Biomass Energy Study

Within a 50 Miles Radius of

Aylett, VA

Tidewater Resource Conservation and Development Council

Forestry Committee

October, 2008

The Basics

The study area is composed of some 5,026,544 acres of which 2,518,910 acres are forested. Thus the area is 50.1% forested. Ninety-two percent of the forested acreage is in non-industrial private ownership. No Maryland Counties or portions thereof are a part of this study.

Timber inventory on private forested acres in the study area is shown in Table 1. The table footnotes are important.

Some 56% of the softwood volume is in plantations. Seventy-two percent of the total volume is hardwood volume. These data yield an average acre with 99.6 green tons of biomass in boles, tops and limb volume (stands > 10 years old and material 5.0" and larger in DBH). This average acre has 27.8 tons/acre of softwood and 71.8 tons/acre of hardwood biomass volume. Other data supplied by DOF indicates this average acre has 8.71 green tons/acre of understory biomass material in the 1.0-4.9" DBH classes. This compares to a range of 2.7 tons/acre to 13 tons/acre of "coarse woody debris" in a Fort A.P. Hill study (Applegate, 2008) (variation caused by forest cover type and structure class). Biomass chip weight (small understory trees + tops/limbs) ranged from 4.9 to 11.4 tons/acre and averaged 7.7 tons per acre in the harvest of a once thinned 30 year old slash pine plantation in Georgia (Westbrook, et al., 2007a). Chips in this Georgia study were produced using a small chipper added to a clearcut harvesting operation.

Another Georgia study found that 3.0 tons per acre of top/limb volume could be produced while thinning a 16 year old slash pine plantation. Top and limb volume recovered during a clearcut operation in a 33 year old loblolly pine plantation (previously thinned one time) yielded an average 3.8 tons/acre of chips from tops/limbs (Westbrook, et al., 2007b).

Estimating Merchantable and Top/Limb volume

Earlier, the DOF had supplied cubic foot timber inventory information to the Committee for all ownerships within the 50 mile radius of Aylett, VA study area. Table 2 shows estimated volumes of merchantable and top/limb volume derived from the cubic foot volumes supplied by DOF. Again the footnotes are important. These data would indicate that the "average" acre in the study area contains 27.1 green tons per acre of tops/limbs and 72.5 green tons of merchantable products with ideal merchandising.

For purposes of this analysis, an average of 4.0 green tons of chips per acre is assumed recoverable through use of a small chipper added to the equipment of a final harvest operation. This volume would come from tops and limbs severed from the boles of merchantable trees. This assumed volume would seem quite conservative since 3.8

tons/acre was produced from a 33 year old thinned pine plantation in the study mentioned above. Harvesting of mixed hardwood/pine stands and especially hardwood stands would likely provide a much higher volume of tops/limbs available for recovery.

In the Georgia study, biomass chips from tops/limbs could be produced for under $15/ton delivered (forty mile haul and no stumpage value) as long as at least one ton of chips was produced per twelve tons of roundwood. Production of more tons of biomass chips per ton of merchantable roundwood lowered the cost of biomass chips. Harvested roundwood-to-chip ratios between 5 and 10 with less than 15 tons per acre of tops/limbs had the lowest delivered costs per ton of biomass ($11 to $13/ton) (Westbrook, et al., 2007b).

Estimation of Removals

The information supplied to the Committee by DOF provided no removal from inventory data. A quick search of the DOF website yielded no detailed removal data and certainly no removal data specific to the 50 mile radius study area. That said, survey data from the last statewide forest inventory indicate that removals from inventory for all species in the coastal plain portion of Virginia were 2.4% annually. Therefore, annual removals in the study area could be expected to be in the range of 231,092,716 x 0.024 or 5,546,225 green tons of total bole, top and limb volume or in another unit, about 55,700 acres harvested annually. Using the ratios/numbers estimated above, some 1,508,573 green tons of tops/limbs (27.1 tons per acre) would be available for recovery as biomass chips annually. But all of this volume is certainly not economically recoverable. Using the conservative 4 tons of easily recoverable biomass chips per acre from tops/limbs would supply 222,760 tons of biomass chips annually. Put another way, recovery of less than one-sixth of the available top/limb volume (the least expensive one-sixth of available volume) would provide 222,760 tons of biomass chips annually within the study area.

When Mr. King and Mr. Fritsch of Fulghum Fibers talked with the Committee in January, they indicated that the minimum sized wood pellet plant required 50,000 green tons of wood annually and would cost $6 million to construct. Utilizing a 20 year life for the plant yields a fixed cost of $12 per dry ton of wood pellets which sells for some $150.

Bottom line, the study area within a 50 mile radius of Aylett, VA would appear to generate more than enough (by a factor of four or more) economically recoverable biomass volume from tops/limbs to support a wood pellet plant.

Other Information

1. Gross data indicate that for Virginia as a whole, 4.5 million of 15.8 million forested acres are in ownerships less than 50 acres so 28.5% of all forest ownerships are less than 50 acres. One could estimate that 222,760 x 71.5% or 159,273 green tons of tops/limbs annually could be produced from private forested ownerships greater than 50 acres in size within the study area. This

amount is still far above the minimal wood pellet plant size. Median NIPF ownership size in Virginia is 73 acres.

2. The little literature reviewed here indicates the most economic production of biomass chips from tops/limbs is done with a "modified" delimbing method. Large trees are topped at 5.0" while smaller trees are topped at the live crown. Using this method (Georgia Study) pulpwood production fell 1.75 tons/acre (from 5.02 to 3.27 tons/acre) and biomass chips increased 3.82 tons/acre (from 4.87 to 8.69 tons/acre). If the delivered price for biomass chips was at 43% or more of the delivered price of pulpwood, it made sense to take the "modified" delimbing approach. Recall this was a final harvest in a 30 year old plantation that had been thinned one time so there was little pulpwood volume. Also, pulpwood "lost" with this approach would have the highest moisture content, highest bark content and lowest paper yield.

3. Removing tops and limbs from the harvesting site as biomass chips results in no net nutrient loss. Removing tops/limbs and understory material does cause site nutrient reduction.

4. It appears that ethanol yield from a ton of tops/limbs is higher than the ethanol yield from a ton of clean bole chips.

5. The ash content (an index for sand/grit encountered in the biomass burning process) from clean chips is 0.30% by weight. The comparable number for tops/limbs is 0.78%. Problem?

Table 1. Volume of tree biomass inventory on private ownerships within a 50 miles radius of Aylett, VA. [1] Data from Virginia Department of Forestry.

	Thousands of green tons
All Softwood [2]	64,499.8
All Hardwoods	166,592.9
Total	231,092.7

[1] Volume of all trees 5.0" and larger in DBH and 11 years and older in age. Includes bole, top and limbs.

[2] Of this softwood volume 36,176,026 green tons is in plantations. So 65.1% of the pine volume is in plantations.

Table 2. Estimated merchantable volume and top/limb volume on private ownerships within a 50 mile radius of Aylett, VA. [3] Data supplied by Virginia Department of Forestry.

Thousands of Green Tons

	Merchantable Volume	Top/Limb Volume	% Top/Limb Vol. of Total Vol.
All Softwoods	42,102.0	22,397.7	34.7% by weight
All Hardwoods[4]	126,025.4	40,567.5	24.3% by weight

Percent top/limb volume on "average" acre = 27.2% by weight

[3] Cubic foot volume used to derive these green ton estimates:
For Softwood: 75 cubic feet/cord and 5,250 lbs./cord
For Hardwood: 80 cubic feet/cord and 6,000 lbs./cord
ALSO the cubic foot volume provided by DOF was for all ownerships, so cubic foot volume was reduced by 7.88% to account for the 7.88% of acreage within the study area in public ownership. Assumes proportionality.

[4] For oak-pine forest type all volume treated as hardwood.

Citations

Jason R. Applegate. 2008. Estimates of Down Woody Materials on Fort A.P. Hill, Virginia Southern Journal of Applied Forestry. Volume 32, (2) p. 53-59.

Michael D. Westbrook, Jr. and W. D. Greene. 2007a. Adding a Chipper to a Treelength System for Biomass Collection. Forest Resources Association. Technical Release 07-R-3 2.

Michael D. Westbrook, Jr. S.A. Baker and W.D. Greene. 2007b. Chipping Biomass: A Challenge in First Thinnings. Forest Resources Association. Technical Release 07-R-32 2.