Wood Energy from Farm Forests

A Basic Guide

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Introduction

What is wood energy?

Wood energy is energy produced from wood and/or wood by-products. It is a home-grown, renewable, sustainable, carbon-neutral and secure source of heat, electricity and bio-fuel.

Ireland has excellent wood growing conditions: growing and using wood as a source of energy can make Ireland less dependent on international energy prices. Modern wood-fuelled heating systems offer the same level of comfort, convenience and reliability as oil or gas boiler systems.

The use of wood to provide heat has great potential in Ireland. Wood as a source of heat only (rather than the production of electricity) has the largest potential in Ireland: this is a proven technology with very high efficiency and is locally available. The demand for wood fuel is increasing rapidly as it becomes more competitive compared to other heat forms.

Wood is a form of biomass produced from organic material. Other forms of non-woody biomass used for energy purposes include Miscanthus, grains, animal wastes, municipal waste products, rape and maize. These are also sometimes referred to as 'bioenergy' or 'biofuel'.

Spiralling oil prices remind us that we are gradually running out of fossil fuels such as oil, gas and coal. Burning fossil fuels releases huge amounts of carbon dioxide (CO_2) and other greenhouse gases into the atmosphere trapping the sun's heat (greenhouse effect). This has led to global warming, a major cause of serious environmental damage.

In contrast however, using wood as a source of energy does not contribute to global warming because CO_2 released during the wood burning process is equal to the amount of CO_2 taken out of the atmosphere during tree growth through photosynthesis. Even by taking harvesting, processing, etc. of wood fuel into account, CO_2 emissions are reduced by more than 90%.

Farmers as wood fuel growers?

Growing wood as an energy crop isn't as mad as it sounds. Many farmers are doing this already throughout Europe. We only need to go back a few decades when 20% of the agricultural land in Ireland was devoted to growing fuel: oats to "fuel" horses pulling the plough, before tractors (and fossil fuel) took over.

If the same trend takes place as in other European countries, energy crops may well displace food crops on Irish farms. Ireland imports more than 90% of its energy with energy demand increasing by approximately 5% per year. This makes Ireland the most import-dependent country in Europe for energy and therefore the most vulnerable. Wood energy will assist substantially in reducing the amount of imported fossil fuel, increasing our self-sufficiency and therefore securing Ireland's long-term energy security.

Energy wood is a real and secure opportunity. Farmers are in a good position to benefit: both as growers of energy wood and as users of cost-effective wood energy. Ireland's soil and climatic conditions are excellent for timber growth. Sawlog (large diameter wood) is and will remain for the foreseeable future the most profitable product that a forest can produce. Sawlog can be produced quicker by carrying out thinning. Large volumes of pulpwood (smaller diameter wood) are produced in earlier thinnings. Local energy wood markets need this pulpwood and will make these thinnings more financially viable, particularly for smaller plantations.

Changing farm conditions may also give landowners the opportunity to produce wood fuel as a main crop.

Construction timber will remain the most profitable forest product

Wood fuel sources

Wood fuel can be produced from forestry timber, forest residues, arboricultural thinnings, untreated (clean) wood waste such as sawdust and other sawmill residues and also willow plantations.

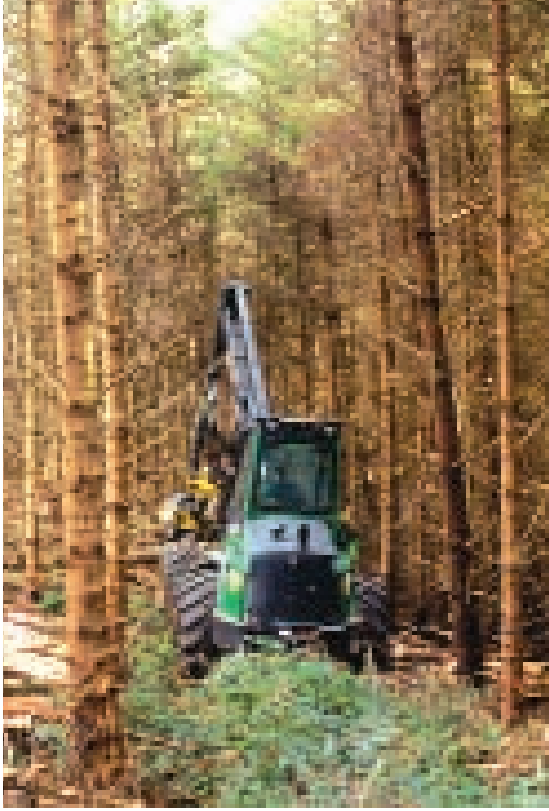
Conventional forestry thinnings

"Conventional" forestry provides great potential as an alternative farm enterprise and supplies different categories of wood. Larger diameter trees tend to have a higher value and include categories such as sawlog and palletwood. Such timber provides a welcome tax efficient income and is much sought after by sawmills.

Thinning is the removal of a proportion of trees from a forest. This increases the quality and size of the remaining trees, allowing them to produce sawlog timber. Thinning optimises the return from your forest crop, provides periodic returns as the crop matures and improves the biodiversity value of the forest. Less economic, first thinnings involve the removal of mainly smaller diameter trees (pulpwood). These large pulpwood volumes would have been traditionally used as the raw material for panelboards (MDF, OSB and chipboard). Pulpmills are often located a long distance from where the forests are located making it less economic due to the haulage distances involved. As most planting over the last fifteen years has been carried out by farmers, most pulpwood will be supplied by farmers in the coming years.

In addition to the above mentioned thinning assortments, energy wood could be produced from the remaining assortments such as the crown, branches, unsaleable assortments or undersized trees. This additional income can help to reduce

Pulpwood for wood energy



Thinning adds value to a farm forest

the cost of thinning and add value to it. This should only be considered where the soil is sufficiently nutrient-rich to allow for this additional wood volume to be removed from the site rather than being returned to the soil as valuable nutrients. Nutrient-poor areas such as certain upland and bog areas are unsuitable due to nutrient loss and soil damage by large harvesting machines.

The emerging wood fuel market could provide the solution for pulpwood as thinnings can be harvested locally, processed locally and provide a source of renewable heat locally. This is a win-win situation for the local farm forest grower, the consumer and the environment.

For further information on thinning, contact your local Teagasc forestry development officer or have a look at Teagasc's farm forestry leaflet on " First thinning in conifers"

Chipping in a young broadleaf plantation

Sawmill waste

Clean sawmill waste such as off-cuts, sawdust, etc. can also be used to generate energy. This option is gradually gaining momentum in Ireland as more and more sawmills are using this resource to generate heat and electricity on-site.

Arboricultural material and other waste

Developers, landscape contractors, tree surgeons, local authorities and agricultural contractors produce thousands of tonnes of wood chip every year from removing trees, hedges, amenity plantings, branches, stumps, etc. Rather than regarding this material as a waste product that needs to be "disposed off", it could be used to generate heat or electricity if handled correctly.

Other sources include products that have been previously used such as wooden pallets, construction timber, etc. This material must be avoided due to contamination with paint residues, glue, wood preservatives, plastics, etc. Pressure-treated fencing stakes, varnished or painted furniture, chipboard, MDF, OSB, etc. cannot be used as a wood fuel because of the danger of serious air pollution.

Sawmill byproducts can be used as a source of heat

Willow SRF

What is Willow SRF?

SRF (or Short Rotation Forestry) - also referred to as SRC (Short Rotation Coppice) - is a specialised form of forestry and involves growing high yielding trees at close spacing and harvested at regular intervals. Willow is a species that coppices well. This means that when cut back, it will resprout from the stump producing multiple new fast-growing shoots suitable for energy production.

Willow planting in progress

Establishment and management

Willow can be successfully established on a relatively wide range of sites. Generally the most suitable sites are imperfectly to moderately well drained soils of good fertility. Poorly drained, infertile sites should be avoided. Harvesting operations are carried out in winter, making ease of access and trafficability requirements very important. Avoid fields that are too small, too wet, too steep or too awkward but rather work with your neighbours to plant few but large, good quality areas and spread the planting over at least three years to improve harvesting options.

Establishment and management are similar to other arable systems. Good soil cultivation is essential to facilitate ease of planting and successful establishment. Prepare ground well by deep ploughing; compacted soils should be subsoiled. Before planting, cultivate lightly with harrow or rotavator. All grass and weeds must be killed off prior to planting. Ensure optimum soil fertility levels.

Planting takes place from February to May. Machine planting takes place by inserting 20 to 25 cm long cuttings and with a minimum diameter of 9 mm three quarters into the soil. The material should preferably be taken from one-year old shoots. Plant immediately or keep in cold storage before planting. Do not allow cuttings to dry out. Plant a stocking density of up to 20,000 stems per hectare. Rust damage (a fungal willow disease) is reduced by planting a mixture of different willow clones (similar to varieties). Good fencing is essential as all livestock as well as rabbits, hares and deer must be excluded for the duration of the crop's lifetime.

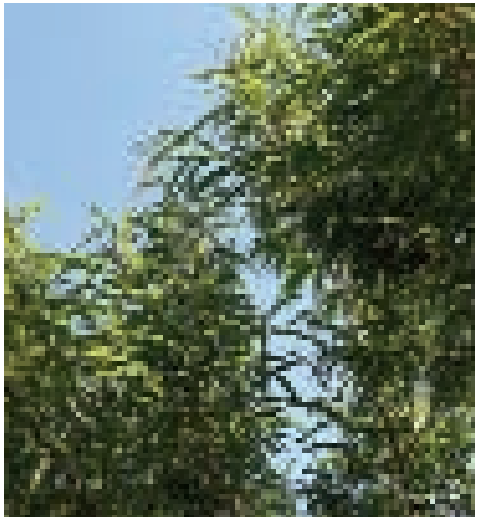
Vegetation control must be first-rate as recently established young willow plantations are very susceptible to weed competition. It is vitally important to have complete control of competing vegetation, especially in the first two years of establishment. Apply an overall residual herbicide post planting. Spot treatment during the growing season may be necessary.

After one year, all willow shoots are cut back to encourage the development of multiple shoots. Repeated fertiliser applications for this purpose may be required to maintain productivity. Sewage sludge or slurry is sometimes used. Willow roots are very effective at capturing nutrients and heavy metals contained in the sludge which are locked up in the willow wood.

Willow is harvested after leaf fall over the winter so that nutrients contained in the leaves are returned to the soil.

Willow will be harvested for the first time after four years in the winter when the shoots are about six metres tall. After cutting, the stumps will resprout in the spring and the 2-3 year cycle recommences. A willow plantation has a typical lifespan of 15 to 25 years.

At present, most willow is cut, chipped and blown into a container in one harvesting operation. This operation requires heavy, expensive machinery producing wet chips (up to 60% moisture content) that will require thorough drying before storage can be considered. Specialised but expensive drying facilities can be installed to dry wet wood chips.



If wet wood chips are stored without appropriate drying facilities, they will start decomposing (rotting) which may lead to a substantially lower calorific (heating) value. Mould and fungal spores may also lead to health problems and boiler damage. Some larger installations are able to burn wet chips so that the above problem can be avoided.

A production of six to twelve tonnes of dry matter can be expected per hectare per year.

Economics/costs of SRF

Profit margins tend to be low because a low-value product (i.e. willow chips) must pay for the entire costly establishment, management and harvesting operations. In conventional forestry, the production of pulpwood (i.e. energy wood) as a by-product is carried by the production of high value timber such as sawlog and stakewood.

Establishment and early management costs tend to be high and include ground cultivation, fencing, pre- and post-planting vegetation control, supply and planting of cuttings and subsequent cutting back.

SRF may be economically more viable if carried out in conjunction with another enterprise.

A recently established willow plantation

For instance, the spreading of sewage sludge, slurry or waste water in a willow plantation may attract a "gate price". This is called bio-remediation or bio-filtration. It is advisable to secure market outlets in advance.

Grants may be available to establish short rotation willow plantations. Please contact the Forest Service for further information (Forest Service, Department of Agriculture, Fisheries and Food, Johnstown Castle estate, Co. Wexford; 053-9160200).

Advantages/disadvantages

Growing willow as a fuel crop has very distinct advantages as well as disadvantages.

Advantages:

- Secure long-term local resource
- Potentially viable alternative farm enterprise
- Establishment and management much similar to other arable crops
- Relatively low maintenance costs
- Using a willow plantation for bio-filtration purposes offers the following benefits:
  - Economic: gate price for sludge, etc.
  - Environmental: soaks up a lot of nitrates and phosphates, can be irrigated with contaminated water / sludge, can be used to clean up contaminated land
  - Social: visual benefits, rural employment, etc
- Very short lead-in period of only 4 years versus 15 for conifers
- It is regarded as an agricultural crop and therefore the Forestry Act 1946 doesn't apply which means that the land can be converted back to agriculture
- Another wildlife habitat created on farms

Disadvantages:

- Good quality land required
- Sufficient road access is required for heavy machinery
- Wet chips are difficult to dry (because willow chipping usually takes place prior to drying) and will start to deteriorate rapidly decreasing its energy value
- Poorer wood fuel quality due to the lower proportion of wood to bark in comparison to "traditional" wood chip from forestry
- Relatively low value and bulky product
- High establishment costs
- Usually high harvesting, storage and drying costs
- Willow plantations may be prone to diseases such as rust
- There may be issues in relation to conversion back to food production due to the potential build-up of contaminants in the soil
- Markets must be in close proximity to supply

Forage harvester with adapted maize head harvesting willow

Wood fuel:
types, harvesting and storage options

Energy wood can be used for the production of heat and electricity or converted to bio-fuel. It is most commonly used for the production of heat. The most common forms of energy wood are firewood logs, wood chips and wood pellets.

Firewood ready for delivery

Firewood

Firewood is probably the oldest and still the most widely used fuel source on earth. Demand for quality firewood in Ireland is growing rapidly. It is also the easiest wood fuel market for farmers to get involved in as normal farm machinery such as tractors, trailers and chainsaws can be used. After felling, the wood should be cut and split as soon as convenient as this will speed up the drying process. A very efficient way of preparing firewood is to use a firewood processor which will crosscut and split the firewood in one operation. Firewood processors vary in size from compact, highly mobile processors to huge machines able to process large volumes of firewood per hour. Some are PTO driven while others have their own engine.

Once the firewood has been processed, it needs to be fully seasoned for twelve months or preferably for two years to bring the moisture content down to approximately 20%. Firewood is usually stacked under cover ensuring optimal ventilation (for instance in a drying shed). Transport of either logs or firewood can take place using a tractor / trailer combination.

Most firewood in Ireland is sold per tonne so it is important for the buyer to buy wood rather than water: the weight of firewood may well have dropped by half during seasoning! Due to demand, most firewood for sale still requires additional drying at home: the wood's heat will otherwise be used to dry it in the appliance rather than heating the room. Burning damp wood may also damage the chimney and causes pollution due to incomplete combustion. Firewood is typically used in an open fire, closed stoves or in small (domestic) scale central heating systems (see page 23).

Wood chips

Logs can also be chipped and used for heat and/or electricity production. Wood can be sourced from conventional forestry (pulpwood from thinnings), willow SRF, arboricultural waste, sawmill off-cuts, etc.

Most wood chips used in energy production are sourced from forestry thinnings, especially first thinnings and later thinnings with a large pulpwood fraction.

This firewood processor will cut and split logs into suitable lengths

Drying

The importance of sufficient drying cannot be overstated. It is important to ensure that wood for energy has had a chance to dry out for 12 months or more before chipping takes place. Moisture content will have dropped from 50-60% to 35-45%. Chipping can take place once the wood has dried out sufficiently. Wood is nearly always felled and air-dried before chipping takes place for a number of reasons:

- Energy content is directly related to moisture content and therefore a higher price is paid for dried wood
- Transporting costs are lower
- Stacked, freshly cut wood chips will degrade (decompose, rot) rapidly, while producing harmful fungal spores and bacteria
- It is cheap and straightforward to air-dry logs while it is expensive and difficult to dry wet wood chips
- It will allow for needles and small branches to drop off so that those nutrients can be returned to the soil

One of the better ways to air-dry energy wood is to remove the cut trees from the forest. Logs can be stacked at roadside in an appropriate area in the forest where the logs are covered on top by a securely fastened tarpaulin. The logs can also be transported to a yard where they are stacked either in the open with a tarpaulin on top or in an open-sided, drying shed. Either option must ensure that ventilation around the logs is maximised.

Wood chips as a fuel are best suited to medium to large installations (upwards of 30 kW). The type of wood chip required depends very much on the size and type of heating system.

Chipping

Moisture content, calorific value, level of impurities and size and uniformity of chip are important elements and will affect the boiler's efficiency. The smaller the boiler's heat output, the more important size of chip and moisture content become.

The heating value of wood depends on the wood's calorific value. It is therefore important when considering buying wood chip fuel to determine prior to purchase if the calorific value is expressed per dry matter weight, per total weight, per stacked volume or per solid volume. On average 3-6 tonnes of wood chips will displace 1000 litres of home heating oil dependent on moisture content and other factors.

Different sized chipping machines are available that produce different types of chip dependent on the machine's power, size, technology and chipping mechanism.

Small-scale wood chippers are widely available and can be an additional on-farm enterprise

Chipping machines range from small-scale wood chippers that are either trailer-based powered by their own engines or tractor-mounted and operated by a tractor's PTO to huge, high capacity lorry-mounted chippers. Outputs range from a few cubic metres to a hundred cubic metre per hour. The type of chipping machinery will determine to a large extent the size and type of heating system that can be supplied with fuel.

Lorry-mounted chipper

Chipping forwarder

Wood chips can also be delivered by blowing them into a silo

Wood chips can be tipped into a stockpile in the corner of a shed

Farmers are in a good position to deliver wood energy services

Transport and storage

Wood chips are bulky and expensive to transport and are best used locally.

Transportation can take place using a tractor/trailer combination, curtain or bin lorry. Chips can also be delivered in large ½ tonne bags.

Chips can be tipped into a reception pit or in a stockpile in the corner of a shed. Wood chips can also be blown into a silo but this is a very inefficient and expensive delivery system. Wood chips should only be stored once moisture content has dropped below 35%.

If long term storage is necessary, logs should be protected and stored in the round and chipped when required.

Wood chip bunker

Wood pellets

Wood pellets are usually made from dry, untreated, industrial wood waste such as sawdust, shavings or chips which under high pressure and temperature is compressed and pelletised. A number of pellet production plants are operational in both Ireland and the UK with several more coming on stream. Pellets are also being imported from continental Europe and other areas.

Pellets can be purchased either bagged or in bulk. Bulk delivery of pellets is very similar to a delivery of home heating oil and is carried out by the lorry driver blowing the pellets into the storage space. Storage solutions include underground tanks, container units, silos or storage within the boiler room.

Sawdust is compressed through a die under high pressure and temperature producing wood pellets

Bulk delivery of wood pellets is very similar to the delivery of animal feed nuts

European wood pellet regulations require that a consistent, standardised pellet is produced. The regulations also cover the type of wood used and the storage and transport of wood fuels. Beware of very cheap wood pellets: they may not comply with the above regulations and may contain different types of contaminants.

A good quality wood pellet is pale brown without any other colours present and will have fallen apart in a glass of water after 15 minutes. If a match is held to a pellet, it should smell of wood smoke.

Wood pellets can also be delivered in either small or large bags

Wood briquettes

Wood briquettes are made from compressed sawdust and "look" like very large pellets with the same calorific value.

For further information on wood fuel, see "COFORD Connects" notes or COFORD's publication: "Wood for Energy Production, Technology - Environment - Economy", published in 2005.

Wood fuel heating options

There are a wide variety of domestic applications for wood heating, ranging from highly efficient stand-alone room stoves to central heating systems. Pellets can be used in small and attractive pellet stoves for individual room heating. Wood pellet or wood chip central heating systems can heat whole houses, providing space and water heating. Wood heating works very well in combination with solar panels, where the solar system provides the hot water needs in the summer time when the need for space heating is at a minimum.

Wood is also used very successfully in large installations ranging from hospitals and hotels to large industrial heat and power plants.

Room stoves

Everyone loves a wood fire; it really turns a house into a home. But open fires and old-fashioned stoves can be polluting, inefficient and inconvenient. More than 90% of the energy generated goes up the chimney in the case of an open fire while a traditional room stove has an efficiency of 20 to 50%. Prices start from around €500. Modern wood pellet stoves are highly efficient (80%), clean burning and totally automatic, saving you time and money. Prices range from €2,500 to €5,000. Such a system can be used for heating a single room, hot water or several rooms. Electricity is required to operate a wood pellet stove.

Wood pellet stoves have fuel storage built into the design so that a full 15-kg bag can be emptied into the hopper. This built-in hopper can hold enough pellets for a period of four to five days burning four to five hours per day.

It is important that there is adequate ventilation and that a clean air source is supplied to the stove, as the combustion process uses oxygen (in the same way as any fuel-fired appliance). The ash from a wood stove can be used as fertiliser in the garden.

Given that some stoves come equipped with an integral boiler for hot water and heat delivery, it is important that these systems are correctly integrated with the existing hot water system (e.g. cylinder).

Central heating systems

Modern wood chip or pellet boilers offer the warmth and comfort of wood heating but are highly efficient, clean burning and totally automatic, saving you time and money. They are nearly as convenient as oil or gas. More and more Irish homes and many houses in Europe have wood-fuelled systems as their sole source of central heating. These units are fairly costly with prices ranging from €5,000 to €15,000 plus installation costs.

This containerised unit houses fuel storage, boiler and solar panels

They are also very cost-efficient because their running costs are generally lower than oil. The higher the heat requirement and the bigger the system installed, the shorter the pay-back period on the investment. These systems can be easily plugged into the existing plumbing set-up.

Pellet systems

Automatic ignition, fuel supply and temperature control make these systems very user-friendly. The ash pan needs to be emptied every few weeks or less frequently, depending on use and automation. This wood ash can be spread in the garden as an excellent (organic) fertiliser. Output is usually larger than 15 kW with efficiencies of 90%.
It is recommended to install a hot water buffer store with the system to obtain maximum efficiency and autonomy: the boiler will transfer and store heat to the hot water buffer store. It is important that there is adequate ventilation and that a clean air source is supplied to the boiler: most chimneys consist of a double-lined stainless steel flue.

Bulk pellet prices are more competitive than those for bags and tend to be lower than the price of home heating oil. The wood pellet market (quality, supply and availability) is already well developed in Ireland and growing rapidly. Delivery of pellets is easy: they are delivered by lorry and are blown directly into the storage unit (just like feed nuts).

Storage solutions include container units, silos or hoppers. In contrast to oil or gas, it is important that storage facilities are located close to the boiler unit.

Wood chip systems

Central heating wood chip boilers also provide many of the advantages listed above. Wood chips can be sourced locally. The appliance will determine the wood chip used (quality, size, moisture content). Output is usually (much) larger than 30

Wood pellet central heating boiler

Wood chip central heating boiler

kW. The wood chip market is currently developing rapidly. Domestic-scale wood chip heating systems require a chip moisture content of approx. 25% by preference. Larger systems can handle moisture levels of 35 to 45%.

Chips can be delivered in large ½ tonne bags or by using a tractor/trailer combination or a bin lorry. Chips can be tipped into a bunker, delivered into a silo or in a stockpile in the corner of a shed. Size of storage space will depend on heat requirements, fuel delivery frequency and moisture content.

It may suit many farmers who have their own thinnings, to install wood chip central heating systems.

Log boilers

In addition to the above mentioned fully automated central heating systems, manually fed boilers are also available. These run on logs. A major advantage of such systems is that a farmer with his/her own supply of small diameter logs could do most of the work him - or herself with a minimum of processing and without the need of expensive large machinery. Timber can be cut up using a chainsaw and stored and dried under a tarpaulin or in an open-sided drying shed. Disadvantages include manual feeding with firewood at least every few days, limited storage tank autonomy and large variance in boiler efficiencies.

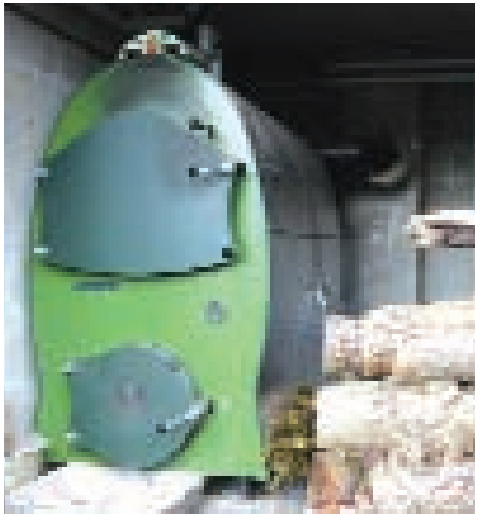
These modern types of log boilers can provide clean and efficient heating. They are most appropriate for domestic sized applications (up to 50 kW). Boilers are fed by hand by loading logs – sometimes up to a metre long- into the feed chamber once a day or every few days. Water is heated and stored in a highly insulated hot water buffer store and is then available upon demand.

District heating systems and CHP's

Wood-fuelled district heating systems are common in Europe and have been operating successfully for the last couple of decades. Heat is provided by one single heating plant delivering heating through a network of insulated pipes to radiators in individual houses. Several district heating plants are also CHP plants (Combined Heat and Power) producing heat and electricity. This electricity is then sold into the national grid.

Size can range from heating a few houses to large towns. Large, industrial installations can deal with a moisture content of up to 55%.

Assistance may be available from SEI.



Wood log central heating boiler

Important issues

Supply chain

Demand for firewood, wood chips and wood pellets is rising rapidly in Ireland as more and more wood-fuelled heating systems are installed. A growing number of companies are supplying and/or producing different types of wood fuel for the Irish market. Important issues remain and need to be addressed.

Quality Control

To compete in the heating market, wood fuels and heating equipment need to offer a consistent, reliable, standardised quality. Wood heating technology or fuels that do not conform to the highest European standards can cause emission problems, damage heating systems and the reputation of the wood heating industry. A bad image problem because of poor fuel or equipment can affect the market for years.

Wood fuels

The quality, size and uniformity, moisture content, calorific value and level of impurities are very important issues. Potential buyers must verify the quality of the wood fuel offered for sale.

Wood fuels that conform to the European-wide CEN standard are of the highest quality and the consumer can have every confidence in choosing wood heating. CEN, the European Committee for Standardisation, published in April 2005 five standards, which have now been adopted in Ireland. For a copy of the standards, contact the National Standards Authority of Ireland www.nsai.ie or contact Sustainable Energy Ireland for further details. All Irish wood fuel producers should adhere to these standards.

Wood heating technology

There are many different makes of wood fuel boilers and stoves available, produced to different standards and with varying specifications. Build quality and fire safety are important issues and potential buyers should research all options carefully.

Some wood pellet brands add coded pellets to ensure traceability and quality

Installation, management and contract options

Different scenarios will require different wood heating solutions. Wood fuel, equipment suppliers/installers and Energy Supply Companies (ESCo's) can provide services to meet individual heating requirements.

Private individuals often consider the option of a contractor installing and commissioning the heating system with all subsequent management (wood fuel supply, maintenance, servicing, etc.) being the responsibility of the home owner. The home owner will pay the installer for materials and labour for supplying, installing and commissioning the system. A good quality system should have a satisfactory warranty. Some installers will also provide the subsequent management such as annual servicing at an additional charge and offer extended warranties.

Larger heat users such as hotels, swimming pools, office buildings may look at different contract options. Three basic contract options are generally used:

- A group of farmers will enter into a wood fuel supply contract to supply wood chips for a particular boiler at specified size and moisture content.

- A farmer's group can also consider entering into a heat supply contract based on heat requirements. They are contracted to supply an annual heat demand, expressed in kWh - kilo Watt hours. Payment is based on heat delivered plus maintenance. The farmer's group must supply specified chips or carry any additional costs. Farmers would usually carry out basic boiler maintenance. Farmers may also consider a joint venture with the boiler supplier.

- Farmers can also consider setting up an ESCo (Energy Supply Company) by forming a joint venture with a boiler supplier to provide the following services. Supply of both boiler and

wood fuel, delivery of heat as and when required and provision of boiler maintenance. The heating bill will then be based on heat used plus the capital cost of the boiler.

Producer groups

Forest owners can get involved in a number of ways.

- They can opt to sell pulpwood to a wood chip supplier, or to a heat provider. In this case, the forest owner's only involvement is to sell timber.
- Forest owners may also opt to get involved in the business of supplying wood chip directly to a boiler under contract from the installer. In this instance, the forest owner is paid in Oven Dried Tonnes (ODT) of wood chip supplied. The drier the wood chip, the more the wood chip supplier is paid.
- Another option for farmers/forest owners to consider is to set up producer groups so that potential buyers can be offered a secure, multi-annual, large volume of timber. This will result in improved timber prices and reduced costs to group members. For instance, one farmer with a forest of 10 ha coming up for first thinning may be able to offer for sale 400 tonnes of timber. This farmer may find it difficult to attract a buyer/contractor as overheads such as machinery transport will be high. Other issues such as location, access, distance to sawmill etc. may also have a negative influence.

  However, fifty farmers of 10 ha each can offer a sawmill 20,000 tonnes of timber, spread over several years offering the sawmill security of supply. Such a scheme could be organised through a group manager which has the added advantage to the sawmill of dealing with one person only. This group manager can also organise management works for group members at reduced costs. For further information on producer groups, contact your local Teagasc forestry development officer who can offer practical assistance.

Wood pellet plant at Balcas, Enniskillen

Case studies

Gartan Outdoor Education Centre

The Sustainable Land Use Company

Thomas and Lucy Becht farm organically near Glenties in county Donegal. They have a farm shop, operate a box scheme, have a stall at farmers' markets and organise several eco-friendly activities on the farm such as The Millennium Forest Tree Sponsorship Scheme, Highland Eco Camps and nature trails.

The Sustainable Land Use Company's log boiler

The farm also produces renewable energy from two small-scale hydropower schemes producing up to 350 kWh of electricity. Tourist accommodation has now been added to their farm activities.

Heat and hot water for the self-catering accommodation and for the farmhouse is supplied by a solid wood log boiler. The 65 kW HERLT HV65 boiler was installed in 2005. The wood fuel is sourced from first thinnings from their own farm forest as well as bought in round logs from local sawmills in 3 metre length, cut down in the farmyard to 1 metre logs. Then they are stacked and air-dried without cover for eight months over the summer and burned over the next winter in the log boiler with a moisture content of 30%.

Boiler size	**65 kW**
Wood log consumption	30-35 tonnes per year
Payback / fuel savings	€4,000* per year
Investment	€27,000
System design and installer	HERLT, Germany
Wood boiler manufacturer	www.herlt.eu
The Sustainable Land Use Company	www.donegalorganic.ie

* this fuel saving will increase as their own farm forest grows so that fewer logs need to be bought in

One tonne of conifer logs will replace approximately 200 litres of oil. One fill per day is required in the winter while during the summer the HERLT is only fired up every five days.

Main reasons for choosing the HERLT was its ability to handle big, low quality logs with relatively high moisture content coupled with a high efficiency.

Advantages of this heating system include that:

- farm-grown timber can be used
- all operations can be carried out on the farm
- little effort is required in processing and storing the firewood coupled with a very small external energy requirement.

The McNally family

The McNally family lives in Drumalee, Cavan Town. Until 2004, they lived in a small, very poorly insulated 140 m^2 (1500 ft^2) bungalow with an annual home heating oil bill of €3,600.

In 2004, they moved to a newly built, highly insulated house of 420 m^2 (4500 ft^2) and installed a Kuenzel P25 wood pellet boiler providing all their heat and hot water requirements to their new home.

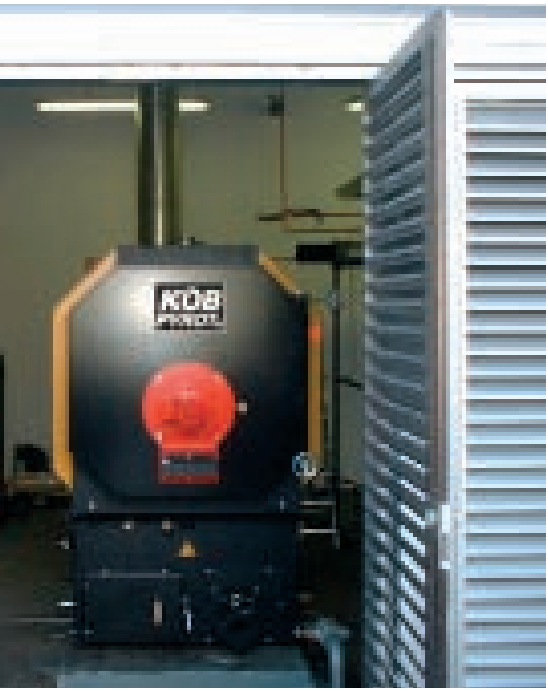
Three tonnes of pellets are delivered every six months. Delivery is very similar to the delivery of feed nuts as they are blown into a silo. The silo has a capacity of five tonnes and was constructed on site close to the boiler by the installer, Solar Energy Ireland. Pellets are supplied by Balcas at a cost of €182 per tonne including VAT and delivery. Their annual heating bill has now dropped to €1,200.

The new boiler's efficiency is very high at over 90% and to ensure maximum efficiency Frank McNally cleans the boiler himself every three months. The pellet boiler produces very little ash which is used in the garden as a fertiliser rich in potash – good for the roses!

Boiler size	**25 kW**
Wood pellet consumption	6-6.5 tonnes per year
Annual fuel savings	50% pa
Payback period	4 years
Total investment	€13,500 (excludes 50% grant* on the boiler) Net cost: €10,000
System design and installer	www.solarenergyireland.com
Wood boiler manufacturer	www.kuenzel.de
Wood pellet manufacturer	www.balcas.com

* This project was supported by the INTERREG IIIA programme

McNally house, Co. Cavan



Olympus boiler

Boiler size	220 kW
Wood chip consumption	120 tonnes per year
Annual fuel savings	€17,500-21,000 pa
Payback period	2.5-3 years
Total investment	€90,000 (excludes 30% grant*) Net cost: €60,000
Wood boiler manufacturer	www.koeb-schaefer.com
Olympus Life and Material Science Europa GbmH (Irish Branch)	www.olympus-europa.com

* This project was supported by SEI's Bioheat Programme and the County Clare Wood Energy Project (CCWEP) – www.rrd.ie

Olympus Life and Material Science Europa GbmH (Irish Branch)

Based in County Clare, Olympus produces medical diagnostics test kits. The plant buildings are a combination of office space, production area, warehousing and laboratories, which results in a large demand for space heating between September and April.

Olympus was contacted by the County Clare Wood Energy Project (CCWEP) in November 2005 with a view to switching a substantial amount of their heat requirement from oil to woodchips. Heating was previously provided by two 350 kW oil-fired boilers with an annual fuel bill of €35,000. One of these oil boilers has been replaced with a KOB Pyrot 220 kW woodchip boiler and retrofitted to the existing plinth, limiting the amount of construction works required. It operates from October to April as the lead boiler and meets 80% of the peak heat demand.

An above ground woodchip silo is situated alongside the existing boiler room where the chips are delivered by tipping trailer into a reception bin and then blown into the silo using a fan. The silo contains approximately 30 tonnes of woodchips at 45% moisture content.

The company has received great support from the local growers as the potential benefits to the local economy and environment have emerged. Local forest owners were contacted with a view to supplying 120 tonnes of wood chips annually. There are sufficient plantations in the supplier group to ensure that the annual demand is met and that the demand fits in with the normal five year harvesting cycle.

Gartan Outdoor Education Centre

Gartan Outdoor Education Centre is located on the shores of Gartan Lough close to Letterkenny, Co Donegal. Over 6,000 people visit Gartan each year and take part in a range of water sport and mountaineering courses. The Centre is owned by Donegal Vocational Education Committee (VEC) and caters for the needs of primary, secondary and third level education, as well as the tourism and private sectors.

The Gartan Centre has installed a wood chip heating system in their new boathouse building. The new boathouse incorporates shower and changing facilities, a meeting room, coffee shop, boat and equipment storage, work shop and a drying room. The boiler is fuelled with willow wood chip and caters for the full heating and hot water needs. The willow chips are supplied by Rural Generation Ltd by trailer with the capacity to blow the fuel chip directly into the store, avoiding manual handling. This is a practical solution in cases where access to the fuel store is difficult. Such systems can blow chips a distance of 30 metres. Gartan OEC is the first outdoor education centre in the Republic of Ireland to venture down the wood heating road, and will continue to pursue this policy, with plans to use wood chip from its own 35 ha estate.

Boiler size	**80 kW**
Willow chip consumption (per 24 hours)	400 kg (peak demand) 200 kg (low demand)
Willow chip consumption (per year)	22 tonnes pa
Payback / fuel savings	€2,600 pa
System and fuel supplier	www.ruralgeneration.com
Architect	www.carrandcompanyarchitects.com
Consulting engineers	www.delap-and-waller.com
Gartan Outdoor Education Centre	www.gartan.com

The boathouse development was also supported by the Department of Education and Science and Failte Ireland.

Roganstown North County Dublin's first carbon-neutral hotel

Located in Swords, North County Dublin Roganstown Golf and Country Club is a luxury 4 star hotel with 52 bedrooms, conference facilities and state of the art leisure and spa facilities. It recently became the first carbon-neutral hotel in North County Dublin when it installed a wood chip boiler.

The installation of the wood chip boiler is part of the hotel's drive to use alternative sources of energy which are renewable and sustainable. This boiler is one of the largest to be installed in Ireland and will heat the entire hotel and supply hot water for all the bedrooms and leisure centre. Compared with the previous LPG boiler system (that is still in situ as a back up if required) the wood chip boiler displaces over 400,000 litres of LPG and will save more than 550 tonnes of CO_2 emissions each year.

Given the ever increasing energy costs and concerns over security of supply and costs of fossil fuels, hotel owner Ian McGuinness opted for the biomass boiler and wood chips that are half the price of heating oil or LPG without the fluctuations in price. The system's installer Clearpower has an ongoing maintenance and fuelling contract with Roganstown Golf and Country Club.

The owner has also future proofed the hotel's energy profile should the government introduce a carbon tax as all refined wood fuels (chip and pellet) are classed as carbon neutral, as the emissions equate only to the CO_2 absorbed by

the timber when it is growing. Ian McGuinness, Managing Director, Roganstown Golf and Country Club commented:

"We're delighted to be playing our part in reducing emissions, but installing a wood chip boiler also makes economic sense. There's a lot of uncertainty about both the supply and price of fossil fuels, and wood chip is about half the price of heating oil or LPG without the fluctuations. Because it's 'carbon neutral', wood fuel will not be subject to carbon taxes which are likely to be introduced at some point and while the capital outlay was quite high, that was partly offset by government grants. If the Irish government is fined €20 per tonne as part of the Kyoto Protocol over the agreed obligation, this will equate to an annual saving of over €10,000 to the exchequer. We believe that wood fuel is definitely the way forward!"

Boiler size	**540 kW**
Wood chip consumption	Approximately 600 tonnes per year
Annual fuel savings	50% pa
Payback period	Approximately 3 years
Investment (including all equipment and associated storage facility and services)	€210,000 (excludes 30% grant*) Net cost €163,000
Wood chip supplier and project developer	www.clearpower.ie
Roganstown Golf and Country Club	www.roganstown.com

* This project was supported by SEI's Reheat Programme

Roganstown Golf and Country Club

County Clare Wood Energy Project

The aim of the project is to stimulate the market for pulpwood in County Clare by facilitating both the supply and demand of wood chips. The project is managed jointly by Rural Resource Development (Clare LEADER) and Teagasc and is largely funded by the Forest Service.

The heat requirement, boiler size, wood chip requirement and storage for different large premises were identified. These specifications were used as the basis for boiler installation tenders, wood chip supply tenders and Sustainable Energy Ireland grant applications under the Bioheat programme.

Clusters of potential thinning sites in the vicinity of possible boiler locations were also identified so as to form the basis for a wood supply chain. Farmers will carry out thinnings - sell the pallet-wood and stakewood at a profit and sell pulpwood for wood energy locally as opposed to having to transport it outside the county at a loss.

Visit www.ccwep.ie for further information.

The Donegal Forestry Forum and Forest Link Project

The Donegal Forestry Forum was initiated by Teagasc and operates as a forum where forestry issues can be raised in an inclusive partnership approach and acts in an advisory and monitoring capacity during the implementation period of the strategy.

One of the outcomes of the work of the Forum was the Forest Link project with the aim to improve market outlets for private timber growers by highlighting and encouraging the use of locally grown wood energy. This was achieved by developing demonstration projects of wood fuel heating systems and by developing a wood fuel supply chain. Private woodland owners play a key role in this supply chain. A joint initiative of Teagasc and Forest Link was the establishment of the Donegal Woodland Owners Society. These Donegal woodland owners came together to improve the marketing and management of private timber to maximise returns to the growers while providing services to its members. To find out more, visit www.donegalwoodlandowners.com.

Support schemes

Establishment supports

Farm forestry establishment grants

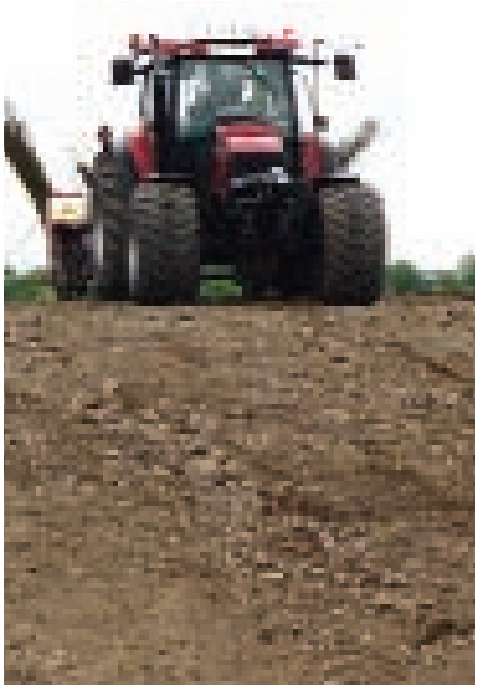
During the past decade over 14,000 farmers have planted a total of 250,000 hectares of forestry. Planting by farmers now accounts for 90% of total afforestation compared to less than 10% in the early 1980's.

The first point of contact for those considering planting should be their local Teagasc forestry development officer. Teagasc can help farmers to make an informed decision. It is vital to contact Teagasc before making the decision to take land out of agriculture to plant trees. There may be implications for Single Farm Payments, compensatory allowances, Rural Environment Protection Scheme (REPS), nitrates directive and farm retirement pension payments.

Teagasc forestry development officers provide a range of technical services to farmers and meet the growing demand for forestry advice from landowners who have planted trees.

People who have planted may want to know if the trees are healthy and are growing well. If problems are identified on time, it is usually possible to correct these successfully. Another typical scenario is where the farmer would like to know if all the work has been carried out to the specifications set by the Forest Service. This is a free service and all advice is confidential, independent and objective.

Attractive establishment grants are available



Willow establishment in progress

Generous establishment grants and annual forestry premium payments -depending on land type and tree species- may be available. The minimum area for grant aid is 0.1 hectare for broadleaves and 1 hectare for conifers. Contact your local Teagasc forestry development officer for further information or log on to www.teagasc.ie/forestry.

Bioenergy Scheme for Willow and Miscanthus (BES)

The Bioenergy Scheme may be available to provide establishment grants to farmers for up to 50% of the costs associated with establishing willow and Miscanthus for the production of biomass suitable for use as a renewable source of heat and energy.

For further information, contact your local forestry development officer or the Biofuels Policy Unit, Department of Agriculture, Fisheries and Food, Kea-Lew Business Park, Mountrath Road, Portlaoise, Co. Laois, 057-8692231.

Supports for wood fuel heating appliances

Sustainable Energy Ireland administers a range of wood heating support schemes. It is very important to compare different options, products, specifications and installers very carefully before making a decision.

For further information on SEI's support schemes, please contact:
Renewable Energy Information Office, Sustainable Energy Ireland, Unit A, West Cork Business & Technological Park, Clonakilty, Co. Cork, 023-8842193 or log on to: www.sei.ie.

Support may also be available from Enterprise Boards, local LEADER companies, etc.

Farmers can develop a wood fuel supply company

Some facts and figures

- 96% of all Europe's renewable heat comes from wood!
- 3% of Ireland's energy requirements are from renewable sources with biomass contributing more than wind, hydro, biogas, solar and geothermal combined!
- Calorific values (approx.)
  - Wood pellets: 18 GJ/tonne
  - Firewood (@ 30% MC): 14 GJ/tonne
  - Wood chips (@ 30% MC): 12 GJ/tonne
- 1000 litres of home heating oil
  = 2-2.5 tonnes of wood pellets
  = 3 tonnes of firewood (at 30% MC)
  = 3-4 tonnes of wood chips (at 30% MC)
- 1 tonne of solid wood (@ 60% MC, i.e. fresh) = 1 m^3 = 2.5 m^3 wood chip
- 1 tonne of solid wood (@ 30% MC) = 1.75m^3 = 4.5 m^3 wood chip
- A large detached house (200 m^2 = 2150 ft^2) will need (dependent on insulation levels)
  - 6 tonnes of wood pellets per year
  - or 9 tonnes of firewood (at 30% MC)
  - or 9-12 tonnes of wood chips (dependent on MC)
- 5-10 kilowatt (boiler output) is required per 100 m^2 of house floor area (variance relates to different insulation levels)

» Annual fuel requirement:
  - 0.7 tonne of wood fuel (30% MC) per kW boiler output.

» Fuel densities (in kg/m³):
  - Wood chips: 200-250
  - Wood pellets: 500-700
  - Spruce firewood: 350-400
  - Pine firewood: 550-600
  - Beech/oak firewood: 550-600

» Storage space (equivalent to 1000 litres of home heating oil)
  - Oil: 1.5 m^3
  - Wood pellets: 3 m^3
  - Wood logs: 6 m^3
  - Wood chips: 12 m^3

» One hectare of first thinnings will supply about 5,000 l of oil

» One hectare of forest will "grow" more than 100,000 l of oil over its lifetime or more than 3,000 l/ha/year

MC = Moisture Content

Energy conversion factors:

	MJ	GJ	kWh	toe	Btu
MJ	1	0.001	0.278	24×10^{-6}	948
GJ	1000	1	278	0.024	948,000
kWh	3.6	0.0036	1	86×10^{-6}	3,400
toe	42,000	42	11,700	1	39.5×10^{6}
Btu	1.055×10^{-3}	1.055×10^{-6}	295×10^{-6}	25.3×10^{-9}	1

Further information

Contact your local Teagasc Forestry Development Officer for further information via your local Teagasc office or log on to www.teagasc.ie/forestry

Establishment and development grants may be available from the Forest Service. For further information, contact: Forest Service, Department of Agriculture, Fisheries & Food, Johnstown Castle estate, Co. Wexford; 053-9160200 or log on to www.agriculture.gov.ie

COFORD operates a wood energy advisory service on www.woodenergy.ie and queries about the harvesting and supply chain sector of the wood energy industry can be submitted online.

Queries about boilers, stoves, approved installers, wood fuel standards, etc. can be directed to Renewable Energy Information Office, Sustainable Energy Ireland, Unit A, West Cork Business & Technological Park, Clonakilty, Co. Cork, 023-8842193 or log on to: www.sei.ie.

In contrast to many other European countries, we are still in the early stages of wood energy development in Ireland. Anyone interested in wood energy, should contact all the relevant agencies as this sector will develop and change rapidly in the coming years.

For all your forestry advice and training needs

Contact your local Teagasc Forestry Development Officer:

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Athenry, Co. Galway
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teagasc
Agriculture and Food Development Authority
www.teagasc.ie

NDP

Forest Service

Department of Agriculture, Fisheries and Food

www.teagasc.ie/forestry