



Source: BFW (Austrian Research Centre for Forests)

Despite intensive use, growing stock of standing wood in Austrian forests has increased in past decades.

© Norbert Weber/MM Forst

Climate change brings immense damage to spruce trees by bark beetles; chopping the affected parts of trees is an important control measure.

© Christian Freinschlag/Bezirksforstinspektion Bregenz

The ash, Austria's second most common hardwood species, is fighting for survival, other important tree species are affected as well.

Wood Fuels – the Golden Oldie

Wood chips by definition are chopped woody biomass in the form of pieces with a defined particle size, produced via mechanical treatment with sharp tools. Due to excellent fuel properties, the continuously low price as well as their regional origin and being climate-neutral, wood chips are all around favorable among fuels. Together with bark and other sawmill by-products, wood chips have the highest percentage of all biogenic fuel in Austria (fig. top left). With 37 % they are even before logwood (23 %).

Low Costs – High Efficiency

Compared to other energy sources, wood chips are not only the cheapest fuel for households, but it stands out due to minimal price fluctuations. In the last ten years, the price of wood chips was increased by less than 2 % annually and is almost unchanged since 2011. The higher acquisition costs of the wood chip heating system compared to pellets or fossil fuels is compensated by lower fuel costs.

For municipalities, commercial enterprises and private individuals the federal government offers substantial funding for the installation of wood chip combustion plants or biomass-local district heating plants. Additional funding for the private boiler exchange is also provided by the federal states. More information about subsidies:
www.umweltfoerderung.at, www.biomasseverband.at

Steady Increase in Wood Stock

Domestic wood chips are available in abundance in Austria. 47.6 % of the national territory are covered by wood. After a steady increase in the last 50 years, growing wood stock is as high as never before with 1.135 billion solid cubic meters (scm) of wood reserve. The yearly increase alone amounts to 30.5 million scm. Also the forest area is constantly on the rise. Since the first forest inventory in 1961/70, it has increased by 300,000 hectare – more than the area of Austria's federal state Vorarlberg.

Forestry and Climate Protection

Sustainability and the prevention of climate change are necessities to secure next generations' livelihood. The domestic forest and its products naturally combine both notions. When burning wood, only the amount of CO_2 is set free that was previously absorbed from the atmosphere by the plant during its growth. Therefore, wood is a carbon-neutral energy source and the most nature-oriented alternative to fossil fuels.

Forest cultivation is an important step against global warming. At the same time, extreme weather events pose a serious problem for our forest. Hot and dry summers lead to devastating damage from the bark beetle for the Norway spruce. The Austrian pine suffers from fungal infestation, which is becoming life-threatening due to water stress. The future of the common ash tree is highly endangered because of the ash dieback. Parts of the affected trees can only be used energetically. By quickly removing the accumulating wood, domestic biomass heating systems make an irreplaceable contribution to the protection of the forest.

Origin and Quality

Where do Wood Chips come from?

„Forest wood chips" are generated as by-product of timber harvesting of small-diameter timber and inferior wood like branches or treetop material. When wood is processed in a sawmill the chopped pieces are called „industrial wood chips". Another origin is short rotation coppice on fallow agricultural land where the wood chips are made of fast-growing tree species. Wood chips may be purchased from regional suppliers. Here you can find fuel suppliers in Austria: www.wärmeausholz.at/info/betriebe

Standardization – Playing by Rules

Standardization can be a reliable foundation for business negotiations and contracts. Abidance by said rules, however, is optional. The ÖNORM EN ISO 17225 Standard defines quality-related fuel categories and specifications for solid biomass fuel worldwide. With ÖNORM C 4005 a particular series of regulations was published in Austria for energy recovery of wood chips and hog fuel in biomass plants over 500 kW. Instead of 28 subcategories, it distinguishes only between the four resource groups C1 (logs), C2 (whole trees), C3 (forest residue) and C4 (bark, stumps, roots).

Size and Qualities

Depending on size, wood chips are distinguished between fine, medium sized and coarse wood chips. With the ÖNORM EN ISO 17255 series the designations G30, G50 and G100 were replaced by the particle sizes P16, P31/P45 and P63. They indicate that the length of the main fraction is ≤16 mm, ≤31 mm/≤45 mm or ≤63 mm. Furthermore, there are four classes referring to quality: A1, A2, B1 and B2. Fine wood chips are most suitable for smaller plants, although oversized pieces and a high percentage of fines (dust) may affect the plant. Industrial wood chips usually correlate with the medium size P31/P45. Coarse wood chips are mostly used in large-scale plants.

To run smoothly, it is essential that smaller biomass combustion plants <100 kW or wood gasification plants only use dry, quality wood chips (class A1, A2). Apart from a high water content, leaves, needles, bark or a high percentage of humus in the fuel can be detrimental to the combustion process. In bigger heating plants as well as industrial combustion plants, inferior or wet wood chips can be used. Low-emission combustion is feasible there because of flue gas cleaning and condensation.

Purchasing Wood Chips

In the fuel market, wood chips are sold loosely piled and measured in loose cubic meters (lcm) or absolutely dry in oven-dry metric tons (odmt). The energy content per lcm can vary between 630 and 1,200 kWh depending on the type of wood and the water content. The water content is the most important sign of quality because it is decisive for the heating value and suitability for storage of fuel.

The exact shipping weight is determined by calibrated scales (weighbridge). By taking a sample that is dried in a drying cabinet or a convection oven, the water content and respectively the oven-dry weight of the whole load can be determined due to the reduction in mass. The guidelines provided by the cooperation platform FHP (Forest Wood Paper) serve as detailed instructions to calculate the allocation base of energy wood according to weight and energy content. www.forstholzpapier.at

DOMESTIC QUALITY WOOD CHIPS: Forest associations and forestry communities provide quality wood chips under the certification mark „Holzschnitzel". Grain size and water content are customized for plants with a smaller power range. **Info:** www.waldverband.at/service/ofenholz

Quality classes for wood chips regarding water content

Wood Chips	Water Content M
M 20 Air-dry wood chips	M ≤ 20 %
M 30 Wood chips suitable for storage	20 % < M ≤ 30 %
M 35 Wood chips w/ ltd. storage durability	30 % < M ≤ 35 %
M 45 Damp wood chips	35 % < M ≤ 45 %
M 55 Freshly cut wood chips	45 % < M ≤ 55 %
M 55+ Wet wood chips	M > 55 %

Source: ÖNORM M 7132

Weight and energy according to woods and water content M

Unit	M	t	t_{odmt}	kWh
1 lcm Spruce Wood chips	20 %	0.19	0.15	787
	30 %	0.22	0.15	757
	45 %	0.28	0.15	717
1 lcm Beech Wood chips	20 %	0.28	0.23	1,095
	30 %	0.32	0.22	1,044
	45 %	0.40	0.22	985

Source: Energy from wood, Chamber of Agriculture of Lower Austria

© Austrian Forest Products Research Society

To determine the water content, wood chips are weighed after sampling and subsequently dried in a drying oven.

© Archive ABA

Quality wood chips have low water content, smooth and clean cuts as well as a low percentage of fines and a low green component.

Wood Chip Production

© Liptay/ABA

Drum chipper with wide material feeder and conveyor belt.

© Jedinger/ABA

Production of forest chips is usually carried out on the forest road.

POSITIVE ENERGY BALANCE: The energy input for the production of wood chips for every step from the felling to the transportation to the chipping amounts to only 2 to 5 % of the energy output.

Mobile Wood Chippers

To be able to use the biomass that accumulates as by-product at the timber harvesting for the production of wood chips, the material has to be mechanically chopped. For that, mobile wood chippers are employed. Rural machinery cooperatives often use manually-fed add-on units for tractors. Those reach a chipping performance of 10 to 15 lcm/h. For larger quantities crane-fed large-scale chippers are used that either have a hauler PTO shaft or a separate diesel engine, or are powered by the engine of the truck. Provided the work organization is good, an output of up to 200 lcm/h or more is possible. With a maximum speed of 80 km/h, truck-chippers can be moved quickly even on long distances on motorways all over Europe.

A positive effect for forestry is that with wood chippers also wood with a smaller diameter can be economically exploited. Further, they help remove the breeding grounds for the bark beetle.

Designs

There are disk chippers, drum chippers and screw chippers. With the first, the wood is led to a disc with blades in a radial pattern arranged via a feed roller. Those produce homogenous wood chips. For wood with a bigger diameter and a higher throughput performance, drum chippers are usually used. There the knives are situated above a rotating cylindric drum. Drum chippers chop round wood, brushwood and forest residue and are well-suited for a mobile construction. In screw chippers, a conical screw serves as chipping instrument. This chipper type is not very commonplace. Before investing in a mobile chipper one should be aware of the planned annual amount, material (hardwood, softwood), dimensions and locations (distance, terrain).

Examples of mobile Wood Chippers

Model	Biber 84 VICTOR	Heizohack HM 14-860 KL	Wood-Terminator 12 NMV Hack-Truck
Manufacturer, Location	Eschlböck Maschinenfabrik GmbH, Prambachkirchen/AT	Heizomat Gerätebau GmbH, Gunzenhausen/DE	MUS-MAX GmbH, Groß St. Florian/AT
Throughput	200–250 lcm/h	n. s.	300 lcm/h
Feeding Width	122 cm	122 cm	135 cm
Max. Tree Diameter	60 cm	65 cm	90 cm
Engine Power	404 kW (Truck)	390 kW (Truck)	460 kW (Truck)
Weight	26 tons	26 tons	32 tons
Dimensions (l, w, h)	8.5 m x 2.55 m x 4.0 m	7.8 m x 2.5 m x 4.0 m	9.2 m x 2.5 m x 4.0 m
Axles	3	3	4
Special Features	More power and less fuel consumption due to BPT-gears; High mobility with up to 80 km/h; High driving comfort and ease of use	Truck can be moved while chipping rotor is running; In-feed flap with integrated in-feed chain, adjustable during chipping; Large upper in-feed roller	Mercedes-truck with NMV-auxiliary drive, 3.000-Nm-torque; Steerable rear-axle – narrow turning radius; Multi-tool chipping rotor for knives and blades
Contact	www.eschlboeck.at	www.heizomat.com	www.mus-max.at

Source: Paid ad; Information provided by manufacturer

From the Source to the Boiler

Transportation

Transport costs very much depend on the distance and loading density. Forest wood chips are mostly produced on the forest road, with the wood chips often directly blown into the transportation vehicle. Dependencies and waiting times between wood chipper and truck as well as insufficient space on the forest road under mountain conditions can cause logistical problems. Using large stationary chippers for producing biomass in the factory, enables a high productivity. But besides dust and noise pollution, the low density when transporting forest residue and treetops to the factory is disadvantageous.

The usual wood chip transports in the agricultural sector are carried out by tractor in combination with a trailer (dump trailer, combined trailer or tandem tipper) or a push-off trailer. Long distance transports mostly happen in trucks, which allows for less travel time and higher capacities. Because of the usually short distances, transportation by train is uncompetitive compared to using roads.

Storage

The storage capacity of wood chips is relatively large: In comparison, wood chips need about ten times as much space as heating oil and about three times as much as pellets. Central storage facilities near the forest, for example regional Biomass Trade and Logistic Centres, can be used to bundle and dry wood chips. That way the plants can be continuously supplied with wood chips from the forest. The chips should be stored in a well-ventilated and tall storehouse with roof so that the moisture can escape. While the chips are in storage, the avoidance of decomposition and the development of fungal spores pose a challenge; main cause is a high water content.

© Forest Administration Heiligenkreuz, Fiegl

In lower halls (left) wood chips can be brought in by push-off trailers, in remote bunkers also with a high power blower.

© Viennamotion KG/Krisztian Juhasz

Wood chips need a lot of storage space and should be stored so that the moisture can escape.

DAMAGE FROM BARK BEETLE: To prevent the spreading of the bark beetle, in the coniferous forest stocking of harvest residue from spruce for several months during the warm season has to be refrained from.

Drying

Because of financial reasons technical drying procedures are not very common. Instead, natural drying processes are far more important. Whenever possible the wood dedicated for chopping should be stored in well-ventilated and sunny places over the summer. During that time the water content of fresh wood from the forest drops from around 50 % to under 30 %. After storing the wood during the hotter months, it can be chopped in late summer or fall.

Wood chips can also be naturally dried in loose bulks while in storage but this method often leads to high losses of dry matter. Another way to dry wood chips is with technical ventilation systems, for example with waste heat from biogas plants.

Economic Principles

The table below shows chipping and transport costs as well as the wholesale price separated by the resource classes C1, C2 and C3 in compliance with ÖNORM C 4005 at the example of the Forest Association Styria. Lower costs for the transportation from the forest to the Biomass Trade and Logistic Centre (account based on time) for wood chips made of logs compared to chips out of forest residue is because chipping and filling the containers is quicker and therefore the daily output is higher. Higher prices for the classes C1 and C2 are due to their better characteristics regarding fines, ash content, nitrogen, chlorine and sulfur.

Statement of average costs on the example of Biomass Trade and Logistic Centres (BTC) in Styria

	Logs C1	Whole trees C2	Branches/ crowns C3
Chipping Costs	2 €/lcm	3 €/lcm	4,5 €/lcm
Transport Costs			
Roundwood (forest-BTC) *	8-12 €/scm	80 €/h	80 €/h
Wood chips (forest-BTC) *	2-3 €/lcm	3-5 €/lcm	3-8 €/lcm
Wood chips (BTC-heating plant) **	2-5 €/lcm	2-5 €/lcm	2-5 €/lcm
Wholesale price wood chips for heating plants	88-140 €/t_{odmt}	88-110 €/t_{odmt}	73-90 €/t_{odmt}

* Distances from 15 km to 50 km; ** Distances from 5 km to 200 km
Source: Forest Association Styria

© Leitner/Austrian Chamber of Agriculture

The storage of forest residue over the summer can reduce the water content to less than 30 % and enhances the fuel quality.

Heating with Wood Chips

Wood Chip Boilers

Typically, wood chip boilers are used in agricultural and timber processing factories, businesses, apartment or public buildings as well as micro- and local district heating plants. Modern wood chip-fired furnaces work largely fully-automated and are easy to operate. After filling the storage space, the fuel goes via the feeding system into the combustion chamber as needed. Combustion and ash removal happen automatically. To minimize low load and partial load, the boiler power rating has to be adapted to the intended demand for heating. Almost all malfunctions can be attributed to non-standard wood chips (high water content, inappropriate particle size).

Buffer Tanks

Most wood chip systems are combined with a storage tank. This buffer tank can store excess energy at reduced heat demand (night set-back, between seasons) and release it at demand to the heating system. Advantageous are a higher annual efficiency, reduced fuel consumption, fewer emissions and a higher thermal comfort for the user.

Popular on International Market

With their innovations in bioenergy, Austrian companies occupy leading positions worldwide. Austrian biomass-boiler manufacturer sell about 80 % of their production abroad. For example, two out of three biomass combustion plants that are installed in Germany are made in Austria. For Austrian producers the most important foreign buyers come from Germany, France, Italy and Spain. Promising market places are Great Britain and the US. A strong domestic market with a positive environment for innovation is a requirement for export.

SPECIALISTS ON HEAT FROM BIOMASS: Depending on the adjustments, modern wood chip heating systems can reach up to 90 % efficiency. Chimney sweeps and installers for biomass heating systems are specially trained and help with any questions about wood heating procedures. Info: www.biowaermepartner.at

Local and Remote District Heating

Connection to a local district heating plant is probably the simplest kind of heat supply. Local district heating from biomass is easy to manage, saves space because it does not need additional storage room for fuel, but also saves time and work. By now there are more than 2,100 biomass heating plants all across Austria, that supply public, commercial but also private customers with carbon-neutral heat. A connection to the heat network is government-funded in almost every Austrian federal state.

Wood chip boiler with storage room and agitator discharge (left) and connection to local district heating system if space is insufficient (right).

Examples of Wood Chip Boilers

Boiler	PuroWIN 24	ETA eHACK 60 kW	Firematic 499	RRK 1800-2300
Manufacturer, Location	Windhager Zentralheizung GmbH, Seekirchen/AT	ETA Heiztechnik GmbH, Hofkirchen/Trattnach/AT	Herz Energietechnik GmbH, Pinkafeld/AT	Binder Energietechnik GmbH, Bärnbach/AT
Performance	7.2–24 kW	17.9–59.9 kW	103.9–499 kW	420–2,100 kW
Partial Load Cap.	30–100 %	30–100 %	30–100 %	20–100 %
Energy Consumption/kWh$_{th}$	0.0034 kWh	0.002 kWh	0.002 kWh	project based
Fuel according to EN ISO 17225	Wood chip size P16S, P31S; Class A1, A2	Wood chip size P16S, P31S; Pellets class A1, A2	Wood chip size P16S, P31S; Class A1, A2, B1	Woodchip size up to P300 Class A1, A2, B1, B2
Water Content	≤35 %	≤35 %	≤40 %	≤60 %
Dust Emission as per test bench	1 mg/MJ	6 mg/MJ	8 mg/MJ	<20 mg/m^3*
Efficiency	93.5 %	94.7 %	>92.0 %	>90.0 %
Dimensions (w,d,h)	654 x 1,018 x 1,674 mm	770 x 1,550 x 1,766 mm	1,610 x 3,015 x 2,185 mm	2,580 x 4,200 x 4,960 mm
Special Features	Patented zero-emission-gasification boiler; Exceptionally robust and quiet; Optional wood chip suction feed	Integrated precipitator; Single chamber rotary valve	Touch controller; Automatic burner cleaning and ash removal; Heat exchanger optional	Customer-specific solutions and individual fuel preferences
Contact	www.windhager.com	www.eta.co.at	www.herz-energie.at	www.binder-gmbh.at

* Emission regulations according to § 11 Feuerungsanlagen-Verordnung (combustion plant regulation)
Source: Paid ad; Information provided by manufacturer

Powered by Wood Chips

Combined Heat and Power (CHP)

Wood chips are suitable for cogeneration. In contrast to hydro, wind or solar energy, biomass CHP plants do not depend on the season or weather. Different technologies are applied: In a Stirling engine, for example in micro-CHP systems for households, thermal energy can be directly converted into motion and electricity. For an average or higher performance, steam is produced by wood combustion and then converted into electricity by a turbine or an engine. In the ORC, water is replaced by an organic medium, which allows for power generation at relatively low temperatures.

During the wood gasification, wood is converted into a producer gas that is then used in a gas engine. High efficiency rates of about 30 % are possible; including waste heat, an efficiency of up to 80 % can be reached. The quality requirements for the wood chips are high.

Biomass and the Green Electricity Act

The Austrian Green Electricity Act of 2002 triggered an investment boom for biomass-CHP systems. By the end of 2017, about 130 units are registered in Austria. They cover the demand for electricity of 600,000 households and provide 20 % of the Austrian district heating output. Especially during the colder seasons, they relieve the power grid and provide reliable green power and heat, even at peak times. The plants secure 6,400 jobs, primarily in disadvantaged areas.

Currently, although technically fully functional, almost every wood-fired power plant is being confronted by the expiration of the feed-in tariffs. For the maintenance and further development of these plants, a long-lasting green electricity support scheme is indispensable.

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Wood gasification plants achieve an efficiency of up to more than 80 %.

© Jedinger/ABA

The operators of the about 130 domestic wood-fired power plants in Austria supply reliable power and heat even in winter.

Wood power-technologies	Electricity Electric Power Output	Heat Thermal Output
Combustion Power Plant		
With Stirling Engine	0.5–10 kW	50–100 kW
With ORC Turbine	300 kW–2.5 MW	2–15 MW
With Steam Turbine	5–50 MW	20–200 MW
Gasification Power Plant		
With Gas Engine	20 kW–5 MW	80 kW–20 MW

Projects Power from Wood Chips

Project	Nahwärmeversorgung Gemeinde Weng	Heizwerk Fritzer, Sirnitz	CraftWERK Innsbruck CW 1000-300
Manufacturer, Location	HARGASSNER GmbH, Weng/AT	GLOCK Ökoenergie GmbH, Griffen/AT	SYNCRAFT® GmbH, Schwaz/AT
Size of Plant/ Module	20 kW electrical, 60 kW thermal	3 x 55 kW electrical, 3 x 120 kW thermal	261 kW electrical, 402 kW_{th} high temperature; 199 kW_{th} low temperature
Technology	CHP fixed-bed downdraft gasifier	Fixed-bed downdraft gasifier	Staged floating-fixed-bed gasifier
Fuel EN ISO 17225	Wood chips P16-P31S Class A1	Wood chips P16-P45	Wood chips P16-P45, including fine fraction and bark
Water Content	<17 %	<23 %	<10 %
Chips Consumption	20 kg/h	50 kg/h per unit	215 kg/h
Special Feature	Compact, modular system; Level of efficiency more than 90 %	Plug and play unit on a platform; No screening necessary	Utilizes low quality wood chips; Biochar as by-product; Electric efficiency 30 %
Number of Units operating in AT	1	34	4
Contact	www.hargassner.at	www.glock-oeko.at	www.syncraft.at

Source: Paid ad; Iwnformation provided by manufacturer

Further Information

Österreichischer Biomasse-Verband — www.biomasseverband.at
Arbeitsgemeinschaft — abina.biomasseverband.at
Biomassehof Steiermark — www.biomassehof-stmk.at
Landwirtschaftskammer Steiermark — www.lk-stmk.at
Strom aus Biomasse wächst einfach wieder nach. — www.stromausbiomasse.at
Landwirtschaftskammer Österreich — www.lko.at

Overview of Wood Chip Combustion Plants

	Boilers						Cogeneration (CHP)					
	< 20 kW	20 to < 50 kW	50 to < 100 kW	100 to < 500 kW	500 kW to < 2 MW	≥ 2MW	2 to < 20 kW_{el}	20 to < 50 kW_{el}	50 to < 150 kW_{el}	150 to < 500 kW_{el}	500 kW_{el} to < 2 MW_{el}	≥ 2 MW_{el}
Binder Energietechnik GmbH	x	x	x	x	x	x			O, S	O, S	S	
ETA Heiztechnik GmbH	x	x	x	x	x	x						
Fröling Heizkessel- und Behälterbau GmbH	x	x	x	x	x	x		G	G			
Glock Ökoenergie GmbH							G	G	G			
Guntamatic Heiztechnik GmbH	x	x	x	x	x	x						
Hargassner GmbH	x	x	x	x	x	x	G	G				
Herz Energietechnik GmbH	x	x	x	x	x	x			O, S	O, S	S	
HZA GmbH (Heizomat)	x	x	x	x	x							
KWB GmbH	x	x	x	x	x	x						
Polytechnik Luft- und Feuerungstechnik GmbH				x	x	x				O, S	O, S	O, S
Solarfocus GmbH		x	x									
Syncraft® GmbH										G	G	
Viessmann Holzfeuerungsanlagen GmbH				x	x	x				O, S	O, S	
Windhager Zentralheizung GmbH	x	x	x	x								

Abbreviations for Wood Electrification Systems: G = Wood gas CHP O = ORC S = Steam power cycle
Paid ad; Information provided by manufacturer, table makes no claim to completeness.

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