AN INTRODUCTION TO WOOD FUEL: HANDOUT, November 2014

1. WHY HEAT WITH WOOD?

Summary: In the UK wood is an under-used resource, but has environmental, economic and security benefits over oil, gas and coal.



- **Saving money:** Burning fuelwood efficiently can be cheaper than heating your home with other fossil fuels.
- **Local economy:** Local markets for wood support local livelihoods as well as local landscapes and wildlife.
- **Environmental benefits**: Fuelwood can support sustainable woodland management, which in turn brings benefits for wildlife and woodland habitats. Opening up space allows sunlight in, which enables a wider range of plants, insects and animals to live in the woodland.
- **Climate Change**: Wood is a carbon-lean fuel. Net CO^2 emissions are significantly lower than burning other fossil fuels. Logs = 0.008kg of carbon per kw, gas = 0.198 (x 25), oil = 0.274 (x 65) and electricity = 0.517. Burning wood releases carbon dioxide but this is balanced by the carbon dioxide absorbed by the original trees and in the growth of new ones. The biggest savings of carbon dioxide occur when wood replaces carbon-intensive fossil fuels.
- **Security:** a wood burning stove will provide emergency heating and possibly cooking facilities if the main energy supplies are disrupted.

2. WOOD AS A FUEL

Summary: Wood is a complex fuel. Aim for **high calorific value** (calorific value = measure of the heat released per unit). Burn dry, seasoned, split logs of the right size.

Different species:

Different species have different characteristics e.g. density, resin content and …

- **Hardwoods** will burn longer and give out more heat than softwoods.
- The **best common woods** for burning are oak, beech, ash and birch.
- **BUT** all woods if properly dried and stored can burn well.
- Different **density and moisture content** are reasons species burn differently. All wood have approximately the same heat content by weight, but oak is twice as dense as pine. Poplar is one of the wettest woods when freshly felled and ash (at approximately 35%) one of driest.
- Softwoods have a higher proportion of **resins and oils that give** greater calorific value BUT

can mean more tar on your flue especially if wet. So always make sure soft woods are properly dried.

- Some types of wood fuel are prone to **spitting**, - e.g. willow and most softwoods such as spruce and pine – and should not be burned on an open fire but can be burned safely in a woodburning or multifuel stove.
- 1 m^3 of properly seasoned oak is the equivalent of 190 litres of oil. The same volume of poplar is only the equivalent of 120 litres.

Moisture content:

The moisture content of the log impacts the calorific value. Every 1kg of wet (green) wood adds half a litre of water to the fire which has to evaporate first before generating heat. This is very inefficient and costly.



- **Fully seasoned logs** have approximately double the calorific value of green wood.
- **A fire must dry out wet or unseasoned logs** before they can start to burn and release heat. Water from wet logs is driven off up the chimney, where it condenses and causes tar deposits that can damage the flue liner.
- **Tip:** Bring your wood into the house a week or more before you burn it. This will bring the water content down and increase the heat you get from the log.
- **Tip:** If you have to use some "wet" wood then it can be burnt efficiently once the fire is very hot. Starting a fire with wet fuel will not give any heat at all. Start the fire with dry wood and then mix the wet wood in with dry once the fire is very hot.

- **Moisture meters** are around £20 and will give you an instant readout of moisture content. Anything above 30% is not fully seasoned or has been stored in wet conditions.

Table 1. Moisture content at different levels of seasoning

	Description	**Moisture content**	**Energy potential**
Green	From the living tree	Approx. 50%	1898 kWh/t – 36%
Part-seasoned	1 year seasoning	30 – 35%	3339 kWh/t – 63%
Fully seasoned	2 years seasoning	20-25%	3915 kWh/t – 74%
Kiln dried	Artificially dried	8-12%	4600 kWh/t – 87%
Oven dried	Dried at 105 0C	0%	5300 kWh/t – 100%

Source: Rolls, W. (2013) The Log Book: Getting the most from your woodburning stove / Bretagne Bois Buche / Biomass Energy Centre

Seasoned wood:

Firewood is ready for use when its moisture content reaches 20% (or less). You can use a moisture meter or look for:

- The wood is grey/darker in colour – meaning it no longer looks fresh cut,

- The ends of the wood are cracked and split,
- Logs feel lightweight for their size,
- When you bang two logs together, they make a ringing sound (fresh cut logs will make a "thud" sound),
- If you throw a test piece on the fire, you don't see a lot of boiling water or steam coming off the log, and it burns well,
- Most wood will be ready for use after 6-12 months of seasoning, but certain hardwoods, like oak, may take up to two years.

Log size:

- Smaller diameter logs tend to be drier and quicker to ignite,
- The maximum size log you should use is approximately half the size of your firebox, otherwise the logs restrict air and heat moving around,
- You should be able to fit 3 well sized logs in your burner,
- Ideally, logs purchased should be no more than 10cm thick, any that are more than this will need to be split again to ensure that they burn efficiently.

3. STACKING, DRYING AND STORING

Cutting and drying:

- Trees should be **cut in the autumn or winter** when the moisture content is least.
- Ideally, the wood should then be left to **air dry** in stacks for at least 1 year.
- A tarpaulin over the top will keep the worst of the rain off but the sides of the **stack** must be open to the wind to allow the air to circulate.
- It can then be **cut into short sections and split** into logs not more than 10 cm in diameter.
- **Store logs** in a roofed stack until needed.

Outside stores:

Outside stores must be well ventilated and dry, protected from rain and groundwater. It needs a roof/cover but ensure permeable sides to your stack/shed to air dry. Stack your fuelwood off the ground and you need air circulation at ground level (pallets are ideal for this, or on stone). Store as close as possible to the house but if you have a store against your house wall make sure you stack the wood so that it doesn't touch the wall. You should also make sure it doesn't constitute a fire risk. Make sure your logs are stacked safely and won't collapse on anyone removing wood from the stack.



Methods for cutting your own wood:

Cutting and splitting wood can be dangerous, so ensure you are safe and proficient in using any of the following methods:

- Hand saw
- Reciprocating saw
- Chain saw
- Axe
- Saw bench
- Firewood processor
- Splitting



4. ECONOMICS

If logs are used correctly and burnt efficiently, seasoned logs can be cheaper than many other heat sources:

Table 2: Costs of wood compared to other fuels

Fuel	**Pence per KW Hour**
Electricity	16.02
Oil	7.03
LPG	6.82
Coal	6.22
Seasoned wood	5.30
Mains Gas	4.66

For up to date prices see http://www.nottenergy.com/energy_cost_comparison

In August 2014 wood was over 3 time cheaper than heating with electric.



5. BURNING WOOD EFFICIENTLY



Different ways to burn logs:

- **Open fires** are not efficient (only about 20% of the calorific value of the wood is used for heating the room, the rest goes up the chimney!). An open chimney will also suck up warm air when fire is not on causing net loss of heat.
- **Wood stoves** - Simple, cheap, greater efficiently than open fires at approximately 70% efficient, also safer than open fires if used properly.
- **Wood boilers** heat water for heating and hot water systems – but big investment. Require space for boiler, storage etc.

How wood burns:

Up to 80% of the energy from wood comes from burning gaseous volatile compounds which are driven off in combustion (secondary combustion), only 20% comes from the solid 'char' which remains in the grate (primary combustion). There are different phases in a fire:

- **Phase 1:** The heat from the wood already burning heats up the water in the igniting log and evaporates it. This takes a lot of heat and keeps the temperature of the fire down.
  TIP: - wood must be as dry as possible, otherwise wood gasses will condense and create tar in the chimney and water vapour will reduce the heat of your fire.
- **Phase 2:** Once the moisture has been driven off, the temperature rises and hydrocarbon gases are released. These can burn if there is sufficient heat and oxygen. Most of the heat potential of wood is in these gases.
  TIP: For gases to burn freely there needs to be air available just above the logs. The air vents in a stove are designed to create turbulence to mix the gasses and air together in the hottest part of the fire.
- **Phase 3:** All gasses have been removed to leave charcoal, which burns with no visible flame – but has a voracious appetite for oxygen.
  TIP: wood needs plenty of air to complete the burning process and give efficient, clean burning. Your stove should have a separate air supply to the charcoal layer. Shutting down the air supply will create an inefficient burn and more tar which damages your stove.

Manage the airflow:

Managing the airflow is key to efficient and economic burning. Primary air feeds the bed of the fire, and secondary air feeds the flames above it. Nearly all the energy from wood comes from burning gases released when it is heated – so secondary air is much more important than primary. **Top tips:**

- Never completely close the secondary air vent. It's the easiest way to create soot and tar.
- Don't leave the stove door open, unless you have been specifically instructed to by the manual when lighting the fire.
- Always look for a hot, fast burn, as this will be the cleanest, most efficient way of running the stove. A small hot fire is much more efficient than a large slow-burning one.

6. BUYING LOGS

Summary: buy seasoned, dry, split wood by the cubic meter, be clear on what you are getting before you buy.

- Find a supplier that can **deliver quantity at good price**.
- **Buying green wood is cheaper** if you can buy ahead and have somewhere to store it and can set up your own system for seasoning. But if you don't have somewhere you can store your wood for some months, buy well-seasoned wood, which will have a low moisture content; 25% or below.
- **How much wood you need** depends on fuel quality, weather, how you are burning it and heat demand.
- **Check the size of a 'load'** before buying, a 'load' can mean pretty much anything – depends on the truck of the merchant!
- **What is in a metre or a tonne**. Make sure you know whether the logs are sold by solid, stacked or loose volume. 1 m^3 of solid round wood forms a 1.4 m^3 stack of 1m long split logs; This will turn to 2 m^3 of loose and chopped firewood and 3m^3 of medium grade wood chip. If buying by the tonne remember that 1 tonne of seasoned hardwood logs should make a loose pile of around 2.8 m^3 or a stack of around 2 m^3. 1 tonne of seasoned softwood logs should make a loose pile of around 3.3 m^3 or a stack of 2.3 m^3.
- **You want to be paying** between £90 and £120 per cubic meter delivered. Split logs are more convenient and drier, but remember they take up more space than in the round so the price will be higher.
- **Buying by weight is problematic** as wet wood weighs more (green wood is approx. 50% water). So better to buy by volume than weight

Questions to ask when buying wood

- What is the species?
- What is the moisture content?
- What size are the logs?
- When was the wood cut and split?
- Where has it been stored, if stored undercover?
- What is the price per cubic meter? Is that as solid wood, stacked logs or loose logs?



7. RESOURCES

Books

Rolls, W. (2013) The Log Book: Getting the most from your woodburning stove

Reynolds, A. (2009) Heating with wood: Wood fuel, stoves and home heating

Bushway, S. (1992) The new woodburner's handbook: A guide to safe, healthy & efficient woodburning

Butterworth, J. (2010) Woodburning: The Greener Way to Fuel your Home

Websites

www.biomassenergycentre.org.uk

www.woodsure.co.uk

www.southwestwoodshed.co.uk

http://www.nef.org.uk/knowledge-hub/wood-fuel-logpile/buying-wood-fuel

http://www.bretagneboisbuche.com/ (French)

http://www.cordialeproject.eu/en/toolkit

http://blackmountainwoodfuels.co.uk/

http://www.nottenergy.com/energy_cost_comparison

Factsheets

http://www.arnsidesilverdaleaonb.org.uk/images/stories/pdfs/buying_logs.pdf

http://www.arnsidesilverdaleaonb.org.uk/images/stories/pdfs/woodburning_stoves.pdf

This information leaflet was produced on behalf of the community energy training partnership by Dr Ruth Fuller with input from Kit Vaughan and Ian Rees.

FIREWOOD POEMS

The Firewood Poem

Beechwood fires are bright and clear
If the logs are kept a year,
Chestnut's only good they say,
If for logs 'tis laid away.
Make a fire of Elder tree,
Death within your house will be;
But ash new or ash old,
Is fit for a queen with crown of gold

Birch and fir logs burn too fast
Blaze up bright and do not last,
it is by the Irish said
Hawthorn bakes the sweetest bread.
Elm wood burns like churchyard mould,
E'en the very flames are cold
But ash green or ash brown
Is fit for a queen with golden crown

Poplar gives a bitter smoke,
Fills your eyes and makes you choke,
Apple wood will scent your room
Pear wood smells like flowers in bloom
Oaken logs, if dry and old
keep away the winter's cold
But ash wet or ash dry
a king shall warm his slippers by.

Celia Congreve, 1930

logs to burn, logs to burn

Logs to burn; logs to burn;
Logs to save the coal a turn.

Here's a word to make you wise
when you hear the woodman's cries;
Never heed his usual tale
That he's splendid logs for sale
But read these lines & really learn
The proper kind of logs to burn.

Oak logs will warm you well,
If they're old and dry.
Larch logs of pinewoods smell
But the sparks will fly.
Beech logs for Christmas time;
Yew logs heat well;
'Scotch' logs it is a crime
For anyone to sell.
Birch logs will burn too fast;
Chestnut scarce at all;
Hawthorn logs are good to last
If cut in the fall.
Holly logs will burn like wax,
You should burn them green;
Elm logs like smouldering flax,
No flame to be seen.
Pear logs and apple logs,
They will scent your room;
Cherry logs across the dogs
Smell like flowers in bloom,
But ash logs all smooth and grey
Burn them green or old,
Buy up all that come your way
They're worth their weight in gold.

Honor Goodhart, 1926