

Oilseed Rape straw as a biomass fuel source



Harper Adams University College Project Report



Image courtesy of T. Pickthall

SUMMARY

- Oilseed Rape (OSR) straw shows considerable promise as a crop residue biomass fuel. Being an agricultural waste product, it offers a significant environmental benefit in the food versus fuel debate that has arisen from the increasing use of energy crops such as Miscanthus. It also offers the opportunity to increase the gross margin of the OSR crop.
- Straw is a difficult material to handle and transport because it typically has a low density. By processing straw into pellet form, its bulk density can be more than doubled, offering a significant logistical benefit. There is however a production cost and energy usage associated with pelletising straw.
- A project sponsored by the Douglas Bomford Trust and the Claas Foundation is underway at Harper Adams to determine whether OSR straw pellets present a suitable and economically viable alternative to traditional fuels.

THE NEED FOR ALTERNATIVES TO FOSSIL FUELS

Fossil fuels are the dominant source of global energy, accounting for approximately 80% of world energy consumption and 90% of UK energy demand in 2006. Fossil fuel use is also the principal source of UK carbon dioxide emissions, accounting for some 586 million metric tons of carbon dioxide emissions in 2006 (EIA, 2008).

Renewable energy sources have long been identified as desirable alternatives to fossil fuels, providing a sustainable, low carbon dioxide source of power and heat which also improves the security and diversity of energy supply. The EU target is for 20% of all energy consumption to come from renewable sources by 2020. The UK's contribution to this challenging and highly optimistic target is to increase the energy we obtain from renewable sources from 1.5% in 2006 to 15% by 2020.

The main renewable energy technologies are wind, hydroelectric and tidal for the generation of electricity and biomass for both electricity and heating.

BIOMASS

There are two main sources of biomass for energy generation; purpose-grown 'energy crops' and residual materials from food crops. Energy crops, such as Miscanthus and Short Rotation Coppice, are cultivated mainly for energy purposes, but have the well-known disadvantage of using land that may better be utilised for food production. The use of agricultural residues such as straw for energy generation avoids some of the food vs. fuel dilemma and may also add value to existing food crops.

As part of its commitment to EU targets, the UK target is for 30% of all renewable electricity and heat (4.5% of *total* energy) to be obtained from biomass by 2020. In the UK in 2007, biomass accounted for 81.8% of all renewable energy generated, but this was only 2.3% of total UK electricity generation and less than 1% of heat needs. Biomass use therefore needs to increase by more than double by 2020 to reach the EU target.

OILSEED RAPE STRAW AS A BIOMASS CROP

One agricultural residue that could be used as a fuel for energy generation is Oilseed Rape Straw (OSR, *canola*, *Brassica napus*). In the UK, the total area of OSR harvested increased from 332,000 to 598,000 ha between 2000 →

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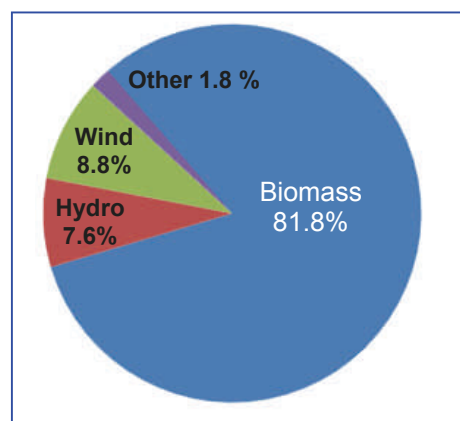


Figure 1. Split of UK renewable energy types (2007). In total they represented **6.28%** of primary energy used, equivalent to 5.17M tonnes of oil.



Image courtesy of M. Robinson

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and 2008, representing 12.6% of the total crop area (DEFRA, 2009). Currently there is not a significant market for OSR straw in the UK, and a large proportion of it is chopped and incorporated into the soil through ploughing. Consequently, development of a market for OSR straw would add value to the gross margin of the crop at farm level.

THE BULK DENSITY CHALLENGE: STRAW PELLETS

One disadvantage with straw is its relatively low density. The bulk density of loose and standard baled straw is approximately 40 kg/m³ and 100 kg/m³, respectively. At best, baled straw can be packed to around 250kg/m³. This makes straw more expensive to transport and store when compared to other widely used fuels such as wood and coal.

Densification into **pellets** increases the bulk density of biomass materials and as a result the net energy content per unit volume is increased. Storage, transport and handling of the material is also easier and cheaper, as shown by the data in Table 1. Allowing for the UK maximum permissible lorry load, there is a 42% by weight advantage of pellets over straw.

Straw Type	UK lorry Trailer	Maximum UK lorry load	Cost to move 1 Tonne 100km	Energy to move 1 tonne 100km
Bale	18m double	17.7 tonnes	£1.47	4.04MJ
Pellet	15m single	28 tonnes	£0.93	2.55MJ

Table 1. Equivalent transport costs of straw & pellets (ASABE 096105, 2009)

BIOMASS FEASIBILITY PROJECT AT HARPER ADAMS

A project sponsored by the Douglas Bomford Trust and Claas Foundation is underway at Harper Adams to assess whether OSR straw pellets present a suitable and economically viable alternative to traditional fuels. This includes studying the effect of storage period on the quality of both straw and pellets. See project report 036 for further details on the project.

ENERGY BALANCE OF PELLET PRODUCTION

There is a logistical benefit from pelletising straw, but energy is required to do so. This energy is known for the production of wood pellets (Figure 2). 20-25% of the energy available from wood sawdust is used in pelletisation.

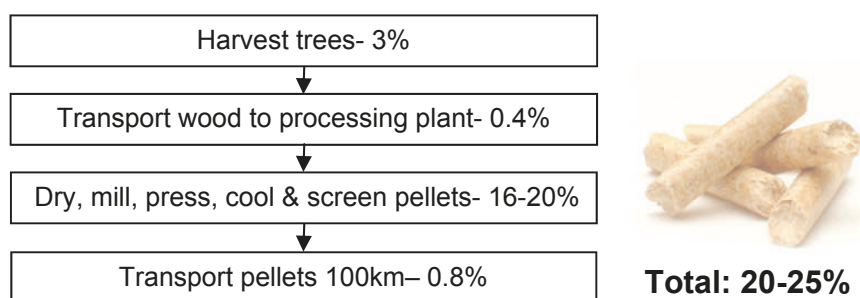


Figure 2. Energy balance of wood pellet production. Chico-Santamarta, 2009.

The energy required to produce OSR pellets will be measured during the project. As OSR straw does not require drying before pelletising, it is expected to use around 15% less energy than making sawdust pellets.

EFFECTS OF STORAGE

Storage can result in changes to the chemical and biological properties of both straw and pellets which can reduce their value and quality. Whilst this effect has been quantified on pellets made from forestry materials, there is little data available on OSR. Part of the Harper Adams project is to gather this data. More information can be found in HAUC Project Report 036 (<http://ofi.openfields.org.uk/1.09080168>).

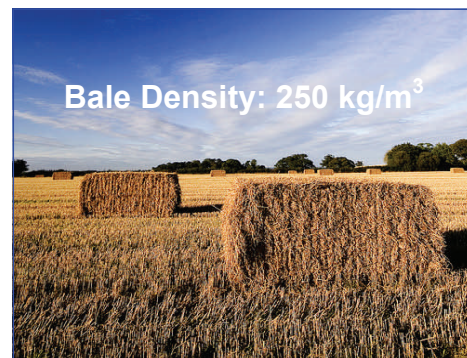


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Further information

Chico-Santamarta, L., Humphries, A.C., White, D., Chaney, K., Godwin, R.J. (2009), "Effect of Pre- and Post-pelletisation Storage of Canola (Oilseed Rape) Straw on the Quality and Properties of Pellets", *ASABE Annual Meeting Paper N° 096105*.

If you are interested in learning more about this innovative project, please contact **Miss Leticia Chico-Santamarta** in the Harper Adams Engineering Department at lchico-santamarta@harper-adams.ac.uk.

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Series Editors:
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