

Wood as Fuel

Technical Supplement for Fuel Suppliers

This document is a technical supplement to 'Wood as Fuel, A Guide to Choosing and Drying Logs' it is aimed at log suppliers and individuals processing logs for their own use. For further information, contact the Biomass Energy Centre on 01420 526197.

Wood Calorific Value

When choosing wood for burning there are three factors which have an effect on the calorific value (CV) or the amount of available heat per unit of fuel:

1. Species Choice
2. Wood Density
3. Moisture Content

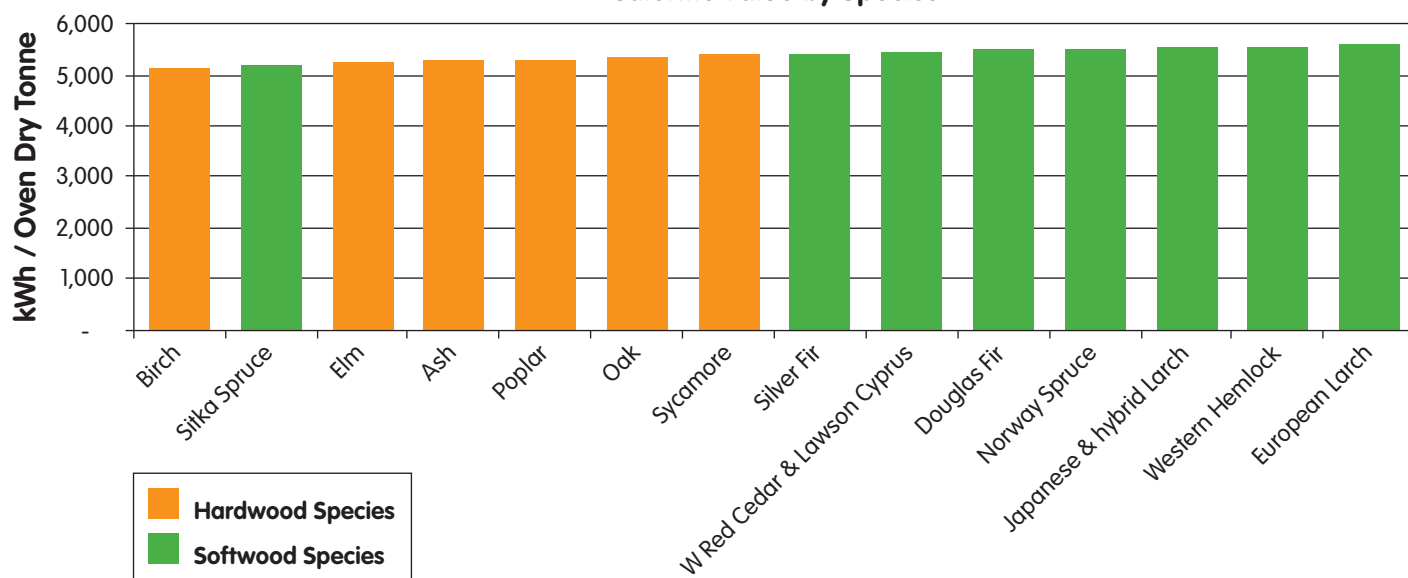
Species Choice

The general differences are that hardwoods (deciduous, broadleaved tree species) tend to be denser, and softwoods (evergreen, coniferous species) tend to contain more resins. There is little variation of CV between species when tested at the same moisture content.

The main differences between species are moisture content when the timber is green, at the time of felling, and the rate at which this moisture is lost during seasoning.



Calorific Value by Species



Data from: Matthews, R, Mackie, E, (2006) *Forest Mensuration: a handbook for practitioners*. HMSO

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Wood Density

As hardwood species are generally denser than softwood species, a tonne of hardwood logs will occupy a smaller space than a tonne of softwood logs. Dense woods will burn for longer than less dense woods, this means you will need fewer 'top ups' to keep a log stove burning. If you measure wood by volume you will generally receive more kilowatt hours (kWh) of heat from a cubic metre (m³) of hardwood than softwood. However, softwoods are often cheaper and easier to source.

Moisture Content

The moisture content of wood has the greatest effect on CV of any of the variables. Not only does any water in the timber represent less fuel when buying by weight, but it also has to evaporate away before the wood will burn, using some of the fuel energy reducing the net energy released as useful heat.

Determining Moisture Content

How to Calculate Moisture Content

The moisture content (MC) of a piece of wood is defined as the weight of water expressed as a percentage of the weight of the wood. This can be expressed as either 'dry basis' or 'wet basis'.

To Calculate a Dry Basis MC

Dry basis is expressed as the percentage of the oven dry weight of the wood. For example, if the wood in a piece of timber weighs 50kg and the water also weighs 50kg then the dry basis moisture content is 100%. The main advantage of this method is that the oven dry weight of the wood remains constant. This method is the standard used by many of the organisations doing research on wood.

$$\frac{\text{Weight of water in a given sample}}{\text{Total oven dry weight of the sample}} \times 100 = \text{MC\% (dry basis)}$$

To Calculate a Wet Basis MC

Wet basis is the most commonly used measurement when calculating for fuel. This measurement is expressed as a proportion of the sample which is water. For example if the wood in a sample weighs 50kg and the water in the sample also weighs 50kg, then the total MC of the sample would be 50% as half of the total sample is water.

$$\frac{\text{Weight of water in a given sample}}{\text{Total weight of the sample}} \times 100 = \text{MC\% (wet basis)}$$

Moisture Meters and Testing

Moisture meters can be a useful tool for assessing the moisture content of fuel, but they will only ever give an indication of MC. For an accurate measurement you should assess moisture content by oven drying the fuel and applying the calculations above; to date oven dry method is the most reliable method, and the only one validated by the standards in their current form.

Methodology on how to determine moisture content and other physical properties of woodfuel has been published in the European standard TS/CEN 335, this is expected to be adopted by the BSI as an EN standard in 2010. For further details go to www.bsigroup.co.uk

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Hetas Solid Biomass Assurance Scheme



HETAS is the official body recognised by government to approve solid fuel domestic heating appliances, fuels and services.

Its work in approving products covers boilers, cookers, open fires and stoves and room heaters. The HETAS biomass fuel quality scheme covers logs, wood chip, pellets and briquettes.

The aim of the scheme is to enable the public to easily identify woodfuel of the appropriate quality for a specific use. Increasing customer confidence in the woodfuel supply chain and ensuring that the correct type of fuel is used in the correct heating appliances.

Benefits of assurance schemes can include:

1. The woodfuel customer will be assured that (s)he is buying the right product for their installation.
2. If product labelling is consistent across suppliers, the consumer can make an informed choice.
3. Producers may be able to earn higher returns on fuel that conforms to an assurance scheme.
4. An assurance scheme will help enhance the reputation of woodfuel heating.

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Web: www.hetas.co.uk



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Minimum information to be displayed when a logs are being sold under the Solid Biomass Assurance scheme : www.hetas.co.uk

Information	Category	Notes
Ready to Burn / Oven Ready	- Ready to burn if kept dry - Not ready to burn (requires drying)	In addition to the moisture information given by the grade assessment.
Length	10 inches / 25cm / L25*	can be +/- 2cm and 15% can be shorter than the minimum.
Diameter	2 to 6 inches / 5 to 15 cm / D10 and D15*	15% can be less than the minimum, small portions of a log can exceed the maximum.
Species	- ash - beech and birch - All hardwood species - All softwood species - Mixed hardwood and softwood	Species must be listed in order of highest proportion, the first species must always be present, the others may not always occur in a sale pack.
Grade	A1 – mostly split – suitable for stoves, fireplaces and log boilers	Grade A1 has no branchwood, >90% split pieces, has 'even and smooth' cut-off surface (which can include chainsaw cut) and shows no visible decay (mould or other). Less than 25% moisture content (wet basis) or CEN M25 w-% grade A1 can be M20 or M25*.
	A2 – some split – suitable for stoves, fireplaces and log boilers	Grade A2 must have >50% split wood. A2 has less than 5% visible decay. Less than 25% moisture content (wet basis) or CEN M25 w-% grade A2 can be M20 or M25*.
	B – suitable for log boilers only	Grade B has no requirements for split wood. Grade B must declare if decay is greater than 10%. Grade B can be M25 or M35*.
UK / Country of Origin	with further detail optional (e.g. Yorkshire)	Country of origin is where the tree was growing, unless the firewood is a by-product or residue from a wood process which uses more than 50% of the stem wood (eg a sawmill), in which case the county of origin is as the site where it became a by-product / residue.
[Optional] Calorific Value	kWh energy content per unit of sale	
[Optional] Drying Method	- Kiln dried - Natural air dried	If kiln dried, you may wish to state whether the kiln was heated with fossil fuels or renewable energy.

NB. 1m³ loose volume is approximately 0.66m³ stacked volume

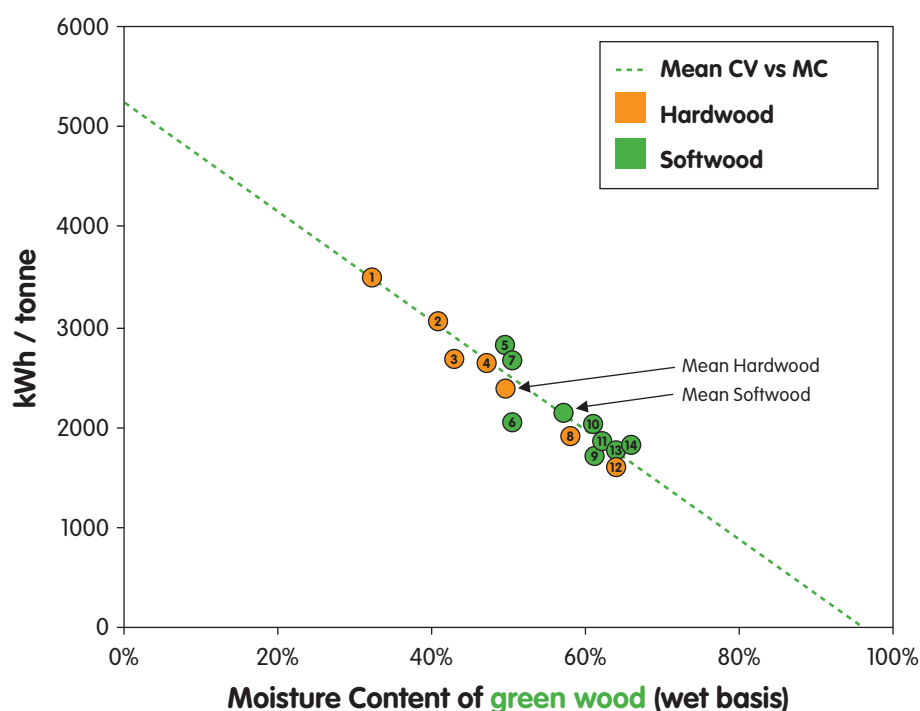
* Relates to CEN standard

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The Effect of Drying on Energy Content

This graph shows the different net calorific value (CV) of tree species when felled. It shows that most of the variation in CV between species is caused by the amount of water naturally present in the wood when felled. Therefore fresh poplar timber will have about half the CV of fresh ash, but if both are dried to the same moisture content they will have a very similar CV per weight, (the volume of material will still differ, as the species have different densities).



Graph Reference No.	Species	Green MC (wet basis)	kWh per Green tonne
1	Ash	32%	3448
2	Sycamore	41%	3044
3	Birch	43%	2668
4	Oak	47%	2635
5	European Larch	50%	2722
6	Douglas Fir	51%	2596
7	Japanese & hybrid Larch	51%	2653
8	Elm	58%	1915
9	Sitka Spruce	61%	1705
10	Western Hemlock	61%	2040
11	Silver Fir	62%	1855
12	Poplar	64%	1610
13	W Red Cedar & Lawson Cypress	64%	1755
14	Norway Spruce	65%	1787

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Contamination

You should not sell or use firewood that has been produced from wood contaminated or treated wood. Contamination includes:

- Varnished, painted or plastic-coated wood,
- wood treated with wood preservatives (including stains, and creosote)
- household waste

Contamination can affect the amount and composition of tar and deposits building up in the flue. This may increase the risk of corrosion and shorten the lifespan of the heating appliance. Burning contaminated wood may, release noxious chemicals into the atmosphere, it often leaves melted debris in the ash, and can have serious health implications when burnt.

There are different categories of contamination. Material contaminated with halogenated organic compounds or heavy metals falls under the Waste Incineration Directive (WID) and its combustion is closely regulated by the Environment Agency (in England and Wales) or by the Scottish Environment Protection Agency (in Scotland). CCA treated wood and other timber preservatives fall into this category. Other types of contamination would not fall under WID, but will still fall under waste regulations governing combustion, handling and transport, for which a license or exemption may need to be obtained from the Environment Agency. These regulations also cover the use of materials that have come from the secondary processing of timber, such as furniture manufacture.

While it is not covered by the WID, large amounts of earth, stones and other inert matter may have a serious effect on the operation of many wood fired systems, particularly those with automatic feed systems.

For more information in the Waste Incineration Directive (WID), see information at www.biomassenergycentre.org.uk or contact your national environment agency.



Online Woodfuel Suppliers Directory

Supplies of woodfuel can be included in the Biomass Woodfuel Suppliers Directory www.biomassenergycentre.org.uk, downloading the form and returning it to either biomass.centre@forestry.gsi.gov.uk or:

**Biomass Energy Centre,
Forest Research, Alice Holt Lodge,
Farnham, Surrey GU10 4LH**

Useful Links and Further Information:

Biomass Energy Centre

"A 'one stop shop' to provide information to anyone in the UK with an interest in biomass derived solid, liquid and gaseous fuels and associated conversion technologies."

www.biomassenergycentre.org.uk

Logpile

For information on fuel suppliers and boiler installers.

www.logpile.co.uk

Forestry Commission

Further information on using wood as fuel and finding your regional contact:

www.forestry.gov.uk/woodfuel

www.forestry.gov.uk/yhwoodfuel



Expect to see quality suppliers signing-up to an assurance scheme run by HETAS. With consistent product labelling, it will be easier to choose appropriate fuel for an appliance. See www.hetas.co.uk/public/Solid_Biomass_Assurance_Scheme.html for further information.



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CO₂Sense Yorkshire is a not-for-profit company funded by Yorkshire Forward and the European Regional Development Fund. It is committed to helping businesses in Yorkshire and Humber to prosper in a low carbon economy. CO₂Sense's woodfuel programme is supporting and funding businesses and other organisations to develop the sourcing, supplying and use of woodfuel in Yorkshire and Humber.

www.co2sense.org.uk

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