

**HIGHLAND
BIRCHWOODS**
Coille Beithe na Gàidhealtachd




**NORTHERN
WOODHEAT**

Northern WoodHeat

THE CARBON BALANCE OF WOODFUEL



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Background

Growing concern over CO₂ emissions from fossil fuels has led to increased interest in use of alternative fuels which are either carbon neutral or produce significantly less emissions than fossil fuels

Woodfuel counts as one of these fuels because the CO₂ emitted when it is burnt was previously absorbed from the atmosphere by the tree while it was growing. However, it can only approach carbon neutrality if it comes from a sustainably managed source in which all harvested trees are replanted. Even then there are still some CO₂ emissions associated with the various stages of woodfuel production. These stages are:

- Planting and harvesting of trees
- Transporting and processing timber
- Transporting and using finished woodfuel

Carbon is stored in virtually every part of the Earth; from the Oceans to the Rainforests, and all that lies between. The 'carbon balance' is the net amount of CO₂ released into the atmosphere by any natural or man made process.

This leaflet estimates the 'carbon balance' of a range of different woodfuels and compares them with the carbon balance of fossil fuels conventionally used for heating. The results are also compared with the carbon balance of ground source heat pumps - an alternative renewable energy technology which, like woodfuel can be used to produce heat directly.

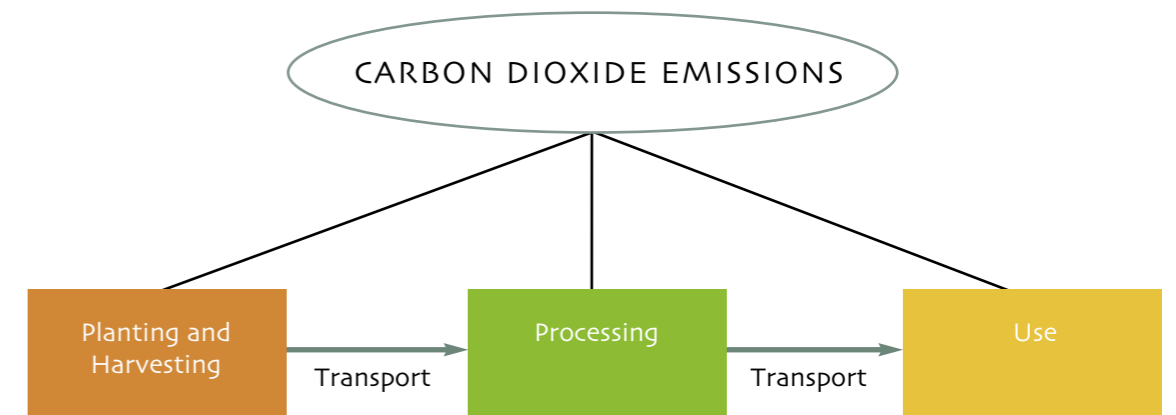


Figure 1. Carbon dioxide emissions can be associated with the growing and harvesting of trees, and the transportation, processing and use of wood fuels.

Scope and information sources

The CO₂ emissions associated with the use of wood as a fuel have been calculated, considering every step in the process. These include: Planting; Harvesting; Transportation of timber; Processing; Transportation of processed fuel and finally the use of the wood as fuel. The information used to quantify CO₂ emissions has, where possible, been obtained from existing wood fuel suppliers currently operating in the North of Scotland.

Data gathering and calculations were carried out by the Edinburgh Centre for Carbon Management.

Results

For wood pellets and woodchip, highly automated boilers are available which require electricity for ignition, control systems and operating the auger to feed the boiler. However the carbon emissions from this are very low and so have very little impact on the net carbon balance of woodfuel. For all types of woodfuel, air-drying to 35% mc prior to processing deducts approximately 9g CO₂/kwh.

LOGS USED IN LOG BOILERS AND LOG BURNING STOVES

The production and use of log wood results in the emission of **4 grams of carbon dioxide for every available kWh of delivered heat**, as shown in Figure 2.

Log Wood	Emissions produced	
	(gCO ₂ /kWh delivered heat)	%
planting and harvesting	1	17
processing	1	15
transport	3	68
TOTAL	4	100

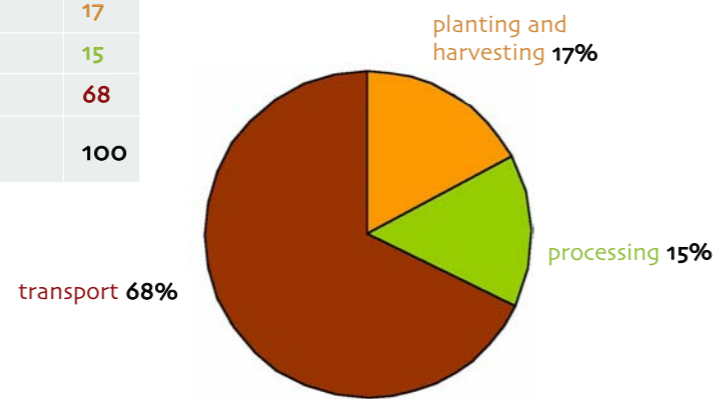


Figure 2. The carbon balance of log wood

ASSUMPTIONS

- manual planting
- chainsaw harvesting
- quad bike extraction
- air drying
- mechanised log splitter
- 50km delivery radius
- 80% efficient stove

Using an accumulator boiler set-up (a semi-automated boiler in combination with a large hot water tank to store the heat) would add approximately 0.3g/kwh of carbon due to electricity required for ignition and controls.

WOODCHIP IN AUTOMATED BOILERS (DISTRICT HEATING SCALE)

The production and use of woodchip results in the emission of **64 grams of carbon dioxide for every available kWh of delivered heat**, as shown in Figure 3.

Wood Chips	Emissions produced	
	(gCO ₂ /kWh delivered heat)	%
planting and harvesting	1	2
processing	11	17
transport	2	3
fossil-fuel for boiler ignition and automated fuelling	50	78
TOTAL	64	100

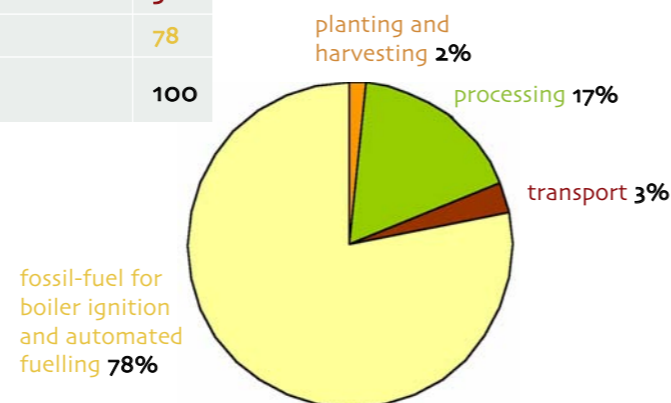


Figure 3. The carbon balance of wood chips

ASSUMPTIONS

- manual planting
- mechanised roundwood harvesting
- forwarder extraction
- 20km haulage to processing plant
- mechanised drying
- 16 tonne/hr chipper
- 50km delivery radius
- 65% efficient boiler

SCOTTISH WOOD PELLETS IN PELLET STOVES (DOMESTIC SCALE)

The production and use of locally produced wood pellets results in the emission of **34 grams of carbon dioxide for every available kWh of delivered heat**, as shown in Figure 4.

Wood Pellets	Emissions produced	
	(gCO ₂ /kWh delivered heat)	%
planting and harvesting	1	2
processing	32	93
transport	1	4
fossil-fuel for boiler ignition	0.3	1
TOTAL	34	100

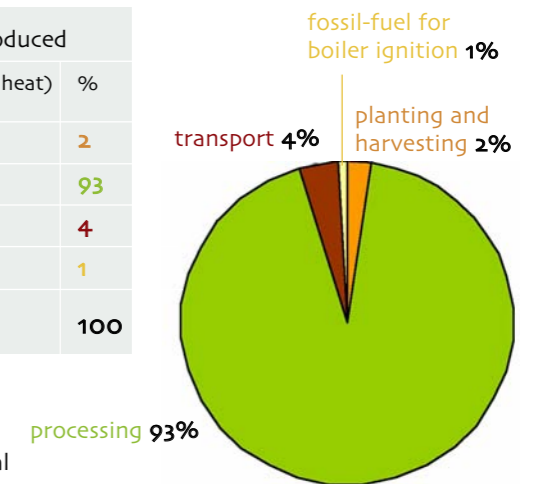


Figure 4. The carbon balance of locally produced wood pellets

ASSUMPTIONS - AS WOODCHIP EXCEPT:

- pellets are manufactured in a large scale electrical pellet plant (the carbon emissions from a pellet plant powered by a renewable electricity source such as wood-fuelled CHP would be significantly less).
- 80% efficient stove with auto ignition

Automated fuelling would add approximately 40-50 g/kwh

Substituting sawmill co-product for roundwood has no significant impact on the carbon balance.

IMPORTED WOOD PELLETS IN PELLET STOVES

The production and use of imported wood pellets results in the emission of **52 grams of carbon dioxide for every available kWh of delivered heat**, as shown in Figure 5.

Imported Wood Pellets	Emissions produced	
	(gCO ₂ /kWh delivered heat)	%
planting and harvesting	1	1
processing	40	78
transport	10	20
fossil-fuel for boiler ignition	0.3	1
TOTAL	52	100

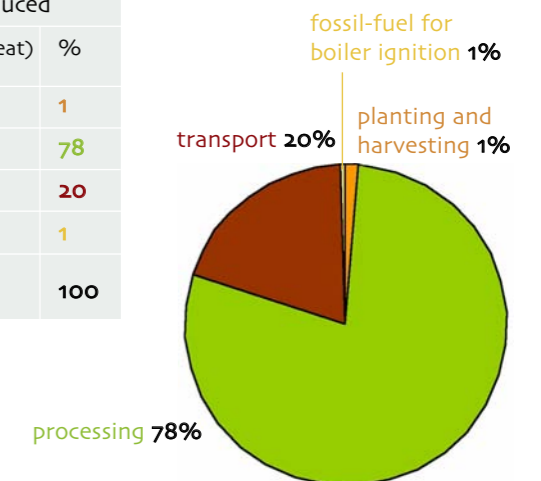


Figure 5. The carbon balance of imported wood pellets

ASSUMPTIONS - AS FOR SCOTTISH WOODPELLETS EXCEPT:

- Higher carbon emissions from Estonian electricity generation
- 100km haulage from processing plant to Estonian port
- 1644 km shipment to Scotland
- 100km haulage within Scotland

Conclusions

Log wood has significantly lower associated CO₂ emissions than alternative forms of wood fuel. This is for a variety of reasons:

- the log wood is air dried and so there are no emissions from heat generation;
- the log wood requires less mechanical processing than other forms of wood fuel;
- the log wood can be burned on open fires or in boilers that require no additional support fossil fuel

There are CO₂ emissions associated with wood pellets at both the production and combustion stages. Wood pellets require mechanical processing and are dried using heat generated by fossil fuels (emissions calculations here are based on gas combustion). Wood pellet boilers also require electrical energy for boiler ignition and some for automated fuelling. Carbon dioxide emissions associated with imported wood pellets are greater than locally produced wood pellets because they are transported further; by road in Estonia; by ship to the UK; and by road in the UK from the port to the customer.

Woodchip has the greatest associated carbon dioxide emissions principally because it needs the most fossil fuel to ignite and support the boiler in which it is combusted.

Summary of Carbon Balances

Figure 6 shows that the carbon balance of woodfuel is significantly lower than those of fossil fuel alternatives. This is because fossil fuels emit significant amounts of carbon dioxide when they are burnt. Woodfuel also emits carbon dioxide when it is burnt

BUT

because this carbon was absorbed from the atmosphere by the tree while it was growing there are no net carbon dioxide emissions from burning wood fuel apart those caused by automated ignition and fuelling) systems

Ground Source Heat pumps also have a higher carbon balance than woodfuel because they require electricity to run.

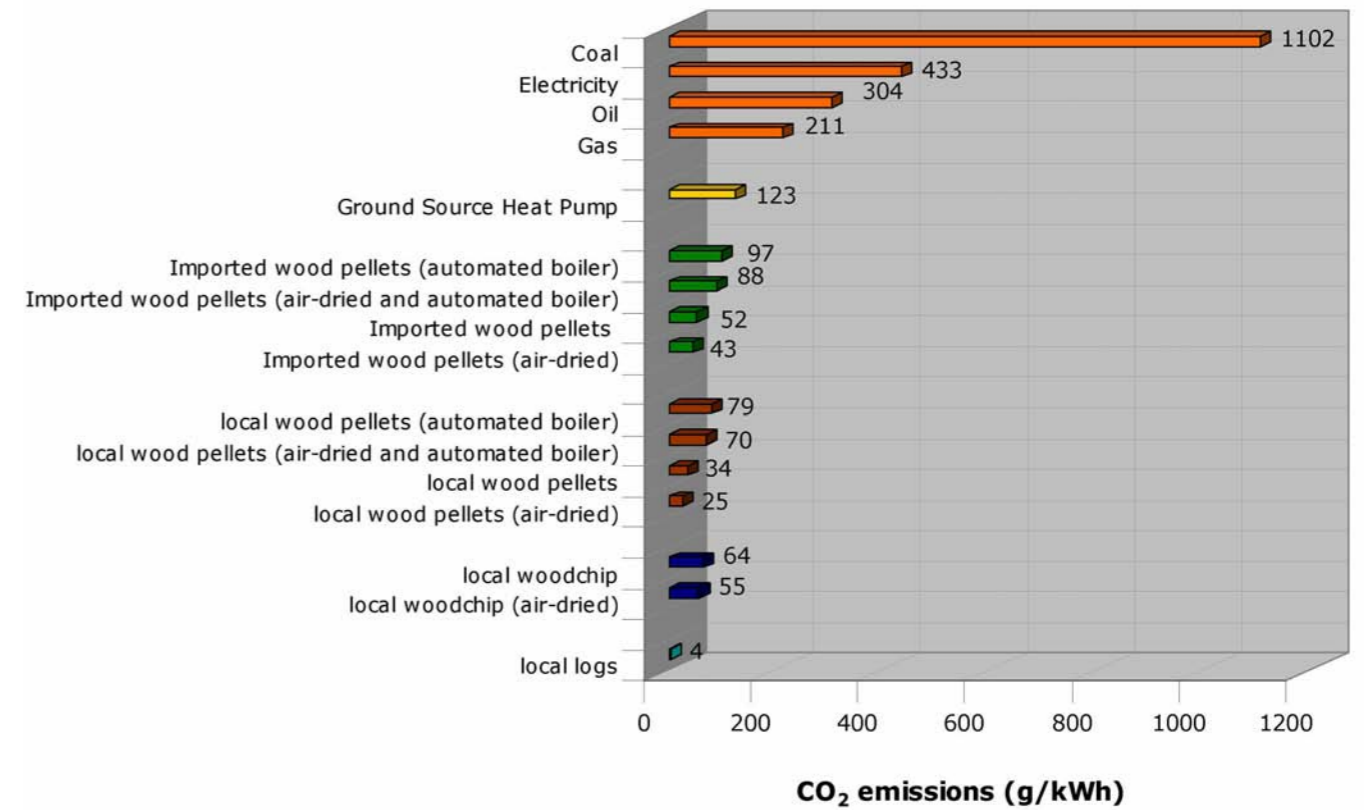


Figure 6. The carbon balances of wood fuels, fossil fuels and ground source heat pumps

If you would be interested in seeing the calculations used above in more detail, please contact us using the details on the back of this booklet.

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The Northern Periphery Programme

The NPP is one of 13 Interreg IIIB programmes aimed at encouraging and supporting transnational cooperation between the regions of Europe. It provides the opportunity for organisations from the programme area to work together on joint projects concerning common issues and problems.



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