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- *Gasifier-type firewood boilers are suitable for heat production for large homes and small commercial installations.*
- *This note outlines how gasifier-type boilers operate, as well as considerations with regard to installation and connection, and investment and operating costs.*

Gasifier-type firewood fuelled boilers

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The past decade has seen considerable advances in efficiency and emission profiles of gasifier-type firewood boilers, making them a suitable source of sustainable heat production for large homes and small commercial installations. These appliances have heat output capacities in the range of 15–145 kW, enabling them to replace significant quantities of fossil fuel, particularly home heating oil.

In line with the development of gasifier-type firewood boilers, supply of well graded, dried firewood is rapidly increasing, with a number of companies already active in the market. Expanded harvesting, storage and drying systems are being put in place by the companies concerned, with the objective of producing pre-dried quality fuel, that can be supplied bagged or on pallets, reducing the need for dedicated storage space and prolonged drying by the end-user.

Gasifier-type boilers and their operation

Normally gasifier-type firewood boilers work using a downdraft gasification system, which is a two-stage process. Wood is put into the gasifier/feed chamber, usually made of stainless steel, and as the fire lights, the bottom logs begin to burn and release heat – the first stage of the process. As the chamber begins to heat up volatile gases are emitted, the downdraft pushes the gas to another chamber where it is combusted – the second stage (Figure 1).

The wood gases are drawn through the slotted orifice (**4**) and into the ceramic swirl combustion chamber (**5**), where the intensive swirl mixes it thoroughly with the super-preheated secondary air introduced from the rear, and combustion takes place. The subsequent path of the fuel gases through the superheated after-burn chamber (**6**), underneath the swirl chamber, is prolonged in order to allow adequate reaction time for the combustion process.

The ceramic liner (**3**) significantly increases the temperatures at the inner wall. This means the entire chamber is hotter, so the wood gases more effectively. The temperature at the inner walls of the feed chamber is too hot for tar deposits or acids, that can damage the boiler, to form.

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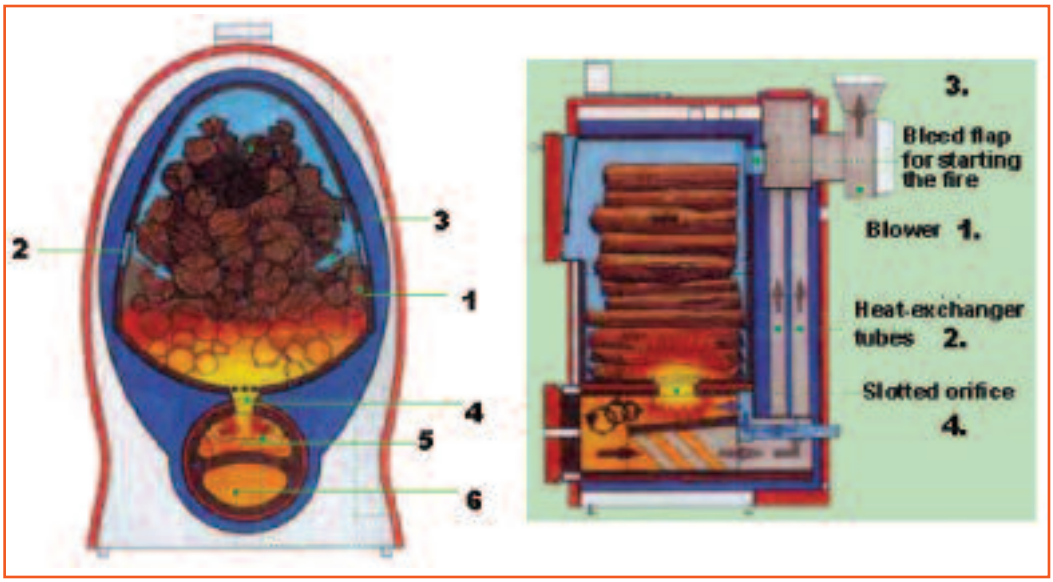

Figure 1: Example of a modern firewood gasifier – the Herlt system.

The system works by simply laying wood into the feed chamber (**1**). The chamber is narrow at the top, widening further down, and is where the wood gas is generated. This is the ideal geometry to keep the flames from burning up into the centre of the wood stacked above the fire. The primary air supply (**2**) is from both sides, and this helps ensure that the stack burns away close to the bottom, so the wood in the stack will keep feeding gradually down into the fire. These units can be charged with sufficient fuel to provide heat and warm water for a large house for at least a full day. With a suitably sized buffer tank this can be extended significantly, to as much as once a week for hot water or once every 2-3 days during the heating season.

Boiler installation and connection

The unit is connected to a water storage tank as, unlike gas or oil boilers, a wood gasifying installation cannot be simply switched off once it has heated the dwelling. Therefore hot water must be stored in an insulated accumulator tank. The minimum volume recommended is in the region of 50–70 l per kilowatt (kW) output of the boiler (Figure 2 provides an example of a typical installation).

The cost of the ancillary equipment depends on the existing plumbing system and connecting to it. (It is also possible to connect solar panels to the accumulator tank.)

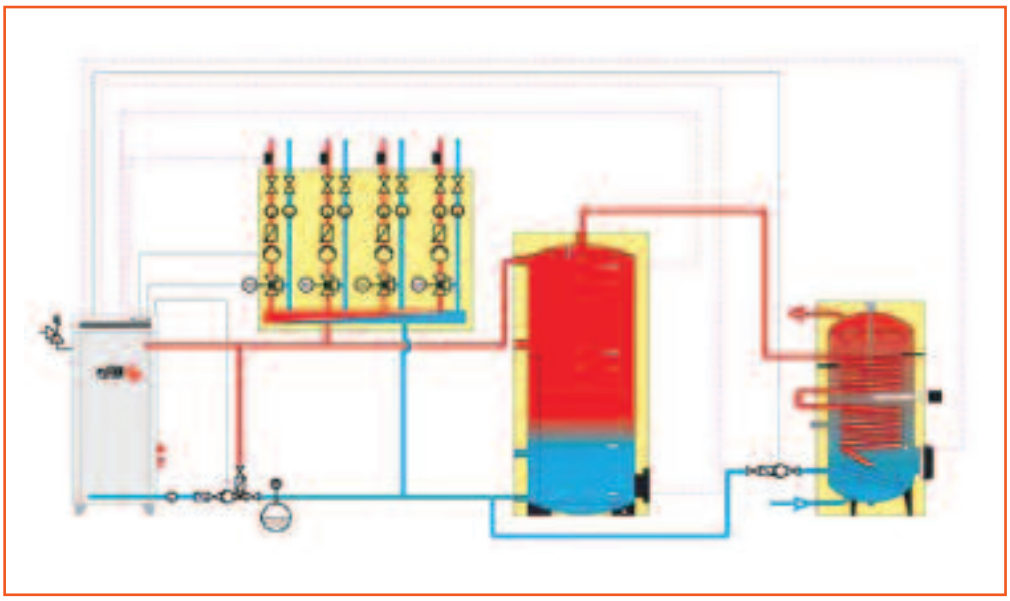

Figure 2: Schematic of a Fröling domestic gasifying system.[1]

[1] *www.powertechireland.co.uk*

Due to the nature of the boilers it is advisable to have them located in an outhouse, garage or cellar. When deciding where to locate the boiler the following issues need to be considered:

- the ventilation of the boiler room should be in line with the manufacturer's guidelines, which should demand a good thermal draught effect in the room;
- the flue gas system needs to be designed in relation to the size of the boiler and must prevent down draught; insulation is also a very important safety issue with regard to flue design, as exhaust gas temperatures commonly exceed 150°C;
- the boilers are manually fed and there needs to be unrestricted access to the boiler from where the wood is stacked;
- removal of ash is a necessary part of the smooth running of the boilers and is usually carried out weekly; due to the low ash content of wood (<1%) the average size house will only produce a bucket load of ash with every 20 charges of the boiler;
- on opening the hatch to where the logs are loaded some smoke and ash may escape; some manufacturers install a fan to extract this smoke and ash, located directly above the loading chamber.

The correct sizing of the boiler depends on the U-values throughout the house,[2] and on a number of other factors such as the size of the house, occupancy levels and air tightness etc. Boilers may be slightly oversized as the buffer tank will absorb all the excess heat that is generated.

Investment and operating costs

A typical investment cost based on boiler and ancillary equipment is provided in Table 1.

Operating costs and return

As stated, the market for gasifier-type firewood boilers ranges from single, detached houses in a rural setting, to small commercial installations, which are removed from gas pipelines and are dependant on oil.

As an example, consider a house of 200 m^2, which requires a 22 kW boiler. High end boilers have a feed chamber capacity of 150 l[3], which could deliver enough energy to heat a 2500 l buffer tank to 85°C. Heat is stored in a well insulated buffer tank. This might be enough heat for three days, with relatively efficient insulation. However, this could last longer for houses fitted with the latest in insulation design and materials.

- Assuming that a 150 l feeding chamber can take approximately 120 litres of wood, or 0.12 m^3 (solid volume), it is possible to calculate the amount of wood needed per year.
- Filling the chamber once every three days amounts to over 120 loads of wood over the full year (in practice less loads will be required). This amounts to a maximum of 15 m^3 (solid volume) of firewood for the entire year, or about 8 tonnes.
- Assuming that the moisture content of the firewood is about 25%, this equates to an energy content of about 13.8 GJ per tonne, or 110 GJ.
- 1000 l of oil contain 36 GJ, so the equivalent amount of oil required for heating would be 110/36 GJ, or a little over 3000 l.
- Home heating oil currently sells at about €600/1000 l, so the heating cost per year with oil would be about €1,830. Firewood is currently about €120/t[4], so the heating cost per year with firewood would be about €960. The potential fuel saving is therefore about €870.

Table 2 lists the manufacturers and suppliers of gasifier-type firewood boilers on the Irish market.

Table 1: Typical investment cost based on boiler and ancillary equipment.

Item	Cost
Wood gasification log boiler	€8,595
1650 litre hot water accumulator tank	€985
Insulation jacket (100 mm top, bottom & sides)	€685
Other fittings and ancillary equipment	€2,455
Shipping	€150
Installation	€1,000
Subtotal	€13,870
+VAT	€16,780

[2] *U-values indicate the heat flow through materials - the higher the figure, the higher the heat loss.*
[3] *Larger boilers can accommodate charges of well over 500 l fuel at a time.*
[4] *This figure is for seasoned, delivered firewood. If the gasifier-type owner was willing to do most of the labour themselves the figure could be significantly lower.*

Table 2: Manufacturers and suppliers of gasifier-type firewood boilers on the Irish market.

Manufacturer	Supplier	Description	Model	Output (kW)	Cost including boiler and installation + (VAT)
Atmos	Choice heating solutions	Gasifying log boiler	DC	15-75	-
ETA	Evergreen energy Ltd	Gasifying log boiler	SH	20-60	€15,0 00 (40kW)
Froeling	Power Tech Ltd	Gasifying log boiler	FGH	20-70	€10,0 00 (20kW)
Gerkros	Gerkros heating technology	Gasifying log boiler	Effecta	35	€3,50 0/Boiler
HERLT	Sustainable landuse company	Gasifying log boiler	Herlt HV	15-145	€14,2 00 (22kW)
Köb & Schäfer	Clearpower Ltd	Gasifying log boiler	Pyromat	35-120	€15,0 00 (35kW)
Windhager	Heatright Ltd	Gasifying log boiler	HMX	21-40	-

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For information and a free on-line advisory service on the wood energy supply chain, the quality of wood fuels and internal handling visit ***www.woodenergy.ie***

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