Biomass heating in Upper Austria
Green energy, green jobs

LAND OBERÖSTERREICH

OEKOENERGIE CLUSTER

O.Ö. ENERGIESPARVERBAND

This publication uses European and US units.

"Tons" in this publication are metric tons, for conversion to US tons, multiply by the factor 1.1

1 kW = 3,412.14 BTU/h
1 kWh = 3,412.14 BTU

O.O. = Oberösterreich (O.Ö.), the federal state of Upper Austria

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Biomass heating in Upper Austria

Biomass is a sustainable and carbon-neutral fuel that is well-suited for heating homes, businesses and public buildings. There has been significant innovation in the field of biomass technology during the past two decades, and modern systems are fully automatic with ultra-low emissions. The use of biomass for heating ensures energy independence, supports the forest products economy and is environmentally friendly.

Modern biomass heating applications include:

- automatic wood pellet heating systems, mostly in single-family homes with bulk delivery
- automatic wood chip heating systems for commercial and public buildings
- low-emissions firewood boilers, mainly in rural areas
- district heating systems supplied by biomass thermal plants
- large-scale combined heat and power plants supplied by biomass

The state of Upper Austria has a leading position in biomass heating: not only are more than 25% of all modern biomass boilers installed in the European Union manufactured in the state, but it has one of the highest densities of small-scale automatic heating systems in the world. Stringent emission standards and cutting-edge technologies have contributed to rapid market development. Biomass energy has emerged as an important economic driver for the state, and the biomass heating industry employs more than 4,500 people.

Upper Austria – key facts

- **Country:** Austria
- **Population:** 1.4 million (similar to New Hampshire)
- **Surface area:** 11,980 km² | 4,633 mi² (similar to Connecticut)
- **Capital city:** Linz (population: 190,000), situated on the banks of the Danube

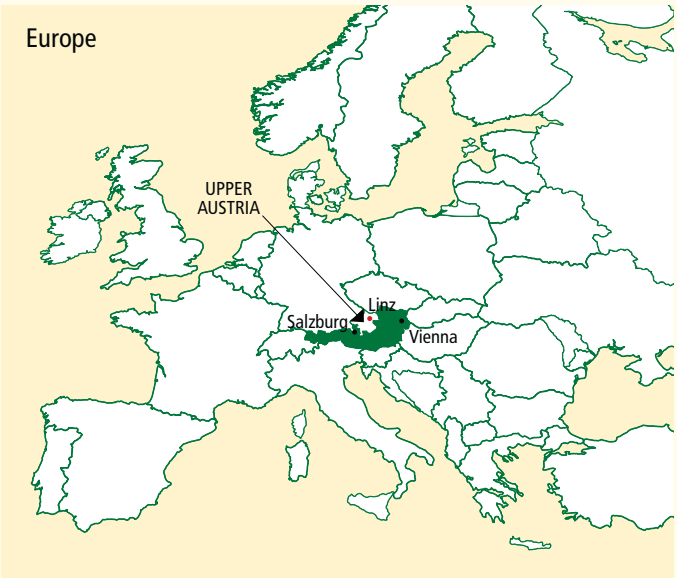
The region of Upper Austria

Upper Austria is one of Austria's nine federal states and is located in the northern part of the country, bordering Germany and the Czech Republic. The region is highly industrialized and accounts for more than 25% of national exports. Upper Austria's primary industrial sectors include machinery, automotive industries, metal production, wood processing, information/ communication technologies, and renewable energy.

Upper Austria has enjoyed steady economic prosperity, and has had the lowest unemployment rate of all Austrian states during the past 10 years (at consistently below 5%). Upper Austria's Gross Domestic Product (GDP) is 45 billion Euro / 56 billion US$ which ranks it second in Austria behind the state of Vienna.

Climate

The climate is temperate continental (mean temperatures: 13.9°C | 57°F daily high, 5.9°C | 42.6°F daily low), and winters are comparable to those in the northeastern United States.



Renewable energy in Upper Austria - an economic engine

Since the mid-90s, the government of Upper Austria has prioritized energy efficiency and renewable energy. Renewable energy currently supplies more than 33% of the total primary energy demand in the state, of which 15% comes from hydro power, 15% from wood biomass and about 4% from solar and other renewable energy sources.

The impressive share of renewables in the energy mix was achieved through comprehensive regional energy action plans that laid the foundation for more than a decade of steady progress. Building upon the success of its policies to date, Upper Austria has set a target to meet 100% of its electricity and space heat demand with renewable energy sources by 2030.

The O.O. Energiesparverband, the state agency for energy efficiency and renewable energy, supports the state government in developing and implementing these policies. The O.O. Energiesparverband also manages the "Okoenergie-Cluster", the network of renewable energy and energy efficiency companies in the state. There are currently 150 companies and institutions in the network, which employ more than 6,200 people and generate annual revenues of more than 1.7 billion Euro | 2 billion US$ (~ 3.5% of state GDP).

Although the network members represent the full spectrum of sustainable energy products and services, Upper Austrian companies are leaders in the fields of automatic biomass heating, solar thermal energy, and high-efficiency building technologies. In recent years, companies in these fields have experienced strong growth and have added more than 500 new in-state jobs.

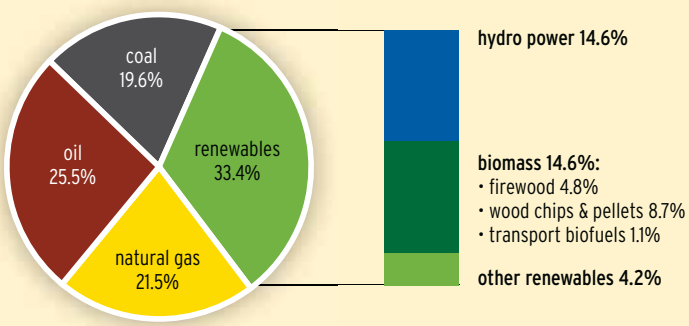
Renewable energy sources in Upper Austria

- **Share of renewable energy sources:** 33.4% of total primary energy demand
- **Share of renewable heating:** 45.6% of total heating demand
- **Share of renewable electricity:** 78.4%
- **Annual investment in new installations:** 210 million Euro | 263 million US$ (of which 110 million Euro | 140 million US$ is in biomass heating)
- **Avoided CO_2 emissions:** 7.4 million tons per year
- **Avoided imports of fossil fuels:** 1 billion Euro | 1.25 billion US$ per year

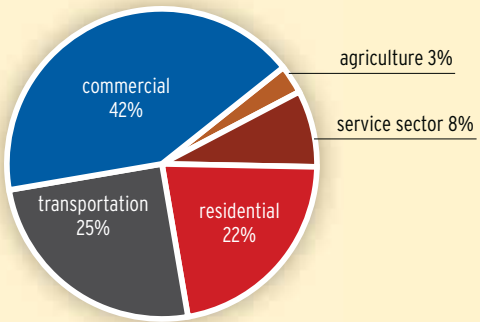
data: 2009

Energy production and consumption in Upper Austria

Energy Sources



Energy Consumption per Sector



Biomass market development

Cultivating the biomass heating market

Biomass heating has a long tradition in Upper Austria, but the introduction of innovative technologies and business models in recent years has created a booming market. Several important drivers have contributed to the development of the modern biomass heating industry in Upper Austria.

The **first driver** was **forward-thinking farmers and forest owners** who were looking for new sources of revenue and markets for forestry residues in the early 1980s. Only about 50% of the material harvested from trees can be sold to sawmills and other commercial users. Approximately 10-20% (e.g. needles and small branches) needs to be left in forests for environmental reasons. This still leaves a significant unused resource for which a market was needed.

The business model that emerged was **cooperatives of farmers and forest owners** that develop, build and operate small-scale biomass district energy systems. The cooperatives generate and supply heat to local government buildings, schools, businesses and housing. Today, 300 such biomass district heating networks are in operation.

A **second driver** was **creative entrepreneurs** in Upper Austria - some of them with farming and forestry backgrounds - who sought to minimize the manual labor required to prepare fuels and operate heating systems. The vision was to compete with the cost and convenience of oil heating, which dominated the heating market in the 1980s. These entrepreneurs designed fully-automated, high-efficiency, and user-friendly biomass systems and subsequently pioneered a new form of heating. An important milestone was the introduction of automatic wood pellet heating systems in 1996. Consumers responded very positively to the new technology, which gave the market a strong boost. Today, some of these innovative Upper Austrian boiler companies are global market leaders.

A **third driver** has been **state policy,** which has provided stable support to the market for more than 25 years. The government of Upper Austria has been able to actively support the biomass heating market because states have jurisdiction over heating according to the Austrian constitution, whereas the federal government has jurisdiction over electricity. Policy support for biomass heating in Upper Austria is targeted to specific market segments and consists of financial incentives, legislation and promotional activities.

A key incentive is **investment grants**, which are available both for purchasing biomass boilers and for connecting buildings to biomass district heating plants. Agricultural programs have also supported investments in district thermal energy plants and in heating grids. **Strict emissions and efficiency standards** - which have been progressively tightened by state government – have supported the development of cutting-edge products. Awareness campaigns and independent technical advice, offered by the O.O. Energiesparverband, have also been key in boosting consumer confidence in new technologies.

Biomass heating today

Currently, advanced biomass technologies provide about **15% of the total primary energy supply in Upper Austria** and 31% of thermal energy. Renewables supply approximately 33% of total primary energy in Upper Austria and 45% of thermal energy.

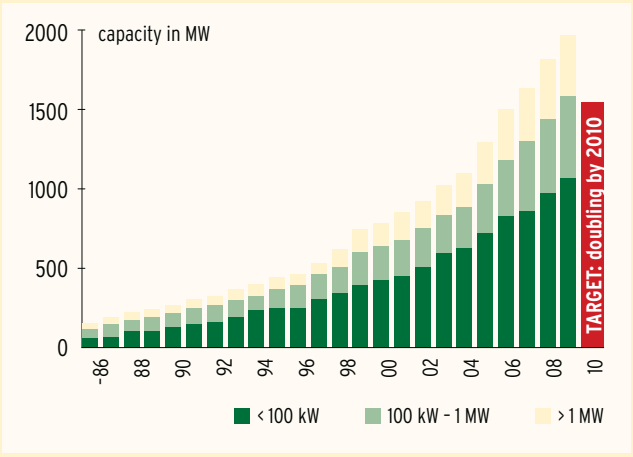
There are **40,000 automatic biomass boilers in operation** in residential, commercial, and public sector buildings. Of these, half are fuelled with pellets, and half with wood chips. They have a total installed capacity of 1,560 MW and produce 2,500,000 MWh each year. This equates to an annual fuel consumption of 850,000 tons of solid biomass (including saw mill residues), and an emission reduction of 750,000 tons of CO_2 per year. Additionally, about 500,000 tons of biomass are used in large biomass CHP plants (for electricity and heat production).

In 2009, 60% of the newly installed automatic biomass boiler capacity was below 100 kW, 30% was between 100 kW - 1 MW and 10% was larger than 1 MW. In total, 170 MW were installed.

The state government has adopted a target to reach **100% space heating and electricity** from **renewable energy by 2030**. In-state biomass will play a key role in achieving this target, in combination with significantly strengthened energy efficiency programs.

Biomass heating in Upper Austria

Market development



Typical biomass heating applications in Upper Austria

					
technology	automatic pellet heating	modern firewood boilers	automatic wood chip boilers	district heating with wood chip boilers	combined biomass heat and power stations
	pellets	firewood	wood chips	wood chips	whole trees
fuel					
typical installed capacity	5-15 kW	20-40 kW	50-150 kW	100 kW-3MW	> 1 MW_{el}, > 10 MW_{th}
users, customers	single-family homes	farm buildings	public and commercial buildings	domestic, public and commercial buildings	domestic, public and commercial buildings
fuel supply	bulk delivery by a large number of fuel distributors	usually harvested from own forest	often by local farmers-forest owners	partly by the cooperative members, partly from sawmills	farmers & sawmills & other channels

Source: Christiane Egger

Forest resources, management and ownership

Austria is one of the most experienced countries in the world in terms of forest management. This is because of the importance of forests to nation's economy, particularly the tourism industry and the country's export-oriented timber industry.

The management, protection and sustainable development of Austrian forests is based on a well established legal and institutional framework. For more than 100 years, **Austrian forestry practices have emphasized sustainability.** The underlying principle is that forestry activity must respect biodiversity and ensure a stable and functioning ecosystem. The national forestry laws strictly regulate forest management with policies such as mandated reforestation and strong clear-cutting restrictions. To maintain the nutrient cycle, especially in sensitive areas, needles and branches (especially those thinner than 4 cm | 1.6 inches) must remain in the forests.

Comprehensive forest practitioner training has a long tradition in Austria. Specialized sustainable forestry schools provide up-to-date know-how and skills. An important factor in sustainable forestry is family-ownership: not only is forestry know-how passed on within families but there is also the strong motivation to keep forests intact and productive for future generations.

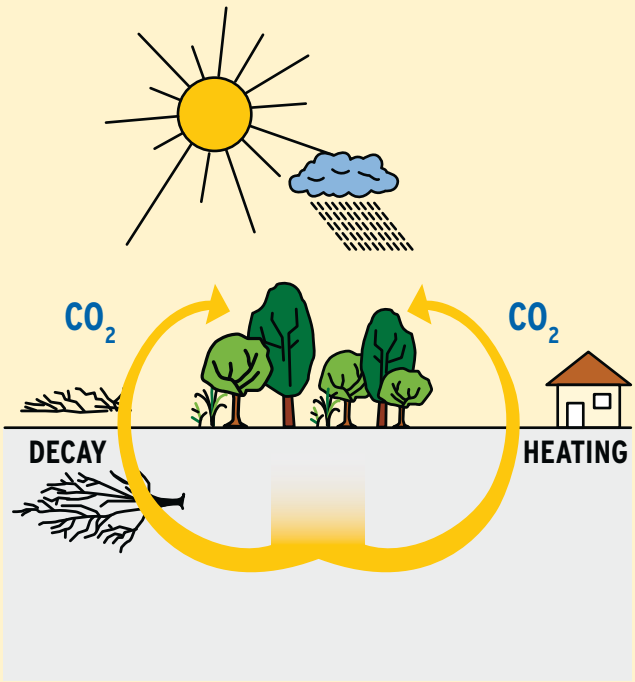
By European standards, Upper Austria is rich in wood: 41% of the land area is forested (in total, 494,000 hectares | 1,220,700 acres). Of this, 83% is utilized for forestry purposes, 10% is unutilized, and 6% fulfills a special function as "protected forests" in mountainous areas. The total area covered by forests has increased during the past several years by a few percentage points. Less than 60% of the forest growth has been harvested and thus there is a large potential for increased wood use.

Based on its climate, deciduous forests should dominate Upper Austria. However, past forestry management strategies, have led to deciduous trees accounting for only 25% of the harvested trees, whereas spruce accounts for 64% of the total and other conifers account for 11%. The aim for the coming decades is to return to more mixed woodlands, which are also better able to adapt to climate change.

Half of the state's forests are owned by small-scale owners (less than 5 hectares | 12 acres), about 20% are owned by larger forest owners, and about 30% are owned by the "Austrian National Forests". The volume of stock is growing: of the 11 million solid m^3 | 388 million solid ft^3 of new growth in 2008, about 6 million solid m^3 | 212 million solid ft^3 were harvested. An important segment of the forest owners are farmers who own parcels of forest in addition to their farmland.

Biomass heating: a "carbon neutral" fuel

As a tree grows, it absorbs CO_2 from the air and stores it during its lifetime. This CO_2 is released in the same quantity at the end of the lifetime, independent of whether the timber is burned or the tree decomposes naturally in the forest.



The use of biomass for energy production is therefore part of a closed CO_2 cycle with no additional CO_2 emissions. This has been recognized by the energy and environmental policies of the European Union. Sustainable forestry management practices ensure that the forested areas (with their respective carbon storage function) are not decreased.

Percentage of surface area covered by forests

Upper Austria	41%
Germany	30%
USA	32%
British Columbia	63%
Sweden	67%
Maine	90%

Biomass heating technologies

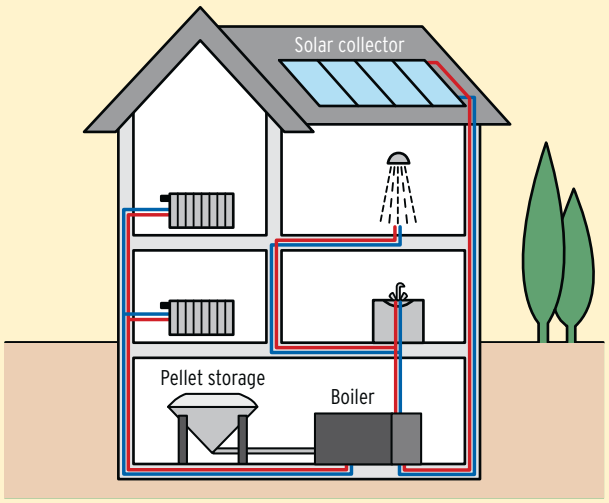
This chapter focuses on small to mid-scale biomass heating systems, ranging from an installed capacity of a few kW to a few hundred kW. These systems are the most common systems installed in Upper Austria.

Biomass heating systems in Upper Austria typically produce hot water for central hydronic heating systems. Such a system usually consists of the following components:

- biomass boiler (often in the basement, but can also be placed in a container outside of the building)
- fuel storage
- chimney (stainless or ceramic)
- hydronic distribution system for the hot water produced by the boiler
- hydronic heat discharge systems (radiators or floor/ wall heating)
- a central control device with an outdoor temperature sensor

In biomass heating systems, the fuel is transported from storage to the combustion chamber, where it is ignited and combusted. To improve the heat transfer and supply sufficient air for optimal combustion, a fan is installed. The flue gas from the combustion process passes through a heat exchanger and transfers its energy to the water. A pump circulates the heated water through the hydronic heat distribution system. The boiler is highly insulated and covered with a metal skin in order to reduce heat losses to the boiler room.

Central heating system



Features of modern biomass heating systems include:

- convenient, fully automatic operation (automatic ignition and shutdown, fuel supply, ash removal, heat exchanger cleaning)
- high fuel efficiency (80-90%)
- ultra-low emissions
- very high operation and fire safety standards
- low fuel costs
- the potential to combine with solar thermal systems, using an accumulator tank (storage tank)

Modern biomass systems utilize a **two-stage combustion process** in order to combust fuel as completely as possible, thereby achieving high efficiencies and low emissions. In the primary combustion zone which is located on the grate, drying and solid combustion take place. In the secondary combustion zone, the volatile gases are burned with air that is introduced in a controlled manner. Other advanced features include an electronic combustion control, a controlled fuel feed into the combustion chamber, a sophisticated burner with electronic ignition, and automatic ash removal and combustion chamber cleaning.

The complete combustion of the fuel in an optimized, two-stage combustion design results in very low emissions of particulate matter because of the absence of unburned hydrocarbons in the flue gas. The particulate matter (dust) from the optimized system are primarily inorganic, while emissions from lower-technology stoves and boilers are mostly unburned organics.

There are three main types of burners, that vary according to the orientation of their fuel feeds:

- **underfeed burners** (underfeed stoker or underfeed retort burners): the fuel is fed into the bottom of the combustion chamber or combustion retort. These burners are best suited for fuels with low ash content (wood pellets, wood chips).

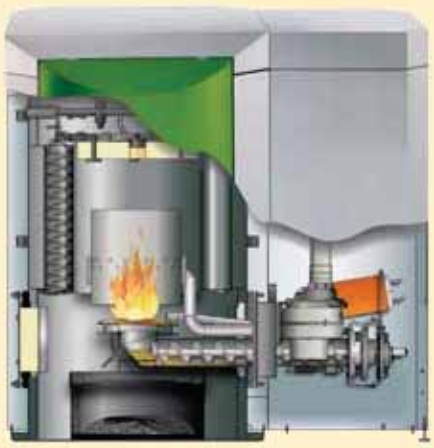
- **horizontal feed burners:** the combustion chamber is either fitted with a grate or a burner plate. The fuel is introduced horizontally into the combustion chamber. During combustion, the fuel is moved or pushed horizontally from the feeding zone to the burner plate or the grate. Horizontal feed burners can burn wood chips and pellets.

- **top feed burners:** developed for pellet combustion in small-scale units. The pellets fall through a shaft onto a fire bed consisting of either a grate or a retort. The separation of the feeding system and the fire bed ensures the effective protection against burn-back into the fuel storage. The ash is removed manually or mechanically by a dumping grate. This feeding system allows very accurate feeding of pellets according to the current heat demands.

Wood chip boiler

Source: Guntamatic

Wood pellet boiler



Source: Ökofen

Firewood boiler

Source: Fröling

Accumulator tank (heat storage)

In many cases, biomass heating systems are combined with accumulator tanks. They are recommended for wood chip and wood pellet boilers (especially if also used for hot water heating in summer) and required for modern firewood boilers. They allow the boiler to operate at nominal load and to avoid frequent ignition and shut-down.

An accumulator tank is a highly insulated steel tank. Hot water from the boiler is introduced into the accumulator tank at the top. The design of the inlet ensures that turbulence is low and that the temperature stratification is not disturbed. The sizing of the accumulator tank is influenced by factors such as the nominal capacity and size of the boiler, the type of fuel used, and the space available.

Accumulator tank

Fröling

Multi-boiler cascade system (staged boiler system)

As mentioned before, boilers work most efficiently at nominal power. However, due to seasonal temperature differences, heat demand differs throughout the year: it is lowest in summer when only domestic hot water is required, and highest in winter when space heating is required. Even though modern biomass boilers can significantly modulate their operation load (from 100 to 30%) and accumulator tanks can compensate for some seasonal differences, it is often not cost-effective to size the boiler for peak demand. This is especially true for larger buildings.

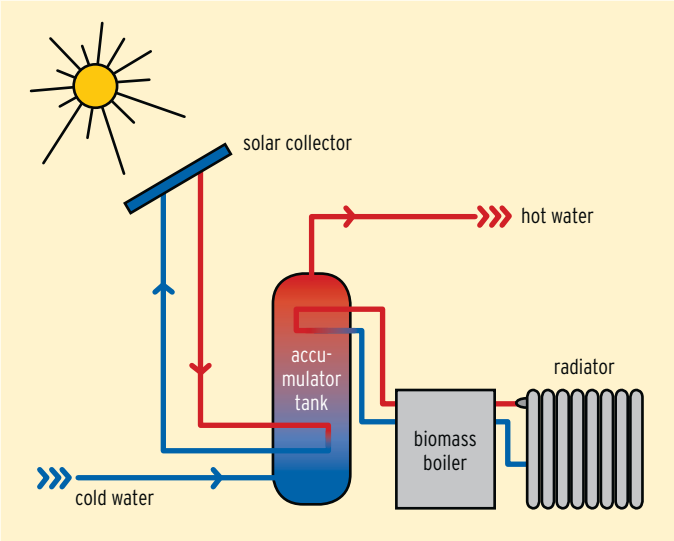
In such cases, it is better to install cascade systems that consist of two or more biomass boilers. System operation is simple: When heating or domestic hot water is required, one boiler will start up and operate at its most efficient level. When the system requires additional capacity, additional boilers are brought online at maximum efficiency until all boilers in the cascade system are operating. That ensures that the system always operates in its most efficient mode.

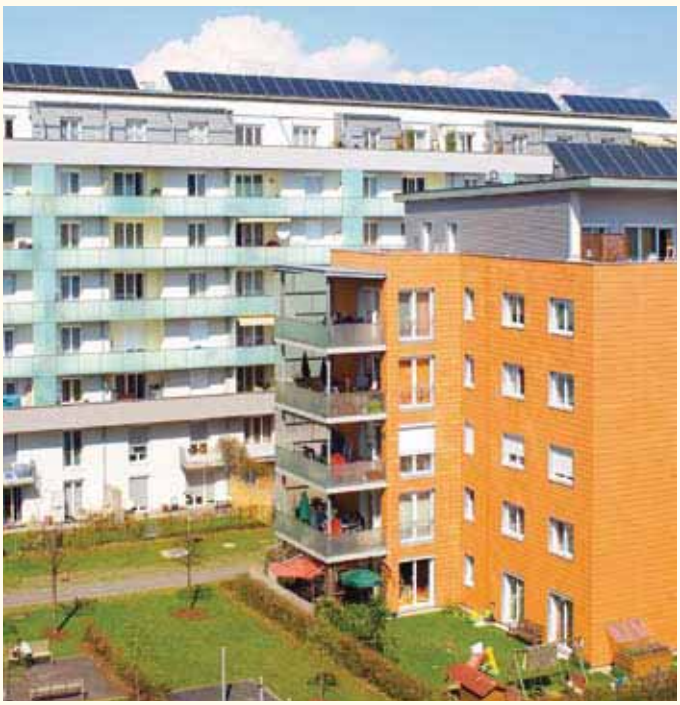
An additional advantage is that cascade systems provide increased operational safety and can accommodate building extensions more cost-effectively. Cascade systems can also include existing fossil-fuel boilers which can be used for back-up or peak demand.

Integration of solar thermal systems

Biomass boilers in combination with solar thermal systems for domestic hot water production in the warmer months are an optimal heating solution and very popular with building owners in Upper Austria.

A solar collector system allows the biomass boiler to be shut down in summer months, which saves fuel and reduces the need for part-load operation. The summer shut-down of the boiler also significantly increases the lifetime of the heating system and thereby increases its profitability.





Pellet heating systems

Pellet heating systems are typically sited in special boiler rooms in the basement or in dedicated containers outside the house. Several tons of loose pellets are delivered in bulk by a pressurized tank truck and transferred into storage through a filler pipe. A second pipe is used to extract air from the storage to avoid overpressure during the filling process. The pellet storage should be located not more than 30 meters | 98 feet from where the delivery truck will be operating (e.g. the driveway or road). The walls and ceilings of the store room and boiler room must be fire-proof in compliance with state regulations (see page 17). The pellet storage must also be dry because water will cause the pellets to break up. For further information on pellet logistics, see page 19.

Fuel storage and fuel feeding systems

The following systems are used in Upper Austria:

- storage rooms next/close to the boiler (inside the building)
- textile or steel tanks (inside or outside the building)
- storage integrated into dedicated heating system containers (outside the building)
- underground tanks (outside the building)

There are two types of fully automatic fuel delivery systems that transfer pellets from storage into the boiler:

- auger screw systems: suitable if boiler and storage rooms/tanks are located next to each other. This can be the most cost-effective solution.
- vacuum suction systems: a flexible solution if the storage and boiler room are, for example, separated by a corridor or by another room (max. distance 20 meters | 66 feet)

Vacuum suction system

Auger screw system

Source: Ökofen

Overview storage systems

	Type of storage	Placement	Requirements	Recommended storage sizes	Delivery considerations
Storage room 	Most frequent storage system: a dry room, usually in the basement	**Indoor** Storage in basement room next to or close to the boiler room, especially suitable for new construction or when converting from oil heating	**Walls:** at least 12 cm bricks or 10 cm concrete **Fire safety:** Walls, ceiling and floor must be fire-resistant, the floor has to be inflammable **Moisture protection:** the room has to be dry all year round	0,9 m³ | 32 ft³ storage room/kW heating load (including head space)	Two wall breakthroughs with 125 - 150 mm | 5-6 inches diameter are necessary (for delivering pellets and for extracting air and dust post-delivery)
Textile or steel tank 	Tank made from antistatic materials or galvanized steel, which are dust and moisture-proof, placed on a wooden or metal frame	**Indoor or outdoor** Can be placed in a room in the basement or outside the building. Humid walls are not a problem as long as the textile/steel tank does not directly touch the walls	**Walls:** no special construction requirements **Fire safety:** Up to 15 m³ | 530 ft³ of pellets can be stored in tanks located inside the boiler room (min. distance 1 m | 3 ft between tank & boiler). If the tank is placed in a storage room, see above. **Moisture protection:** not needed	300-400 kg | 660-880 lb tank capacity/kW heating load, available in square or rectangular design in sizes from 1-16 m³ | 35-565 ft³	Fuel can be delivered directly into the tank or by injection nozzles. Extracting air from textile tanks is not necessary as they are air-permeable
Heating container 	Pre-assembled container which includes boiler and storage system	**Outdoor** Used if no suitable solution for the boiler and the storage is available inside the building	Installation requires groundwork, connection pipes (flow and return), electricity connections and rainwater drain	Varies by system configuration	In general, easily accessible
Underground tank 	Underground tank outside of the building	**Outdoor** Used if no suitable solution for the storage is available inside the building	Pipes to and from the tank have to be airtight and waterproof	0,6 m³ | 21 ft³ tank capacity/kW heating load	In general, easily accessible

Wood chip heating systems

Wood chip heating systems are installed primarily in non-residential buildings, but are also popular for home heating in rural areas. In Upper Austria, wood chips are also used in biomass district heating systems (further details see page 31).

Wood chip heating systems are often sited in basements, in free-standing heating containers (that combine boiler and storage) or - for larger systems - in their own separate buildings. Fuel is typically delivered by tractors or trucks. For further information on wood chip logistics, see page 21.

Fuel storage and fuel feeding systems

Wood chips can be stored inside the building in a room close to the boiler room or in storage facilities outside the building (e.g. silos, barns). The wood chips are then transported to the boiler, often using an auger screw feed system. Storage containers are typically filled from above.

The sizing of the storage depends on the specific situation (heating load, fuel delivery intervals, available space, etc.). In case of existing storage facilities, it is often cheaper to adapt the delivery intervals to the available storage volume. For new storage facilities, storage should be sized to accept 1.3 times the volume of a delivered truckload.

Examples: Sizing of a wood chip storage

	Example 1	Example 2
boiler heating load	75 kW	300 kW
annual energy demand	187,500 kWh	750,000 kWh
annual fuel demand	203 m^3 | 7,270 ft^3	811 m^3 | 28,640 ft^3
Example for storage facility dimensions		
weekly filling	3 x 3 x 2 meters | 10 x 10 x 6.6 feet	5 x 5 x 2.75 meters | 16 x 16 x 9 feet
annual filling	6 x 6 x 6 meters | 20 x 20 x 20 feet	11 x 15 x 5 meters | 36 x 49 x 16 feet

For: 2,000 h full load, 85% boiler efficiency

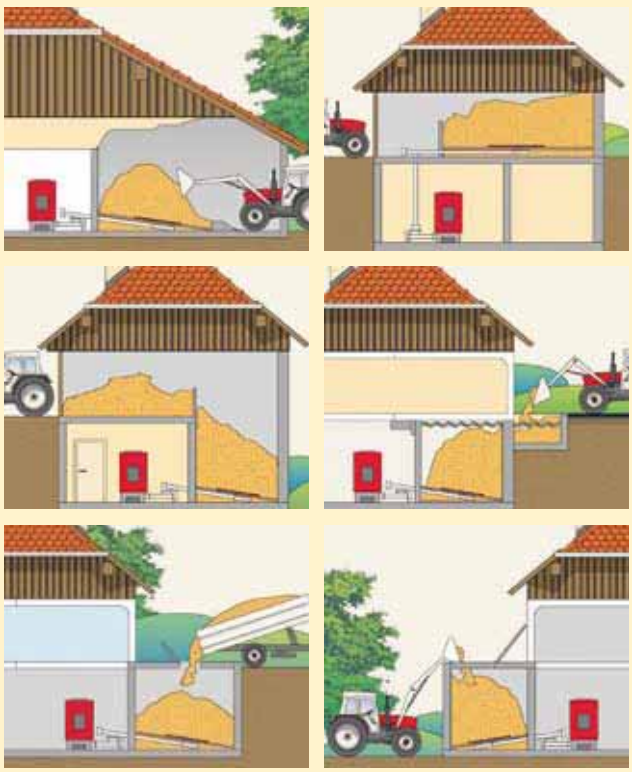
Modern firewood heating systems

Firewood heating systems are still very popular in the countryside in Upper Austria. There have been significant technological advances in firewood heating systems during the past several years, including:

- two-stage combustion with automatic ignition and fan
- improved control systems
- reduced heat losses

User convenience can be enhanced by large fuel hoppers and an appropriately sized accumulator tank.

Examples for wood chip fuel storage solutions



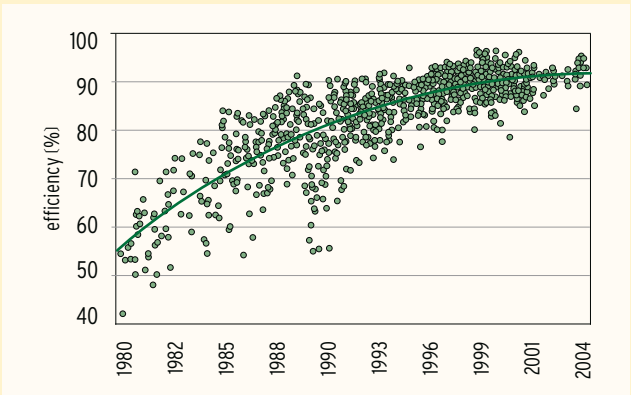
O.O. Energiesparverband

Efficiency and emissions

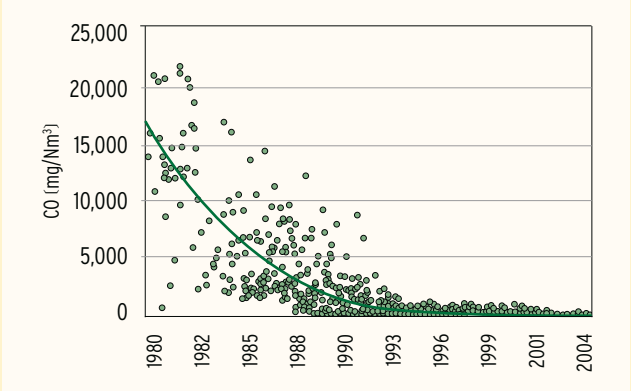
The state has progressively tightened emission standards, which has triggered the development of ultra-low emission boilers. The following tables show the improvements in biomass boiler technologies using firewood, wood chips and wood pellets. These data derive from more than 1,000 boiler certification tests done by the Austrian Federal Institute of Agricultural Engineering, the FJ-BLT. The FJ-BLT is one of the leading boiler test and certification institutes in Europe.

Over the last 30 years, the average efficiencies of biomass boilers have increased from approximately 55% to more than 90% (based on the net calorific value) and the average carbon monoxide emissions have decreased from 15,000 mg/m³ to less than 50 mg/m³ (at 13% O_2).

Efficiency factor of tested biomass boilers



Carbon monoxide emissions of tested biomass boilers



FJ-BLT Wieselburg; Bioenergy 2020+

Legal requirements for small scale biomass heating systems in Upper Austria

Biomass boilers have to meet emissions and efficiency standards in order to be sold commercially. Boilers have to pass a certification test and have to carry labels displaying boiler data.

State regulation requires all heating systems to be checked annually for safety. Additionally, systems larger than 15 kW are also required to be checked for emissions and flue gas losses every third year (larger than 50 kW every second year).
In addition, older installations larger than 20 kW need to be comprehensively inspected after they have been in operation for more than 15 years.

The tables below contain proposed standards for automatic biomass heating systems up to 400 kW in size.

Flue gas losses for automatic biomass heating systems cannot exceed 19%.

Emission limits [mg/MJ]*

	wood pellet stoves	wood pellet central heating
CO	500*	250*
NO_x	150/100**	150/100**
VOC* **	30	30/20**
Dust	50/25**	40/20**

* the limit can be exceeded up to 50% in part load operation (30% of the heat capacity)
** emission limits foreseen from 1 January 2015 onwards
*** volatile organic carbon

Minimum efficiency levels (COP)

installed capacity	efficiency (%)
≤ 10 kW	80
> 10 - 200 kW	80 - 90
> 200 kW	90

Fire safety

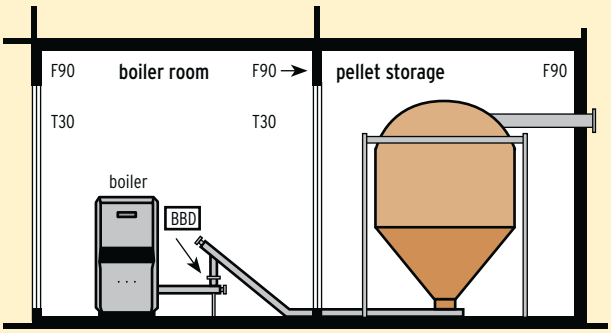
Fire safety is a key requirement for any heating system. For biomass boilers, there are state safety requirements that apply to both the building (boiler room and rooms in which fuel storage systems are located) and the boiler technology. These requirements are stricter for larger systems.

All boilers must have safety features to prevent burn-back. The most common are tested fire dampers (rotary valves).

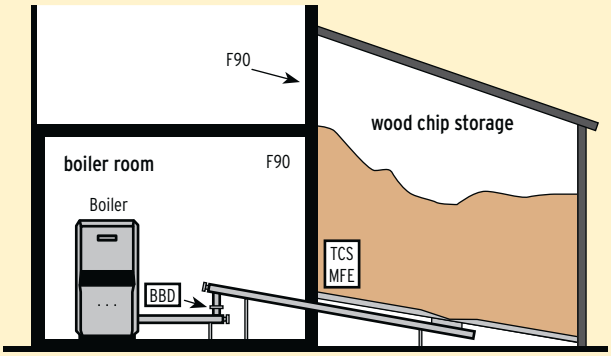
The walls, ceilings and floors of the storage room and the boiler room must be fire-resistant (fire resistance class F90 - fire resistance rating for 90 minutes). This level can be attained, for example, with a 15 cm | 6 inch brick wall or a 10 cm | 4 inch concrete wall. The door to the storage room must be a fire-stop door (T30 - fire resistance rating for 30 minutes).

Fire safety requirements

Example: Fire safety requirements for an automatic pellet heating system (up to 150 kW), with a textile storage system and a storage capacity > 15 m³ | 530 ft³



Example: Fire safety requirements for an automatic wood chip heating system (up to 400 kW), with an attached storage (fuel storage capacity 50 - 200 m³ | 1,766 – 7,063 ft³)



F90: fire resistance class 90
T30: fire-stop door
BBD: burn-back safety device
TCS: temperature control device in the fuel storage
MFE: manually-operated fire extinguisher

Biomass fuels and supply chains

This chapter describes the main biomass heating fuels used in Upper Austria: wood pellets, wood chips and firewood. Early standardization was crucial for the positive development of biomass fuels, just as it was for the development of the heating technologies described above.

Non-wood biomass, such as grass and agricultural waste, does not play a significant role in the heating market, despite its wide availability. This is because it is technically challenging to achieve clean combustion with non-wood biomass in small and mid-scale installations. Despite extensive research in Europe, there are only a few commercially available boilers that meet the stringent emissions standards in Austria.

Wood pellets

Wood pellets are a clean and CO_2-neutral fuel that is produced primarily from sawdust and wood shavings. The pellets are compressed under high pressure using no glue or other artificial additives. They are cylindrical in shape and usually 6-10 mm | 0.2-0.4 inches in diameter and 10-30 mm | 0.4-1.2 inches in length.

Pellets are a highly standardized and energy-dense fuel that has key advantages over other fuel types: pellets can be cost-effectively transported, they can be readily utilized in automatic boiler systems, and they have an ultra-low emissions profile. These advantages have driven rapid market growth for pellets in the heating sector in Europe and beyond.

In Upper Austria, automatic pellet heating systems have become a standard solution for home heating with about 20,000 systems installed since 1996.

Typical pellet home heating solution

- fully automatic central heating systems
- installed capacity: 5-15 kW
- usually placed in the basement
- hydronic (heat distribution) system
- bulk delivery of wood pellets by a pressurized truck (once per year)
- annual pellet demand: 3-6 tons
- typical pellet storage capacity: 3-6 tons (at minimum equal to the annual pellet demand)
- automatic pellet feed from storage to the boiler
- ash removal: 2-4 times/year

Typical costs for a pellet home heating system

- investment costs: 15,000 - 20,000 Euro | 18,750 – 25,000 US$ (including storage and feeding systems)
- fuel costs (bulk delivery of 6 tons): 200 Euro | 250 US$ per ton (summer 2010), 35 Euro | 44 US$ delivery fee
- operations and maintenance costs (including electricity, chimney sweep and annual servicing): 350 - 500 Euro | 440 - 625 US$ per year

Pellet standardization

The early standardization of wood pellets was a key factor for their success in the heating market. Austria was the first country to adopt a pellet standard which helped market development tremendously. From the outset, only pellets of a clearly defined quality were commercially available, allowing boiler manufacturers to develop very low-emission appliances. Also standards for wood pellet logistics and storage were set. Other countries in Europe (such as Germany) followed Austria's lead with their own standardization schemes, and European-wide standards are being adopted.

The technical fuel requirements for pellets according to ÖNORM EN 14961-2

Quality characteristics	Requirements
Diameter	6–8 mm | 0.24–0.31 inch
Length	3.15–40 mm | 0.12–1.57 inch
Calorific value	> 16.5 MJ/kg | 72 MJ/lb
Ash content	< 0,5%
Water content	< 10%
Bulk density	> 600 kg/m³ | 37 lb/ft³
Ash melting point	> 1,200° C | 2,200° F
Fines	< 3.15 mm: 1%
No chemical adhesive	

For comparison	
2 kg pellets	~ 1 liter oil | 0.3 gallon oil
1 m³ pellets	~ 320 liter oil | 84.5 gallon oil

The pellet supply chain

In Austria, wood pellets are predominantly produced by the sawmill industry. Domestic production has historically exceeded domestic demand. In 2009, domestic consumption of wood pellets in Austria was at about 515,000 tons, about 285,000 tons were exported and 160,000 tons imported. Wood pellets are produced at 28 production plants. Recently five further production facilities were opened, increasing annual production capacity to 1.1 million tons.

Wood pellets are produced in a wood pellet press or pellet machine. Particle size and moisture content are two crucial aspects that must be controlled before the raw material can enter the pellet mill. Pellets are produced by compressing wood material (in Austria, mostly saw dust) which has first passed through a hammer mill to provide a uniform dough-like mass. This mass is fed into a press (pelletizer) where it is squeezed through a die with holes of the required size. The high pressure of the press causes the temperature of the wood to increase, and the lignin to plastify slightly, forming a natural "glue" that holds the pellet together as it cools.

Soon after the introduction of automatic pellet boilers in Upper Austria (in 1996), a number of fuel oil distributors acquired pellet trucks for **bulk delivery**. The delivery of pellet fuels is comparable to the delivery of heating oil and is as convenient for homeowners. The emergence of bulk delivery infrastructure and pellet distribution channels was a key success factor for the wood pellet heating market.

Along the whole pellet supply chain (production, truck loading and logistics, transport, interim storage, and delivery to the end consumer), it is critical to avoid abrasion and dust. That is why pellet trucks and interim storage have to meet specific requirements.

Pellet delivery trucks are a key element in the pellet supply chain. In Upper Austria, these are fully-pressurized vessels equipped with pneumatic discharge through a hopper, to allow for fast fuel delivery (about 1 ton in 5 minutes) and to avoid dust. They have calibrated on-board weighing systems and noise-proof compressors. High quality pipes (usually 10 cm | 4 inches in diameter) are necessary to avoid abrasion. The cost for the truck is between 200,000 and 250,000 Euro | 250,000 and 315,000 US$ (of which about 100,000 - 150,000 Euro | 125,000 - 190,000 US$ is for the pellet-related equipment, the remainder is for the truck itself). As rule of thumb, a pellet truck needs to deliver about 5,000 - 6,000 tons/year within a delivery radius of around 150 km | 90 miles in order to be profitable.

In most cases, the truck's pumping hose is a maximum of 30 m | 100 ft in length, which effectively limits the distance that a boiler can feasibly be sited from the point of delivery (i.e. the road, driveway, etc.). The pellet storage and feeding system into the boiler are described at page 14.

As the storage is filled with pellets, air (and dust that has accumulated in the area) is extracted with a second filler pipe. Furthermore, according to the standard, the percentage of dust in a fully loaded delivery truck must be below 1%. Therefore, devices for dust extraction must be in place in the loading station where the delivery trucks are filled.

Wood chips

Wood chips have been burned to produce heat for decades. However, modern equipment allows for fully automatic operation and low-emission, CO_2-neutral combustion. Compared to wood pellets, wood chips require more storage capacity (the volume is about four-times that of wood pellets) and somewhat more operations and maintenance efforts. A modern 50 kW wood chip system, for example, requires about 20 minutes of operations and maintenance work per week, whereas a 500 kW system requires about 45 minutes. Wood chips have a significant cost advantage over wood pellets, however.

Wood chips are primarily used in larger buildings where space requirements are not a limiting factor. For homeowners that have extra space and are willing to invest more time in operations and maintenance, however, wood chips can be a very economic heating solution.

If a local supply chain can be established, wood chips can create new income for local forest owners. In Upper Austria, hundreds of local farmers and forest owners have become "heat entrepreneurs" by developing local district heating networks which use forest residues from their woods and also by establishing "biomass ESCOs" which heat non-residential buildings.

In Upper Austria, more than 10,000 automatic wood chip heating systems were installed in the last 10 years.

Example of a typical heating solution for a school

- fully automatic central heating system
- installed capacity: 150 kW
- placed in the basement
- hydronic heat distribution system
- wood chip delivery by local farmers, 3-4 times/year
- annual fuel demand: 50 tons wood chips
- storage capacity: 4 x 4 meters | 13 x 13 feet (converted former oil storage room)
- automatic wood chip supply from storage to the boiler
- ash removal: every 2 weeks

Wood chip standardizations and classifications

Due to its wide variety of sources, wood chip quality can vary widely. Important quality characteristics are bulk density (weight), size and water content.

Depending on the size and the technical features, wood chip heating systems can be operated with wood chips of different sizes and moisture contents. In general, higher moisture content results in lower boiler efficiency and higher emissions.

The ability of wood chips to be stored is determined by several factors: chip size, weight (usually expressed in bulk density (kg/loose m^3) and moisture content. Moisture content at harvest is about 50%.

The price of quality wood chips is determined by the weight and the moisture content. The price for forest wood chips (W20-35) ranges from 70 - 100 Euro | 88 - 125 US$.

Requirements for wood chips according to Austrian standardization (ÖNORM M 7133)

heating value	4 kWh/kg for 25% water content
density	200-250 kg/m^3 | 440-550 lb/ft^3
water content	15-35%
size	G30 (size < 3 cm | 1.2 inch) G50 (size < 5 cm | 2 inch)
primary energy demand	1.8-2%

Moisture content classes (Austrian standard M 7133)

W 20 air-dried	W 30	W 35	W 40 moist	W 50 harvest-fresh
< 20%	20 - 30%	30 - 35%	35 - 40%	> 40%

The wood chip supply chain

In Upper Austria, wood chips are either sourced from sawmills, using the wood that is not suitable for lumber, or from forest owners, using a portion of the residues from harvesting operations (a significant amount of the branches needs to remain in the forest to replenish the soil).

In Upper Austria, numerous service providers (usually farmers, forest owners or cooperatives) offer chipping services using mobile chippers. In many cases, the same providers also offer forest thinning services which improve tree growth and help to prevent beetle infestation (forest fires are not a problem in the Austrian climate).

In most cases, these chips are blown from the chipper into a tractor trailer or truck. The volume of chips produced per hour depends on the feedstock and the machinery. If the chipper is manually fed (e.g. with wood up to 10 cm | 4 inch diameter and up to 5 m | 16.4 ft length), an output of about 10 – 15 loose m^3/h (350 – 530 loose ft^3/h) can be achieved. If high power chippers with a crane are used, an output of 50 - 200 loose m^3/h (1,800-7,100 loose ft^3/h) is possible.

The costs of wood chip production are mainly determined by the output rate:

Type of chipper	Average chipping costs and output
Chipper on a tractor trailer with manual feeding	4-8 €/loose m^3 (9-15 loose m^3/h) 5-10 US$/loose ft^3 (320-530 loose ft^3/h)
high power chipper with crane	2-6 €/loose m^3 (30-60 loose m^3/h) 2.5-7.5 US$/loose ft^3 (1,000-2,800 loose ft^3/h)

The costs for wood chippers range from 200,000 Euro | 250,000 US$ for a simple chipper on a tractor trailer to 500,000 Euro | 625,000 US$ for a high-power chipper mounted on a truck.

Wood chips are either chipped on-site or delivered by a local farmer or forest owner. The fuel is fed into the storage area either by a pipe or, if possible, poured from a dump truck. In some cases, special delivery trucks are available that blow wood chips into the storage area in a manner similar to wood pellet trucks.

The energy consumed during wood chip production - including cutting trees, transport and chipping - is equivalent to about 2 – 5% of the energy that is generated by firing wood chips.

Fuel selection - pellets or wood chips?

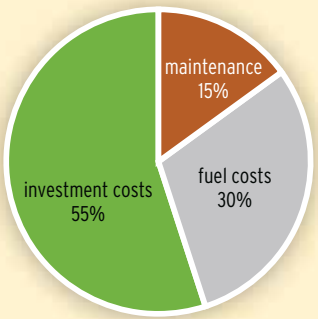
Both wood pellets and wood chips have advantages and disadvantages when being used as a fuel for a heating system. The following table provides guidance on when one fuel is preferable to the other.

In Upper Austria, homeowners usually prefer pellet heating systems, while owners of systems larger than 200 kW usually use wood chips. For system sizes between these two applications, space availability, delivery intervals, staff availability and the possibility of a local supplier are often decisive factors in determining fuel choice.

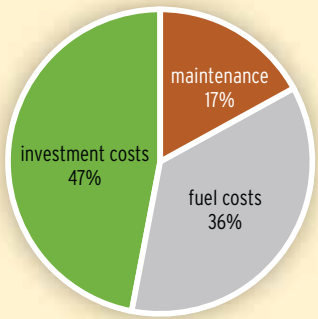
Criteria	Wood pellets?	Wood chips?
installed capacity & fuel demand	smaller heating systems (< 100 kW), lower fuel demand	larger heating systems (> 100 kW), higher fuel demand
space requirement	limited availability of storage capacity	ample storage capacity
delivery	frequent delivery is a sensitive issue (residental area, etc.)	frequent fuel delivery is not a problem
staff	no staff for operations and maintenance	staff for operations and maintenance
fuel	highly standardized fuel with stable quality is desired	different levels of quality are acceptable
fuel supply	interest in working with commercial fuel suppliers	interest in "buying local" - availability of local fuel suppliers, local economic benefit from using wood chips
wood resource ownership	end-user does not own wood resources	end-user owns wood resources (e.g. forest lands)
fuel costs	can be an attractive option if long-term supply contracts with favorable conditions can be negotiated	in general, cheaper than pellets

Life-cycle cost split

Pellet home heating system



Wood chip heating system (150 kW)



calculated for 20 years, 6% annual financing costs, excluding investment grant

Firewood

Despite the booming markets for fully automatic biomass heating systems, firewood heating systems still play an important role in Upper Austria. Since 2001, more than 8,500 firewood heating systems have been installed, with a total capacity of about 225,000 kW. The large majority of the systems are used for home heating, with installed capacities generally below 30 kW.

In most cases, the homeowners either own forest land themselves or have access to it through family members or neighbors. This ensures very short fuel transportation routes.

Firewood burns most efficiently and cleanly when combustion is hot and fast. A heat storage system allows the boiler to operate at optimal efficiency while storing the excess heat in a water tank for later use.

Firewood should have low water content and not be decayed or moldy. The moisture content of the firewood should not be over 20%.

type of firewood	water content	heating value
harvest wood ("fresh")	50-60%	2.0 kWh/kg = 7.2 MJ/kg
stored over one summer	25-35%	3.4 kWh/kg =12.2 MJ/kg
stored over more than one year	15-25%	4.0 kWh/kg = 14.4 MJ/kg

Boilers that will be used to burn firewood should be properly dimensioned and should not use any other fuel sources. The boiler should be run at nominal load as often as possible and heat exchangers should be cleaned regularly.

Sticks, carrots and tambourines for biomass heating

Biomass heating plays an important role in the renewable energy mix of Upper Austria. The state has successfully driven its transition toward a clean energy economy through the use of comprehensive plans since 1994.

To achieve its ambitious goals, Upper Austria has developed policy packages for different target groups. These packages consist of financial incentives (mostly investment grants), legislation to mandate installation obligations, and promotional activities (energy advice, outreach campaigns, training). The different types of support mechanisms can be thought of, respectively, as carrots, sticks, and tambourines (see cartoon). Most support mechanisms are adopted for the long-term: the biomass heating grant program, for example, has been in place continuously since the mid-80s.

The stable support offered by the state government over more than two decades has not only contributed to a well-developed biomass heating market. It has also supported the growth of a vibrant renewables industry which now is the global technology leader in this field and strong in exporting their products in Europe and beyond.

A key success factor for biomass policy development is that biomass helps meet multiple objectives beyond just climate and environmental goals (in fact, climate protection was not a consideration when the first support programs were launched in the 80s!). Biomass development positively impacts policy fields, such as agriculture, regional and economic development, innovation, etc. The employment and income opportunities from locally produced biomass fuels were recognized early on by many farmers and forest owners. This had a very positive impact on state policy for biomass heating.

Source: O.O. Energiesparverband

The O.O. Energiesparverband is in charge of implementing many of these programs and providing related services.

"stick"

Legal measures

- Emissions & efficiency standards
- Fuel requirements
- Renewable heating mandate
- Minimum requirements for heating & cooling

"carrot"

Financial measures

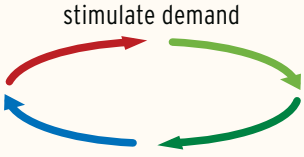
- Investment grant programs
- Renewable heating as a program requirement
- Contracting program
- Regional R&D program, pilot projects

"tambourine"

Information & training

- Energy advice
- Training & education programs
- Publications, campaigns & competitions
- Local energy action plans
- Sustainable energy business network

Policy Packages



Source: Christiane Egger

Main policy instruments

Financial support

One important incentive for biomass heating is a residential grant program that has been in place since the mid-80s. Upper Austria also provides incentives for a broad range of biomass heating installations beyond just those for residential systems, such as biomass district heating. No financial support is given for the operation of biomass plants.

Example: grants for homeowners

Automatic pellet and wood chip heating systems (max. 50% of the total investment costs)	
new installations	1,700 Euro | 2,125 US$
switch from fossil heating system to pellets or wood chips	2,200 Euro | 2,750 US$
replacement of an old biomass heating system	500 Euro | 625 US$

Grants typically cover about 20% of the investment costs for an automatic home heating system and are provided by the state government. A separate program exists for apartment buildings.

For non-residential buildings, an attractive funding program exists, whereby the costs are shared between the state and the federal governments. For example, a biomass heating system in a commercial building could receive a grant of 30 - 45%.

There is also a dedicated funding program for biomass district heating systems operated by farmer cooperatives. Other programs include a contracting program (see page 30) and renewable R&D program (see page 34).

Driving the market through standards

Austrian biomass boiler technology is a textbook example of how technological advances (resulting in significant environmental and economic benefits) can be driven by regulatory requirements and incentives. The government increasingly tightened efficiency and emissions standards over the years, which spurred innovation. Austrian boiler manufacturers responded favorably to these standards by developing equipment with high-efficiency and ultra-low emissions. This, in turn, positioned Austria's small-scale biomass boiler industry to capture a global leadership position and create more than 3,000 manufacturing jobs in the process.

Early standardization of fuels (especially pellets) was a key success factor: it allowed manufacturers to design ultra-low emissions heating systems that were convenient to use. The quality and convenience of these systems helped create consumer confidence.
Fuel standards are a legal requirement, but are also reinforced through product warranties on biomass boilers.

The strong focus of the manufacturers on product development has also led to equipment designs that attract customers that otherwise would not consider a biomass heating system, especially those in less rural areas.

Renewable heating mandates

Since 1999, all new or renovated public buildings must use renewable thermal technology for heating and hot water. Since 2008, all new private sector buildings larger than 1,000 m^2 | 10,800 ft^2 must also use renewable energy for heating and hot water.

New homes that receive funding from the state housing program (i.e. 95% of all new single-family homes) must also install a renewable heating system. The only fossil fuel-based heating systems that are allowed are gas condensing boilers, which must be combined with a solar thermal system of at least 4 m^2 | 43 ft^2 in size.

Advice, information and awareness campaigns

Awareness programs that are independent of the sales of a product and service are crucial to market growth; this is especially true for an emerging industry that has limited resources for marketing. Successful promotion is characterized by a smart and effective mix of communication instruments.

The O.O. Energiesparverband supports homeowners, public agencies, and businesses with **energy advice** when they are making building or energy-related investment decisions. Each year, the O.O. Energiesparverband provides 15,000 free face-to-face energy consultations to homeowners and public agencies. Businesses must pay 25% of the cost of their own energy consultations, with the remainder covered by state and federal funding.

The O.O. Energiesparverband has also carried out a number of **information campaigns** to promote biomass heating utilizing the media, billboards and other advertising strategies. Competitions have also proven to be a powerful tool for drawing people's attention to heating with wood. For example, **pellet competitions** have invited schools to carry out pellet-related projects, with extraordinary responses: school kids created sculptures, videos, paintings, comics, cross word puzzles, jewelry and computer games focusing on pellets.

The Chamber of Agriculture operates a support service for farmers and forest owners that are interested in starting a biomass district heating project and advises them on economic and technical issues.

Education & training

A vibrant biomass heating market requires a **highly skilled workforce** across the entire value chain - from fuel production, to equipment manufacturers to contractors that design, install, service and operate heating systems.

The **Energy Academy**, which is managed by the O.O. Energiesparverband, offers more than 30 technical training seminars on sustainable energy every year, many of which cover biomass heating. The target groups include companies that manufacture renewable energy and energy efficiency technologies, public agencies, architects, HVAC designers and installers, energy managers in companies and institutions, energy service company staff, energy auditors, and others interested in the sustainable energy field.

One of the main challenges encountered in all emerging biomass heating markets is that heating contractors generally lack confidence in, and knowledge of, biomass systems. As a result, many contractors may not offer biomass heating systems, or may actively discourage potential clients from investing in them. To overcome this market barrier, a vocational training for **"eco-installers"** was developed in cooperation with the state school for heating system installers that allows young professionals to specialize in renewable energy systems at the beginning of their training. The curriculum includes designing, installing, and servicing biomass, solar thermal, and geothermal heat pump systems. More than 200 installers have been trained in this program in the last few years.

The **state agricultural schools** include biomass fuel production in their curricula and three of them have recently started a bioenergy training program for farmers.

Supporting biomass heating manufacturers

Several state programs support biomass heating manufacturers. The most important is the **"Okoenergie-Cluster"**, a renewable energy and energy efficiency industry network in Upper Austria that supports business development, networking and cooperation, joint marketing, and export activities. A regional R&D program supports product development and ensures the competitiveness of the biomass heating industry in Upper Austria.

Success factors for biomass heating programs and action plans

- **"policy packages"** (consisting of a mix of regulatory, financial and training/awareness programs) are likely to deliver the fastest market growth by stimulating demand for biomass heating systems, while simultaneously supporting the development of cost-effective and good-quality products

- clearly defined **quantitative targets**, supported by well-developed action plans, give confidence to biomass heating businesses

- regular **market intelligence** is necessary to understand progress, communicate success, and take corrective action when necessary

- **high efficiency equipment** that meets stringent emissions and quality standards is crucial for market transformation

- **fuel standardization** will support consumer confidence

- heating systems must offer **user convenience levels** similar to oil and gas

- biomass heating will only gain public acceptance if the fuel is sourced from forests where **sustainable forest management** practices are in place

- understanding and effectively **communicating the benefits** of biomass market growth beyond climate and environment protection is critical (e.g. energy independence through local fuels, income for the farming community, local employment in rural areas, innovation, etc.)

- involving farmers and forest owners in the biomass business can help to develop **biomass fuel supply chains** and provide important support for policy development

- typically, the **most promising markets** for biomass heating are in areas where oil heating dominates and there is no connection to the natural gas grid. Conversion from oil-based heating to biomass is technically easier (because both require fuel storage) and usually more financially viable. Hydronic heat distribution systems in a building also make conversion to biomass more economically attractive.

- for larger buildings, it might be easier for programs to initially target **new construction**, and then to move to renovation after an initial learning period. Biomass heating in new buildings is usually simpler to implement and often less expensive to install than it is in existing buildings.

- **demonstration programs** (e.g. the first 10/100/1000 biomass heating systems in a specific market segment) are very useful, especially if the findings are used to design training and funding programs

- **training needs** to be proactively offered to all actors along the value chain as a part of any policy package; it should target producers, installers and users of larger systems

- **local biomass information campaigns** can be very helpful to kick-start markets, especially for private homes or public buildings

- **a longer term perspective** on market development, which takes into account the learning curves of different market actors and the expansion of production and installation capacities, is important for developing a healthy industry. In the long run, it is better to have only a few installations in the first years that work well than it is to risk having faulty installations during rapid market growth. This includes getting funding programs right by taking a longer term perspective and avoiding boom-and-bust markets.

Overcoming the chicken or the egg problem

When trying to start a local market for automatic pellet heating, a primary challenge is the "chicken-or-egg" problem: without sufficient customers, investors in a pellet distribution system will be hard to find; without a pellet distribution system, a market for automatic boilers which requires bulk delivery, can not be established. Here, public programs have an important role to play by providing information, training, and financial support.

Factors that will support the successful launch of a local pellet market include:

The pellet supply chain

- pellets can either be produced locally, sourced from another part of the country or imported. Respecting strict fuel quality standards, both in production and in handling, is important from the very beginning. While stringent quality requirements can usually be met by plants producing tens of thousands of tons each year, this level of a production capacity presents a challenge in a young market with low pellet demand.
- pellet distributors for bulk delivery need to have fully-pressurized trucks, loading stations, interim storage (if producer is not located in the vicinity) and the skills to handle pellets (further details, see page 19).

The equipment

- well-functioning and proven pellet boilers, meeting stringent emission standards and providing high consumer convenience, are required. Despite the higher costs of such equipment (with the related slower market growth), experience from different parts of Europe have shown very clearly that equipment requiring frequent fuelling and cleaning occupies a very small market niche.
- technicians that are trained to install and service the equipment. Ultra-low emission boilers are high-tech and require specialized skills and know-how from the workforce that handles them. Good boiler producers have their own training centers which provide skills and up-to-date information to installers and heating engineers.

The customers

- in addition to individual homes (where market growth is generally slower to develop than in other sectors), it is important to have some larger buildings to supply with pellets in order to avoid overly-long payback periods for the investments in bulk delivery systems.

Information and awareness for market actors and stakeholders

- automatic pellet heating and the related distribution systems represent a new and different approach to heating. Therefore, information, awareness and training is needed for different market actors (potential pellet producers and distributors, heating companies, installers), stakeholder groups (public administration and permitting agencies, emission and efficiency standards, funding programs) and potential customers (homeowners, housing developers and associations, owners and operators of larger commercial and public buildings). Information about these programs in Upper Austria can be found at page 26.

Business models for operating biomass plants

Two distinct business models have emerged in Upper Austria for operating larger biomass heating systems. Local farmers and forest owners looking for a new market for their forestry residues developed strategies for biomass district heating networks and biomass heat contracting. In both cases, wood chips are the dominant fuel.

Biomass heat contracting

One major barrier for customers considering an investment in a biomass heating system is that the upfront costs are relatively high. Also, many building owners do not want to be bothered with fuel purchase and boiler maintenance. One well-tested and successful solution is biomass heat contracting. Biomass heat contracting is a service that combines technical skills in operating larger biomass plants with access to reliable and cost-efficient biomass fuels.

The concept is simple: an energy service company (an ESCO) invests in and operates a biomass installation located on the premises of a company or public agency and sells the heat to the owners/users of the building at an agreed price. One main advantage for biomass contracting is that ESCOs are specialists in purchasing and handling the biomass fuel and ensure that the plant is running at optimal efficiency.

Since this business model helps to overcome several significant market barriers, the state of Upper Austria set up a specific program to support it, the so-called "energy contracting program". The program covers both energy efficiency investments as well as renewable heating installations. The grant for biomass heat contracting - which is given in addition to other funding programs - amounts to up to 13.5% of the investment costs for biomass contracting. In total, the program has supported more than 100 contracting projects.

After a lengthy market development phase, several ESCOs now successfully offer their biomass heat contracting services in Upper Austria. For smaller projects (e.g. heating a school) local farmers that own forests can provide this service. The time commitment required to run a biomass heat contracting service is amenable to a farmer's schedule because the busiest time is in winter (when work on the farm is slow) and the reliability and regularity required for running a heating system is compatible with a farmer's work pattern. Cooperative structures are helpful for sharing potential risks and obtaining project financing.

Larger projects tend to be carried out by specialized engineering companies and several of them have successfully combined energy efficiency improvements in the building with renewable heating.

Biomass district heating networks

The first project for a biomass district heating network was developed by forward-thinking farmers in the mid-80s. They were motivated by volatile prices for agricultural products, and were also looking for possibilities to create a market for forestry residues.

The business model that emerged was to form cooperatives of farmers that owned forest land with a goal to develop, build and operate small-scale biomass district heating systems which typically supply village centers (e.g. the local government buildings, schools, businesses and housing) with heating. The district heating plants were built from scratch in areas where district heating did not previously exist, and many farmers became successful "heat entrepreneurs".

Today, 300 such biomass district heating networks are in operation, with about 20 new projects built each year and another 20 existing ones extended each year.

This market development was strongly supported by a specific grant program for biomass district heating systems operated by farmers or farmer cooperatives which covers up to 40% of the investment costs. The budget for this program draws upon European agricultural and structural funding programs.

Cooperatives typically have around 10 members. Members are predominantly local farmers, although the municipality or local business owners may also be members. About 70% of the fuel is sourced from the cooperative members' own forests. The installed capacity of a district heating network averages around 800 kW. Projects that include several larger buildings in the planned network are usually more economically viable.

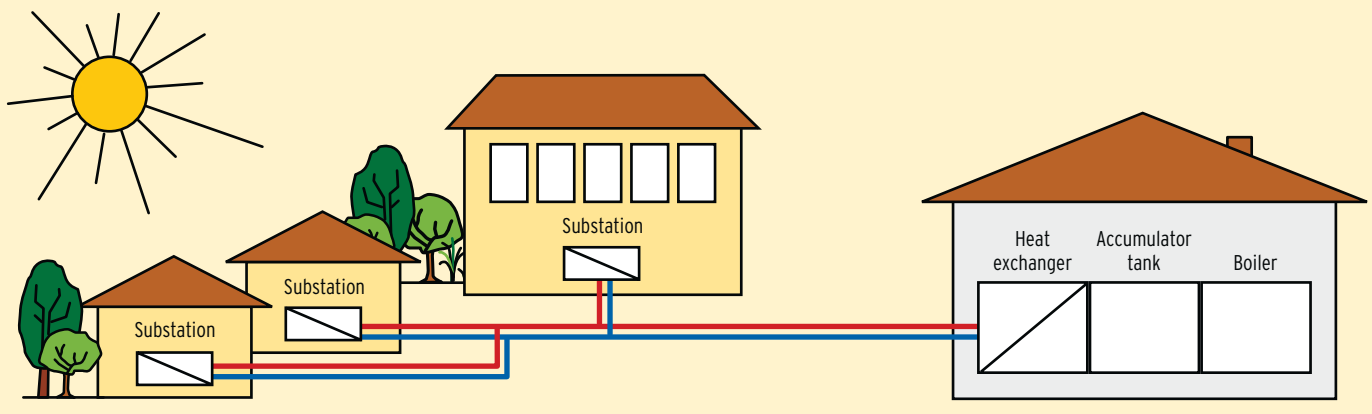
Technically speaking, the district heating network consists of one or more biomass boilers (using wood chips as a fuel), a hydraulic control system with substations at the customer sites, and the heat distribution grid.

It is very important to plan and design the network properly, taking into account:

- heat load and heat demand, including how much of the demand will be simultaneous and how much will be at different times
- proper pipe dimensions in order to avoid excessive heat losses in the grid. As a rule of thumb the efficiency factor of the grid (ratio of annual distributed/sold heat to annual produced heat) should be at least 75%
- number of customers and length of the grid. For economic reasons, as a rule of thumb the amount of heat sold/distributed annually compared to the length of the grid should be at least 900 kWh/m - and preferably 1,200 kWh/m.

Most of the biomass district heating systems are located in rural areas. The main cities in Upper Austria have larger district heating networks which are fuelled by gas CHP, industrial waste heat and biomass CHP. They are operated by the public utility companies (which also distribute gas and electricity).

District heating grid



Biomass heating industry

A grassroots biomass movement, stemming from farmers and forest owners, combined with innovative entrepreneurs and long-term state policy support, has resulted in a vibrant biomass heating industry in Upper Austria.

Over the last few years, biomass boiler manufacturing has grown into a flourishing part of Upper Austria's economy. In 2009, the in-state biomass boiler manufacturers produced approximately 50,000 boilers. Manufacturing and sales of biomass boilers and stoves employs more than 3,600 people. If fuel production and all related services are included, the biomass heating sector in Upper Austria accounts for about 4,500 full-time jobs.

Upper Austrian biomass boiler manufacturers play a leading role on the European market - more than 25% of all modern biomass boilers installed in the European Union were "made in Upper Austria".

For nearly a decade, all heating installers have included biomass heating in their product and service portfolio in response to customer demand. The transformation in contractor services and consumer awareness has been supported by industry training programs, the vocational school for installers, energy awareness campaigns, and counseling services provided by the O.O. Energiesparverband.

Employment and investments in biomass heating

Biomass boiler and stove industry in Upper Austria:

- annual revenue (from production, sales, installation): 530 million Euro | 660 million US$
- employment (from production, sales, installation): 3,600 jobs

Total employment in biomass heating (including fuel production and distribution): 4,500 jobs

Annual investment in new biomass heating installations: 110 million Euro | 138 million US$

Annual sales of biomass heating fuels, incl. CHP plants (2009): 90 million Euro | 113 million US$

Data: 2009

The "Okoenergie-Cluster"

The "Okoenergie-Cluster" plays an important role in supporting industry development. Biomass boiler manufacturers, installers, ESCOs, designers, architects and many other stakeholders cooperate in this network to improve products and services, and to increase biomass heating market share. Activities include joint promotional campaigns, export activities (for example, market study tours or group stands at trade shows in new markets) and training activities. The network is managed by the O.O. Energiesparverband on behalf of the state government. The network includes 150 companies that employ 6,200 people and generate more than 1.7 billion Euro | 2 US$ billion in annual revenue. More information, including a product and partner database in English, can be found at www.oec.at.

Biomass boiler & stove manufacturers in Upper Austria

Company	Main products	Export countries (ex.)	Website
Fröling	boilers for wood pellets, wood chips, firewood; heat storage systems	European Union, United States, Russia	www.froeling.com
Guntamatic	boilers for wood pellets, wood chips, firewood, energy grain; heat storage systems	European Union, United States	www.guntamatic.at
Ökofen	boilers for wood pellets; energy box; heat storage systems	European Union, United States	www.oekofen.at
ETA	boilers for wood pellets, wood chips, firewood; heat storage systems	European Union, Japan, New Zealand	www.eta.co.at
Hargassner	boilers for wood pellets, wood chips, firewood, agro-biomass; energy containers	European Union, New Zealand	www.hargassner.at
Solarfocus	boilers for wood pellets, wood chips, firewood; heat storage systems	European Union, United States	www.solarfocus.at
Gilles	boilers for wood pellets, wood chips, firewood; energy containers	European Union, Japan, South Korea	www.gilles.at
Biokompakt	boilers for wood pellets, wood chips, firewood, agro-biomass	European Union	www.biokompakt.com
Tropenglut	boilers for wood chips	European Union	Bekommenes Tropenglut-Logo ist von der Qualität nicht ausreichend, Fr. Brandstätter weiß schon Bescheid. www.tropenglut.com
Rika	stoves for pellets and firewood	European Union, United States	www.rika.at

Product innovation

Technological innovation is critically important to biomass heating market development, and to businesses competing in the global biomass heating marketplace.

A state R&D program in Upper Austria, known as the Energy Technology Program (ETP), supports innovative projects aimed at increasing energy efficiency and the use of renewable energy. This program has supported 29 biomass R&D projects with over 1.8 million Euro | 2.3 US$ million in funding, over the past few years.

Recent product innovation by partners of the Okoenergie-Cluster includes:

pellet condensing boilers
Condensing boilers harness the heat which is normally lost with the flue gas. The water vapor in the exhaust gas is cooled down until it condenses and emits condensing heat. This heat is recycled, thus achieving efficiencies of over 100% (based on the net calorific value of the used fuel).

innovative pellet and firewood stoves
In Upper Austria, modern stoves are used as heating systems for passive homes and are also used in homes with fossil fuel heating systems as an additional heating source. They have very low emissions and are equipped with automatic ignition and modulated combustion. Some models are offered with heat exchangers (which can function as small central heating systems).

very small-scale boilers for low energy buildings
Due to building regulations in Upper Austria, the heating load of new homes is very low (usually significantly below 10 kW). This has triggered a new generation of "very small-scale" pellet boilers, some of which can even be wall-mounted (like a gas boiler).

heating container solutions
Heat containers are pre-assembled and include the boiler, the fuel storage (for pellets or wood chips) and the control system. They are an ideal solution if there is not sufficient space available in the building or for contracting projects. They can be installed in a few hours.

agro-boilers meeting stringent efficiency standards
Due to their wide availability, non-wood biomass, such as straw, energy grain or miscanthus, are very attractive fuels. However, it is very challenging to achieve low emissions combustion similar to modern wood boilers with these fuels. Presently, there are a few agro-boilers on the market, which are able to meet stringent Austrian emissions requirements.

European Pellet Conference and trade show "Energiesparmesse"

The European Pellet Conference is an annual conference held in Wels, Upper Austria in March and organized by the O.O. Energiesparverband. With more than 600 participants every year, it has become the largest annual pellet event in the world. The European Pellet Conference is held as a part of the World Sustainable Energy Days. Every year, several conference topics are selected to reflect important trends; topics range from biomass heating, to solar process heat, to energy efficient building renovation. In the last 12 years, the conference has attracted more than 10,000 participants from 98 countries.

A trade show ("Energiesparmesse") is held in parallel with the conference, and attracts 100,000 visitors and over 1,000 exhibitors, making it one of the largest sustainable energy trade shows in the world. Biomass thermal is well-represented, with more than 100 companies exhibiting biomass heating related products and services. Further information: www.wsed.at

Project examples

Passive home, Neumarkt/Mühlkreis

The owners wanted their new home to be as sustainable as possible: it was built according to passive building standards and is equipped with a CO_2-neutral and fully automatic pellet heating system. A solar thermal system (7.5 m² | 81 ft²) and an 800 liter | 211 gallon accumulator tank further increase the environmental performance of the building. In addition to very low energy costs, the family also benefits from the convenience of their energy systems.

The building

- private home built to according to passive building standards
- heated area: 246 m² | 2,648 ft²
- floor heating system
- year built: 2007

The biomass heating system

- automatic pellet heating system
- investment cost: 14,000 Euro | 17,500 US$, 18% incentive
- installed capacity: 2-8 kW
- pellet storage: 5 m³ | 177 ft³, capacity: 2.5 tons, located in the basement
- pellet feeding system: auger system
- annual pellet consumption: 0.85 tons
- annual fuel costs: 200 Euro | 250 US$
- pellet delivery: every second to third year, bulk delivery by a local pellet distributor
- ash removal: twice per year
- CO_2 avoided: 0.85 tons per year

Low energy home, Kirchberg

This small, new wooden house is situated in the countryside and surrounded by a nature reserve. The energy efficiency of the building and the comparatively limited living space permitted a smaller-than-average heating system to be installed: a wall-mounted pellet boiler, which can modulate its capacity between 2 and 7 kW. The heater not only saves space, it was also installed very quickly.

The building

- new low energy home
- heated surface area: 75 m² | 807 ft²
- floor heating system
- year built: 2009

The biomass heating system

- fully automatic, wall-mounted, pellet heating system
- investment costs: 10,000 Euro | 12,500 US$, 25% incentive
- installed capacity: 7 kW
- pellet storage: 2 m³ | 71 ft³
- annual pellet consumption: 0.9 tons
- annual fuel costs: 190 Euro | 238 US$
- pellet delivery: twice per year, bulk delivery by a local pellet distributor
- CO_2 avoided: 0.9 tons per year

Renovated home, Hohenzell

In the course of renovating this spacious, 1970s home, the old boiler was replaced with a modern firewood boiler. The family of four installed a solar thermal system with a 7,500 liter | 1,982 gallon accumulator tank as an additional labor saving measure. With the solar thermal system in place, the wood storage only needs to be filled every second day in the winter, even during periods with no or little sunshine. During winter months with more sunshine, the storage system only needs to be filled once per week.

The building

- renovated home
- heated area: 260 m² | 2,800 ft²
- floor and wall heating system
- year of renovation: 2007

The biomass heating system

- automatic firewood boiler
- investment costs: 8,000 Euro | 10,000 US$, 17% incentive
- installed capacity: 40 kW
- fuel storage: a dry barn next to the garage, 10 m² | 108 ft²
- annual firewood consumption: 3.5 tons
- annual fuel costs: 450 Euro | 563 US$
- firewood delivery: every second year by local farmers
- CO_2 avoided: 6 tons per year

Renovated farm building, Pichl/Wels

In 2006, this former farm building was converted into two apartments in which two generations of the same family now live. It is heated by a wood chip heating system. Every year in fall, the fuel is sourced and chipped in the family's forests by a service provider (about 260 Euro | 330 US$ per hour, which produces about 100 loose m^3 | 3,530 ft^3 wood chips). Other building features include a solar thermal and a PV system, triple glazed windows, and a controlled heat recovery system, making the building energy independent.

The building

- converted farm building
- heated area: 600 m^2 | 6,460 ft^2
- floor heating system and radiators
- year of renovation: 2006

The biomass heating system

- automatic wood chip heating system
- investment costs: 14,000 Euro | 17,500 US$, 26% incentive
- installed capacity: 35 kW
- wood chip storage: in a storage barn (about 300 m^3 | 10,600 ft^3, where the annual supply can be stored) and a storage inside the building (55 m^3 | 1,940 ft^3)
- annual wood chip consumption: 110 loose m^3 | 3,530 ft^3
- annual fuel costs: 290 Euro | 363 US$ (for chipping, own forest)
- annual electricity costs for the heating system: 270 Euro | 338 US$
- CO_2 avoided: 18 tons per year

Low energy office building, Munderfing

The "Energiewerkstatt" is a planning and consulting company, specializing in wind energy projects and sustainable energy programs for municipalities. Their office building provides work space for 25 staff. Due to the building's high level of energy efficiency, pellet consumption is very low. The pellet heating system is supported by a solar thermal installation with a 2,000 liter | 530 gallon accumulator tank.

The building

- low-energy office building
- annual heat demand: 8,500 kWh
- heated area: 380 m^2 | 4,090 ft^2
- year built: 2003

The biomass heating system

- automatic pellet heating system
- investment cost: 16,000 Euro | 20,000 US$, 44% incentive
- installed capacity: 15 kW
- pellet storage: 8 m^2 | 86 ft^2 capacity: 10 tons, located next to the heating system
- pellet feeding system: auger system
- annual pellet consumption: 1.7 tons
- annual fuel costs: 320 Euro | 400 US$
- pellet delivery: every 3 years, bulk delivery by a local pellet distributor
- CO_2 avoided: 1.7 tons per year

Institutional building, Peilstein

"Ariola Sozialwerkstatt" is a workshop in Peilstein that employs 32 people with disabilities who make, for example, candles and greeting cards to order. A pellet heating system was installed in 2003 by an ESCO, decreasing the upfront investment costs for the new building. The ESCO operates and maintains the system on behalf of the workshop.

The building

- social institution
- heated surface area: 1,000 m^2 | 10,764 ft^2
- floor heating system and radiators
- year built: 2003

The biomass heating system

- automatic pellet heating system
- investment costs: 26,630 Euro | 33,290 US$, 30% incentive (ESCO)
- installed capacity: 2 x 30 kW (2 boilers)
- pellet storage: 36 m^2 | 388 ft^2, located next to the boiler room
- annual pellet consumption: 20 tons
- annual contracting installment: 6,450 Euro | 8,063 US$ (15 years ESCO contract)
- pellet delivery: 3 times per year, bulk delivery
- CO_2 avoided: 30 tons per year

Transport company, Linz

Mitter Transporte is a transport company with around 80 employees in Linz. The company's primary business is to transport oil and lubricants and to manage newspaper logistics. A few years ago, the company also added a wood pellet distribution service. In line with this new business field, the company installed a pellet heating system in 2009. The heating system is housed in a free-standing container because no space was available inside the company buildings.

The buildings

- an office and a maintenance building and a garage
- heated area: 1,200 m^2 | 12,920 ft^2
- radiators
- year built (heating system): 2009

The biomass heating system

- automatic pellet heating system in a container adjacent to the building
- total investment costs: 80,000 Euro | 100,000 US$, 30% incentive
- installed capacity: 2 x 49 kW (2 boilers)
- pellet storage in the container: 22 tons
- annual pellet consumption: 25 tons
- annual fuel costs: 5,375 Euro | 6,720 US$
- pellet delivery: once per year (by the company's own trucks)
- CO_2 avoided: 37.5 tons per year

Guesthouse, Mondsee

The "Guesthouse Anna" is located at one of Austria's most beautiful lakes, Lake Mondsee. The guesthouse can accomodate a total of 30 guests in two buildings with seven rooms and five holiday apartments. In 2008, oil heating systems in both buildings were replaced by a central wood chip heating system. Each building was also equipped with solar collectors (20 m^2 | 215 ft^2 and 16 m^2 | 172 ft^2) and accumulator tanks (in total 3,500 liters | 925 gallons).

The building

- guesthouse for 30 guests
- heated area: 1,000 m^2 | 10,764 ft^2
- floor heating system and radiators
- year of renovation: 2008

The biomass heating system

- automatic wood chip heating system
- investment costs: 35,000 Euro | 43,750 US$, 40% incentive
- installed capacity: 100 kW
- wood chip storage: 100 m^3 | 3,530 ft^3
- annual wood chip consumption: 130 m^3 | 4,590 ft^3
- annual fuel costs: 2,000 Euro | 2,500 US$
- wood chip delivery: twice per year, from the guesthouse's forest and from local farmers
- CO_2 avoided: 31 tons per year

School building, Reichraming

The school building in Reichraming, a picturesque mountain village, houses a kindergarten, an elementary school, and a high school. In the course of a building renovation, the old oil heating system was replaced by a fully-automatic wood chip heating system, installed and operated by an ESCO. This was an ideal solution because no upfront investment was required and because the ESCO has an incentive to optimize system performance.

The building

- school building
- heated surface area: 4,440 m^2 | 47,800 ft^2
- radiators
- year of renovation: 2005

The biomass heating system

- automatic wood chip heating system
- total investment costs: 120,000 Euro | 150,000 US$, 36% incentive (ESCO)
- installed capacity: 2 x 100 kW (2 boilers)
- wood chip storage: 50 m^3 | 1,766 ft^3
- annual wood chip consumption: 380 loose m^3 | 13,418 ft^3
- annual contracting installment: 27,500 Euro | 34,375 US$ (15 years ESCO contract)
- wood chip delivery: 8 times per year by a local farmer
- CO_2 avoided: 90 tons per year

Biomass micro-district heating grid, Oberwinkl

A small wood chip heating grid supplies two farm buildings and one apartment building, which were previously heated by firewood, coal and natural gas. A smart control system, which the farmers continuously improve, and an accumulator tank, ensure efficient operation and low costs. The fuel is supplied from the farmer's own forests.

The buildings

- two farm buildings, one apartment building (4 apartments)
- heated area: 2,000 m^2 | 21,530 ft^2
- floor heating system and radiators
- year built (district heating grid): 2005

The biomass heating system

- wood chip heating system in a separate building
- investment costs: 35,000 Euro | 43,750 US$, 19% incentive
- installed capacity: 86 kW
- wood chip storage: 1,000 m^3 | 35,310 ft^3
- annual wood chip consumption: 180 m^3 | 6,356 ft^3
- annual fuel costs: 290 Euro | 363 US$ (costs for wood chipping, once per year)
- CO_2 avoided: 430 tons per year

Biomass micro-district heating grid, Bachmanning

Bachmanning is a small municipality with around 670 inhabitants. When the municipality decided to replace the old oil heating system in 2007, its public buildings (municipal office, kindergarten, elementary school), as well as the church and the supermarket, were connected to a 110 kW pellet-fueled district heating system. Pellets were chosen because storage space was too limited for wood chips.

The buildings & the biomass heating system

- automatic pellet heating system with screw conveyor system
- installed capacity: 110 kW, 4,000 liter | 1,057 gallons accumulator tank
- heated area: 2,723 m^2 | 29,311 ft^2
- total investment costs: 95,700 Euro | 119,625 US$
- length of district heating grid: 350 m | 1,150 ft
- year built: 2007

Fuel and storage system

- pellet storage: 35 m^3 | 1.236 ft^3 for 23 tons, located in the basement of the school building
- annual pellet consumption: 65 tons
- annual fuel costs: 11,500 Euro | 14,375 US$
- pellet delivery: 4 times per year, bulk delivery by a local pellet distributor
- CO_2 avoided: 100 tons per year

Biomass district heating, Buchkirchen

The biomass district heating system in Buchkirchen, developed and managed by a cooperative of four farmers, has been operating since 2007. There are 26 residential, commercial, and public sector customers connected to a 1,800 m | 5,900 ft district heating grid. Local farmers deliver the wood chips to the heat plant, which increases the local economic impact of the system.

The district heating system

- biomass district heating system with wood chips
- installed capacity: 850 kW + 150 kW (2 boilers)
- customers: 26 (equivalent to the heat demand of 100 households)
- total investment costs: 1,100,000 Euro | 1,375,000 US$, 30% incentive
- length of district heating grid: 1,800 m | 5,900 ft
- construction time: 3.5 months
- year built: 2007

Fuel and storage system

- storage building with 1,500 m^3 | 52,972 ft^3
- annual wood chip consumption: 2,500 loose m^3 | 88,290 ft^3
- annual fuel costs: 45,000 Euro | 56,250 US$
- wood chip delivery: in winter, once per week
- CO_2 avoided: 375 tons per year

Industrial company, Gurten

Fill is a family-owned industrial company, specializing in complex production lines and related machinery. The heat for the 25,000 m² | 269,100 ft² of office and production buildings is supplied by a biomass district heating plant, developed by eight farmers in cooperation with the municipality of Gurten. The local fire department's building is also connected to the system and more buildings will be connected in the near future.

The biomass district heating

- biomass district heating system (wood chips)
- installed capacity: 980 kW
- total investment costs: 650,000 Euro | 812,500 US$, 30% incentive
- length of district heating grid: 250 m | 820 ft
- construction time: 2 months
- year built: 2009

Fuel and storage system

- storage building: 800 m³ | 28,250 ft³
- annual wood chip consumption: 2,000 loose m³ | 70,630 ft³
- wood chip delivery: 3 - 4 times per year by local farmers
- annual fuel costs: 36,000 Euro | 45,000 US$
- CO_2 avoided: 320 tons per year

Industrial company, Losenstein

Weber is an industrial company specializing in hydraulic drives and control engineering. It employs more than 200 staff at the site in Losenstein. When the heating system had to be expanded in 2006, an ESCO installed a wood chip heating system. The ESCO manages the heating system and sources fuel from local forest owners.

The building

- company building (office and production buildings)
- heated area: 1,700 m² | 18,300 ft²
- floor heating system and radiators
- year built: 1969

The biomass heating system

- wood chip heating system
- total investment costs: 173,000 Euro | 216,250 US$, 41% incentive (ESCO)
- installed capacity: 500 kW + 85 kW
- wood chip storage: 200 m³ | 7,063 ft³ (underground next to the boiler room)
- annual wood chip consumption: 1,200 loose m³ | 42,380 ft³
- annual contracting installment: 32,000 Euro | 40,000 US$ (15 years ESCO contract)
- wood chip delivery & ash removal: every 3 weeks by local farmers
- CO_2 avoided: 290 tons per year

Monastery and historic landmark building, Kremsmünster

The monastery in Kremsmünster was founded in the year 777 by the order of St. Benedict. In 2004, an ESCO installed a wood chip heating system, powered by fuel from the monastery's own forest products company. The heating system is also connected to an existing district heating grid (which serves the town). When the monastery's heat demand is low, its biomass system can feed heat into the municipal network.

The buildings

- monastery (historic landmark building)
- floor heating system
- heat demand: 3,500 MWh
- numerous buildings (monastery, schools, brewery buildings, swimming pool etc.)

The biomass heating system

- wood chip heat plant (located in an underground building)
- total investment costs: 430,000 Euro | 537,500 US$, 40% incentive
- installed capacity: 1,000 kW, the old oil boiler (1,500 kW) is also available as a back-up for peak loads and for operational security
- storage room: 400 loose m³ | 14,125 ft³
- annual wood chip consumption: 4,000 - 5,300 m³ | 141,260 - 187,170 ft³
- wood chip delivery: the wood storage room is located next to the boiler, wood is chipped 2 - 3 times per year
- CO_2 avoided: 1,200 tons per year



Why biomass heating?

Biomass is a sustainable and carbon-neutral fuel and especially suitable for heating of homes, businesses and public buildings. Modern heating systems are fully automatical with ultra-low emissions. The installation of a biomass heating system ensures energy independence, supports the local forest economy and is environmentally friendly.

The state of Upper Austria has pioneered biomass heating in the last two decades and achieved global leadership in small-scale systems. Biomass heating has created 4,300 jobs in the state.

In Upper Austria, the most important ways to heat with biomass are:

- automatic wood pellet heating systems, mostly in single-family homes with bulk delivery
- automatic wood chip heating systems for commercial and public buildings
- low-emissons firewood boilers, mainly in rural areas
- district heating systems supplied by biomass thermal plants
- large-scale combined heat and power plants supplied by biomass

The region of Upper Austria & the O.O. Energiesparverband

Presently, renewable energy sources provide 33% of the primary energy (of which 15% is biomass) and more than 45% of all heating is produced from renewable energy in Upper Austria. The state is also home to a number of Europe's leading biomass boiler producers, and pellet heating systems have become a standard solution. Currently, 40,000 automatic biomass boilers are in operation, heating homes, public and commercial buildings (half are fuelled with pellets, half with wood chips).

Biomass market development in the region is supported by a state energy strategy and an action plan which targets 100% renewable space heating by 2030.

The O.O. Energiesparverband is the energy agency of Upper Austria and was set up by the state government in 1991. The agency, which is funded by the state, promotes energy efficiency, renewable energy and innovative energy technologies. The agency's main target groups are private households, municipalities and businesses. The O.O. Energiesparverband manages the state's sustainable energy business cluster (the Okoenergie-Cluster) and cooperates with national as well as international energy institutions.

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