Best Management Practices (BMPs)
For the Sustainable Harvesting of Biomass

In response to HB2026 and SB1231 from the 2023 GA Session
Virginia Department of Forestry
July 1, 2024

In the 2023 General Assembly session, HB2026 and SB1231 amended the Virginia Clean Economy Act (VCEA) to enable woody biomass to continue to be used as a source of electric power generation in Virginia and for specific biomass energy facilities to be included as eligible sources in the renewable energy standard. This legislation reflects the importance of biomass energy as a critical market for residual woody material from timber harvesting and from forest products manufacturing and addresses the need to ensure that woody biomass is produced and utilized sustainably.

The legislation directed the Virginia Department of Forestry (DOF) to develop best management practices (BMPs) for the sustainable harvesting of biomass. In order for the biomass-fueled electric generation to qualify under the Renewable Portfolio Standard and be eligible for the sale of renewable energy credits, the biomass must be harvested in compliance with these biomass BMPs.

The legislation directed that the BMPs include a life-cycle carbon analysis (LCA), developed in coordination with the Virginia Department of Environmental Quality (DEQ) and relevant stakeholders, that includes all carbon emissions, including supply chain emissions, forgone sequestration, and the emissions from burning biomass resources for electricity generation.

Forestry BMPs focused on protecting water quality during timber harvests have been developed over many years and their implementation is well documented. More recently, sustainability programs have been implemented to ensure that timber is being harvested and forest products manufactured in a way that is environmentally and socially sustainable. BMPs have not previously been applied to the sustainable harvesting of biomass that focus on reducing atmospheric carbon. Working with the stakeholder group, DOF was able to characterize the various elements of the LCA at a high level. This information contributed to development of the biomass BMPs.

Benefits of Woody Biomass Utilization

Wood, from sustainably managed forests provides a renewable and sustainable raw material of tremendous utility. Wood is a raw material that requires minimal human inputs to produce and which removes carbon from the atmosphere during its creation.

Forests and wood can reduce atmospheric carbon in two ways. The utilization of wood, especially in long-lived materials like building products provides long-term carbon storage. This also increases the carbon uptake capacity of the forest when the land that the wood was harvested from grows new trees that store additional carbon. Wood can also prevent more carbon from being released when wood is used in the place of more carbon-intensive materials.

These carbon benefits are reduced when forest growth is slowed by poor health, when forests are damaged by storms and wildfire, or when forestland is cleared and converted to another land use. The forests of the Eastern U.S. face many threats, such as: exotic insects and diseases, invasive plants, deer populations, lack of natural fire regimes, fragmentation, climate change, and lack of thoughtful management which is related to the lack of diverse markets for forest products.

Sustainable timber harvesting and the use of wood products are not a threat to our forests. In fact, markets for forest products provide the economic incentive for landowners to protect and manage their forests. Virginia's

forests are 80% privately owned. Forest landowners incur annual expenses and rely – to varying degrees – on income from the sale of timber. Even landowners who do not identify themselves as focused on timber production, typically rely on timber harvest income to fund forest management work. Forests that don't offer income potential due to poor quality and/or lack of local markets are at greater risk of fragmentation or conversion to other land uses.

Utilizing woody biomass for electricity generation provides several important benefits. Biomass is a cost-effective means for landowners to remove low-value wood and debris from their property. This can facilitate reforestation, improve forest health by removing undesirable trees, reduce fire risk, hasten growth of desirable trees, and improve wildlife habitat. Woody biomass can increase the profitability of timber harvesting so that more landowners are able to manage their forests. This is especially true for small acreages, or landowners without the means to invest in proper management, and properties that have been poorly managed in the past. Woody biomass also provides a critical outlet for sawmills to dispose of residual materials like sawdust and wood chips. Without an outlet for these residuals, sawmills would be unable to operate, undermining the entire forest economy.

Woody biomass is also beneficial for the electric power grid. A reliable form of dispatchable electricity generation, biomass is a renewable fuel source that does not add additional carbon to the environment like fossil fuels. Sustainable woody biomass can complement other renewable energy sources that can only operate intermittently such as solar and wind.

Of course, these benefits depend on being able to ensure that woody biomass is harvested sustainably. Fortunately, in the Eastern U.S., millions of acres of managed forests provide vast quantities of low-value or undesirable woody material. Because it is so readily available, woody biomass can serve as an economical bulk feedstock for electricity.

The Forest Inventory Analysis (FIA) program run by the USDA Forest Service in cooperation with state forestry agencies, provides routine assessments of the growth and utilization of all the forests in the country. This data shows the tremendous annual increase in the volume of wood (and stored carbon) accumulating in our forests. In Virginia, biomass used for electricity represents a small fraction of that annual growth.

This is one reason that landowners in Virginia do not plant or manage forests specifically for woody biomass. This market does little to incentivize forestry, but it does enable forest management by providing an economical outlet for undesirable or unmerchantable material that landowners want removed to achieve their land management objectives.

BMPs for Timber Harvesting

Virginia first published Forestry BMPs for Water Quality in 1978 and the 5th Edition of the BMP manual was published in 2011. BMPs provide a suite of practices that can be implemented to prevent erosion from timber harvesting. In Virginia, BMPs are voluntary as long as sediment is prevented from entering any state waters. Virginia's Silvicultural Water Quality Law (§ 10.1-1181.1) gives the State Forester authority to prevent sedimentation of any state waters resulting from silvicultural operations. The law also requires DOF to be notified of all timber harvests which enables the agency to inspect all harvests and work with loggers and landowners to ensure BMPs are implemented effectively. When DOF determines that water quality BMPs are not sufficient, DOF has the authority to require further BMPs and to impose civil penalties.

Within the Chesapeake Bay Preservation Areas, silvicultural activities must adhere to DOF water quality BMPs in order for the silvicultural operation to be exempt from regulations of the Chesapeake Bay Preservation Act. Therefore, timber harvest water quality BMPs are in effect mandatory in Chesapeake Bay Preservation Areas.

The final piece of Virginia's timber harvest BMP program is the annual audit. Each year, DOF randomly selects 240 completed timber harvests for an in-depth review of all the potential BMPs that could have been applied.

Data from all the surveys are compiled to determine the statewide rate of BMP implementation on timber harvests. Virginia has consistently achieved a rate of 95% or better.

BMPs for the Sustainable Harvesting of Biomass

This legislation requires DOF to develop BMPs for the sustainable harvesting of biomass. If we define 'sustainable harvesting' as harvesting that can be sustained long term without negative consequences to the resource, then we have considerable evidence that current practices are effective.

The draw radius of the three Dominion biomass facilities includes almost 12 million acres of forest. Based on FIA data, these forests contain 820 million tons of above ground dry biomass and add an average of 29.7 million tons each year in growth. Removals (harvests and land conversion) average 17.7 million tons each year, for a net annual increase of dry biomass of 12 million tons. For 2021 and 2022, the three facilities utilized an estimated 0.57 – 0.70 million dry tons of forest residuals per year, about 2% of what the forest added in growth.

During the past two years, in the Virginia portion of the draw radius (76% of the total), there were 5,768 timber harvests that covered 300,000 acres. The large acreage of productive forest within the draw radius of the three facilities and the high level of routine management and timber harvesting means that ample harvest residuals are available, far exceeding the demand for biomass.

DOF provided a report with preliminary biomass BMPs to the stakeholder workgroup in December 2023, and requested their review and feedback. Based on stakeholder feedback and further consideration by agency staff, DOF determined that a revised approach was necessary.

These biomass BMPs address stakeholder concerns related to clarity for compliance and enforcement and providing the opportunity for real-time cure and redress of issues prior to determination of non-compliance. Also, this approach can be performed without additional agency resources and implemented readily.

Revised (2024) Virginia Forestry Biomass BMPs

Per Virginia Code § 10.1-1308.1 A.1, REC-eligible biomass can include the following forest-derived materials: mill residues, logging residues, forest thinnings, slash, brush, low-commercial value materials, undesirable species and woody material harvested for the purpose of forest fire fuel reduction or forest health and watershed improvement.

Any of these materials harvested such that:

1. there is no sedimentation of state waters, and
2. the harvesting of biomass does not reduce the productive capacity of the site for forest growth,

will be considered to be harvested in accordance with best management practices for the sustainable harvesting of biomass.

DOF Enforcement Process

1. Timber harvesters will self-identify whether a harvest will include "REC-eligible biomass," as part of the mandatory timber harvest notification process. This will alert the DOF inspector to monitor the harvest for biomass BMP compliance.
2. Along with the normal timber harvest water quality inspections, the DOF inspector will monitor these harvests for three factors that would disqualify the harvest from meeting the standard for sustainable harvesting of biomass:
    a. Potential for sedimentation of state waters.

b. Ineligible forest derived materials based on § 10.1-1308.1 A.1 being collected for biomass.

c. Potential for harvesting biomass to reduce the productive capacity of the site for forest growth.

3. Concerns related to biomass harvesting will be handled in the same manner as DOF procedures related to sedimentation issues. The DOF inspector will notify the timber harvester if any concerns are identified. If the concerns cannot be readily addressed, the DOF regional water quality specialist or engineer will be engaged to work with the timber harvester. DOF will conduct repeat inspections to provide the opportunity to address concerns before the harvest is closed out.

4. Biomass harvesting enforcement will differ from enforcement of sedimentation in that DOF does not have authority to issue special orders to enforce biomass harvesting issues.

5. During the final harvest inspection, DOF will determine and record if all three factors for biomass REC-eligibility have been met.

6. DOF will also include the two additional REC-eligible biomass questions in the BMP audit process.

DOF Internal Guidance

1. Forest derived materials eligible for biomass harvesting based on § 10.1-1308.1 A.1 include:

a. **Mill Residues** – Not applicable here, these are not covered by biomass BMPs.

b. **Logging Residues** – Material generated as a byproduct of a timber harvest that is conducted for a purpose other than solely for generating REC-eligible biomass.

c. **Forest Thinnings** – All the material harvested, including the byproducts generated, during a thinning harvest.

d. **Slash** – Material generated as a byproduct of a timber harvest, naturally shed by trees or resulting from storm damage.

e. **Brush** – Material from small diameter trees and shrubs.

f. **Low-Commercial Value Materials** – Material from trees or portions of trees that the harvester cannot economically merchandize for a higher commercial value.

g. **Undesirable Species** – All the material harvested from trees in species that the owner deems undesirable. Typically, this would include species with limited merchantability, invasive species, or species that are prone to disease or storm damage.

h. **Woody Material Harvested for the Purpose of Forest Fire Fuel Reduction or Forest Health and Watershed Improvement** – All the material from trees harvested for these purposes.

2. **Potential for the harvesting of biomass to reduce the productive capacity of the site for forest growth.** This would involve changes to site conditions impacting a significant proportion of the tract such as rutting, soil compaction, or changes to surface water flow that would prevent regeneration or forest growth.

Information Gathered for the Carbon LCA in 2023

Elements of the Life-cycle Carbon Analysis

The legislative amendments apply specifically to three biomass energy facilities operated by Dominion Energy located at Altavista, Hopewell and Southampton. Under the VCEA, these three facilities were required to cease operation by 2028. This legislation allows them to stay open and also to be included as eligible sources in the renewable energy standard. The eligibility for Renewable Energy Credits or RECs increases the potential profitability of these facilities and increases the likelihood that they will be operated more consistently. For the purpose of the LCA, the three facilities are functionally identical.

The basic premise of the LCA is to estimate the change in atmospheric carbon levels resulting from the continued operation of these three facilities with REC eligibility. The main questions to be addressed in the LCA include:

- How much carbon will be emitted from biomass combustion for electricity at the three facilities?
  - How much will they operate in a given year and for how many years?
  - How much would these facilities have operated before 2028 without this legislation?
- How much carbon will be emitted from biomass harvesting and transport?
- How much of the carbon would have entered the atmosphere anyway if the woody biomass material had not been burned for energy?
  - How much of the biomass comes from harvest residuals that would decay within a short timeframe?
  - How much of the forest residuals would have been burned otherwise?
  - How much of the biomass comes from manufacturing residuals?
  - How much of the biomass would have gone into short-lived forest products?
  - How much above-ground and below-ground carbon would result from forestland being converted to other uses because these biomass energy markets did not exist.
- How will the amount of carbon captured by tree growth change as a result of the biomass harvesting?
  - How many additional acres will be harvested due to biomass demand?
  - How many more trees will be cut on harvests that would have occurred anyway?
  - How much additional carbon will be sequestered by residual or planted trees due to biomass harvesting?
- How much carbon would be sequestered through forest growth?
- How much carbon would be emitted from the alternate energy sources that would have been relied on to replace the electricity if it did not come from biomass?

Biomass Consumption and Carbon Emissions

The three Dominion Energy biomass power plants only accept woody biomass delivered by tractor trailer. Dominion Energy was not able to publicly share specific quantities and sources of biomass utilized but they provided ranges for the sources of biomass. Dominion Energy reported that 75% – 85% of the biomass used is in-woods fuel chips that are produced during timber harvests, 5% – 15% is from manufacturing byproducts such as sawdust and shavings from sawmills, and 5% – 15% comes from other non-forest sources.

Heat input[i] measured at each of the three facilities can be used to estimate the quantity of biomass burned. Using a ratio of 4,750 Btus per pound of biomass yields an estimated total annual consumption of 1.51 and

1.64 million short tons of woody biomass for the three mills in 2021 and 2022, respectively. Using Dominion Energy's reported range of 75% – 85% from forest residuals results in an estimated range of 1.13 – 1.28 million short tons in 2021 and 1.23 – 1.40 million short tons in 2022 from in-woods fuel chips being consumed each year for all three facilities.

CO^2 emissions[ii] are measured at each of the three facilities. Carbon represents 27% of the total weight of CO^2. In 2021, the three facilities emitted 0.42 million short tons of carbon, and 0.46 million short tons in 2022.

The carbon from burning mill residuals is not attributed to biomass energy as additional atmospheric carbon because mill residuals are being produced regardless of biomass energy use and are short-lived materials like sawdust that would release their carbon quickly anyway.

Using the sourcing estimates provided by Dominion, 75% – 85% of the carbon emitted can be attributed to forest harvesting residuals. This results in an estimated 0.32 – 0.36 million short tons of carbon emitted in 2021 and 0.35 – 0.39 million short tons of carbon emitted in 2022 from combustion of timber harvest residuals.

As part of the Forest Inventory and Analysis Program led by the USDA Forest Service, Dominion Energy reports the amount of biomass utilized in response to the Timber Products Output (TPO) survey. This data is not publicly available at the individual facility level, but DOF was able to view the survey responses for the three biomass facilities. The utilization reported for TPO matches the estimates derived from the Heat Input data very closely.

In-woods fuel chips are produced during timber harvests from trees and residual harvest matter that does not have a more profitable use. Modern timber harvesting is mostly done with tree felling machines and some hand-felling by sawyers. Skidders drag the trees to a central deck where they are sorted for markets based on an ever-changing combination of regional economies, sales contracts, mill demand, hauling distances, anticipated weather, and other factors. Because biomass is generated as an ancillary product to timber harvests, the carbon generated from equipment for felling and skidding specifically related to the biomass is considered to be negligible. In-woods chips are produced by a chipper and fed directly into the trailers that haul the chips to the power plant.

Using an estimated range of 1.1 – 1.4 million short tons of in-woods fuel chips being delivered to the three facilities each year and an average capacity of 26 tons per tractor trailer yields 43,000 to 53,000 trips per year. DOF worked with the Virginia Loggers Association to survey loggers and the survey responses indicated a 50-mile average haul distance for in-woods fuel chips. An average 100-mile roundtrip per load yields 4.3 – 5.3 million tractor trailer miles annually. Using the EPA factor[iii] of 1.387 kg per mile driven for tractor trailers yields 1,800 – 2,200 short tons of carbon emissions from transportation each year.

Total annual carbon emissions related to in-woods fuel chips includes stack emissions plus carbon from production and transport. This is estimated to be 0.32 – 0.36 million short tons per year for 2021 and 0.35 – 0.39 million short tons in 2022.

The Forest Resource

There are 11.6 million acres of timberland (forests available for timber harvest) located within the draw radius of these tree facilities. The draw radius was defined as a 64-mile straight-line from each facility. This straight-line distance roughly matches the farthest extent of the 75-mile road-distance around each facility. 75 miles is an industry standard maximum one-way haul distance for timber harvesting. Combining the three radii creates a total draw area of 19.7 million acres. This includes all land cover types, not just forestland. This area is 76% in Virginia and 24% in North Carolina.

The forest includes 5 million acres of upland hardwood, 4 million acres of pine forest, 1.1 million acres of bottomland hardwoods and 1.5 million acres of mix pine hardwood stands. 91% of the forest (10.5 million acres) in the draw radius is privately held.

The forests within the draw radius currently store 487 million short tons of carbon (aboveground + belowground) with 409 million short tons of aboveground carbon. Each year the carbon stocks grow by 14.87 million short tons of carbon, 8.87 million short tons of carbon is removed through harvests or lost to land conversion, for a net increase of 6 million short tons of carbon on average.

Given the total annual carbon emissions attributable to producing and burning forest residuals (0.32 – 0.39 million short tons per year) this is equivalent to 5.3% – 6.6% of the net carbon being captured by the forest within the draw radius each year.

Utilization of Biomass

Woody biomass represents the lowest value market for timber. While it is possible for any portion of a tree to be chipped for biomass, the profit motive of the logger and landowner drive the logger to merchandise every part of the tree to the most profitable market. It is possible for trees that could be used for a higher value product to be utilized for biomass. This can happen because the higher value markets are further away and don't justify the hauling costs or the higher value markets may not be accepting wood at that time.

Woody biomass also provides a low cost means for removing low value and undesirable trees to prepare for reforestation, reduce fire risk, improve forest health and/or increase productivity. In these cases, biomass markets enable the landowner to achieve their desired management objective.

There is no indication that landowners are managing forestland in Virginia intentionally to supply woody biomass for the Dominion Energy facilities. Evidence of this would include reforestation with high density plantings and harvesting very young or "pre-merchantable" stands.

For the most part, woody biomass is being gathered as a byproduct from harvesting for other timber product classes. In rare cases, where landowners want to harvest forest stands that have been severely degraded by poor management, storm damage, or insect or disease problems, biomass energy may be the only market for the trees. Again, biomass enables the landowner to achieve their management objective, which hopefully leads to the site being reforested with a more productive stand.

Woody biomass also provides a market for trees that are being harvested in preparation for the forestland to be converted to another land use. In this case, biomass markets can prevent the material from being burned on site.

Carbon Implications of Biomass Utilization

Woody biomass utilization at the three Dominion facilities provides a market for harvest residuals and low-value and undesirable trees. These trees and residuals are being removed as part of timber harvesting operations conducted to achieve the management objectives of the landowners. Because biomass utilization is ancillary to the harvest intent, it is difficult to tease out the atmospheric carbon impacts related specifically to the biomass use.

The primary carbon implications of biomass utilization for the three Dominion facilities include carbon emissions from transportation and from combustion, as well as carbon sequestration changes in the forest directly attributable to the biomass utilization. This includes foregone sequestration from trees that wouldn't otherwise be cut and acres that wouldn't otherwise be harvested if the biomass market did not exist. There are also increases in carbon sequestration in remaining trees that result from other trees being utilized for biomass and from reforestation that results in more productive stands.

Not all of the carbon emissions from combustion would be considered an increase in atmospheric carbon because some proportion of the biomass material would have released stored carbon through decay. Also, in the absence of the biomass markets, some forest residuals would be burned on site as part of land management activities. This is also the case for some of the undesirable and low value trees that landowners remove to clear for reforestation or for land conversion.

The atmospheric carbon implications will vary depending on the type of harvest conducted. The logger survey asked loggers to estimate the proportion of in-woods fuel chips that came from different types of timber harvests in recent years. Eight timber harvest types were identified for the survey:

- Pine sawtimber clearcut
- Pine pulpwood clearcut
- Pine sawtimber thinning harvest
- Mixed pine/hardwood clearcut
- Hardwood sawtimber clearcut
- Hardwood pulpwood clearcut
- Hardwood thinning harvest
- Clearing forests for conversion

Ninety loggers responded to the survey, two-thirds of whom produce in-woods fuel chips. Based on the survey results, 88% of biomass comes from clearcut harvests, 9.6% from thinning harvests, and 2.6% from clearing for land conversion. The source of the biomass was nearly evenly divided amongst pine, hardwood, and mixed stands.

Electricity Generation and Demand

In 2021 and 2022, the three facilities produced 918,086 and 1,024,958 MWh respectively. Dominion Energy projects demand and utilization to remain at a similar level for the foreseeable future. Utilizing the 2022 marginal on-peak CO^2 emissions rate provided in PJM's annual transmission report of 1,041 pounds CO^2/MWh, alternative electricity generation would have produced an estimated 0.129 and 0.144 million tons of carbon for the two years.

Carbon LCA Status and Next Steps

The data elements above describe the current annual atmospheric carbon flux related to the production, transport, and combustion of forest-derived woody biomass at the three Dominion facilities. Determining the net, long-term effects, specifically attributable to biomass utilization, on forest carbon stocks and atmospheric carbon requires far more analysis. Predicting how landowners and the forest industry would operate in the absence of these biomass markets will also be a challenge and this will need to be one focus of the LCA study conducted in 2024.

From the information gathered this year, it is clear that woody biomass is a sustainable resource for the three Dominion biomass plants and the addition of biomass BMPs will help it to remain so.

Healthy, resilient, and sustainable forest resources will be critical for minimizing the impacts of climate change. Privately owned and managed forests rely on robust and diverse markets to enable the protection, management, and retention of forestlands. Biomass energy markets provide a critical outlet for low value and undesirable materials…one that is important for improving forest health and productivity, while providing a reliable fuel source for renewable, dispatchable electricity generation.

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[i] Units of million British thermal units, measured via continuous emissions monitoring system and/or mass emissions determined based on measured values for pollutant concentration and stack gas flow; CAMD's Power Section Emissions Data Guide, EPA

[ii] Units of mass emitted in short tons, mass emissions determined based on measured values for pollutant concentration and stack gas flow; CAMD's Power Section Emissions Data Guide, EPA

[iii] Units of kg/vehicle-mile, distance-based method of CO2 release for tractor trailers; Emissions Factors of Greenhouse Gas Inventories, EPA