CASE STUDY

Hoggers open up energy supply from forestry

Forestry generates huge quantities of wood residues. Those residues could be a valuable new source of carbon-neutral energy for the industry and New Zealand.

In practice however, using wood residues is difficult in some sectors of the industry, particularly in forests after cutting. Here, the process can end up costing more than using coal.

Machines called 'hoggers' have been developed which are specifically designed for collecting wood residue from forests.

As part of a new initiative co-ordinated by the Energy Efficiency and Conservation Authority (EECA), researchers have studied the economics of these machines in New Zealand conditions.

The bottom line is – today's hoggers are making wood residue a practical and economic energy option in more situations than ever before.

Renewable, carbon-neutral

Usually wood is grown and used sustainably and energy created from its residues is bioenergy, a renewable energy source.

As such, the net greenhouse effect is virtually zero when it is burnt: carbon dioxide given off during combustion is offset by the carbon dioxide absorbed during the life of the tree.

Using wood residue biomass for energy offers other benefits.

It can provide a low-cost, on-site source of energy, reducing demand for – and reliance on – national supplies of gas or electricity and reducing the impact of rising energy costs. It also solves environmental and compliance problems when wood residues have to be disposed of in landfills.

Use is restricted in NZ

The distance residue has to be transported significantly affects the economics. As a result, use of woody biomass in New Zealand is limited largely to forestry processors like mills that can source the material on-site. This material includes wood waste, such as bark, off-cuts, sawdust and shavings; and black liquor, an end product of the chemical pulping process. In these situations, avoiding landfill costs makes wood residues an energy source that is virtually free.

Extracting woody biomass from forests is a different story.

In some European countries and parts of the USA it is very common.

In New Zealand, however, forestry practices and geographical conditions make utilising residues difficult. Here, most residue from forest harvesting (slash) is usually left where it falls or abandoned at landings, and left to decompose (and emit carbon dioxide and methane).

A typical scene after logging. A pile around 12 metres high with anything from 200 to 300 tonnes of residues.

Hoggers offer solutions

Hoggers are specialised machines for processing residues on-site. They produce processed wood used to fire boilers (hog fuel).

A number of these machines have been imported, or designed and built in New Zealand. Their operators are using them now to collect residue from several forests in the central North Island and processing it on-site for delivery to pulp mills nearby.

The three that have been studied are the 'Woodweta', the 'Ripper' and the 'Crambo 600'.

Please note, the figures in this paper are estimates only. Costs will vary case by case, depending on the availability and quality of the wood residue, and the transport distances involved.

Issues to consider

There are two key issues to keep in mind in reviewing these machines' performances.

One is cost efficiency, which depends largely on the systems involved in handling and transport.

The other is product quality. This is a matter of moisture content and contamination by dirt and ash. Quality varies with the type and condition of forest residue being processed, and how well it is handled.

Wood fuel with a greater weight for a given volume is not necessarily better. It generally indicates a higher moisture content and hence a lower fuel value.

Plateau Bark's 'Woodweta'

The Woodweta is based out of Kawerau. Operated by Terry Robinson and Ian McLaughlin through their company Plateau Bark, its principal role is to provide boiler fuel for the energy plant at the Kawerau Mill's industrial site. It has also worked as far away as Invercargill and Whangarei.

It is anticipated that the Woodweta will provide up to 30,000 tonnes of hogged fuel a year.

The Woodweta at work at a roadside near Kawerau. It is being fed unmerchantable logs from a loader båind it.

Built on a three-axle semi-trailer, the Woodweta can be towed from site to site and set up quite easily. The unit weighs 30 tonnes and is not suitable for moving in soft or wet conditions. An internal screening system separates out dirt before the residue reaches the grinding disc and there is an out-feed conveyer that can feed directly into a chip truck.

Under good conditions, the Woodweta is expected to produce approximately 100m³ of product an hour.

In a recent operation, the cost of the processing was approximately $4.5 per m³ or $13 per tonne. The cost of loading and transport was approximately another $2.00 per m³ or $5.60 per tonne. With the moisture content of the wood at approximately 42% to 44%, this equated to a delivered cost of approximately $2.00 per gigajoule, which compares favourably to the current cost of coal at $4.50 to $5.50 per gigajoule.

Central Waste Recyclers' (CWR) 'Ripper'

The Ripper working on a forest-to-farm conversion at Ohaaki near Taupo.

The Ripper is operated out of Taupo by Noel Richmond's Central Waste Recyclers. This machine covers several sites and is currently working north of Taupo. It has also worked at Tokoroa, Napier, Bennydale and processed logging residue into landscaping mulch near Wellington.

The Ripper's main task is providing boiler fuel to the cogeneration plant at the Kinleith Pulp and Paper Mill near Tokoroa. It could supply up to 70,000 tonnes of hogged fuel per annum.

This model of the Ripper (one of two Rippers CWR operates) is track-mounted and self-propelled. It can be driven and controlled remotely by the excavator operator, who can effectively operate both the loader and hogger.

A recent contract north of Taupo involved processing wood waste from a forest-to-farm conversion. It produced 250 to 300 tonnes per day, and involved four machines (two excavators, one wheel loader and the Ripper) and three operators on-site, with an estimated cost of $710 per hour.

The estimated cost of production was $22 to $24 per tonne. Moisture content tests and dirt/ash content tests were done regularly.

Processed fuel was loaded into a large truck and trailer unit for the 70km trip to the Kinleith Pulp and Paper Mill near Tokoroa. Transport costs were estimated at $11 per tonne.

Total delivered costs were between $33 and $35 per tonne. At an average moisture content of 57% wet basis, the delivered cost of the fuel was estimated at $4.70 per gigajoule.

Materials Processing's 'Crambo 6000'

The Crambo 6000 is one of several hoggers operated out of Kawerau by Peter Fredricsen's Materials Processing team.

Its main job is processing a variety of locally-sourced, wood waste streams into boiler fuel for use at the Kawerau Mill. It also works elsewhere, including processing biomass at the Rotorua Landfill.

The Crambo 6000 can produce over 80,000 tonnes per annum of hogged wood waste if fully utilised. It can be remotely driven and controlled by the excavator loader operator, who can effectively operate the loader and hogger.

The Crambo 6000 weighs 26 tonnes and is moved from site to site on a transporter. Track-mounted and self-propelled, once on-site it can manoeuvre quickly and easily.

The Crambo 6000 is a low-speed, high-torque hogger with two shafts or augers that rotate at between 30 and 40 rpm. These have 67 knives each, in a spiral pattern, which grab the material then tear and shred it into the screens.

Production rates vary with the raw material being processed. On large, green, log waste, it might be as low as 20 to 22 tonnes per hour. On light material, such as bark, it can be higher (40 or more tonnes per hour). The processed fuel can be directly loaded into either large hook bins or into a truck.

At these production rates, costs are estimated to be anywhere between $12 and $24 per tonne. With residues such as logging landing waste (a mix of stem wood and branches) it is estimated to be around $18 per tonne or $1.90 per gigajoule. This does not include transport costs. With residue processed at the Kawerau Mills industrial site, transport costs are approximately another $3 per tonne or $0.3 per gigajoule. These costs assume a moisture content of 45%.

The Crambo 6000 processing wood waste into boiler fuel.

Key drivers of efficiency

The analysis found several key factors to consider in choosing machinery and contractors for a wood residue extraction programme:

- condition and accessibility of the woody residue available;
- productivity and reliability of hoggers, plus the costs involved;
- safety of the machinery;
- transport and system logistics – minimising handling and losses;
- specifications for the processed biomass – ability to screen out contaminants from the residue and control size of the finished product; and
- overall cost efficiencies, which need to factor in variable costs such as fuel prices and transport distances.

Transport costs

A major cost factor is transporting processed residue to the end user. Trial work and cost comparisons have shown that usually:

- Roading infrastructure is vital. It is best at, or soon after, harvesting.
- Processed fuel can be loaded and transported more efficiently than unprocessed waste. This is an important factor for logistics.
- Efficiency is increased if processing sites are located close to arterial roads.
- Logging landings provide ideal processing sites, particularly if they are relatively flat, well drained and greater than 0.3 hectares – with room for trucks and machines to manoeuvre, store residues and process biomass.

Transporting processed residue to the end user is a major cost factor.

Ensuring quality

Generally, moisture content should be less than 50%, dirt contamination less than 3%, ash content less than 10%, and the material sound (no rot).

Payment should be based on energy content rather than weight, because with biofuels weight is not necessarily directly correlated with energy, as it is with diesel or coal.

Weight-based payments can lead to deliveries of wet fuels with low energy value. This can lead to poor combustion and a distorted view of fuels derived from forest residue.

The best quality biomass comes from forest waste less than 12 months old. Log off-cuts and unmerchantable logs provide better biomass than small branches and needles. The desired size of the processed biomass depends on the end use, but generally it is best at about 50mm² end section by 100mm length.

Minimising contamination

Businesses should also look for handling systems in which the processed wood residue is loaded into bins or directly into a truck, rather than dropped on the ground.

Bin or truck loading reduces the loss of processed material and also lessens the chance of dirt contamination. However, it does require a well organised and continuous supply of trucks or bins.

Scale and access

To be economically viable, the fuel processor needs a reasonable scale of operation and continuity of work. It takes approximately 50,000 tonnes per annum of work to justify investment in a hogger.

A reasonable length of contract (three years) is required to make the capital cost of the investment attractive.

Access to forests is required, but this is not always easy because of the separation between the forest growing and forest processing industries. Forest owners have only a marginal interest in encouraging the use of forest residues, unless there is revenue or other benefit for them, such as mitigation of environmental risk.

EECA – supporting the use of woody biomass

This paper has been produced as part of the bioenergy stream of the Government's Forest Industry Development Agenda (FIDA). This stream is co-ordinated by EECA.

This resource is one of a series developed to make forestry businesses more aware of their bioenergy options and to increase the utilisation of woody biomass.

FOR MORE INFORMATION

More information is available on bioenergy in general. Please contact the Bioenergy Knowledge Centre.

For more information on the three machines considered in this study, contact the operators or the Bioenergy Knowledge Centre.

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