- *The traditional method of harvesting can be adapted so that good quality pulpwood and an energy assortment are produced.*
- *In the integrated method, small sawlog and stakewood are processed as usual, but all the pulpwood is used for energy.*
- *The whole stem method could be used on soft terrain or where the stand quality is low. Whole stems are chipped with a terrain chipper, and the chip quality using this method is very good.*
- *Once felled, the timber should be stored for 6 to 18 months to allow moisture content reduction. This will also allow greater volumes to be transported within legal weight limits.*

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Harvesting wood for energy from second and later thinnings

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Background

A previous COFORD Connects Note (Harvesting, Transport and Machinery No. 3) described methods for harvesting whole trees from first thinnings. This note describes methods which could be used either in later thinnings or on terrain with lower bearing capacity.

In Ireland the general practice has been to time first thinning so that the trees have grown large enough to produce a fair proportion of small sawlog and stakewood. These more valuable assortments balance the cost of thinning or even generate a small profit. The pulpwood is often sold at a loss, but it has to be harvested anyway, otherwise large volumes of wood would be left in the forest, making it inaccessible for later harvests.

A significant amount of wood can be left in the forest in the form of tops and trees that are too small or too difficult to handle.

There are several ways to harvest wood for energy from these stands:

- the traditional harvesting method;
- the integrated harvesting method, where small sawlog and stakewood are harvested and everything else is used for energy;
- a whole stem method without any industrial assortment.

The traditional method

This entails harvesting small sawlog and stakewood as well as pulpwood. All assortments are forwarded to the roadside, and the small sawlog and stakewood are sold as soon as possible and preferably in advance of thinning. The fate of the pulpwood is then decided: if the price is good it can be sold and if the price is not sufficient the pulpwood can be left at the roadside for summer drying and then used for energy.

The method can be adapted so that good quality pulpwood and an energy assortment are produced. This energy assortment consists of small stems, double stems, wood damaged by machines, trees with heart rot, or wood from forest

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fires. Tree species which would not be sold as pulpwood can be processed for energy. The top diameter of this assortment can be as small as 2-3 cm, depending more on the ability of the harvester to handle the wood than a demand from the user of the assortment.

Integrated harvesting method

In integrated harvesting, all pulpwood will be used for energy. The small sawlog and stakewood assortments more or less pay for the harvesting operation; the energy assortment will provide a profit to the forest owner.

Small sawlog and stakewood are processed as usual: delimbed and cut to a specified length. The pulpwood part of the tree requires only a relatively crude delimbing to remove most of the green matter. The length of the assortment is not important and the pulpwood section does not have to be topped. The energy assortment may vary in length from 3-6 m, as dictated by the forwarding operation. Lengths should be as long as possible for chipping.

The harvester should be adapted to allow for good delimbing of the industrial assortments and a cruder delimbing of the energy assortment. While harvesting the industrial assortment, the pressure on the delimbing knives should be high and the pressure on the feed rollers low. The low pressure on the feed rollers prevents damage to the industrial assortment, while the spikes of the feed rollers do not penetrate the bark.

For processing the energy component, the reverse applies: the pressure on the delimbing knives should be low and the pressure on the feed rollers high. Because of the low pressure on the delimbing knives a proportion of the branches are left on the stem, but the green outer part of the branches is removed. The high pressure on the feed rollers will break the branch stubs, fold them along the stem and puncture the bark. The bark is an insulating layer around the stem which prevents evaporation; breaking this layer will allow for faster drying.

Usually it is possible to program the computer of the harvester to exert a certain pressure on the delimbing knives and feed rollers. The setting is then valid for all assortments. The manufacturer will have to change the program to allow different pressures for different assortments. In that way the processing of the different assortments for industry and energy will again be automatic.

Because the harvester is producing tree sections for energy with a greater average length than the standard 3 m pulpwood, processing should be faster. Partial delimbing becomes a one pass operation, instead of at least two passes for normal delimbing. Time is saved as cutting off the top is no longer required. The forwarding of the energy assortment should be cheaper than the forwarding of standard pulpwood because the average length is greater, so more volume is transported on each load. However, the bulk density of the energy assortment load is lower because of all the branch stubs. The cost of forwarding energy wood per m^3 will therefore be of the same order as standard pulpwood.

The piles of wood are chipped at the roadside by a large chipper, such as a truck chipper. If cleanly delimbed wood has been produced, it can also be transported to a yard for chipping. The crudely delimbed tree sections do not lend themselves to road transport because too many branch stubs will protrude from the load.

All transport of the wood should be carried out after summer drying, as the reduction in moisture content will allow a greater volume to be carried within the legal weight limits.

Whole stem method

If the terrain cannot bear a chip harvester without a branch layer and the stand quality is too low for box- and stakewood, the whole stem method might be preferable, where the harvest is carried out with a normal harvester instead of the feller-buncher of the first thinning. The harvester carries out a combined row and selective thinning. The trees are processed parallel to the machine in the rack on the left side of the machine. Again the pressure on the delimbing knives is lowered and the pressure on the feed rollers is increased.

The trees are not topped. Two or more small trees could be processed simultaneously. It is important to get sufficient branch material under the wheels of the machine to reduce the amount of green material on the trees, as well as to break the bark for better drying.

The whole stems are chipped with a terrain chipper like those used in first thinnings.

A truck chipper processing a pile of 3 m pulpwood. Note the stacking height.

The costs of this method have not yet been documented, but are obviously higher than the costs of the whole tree method.

The quality of the chips from this method is much better than from the whole tree system, because the chip does not contain as many twigs as the whole tree chip. The bulk density of the chip from the whole stem method is greater than that of whole tree chip, which will reduce road transport costs.

Storing assortments along the road

Whether it be normal 3 m pulpwood for energy, a special energy wood assortment or the crudely delimbed tree sections, storing should be done in the same way along the forest road or on the landing.

The wood should be stored in a location where it can remain for a period of 6 to 18 months, without hindering future operations or being put at risk of theft.

There is much good advice that will help in getting a good product after storing:

- The wood should be stacked in an area which is accessible in most weather conditions;
- The wood has to be stacked on logs to keep the bulk free from the ground;
- The wood should be situated in a spot where there is lots of air and sunshine, not in a secluded spot deep in a valley with shade from surrounding trees;
- The pile should be as high as possible, preferably over 5 m. The higher the pile, the smaller the influence from the edge of the pile;
- The pile should be covered with a sheet of plastic with the sides open to air and sunshine; the plastic should be fixed to the pile by placing logs on the top.
- The pile should be made in such a way that the top slopes to the rear, to allow rain falling on the plastic to drain off.
- There should be enough space next to the pile to allow a truck-mounted chipper to stand on a solid road alongside the pile and blow the chips into a curtainsider. The ideal situation would be if there was sufficient space on the landing that the curtainsider could stand next to the chipper and be filled from the top.

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