

The American Forest & Paper Association (AF&PA) appreciates the opportunity to share information on House Bill 875 on behalf of our members who are essential, critical infrastructure employees under Maryland and federal guidance. Our members with facilities outside of Maryland that generate biomass Renewable Energy Credits (RECs) into Maryland are operated by companies that have a substantial economic presence in the state. We must respectfully ask the Committee to give HB 875 an unfavorable report for the reasons detailed below.

<b>MD State and Local Taxes</b>	\$1.8 Billion	<b>MD Products:</b> Packaging, sales displays, corrugated boxes
<b>Maryland Payroll</b>	\$374 Million	
<b>Maryland Employees</b>	6000 people	

- AF&PA members generate renewable energy, have improved their energy efficiency and reduced fossil fuel use and greenhouse gas (GHG) emissions.
  - o GHG emissions were reduced by 23.2 percent from our 2005 baseline.
  - o On average, approximately two-thirds of the energy used at AF&PA member pulp and paper mills is generated from carbon neutral biomass.
- Bioenergy from forest products manufacturing residuals provides enormous greenhouse gas reduction benefits – roughly equivalent to removing 35 million cars from the road.
- Baseload power, such as biomass from mill residues, is needed to complement the growing intermittent sources of renewable energy in the portfolio, such as wind and solar. The recent storm and deep freeze in much of the U.S. highlight the need for a diverse energy portfolio.
- Removing biomass energy from mill residues based on it being from facilities outside Maryland ignores the fact that the entire Maryland RPS is dominated by out-of-state resources.
  - o In 2019, 18 percent of Tier 1 RECs were from in-state resources, including 1.2 percent from wind. In fact, more than half of all wind RECs originated in Illinois.
- The inclusion of biomass from mill residues does not “crowd out” other renewable resources. Wind and solar RECs are growing rapidly; wind has the largest share of RECs for the last three years and total wind RECs retired for compliance nearly tripling since 2015.
- The RPS program has cost Maryland ratepayers over \$650 million from 2014 through 2019 and could cost ratepayers a total of over \$7 billion by 2029—and that is before removing approximately 29 percent of supply, as would occur under this bill. Maryland should not risk imposing even higher RPS costs on ratepayers by enacting this bill.

### **AF&PA Full Testimony- Oppose HB 875**

AF&PA serves to advance a sustainable U.S. pulp, paper, packaging, tissue and wood products manufacturing industry through fact-based public policy and marketplace advocacy. AF&PA member companies make products essential for everyday life from renewable and recyclable resources and are committed to continuous improvement through the industry's sustainability initiative — [Better Practices, Better Planet 2020](#). The forest products industry accounts for approximately four percent of the total U.S. manufacturing GDP, manufactures nearly \$300 billion in products annually and employs approximately 950,000 men and women. The industry meets a payroll of approximately \$55 billion annually and is among the top 10 manufacturing sector employers in 45 states.

AF&PA's sustainability initiative - [Better Practices, Better Planet 2020](#) - comprises one of the most extensive quantifiable sets of sustainability goals for a U.S. manufacturing industry and is the latest example of our members' proactive commitment to the long-term success of our industry, our communities and our environment. We have long been responsible stewards of our planet's resources. We are proud to report that our members have already achieved the greenhouse gas reduction (GHG) and workplace safety goals. Our member companies have also collectively made significant progress in each of the following goals: increasing paper recovery for recycling; improving energy efficiency; promoting sustainable forestry practices; and reducing water use.

In 2011, AF&PA publicly announced the adoption of energy efficiency and GHG sustainability goals to be achieved by the year 2020. The original GHG sustainability goal was to reduce the intensity of the industry's emissions by at least 15 percent from 2005. When members surpassed the original goal, they raised the bar, increasing the goal to 20 percent. In 2018, members surpassed the new goal, reducing GHG emissions by 23.2 percent from the 2005 baseline. One of the main ways in which we have lowered our GHG emissions is through the use of carbon neutral biomass manufacturing residuals and wood waste.

The forest products industry plays an essential role in responding to COVID-19 challenges by making numerous products for every day healthy living, including tissue products, pulp used in diapers and other personal hygiene products, papers for communication and education, building/construction products, and packaging for food, beverages, foodservice, cleaning supplies, pharmaceuticals, medical equipment and other consumer products, and shipping boxes that get those products to market. Forest products also are playing an important role in ongoing safety efforts and in supporting essential commerce, including the safe packaging and shipment of COVID-19 tests and vaccinations.

### **The Industry Has a Significant Presence in Maryland**

The forest products industry in Maryland employs almost 6,000 individuals with an annual payroll of over \$374 million and produced almost \$1.8 billion in products. The estimated annual state and local taxes paid by the Maryland forest products industry totals \$32 million.

Even without the Verso Luke mill, which closed in 2019, the industry is a significant economic contributor in Maryland, producing packaging, sales displays, and corrugated packaging, among other things. Out-of-state facilities that generate biomass Renewable Energy Credits (RECs) into Maryland are operated by companies that have a substantial economic presence in the state.

### **AF&PA Members Generate Renewable Energy, Have Improved Their Energy Efficiency and Reduced Fossil Fuel Use and Greenhouse Gas (GHG) Emissions**

The forest products industry produces and uses renewable energy for manufacturing operations and is a significant contributor to our country's existing base of renewable energy. On average, approximately two-thirds of the energy used at AF&PA member pulp and paper mills is generated from carbon-neutral biomass.

The industry also strives to use all types of energy as efficiently as possible. The industry is a leader in the use of combined heat and power (CHP) technology, which is extremely efficient because it uses the same fuel to produce both thermal energy used in the manufacturing process and electricity, some used on-site and some sold to the grid. In 2018, over 98 percent of electricity produced by the industry was CHP-generated. The use of CHP provides energy efficiencies in the range of 50 to 80 percent at forest products mills, far beyond non-CHP electrical stations such as utilities, which are only about 33 percent energy efficient.

Our commitments to renewable biomass energy and energy efficiency, including our extensive use of CHP, have led to a dramatic decrease in the sector's use of fossil fuel and GHG emissions. Energy purchased by member pulp and paper mills -- most of which is fossil fuel-based -- has decreased dramatically. In 2018 we exceeded our *Better Practices, Better Planet* purchased energy efficiency goal with a 13.3 percent improvement since 2005, surpassing our 10 percent goal. Further, in 2018 AF&PA member GHG emissions were 23.2 percent less than the 2005 baseline year, surpassing our new 2020 goal of 20 percent reduction.

### **Bioenergy from Forest Products Manufacturing Residuals Provides Enormous GHG Reduction Benefits**

The bill would remove "mill residue, except sawdust and wood shavings" from the definition of Qualifying Biomass. Over the years that the legislature has been considering changes to the

RPS, concerns have been raised as to the carbon neutrality and GHG reduction benefits of liquid biomass (also known as black liquor) in the RPS. Those concerns are unfounded.

Below are some insights into the GHG reduction benefits of renewable biomass energy:

- The scientific evidence shows there are enormous GHG reduction benefits from using forest products manufacturing residuals for energy.
  - As indicated in Appendix II, specifically with regard to liquid biomass (black liquor): During the Obama Administration, the EPA conducted an extensive analysis and concluded that black liquor is at least carbon neutral and can be *even better than carbon neutral* under certain scenarios, assigning it a zero to negative biogenic assessment factor.
  - Moreover, an extensive, peer-reviewed study by the National Council for Air and Stream Improvement shows that each year, the bioenergy produced from manufacturing residuals in U.S. forest products industry avoids the emission of approximately 181 million metric tons of CO<sub>2</sub>e. (This is roughly equivalent to removing about 35 million cars from the road.)
  - Dr. Timothy Searchinger, the scientist who prompted the discussion about the carbon neutrality of biomass, stated specifically that “black liquor from paper making” is an “advisable” source of biomass energy use. In addition, in a joint paper with Dr. Steven Hamburg, the Chief Scientist of the Environmental Defense Fund and other experts, the co-authors concluded that “biomass should receive credit to the extent its use results . . . from the use of residues or biowastes.”
- The rest of the world recognizes the carbon neutrality of forest products manufacturing residuals, and competitors in Europe are rewarded with credits. Thus, this bill would set an adverse precedent for energy policy in the U.S., potentially placing U.S. mills at a competitive disadvantage.
- A bipartisan amendment was agreed to in the 2017 Omnibus Appropriations Act passed in May 2017 that required three federal agencies to work together to create a consistent policy on biomass carbon neutrality. Former Maryland Senator Mikulski signed a letter stating that there has been no dispute about the carbon neutrality of biomass derived from residuals of forest products manufacturing and agriculture. That provision has been included in the appropriations acts for 2018, 2019, 2020 and 2021 (in the recently enacted stimulus bill), as well.
- The failure to recognize the carbon benefits of certain forest products manufacturing residuals also could set an adverse, scientifically unfounded precedent against recognizing the carbon benefits of other kinds of biomass residuals, whether from agriculture or other industries.

Finally, a recent scientists’ letter to the leaders of the U.S., EU, Japan, and South Korea raised concerns about negative effects of using some biomass for energy. However, the letter stated up front that:

“[f]or decades, producers of paper and timber products have generated electricity and heat as byproducts from their process wastes. This use does not lead to the additional harvest of wood.”<sup>1</sup>

While AF&PA does not agree with many of the assertions in the letter, it is clear that the biomass used for energy at pulp and paper mills that contribute RECs into the Maryland RPS program is not the focus of the letter or of the concerns it discusses.

### **The Bill is Inconsistent with the Goals of the RPS**

When it was enacted, Maryland legislators provided several goals for the RPS, including to recognize the economic, environmental, fuel diversity and security benefits of renewable energy resources, and to establish a well-functioning market for renewable electricity. The bill would work contrary to these goals. It does not recognize the benefits of numerous renewable energy resources and decreases fuel diversity, and it interferes with the functioning of the market, as it creates favored resources and upends investor expectations. Furthermore, the legislature’s frequent changes to the RPS make business planning in the state more challenging.

### **Baseload Power is Needed**

It would be counterproductive to remove reliable baseload renewable electricity from the portfolio. In fact, this is exactly what is needed to complement intermittent sources such as wind and solar. With increased intermittent deployment, saturation becomes an issue. Once wind or solar facilities reach a saturation point, no additional energy can be used by the grid--in fact those energy sources might have to be curtailed. In other words, during the day if there is more wind or solar power being produced than is needed for the system, those sources would have to be curtailed to prevent a system overload. In contrast, pulp and paper mills mill generate their own renewable, carbon neutral energy to displace fossil fuels virtually around the clock.

### **The Renewable Energy Resources in the Maryland RPS Are Predominantly Out of State**

Those selling liquid biomass RECs in the Maryland RPS have been criticized because they are predominantly out of state. However, the entire Maryland RPS is dominated by out-of-state resources. In 2019, only 18 percent of all the Tier I RECs used for compliance were from in-state. Indeed, liquid biomass and wind have virtually identical percentages of in-state generation, with Maryland facilities generating 1.9% of liquid biomass RECs and 1.2 percent of wind.<sup>2</sup> More than half of all wind RECs --56.1 percent -- originated in Illinois.

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<sup>1</sup> <https://www.wwf.eu/?uNewsID=2128466>. p.1.

<sup>2</sup> Renewable Energy Portfolio Standard Report, With Data for Calendar Year 2019, Public Service Commission, December 2019 (“PCS RPS Report”), Figure 6.

We recognize that with the closure of the Luke mill, there are no in-state liquid biomass resources selling RECs into Maryland. However, the companies selling those RECs have a much greater connection and make much greater economic contributions to Maryland, than, for example, the wind resources from Illinois, which were the number one Tier I REC contributors in 2019. For example, WestRock has a facility in Baltimore providing 129 jobs using base materials produced in Virginia. WestRock's Virginia mills also purchase thousands of tons of fiber from Maryland landowners, helping those landowners continue practicing sustainable forest management. Additionally, Pixelle directly employs 7 fulltime workers in their Delmar, MD facility with a \$1 million operating budget and \$11.5 million dollars' worth of timber purchases which also helps many people in the value chain practicing sustainable forest management in the state.

### **Biomass Energy is Clean Energy**

The forest products industry is making large investments in highly efficient biomass energy that meets stringent state-of-the-art environmental standards. Biomass is burned in industrial boilers under very exacting conditions to optimize efficiency and production of energy. Boilers are operated from highly sophisticated, computerized control rooms that continuously monitor combustion conditions. EPA continuously examines air regulations to ensure they adequately protect public health and the environment. EPA confirmed there are no significant risks from recovery furnaces and other major parts of pulp and paper mills on the surrounding areas.<sup>3</sup>

### **Other Resources are Growing Rapidly**

Wind and solar RECs have rapidly increased their share of the Tier I RPS, while liquid biomass' share has decreased significantly. As stated in the Maryland Public Service Commission's 2019 RPS Report:

“For the third year in a row, wind (“WND”) was the largest contributor of the total number of RECs. Total wind RECs retired for compliance have nearly tripled since 2015.”<sup>4</sup>

While the share of liquid biomass RECs had an atypical significant increase between 2018 and 2019, the overall trend still is for it to have a decreasing share compared to wind and solar.<sup>5</sup> If the bill's sponsors' goal is to favor wind and solar RECs over liquid biomass, it seems that the market is heading in that direction anyway. There is no need to disrupt the market and the

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<sup>3</sup> EPA conclusion of no significant risks for the major parts of pulp and paper mill operations was concluded in two phases, first in 2012 and then in 2017 as it finished its risk and technology review of the 1998 and 2001 Cluster MACTs.

<sup>4</sup> PCS RPS Report, page 16.

<sup>5</sup> See Appendix I, which is based on PJM-GATS data.

business plans of electricity suppliers and REC providers by enacting a complete ban on liquid biomass RECs.

Finally, the bill is overly broad and would remove from the RPS more than just liquid biomass or black liquor. While we do not support removing liquid biomass from the RPS, if the bill moves forward it should be clear that only “black liquor” or “liquids derived from mill residues” are excluded from the definition of “Qualifying Biomass.”

### **Maryland Ratepayers Could Spend Over \$7 Billion on the RPS Program From 2014 to 2029 and the Legislature Should Not Risk Even Greater Costs by Removing Almost 30 Percent of Existing Tier I Non-Solar Supply from the RPS**

The costs that electricity suppliers incur to purchase RECs to comply with the RPS are included in Maryland ratepayer bills. According to the PCS RPS Report, Maryland ratepayers paid over \$657 million in total REC costs between 2014 and 2019.<sup>6</sup> To calculate potential program costs for 2020-2029, we used PJM-GATS data<sup>7</sup> for CY 2020 for Maryland load and held that load constant through 2029.<sup>8</sup> For Tier I Non-Solar REC prices, we used the average of bid/ask prices averaged over CY21-24 (\$12.21) from the daily price sheets of one of the primary REC marketers.<sup>9</sup> For Solar REC prices, we averaged over CY21-22, the years for which prices are provided in the daily sheets (\$71.75).

Based on this analysis, Tier I Non-Solar REC costs total almost \$2 billion and Solar REC costs were over \$4.6 billion, for a total of \$6.6 billion.<sup>10</sup> When added to the documented past costs from 2014-2019, the total program cost from 2014-2019 could be over \$7.2 billion.

As indicated in testimony provided by AF&PA member Domtar today, biomass RECs represented over 29 percent of the MD Tier I non-solar renewable generation in 2019. Their testimony also strongly suggests that the REC market already has reacted to signals of increasing (e.g., a mill receiving certification to sell RECs into Maryland) or decreasing (e.g., announcement of a mill closure or the actual closure of a mill) REC supply provided by Domtar mills. Maryland legislators should not risk imposing REC costs even greater than the potential \$7.2 billion total program cost by removing a significant source of supply that provides numerous benefits to the MD RPS program.

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<sup>6</sup> PCS Report, Table 5, p. 11.

<sup>7</sup> The PCS Report only has data through 2019.

<sup>8</sup> This is a conservative assumption, as PJM projects between 0.7% and 1.0% energy load growth for the upcoming years.

<sup>9</sup> Karbone Brokerage & Research Group Daily Price Sheets from February 12, 2021.

<sup>10</sup> See Appendix III.

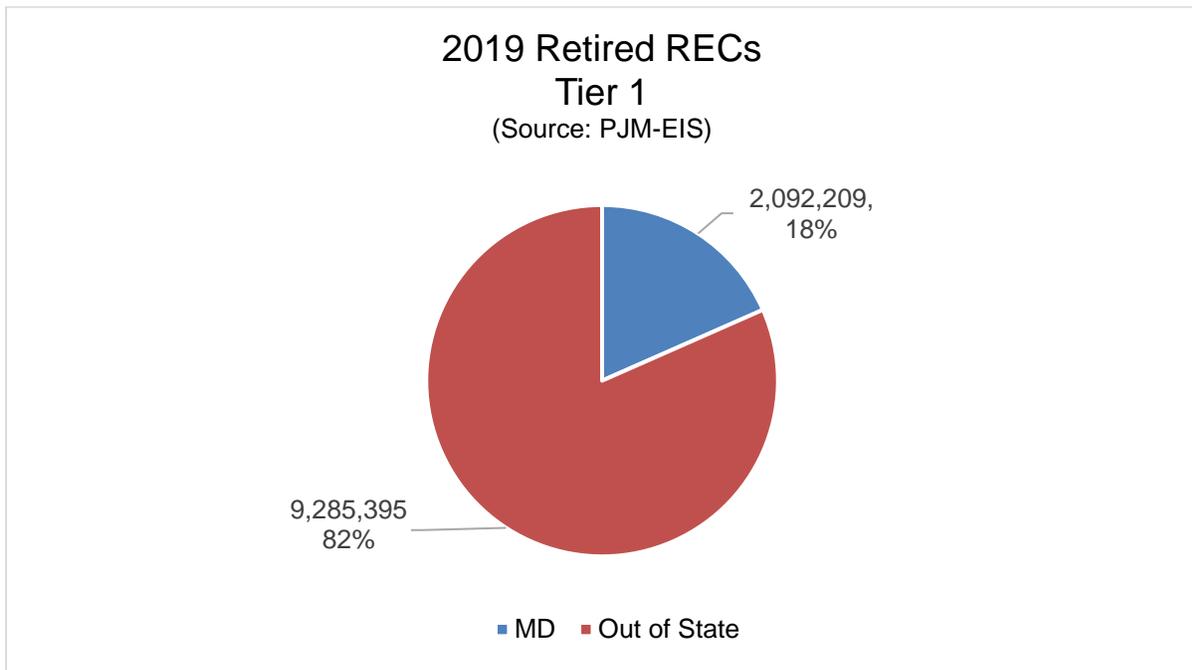
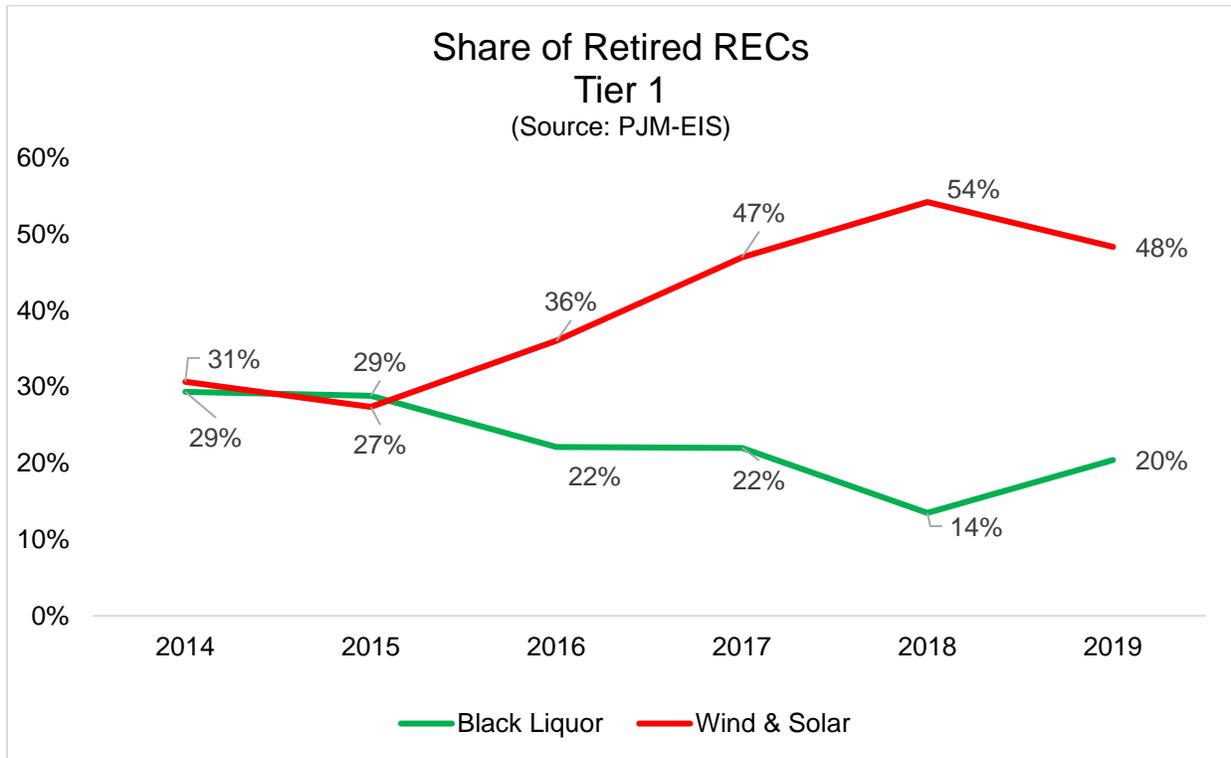
## **Conclusion**

The forest product industry has played an important role in helping Maryland and the nation meet their renewable energy objectives. HB 875 could impede our ability to continue doing so and set an adverse, scientifically unsound precedent. We have increased energy efficiency, displaced fossil fuels and reduced greenhouse gas emissions in a highly sustainable manner. We request that the Committee give the bill an unfavorable report.

We look forward to continuing our work with the state of Maryland. Please feel free to contact Jerry Schwartz, Senior Director, Energy & Environmental Policy, AF&PA at (202) 463-2581 or [jerry\\_schwartz@afandpa.org](mailto:jerry_schwartz@afandpa.org) for further information.

Thank you

**APPENDIX I**



## APPENDIX II

### **There is Widespread Recognition of Forest Products Manufacturing Residuals as Carbon Neutral**

- **U.S. Environmental Protection Agency**, Memorandum from Janet G. McCabe, Acting Assistant Administrator, Office of Air and Radiation, to Air Division Directors, Regions 1-10 (Nov. 19, 2014) (“Information considered in preparing the second draft of the Framework, including the [Science Advisory Board] peer review and stakeholder input, supports the finding that use of waste-derived feedstocks and **certain forest-derived feedstocks are likely to have minimal or no net atmospheric contributions of biogenic CO<sub>2</sub> emissions, or even reduce such impacts**, when compared with an alternative fate of disposal.”) (p. 2)
- **U.S. Environmental Protection Agency**, *Draft Framework for Assessing Biogenic CO<sub>2</sub> Emissions from Stationary Sources* (Nov. 19, 2014) (“The information in this appendix, including example calculations of alternative fate-related biogenic emissions, supports that a 0 or negative [biogenic] assessment factor for black liquor may be reasonable.”) (Appendix D, p. D-22); **calculating negative biogenic assessment factors for black liquor** and stating that “avoided emissions associated with disposal of black liquor as compared with the current management practice (burning for energy and chemical recovery in a recovery furnace) **resulted in hypothetical example [biogenic assessment factors] BAFs ranging from different negative values to 0**, depending on the treatment method.”) (Appendix D, p. D-31)
- **Dr. Timothy Searchinger** and Ralph Heimlich “Avoiding Bioenergy Competition for Food Crops and Land.” World Resources Institute (2015) (**listing “black liquor from paper making” as “advisable” sources of biomass energy use**) (p. 22 and Table 3, p. 24)
- **Dr. Timothy Searchinger, Dr. Steven Hamburg**, et al., “Fixing a Critical Climate Accounting Error,” *Science* (Oct. 22, 2009) (“Instead of an assumption that all biomass offsets energy emissions, **biomass should receive credit to the extent its use results . . . from the use of residues** or biowastes.”)  
Note: Steve Hamburg is the Chief Scientist of the Environmental Defense Fund.
- Caroline Gaudreault and Reid Miner, *Temporal Aspects in Evaluating the Greenhouse Gas Mitigation Benefits of Using Residues from Forest Products Manufacturing Facilities for Energy Production*. *Journal of Industrial Ecology* (Dec. 2015), at 1,004-05 (“[The ongoing use of manufacturing residues for energy in the forest products industry has been yielding net benefits for many years. . . . [T]he use of biomass residues from forest products

manufacturing, including black liquor, to produce energy in the U.S. forest products industry for 1 year avoids, over a 100-year period, 181 million t CO<sub>2</sub>-eq/yr. The avoided disposal of the forest products manufacturing residues alone (i.e., ignoring [fossil fuels] substitution and chemical recovery benefits) results in a GHG benefit of approximately 5 million t CO<sub>2</sub>-eq/yr.”)

- Reid Miner, Robert Abt, et al., “Forest Carbon Accounting Considerations in U.S. Bioenergy Policy,” Journal of Forestry (Aug. 29, 2014) (“ . . . if mill residues were not used for energy, most of these materials . . . would be wastes that would be either incinerated, in which case the atmosphere would see the same biogenic CO<sub>2</sub> emissions as if the material had been burned for energy, or disposed in landfills . . . [in which case] the net impact of burning for energy on biogenic emissions, in terms of warming (i.e., CO<sub>2</sub> equivalents), can actually be less than zero because of the warming potency of the methane generated in landfills.”)
- U.S. Environmental Protection Agency, “Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units; Final Clean Power Plan Rule,” 80 Fed. Reg. 64,661, 64,885-86 (Oct. 23, 2015) (“The EPA recognizes that the use of some biomass-derived fuels can play an important role in controlling increases of CO<sub>2</sub> levels in the atmosphere. The use of some kinds of biomass has the potential to offer a wide range of environmental benefits, including carbon benefits. . . . With regard to assessing qualified biomass proposed in state plans, the EPA generally acknowledges the CO<sub>2</sub> and climate policy benefits of waste-derived biogenic feedstocks and certain forest- and agriculture-derived industrial byproduct feedstocks, based on the conclusions supported by a variety of technical studies, including the revised *Framework for Assessing Biogenic Carbon Dioxide for Stationary Sources.*”)
- Linda A. Joyce (U.S. Forest Service), Steven W. Running (U. of Montana), et al., Climate Change Impacts in the United States: The Third National Climate Assessment, Ch. 7: Forests, U.S. Global Change Research Program, doi:10.7930/J0Z60KZC (2014) (“Forest biomass energy could be one component of an overall bioenergy strategy to reduce emissions of carbon from fossil fuels, while also improving water quality, and maintaining lands for timber production as an alternative to other socioeconomic options.”) (p. 182)
- Dr. Roger A. Sedjo, Resources for the Future, “Carbon Neutrality and Bioenergy: A Zero-Sum Game?” RFF DP 11-15 (April 2011) (noting that both sides in the carbon neutrality debate [see two letters below] recognize that “some biomass, such as dead wood and forest debris, can constructively be used for bioenergy, since it will otherwise release carbon through natural decomposition . . . thus no net emissions result from its use as energy”) (p. 3)

- Dr. Bruce Lippke, Professor Emeritus, University of Washington School of Forest Resources, et al., Letter to Congress from Forest Scientists (July 20, 2010) (“equating biogenic carbon emissions with fossil fuel emissions . . . is not consistent with good science and, if not corrected, could stop the development of new emission reducing biomass energy facilities. It also could encourage existing biomass energy facilities to convert to fossil fuels or cease producing renewable energy. This is counter to our country’s renewable energy and climate mitigation goals.”)
- Dr. William H. Schlesinger, Member, National Academy of Sciences, et al., Letter to Congress from Scientists (May 17, 2010) (“Bioenergy can reduce atmospheric carbon dioxide if . . . bioenergy can use some vegetative residues that would otherwise decompose and release carbon to the atmosphere rapidly.”)
- Environmental Defense Fund, “Comments on the Science Behind EPA’s Proposed Accounting Framework for Biogenic CO<sub>2</sub> Emissions From Stationary Sources” (Oct. 18, 2011) (“enterprises should be allowed . . . to demonstrate that they are using biomass sourced from materials with no or limited impacts on net emissions. . . . Those who can demonstrate they are using wastes and other low emissions feedstocks would be assigned a BAF of 0 or near 0.”) (p.5)

Updated: January 2020

**APPENDIX III**

<b>MD RPS Total Program Cost: 2014-2019</b>				
<b><u>CY Retired</u></b>	<b><u>Tier 1</u></b>	<b><u>Solar</u></b>	<b><u>Tier 2</u></b>	<b><u>TOTAL[\$]</u></b>
<b>CY14</b>	<b>\$ 70,630,620</b>	<b>\$ 29,372,737</b>	<b>\$ 3,987,557</b>	<b>\$ 103,990,914</b>
<b>CY15</b>	<b>\$ 85,054,001</b>	<b>\$ 39,055,714</b>	<b>\$ 2,617,917</b>	<b>\$ 126,727,632</b>
<b>CY16</b>	<b>\$ 88,200,121</b>	<b>\$ 45,556,987</b>	<b>\$ 1,441,416</b>	<b>\$ 135,198,524</b>
<b>CY17</b>	<b>\$ 50,045,621</b>	<b>\$ 21,275,664</b>	<b>\$ 687,785</b>	<b>\$ 72,009,070</b>
<b>CY18</b>	<b>\$ 56,406,247</b>	<b>\$ 27,351,388</b>	<b>\$ 1,049,293</b>	<b>\$ 84,806,928</b>
<b>CY19</b>	<b>\$ 79,320,505</b>	<b>\$ 55,166,116</b>	<b>\$ 58,899</b>	<b>\$ 134,545,520</b>
<b>Total Program Cost:</b>				<b>\$657,278,588</b>

Source: Public Service Commission of Maryland Renewable Energy Portfolio Standard Report, with Data for Calendar Year 2019, October 2020, Table 5, p.11.

<b>MD Non-Solar &amp; Wind RPS Program Costs: Projections 2020-2029</b>					
<u>CY Retired</u>	<u>Tier 1 (Non-Solar &amp; Wind)</u>	<u>MD Load (MWh)<sup>a</sup></u>	<u>Tier I - Non-Solar &amp; Wind RECs Retired</u>	<u>Price<sup>b</sup></u>	<u>TOTAL[\$]</u>
CY20	22.00%	58,902,595	12,958,571	\$ 9.68	\$ 125,438,966
CY21	23.30%	58,902,595	13,724,305	\$ 12.21	\$ 167,573,760
CY22	24.60%	58,902,595	14,490,038	\$ 12.21	\$ 176,923,368
CY23	25.90%	58,902,595	15,255,772	\$ 12.21	\$ 186,272,977
CY24	27.20%	58,902,595	16,021,506	\$ 12.21	\$ 195,622,586
CY25	28.50%	58,902,595	16,787,240	\$ 12.21	\$ 204,972,195
CY26	30.00%	58,902,595	17,670,779	\$ 12.21	\$ 215,760,205
CY27	32.00%	58,902,595	18,848,830	\$ 12.21	\$ 230,144,219
CY28	33.00%	58,902,595	19,437,856	\$ 12.21	\$ 237,336,226
CY29	35.00%	58,902,595	20,615,908	\$ 12.21	\$ 251,720,240
<b>Total Program Cost:</b>					<b>\$ 1,991,764,744</b>

## Sources:

a. PJM-GATS load for 2020 held constant through 2029.

b. Karbone Brokerage & Research Group Daily Price Sheets from February 12, 2021. CY20 price is actual price as reported in PJM-GATS. CY 21-29 is the average of the bid/ask prices averaged over CY21-24.

<b>MD Solar RPS Program Costs: Projections 2020-2029</b>					
<u>CY Retired</u>	<u>Tier 1 Solar</u>	<u>MD Load (MWh)<sup>a</sup></u>	<u>Tier I – Solar RECs Retired</u>	<u>Price<sup>b</sup></u>	<u>TOTAL[\$]</u>
CY20	6.00%	58,902,595	3,534,156	\$ 78.50	\$ 277,431,222
CY21	7.50%	58,902,595	4,417,695	\$ 71.75	\$ 316,969,589
CY22	8.50%	58,902,595	5,006,721	\$ 71.75	\$ 359,232,201
CY23	9.50%	58,902,595	5,595,747	\$ 71.75	\$ 401,494,813
CY24	10.50%	58,902,595	6,184,772	\$ 71.75	\$ 443,757,425
CY25	11.50%	58,902,595	6,773,798	\$ 71.75	\$ 486,020,037
CY26	12.50%	58,902,595	7,362,824	\$ 71.75	\$ 528,282,649
CY27	13.50%	58,902,595	7,951,850	\$ 71.75	\$ 570,545,261
CY28	14.50%	58,902,595	8,540,876	\$ 71.75	\$ 612,807,873
CY29	14.50%	58,902,595	8,540,876	\$ 71.75	\$ 612,807,873
<b>Total Program Cost:</b>					<b>\$ 4,609,348,943</b>

Sources:

a: PJM-GATS load for 2020 held constant through 2029.

b. Karbone Brokerage & Research Group Daily Price Sheets from February 12, 2021. CY20 price is actual price as reported in PJM-GATS. CY 21-29 is the average of the bid/ask price averaged over CY21-22.