SWS Group

Heating Large Buildings With Wood Fuels

Basic Information for Project Planners

Preface

This brochure contains basic technical information to assist with the preparation and planning of wood-fired heating systems in large buildings. Typical projects where wood heating represents an attractive alternative include residential blocks, hotels, commercial premises or public buildings, such as schools, hospitals, old people's homes, town halls and other large buildings with a heating rating of between 50 kW and 500 kW. Wood heating systems of this class offer considerable economic advantages in many cases and are relatively simple to install, as the boiler can usually be housed in the existing buildings.
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Contents

Why heat with wood?

There are many reasons in favour of heating large buildings with wood. Apart from the fact that such systems are eco-friendly and have proven themselves in technical terms, they constitute an economically viable solution. Wood fuels are domestic raw materials in reliable supply and at stable prices.

(1) Political support

The Kyoto Protocol demands a substantial reduction in greenhouse gas emissions. Using wood fuel for heating is one of the most cost-effective ways of achieving this objective.
Indeed, the European Commission expressly supports the increased use of wood fuel for heating purposes. A growing number of European countries promote the use of wood fuel in national programmes.
The Irish market is at the very early stage of development. However, support is provided under The Renewable Energy (RE) Research Development & Demonstration (RD&D) Programme which is administered by Sustainable Energy Ireland.
The programme which comes under the Economic & Social Infrastructure Operational Programme of the National Development plan offers grant support for Renewable Energy Projects and so will help to develop wood heat projects.
For further information contact the Renewable Energy Information Office at www.sei.ie/reio.htm

(2) Uncertainty regarding future energy supply

It is not only ecological reasons that are behind the political support for renewable energy. In the green paper "Towards a European strategy for the security of energy supply" COM 769 (2000) the European Union expressed major concerns regarding the security of future supplies of fossil fuels. The European Commission expects a drastic increase in Europe's dependence on energy imports.
According to studies by the International Energy Agency, there will be a sharp rise in dependence on supplies in the Middle East over the next few years due to declining oil production in the North Sea and most other production areas in non-OPEC countries (caused by the successive depletion of reserves). From 2015 world production of oil could begin to fall.
Ireland has the highest import dependence of all OECD countries importing about 90% of all fuels.

(3) The availability of advanced technology

Over the past 20 years tremendous progress has been made in wood boilers. Emissions of state of the art boilers have been reduced to a hundredth of the original figures and efficiency is now in the same range as for oil or gas boilers. Technical progress has also led to high reliability in automatic boiler operation.

Efficiency factor of a wood-fired boiler

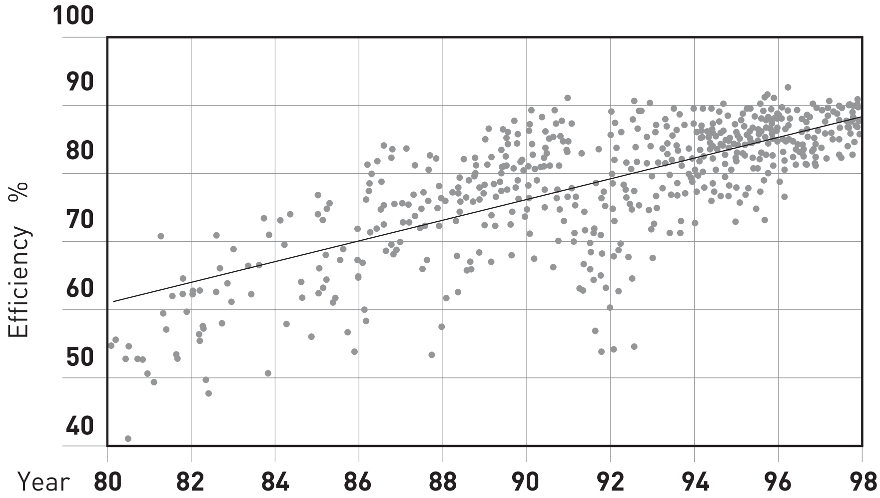


Figure 2: Each point is a new type of boiler which was tested.
Source: Bundesanstalt für Landtechnik Wieselburg

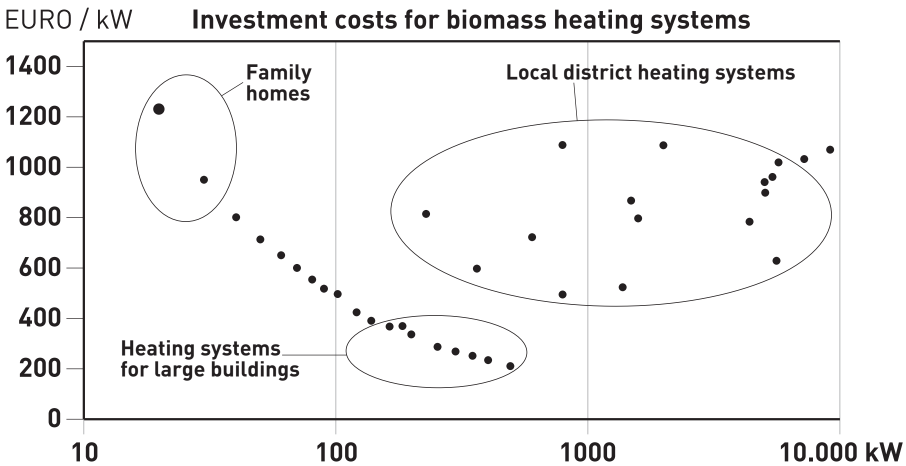


Figure 2 Source Styrian Chamber of Agriculture 1998, E.V.A1999

(4) Ability to compete

Investment costs for installing a wood heating system are slightly higher compared to oil and gas systems. However, fuel costs are lower and stable. This will quickly compensate for the initial high investment cost in the long term.

(5) Benefits for the environment

When comparing the environmental impact, not only should boiler emissions be examined. Emissions are also caused during manufacture, the transport of the fuel and other processes (e.g. manufacture and disposal of the boiler). To calculate the total emissions over the entire life cycle, the GEMIS database was used. The results are based on the emission figures for state-of-the-art boilers. To calculate the emissions from pellet transport, 300 km transport by truck was assumed.
Comparison of the eco-balances in Fig.3 shows that pellets rate best in terms of CO2 and CO emissions. Regarding SO2 emissions, pellets are much better than oil, but somewhat less favourable than natural gas.

Total dust emissions are higher than for oil or gas, however still very low in absolute terms: the assumed 400 kW system gives rise to some 30 kg of dust emissions annually.

The whole study can be downloaded from http://www.eva.ac.at/projekte/oekobilanz.htm.

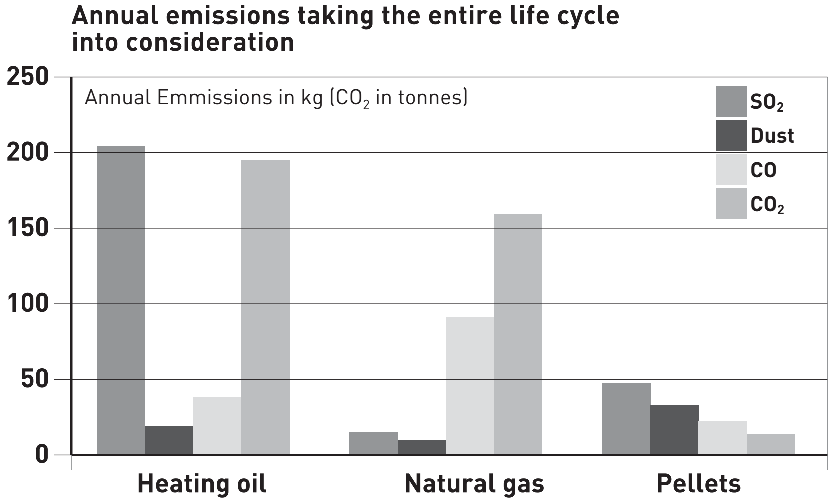


Figure 3 Source: E.V.A.

(6) Growing market

The heating market is a very large energy market. In many countries, such as Austria, Denmark, France, Germany and Sweden, there has been rapid growth in the use of wood fuels over the past few years. This opens up attractive economic perspectives for all the sectors involved. Innovative companies that become established right from the outset as competent partners for installing wood heating can expect substantial growth.

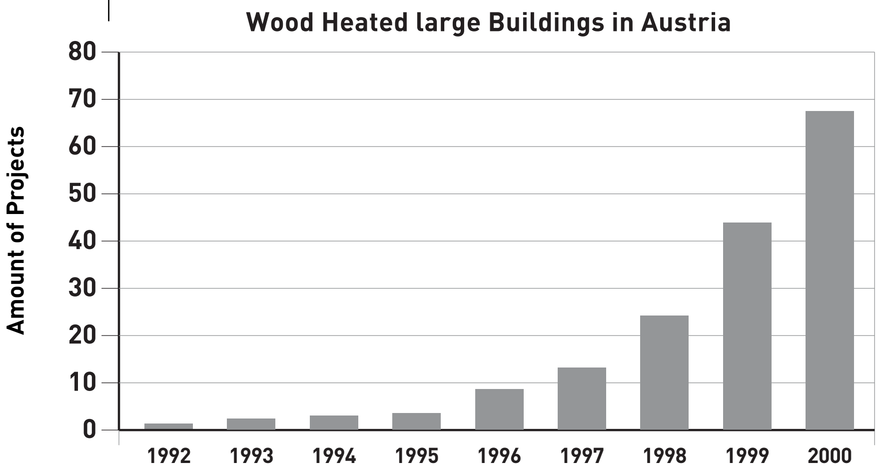


Figure 4 Figure : E.V .A.

Fig.5 shows the growth in the number of apartment blocks heated by biomass in Austria. (source: http://www.eva.ac.at/projekte/holzwaerme.htm). Most of these projects are to be found in the Province of Salzburg where 47% of all the newly built subsidised floor space was heated with wood by 2001.

Building a wood-fired heating system

(1) Basic considerations

Nowadays, modern wood heating systems operate just as well as conventional oil or gas systems; they are just much less common. Consequently, much more communication is required when carrying out a wood-heated project. All the relevant people, i.e. the building contractor, potential users of the building, neighbours and the applicable local authorities, have to receive detailed information on the project in good time.

A wood heating system requires a little more room for the boiler and the fuel storage. Access for fuel delivery vehicles must be easy. It is a great advantage if a new building is being erected, as these requirements can be taken into consideration during the planning stage. Good communication between the architect and designers plays a vital role here.

In Ireland up until recently, securing a reliable source of wood fuel involved quite some organisation. Fortunately, there have been considerable improvements in this area. For example, both Galtee Fuels in Limerick and Celtic Flame in Dublin import and distribute wood pellets. Balcas in Enniskillen have plans to open Ireland's first pellet production plant in 2004. Feasibility studies for four other wood pellet plants are at an advanced stage and should herald the opening of Ireland's wood fuel market. Galtee Fuels also hope to begin building a wood pellet production plant in the very near future. Automatic wood boilers require slightly more maintenance than oil or gas ones. The question of periodic cleaning of the boiler, disposing of the ash and supplying the fuel therefore has to be addressed in advance.

(2) Estimating the right boiler size and fuel requirements

Selecting the right capacity for the boiler is very important if it's operation is to be economical and trouble-free. In well-insulated, modern buildings in particular, the heating systems are frequently far too big, as a current E.V.A. study has shown (Fig.5). It classifies heating systems as extremely overdimensioned if the boiler capacity is over twice as high as the building's heating load.

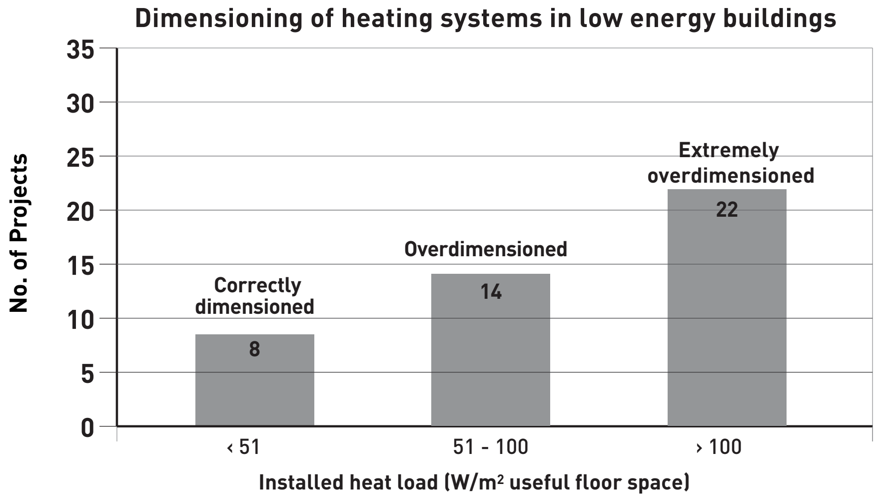


Figure 5 Source : E.V .A.

If wood heating is to replace a system in an existing building, the previous fuel consumption is the best basis for calculating the future requirements and the heat load (which does not correspond to the existing boiler rating in many cases). The correct heating load can be calculated from the net energy requirement (fuel consumption multiplied by estimated boiler efficiency) by dividing it by the number of full load hours, which depends on the local climate and building use.

For example, as a rule of thumb, the heating load for a typical office block in Ireland may be calculated as follows:

Assumptions:
Floor Area = 2000 m2
Oil Consumption = 25,000 litres/year (for heating purposes)
Energy Content of Oil = 10.56 kWh/litre
Boiler Efficiency = 80%
2,500 hours per year full load

Step 1
Convert the annual oil consumption from litres to kWh

Oil Consumption = 25,000 litres/year * 10.55 kWh/litre = 263,750 kWh/year

Step 2
Calculate the useful heating delivered

Oil delivered as useful heating = 263,750kWh/year *0.8 = 211,000 kWh/year

Step 3
Calculate the heating requirement and divide the useful heating by the number of hours per year at full load
Heating requirement = 211,000 Wh/year / 2,500 h/year = 84.4 kW
To calculate the heating requirement for an alternative building, use the three steps outlined above using appropriate values.

When replacing an existing heating system, it is strongly advisable to consider improving the building's insulation as the new system could then be adapted to the lower requirements following renovation.
If a system is installed in a new building, an accurate calculation of the heat load is vital. In the case of well-insulated buildings the hot water requirements play a more important role in the heat rating calculations than in conventional buildings and have to be taken into consideration accordingly.

(3) Estimating the Feasibility

The simplest way to compare the feasibility of various heating systems is the standard calculation method VDI 2067. Using a calculation model developed by E.V.A. on the basis of this standard, which can be downloaded from www.bioheat.info, it is possible to calculate the total costs for the system and to compare various alternatives.

The Austrian consultant "Regionalenergie Steiermark" (www.regionalenergie.at) which has already promoted and provided advice for over 70 wood heating projects, examined 26 completed projects in autumn 2002. This study showed the following average distribution of the investment costs for heating buildings with biomass:

Breakdown of Investment Costs

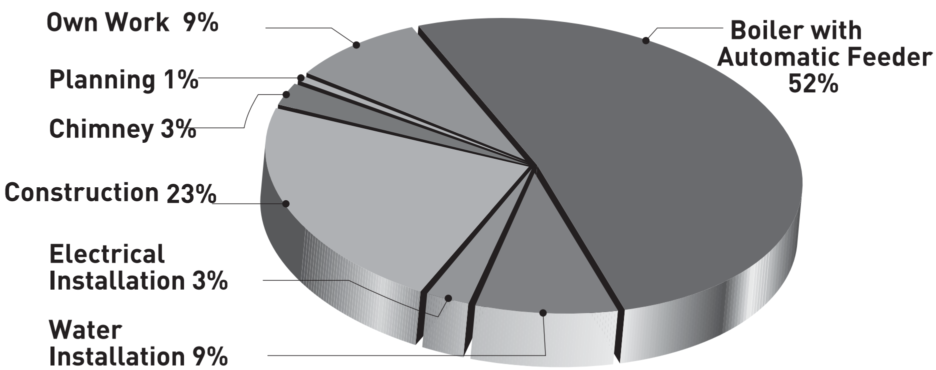


Figure 6 Source: Regionalenergie Steiermark

Fig. 7 shows a wide range of the costs, a sign that the market is still young. It is noteworthy that the specific costs in the investigated power range are at a minimum at 100kw.

This is due to the availability of compact boilers for this size

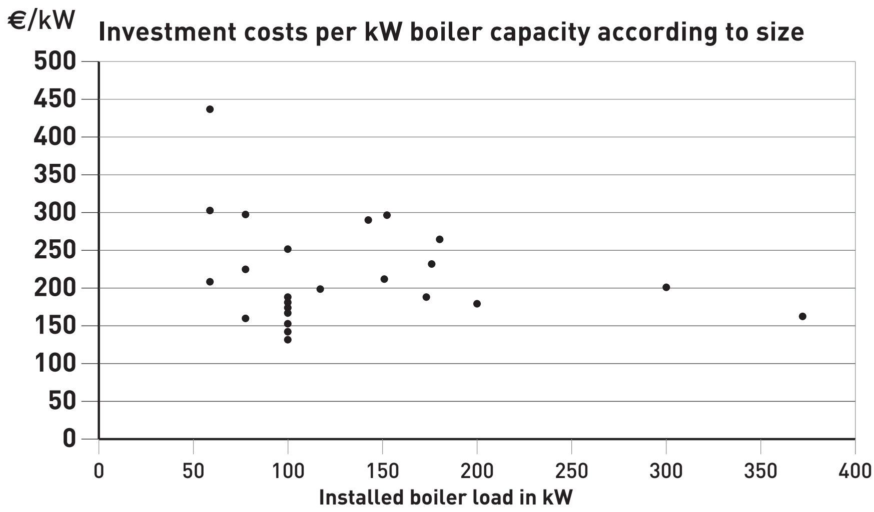


Figure 7 Source: Regionalenergie Steiermark

Selecting the fuel

(1) Properties of pellets and chips

Wood pellets and chips are the two most suitable fuels for automatically fired heating systems in large buildings. Pellets are a standardised fuel that are made by pressing dry shavings or saw dust. The production process does not use chemical additives – only high pressure and steam. To improve the mechanical stability of pellets often 1-3% of organic additives, such as potato starch, corn flour or waste liquor from the paper and pulp industry are added. Depending on the moisture, the energy content of pellets lies between 4.7-4.9 kWh/kg – 2 kilos of pellets therefore have a slightly lower calorific value than a litre of extra light fuel oil (10 kWh).
Chips are small pieces of wood that are 5-50 mm long (measured in the direction of the fibre). There may also be some longer twigs and finer material among them. The quality of the chips depends on the raw material and the chipping process (sharp chipper blades).

Two sources for chips are available:
1. Chips from the sawmill industry: should have a maximum water content of 30% and be of uniform quality and size. They are suitable for boilers in large buildings.
2. Forest chips: Given their water content of between 40% to 60%, they can only be used in large boilers. Large pieces of wood or high humidity can cause problems with boiler operation. For this reason ensuring the quality of woodchips is an essential precondition for their successful use as fuel.

The following table provides an overview of the key data on pellets and dry chips. The figures for density refer to loose material.

	Wood Pellets	**Chips**
Calorific Value	17,0 GJ/t	13,4 GJ/t
- per kg	4,7 kWh/kg	3,7 kWh/kg
- per m^3	ca. 3077 kWh/m^3	ca. 750 kWh/m^3
Water content	8 %	25 %
Density	650 kg/m^3	200 kg/m^3
Ash content (% of mass)	0.5 %	1 %

(2) Pellets or chips/ pellets and chips

Pellets and chips have various advantages and disadvantages that have to be weighed up. Which fuel is used will depend very much on local conditions. Preferably systems should be installed, that can use both fuels and can therefore respond flexibly to the future market situation.

Chips
+ Local availability
+ Favourable effect of production on the local job market
+ Cheaper than pellets
- Large storage space required
- High, uniform fuel quality is important, but possibly difficult to obtain
- More work required for system maintenance

Pellets
+ Standardised fuel – greater reliability
+ Smaller fuel store
+ Less work for service and maintenance
- Higher fuel costs
- Less favourable for the local economy

To allow fuel flexibility boilers should be selected, that can be operated both with dry chips and pellets. Such boilers have an electronic control system that adjusts the combustion parameters to the selected fuel. It is important that the feed system is suitable for handling both fuels. As chips (unlike pellets) are not generally blown in, the store should be designed to enable the fuel to be delivered by tipper truck if chips are expected to be used. The advantage of above ground silos for Pellets is their lower cost.

Storing the fuel

Wood fuels can either be stored in the existing building in a room near the boiler or in a separate store outside the building. The latter could be an underground store or overground silo from where the fuel is fed to the boiler by conveyor. Another option is a container with loading ramp located at the side of the building, which can be replaced by truck. The illustrations below show two common examples for the location of the fuel store. If it is not possible to locate the filling opening in the middle of the store, screw conveyors can be used to distribute the fuel evenly as shown in the first picture. In underground stores for pellets, it is important to ensure that no moisture can get in. Stores for chips should be well ventilated to let the wood dry and prevent mould.

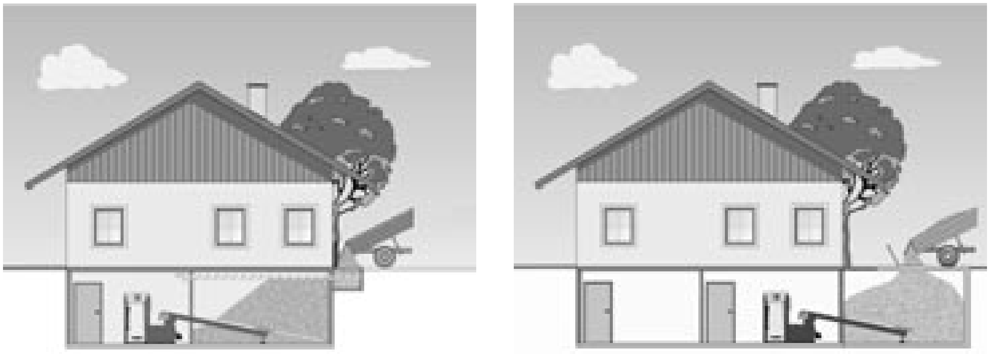


Figure 8

The fuel can be transported from the store to the boiler in various ways:

- Flat floor with horizontal hydraulic feed bar – expensive, but the best possible use of the space, can handle any fuel.
- Rotating spring feed is cheaper and can be used for both pellets and chips.
- Inclined floor with a screw conveyor (only suitable for pellets) – as the gradient has to be at least 35°, the store should be long and narrow to keep the unused volume down to a minimum.
- Inclined floor with a suction pipe – only suitable for pellets. The distance between the store and boiler room may be up to 15 metres with a pneumatic feed system.

The selection of the storage system has implications for the transport and delivery systems, which must be considered. Above ground silos need delivery vehicles that can blow in the fuel. Subsurface silos can be filled by all vehicles with tip loading. This is the most common solution in Austria.

(1) Store size

The size of the fuel store depends on many factors: anticipated fuel requirements, fuel type, reliability of deliveries, space available, delivery vehicle capacity etc. In existing buildings adjusting the fuel delivery intervals to the available storage space is cheaper in most cases than putting in a new store outside the building.
If you need to build a new store, you should ensure that the storage space is larger then the actual truck load to ensure cost-effective fuel delivery. Underground pellet tanks have recently come on to the market. An Austrian company, 'Geoplast' produce the 'Geotank'. Leitl, another Austrian company also supply 'Earthtanks'. For further information log onto www.eurotank.at/leitl.htm.
Software for calculating fuel demand and feasibility can be downloaded from www.bioheat.info.

(2) Specifications for store and boiler room

The boiler room has to be separate from the store for reasons of fire safety. When planning the boiler room, sufficient space should be allowed for daily operation, maintenance and repair work. Experience has shown that replacing the screw conveyor for fuel feeding requires most space. Also ensure that there is enough room for cleaning the surface of the heat exchanger (except if there is an automatic system). The average space required for a boiler in the relevant power range should be between 20 -30sqm.

(3) Safety features for a pellet store

Pellet stores have to meet special safety requirements to prevent problems such as damage to the store, dust explosions or moisture absorption from occurring.

The ideal pellet store would therefore display the following features:
- Solid walls that can withstand the pressure of the pellets and are fire resistant for 90 minutes
- Completely dry
- A protective rubber mat covering the wall that the pellets hit when being pumped in
- Fireproof, properly sealing door to the store with wooden boards protecting it against the pressure of the pellets
- No electrical installations
- Earthed pump pipes that prevent electrostatic sparks from occurring during loading

Once a year the dust that has collected should be removed and the screw conveyor bearings lubricated.

(4) Fuel supply

Wood fuels are generally delivered by truck or tractor trailer that tips the fuel into the opening in the store. Pellets are usually delivered in tankers.

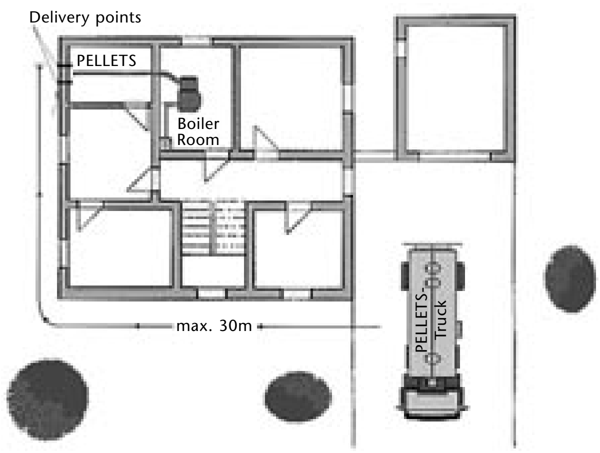


Figure 9: Example of a store location in a smaller building with pellet delivery by tanker that pumps them into the store

As 1 cubic metre of pellets has four times the calorific value of 1 cubic metre of dry chips, the frequency of deliveries is much lower than for chips. As a result, pellet heating systems may be a better solution in urban areas where the traffic plays an important role.
There should be enough room for the delivery vehicle to turn.

If pellets are pumped into the store, the following safety precautions should be taken:
- The driver must check before unloading that the store meets the safety standards
- He has to ensure that the boiler is not in operation (lower pressure in the store could cause backburning)
- The load pressure should be limited to avoid damage to the store and prevent the pellets from crumbling.

If wood fuels are tipped into the store, the following points should be observed:
- Deliveries should be made at times when they cause least disturbance to residents (e.g. late morning)
- Safety precautions should be taken to ensure that nobody could fall into the store. A steel grid is the best guard. However, the mesh has to be wide enough to prevent it from becoming choked during unloading (at least 20x20 cm)
- When deciding the location of the openings in the store, the fact that dust emissions occur during unloading should be taken into consideration
- Any fuel left lying after unloading should be removed to prevent problems with the neighbours

Automatic wood-fired boilers

(1) Selecting the boiler

Automatic boiler models are available in various capacities from 50 to 500 kW. The most common include:

• Compact units: these are larger versions of household pellet boilers – they are comparatively cheap and very suitable because they are designed as household boilers and not for use in the wood industry. This means that they have such comfort features as automatic cleaning, electric ignition and high reliability.

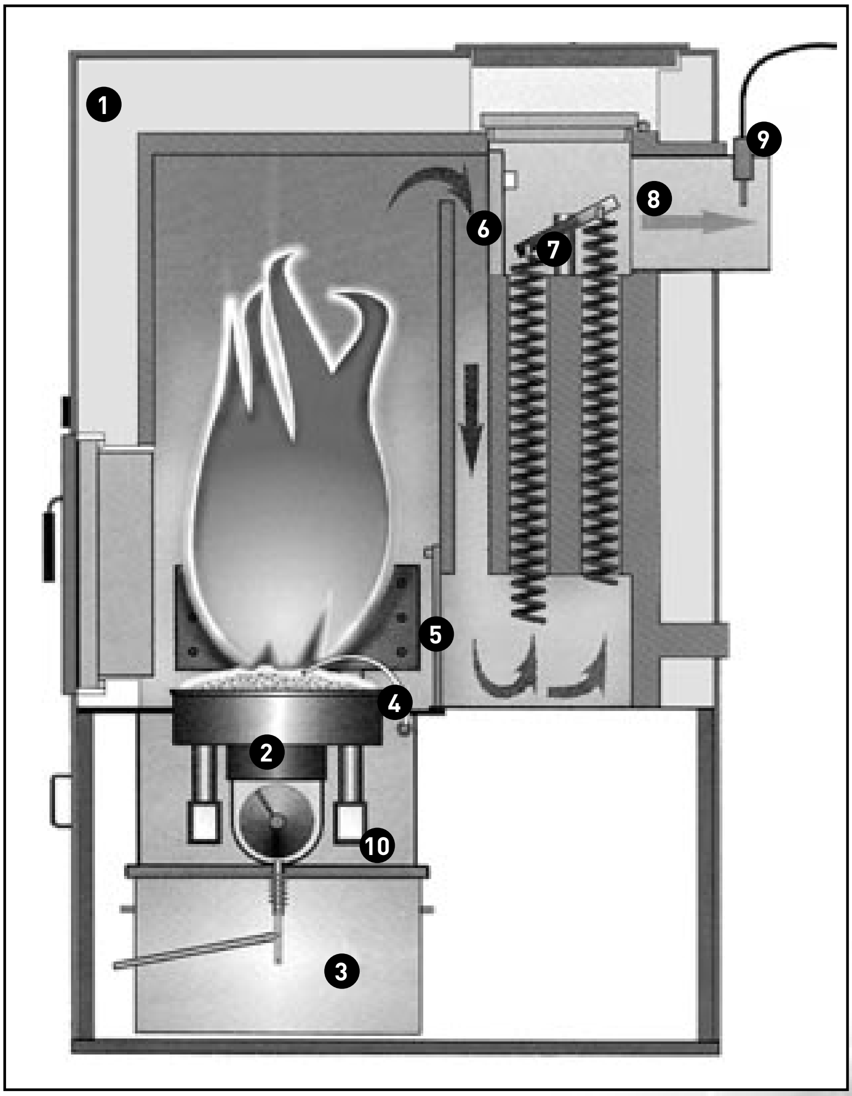
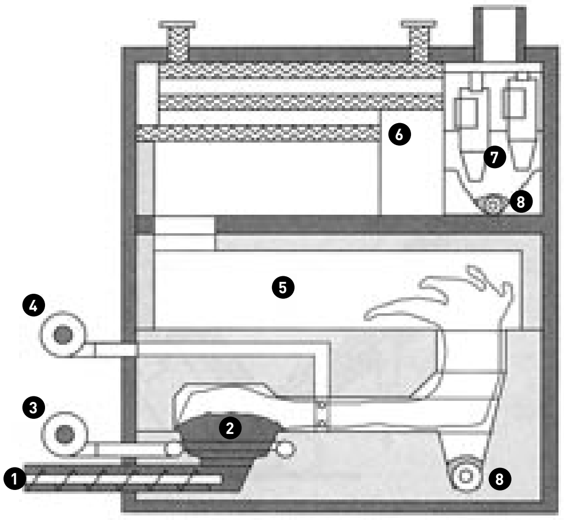


Figure 10

Compact unit

Key
1 Insulation
2 Burner head
3 Ash pan
4 Sensor
5 Ring for secondary air intake
6 Heat exchanger
7 Automatic heat exchanger cleaner
8 Flue connection
9 Lambda sensor
10 Primary air intake

• Underfeed burner: these boilers are suitable for dry fuels with a low ash content, such as chips or pellets and were designed for use in the wood industry.
Check if reliability and operational comfort are confirmed by the experiences of other users in building applications.

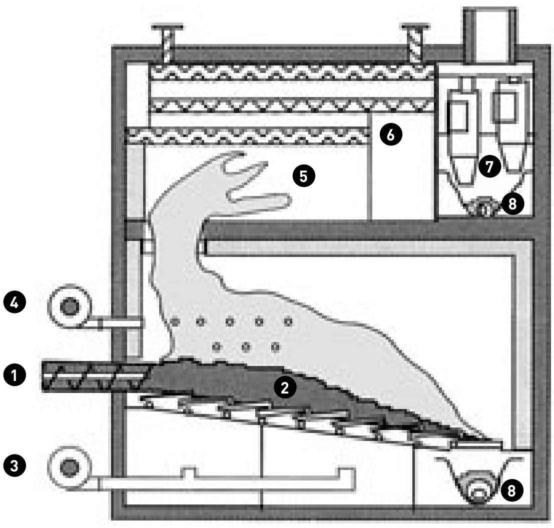


Underfeed burner

Key
1 Auger feed
2 Burning wood
3 Primary air intake
4 Secondary air intake
5 Combustion chamber
6 Heat exchanger
7 Flue gas dedusting
8 Ash discharge

Figure 11

• Boilers with grate feed: these are more expensive, but are also suitable for wood fuels with a high moisture and ash content



Key
1 Auger feed
2 Moving grate
3 Primary air intake
4 Secondary air intake
5 Combustion chamber
6 Heat exchanger
7 Flue gas dedusting
8 Ash discharge

Figure 12

• Converted oil boilers with a pellet burner: a common solution in Scandinavia. It involves fitting a pellet burner to an existing oil boiler. A very cheap alternative, it does however have certain disadvantages: the boiler output sinks by about 30%, and ash removal and boiler cleaning can involve considerably more work.

Sochinsky's Annual Load Duration Curve

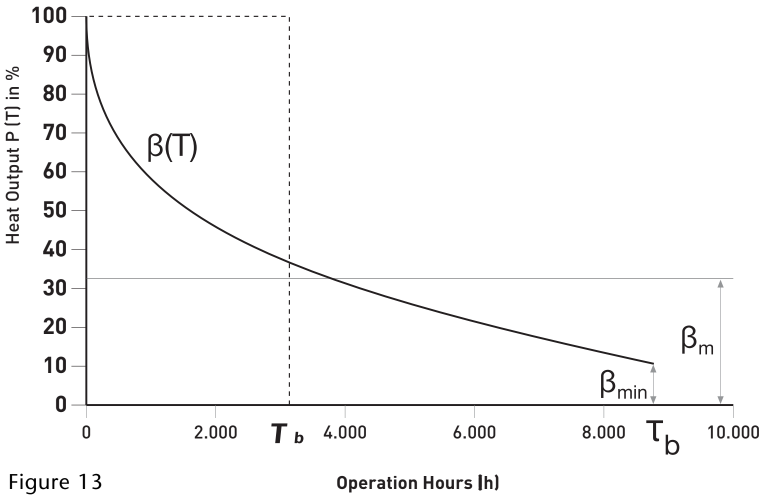


Figure 13

Gleichungen

$$\beta(T) = 1 - \left((1-\beta_{min}) \times T^{\left(\frac{\beta_m - \beta_{min}}{1-\beta_m}\right)} \right)$$

mit

$$\beta(T) = \frac{P(T)}{P_{max}} \quad \text{und} \quad T = \frac{\tau}{\tau_b} \quad \tau_b < 8760 \text{ h p.a.}$$

$$\beta_m = \frac{Q_j}{P_{max} \times \tau_b} = \frac{P_{max} \times T_b}{P_{max} \times \tau_b} = \frac{T_b}{\tau_b}$$

$$\beta_{min} = \frac{P_{min}}{P_{max}}$$

$\beta(T)$ ... Loading Rate
β_{min} ... Minimum Loading Rate in System
β_m ...... Maximum Loading Rate in System
τ .... Time
τ_b .... Operation hours of system
T_b .... Operation hours of system at full load
Q_j .... Gross Annual Heating Output
P .... Heating output of system

(2) Strategies for compensating for load variations

In winter every heating system is subject to great load fluctuations that depend on the weather, users' habits etc. The maximum output is only utilised very briefly during periods of very cold weather. In contrast, the boiler is operated for long intervals at low load. It is therefore important for the boiler to be operated efficiently in off-peak periods. This can be achieved in one of the following ways:

- 1) A conventional (oil or gas) boiler supplements the wood one to cover the peaks and act as a back-up system. The wood boiler's capacity is reduced to around 60-70% of the maximum output. It can thus provide 90-95% of the power required for heating, as the demand peaks are only of short duration. To guarantee 100% supply security, the capacity of the oil boiler should be able to cover the maximum output. This solution is particularly good if an existing oil or gas heating system can be used.

2) The wood boiler can provide the maximum capacity, while a buffer (a hot water tank) covers short-term load fluctuations and ensures that the boiler can be operated efficiently during off-peak periods. In summer the buffer can be used for storing solar energy. This solution has the advantage that only one flue is required.

3) Combination of two wood boilers. The second boiler increases the reliability of supply (for this reason it should have a separate fuel supply system) and ensures that the heating operates efficiently, even in off-peak periods. The best of the three alternatives has to be worked out in each individual case. What is important is that the heat load calculations are correct.

(3) Safety features

A biomass boiler has a somewhat slower response time than an oil or gas-fired one. If there is a power failure, the fuel in the boiler carries on burning thus generating additional heat that has to be dissipated. One option is an open expansion tank to enable the steam to escape as soon as the water temperature reaches 100°C. An alternative is a safety heat exchanger that is cooled with running water if the boiler temperature gets too high. A buffer with natural circulation by convection is another solution. As a power failure can disrupt the electronic boiler control system, the pumps responsible for circulating the hot water in the home should not be controlled by the boiler electronics.

To prevent backburning in the fuel store from the boiler, additional safety features are required. They usually consist of an interruption to the fuel transport system (e.g. a star feeder or chute for the fuel to fall into the boiler) and a sprinkler system, which floods the fuel transport line in the event of backburning.
Another important feature is a device that mixes the cool return flow to the boiler with the hot outflow before it enters the boiler to prevent condensation of the flue gas in the boiler which can cause corrosion. All the relevant safety standards are described in EN 303-5.

Noise

Biomass boilers that are not installed properly may cause noise pollution. Sources of noise are primarily the air and flue gas fans and the fuel feed system. To prevent noise problems, the following points should be taken into consideration:

1. Adjust the architecture. Bedrooms should not be located directly above the boiler room. Where possible, the chimney should also not run past the bedrooms.

2. If it is a new building, elastic filler should be inserted between the concrete floor and the walls in the boiler room and the store.

3. All the contact points between mechanical parts and walls or floor should be sound proofed (e.g. where the screw conveyor from the store goes through the wall into the boiler room, the boiler base etc.)

4. Ask the boiler manufacturer what steps have been taken to keep noise emissions down to a minimum (e.g. careful selection of the motor, R&D projects to reduce noise etc.). Sound proofing material such as rubber mats etc. should be supplied with the boiler.

5. Visit reference systems to listen to and compare the noise emissions during boiler operation. No standardised noise level has been determined to date, as the noise emissions depend very much on local conditions. There can be considerable differences in boiler quality in terms of noise. Delivering and unloading the fuel can also cause noise. Problems can be avoided by selecting a suitable fuel store location and having fuel delivered at times when only a few neighbours are at home.

Emission Limits

Currently, a testing standard or emission limit does not exist for small wood fired boilers in Ireland. However wood fired boilers from Austria are tested according to the European Standard EN 303-5(Heating boilers for solid fuels, hand and automatically stoked, nominal heat output of up to 300kW). For information on emission limits log onto: www.blt.bmlf.gv.at Commercial sector (Austria BGBl 331.Verordnung: – FAV, 1997)
This standard is valid for medium scale wood fired boilers with automatically fed systems, which are used for space heating and/or water heating.

Heat losses through exhaust gas should be below 19%. Emission limits for Commercial boilers (100-350kW)

Boiler Capacity	**Emission limits [mg/m3]**			
	Dust	CO	NOx1	HC
50 kW ≤ 100 kW	150	800*	250-500	50
>100 kW ≤350 kW	150	800	250-500	50

Hot water supply and the integration of solar energy

The combination of a biomass boiler and a solar hot water system can be a particularly attractive alternative. In the summer months the biomass boiler can be switched off as the solar system can supply hot water demand. This not only reduces the maintenance work, but also emissions and energy loss caused by operation at low heat loads. The buffer required for the solar system can be used in winter for compensating for load fluctuations, which is a considerable advantage both at peak and low loads. If a low-temperature heating system is installed, solar energy can also be used for heating the space in addition to the water – especially in between seasons. Another advantage is that a solar system is clearly visible thus enhancing the image of the project.

In Austria where the most combined systems for solar energy and biomass have been installed in Europe, two concepts have become established that offer considerable advantages in terms of simplicity, costs and energy efficiency. Both involve providing hot water and heating with a two-conductor system. A two-conductor network reduces heat loss, installation is less work, it can be easily extended and enables low return flow temperatures – a basic condition for efficient operation of the solar collectors.

System 1: Two-conductor system with local hot water storage

Heat is generated by the solar collectors or the boiler. It is distributed throughout the house and circulated through the radiators if required. To provide hot water there is a heat exchanger that supplies the local hot water tank. This system is an attractive solution for example for terraced houses with relatively long pipes. In summer circulation loss can be reduced with this system, as the water only circulates periodically (e.g. twice a day) to fill the local hot water tank.

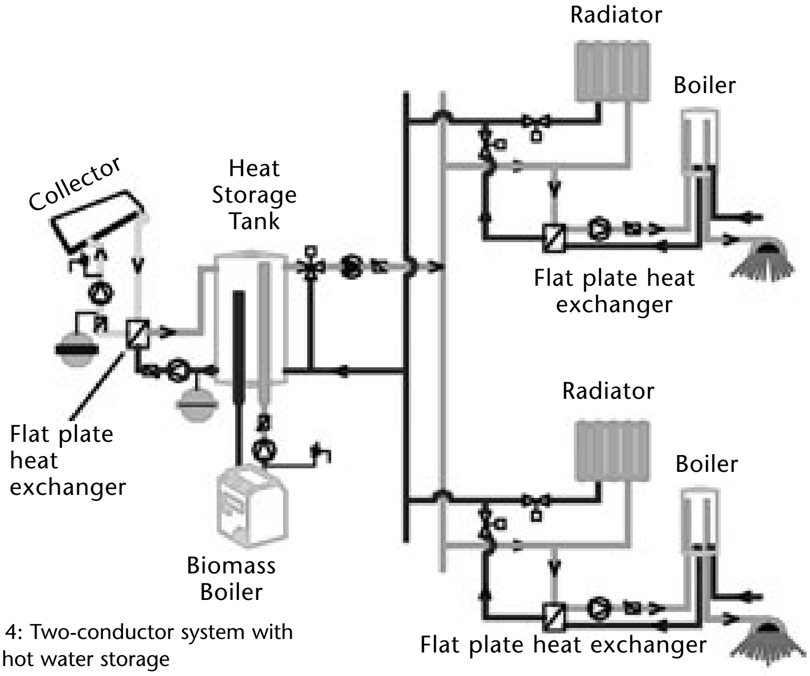


Fig. 14: Two-conductor system with local hot water storage

System 2: Two-conductor system with hot water supply based on direct heat exchangers

A two-conductor system with direct hot water supply using a plate heat exchanger is particularly cost-effective. The heat exchanger is integrated in a heat transfer station also containing a heat meter, cold water meter, differential pressure control for the radiator circuit, etc. Suitable products supplied by the following manufacturers are used in Austria:

Suitable products supplied by the following manufacturers are used in Austria:

Gemina Thermix A/S: C3-009
Navervej 15-17, 7451 Sunds, Denmark, Tel +45 (0)97 141444, Fax: +45 (0)97 141159, E-mail: kh@gemina-termix.dk

Redan: Sindalsvej 33-35m
8240 Risskov, Dänemark
Tel +45 (0)8621 2211
Fax +45 (0)8621 4212
E-mail: mail@redan.dk
www.redan.dk

Logotherm Haustechnik GmbH:
Ringstraße 18
04827 Gerichshain
Deutschland
Tel +49 (0)34292 7130
Fax +49 (0)34292 71347
E-mail: post@logotherm.de
www.logotherm.de

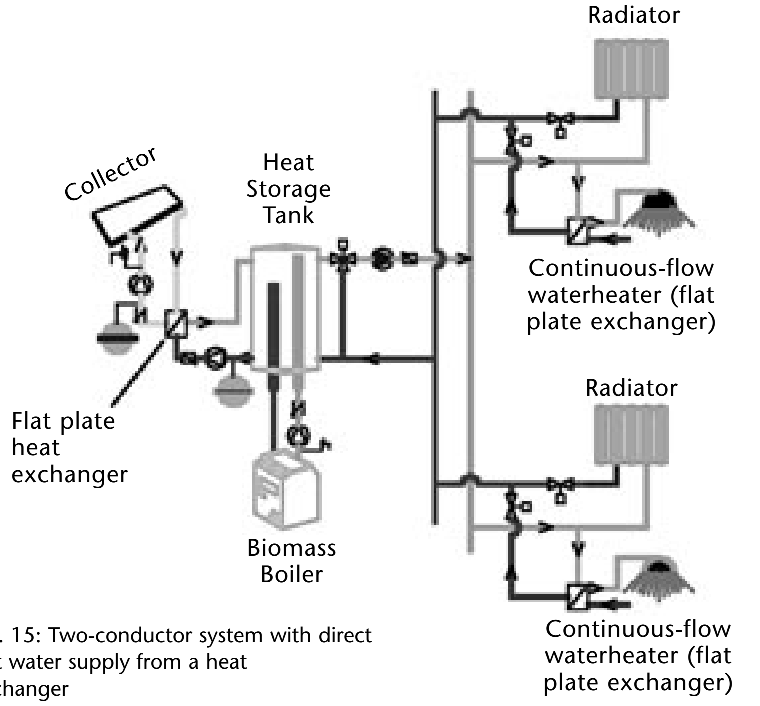


Fig. 15: Two-conductor system with direct hot water supply from a heat exchanger

Key points when planning a solar heating system combined with biomass

- Architecture: the integration of a solar system should be taken into consideration at the early stages of planning – to ensure considerable savings in costs. Solar collectors that are a substitute for the roof are both more cost-effective and more aesthetic compared to collectors mounted on the roof. The collector elements should form a closed surface that is not interrupted by chimneys etc.

- Return flow temperature: the cooler the water when entering the solar collectors, the higher the energy absorption. It is very important to adjust the heat use in the house to this requirement, e.g. by using the hydraulic concepts described above and installing low temperature heating systems (e.g. underfloor heating).

- Hydraulic solar collector connection: the collectors should be connected according to the low-flow principle (10-18 kg/m2 specific mass flow). As a result, there are greater differences in temperature in the collectors, lower heat loss, lower pump energy consumption, better layering in the buffer and lower pipe diameter. The collectors should be connected in series and not in parallel. No Tichelmann connection! Hydraulic compensation should be achieved with the right dimensioning and not with fittings where possible.

- Heat storage management: the heat should only be stored in one buffer where possible (more cost-effective and less loss). The buffer should be well insulated and not very far away from the collectors. If the solar energy is to be used efficiently, it is very important for the buffer to display good temperature layering and the hot and cold water not to be mixed. Self-regulating layer chargers should be preferred. The biomass boiler intake should be connected to the middle or upper area of the tank to enable part of the buffer to be used for compensating for load fluctuations.

- Orientation of the solar collectors: the collectors should be oriented to face south. Deviation of 30 degrees to the west or east only leads to slight reductions in energy absorption. To use the sun's energy to the full in summer, the angle of the collectors should be 30-45 degrees. If solar heating plays an important role during the colder months, the collectors should be tilted more.

- Dimensioning of the solar system: the collectors should be designed to cover 90% of the hot water demand in summer (or slightly less) for financial reasons. Simulation calculations should be carried out to determine the right size for the collector area and the buffer. Fig.16 shows the result of such simulation calculations for a building with a rating of 100 kW that was carried out by the Institute of Heat Engineering at Graz University of Technology.

RETScreen provides software for renewable energy project analysis, including wind.
The software can be downloaded free of charge from this Canadian Government Natural Resources website.
http://www.retscreen.net/

In addition there is a software programme available here in Ireland; known as T-sol it is available through the REIO Bookstore on www.sei.ie/reio.htm T-sol will help in the professional design for a solar thermal system for both solar water and space heating.

REIO Solar CD

This resource contains a "best of" selection of presentations, papers and brochures from SEI REIO's solar energy events over the past three years. The CD is an invaluable source of information for professionals and decision makers on:
-solar technologies and their use in Ireland
-policies and regulations supporting the development of solar energy
-tools for implementing solar energy in buildings
To order your free copy, email renewables@reio.ie

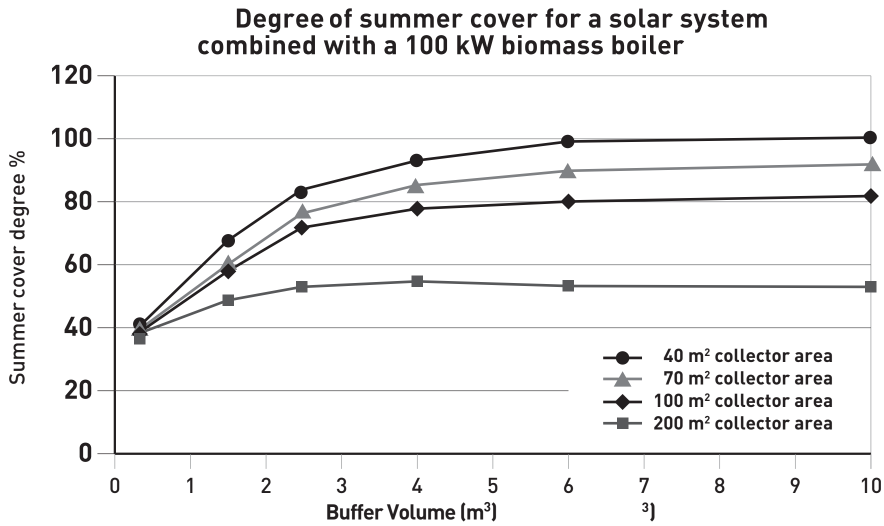


Fig. 16

System care and maintenance

The amount of work involved in maintaining an automatic wood-fuelled heating system depends on various factors, such as whether the boiler has an automatic cleaner for the heat exchanger and automatic ash discharge, whether remote monitoring of the system is possible, whether chips or pellets are used etc.

Typical activities to be carried out include:
- Visual inspection of the boiler
- Rectifying minor problems
- Purchasing the fuel
- Removing the ash

The time required naturally depends on the size of the system and fuel consumption – i.e. fewer hours for smaller systems. According to the boiler manufacturers supplying compact, fully automatic boilers for large buildings, the maintenance work for state-of-the-art boilers using pellets or high quality chips does not exceed 30 minutes a week.

If the following steps are taken, the work involved can be reduced:

- Operation and maintenance of the system contracted out to a facilities management company
- Automatic ash discharge
- Automatic heat exchanger cleaning
- Fuel delivery organised by the pellet suppliers

In Austria most problems have occurred to date because the operator did not receive adequate training on how to run the boiler. Training should cover at least the following points.
- Start up
- Routine operation
- Typical faults
- Rectifying the faults
- Controlling combustion

It is very important to agree on a maintenance contract with the boiler manufacturer. Carrying out an annual service is vital for long-term trouble-free operation.
Furthermore, a maintenance contract frequently includes an extension to the warranty period and guarantees that any faults will be rectified at short notice.

Disposing of the ash

Wood ash is not dangerous and is frequently used as a fertiliser. In urban areas it can usually be disposed of with domestic waste.
Local regulations should be observed.

The table below shows the main constituents of wood chip ash (Obernberger 1997)

Ash constituents	SiO_2	CaO	MgO	K_2O	Na_2O	P_2O
(% of weight)	24.6	46.6	4.8	6.9	0.5	3.8

The zinc content may be between 260-500 mg/kg, while cadmium can account for 3.0-6.6 mg/kg.

Further Information:

www.bioheat.info

Bioheat Hotline:

023 29171

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