April 9, 2018

Ms. Karen G. Sabasteanski
Virginia Department of Environmental Quality
1111 East Main Street, Suite 1400
P.O. Box 1105
Richmond, VA 23218

Filed Electronically and Sent via Certified Mail Return Receipt

Re: Comments on Virginia Draft Regulations for State Carbon Trading System and into the Regional Greenhouse Gas Initiative ("RGGI"). 34 Va. Reg. Regs. 924 (Jan. 8, 2018).

Dear Ms. Sabasteanski:

The National Alliance of Forest Owners ("NAFO") and the Virginia Forestry Association ("VFA") thank the Virginia Department of Environmental Quality and the State Air Pollution Control Board ("the Board") for the opportunity to comment on the draft regulations for the Commonwealth's admission into the Regional Greenhouse Gas Initiative ("RGGI"). 34 Va. Reg. Regs. 924 (Jan. 8, 2018).

NAFO is a national advocacy organization committed to advancing U.S. federal policies that support the long-term economic, social, and environmental benefits of sustainably managed privately owned forests. NAFO member companies own and manage more than 43 million acres of private working forests—forests that are managed to provide a steady supply of timber. NAFO's membership also includes state and national associations representing tens of millions of additional acres.

NAFO seeks common sense policy solutions to sustain the ecological, economic, and social values of forests and to assure an abundance of healthy and productive forest resources for present and future generations. Approximately 360 million acres—or 70%—of the working forests in the United States are on private land, owned by individuals, families, small and large businesses, and an increasing number of Americans who invest in working forests for retirement. Private U.S. working forests support 2.4 million U.S. jobs, $99 billion in payroll, and $282 billion in sales and manufacturing. These working forests are vital to our nation's natural resource infrastructure, providing forest products, open space, wildlife habitat, clean water and air, recreation, and more. U.S. forest owners are the world's leaders in sustainable forestry. Individual states administer the world's most effective framework of forestry laws, regulations, and agreements in a way that is carefully tailored to local conditions and needs.

VFA promotes stewardship and wise use of the Commonwealth's forest resources for the economic and environmental benefits of all Virginians. VFA represents 1,300 forest products businesses, woodland owners, and forestry professionals practicing forestry and operating in the state. VFA's members own or conduct forestry operations on hundreds of thousands of acres of forestlands in Virginia.

Forestry is the Commonwealth's third largest industry. According to the May 2017 publication, "The Economic Impact of Virginia's Agriculture and Forest Industries," produced by the University of Virginia's Weldon Cooper Center for Public Service, "the forestry sector had a total impact of over $21 billion in total output, approximately 107,900 jobs, and 9.3 billion in value-added."[1] This annual economic contribution depends on our 15.72 million acres of forestland of which more than 13 million are privately owned working forests.

Generating, marketing, and selling biomass fuel components from this privately owned Virginia forest land will further support these forest owners in the Commonwealth and continue to develop a carbon-neutral fuel source in a state already committed to moving beyond a traditional fossil fuel-powered infrastructure.

NAFO and VFA respectfully submit these comments to support the Board for excluding biomass-fired facilities from these regulations, and to encourage the Board to amend the final regulations to allow operators that co-fire biomass at their facilities to deduct the biogenic emissions when calculating annual CO_2 emissions for compliance.

Excluding Biomass from the Regulations is Good Environmental and Sustainable Development Policy

Excluding biomass CO_2 emissions from RGGI is good environmental policy and supported by scientific studies. There is an extensive technical and factual record supporting a decision to differentiate biogenic CO_2 emissions from fossil fuel greenhouse gas ("GHG") emissions.[2]

Importantly, there is scientific consensus that, because it is part of the natural carbon cycle, the potential for impacts on atmospheric GHG levels from biogenic carbon is fundamentally different than fossil carbon. In the forests of Virginia (and in the United States as a whole), biogenic CO_2 emissions are more than balanced by carbon sequestered in growing forests. Relying on this scientific premise, studies repeatedly show that combusting biomass for energy offers substantial GHG mitigation benefits when compared to fossil fuel alternatives. Second,

---

[1] Terance J. Rephann, "The Economic Impact of Virginia's Agriculture and Forest Industries" 1 (May 2017), http://www.vdacs.virginia.gov/pdf/weldoncooper2017.pdf.
[2] See "Appendix of Scientific Studies" included at the end of this Comment. All scientific studies cited in the Appendix are incorporated into this Comment by reference.

there is strong evidence that forests are currently being managed sustainably and will be for the foreseeable future. Thus, when forest carbon stocks are evaluated over appropriate time and spatial scales, there is ample support for the proposition that forests are capable of meeting increased demand without reducing overall forest carbon stocks.

A. Because they are part of the forest carbon cycle, CO_2 emissions from the combustion of biomass are offset by carbon sequestration in growing forests

It is well-established that all wood products—including biomass combusted for energy—are part of the natural forest carbon cycle. CO_2 is sequestered in forests through photosynthesis and emitted through decomposition and combustion. Thus, as long as forest carbon stocks remain stable (or increase) over time, biomass energy and other forest product uses do not increase atmospheric GHG concentrations. In contrast, CO_2 emissions from fossil fuel combustion permanently increase atmospheric GHG concentrations because they release carbon that has been geologically stored for millennia. Active, sustainable management of forested lands provide a number of distinct climate change mitigation benefits which serve to reduce net GHG emissions over time: (1) durable forest products such as lumber used in construction continue to store carbon for decades after harvest, (2) manufacturing forest products is much less carbon-intensive than alternative products such as concrete or steel, and (3) biomass used for energy can directly displace fossil fuel emissions over multiple harvest cycles.

This section is supported by the materials included in the Appendix of Scientific Studies, Section A.

B. Scientific studies have repeatedly shown that biomass combustion for energy results in significant GHG emissions reductions when compared to fossil fuel alternatives

Over the past 20 years, many scientific studies evaluating biomass energy have found significantly lower net GHG emissions when compared to fossil fuel combustion. In particular, a number of recent studies—including a number of life cycle analyses—have attempted to quantify in absolute terms the GHG mitigation benefit of substituting biomass energy for fossil fuels. These studies also identify substantial reductions in GHG emissions, but do not directly answer the question whether biomass combustion for energy results in any net CO_2 emissions. However, these studies consistently conclude that active forest management focused on supplying forests products and biomass energy produces the greatest GHG mitigation benefits from forested lands.

This section is supported by the materials included in the Appendix of Scientific Studies, Section B.

C. Forest carbon stocks are stable or increasing across the United States

Stability or growth in forest carbon stocks is an essential prerequisite for establishing that biogenic CO_2 emissions do not increase net atmospheric CO_2 concentrations. If forests are converted to other land uses after harvest, the forest carbon cycle is broken. Thus, given urban development and other external pressures, it is essential to ensure that, at a broader landscape level, forest carbon stocks are not depleted as a result of biomass energy. However, this is not a concern. Projections by the U.S. Forest Service and others suggest that forest stability will continue for decades to come. Whether viewed nationally, or on a regional basis, studies consistently find that forest carbon stocks have remained stable—and in many cases increased significantly—over the past 60 years, and this stability has occurred despite significant increases in demand for forest products.

The most recent data from the U.S. Forest Service and Virginia Department of Forestry indicates that timberland in Virginia has a highly positive net growth/removal ratio of 2.29, meaning that through sustainable management, our forests are growing more than twice as much wood as is harvested.

This section is supported by the materials included in the Appendix of Scientific Studies, Section C.

D. Increased demand for biomass energy feedstocks will not deplete forest carbon stocks

Despite the stability in U.S. forest carbon stocks over time, some have expressed concern that increased demand for biomass energy will reduce the amount of carbon that would otherwise be stored in forests. However, these concerns are inconsistent with the market factors that influence forest management decisions. Studies have repeatedly found that forest owners will respond to increased demand for biomass energy (or any other forest product) by increasing production, and thereby increasing forest carbon stocks. In the case of biomass energy, such responses can take several forms, including (1) increased consumption of existing harvest residuals, (2) increased productivity through investments in forest management practices, and (3) land use changes such as afforestation, reforestation, or avoided deforestation.

This section is supported by the materials included in the Appendix of Scientific Studies, Section D.

E. Increased demand for biomass energy will not result in the harvest of high-grade mature trees for energy

Despite its promise as a renewable energy source that does not increase atmospheric CO_2 concentrations, biomass energy relies on low-cost biomass feedstocks to remain competitive with other types of energy. Thus, biomass energy feedstocks are commonly composed of mill residues, harvest residuals, thinning treatments, and other low-grade feedstocks. In contrast, high-grade trees are reserved for saw timber and other similar products that command higher prices and generally result in products that store carbon for decades. Given the price differential between low-grade biomass energy feedstocks and saw timber, it is unlikely that high-grade, mature trees would ever be harvested exclusively for biomass energy production. While increased demand for biomass energy could increase prices to some degree, even the most optimistic projections for biomass energy would not raise feedstock prices to the point that landowners would begin managing forests for biomass energy instead of high-value saw timber. Thus, concerns over carbon stock depletion due to the harvest of high-grade, mature trees for biomass energy are misplaced.

This section is supported by the materials included in the Appendix of Scientific Studies, Section E.

The Final Regulations Should Continue to Exclude Biomass-Only (or Near Biomass-Only) Facilities from the Requirements

As currently written, the proposed regulations will exempt from its requirements any source that burns between 90% and 100% (of its annual heat input on a Btu basis) of non-fossil fuels to generate electric power. *See* 34 Va. Reg. Regs. at 935 ("Fossil fuel-fired means the combustion of fossil fuel, alone or in combination with any other fuel, where the fossil fuel combusted comprises, or is projected to comprise, more than 10% of the annual heat input on a Btu basis during any year."). This includes facilities that fire entirely biomass (or very close to all biomass).

NAFO and VFA fully support the Board's proposal to exclude 90% to 100% biomass-fired facilities from the requirements and encourages the Board to maintain this exclusion in the final regulations. The Board's proposal is supported by the scientific consensus that biogenic CO_2 should be regulated as being carbon neutral and is consistent with the RGGI Model Rules.

NAFO and VFA understand that at least one other commenter has raised the issue of how emissions from biomass are treated under these proposed regulations. *See* Comment of Michael Kerley (submitted Jan. 13, 2018). The commenter urges the Board to "do something about the biomass wood burning power plants" because "[t]hey release benzene, formaldehyde and twice as much CO_2 when compared to coal." *Id.*

NAFO and VFA are sensitive to the issue of emissions of all kinds from biomass materials; however, this comment raises issues that are beyond the scope of the Board's proposed regulations. These proposed regulations address CO_2 emissions from electric power generating units in Virginia, not any other pollutants or emissions. Pollutants like benzene and formaldehyde are governed by other federal and state regulatory regimes already being administered in Virginia. NAFO and VFA believe that the Board should continue to focus these proposed regulations on carbon dioxide emissions and let existing laws and regulations govern non-CO_2 emissions from electric power generating units.

The Final Regulations Should Allow Operators that Co-Fire Biomass to Deduct Biomass Emissions from Their Compliance Totals

As currently written, these proposed regulations require operators that co-fire biomass with fossil fuels to maintain allowances for every ton of CO_2 generated, regardless of whether that CO_2 is biogenic or from fossil fuels. *See* 34 Va. Reg. Regs. at 951. NAFO and VFA strongly encourage the Board to amend the final regulations to allow operators that co-fire biomass with fossil fuels to deduct the biogenic CO_2 emissions from the total CO_2 emissions the unit must cover with allowances to be in compliance. This is good policy for several reasons, because: A. it is consistent with the carbon-neutral environmental policy discussed above (and already recognized by the Commonwealth, as well as Congress), and B. it would bring Virginia in line with the RGGI Model Rules, as well as other large RGGI state participants, like New York.

A. Allowing operators to deduct biogenic CO_2 emission from total emissions is consistent with the environmental and sustainable development policy discussed above

The Virginia Department of Forestry also recognizes the sustainable development value and economic benefits of promoting use of biomass and biogenic fuel sources in Virginia. On its website, the Department of Forestry states that the "benefit[s] of expanded utilization of biomass include: [p]rovid[ing] new markets for waste wood, manufacturing residues, and materials from forest management activities; … [r]educ[ing] material going to landfills, being dumped or open burned, such as woody debris and other wood waste; [r]educes site preparation costs for artificial regeneration; [r]educ[ing] pollution compared to using fossil fuels …."[3]

The United States Congress also understands the environmental and sustainable development benefits of biomass-based fuel. In a display of bipartisan support, Congress passed the Consolidated Appropriations Act of 2018, where it directed the Department of Energy, the Department of Agriculture, and the Environmental Protection Agency to "establish clear and simple policies for the use of forest biomass as an energy solution, including policies that – (A) reflect the carbon-neutrality of forest bioenergy and recognize biomass as a renewable energy source, provided the use of forest biomass for energy production does not cause conversion of forests to non-forest use; (B) encourage private investment throughout the forest biomass supply chain … (C) encourage forest management to improve forest health; and (D) recognize State initiatives to produce and use forest biomass."[4]

Encouraging the biomass fuel market to grow in Virginia will continue to help the Board achieve the purpose of these regulations: "to control CO_2 emissions in order to protect the public's health and welfare." 34 Va. Reg. Regs. at 924.

As reported in the May 2017 "The Economic Impact of Virginia's Agriculture and Forest Industries," "Biomass energy production has emerged in recent years as a significant new market for surplus wood residues in Virginia. Federal clean and renewable energy programs and Virginia's voluntary Renewable Portfolio Standard offers incentives to the state's power companies to produce electricity from renewable resources. Woody biomass accounted for most of Virginia's renewable power generation in 2015 and approximately 5 percent of total power generation in the state. Since 2012, Virginia has added over 300 MW in electrical power generation capacity."[5] Also, "Virginia hosts 10 wood pellet plants, most of which have been established in the last decade. Collectively, they processed over 1.4 million tons of wood, mill, and forest residues."[6]

Regarding woody biomass for energy as a useful forest product, NAFO and VFA can vouch that a broad range of robust markets for all Virginia wood and fiber are in the best interests of forest health and sustainability, the economic prosperity of the state, and the welfare of citizens of the Commonwealth. Markets for low value wood that may not have other outlets are critical to

[3] Virginia Department of Forestry, Bioenergy and Biofuel Resources, http://dof.virginia.gov/energy/bioenergy.htm.
[4] Consolidated Appropriations Act, 2018, P.L. 115-141, § 431 (2018).
[5] Rephann, *supra* note 1, at 22 (internal citations omitted).
[6] *Id.* at 22-23 (internal citations omitted).

woodland owners and to lumber manufacturers searching for purchasers of sawmill residues. Additionally, energy production from woody biomass aids in reducing the threat of wildfire and insect infestation, and can enhance wildlife diversity. It is also vital to have markets for wood during the necessary clean up, removal, and use of biomass debris resulting from occasional natural disasters.

By exempting biomass-only and near biomass-only facilities, the Board has already demonstrated that it agrees biogenic emissions are inherently different from fossil fuel carbon emissions. NAFO and VFA urge the Board to consistently apply these conclusions by allowing operators that co-fire biomass with other fuel sources to deduct their biogenic emissions when calculating compliance.

B. Allowing deductions for CO_2 from co-fired biomass is consistent with the RGGI Model Rules and many RGGI participant states, like New York

Revising these proposed regulations to allow operators to deduct biogenic emissions from facilities that co-fire biomass should not be difficult, as this policy has already been developed in not only the RGGI Model Rules, but also the implementing regulations for many RGGI-participating states. Six out of the nine RGGI states allow operators to deduct CO_2 emissions from biomass at co-firing facilities.[7] Virginia would be an outlier by disallowing biogenic CO_2 deductions. The Board should revise its final rules to allow these deductions using the RGGI Model Rules and other state regulations as a guide.

Since the regional greenhouse gas initiative began over a decade ago, RGGI engaged working groups to develop Model Rules that can be reviewed, adapted, and implemented by states joining the system. Many stakeholders participate in these reviews and revision processes and many states have chosen to adopt in full substantive provisions of the Model Rules.

RGGI has published Model Rules and revisions in 2006, 2007, 2008, 2013, and most recently on December 19, 2017. In every iteration of these Model Rules, RGGI has allowed operators that co-fire biomass with fossil fuels to deduct the emissions attributable to biomass from the total amount of CO_2 emissions for compliance purposes. *See*, e.g. RGGI Model Rules, XX-6.5(b)(1) "Compliance" (draft published Dec. 19, 2017) ("the REGULATORY AGENCY or its agent will deduct CO_2 allowances … to cover the source's CO_2 emissions … for the control period or interim control period, as follows: Until the amount of CO_2 allowances deducted equals the number of tons of total CO_2 emissions … **less any CO_2 emissions attributable to the burning of eligible biomass** ….") (emphasis added).

Allowing deductions from CO_2 co-fired biomass is simple to implement. The Model Rules set out specific formulas that owners and operators must use to calculate the "total eligible biomass dry basis fuel input," the "CO_2 emissions due to firing of eligible biomass for the operating

[7] These states are: Connecticut (22a-174-31(g)(5)(D)(i); 22a-174-31 (i)(8)); Delaware (1147 6.5.2.1; 1147 8.7); Massachusetts (310 CMR 7.70(6)(e)(2); 310 CMR 7.70(8)); New Hampshire (Env-A 4605.05; Env-A 4609); New York (6 CRR-NY 242-6.5(b); 6 CRR-NY 242-8.7); and Rhode Island (46.8.5(b)(1)(a); 46.10).

quarter," as well as the "heat input due to firing of eligible biomass for each quarter." *See* 2017 Model Rules, XX-8.7(a), "CO_2 budget units that co-fire eligible biomass."

The RGGI Model Rules are not an abstract, aspirational, and impractical framework; most states that participate in RGGI have adopted them almost verbatim and implemented them with great success.

The Board should amend and finalize the proposed regulation to expressly allow operators co-firing biomass with fossil fuels to deduct those biogenic emissions from the annual CO_2 compliance accounting. It is consistent with the environmental and economic policies Virginia has built into the regulations. Allowing for the deduction of biogenic emissions from compliance determinations is sensible and there is an existing regulatory model Virginia can use in the RGGI Model Rules and in RGGI-participating states' regulations.

The Final Regulations Should Include a Definition of "Biomass"

As currently written, these proposed regulations do not include a definition of "biomass." NAFO and VFA encourage the Board to incorporate a definition of "biomass" in the Definitions section. Including such a definition will add clarity to the issue of biomass exemptions in the regulations and allow the Board to more easily review the exclusion of biogenic emission from CO_2 co-firing facilities, as discussed above.

The Virginia legislature has already provided such a definition in the state Code. *See* VA. CODE ANN. § 10.1 - 1308.1 (2008). In this section on streamlining the permitting process for "qualified energy generators," in the Code chapter creating the State Air Pollution Control Board, the legislature defines "biomass" as:

> organic material that is available on a renewable or recurring basis, including:
>
> 1. Forest-related materials, including mill residues, logging residues, forest thinnings, slash, brush, low-commercial value materials or undesirable species, and woody material harvested for the purpose of forest fire fuel reduction or forest health and watershed improvement;
>
> 2. Agricultural-related materials, including orchard trees, vineyard, grain or crop residues, including straws, aquatic plants and agricultural processed co-products and waste products, including fats, oils, greases, whey, and lactose;
>
> 3. Animal waste, including manure and slaughterhouse and other processing waste;
>
> 4. Solid woody waste materials, including landscape trimmings, waste pallets, crates and manufacturing, construction, and demolition wood wastes, excluding pressure-treated, chemically treated or painted wood wastes and wood contaminated with plastic;

5. Crops and trees planted for the purpose of being used to produce energy;

6. Landfill gas, wastewater treatment gas, and biosolids, including organic waste byproducts generated during the wastewater treatment process; and

7. Municipal solid waste, excluding tires and medical and hazardous waste.

NAFO and VFA ask that the Board add a definition of "biomass" in the final regulations similar to this definition adopted by the Virginia legislature in § 10.1 - 1308.1 of the Virginia Code.

<u>Conclusion</u>

NAFO and VFA commend the Board for recognizing that CO_2 emissions from biogenic sources are inherently different than emissions from fossil fuels. The Board can implement this policy in these cap-and-trade regulations by 1) continuing to exempt facilities that burn between 90% and 100% biomass fuel and 2) revising the regulations to include a definition of "biomass" and allow operators that co-fire biomass to deduct the biogenic emissions from compliance obligations.

Respectfully submitted,

William R. Murray
Vice President for Policy & General Counsel
National Alliance of Forest Owners
122 C Street, NW, Suite 630
Washington, DC 20001
(202) 747-0742
cmurray@nafoalliance.org

Paul R. Howe
Executive Director
Virginia Forestry Association
3808 Augusta Ave
Richmond, VA 23230
(804) 278-8733
phowe@vaforestry.org

Appendix of Scientific Studies

A. Because they are part of the forest carbon cycle, CO_2 emissions from the combustion of biomass are offset by carbon sequestration in growing forests

- Science Advisory Board, *Review of EPA's Accounting Framework for Biogenic CO2 Emissions from Stationary Sources* at 7, EPA-SAB-12-011 (Sept. 22, 2012) (concluding that "[t]here are circumstances under which biomass is grown, harvested, and combusted in a carbon neutral fashion").

- World Business Council for Sustainable Development. Recommendations on Biomass Carbon Neutrality (2015). ("…as carbon is released from harvested wood back into the atmosphere, usually as biogenic CO2, growing trees are removing CO2 from the atmosphere at a rate that completely offsets these emissions of biogenic CO2, resulting in net biogenic CO2 emissions of zero or less.").

- Lippke, B., *et al.*, Letter from 113 Scientists to Sen. Boxer and Rep. Waxman (July 20, 2010) (explaining that biomass combustion does not increase net atmospheric CO_2 concentrations because "carbon dioxide released from the combustion or decay of woody biomass is part of the global cycle of biogenic carbon").

- Martin, R.M., *Deforestation, land-use change and REDD*, Unasylva 59(230): 3-11 (2008) ("If the land is encouraged or allowed to regenerate a new forest, the ecosystem effect of harvesting is carbon neutral. . . . The atmospheric effect becomes problematic if the cycle is broken and the land is converted to another use.").

- Lippke, B., *et al.*, CORRIM, *Life-cycle Environmental Performance of Renewable Building Materials*, Forest Prod. J., 54: 8 (2004) (highlighting climate benefits of using wood products as substitutes for other materials that have larger carbon footprints).

- Miner, R., NCASI, *Biomass Carbon Neutrality* (Apr. 15, 2010), *available at* http://www.nafoalliance.org/wp-content/uploads/NCASI-Biomass-carbon-neutrality.pdf) (explaining that biomass is carbon neutral due to its role in the carbon cycle and that additional climate benefits occur over each management cycle as additional carbon sequestration occurs through regrowth).

- Lattimore, B. *et al.*, *Environmental Factors in woodfuel production: Opportunities, risks, and criteria and indicators for sustainable practices and utilization*, Biomass and Energy, 33: 1321-42 (2009) (explaining that biomass energy from sustainably managed forests is carbon neutral).

- Cherubini, F., *GHG balances of bioenergy systems – Overview of key steps in the production chain and methodological concerns*, Renewable Energy 35: 1565-73 (2010) ("When biomass is combusted, the resulting CO_2 is not counted for a GHG because C has a biological origin and combustion of biomass releases almost the same amount of CO_2 as was captured by the plant during its growth.").

- Gower, S., *Patterns and mechanisms of the forest carbon cycle*, Annual Review of Environment and Resources 28: 169-204 (2003) ("The CO_2 emitted when wood and paper waste is burned is equivalent to the atmospheric CO_2 that was sequestered by the tree during growth and transformed into organic carbon compounds; hence there is no net contribution to the atmospheric CO_2 concentration; and the material is considered C neutral.").

- Sedjo, R.A., *Biomass: Short-Term Drawbacks, But Long-Term Climate Benefits*, The Energy Daily (Sept. 20, 2010) (concluding that unlike fossil fuel emissions, biogenic CO_2 emissions have no net impact on atmospheric GHG concentrations).

- Bowyer, J., *et al.*, *Life Cycle Impacts of Forest Management and Bioenergy Production* 1-13 (July 2011), *available at* http://www.dovetailinc.org/files/DovetailLCABioenergy0711.pdf (finding that sustainably managed forest are better than carbon neutral when regeneration, displacement of fossil fuels, and long-term carbon storage in durable forest products is considered)

- Sedjo, R, *Carbon Neutrality and Bioenergy: A Zero-Sum Game?*, Resources for the Future Discussion Paper 1-9 (Apr. 2011), *available at* http://www.rff.org/documents/RFF-DP-11-15.pdf (concluding that there are no net CO_2 emissions from biomass energy as long as forest carbon stocks are stable or increasing because CO_2 emissions will be offset entirely by carbon sequestration).

- Lippke, B., *et al.*, *Life cycle impacts of forest management & wood utilization on carbon mitigation: knowns and unknowns*, Carbon Management 2(3): 303-33 (2011) (concluding that combustion of biomass for energy produces no net CO_2 emissions as long as forest carbon stocks are stable or increasing).

- Malmshimer, R.W., *et al.*, *Managing Forests Because Carbon Matters: Integrating Energy, Products, and Land Management Policy*, Journal of Forestry 109(7S) (2011) (concluding that there will be no net CO_2 emissions from biomass energy as long as forest carbon stocks are stable or increasing because emissions will be offset entirely by carbon sequestration).

- Fargione, J., *et al.*, *Land clearing and the biofuel carbon debt*, Science 319: 1235-38 (2008) ("[B]iofuels made from waste biomass or from biomass grown on degraded and abandoned agricultural lands planted with perennials incur little or no carbon debt and can offer immediate and sustained GHG advantages.").

- Lippke, B. and E. Oneil, CORRIM, *Unintended Consequences of the Proposed EPA Tailoring Rule Treatment of Biomass Emissions the Same as Fossil Fuel Emissions* (2010) ("Life cycle research results accumulated over the last decade . . . demonstrate that the emissions from burning biomass for energy are being offset by the sustained growth in forest carbon.").

B. Scientific studies have repeatedly shown that biomass combustion for energy results in significant GHG emissions reductions when compared to fossil fuel alternatives

- Schlamadinger, B., *et al.*, *Towards a standard methodology for greenhouse gas balances of bioenergy systems in comparison with fossil energy systems*, Biomass and Bioenergy 13(6): 359-75 (1997) (finding that biomass-based fuels produce climate benefits when compared to fossil fuels).

- Abbasi, T. and S. Abbasi, *Biomass energy and the environmental impacts associated with its production and utilization*, Renewable and Sustainable Energy Reviews 14: 919-37 (2010) (finding that biomass-based fuels produce climate benefits when compared to fossil fuels).

- Froese, R.E., *et al.*, *An evaluation of greenhouse gas mitigation options for coal-fired power plants in the U.S. Great Lakes States*, Biomass and Bioenergy 34: 251-62 (2010) (finding that, in the Great Lakes region, co-firing 20% forest residuals in coal-fired power plant reduced GHG emissions by 20%).

- DOE, Ethanol Benefits, *available at* http://www.afdc.energy.gov/afdc/ethanol/benefits.html ("Cellulosic ethanol would reduce GHGs by as much as 86%.").

- EPA, Regulation of Fuels and Fuel Additives: Changes to Renewable Fuel Standard Program, Final Rule, 75 Fed. Reg. 14,670 (Mar. 26, 2010) (finding that cellulosic ethanol reduces lifecycle GHG emissions by more than 60% when compared to conventional fuels).

- EPA, *Renewable Fuel Standard Program, Draft Regulatory Impact Analysis* at 191 (Sept. 2006), EPA420-D-06-008 (finding that cellulosic ethanol reduces lifecycle GHG emissions by 92.7% when compared to conventional fuels).

- Mann, M.K. and P.L. Spath, *A life cycle assessment of biomass cofiring in a coal-fired power plant*, Clean Production Processes 3: 81-91 (2001) (finding that cofiring 15% wood residuals in coal-fired power plant reduced GHG emissions by 18.4%).

- Robinson, A.L., *et al.*, *Assessment of potential carbon dioxide reductions due to biomass – Coal cofiring in the United States*, Environmental Science and Technology 37(22): 5081-89 (2003) (concluding that cofiring forestry and agricultural residuals with coal reduce CO2 emissions by as much as 95% when compared to fossil fuel combustion).

- Pehnt, M, *Dynamic life cycle assessment (LCA) of renewable energy technologies*, Renewable Energy 31: 55-71 (2006) (finding that combustion of biomass feedstocks such as forest wood, short rotation forestry wood, and waste wood for energy could reduce life cycle GHG emissions by between 85 and 95% when compared to fossil fuels).

- Cherubini, F., *et al.*, *Energy- and greenhouse gas-based LCA of biofuel and bioenergy systems: Key issues, ranges and recommendations*, Resources, Conservation, and

Recycling 53: 434-47 (2009) (finding that combustion of forestry residuals for energy reduce life cycle GHG reductions by between 90 and 95%).

- Zhang, Y., *et al.*, *Life cycle emissions and cost of producing electricity from coal, natural gas, and wood pellets in Ontario Canada*, Environmental Science and Technology 44(1): 538-44 (2010) (finding that combustion of wood harvest specifically for energy production reduced lifecycle GHG emissions by 91% relative to coal and by 78% relative to natural gas).

- Raymer, A.K.P., *A comparison of avoided greenhouse gas emissions when using different kinds of wood energy*, Biomass and Bioenergy 30: 605-17 (2006) (concluding that combustion of biomass feedstocks such as fuel wood, sawdust, wood pellets, demolition wood, briquettes, and bark for energy production reduced lifecycle GHG emissions by between 81 and 98%).

- Heller, M.C., *et al.*, *Life cycle energy and environmental benefits of generating electricity from willow biomass*, Renewable Energy 29: 1023-42 (2004) (finding that cofiring 10% willow, a short rotation woody biomass feedstock, with coal reduced GHG emissions by 9.9%).

- Heller, M.C., *et al.*, *Life cycle assessment of a willow bioenergy cropping system*, Biomass and Bioenergy 25: 147-65 (2003) (finding that cofiring 10% willow, a short rotation woody biomass feedstock, with coal reduced GHG emissions by 9.9%).

- Bowyer, J., *et al.*, Life Cycle Impacts of Forest Management and Bioenergy Production 1-13 (July 2011), *available at* http://www.dovetailinc.org/files/DovetailLCABioenergy0711.pdf (finding that on a life cycle basis, biomass energy reduces GHG emissions by 96% in comparison to coal).

- Gaudreault, C., *et al.*, *Life cycle greenhouse gases and non-renewable energy benefits of kraft black liquor recovery*, Biomass and Bioenergy 46: 683-92 (2012) (finding that combustion of black liquor from Kraft pulping operations for energy reduced lifecycle GHG emissions by 90% relative to coal).

- Hall, D.O., *et al.*, *Alternative roles for biomass in coping with greenhouse gas warming*, Science & Global Security 2: 113-51 (1991) (finding that combustion of woody biomass for energy produces substantial GHG benefits over time when used as a substitute for coal).

- Marland, G. and B. Schlamadinger, *Forests for carbon sequestration or fossil fuel substitution: A sensitivity analysis*, Biomass and Bioenergy 13: 389-97 (1997) (concluding that the use of woody biomass as a substitute for coal in energy production yields substantial GHG emissions reductions over time).

- Schlamadinger, B. and G. Marland, *The role of forest and bioenergy strategies in the global carbon* cycle, Biomass and Bioenergy 13: 275-300 (1996) (concluding that the use of woody biomass as a substitute for coal in energy production yields substantial GHG emissions reductions over time).

- Abt, R.C. *et al.*, Climate Change Policy Partnership, Duke University, *The near-term market and greenhouse gas implications for forest biomass utilization in the Southeastern United States* (2010) (concluding, in a study of forests in the southeastern United States, that the harvest and combustion of biomass for energy "generat[es] net GHG reductions relative to the baseline" when used as a substitute for coal).

- Zanchi, G., *et al.*, *Is woody bioenergy carbon neutral? A comparative assessment of the emissions from consumption of woody bioenergy and fossil fuel*, GCB Bioenergy 4: 761-72 (2012) (finding that combustion of biomass for energy produces long-term reductions in cumulative GHG emissions when compared to combustion of fossil fuels)

- Nabuurs, G.J., *et al.*, *Forestry*, Chapter 9 in Climate change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, (B. Metz, *et al.*, eds.) (2007) ("In the long-term, a sustainable forest management strategy aimed at maintaining or increasing forest carbon stocks, while producing an annual sustained yield of timber, fibre or energy from the forest, will generate the largest sustained mitigation benefit.")

- Ryan, M.G., *et al.*, *A synthesis of the science on forests and carbon for U.S. forests*, Issues in Ecology 13: 1-16 (2010) ("[T]he maximum potential benefit from a project that reestablished forest increases if the stand is periodically harvested and the wood is used for substitution and the biomass used for fuel.")

- Gaudrealt. C. and R. 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 19(6):994-1007. (2015). (finding that combustion of mill residuals for energy reduces lifecycle GHG emissions by 86 to 99% when compared to fossil fuels).

- Electric Power Research Institute, *Biopower Generation: Biomass Issues, Fuels, Technologies, and Opportunities for Research, Development, and Deployment* (Feb. 24, 2010), *available at* http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000000001020784 ("Direct firing of biomass is the only proven carbon-neutral generation technology that is both suitable for baseload operation and available for immediate deployment to support capacity expansion.").

- Interlaboratory Working Group, Oak Ridge, TN and Berkeley, CA: Oak Ridge National Laboratory and Lawrence Berkeley National Laboratory, *Scenarios of U.S. Carbon Reductions: Potential Impacts of Energy-Efficient and Low-Carbon Technologies by 2010 and Beyond*, ORNL-444 and LBNL-40533 (1997) (concluding that cofiring biomass with fossil fuels was the single largest potential contributor to near-term GHG emissions reduction of any renewable energy strategy).

- Matthews, R. and K. Robertson, EIA Bioenergy Task 38, *Answers to Ten Frequently Asked Questions about Bioenergy, Carbon Sinks and Their Role in Global Climate Change* (2nd ed. 2005), *available at* www.ieabioenergy-task38.org/publications/faq/ (finding that between 25 and 50 units of bioenergy are produced for every unit of fossil fuel energy consumed in production) (citing Börjesson (1996), Boman and Turnbull (1997), McLaughlin and Walsh (1998), Matthews (2001). and Elsayed *et al.* (2003)).

- Jones, G., *et al.*, *Forest treatment residues for thermal energy compared with disposal by onsite burning: Emissions and energy return*, Biomass and Bioenergy 34: 737-46 (2010) (finding that, for forest residues in western Montana, an average of 21 units of bioenergy are produced for every unit of fossil fuel energy consumed in production).

- Walker, T., *et al.*, Manomet Center for Conservation Sciences, *Biomass Sustainability and Carbon Policy Study* (2010) ("All bioenergy technologies, even biomass electric power compared to natural gas electricity, look favorable when biomass waste wood is compared to fossil fuel alternatives.").

- Heath, L., *et al.*, *Greenhouse gas and carbon profile of the U.S. forest products industry value chain*, Environmental Science and Technology 44: 3999-4005 (2010) (explaining that active forest management that produces forest products and biomass energy reduces overall atmospheric GHG concentrations).

- Morris, G., Pacific Institute, *Bioenergy and Greenhouse Gases* (May 15, 2008), *available at* http://www.pacinst.org/reports/Bioenergy_and_Greenhouse_Gases/Bioenergy_and_Greenhouse_Gases.pdf (finding that the California biomass energy industry produces significant GHG emission reduction benefits by displacing fossil CO_2 emissions from energy production and by avoiding GHG emissions otherwise associated with alternative disposal options for biomass).

- Werner, F., *et al.*, *National and global greenhouse gas dynamics of different forest management and wood use scenarios: A model based assessment*, Environmental Science and Policy 13: 72-85 (2010) (finding that the contributions of the forestry and timber sector to mitigate climate change can be optimized when sustainable harvests are maximized and harvested wood is processed in accordance with the principles of cascade use including the use of "waste wood" residues to generate energy).

C. Forest carbon stocks are stable or increasing across the United States

- Field, C.B., *Primary production for the biosphere: integrating terrestrial and oceanic components*, Science 281: 237-40 (1998) (finding that forests sequester 25-30 billion metric tons of carbon per year).

- Sabine, C.L., *et al.*, *Current status and past trends of the carbon cycle*, *in* The global carbon cycle: integrating humans, climate, and the natural world 17-44 (C.B. Field & M.R. Raupach, eds. 2004) (finding that U.S. forests are a carbon sink).

- Society of American Foresters, *The State of America's Forests* (2007), *available at* http://www.safnet.org/publications/americanforests/StateOfAmericasForests.pdf (noting a 50% increase in forest carbon stocks over second half of the 20th century).

- U.S. Climate Change Science Program and the Subcommittee on Global Change Research, NOAA, *The First State of the Carbon Cycle Report (SOCCR): The North American Carbon Budget and Implications for the Global Carbon Cycle* (King, A.W., *et al.*, eds., 2007) (finding that forests are the largest carbon sink in North America).

- EPA, 2009 US Inventory of Greenhouse Gas Emissions and Sinks: 1990-2007 (stating that U.S. forests capture 10-15% of annual GHG emissions).

- Haynes, R.W., USDA Forest Service, Pacific Northwest Research Station, *The 2005 RPA timber assessment update*, Gen. Tech. Rep. PNW-GTR-699 (2007) (finding that private forests are a net carbon sink and sequester 131 metric tons of CO_2 per year).

- Heath, L.V., *Greenhouse Gas and Carbon Profile of the U.S. Forest Products Industry Value Chain*, Environmental Science and Technology (2010) (projecting that private forests will continue to be a net carbon sink through at least 2040).

- EPA, 2010 US Inventory of Greenhouse Gas Emissions and Sinks: 1990-2008 ("[I]mproved forest management practices, the regeneration of previously cleared lands, and timber harvesting and use have resulted in net uptake (i.e. net sequestration) of [carbon] each year from 1990 through 2008.").

- Smith, W., *et al.*., U.S. Department of Agriculture, U.S. Forest Service, *Forest Resources of the United States 2007 – General Technical Report WO-78* (2007) (concluding, based on data from 1980 to 2007, that forest carbon stocks are stable or increasing in the Rocky Mountain, Pacific Coast, South, and North regions, and for the U.S. as a whole).

- Walker, T., *et al.*, Manomet Center for Conservation Sciences, *Biomass Sustainability and Carbon Policy Study* (2010) (finding that forest carbon stocks in New England are increasing).

- Heath, L.S., *et al.*, *Managed Forest Carbon Estimates for the U.S. Greenhouse Gas Inventory, 1990-2008*, Journal of Forestry 109(3): 167-73 (2011) (finding that overall forest sequestration is increasing and projecting that forest carbon stocks will remain stable for the foreseeable future).

- Pan, Y, *et al.*, *A Large Persistent Carbon Sink in the World's Forests*, Science 333(6054): 988-93 (Aug. 19, 2011) (reporting that United States forest carbon stocks increased by 33% from 1990 to 2007).

- Bowyer, J., *et al.*, Dovetail Partners, *Carbon 101: Understanding the Carbon Cycle and the Forest Carbon Debate* (Jan. 2012), *available at* http://www.dovetailinc.org/files/DovetailCarbon101Jan2012.pdf (noting that between

1950 and 2010 forest carbon stocks increased nationally and across the North, South, Rocky Mountain, and Pacific Northwest regions).

- *More Parkland for Massachusetts*, Northern Woodlands 21 (Summer 2012) (reporting forest carbon stocks in Massachusetts are stable).

- Ince, P.J. and P. Nepal, U.S. Department of Agriculture, U.S. Forest Service, *Effects on U.S. Timber Outlook of Recent Economic Recession, Collapse in Housing, and Wood Energy Trends*, General Technical Report FPL-GTR-219 (Dec. 2012) (projecting that domestic forest carbon stocks will grow through 2060).

- Nepal, P., *et al.*, *Projection of U.S. forest sector carbon sequestration under U.S. and global timber market and wood energy consumption scenarios, 2010-2060*, Biomass and Bioenergy 45: 251-64 (2012) (projecting that U.S. forest carbon stocks will increase annually until at least 2045 and will have net growth from current levels until at least 2060).

- Alavalapati, J.R.R., *et al.*, *Forest Biomass-Based Energy*, *in* The Southern Forest Futures Project: technical report, United States Department of Agriculture (2013) (projecting that increased demand for biomass energy will not reduce forest carbon stocks because increased harvest rates will be offset by increased productivity of fast-growing plantation species).

- Alvarez, M. *The State of America's Forests,* Society of American Foresters (2007) (finding that the amount of forested land in the United States has been essentially constant since 1900).

- Birdsey, *et al.*, *Forest carbon management in the United States: 1600-2100*, Journal of Environmental Quality 35: 1461-69 (2006) (finding that U.S. forests and forest products have been a consistent carbon sink since at least the early 1950s).

- The Heinz Center for Science, Economics, and the Environment, *State of the Nations Ecosystem Report* (2008) ("Since 1953, the amount of carbon stored in live trees—the largest carbon pool in forests reported here—has increased by 43%.").

- Lippke, B., *et al.*, Letter from 113 Scientists to Sen. Boxer and Rep. Waxman (July 20, 2010) (explaining that forested acres have been stable for 100 years, while forest carbon stocks have increased by 50%).

  Forisk Consulting, *Woody Biomass as a Forest Product: Wood Supply and Market Implications* (Oct. 2011) (projecting an adequate supply of woody biomass to meet estimated bioenergy demands through 2022).

- Forisk Consulting, *Three Realities of Wood Bioenergy and Forest Owners* (2010), *available at* http://backup.forisk.com/UserFiles/File/Three%20Realities%20of%20Wood%20Bioenergy%20and%20Forest%20Owners%20final.pdf ("Timber per acre in the US has increased nearly one-third since 1952 and US forest growth has exceeded harvest since the 1940s.").

- Dale, V.H.. et al. Status and prospects for renewable energy using wood pellets from the southeastern United States, Global Change Biology Bioenergy doi: 10.1111/gcbb.12445 ("Overall forest stocks in the SE USA have increased for the last 50 years and are projected to continue increasing if conversion to nonforest uses is low, while also supporting significant removals for sawtimber, pulpwood and wood-pellet production").

D. Increased demand for biomass energy feedstocks will not deplete forest carbon stocks

- Science Advisory Board, *Review of EPA's Accounting Framework for Biogenic CO2 Emissions from Stationary Sources* at 7, EPA-SAB-12-011 (Sept. 22, 2012) ("Some research has shown that when a future demand signal is strong enough, expectations about biomass demand for energy (and thus revenues) can reasonably be expected to produce anticipatory feedstock production changes with associated changes in land management and land use . . . .").

- Nechodom, M., U.S. Department of Agriculture, U.S. Forest Service, Pacific Southwest Research Station, *Biomass to Energy: Forest Management for Wildlife Reduction, Energy Production, And Other Benefits*, CEC-500-2009-080 (Jan. 2010) (finding that the transition from passive to active management can occur without "carbon debt" due to reduced carbon losses from wild fire).

- Zhang, J., *et al.*, U.S. Department of Agriculture, U.S. Forest Service, Pacific Southwest Research Station, *To Manage or Not to Manage: The Role of Silviculture in Sequestering Carbon in the Specter of Climate Change* RMRS-P-61 /(2010) (showing that active forest management increased carbon sequestration and decreased fire-caused mortality).

- Clutter, M., *et al.*, *A Developing Bioenergy Market and its Implications on Forests and Forest Products Markets in the United States* (prepared for NAFO, 2010) *available at* http://www.nafoalliance.org/wp-content/uploads/NAFO-Executive-Summary-Clutter-Et-Al-Final.pdf (concluding that capacity exists to increase forest productivity by as much as 150% in South and Pacific Coast regions in response to increased market demand).

- James, C., *et al.*, *Carbon Sequestration in Californian Forests; Two Case Studies in Managed Watersheds* (2007) *available at* http://www.spi-ind.com/html/forests_research.cfm (concluding that implementing optimal policy incentives could double the amount of carbon sequestered by forests).

- Wear, D.N. and J.P. Prestemon, *Timber market research, private forests and policy rhetoric, in* Southern Forest Science: Past, Present, and Future General Technical Report SRS-75, Southern Research Station, USDA Forest Service, Ashville, NC (H.M. Raucher and K. Johnsen, eds. 2004) (explaining that economic return for forest products creates incentives for private forest stewardship).

- Lubowski, R.N., *et al.*, Economic Research Service, U.S. Department of Agriculture, *Environmental Effects of Agricultural Land-Use Change: The Role of Economics and Policy*, Economics Research Report No. 25, (Aug. 2006) (concluding that in the absence of market incentives, many working forests would be converted to non-forest uses).

- Ince, P.J., *Global Sustainable Timber Supply and Demand, in* Sustainable Development in the Forest Products Industry, Chapter 2, 29-41 (2010) (finding positive correlation between markets for forest products, including bioenergy, and annual increases in forest carbon stocks).

- Sedjo, R, *Carbon Neutrality and Bioenergy: A Zero-Sum Game?*, Resources for the Future Discussion Paper 1-9 (Apr. 2011), *available at* http://www.rff.org/documents/RFF-DP-11-15.pdf (explaining that bioenergy contributes to strong markets for forest products and creates incentives for forest owner to invest in forests rather than alternative land uses).

- Innovative Natural Resources Solutions LLC, *Identifying and Implementing Alternatives to Sustain the Wood-Fired Electricity Generating Industry in New Hampshire* (Jan. 2002), *available at* http://www.inrsllc.com/download/wood_firedelectricityinNH.pdf (explaining that biomass energy markets provide incremental value from low-grade forest products and help ensure that forests remain an economically competitive land use option in New Hampshire).

- Kingsley, E., *Importance of Biomass Energy Markets to Forestry: New England's Two Decades of Biomass Energy Experience* (June 2012), *available at* http://www.usendowment.org/images/Importance_of_Biomass_Energy_Markets_to_Forestry_6.2012.pdf (explaining that biomass energy markets provide incremental value from low-grade forest products and help ensure that forests remain economically competitive with other land uses).

- Maine Forest Service, *Maine Forest Service Assessment of Sustainable Biomass Availability* (July 17, 2008), *available at* http://www.maine.gov/dacf/mfs/about/state_assessment/downloads/maine_assessment_and_strategy_final.pdf (projecting that forest productivity in Maine could be increased by 88-273% through additional investments in site preparation, planting, competition control, and thinning).

- Sedjo, R. and X. Tian, *Does Wood Bioenergy Increase Carbon Stocks in Forests?*, Journal of Forestry 110: 304-11 (2012) (concluding that when "demand [for biomass] is greater than the sustainable harvest of the forest, prices will rise, total forest area will expand to meet the increasing demand, and in the process, will capture and store more carbon").

- Sedjo, R. and B. Sohngen, *Wood as a Major Feedstock for Biofuel Production in the United States: Impacts on Forests and International Trade*, Journal of Sustainable Forestry 23: 195-211 (2003) (explaining that strong market signals supporting future demand for forest products will cause forest owners to make anticipatory changes to ensure that the demand will be met).

- Wear, D.N. and J.G. Greis, *The Southern Forest Futures Project: Summary Report* (May 12, 2011), *available at* http://www.srs.fs.usda.gov/futures/reports/draft/summary_report.pdf (explaining that strong timber markets (1) encourage landowners to retain forests rather than converting them to other land uses and (2) encourage continued investment in forest management).

- MacCleery, D., *American Forests: A History of Resiliency and Recovery* (1996) (concluding that biomass energy can be an important new market that replaces other markets with declining demand and adds economic value to private forest ownership).

- Alavalapati, J.R.R., *et al.*, *Forest Biomass-Based Energy*, *in* The Southern Forest Futures Project: technical report, United States Department of Agriculture (2013) (projecting that under high biomass energy demand scenarios forest owners will increase productivity and expand the number of forested acres to meet demand).

- Daigneault, A., *et al.*, *Economic approach to assess the forest carbon implications of biomass energy*, Environmental Science and Technology 46: 5664-71 (2012) (explaining that strong markets for biomass keep land forested and encourage the planting of new forests).

- Lubowski, R., *et al.*, *What drives land-use change in the United States? A National Analysis of Landowner Decisions*, Land Economics 84: 529-50 (2008) (explaining that demand for wood produces investments by landowners that prevent forest loss through land use change an encourage afforestation).

- Hardie, I., *et al.*, *Responsiveness of rural and urban land uses to land rent determinations in the U.S. South*, Land Economics 76: 659-73 (2000) (explaining that demand for wood produces investments by landowners that prevent forest loss through land use change an encourage afforestation).

- Abt, R.C. *et al.*, Climate Change Policy Partnership, Duke University, *The near-term market and greenhouse gas implications for forest biomass utilization in the Southeastern United States* (2010) ("Forest harvest and planting decisions are affected by an uptick in demand for biomass, which in turn affects net carbon storage over time.").

- Dale, V.H., et al. How is wood-based pellet production affecting forest conditions in the southeastern United States? Forest Ecology and Management 396: 143–149 (2017). (Reporting that since harvesting for bioenergy increased in the southeastern US after 2008, the region experienced increases in acreage of large trees and harvestable carbon, wood volumes in planted stands, and forest area).

E. Increased demand for biomass energy will not result in the harvest of high-grade mature trees for energy

- Forisk Consulting, *Woody Biomass as a Forest Product: Wood Supply and Market Implications* (Oct. 2011) (finding that a 435% increase in biomass energy demand by 2016 would be required to make forest management exclusively for biomass energy as profitable as management for saw timber).

- Ince, P.J., *Global Sustainable Timber Supply and Demand, in* Sustainable Development in the Forest Products Industry, Chapter 2 29-41 (2010) (explaining that biomass energy feedstocks are among the lowest value forest products).

- Innovative Natural Resources Solutions LLC, *Identifying and Implementing Alternatives to Sustain the Wood-Fired Electricity Generating Industry in New Hampshire* (Jan. 2002), *available at* http://www.inrsllc.com/download/wood_firedelectricityinNH.pdf (explaining that biomass energy relies on low-cost, low-grade feedstocks, not high-grade grade feedstocks that command higher prices in the market).

- Kingsley, E., *Importance of Biomass Energy Markets to Forestry: New England's Two Decades of Biomass Energy Experience* (June 2012) (explaining that biomass energy relies on low-cost, low-grade feedstocks, not high-grade feedstocks that command higher prices in the market).

- Maine Forest Service, *Maine Forest Service Assessment of Sustainable Biomass Availability* (July 17, 2008) (concluding that Maine has 9.69 million green tons per year of unutilized biomass available for biomass energy).

- U.S. Department of Energy, *Billion-ton update: biomass supply for a bioenegy and bioproducts industry* (2011) (projecting that a goal of replacing 30% of U.S. fossil fuel consumption with biomass resources can be achieved without using current pulpwood or saw timber supplies).

- MacCleery, D., *American Forests: A History of Resiliency and Recovery* (1996) (explaining that biomass energy can be an important new market that can replace other declining markets and add economic value to private forest ownership).

- Forisk Consulting, *Wood Bioenergy Markets and Forestland Owner Decisions: 2010-2013* (2014) (finding that projected demand for bioenegy feedstocks will not alter current forest management practices that are focused on saw timber production)

- U.S. Department of Agriculture, U.S. Forest Service, *Future of America's Forest and Rangelands: Forest Service 2010 Resources Planning Act Assessment*, Gen. Tech. Rep. WO-87 (2012) (projecting that large, mature trees are unlikely to be used for bioenergy due to price competition from higher value forest products).

- Abt, K.L. *et al.*, *Effect of Bioenergy demands and supply response on markets, carbon, and land use*, Forest Science 58: 523-39 (2012) (projecting that price increases associated with biomass energy demand in the southern United States will remain far below prices for saw timber).

- Abt, R.C. and K.L. Abt, *Potential impact of bioenergy demand on the sustainability of the southern forest resource*, Journal of Sustainable Forestry 32: 175-94 (2013) (projecting that price increases associated with biomass energy demand in the southern United States will remain far below prices for saw timber).

- Timber Mart-South, Univ. of Georgia, *Southeastern Timber Market News and Price Reports* (2013) (projecting that price increases associated with biomass energy demand in the southern United States will remain far below prices for saw timber).

- Haq, Z., *Biomass for Electricity Generation*, EIA (July 2002), *available at* http://www.eia.gov/oiaf/analysispaper/biomass/pdf/biomass.pdf (projecting that by 2020, agricultural residues, energy crops, forestry residues, and urban wood waste/mill residues will provide as much as 7.1 quadrillion BTUs of biomass at a price of $5 per BTU or less).