



Wood Energy from Farm Forests

A Basic Guide

All rights reserved. No part of this publication may be reproduced without prior permission in writing from the publisher.

Text: Teagasc Forestry Development Unit

Photographs: Teagasc Forestry Development Unit, Sustainable Energy Ireland, County Clare Wood Energy Project

Published in 2006

Teagasc acknowledges the assistance provided by Sustainable Energy Ireland in the preparation of this booklet.



Wood Energy from Farm Forests

A Basic Guide



Table of Contents

Introduction

What is wood energy	4
Farmers as wood fuel growers?	5

Wood fuel sources

Conventional forestry thinnings	7
Sawmill waste	8
Arboricultural material and other waste	8

Willow SRF

What is Willow SRF?	9
Establishment and management	10
Economics/costs of SRF	11
Advantages/disadvantages	12

Wood fuel: types, harvesting and storage options

Firewood	15
Wood chips	15
<i>Chipping</i>	16
Small scale chipping operations	16
Medium scale chippers	17
Large scale chipping operations	17
Storage	18
Delivery	19
Wood pellets	20
Wood briquettes	21

Wood fuel heating options

Room stoves	23
Central heating systems	23
<i>Pellet-based systems</i>	24
<i>Wood chip-based systems</i>	25
<i>Log boilers</i>	25
District heating systems and CHP's	25

Important issues

Supply chain	26
Quality control	27
<i>Wood fuels</i>	27
<i>Wood heating technology</i>	27
Installation, management and contract options	27

Case studies

Teagasc Crops Research Centre	29
Gartan Outdoor Education Centre	30
Inchydoney Island Lodge and Spa	31
County Clare Wood Energy Project	32

Support schemes

Establishment supports	34
<i>Farm forestry establishment grants</i>	34
<i>Willow SRF establishment grants</i>	36
Downstream development	36
Boiler supports	36
<i>Greener Homes Scheme</i>	36
<i>Bioheat Programme</i>	38
<i>Other SEI-supported schemes</i>	38



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. While 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 on a small scale. It is likely that in the not-so-distant future, demand for wood fuel will increase dramatically as it becomes more competitive against all other heat forms (oil, gas, etc.).

Wood is a form of biomass produced from organic material. Other forms of non-woody biomass used for energy purposes include Miscanthus (elephant grass), 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 (CO₂) 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 CO₂ released during the wood burning process is equal to the amount of CO₂ taken out of the atmosphere during tree growth through photosynthesis. Even by taking harvesting, processing, etc. of wood fuel into account, CO₂ emissions are reduced by more than 90%.

Farmers as wood fuel growers?

Irish farmers growing energy as a crop isn't as mad as it sounds. Many farmers are doing this already throughout Europe. And 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, then energy crops may well displace food crops on Irish farms. Ireland imports more than 90% of its energy with energy demand increasing by approx. 5% per year. This makes Ireland the most energy import-dependent country in Europe 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 farm 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

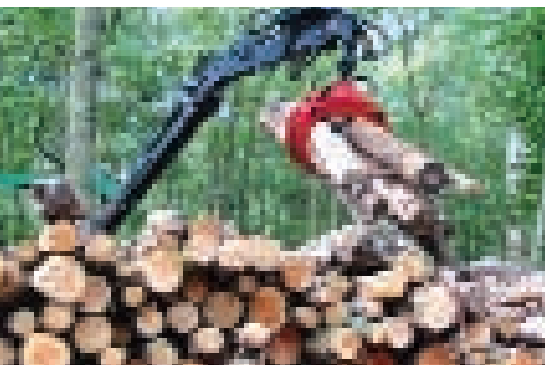
Wood fuel can be produced from forestry timber, forest residues, arboricultural thinnings, untreated (clean) wood waste such as sawdust and other sawmill residues and also willow plantations.

Conventional forestry thinnings

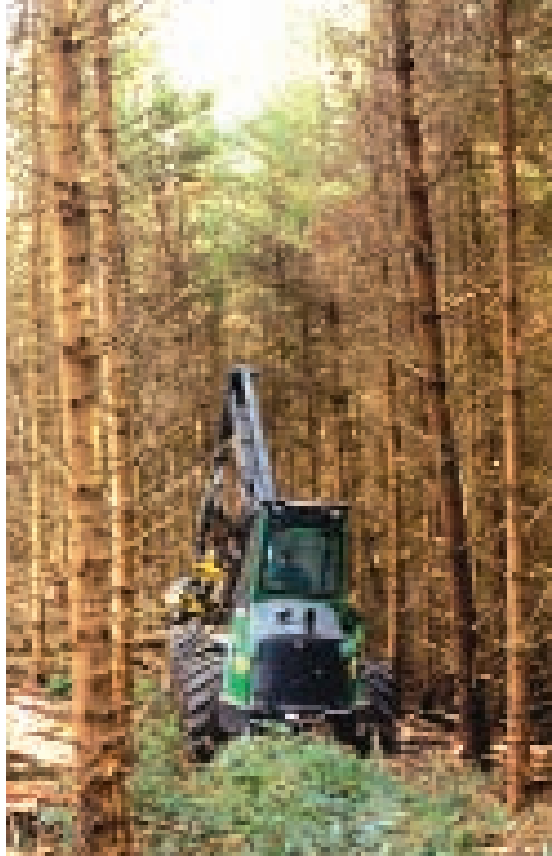
“Conventional” forestry provides great potential as an alternative farm enterprise and supplies different categories of wood. Larger diameter trees tend to have a higher value and include categories such as sawlog, palletwood and stakewood. Such timber provides a welcome tax-free income and is much sought 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. First and uneconomic thinnings involve the removal of mainly smaller diameter trees. 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 uneconomic 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 may be prone to this.

The emerging wood fuel market could provide the solution for this type of wood 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

Forest residues (“lop and top”) are at present not harvested and may provide another source of wood fuel. This however should only be considered if nutrient loss and soil damage by large harvesting machines can be avoided.

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 wood waste includes wood that has been used already 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.



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 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 complement 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 should ideally be completed before the end of March. Machine planting takes place by inserting 20 cm long cuttings and with a diameter of between 8 – 20 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.

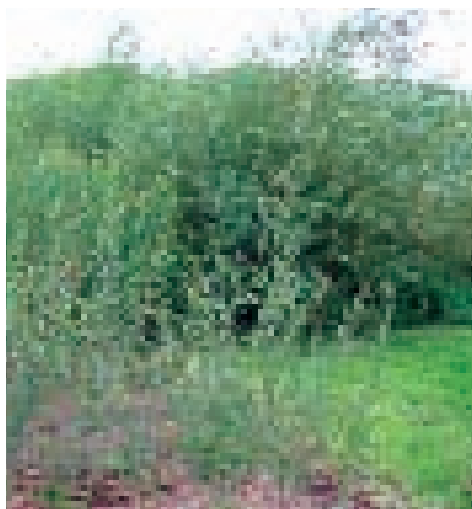
Vegetation control must be first-rate as recently established young willow plantations are very susceptible to weed competition. It is vitally important to have complete control of competing vegetation, especially in the first two years of establishment. Apply an overall residual herbicide post planting. 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 3-4 year cycle recommences. A willow plantation has a typical lifespan of about 15 years.

At present, most willow is cut, chipped and blown into a container in one harvesting operation. Up to 20 tonnes can be harvested per hour but it 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 damp wood chips.



If damp wood chips are stored without appropriate drying facilities, they will start decomposing (rotting) which may lead to a substantially lower calorific 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.

An average production of eight to ten 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 whereas 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 stake wood.

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. For



A recently established willow plantation

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 & Food, Johnstown Castle estate, Co. Wexford; 053-60200).

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 and management 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

Firewood is probably the oldest and still the most widely used fuel source on earth. Tree trunks and branches tend to be cut fresh and then stacked to dry. Firewood is usually stacked outside ensuring good air ventilation with the top of the wood stack covered using a tarpaulin or similar. Drying period depends on initial moisture levels but in general, a drying period of at least 12 months is preferable. Ireland's best firewood species is ash because of its naturally low moisture levels. It therefore usually requires a shorter drying period.

Firewood is widely available in Ireland and easy to use at home. Most firewood is produced nowadays using fast and efficient firewood processors. These mobile machines cut and split logs into suitable lengths.

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 produces pollution because of incomplete combustion. Firewood is typically used in an open fire, closed stoves or in small (domestic) scaled central heating systems (see further).



This firewood processor will cut and split logs into suitable lengths



Mechanically stacked firewood

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 uneconomic thinnings with a large pulpwood fraction.

It is preferable to ensure that wood for energy has had a chance to dry out for at least 6 months 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 left to air-dry before chipping takes place for a number of reasons:

- » Energy content is directly related to moisture content: dry wood has about 40% of the calorific value of oil by weight whereas freshly cut wood is less than 20%
- » A higher price is paid for dry 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

Wood chips as a fuel are best suited to medium to large installations (upwards of 30kW). The type of wood chip required depends very much on the size and type of heating system. Moisture content, calorific value, size and uniformity of chip and level of impurities are important elements and will affect the system's efficiency. The smaller the boiler's heat output, the more important size of chip and moisture content become.

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 per dry

matter weight, per total weight, per stacked volume or per solid volume. On average 4-6 tonnes of wood chips will displace 1000 litres of home heating oil dependent on moisture content, etc.

Chipping

Chipping may take place either in the forest, at roadside or at the final destination. Soil conditions, forest type, end user requirements, etc. will determine operations.

Small scale chipping operations

Small-scale wood chippers can deal with wood up to 30 cm in diameter and are either trailer-based



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



Medium-scale chipper

powered by its own engine or can be tractor-mounted and operated by a tractor's PTO. Output is in the range of a couple of hundred cubic metres per year and can supply a small number of small-scale boilers.

Wood fuel can be sourced, processed and used locally using locally available machinery and allow for very cost-effective handling. Wood chips are expensive to transport and are best used locally.

Chipping carried out on the farm as well as work carried out by local authorities, ESB, Eircom, tree surgeons, etc. can be chipped nowadays and is another source of wood fuel (as long as the chipped material is free of all contaminants).

Medium scale chippers

Medium-scale wood chippers can deal with larger diameters and are driven by the PTO of high horse-power tractors. Several thousands of cubic metres of wood can be processed annually and allows for distribution to small district heating

plants. One cubic metre of freshly cut logs is roughly equivalent to one tonne.

Large scale chipping operations

Specialised forestry machines such as the chipping forwarder fit in very well with normal thinning and harvesting operations: palletwood and stakewood are cut, removed and sold while pulp (energy wood) is left to dry in the forest, ready for the chipping forwarder several months later. Pulpwood is then chipped and blown into the machine's bin and transported.

Roadside chipping is another quite frequently used system. After the wood has been deposited in large piles at the roadside, the wood is allowed to dry for an appropriate drying period. A large, high capacity, mobile (usually lorry-mounted) chipper will then chip the wood directly into a bin lorry. Large chipping machines may be either lorry-mounted or static.



Large-scale chipper



Wood chip bunker

Sometimes wood is delivered to a depot or heating installation and allowed to dry there either as individual larger logs or smaller logs and branches bundled together. Chipping is carried out by a large stationary chipper just before burning at the heating plant.

Such operations are best suited to large energy users such as district heating systems, government buildings, schools, hospitals, swimming pools, etc.

Storage

Wood chips should only be stored once moisture content has dropped below 35%. Temporary storage (for a few weeks) can be provided on a clean base with a tarpaulin stretched across the top of the pile. More permanent storage solutions include underground tanks or container units. If long term storage is necessary, logs should be stored in the round and chipped when required.



Delivery

Transportation can take place using a tractor /trailer combination, curtain or bin lorry (i.e. detachable large container). This makes wood chips a very economical, accessible and environmentally sound wood fuel option. Chips can also be delivered in large 1/2 tonne bags. Chips can be tipped into a bunker, delivered into a silo or in a storepile in the corner of a shed.



Farmers are in a good position to deliver wood energy services



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. The wood's lignin and resin act as natural binding agents and no additional additives are required. Because of the lack of lignin in hardwoods, expensive additives such as starch may be required to produce wood pellets out of hardwoods (such as derived from willow chip). Several pellet production plants are operational in both Ireland and the UK with several more planned for the near future. Pellets are also being



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

imported from continental Europe and other areas.

Pellets can be purchased either bagged or in bulk and price can be calculated per total weight as moisture content is low and uniform because of European pellet standards. 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, while a suction pump takes away any dust. Storage solutions include underground tanks, container units, silos or storage within the boiler room. Wood pellets do not degrade over time, as long as they are stored in dry conditions.

Wood pellets are available from a number of suppliers and producers and ordering is as simple and convenient as ordering oil or other fuel. Wood pellets can be ordered online from some suppliers.

Wood pellets are a popular, renewable fuel, produced in Ireland. Although more expensive, they are compact, uniform in size, easy to store and handle and are used for fully automatic heating in pellet boilers or stoves. Modern pellet heating appliances offer a high level of comfort. They are used for many purposes ranging from domestic stoves and boilers to commercial units.

Pellets have a higher calorific value than wood chips: on average 2-2.5 tonnes of wood pellets will displace 1000 litres of home heating oil at approx. half the cost of oil! Irish pellets (bulk delivery) are available from €150 per tonne (ex VAT). They are also available in bags (15kg from €4 per bag) which is convenient for stove owners as no special storage is needed. Customers may be able to take advantage of lower prices in summer to stock up for winter.

Fuel type	Heating value kWh	Unit	Cost/Unit €	Cost €/kWh
Wood pellets	4.9	Kg	0.15	0.03
LPG	7.09	Litre	0.25	0.04
Home heating oil	10.5	litre	0.50	0.05



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

European wood pellet regulations ensure 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 briquettes

Wood briquettes are made from compressed sawdust, are usually round in shape, “look” like firewood and have the same calorific value as pellets. Due to their large size, they are not usually suitable for automatic feed in small boilers. In larger combustion units, they are usually crushed before combustion.

For further information on harvesting energy wood, see COFORD’s publication: “Wood for Energy Production, Technology – Environment - Economy”, published in 2005.

A black wood pellet stove stands on the left, with a metal bucket filled with wood pellets on the right. The stove has a glass window showing the interior. The bucket is made of metal and has a handle. The background is a plain white wall.

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 while 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 with a high, all-year heat demand where they provide a very competitive heating solution to large industrial heat and power plants. Wood heating systems work very well in conjunction with radiators.

Room stoves

Everyone loves a wood fire 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 30%. Modern wood pellet stoves offer the warmth and comfort of wood heating but are highly efficient, clean burning and totally automatic, saving you time and money. Such stoves are available in a wide range of designs, free-standing or as fire inserts and are an attractive design feature in any home. Prices range from €2,500 to €5,000.

Wood burning systems do emit carbon dioxide. However, as the wood grows, it absorbs the same amount of carbon dioxide that is released when burnt. As such, it does not add to the carbon dioxide in the atmosphere. Such a system can be used for heating a single room, hot water or several rooms.

Pellets can be purchased in bagged or bulk form. 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. For bulk purchases, a dry covered storage area is required.

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 tray needs emptying once a month and can be used as fertiliser in the garden. Electricity is required to operate a wood pellet stove.

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). Output is usually in the range of 6 to 12 kW and can attain efficiencies of over 80%. Although they are not designed to replace central heating systems, they do provide substantial background heating thereby saving on your annual oil bill.

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 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 (e.g. Austria). Although these units are fairly costly with prices ranging from €5,000 to €15,000 plus installation costs, thanks to SEI's Greener Homes Scheme they are becoming more affordable. They are also very cost-efficient because their running costs are only half of 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.



This containerised unit houses fuel storage, boiler and solar panels

Pellet systems

Central heating wood pellet boilers are lit automatically and continue to operate without manual intervention. Automatic fuel supply and thermostat mean you can relax and enjoy the comfort of pellet heating at the switch of a button. Automatic ignition means that lighting the boiler is convenient and easy. Modern pellet boilers are self-cleaning so you can forget the daily cleaning chore of traditional solid fuel heating systems. The ash pan needs to be emptied every few weeks or less frequently, depending on use and can be spread in the garden as an excellent (organic) fertiliser. Even ash removal can be automated. Output is usually larger than 15 kW with efficiencies of up to 90%.

For bulk purchases, a dry covered storage area is required. Generally bulk prices are more

competitive than those for bags and are approx. half 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 adjoining the boiler unit.

Some containerised wood heating systems combine fuel storage and the boiler in one mobile unit while other boiler units can deal with pellets, chips as well as logs. It is also possible to retrofit existing oil or solid-fuelled boilers with a wood pellet burner.

It is important that there is adequate ventilation and that a clean air source is supplied to the boiler, as the combustion process uses oxygen (in the same way as any fuel-fired appliance). Most chimneys consist of a double-lined stainless steel flue. For correct operation and maximum efficiency and autonomy, a hot water buffer store should be supplied with the system. The boiler will transfer and store heat to the hot water buffer store.



Wood pellet central heating boiler



Wood chip central heating boiler

Wood chip systems

Central heating wood chip boilers also provide many of the advantages listed above. Wood chips have the advantage that they can be sourced locally. It is important that the wood chip used (quality, size, moisture content) is suitable for the appliance. Domestic-scale wood chip heating systems require a chip moisture content of approx. 25% by preference. The wood chip market is still in its infancy in Ireland but will develop rapidly over the coming years.

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 storepile in the corner of a shed. Size of storage space will depend on heat requirements, fuel delivery frequency and moisture content (more deliveries will be required for damp wood chips). The feeding system for chips needs to be more robust than for pellets.

Due to the greater storage requirement for chips rather than pellets, wood chip systems are more likely to be used in industrial rather than urban domestic situations. However, 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 farmer with his/her own supply of small diameter logs could do most of the work him - or herself. Timber can be cut up using a chainsaw and stored and dried under a tarpaulin. Disadvantages include manual feeding with firewood at least every few days, limited storage tank autonomy and large variance in boiler efficiencies.

District heating systems and CHP's

Wood-fuelled district heating systems are very 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.

All energy wood types (logs, chips, pellets) can be used for these larger installations although wood chip is the most common form. Size can range from heating a few houses to large towns. Large, industrial installations can deal with a moisture content of up to 55%.

District heating systems often work on a shareholding basis. This means that the individual consumers are the shareholders. A profitable heating plant will result in lower heating bills while a loss-making heating plant will result in higher heating bills to the shareholders/consumers.



Wood log central heating boiler



Important issues

Supply chain

Demand for wood pellets and chips is set to rise rapidly in Ireland - catching up with the rest of Europe- as more and more wood chip and pellet heating systems are installed here.

A number of companies are supplying wood pellets to the Irish market already including one large pellet manufacturer, Balcas in Enniskillen. This sector is expanding. Pellets are supplied to the customer either bagged or in bulk. European wood pellet regulations ensure that a consistent, standardised pellet is produced. The regulations also cover the type of wood used and the storage and transport of wood fuels.

Supplier groups are being formed at present in Ireland. Issues remain in ensuring quality, size and uniformity, moisture content, calorific value and level of impurities.

Quality Control

To compete in the heating market, wood fuels and heating equipment need to offer a consistent, reliable, standardised quality. Wood fuel customers often choose this form of heating because of its environmental credentials. 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

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



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

www.nσαι.ie or contact Sustainable Energy Ireland for further details.

Wood heating technology

There are many different makes of automatic wood-fuel boilers and stoves available, produced to different standards and with different levels of equipment, some of which manufacturers offer as standard and others as options. CE marking is a declaration by the manufacturer that the product meets all the appropriate provisions of the relevant legislation implementing certain European Directives. The directives covering automatic wood-fuelled boilers include the Low Voltage Directive – 73/23/EEC and the Machinery Directive - 98/37/EC.

Wood-fuel boiler efficiencies are typically between 80 and 90%. The manufacturer should have efficiency independently verified in accordance with EN303-5 or another recognised national standard while boiler emissions must comply with regulations set out in the Air Pollution Act 1987. If national limits for emissions are not available then boiler emissions should conform to Euro Norm EN303-5 1999 for boilers up to 300 kW.

Installation, management and contract options

Different scenarios can be considered dependent on objectives and requirements. Wood fuel, equipment suppliers/installers and Energy Supply Companies (ESCO's) will provide such services.

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.



Wood pellet plant at Balcas, Enniskillen



Case studies

Gartan Outdoor Education Centre

Teagasc Crops Research Centre

An automatic wood heating system has been installed and commissioned by Natural Power Supply (NPS) Ltd. at Teagasc, the Agriculture and Food Development Authority, at its Crops Research Centre at Oak Park, Carlow.

The 100 kW KWB boiler is currently powered by wood chips made from short-rotation willow crops but the unit will also be used for trials with fuels such as cereal straws, a by-product of arable farms, rape straw and Miscanthus, commonly known as elephant grass.

The new boiler heats nearly 1,000 m² of office, laboratory and workshop space.

Teagasc at Oak Park have been pioneers in researching and testing sources of sustainable and renewable energy for several decades. Oak Park is recognised as one of the leading research establishments in this particular field.

This wood chip fuelled boiler was installed by John Wills and Damien Dolan of Complete Corporate Support Services, Dublin with Christian Luttenberger, of Conness, distributors of Austrian-manufactured KWB wood heating boilers.

The boiler is a KWB USV 100, with an output capacity of 100kW and has an efficiency of over 90% at rated output and 90% on part load.

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.

Recently the Gartan Centre decided to install a wood chip heating system in a new boathouse building they were developing on their 35 ha property. Ursula McPherson, the Centre's director, comments: "wood heating was a sustainable choice but also makes economic sense for us as we are making fuel savings in the order of €2,600 per year". 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, to avoid manual handling. This is a practical solution in cases where access to the fuel store is difficult as 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 estate. "We are satisfied that the technology works and are now planning to investigate using wood chip from the woodlands and hedges of our own estate and locally to fuel the system in the future" said Ms. McPherson.

This boiler is fuelled by willow chip and was installed by Rural Generation, Derry, N. Ireland; Carr & Co., Ballybofoey, Co. Donegal and Delap and Waller, Derry, N. Ireland.

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



Teagasc Crops Research Centre



Inchydoney Island Lodge & Spa

Inchydoney Island Lodge and Spa

Inchydoney Island Lodge and Spa is a luxury 4 star, 67 bed hotel, conference, spa and leisure centre, located near Clonakilty, West Cork. The hotel recently converted from a LPG gas system to a wood pellet and solar heating system and is Ireland's largest commercial renewable heating system.

The main driving factors were the increasing and uncertain costs of fossil fuels coupled to the impact on the environment. Wood fuels offer not only fuel cost reductions but also stability.

The primary focus is to provide customers with a very enjoyable experience in the hotel. It is vital therefore that the running of the heating system does not distract from that. This modern wood heating system can deliver the level of automation, reliability and flexibility that fossil fuel systems do.

Inchydoney Lodge and Spa has a very considerable (and increasing) heating demand

both in terms of space heating for the hotel and spa facilities and the hot water demand. A 50% cost reduction for heating and hot water has been achieved with the solar and wood heating system when compared to the old LPG system. The savings are generated by the reduced fuel costs of wood pellets, a highly efficient boiler and hot water preparation system and the energy from the solar thermal installation.

It is a low-risk investment because the technology used is a mature technology in many other European countries. The technical risk is low too with the right partner to design and integrate it into the hotel's existing heat distribution system. On the fuel supply side, Balcas in Enniskillen delivers the wood pellets. The pellet truck drives alongside the heating system and the pellets are blown into the top container unit. It is no different than an oil or LPG delivery.

Inchydoney Island Lodge and Spa will no longer be held to ransom by rising oil and energy prices. Investing in renewable energy systems makes good business and environmental sense.

Facts:

Boiler size	450kW (3 X 150kW)
Wood pellet consumption	360 tonnes per year
Solar system	80m ² of flat plate collectors
Payback/fuel savings	€50,000 per year
Investment	€300,000
Supplier-system design and installer	www.rems.ie
Wood boiler manufacturer	www.kwb.at
Wood pellet fuel supplier	www.balcas.com

This project was supported by the SEI RD&D Bioheat Programme

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. Two consultants were employed by the project.

The wood energy consultant approached a number of high heat using premises in the county (nursing homes, hotels, swimming pools, etc.) to make them aware of the benefits of wood fuel. The project employed a further heat engineering consultant from the UK to specify the heat requirement, boiler size, wood chip requirement and storage for each premises. These specifica-

tions were used as the basis for boiler installation tenders, wood chip supply tenders and Sustainable Energy Ireland grant applications under the Bioheat programme.

The forestry consultant was employed to identify clusters of potential thinning sites in the vicinity of possible boiler installers. The consultant is facilitating the thinning of these sites in a co-ordinated manner, so as to form the basis for a wood supply chain. Farmers can carry out thinnings - sell the palletwood and stakewood at a profit and sell pulpwood for wood energy as opposed to having to transport it outside the county at a loss. A number of people in the county have invested in chipping equipment (both mobile and stationary). These operate as "chipping



Seeing is believing - study tour to wood energy plants in Sweden



entrepreneurs” – either chipping logs for forest owners or buying pulpwood to chip and supply to wood chip boilers.

The project is very conscious of the necessity to build confidence in the wood chip supply chain by monitoring wood chip size, consistency and moisture content and ensuring an on-going supply of chip in the county.

Forest owners can get involved in the wood fuel supply chain in a number of ways:

- » They can opt to sell pulpwood to a chipping entrepreneur, or to a heat provider. In this case, the forest owner’s only involvement is to sell timber for wood chip.
- » 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.



Support schemes

Establishment supports

Farm forestry establishment grants

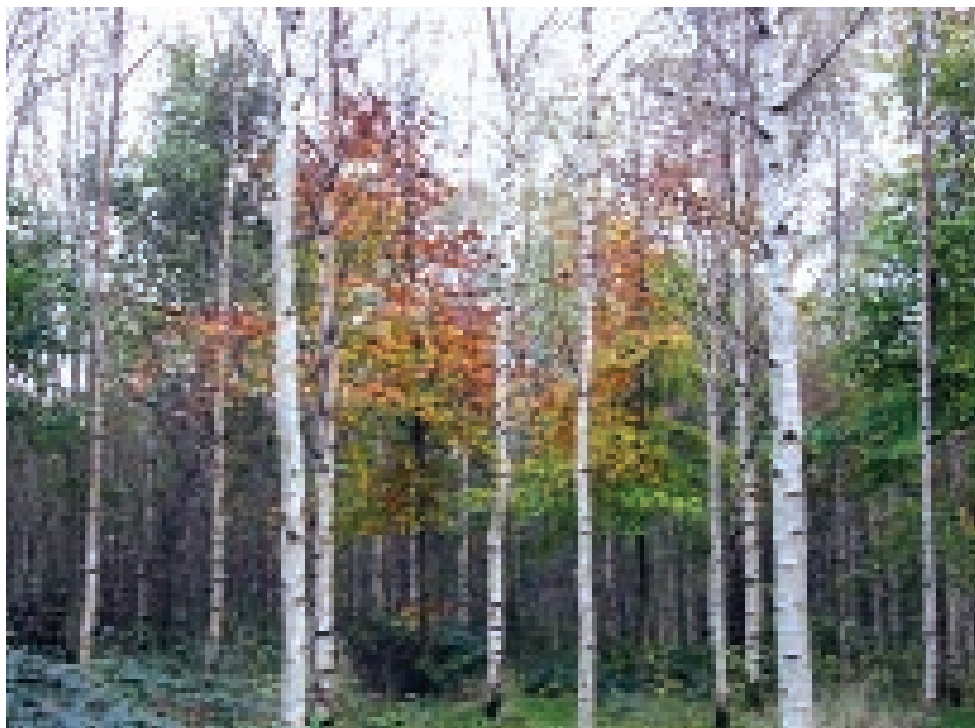
During the past decade over 14,000 farmers have planted a total of 250,000 hectares of forestry. Planting by farmers now accounts for 90% of total afforestation compared to less than 10% in the early 1980's.

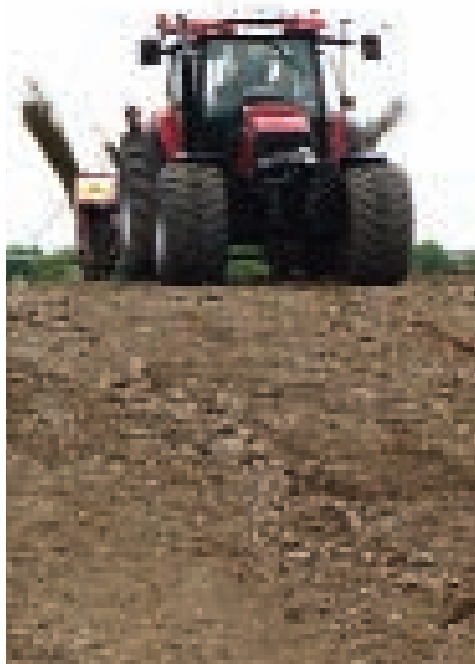
The first point of contact for those considering planting should be their local Teagasc forestry development officer. Teagasc can help farmers to make the right decision to change to a farm forest enterprise and if so whether they should do the work themselves or contract it out. It is vital to contact 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) and farm retirement pension payments. Teagasc employs a number of experienced foresters. They are available to 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



Attractive establishment grants are available

work has been carried out to the specifications set by the Forest Service. This service is provided completely free of cost. All advice is confidential, independent and objective.





Establishment grants - depending on land type and tree species - range from €2,975.63 to €7,335.28 per hectare and cover the costs to year 4. The minimum area for grant aid is 0.1 hectare for broadleaves and 1 hectare for conifers. The present scheme will be replaced by a new scheme from 2007 onwards. Contact your local Teagasc forestry development officer for further information. Current annual forestry premium rates range from €171.41 to €499.01 per hectare for up to twenty years.

Willow SRF establishment grants

Forest Service may introduce grants for the establishment of willow plantations.

For further information contact the Forest Service, Department of Agriculture & Food, Johnstown Castle estate, Co. Wexford; 053-60200.

Downstream development

The Forest Service may introduce grants for the purchase of wood energy machinery. For further information contact the Forest Service, Department of Agriculture & Food, Johnstown Castle estate, Co. Wexford; 053-60200. Support may also be available from Enterprise Boards, local LEADER companies, etc.

Boiler supports

Sustainable Energy Ireland administers a range of wood heating support schemes. SEI also manages an evaluation process for the registration of wood heating stoves and boilers, ensuring that equipment meets minimum quality standards in relation to efficiency and emissions. For further information on any of the following schemes, please contact:

Sustainable Energy Ireland, Renewable Energy Information Office, Shinagh House, Bandon, Co. Cork, 023-42193, renewables@reio.ie or log on to: www.sei.ie.

Greener Homes Scheme

The Greener Homes Scheme provides assistance to homeowners who intend to purchase a new renewable energy heating system for either new or existing homes. The scheme is administered by Sustainable Energy Ireland and aims to increase the use of renewable energy and sustainable energy technologies in Irish homes.



Farmers can develop a wood fuel supply company



Wood pellet stoves are now grant-aided

The objectives of the Scheme are:

- » To assist householders who wish to invest in renewable energy heating technologies
- » To increase the number of households in Ireland that use renewable energy
- » To decrease our reliance on imports of fossil fuels
- » To reduce emissions of harmful carbon dioxide benefiting the environment

The grants will be provided to homeowners who invest in new renewable energy based heating systems such as wood pellet stoves (with or without back boiler) and central heating wood chip or pellet boilers. Solar heating and heat pumps may also be grant-aided.

It may be possible to apply for a second grant where the combination of technologies makes sense in terms of value for money and operating service or which result in a reduction in the CO₂ intensity of meeting the heat requirement but at a higher capital cost. Allowable combinations include:

- » wood chip or pellet boiler and solar hot water
- » pellet-fired stove for room heating and solar hot water

- » pellet-fired stove for room heating and hot water production and solar space heating

The levels of grant support available for each technology are as follows:

- » wood chip/pellet boiler €4,200
- » wood chip/pellet stove with integral boiler €1,800
- » wood chip/pellet stove €1,100
- » solar thermal space and/or hot water heating 300/m² (to max. 12 m²)

Further information is also available from: Greener Homes Scheme, Sustainable Energy Ireland, Glasnevin, Dublin 9, 1850 734 734, greenerhomes@sei.ie or log on to: www.sei.ie.



Bioheat Programme

This is a grant programme available to companies and small businesses for the installation of wood chip and wood pellet boilers in large buildings and commercial premises. Grant aid is up to 30% of overall cost depending on the overall size of the project. The programme is available for wood boilers in the range of 60 kW to 1 MW.

Other SEI-supported schemes

Sustainable Energy Ireland operates in addition a number of programmes that provide financial supports to demonstrate superior energy technologies or provide essential support in specifically identified sectors. Funding is available in the following areas:

Buildings and Housing

House of Tomorrow

This element of the programme provides funding to developers for the design and construction of clusters (minimum 10) of superior energy performing housing units. Projects will be considered where the energy performance is at least 40% better than that required by the current Building Regulations TGD L 2002 (new build). Preference will be given to projects incorporating renewable energy features such as wood-fuelled heating systems.

Warmer Homes Scheme

This programme provides funding to community-based organisations for the installation of energy efficiency measures in low income dwellings in their respective geographic areas.

Public Sector Programme

This programme part-funds improved energy efficiency design strategies, technologies and services in public sector construction and retrofit projects, acting as both an example for good practice and as a demand leader for the services and technologies involved.

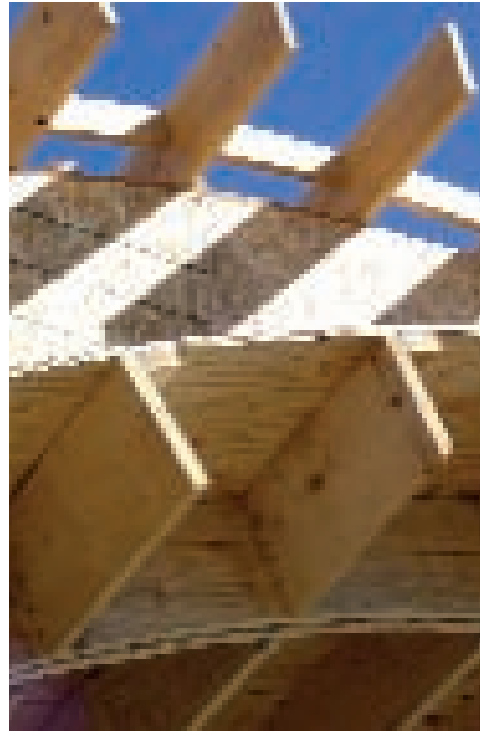
Renewable and Alternative Energies

Renewable Energy Research, Development and Demonstration (RERDD) Programme

The goal of this programme is to make a positive impact on the implementation of renewable energy in Ireland. The current programme strategy is focussed on areas with utility-scale, grid-connected renewable energy featuring strongly. The programme will seek those applications that present excellent possibilities for replication and acceleration of the take-up of appropriate renewable energy technologies which are near-market and also on assessing the development of future renewable energy technologies.

Combined Heat and Power (CHP) and District Heating (DH)

This programme supports feasibility studies into the use of novel CHP/DH systems.





Some facts and figures

- 1000 litres of home-heating oil = 4-6 tonnes of dried chips = 2-2.5 tonnes of wood pellets
- One hectare of thinnings can heat a house for over a year
- A large detached house (200 m² = 2150 ft²) will need approx. 14 tonnes of wood chips or 6 tonnes of wood pellets per year
- Normally, 5 kilowatt (boiler output) is required per 100 m² of house floor area dependent on insulation levels, etc.



Further information

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

Establishment and development grants are available from the Forest Service. For further information, contact: Forest Service, Department of Agriculture & Food, Johnstown Castle estate, Co. Wexford; 053-60200 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 Sustainable Energy Ireland, Renewable Energy Information Office, Shinagh House, Bandon, Co Cork, 023-42193, renewables@reio.ie 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.

