Virginia City Hybrid Energy Center
Response to Data Request
Bruce Buckheit, Member, Virginia Air Pollution Control Board

Question (Page No. 19):

Please review available information concerning the biomass resources of the local area and any (adverse or beneficial) environmental impacts that may be associated with this issue.

Response:

Biomass Resources – Dominion proposes to use biomass as one of the fuels for the Virginia City Hybrid Energy Center (VCHEC). The project is designed to use up to 20 percent biomass. For illustrative purposes, the following discussion is based on an assumption that 55 megawatts (MW), approximately 10 percent of the net energy production, would be produced from woody feedstocks. Based on woody biomass fuel characteristics, this would equate to just over 400,000 *air-dry* tons per year. The expected average moisture content of the delivered biomass is however expected to be over 50% ('green') which significantly reduces the available BTU/#, and subsequently the power station will require approximately 890,000 tons of green woody biomass per year.

Three categories of woody biomass have been identified and quantified;

(1) 'residues', which are the byproducts from processes and for which there is little market competition,
(2) 'clean chips', which are either a primary product or co-product from a processing facility for which the main competitor is the pulp and paper industry, and
(3) 'dirty chips' which would come directly from additional harvesting operations working with the net increase in standing timber volume from forested lands in the area surrounding the proposed mill sites.

Currently, 504,000 tons of green woody residues are produced each year from existing wood-utilizing facilities in the counties surrounding the two proposed power plant locations. Utilization of logging residue currently left by Appalachian harvesting operations could represent a significant source of low-cost residue feedstock; if 50% is recovered this would amount to an additional 230,000 tons/yr.

In addition, 527,000 green tons/yr of chips are currently produced either as the primary product, or as a co-product, for which the main market competition is the pulp and paper industry. Most comes from the wood chipping facility located 25 miles away from the proposed sites. This mill currently has 50,000 tons per year of additional chipping capacity, as well as the ability to increase another 250,000 tons annually by adding a second labor shift (if safeguards are in place to ensure a market for that material). To

realize this potential, this volume would have to be harvested and transported as 'pulpwood' to the chipmill, whereby current timber harvesting capacity could easily supply this demand.

Note: These estimates are based on our survey and site visits specifically for this region. Other state wide studies by the Forest Service as well as a more recent Virginia Department of Forestry / Virginia Tech study would suggest these numbers are slightly conservative (i.e. low). The study is attached to the response to comment number 17.

The standing forest resource in the 100 mile radius area surrounding the proposed power facility locations is growing 9.4 million tons more than is being harvested each year. If additional logging and processing (in-woods chipping) capacity were introduced to the area, this substantial volume of woody biomass could be made available to the power plant without jeopardizing the long-term sustainability of the forest.

Table 1: Biomass availability summary table (in 1000s tons per year) for the area surrounding the proposed power plants (90 minute drive time from proposed mill locations).

Residues

	Sawdust	Chips	Bark	Total		VA only
Primary wood processors	136	*n/a*	130	266		(111)
Secondary wood processors	155	23	*n/a*	178		(64)
Chip mill	17.5	*n/a*	42.5	60		(60)
Logging residues *(potential if 50% reclaimed)*	*n/a*	230	*n/a*	230		(109)
Totals	***308.5***	***230***	***172.5***	***734***		***(344)***

Chip Production

	Sawdust	Chips	Bark	Total		VA only
Primary wood processors	*n/a*	277	*n/a*	277		(116)
Chip Mill *(current production)*	*n/a*	250	*n/a*	250		(250)
Chip Mill *(potential production)*	*n/a*	300	64	364		(364)
Totals		***827***	***64***	***891***		***(730)***

Forest Resource Potential

	Sawdust	Chips & Bark	Total		VA only
Additional from For. Harv. Ops.	*n/a*	9,100	9,100		(2,150)
Totals		***9,100***	***9,100***		***(2,150)***

Forest management in Southwest Virginia faces numerous obstacles including operational difficulties due to steep terrain, historical poor management practices, and lack of markets for low-grade materials. One of the most unfortunate manifestations of these difficulties has been a continuing trend towards "high-grading" in many areas. High-grading refers to removing larger high-value trees while leaving poor-quality and

smaller trees. The result is that these low quality trees are left to regenerate the site, producing more poor-quality trees. Without a market for low-quality material, there is no incentive to stop this trend. A facility able to accept chips from low-grade material offers the opportunity to provide an incentive to reduce high-grading in favor of stand improvement harvests, wherein low-quality material can be removed and the higher-quality trees can be left to grow with reduced competition.

Current forest removal levels in Virginia are lower than the rate of forest growth, meaning that there is an annual increase in the amount of wood in the state's forests every year. The major source of reduction of forests is conversion to other uses, mainly industrial or residential. Within the procurement radius of the proposed power plant sites, there was a net growth of 419 million cubic feet on private timberlands. This figure does not include the growth from government lands or land without a suitable number of trees to be considered economically merchantable. This represents an annual surplus of 9.4 million tons of wood (2.1 million tons in Virginia) that could be removed from private forestlands without reducing the total growing stock of forests within 100 miles of the power plant locations. Thus, even if the facility were to procure its supply entirely from standing timber, the maximum annual consumption of the facility would only represent 4% of the current annual net growth in the area, and the forests would continue to add over 400 million cubic feet of volume each year. Shrinking the area in question to the 50 miles immediately around the sites shows a surplus of 130 million cubic feet or 2.9 million tons per year. Thus, if the power plant were to operate at full capacity using just standing timber from the 50 miles immediately surrounding it, the volume of standing wood in this area would still increase by over 110 million cubic feet each year.

Environmental Impacts – The consumption of biomass at the VCHEC will not facilitate the cutting of timber to supply fuel. The fuel plan for biomass is to consume waste wood only. Combustion of biomass is considered to be "carbon neutral" according to EPA and the Regional Greenhouse Gas Initiative (RGGI). Dominion conducted a modeling analysis of the hazardous air pollutants (HAPs) that are emitted from the combustion of biomass. The modeling demonstrated that all HAPs emitted from the combustion of wood (and coal combustion and waste coal combustion) will result in ambient concentrations well below Virginia's Significant Ambient Air Concentrations (SAAC) as described in 9 VAC 5-60-330.

Attachment 1 is an excerpt from a study prepared by the Florida Public Service Commission and the Department of Environmental Protection titled, *An Assessment of Renewable Electric Generating Technologies for Florida*, January 2003.

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Biomass Fuels

According to information from the National Renewable Energy Lab (NREL) and the U.S. Department of Energy (DOE), biomass represents the largest opportunity for renewable energy production in the U.S. in the short-term (five-year horizon).

Wood Product Residues

Wood processing residues constitute the most important biomass fuel source used in the United States, consistently accounting for more than 50 percent of the country's total biomass fuel supply. Wood processing residues come in a variety of forms. Almost half the biomass content of a typical saw log becomes residue at a primary sawmill. A variety of secondary forest product applications have been developed to use a portion of this material. Active markets for wood processing residues in many regions include pulp chips, wood fiber for fiberboard and composites, animal bedding, and garden products such as decorative bark. Sawmills segregate residues for sale in the highest-value markets available. However, a substantial amount of the residues, typically 15 to 20 percent of the biomass content of the saw logs brought to a sawmill, have no useful application and must somehow be disposed. Biomass power plants have become the disposal option of choice for much of this material.

The traditional method used to dispose of wood processing residues at sawmills was historically incineration in "teepee burners," a technology that produces copious amounts of smoke and other air pollutants. Beginning in the early 1970s, air pollution control efforts applied increasing pressure on sawmills to close down their teepee burners, leading them to search for new disposal alternatives.

This was an important factor that led to the development of the biomass power industry in the United States during the 1980s. In states as diverse as California, Maine, and North Carolina, virtually all the readily available wood processing residues that have no higher-valued applications are used as power-plant fuel. Wood processing residues are one of the cheapest forms of biomass fuel to produce and deliver. The only readily available option for disposing of these materials, if fuel use were not a possibility, is landfilling. However, landfilling of waste wood is an undesirable option for a variety of reasons. Waste wood has a slower decay rate than other biomass forms, and is thus slow to stabilize in the landfill environment. Waste wood can take up 15 to 20 percent of the available space in a typical county landfill, and its decay leads to emissions of methane, a more potent greenhouse gas than carbon dioxide.

In-Forest Residues

In-forest residues constitute a major source of biomass fuels in the United States. Timber harvesting operations produce forest residues in the forms of slash (tops, limbs, bark, broken pieces) and cull trees. If left in place these residues can impede forest regeneration, and increase the risk of forest fire. Increasingly, harvesting plans on public and private lands require some form of residue management, which usually means either piling and burning on-site, or removal and use as fuel. Logging slash is an important source of biomass fuel in several regions. In addition to logging residues, forest treatment residues, or thins, comprise an important source of fuel for the biomass energy industry. Because of past forestry practices and aggressive fire-fighting efforts during the past 80 to 100 years, vast areas of U.S. forests are likely overstocked with biomass

material, representing an increased risk of destructive wildfires and a general degradation of the forest ecosystems. These forests can benefit from mechanical thinning operations. The amount of in-forest biomass residues that could be converted to energy is reportedly far greater than the total amount of biomass fuel demand in most regions of the country. However, this fuel source is generally more expensive to produce than other biomass fuels, so the quantity used is less.

As the market for biomass fuels has retracted in the United States, the amount of logging residues converted to fuel use has remained relatively constant, because of its link to the lumber market. The major adjustment has been in the quantities of thins being collected and converted to fuel. Most logging residues used for energy production would be pile burned if energy applications were not available. On the other hand, forests would simply not be thinned, so material of this origin would accumulate as excess biomass.

Urban Wood Residues

As much as 15 to 20 percent of the solid waste traditionally disposed of in U.S. landfills is clean wood waste that can be segregated and converted into power plant fuel. This material comes from a variety of sources, including: 1) construction and demolition wood waste; 2) wood and brush from land clearing; 3) wood and brush from public and private tree trimmers and landscapers; 4) wood waste from the manufacturing of cabinets, furniture, and other wood products; and, 5) discarded pallets.

Environmental Impacts of Biomass Disposal

All alternatives for the disposal of biomass wastes and residues, including leaving forest residues in place, entail environmental impacts. Energy production from biomass residues produces air pollutants and solid waste (ash), and consumes water resources. These impacts must be balanced against those impacts that would occur if the energy alternative were not employed, including the impacts of alternate disposal of the material used as fuel, the impacts on industries that want to use that material for alternative non-electric products, and the impacts of alternative production of the electricity that must be supplied to the market.

Environmental Impacts of Open Burning

Setting aside the recognized benefits of prescribed burning, open burning of forestry and agricultural biomass residues is a source of air pollution. Open burning can produce massive amounts of visible smoke and particulates, and significant quantities of emissions of nitrogen oxides, carbon monoxide, and hydrocarbons that contribute to the formation of atmospheric ozone. Quantifying the emissions resulting from open burning is difficult because residues, burning practices, and environmental conditions are extremely variable. Nevertheless, use of these residues as power plant fuel vastly reduces the smoke and particulate emissions associated with their disposal, and significantly reduces the amounts of carbon monoxide, nitrogen oxide, and hydrocarbons released to the atmosphere. California's air quality regulatory agencies recognized that the biomass power industry could help eliminate open burning of agricultural residues. To give the biomass power producers credit for the air quality benefits they provide, regulators in California developed a set of agricultural offset protocols, through which facilities that burn agricultural residues that would otherwise be open burned earn an offset for their emissions of pollutants at the power plant.

Because emission offsets are required only for pollutants for which the receiving basin is nonattainment, most agricultural offsets have been for emissions of nitrogen oxide and particulates. For most facilities that were permitted on the basis of the agricultural offset protocols, the permits require that one-half to two-thirds of their fuel be obtained from agricultural residue sources. Environmental Impacts of Burial Recoverable wood waste represents approximately 15 percent by weight, and as much as 20 percent by volume, of the material that

typically enters sanitary landfills. One study by the University of Florida concluded that 23 percent of the waste stream headed to landfills could be attributed to demolition/renovation waste from the construction industry in Florida. Typically, these materials enter the landfill gate separate from mixed household garbage. In the absence of a fuel-use option, they may be buried along with other wastes entering the landfill. It is noteworthy that the combustion of pressure-treated lumber causes unique emission problems and, at this time, this material is best placed in a lined landfill.

Landfill burial of the wood residues that can be recovered and converted into power plant fuel entails the same kinds of environmental impacts associated with the disposal of all kinds of organic wastes in landfills. Compared to other types of organic wastes, woody materials are slow to degrade, which means that landfill stabilization is delayed. Like all organic material in the landfill, waste wood can be a source of water-polluting leachates, and as the material degrades, it produces emissions of methane and carbon dioxide in roughly equal quantities. Methane and carbon dioxide are both greenhouse gases, but methane is much more reactive, by a factor of some 25 times per unit of carbon. Large landfills are now required by EPA regulations to control their fugitive emissions by collecting a portion of the landfill gas and flaring it. In general, gas collection systems capture about 80 percent of the methane released by the landfill, which means that final emissions of the waste carbon to the atmosphere are approximately 90 percent carbon dioxide and ten percent methane (compared with approximately 50/50 for an uncontrolled landfill). The only effective means of eliminating methane emissions from the disposal of wood residues that would otherwise be buried in a landfill is to use the material as fuel.

The immediate result of diverting landfill-bound waste wood to a power plant is that virtually all the carbon content is added to the atmospheric stock of carbon dioxide, rather than being stored underground as buried waste. This means that the atmospheric greenhouse gas burden associated with the biomass residue used as fuel is greater in the immediate aftermath of its combustion than if the material were landfilled. Over time, however, the landfill out-gases a mixture of methane and carbon dioxide, and the much greater radiative effectiveness of methane rapidly leads to a greater greenhouse gas burden, which eventually becomes a major liability for the landfill option, even with the use of gas control systems on landfills.

Environmental Impacts of Energy Generation from Biomass

Combustion of biomass fuels in modern power plants leads to many of the same kinds of emissions as the combustion of fossil fuels, including criteria air pollutants and solid wastes (ash). Fuel processing, which in most cases involves some type of grinding operation, produces emissions of dust and particulates. Air emissions and water consumption are usually the principal sources of environmental concern related to biomass combustion facilities. Biomass power plants are required to achieve stringent emissions control levels for the criteria, or regulated, pollutants. These include particulates, nitrogen oxides, oxides of sulfur, hydrocarbons, and carbon monoxide. Nitrogen oxides, hydrocarbons, and carbon monoxide are usually controlled by using advanced combustion technologies, often including fluidized-bed combustors, staged-combustion, and flue-gas recirculation. Newer biomass power facilities are required to use ammonia injection to further control nitrogen oxide emissions. Sulfur oxide emissions generally are not a concern with biomass combustion because biomass, especially woody forms of biomass, has a very low sulfur content.

Some facilities that have fluidized-bed combustors inject limestone to capture sulfur, but biomass facilities are generally not required to have flue-gas scrubbers to control sulfur oxide emissions. Particulates are controlled using a variety of technologies. Virtually all biomass power plants use cyclones to remove most large particulates from the flue gas. Most biomass combustion facilities are equipped with electrostatic precipitators for final particulate removal; some facilities use baghouses. Most modern biomass power plants are required to achieve near zero visible emissions to meet environmental permit conditions. Emissions of particulates are also regulated and controlled to stringent levels, usually comparable to the emissions levels achieved by the large fossil fuel electric generators.

Table 4 shows average emissions levels of the criteria pollutants for biomass power generation. The data is useful for differentiating biomass emissions by combustor type. The fluidized-bed combustors achieve lower emissions levels of all criteria pollutants of concern for biomass power plants, compared to the grate-burners. The most dramatic difference is in carbon monoxide emissions, for which the fluidized-bed combustors are more than an order of magnitude better than the grate-burners. The fluidized-bed combustors achieve emissions factors of half or less than the grate-burners for all pollutants for which data are available.

The production of electricity in biomass power plants can help reduce air pollution by displacing the production of power using older, more conventional sources. The full net emissions reductions can be calculated as the difference between the net emissions associated with the biomass power cycle alone, and those that would have been produced by the displaced fossil fuel-based generation.