Bioeconomy Science Institute™
Maiangi Taiao

Optimising supply chains for biomass to bioenergy

Optimising the biomass fuel supply chain is important to both maximise the greenhouse gas (GHG) reduction and manage the overall costs. Biomass moisture content (MC) is an important feature, with higher moisture content increasing transportation costs and reducing boiler efficiency. To optimise both transport and boiler efficiency biomass should be around 40 to 45% moisture content (wet basis; MCWB)

Transportation costs

As moisture content of wood reduces from green wood at around 55 to 58% MCWB the transport cost reaches a minimum at around 45% moisture. Above this level the trucks are weight limited - maximum payload is reached before it meets the volume limit; below it they are volume limited. There is often no further transportation cost saving for comminuted biomass below 45% moisture*. Results will vary with transport distance assumed and truck configuration.

Boiler efficiency

The efficiency of biomass boilers varies with the type of boiler and with the condition of the fuel. Boiler efficiency is the conversion of the energy content of the fuel to useful energy out of the heat system. There is a relationship between moisture content and the heating value of wood: the higher the moisture content, the lower the calorific value per tonne and the lower the boiler efficiency. In a typical biomass boiler, using wood chip with a moisture content of 40% instead of 55% will improve efficiency from around 80% to about 88%. This reduces fuel demand, costs and emissions.

Biomass drying costs

A range of technologies are available to dry woody biomass to a lower moisture content. These include uncovered, covered and vented systems. The storage of wood chip in piles should be kept as short as possible to avoid dry matter losses and wetting of the fuelwood feedstock by microbial activity, respiration of living cells and precipitation. Air drying will occur if the ambient air passing through has a lower relative humidity than the chip.

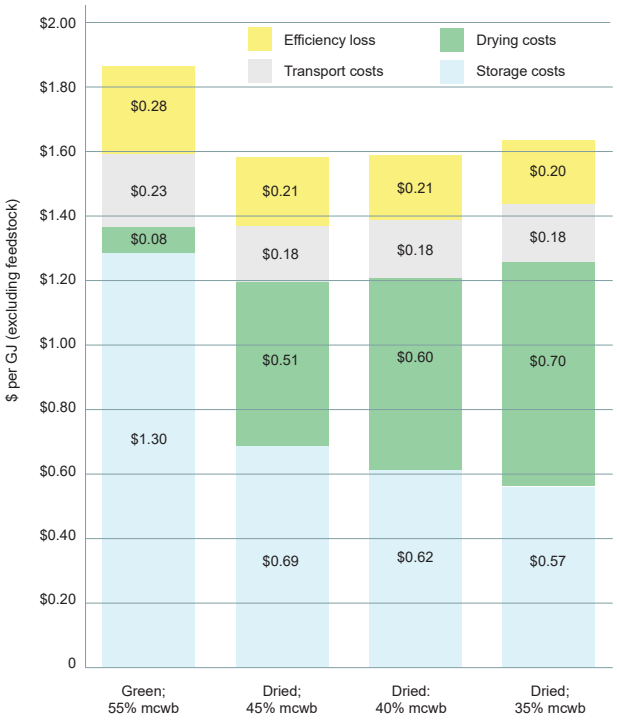

Figure 1. Cost for storage, drying, transport and boiler efficiency

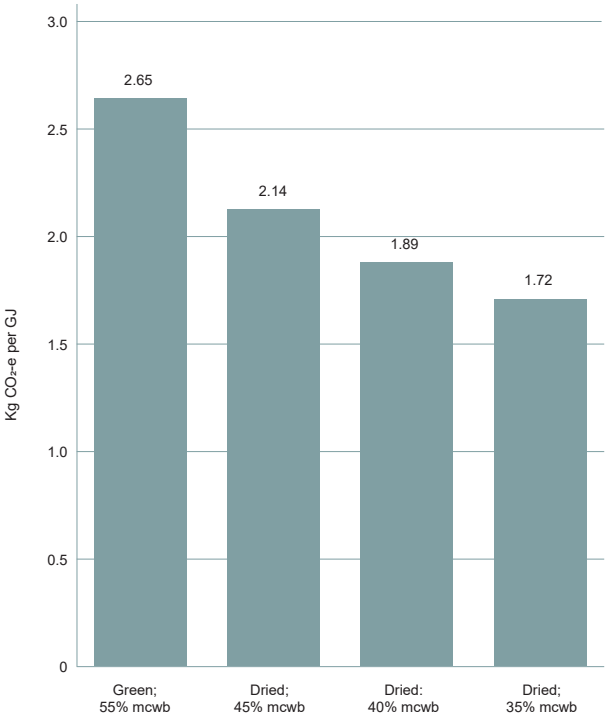

Figure 2. GHG reductions from drying wood fuel.

It has been shown that green chip (~55% MC) could be dried to 25 to 30% in around 7 days using under-pile air inlet pipes, a fan and ambient air, in a covered storage facility.

The impact on heat system output costs (excluding the initial costs of the green biomass) of drying biomass from 55% MC to various lower levels are shown in Figure 1. Drying the biomass to 45% gives a saving of around $0.28 per gigajoule (GJ). Drying to lower moisture content does not affect the cost much.

The emissions of wood from different moisture content scenarios were explored.

The standard emission factor for wood is 2.14 kg of CO_2-e per GJ (Ministry for the Environment). This was used for the 45% moisture content fuel. The other emissions factors were adjusted to allow for differences in transport emissions and combustion emissions (wet wood fuel has slightly higher emission than dry fuel). In this scenario, wood fuel dried to 45% had emissions that are 24% lower than green wood fuel (Figure 2). Drying to 35% MC would further reduce emissions but may compromise transport efficiency.

Optimal wood drying

The graphs represent only one possible scenario of many. The level of saving and the optimum moisture content to dry to will vary with the specifics of the situation, transport distance, truck volume and tare weight etc.

What it shows is the value of some substantial initial drying over delivery of undried "green" fuel at an assumed 55% MCWB.

*In this analysis, we have assumed a transport (one way) of 150km, a chip truck and trailer volume of 100m^3 and a payload of 27.5 tonnes in a 50Max HPMV.

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