LAW OFFICE OF
ROBERT W. KAYLOR, P.A.
3700 GLENWOOD AVENUE, SUITE 330
RALEIGH, NORTH CAROLINA 27612
(919) 828-5250
FACSIMILE (919) 828-5240

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May 24, 2010

Ms. Renné C. Vance, Chief Clerk
North Carolina Utilities Commission
4325 Mail Service Center
Raleigh, North Carolina 27699-4325

RE: Docket No. E-7, Sub 939 and E-7, Sub 940

Dear Ms. Vance:

Enclosed for filing are the original and thirty (30) copies of Duke Energy Carolinas, LLC's Pre-Hearing Brief and Direct Testimony of Witnesses Owen A. Smith, Tracy Beer and Peter Stewart in the above referenced dockets.

Sincerely,

Robert W. Kaylor

Robert W. Kaylor

Enclosures

cc: Parties of Record

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BEFORE THE NORTH CAROLINA UTILITIES COMMISSION

FILED
MAY 24 2010
Clerk's Office
N.C. Utilities Commission

DOCKET NO. E-7, SUB 939
DOCKET NO. E-7, SUB 940

In the Matter of the Registration Statements of Buck and Lee Steam Stations As Renewable Energy Facilities Pursuant to Rule R8-66	)	**DUKE ENERGY CAROLINAS, LLC'S PRE-HEARING BRIEF**

INTRODUCTION

On April 27, 2010, this Commission issued an *Order Consolidating Dockets, Scheduling Evidentiary Hearing and Oral Argument, and Establishing Discovery Guidelines* (the "Order") in these dockets in connection with the registration statements filed by Duke Energy Carolinas, LLC ("Duke Energy Carolinas" or the "Company"), pursuant to Commission Rule R8-66, to register Buck Steam Station ("Buck") and Lee Steam Station ("Lee") as "new renewable energy facilities" such that those facilities may generate renewable energy certificates ("RECs") for use by Duke Energy Carolinas to comply with the North Carolina Renewable Energy and Energy Efficiency Portfolio Standard ("REPS"), N.C. Gen. Stat. § 62-133.8. Pursuant to the Commission's Order in these dockets, Duke Energy Carolinas submits this Initial Pre-Hearing Brief in Support of its Registration Statements for Buck and Lee Steam Stations.

SUMMARY OF FACTS

Lee Steam Station is a thermal electric generating station located in Williamson, South Carolina with a total maximum net dependable capacity ("MNDC") of 370 MW. A biomass co-firing production trial began at Lee in July of 2009, and continued through the end of last year, to evaluate the use of wood as a fuel for energy production in combination with coal. This trial

generated approximately 1,303 megawatt-hours of energy, which would result in the creation of approximately 1,303 corresponding biomass Renewable Energy Certificates ("RECs"). For the co-firing test burns, Duke Energy Carolinas blended coal with three-quarter inch sized wood chips to accommodate the requirements of the boilers at the facility.

Buck Steam Station is a thermal electric generating station located in Salisbury, North Carolina with a total MNDC of 369 MW. Similar to Lee, woody biomass co-firing test burns were conducted at this facility between August 17 and September 9, 2009. This test burn generated 2,254 megawatt-hours of energy, resulting in the creation of 2,254 corresponding biomass RECs. At Buck, the coal was blended with both sawdust and one-half inch sized wood chips for the test burns, again to accommodate the operational specifications of the facility's boilers.

For the test burns at Buck, the Company sourced the wood fuel from trees and other wood that had been previously harvested on-site pursuant to a Company land clearing project related to the construction of a new ash basin to support the existing facility. The land clearing project at Buck was previously authorized and the land would have been cleared if the Buck test burns had not been conducted. The wood fuel was chipped on-site to meet the specifications for the facility. Had the wood fuel not been used for the test burns, the contractor that cleared the land likely would have burned the wood on-site and landfilled the resulting ash, or possibly sold the wood into the market. For the test burns at Lee, the Company sourced the wood fuel in specifically-sized chip form from an external forestry services vendor.

The Company intends to follow up on its successful test burns at Buck and Lee in 2009 with additional co-firing testing at Buck and a full co-firing production run at Lee in 2010. Duke Energy Carolinas will also continue its phased internal technical assessments and economic

evaluations regarding potential development of biomass resources through co-firing and repowering projects. The Company-owned biomass implementation strategy is a multi-year effort that has begun with smaller co-firing projects and will, if successful, build towards long-term repowering projects. At full implementation and build-out, Duke Energy Carolinas-owned "brownfield" biomass projects are expected to produce over 1 million RECs annually. To support these projects, Duke Energy Carolinas intends to use those cost-effective wood fuels qualifying as "biomass resources" under Senate Bill 3.

ARGUMENT

I. The Registration Statements for Buck and Lee Steam Stations Should Be Approved As A Matter Of Law

Pursuant to Commission Rule R8-66, a registration statement must be filed with, and approved by, the Commission for a renewable energy facility to qualify to earn RECs that are eligible for use by an electric power supplier to use to comply with REPS. A registration statement is required for each renewable energy facility that seeks registration with the Commission. In its *Order Approving Final Rules* in Docket No. E-100, Sub 113, the Commission concluded that:

> a determination of whether a resource used by a particular facility is a "renewable energy resource," . . . should be made on a case-by-case basis with an adequate opportunity for the Public Staff or other interested persons to challenge asserted facts. The registration process established in Rule R8-66 permits such a determination to be made on the basis of an appropriate record with regard to a particular facility.

A. The Lee and Buck Steam Stations Meet the Statutory Requirements For Renewable Energy Facilities Under North Carolina Law

Lee and Buck Steam Stations have and will utilize wood biomass fuel to generate electricity, and therefore qualify as "renewable energy facilities" under the requirements of N.C.

Gen. Stat. § 62-133.8. Under North Carolina's REPS statute, a "renewable energy facility" means a facility that either:

a. **Generates electric power by the use of a renewable energy resource.**
b. Generates useful, measurable combined heat and power derived from a renewable energy resource.
c. Is a solar thermal energy facility.

N.C. Gen. Stat. § 62-133.8(a)(7) (emphasis supplied).

The law further provides that a "renewable energy resource":

> . . . means a solar electric, solar thermal, wind, hydropower, geothermal, or ocean current or wave energy resource; ***a biomass resource, including agricultural waste, animal waste, wood waste, spent pulping liquors, combustible residues, combustible liquids, combustible gases, energy crops, or landfill methane***; waste heat derived from a renewable energy resource and used to produce electricity or useful, measurable thermal energy at a retail electric customer's facility; or hydrogen derived from a renewable energy resource. "Renewable energy resource" does not include peat, a fossil fuel, or nuclear energy resource.

N.C. Gen. Stat. § 62-133.8(a)(8) (emphasis supplied).

Neither the statute, nor the Commission's rules implementing Senate Bill 3, further defines "biomass resource." As such, "biomass resource" must be interpreted under the accepted norms of statutory construction to effectuate the intent of the enabling statute. Under North Carolina law, the cardinal principle of the canons of statutory construction is to ensure accomplishment of the legislative intent of the subject statute. *See L. C. Williams Oil Co. v. NAFCO Capital Corp.*, 130 N.C. App. 286, 289, (1998). To that end, one must consider "the language of the statute . . ., the spirit of the act and what the act seeks to accomplish." *Coastal Ready-Mix Concrete Co. v. Board of Comm'rs*, 299 N.C. 620, 629 (1980). Undefined words are accorded their plain meaning so long as it is reasonable to do so, *see Woodson v. Rowland*, 329 N.C. 330, 338 (1991), and the reviewing body must evaluate the statute as a whole and must not

construe an individual section in a manner that renders another provision of the same statute meaningless. *See Williams v. Holsclaw*, 128 N.C. App. 205, 212, *aff'd*, 349 N.C. 225 (1998).

Biomass, as defined by the federal Biomass Research and Development Technical Advisory Committee[1], means "**any organic matter that is available on a renewable or recurring basis**, including agricultural crops and trees, **wood and wood wastes and residues**, plants (including aquatic plants), grasses, residues, fibers, animal wastes, and segregated municipal waste . . ." (emphasis supplied). The North Carolina Biomass Council, the North Carolina State Energy Office, and the North Carolina Solar Center adopted and incorporated this definition into the *North Carolina Biomass Roadmap: Recommendations for Fossil Fuel Displacement through Biomass Utilization,* published in May 2007[2].

Wood, in its various forms and iterations through its life-cycle, is undoubtedly "biomass" under this generally accepted definition of the term. If one reduces the definition to its component elements; (1) wood is organic plant material as it is derived from trees; and (2) wood is available on a renewable and recurring basis in the forests of this State and country. Thus, to effectuate the intent of the General Assembly that "biomass resources" qualify "renewable energy resources" for REPS compliance purposes, wood, particularly that which is derived from whole trees, must be considered a "renewable energy resource" under the law.

Although "wood" is not listed specifically in the statute, interpreting "biomass resource" to encompass more possible fuel sources than those specific sources listed in the statute is consistent with the General Assembly's use of the expansive modifier, "including" ahead of the

[1] A multi-agency federal initiative supported by the U.S. Department of Agriculture and U.S. Department of Energy to coordinate and accelerate Federal biobased products and bioenergy research and development. The Biomass Research and Development Technical Advisory Committee has published "roadmap" documents for biofuels, biopower and bioproducts in 2002 and 2007. *See* http://www.brdisolutions.com/pdfs/FinalBiomassRoadmap.pdf and http://www1.eere.energy.gov/biomass/pdfs/obp_roadmapv2_web.pdf.

[2] *See* http://www.ncsc.ncsu.edu/bioenergy/docs/NC_Biomass_Roadmap.pdf.

list of illustrative "biomass resources". Merriam-Webster Dictionary defines the word "includes" to mean "to take in or comprise *as part of* a whole or group." (emphasis supplied). To "include" one thing does not implicitly "exclude" another due to the plain fact that "including" one or more items in the specified whole or group simply means, pursuant to this definition, that those specified items are *part of* that whole or group.

Based upon generally accepted norms of statutory construction, where a list is preceded by the word "includes," which is a term of enlargement rather than limitation, it indicates that matters other than those enumerated are covered. *See* Norman J. Singer, 2A *Sutherland on Statutory Construction* 231-232 (2000)(emphasis supplied). Moreover, according to *A Dictionary of Modern Legal Usage*, "including should not be used to introduce an exhaustive list, for it implies that the list is only partial." As illustrated by the citation to *Sutherland on Statutory Construction* above, "it is hornbook law that the use of the word "including" indicates that the specified list . . . that follows is illustrative, not exclusive." *Certified Color Mfg. Ass'n v. Mathews*, 543 F.2d 284, 296 (D.C.Cir. 1976).

The North Carolina Supreme Court adopted this rule of statutory construction in *NC Turnpike Authority v. Pine Island, Inc.*, 265 N.C. 109, 120 (1965), wherein it quoted the West Virginia Supreme Court's analysis on the construction of the term "including":

> Clearly, by use of the word 'including' the lawmakers intended merely to list examples . . . but not to exclude others equally well known. Had the latter been their intention, the proper expression to have been used would have been 'comprising,' 'consisting of,' or some synonymous term. This is not a situation which calls for the application of the maxim, '*expressio unius est exclusio alterius*.'

See also Polaroid Corp. v. Offerman, 349 N.C. 290, 301 (1998)("includes" indicates the General Assembly's intention to enlarge, not limit, a statutory definition). More importantly, the

Commission has adopted this interpretation of "including" in the context of the definition of "biomass resource", as it specifically noted that:

> the definition of "renewable energy resource" in G.S. 62-133.8(a)(8) includes biomass resource," **listing several examples without limitation**, and in its Order Adopting Final Rules in Docket No. E-100, Sub 113, the Commission determined that a "determination of whether a resource used by a particular facility is a "renewable energy resource" . . . should be made on a case-by-case basis. (emphasis supplied)

See *Order on Request for Declaratory Ruling*, Docket No. SP-100, Sub 25 (February 24, 2010).

The Commission's reliance on this interpretation has been evident through its decisions on declaratory rulings and decisions to approve registration statements for facilities using biomass fuels that were not included in the explicit statutory list. For example, the Commission has ruled that biosolids[3] (the organic material remaining after treatment of domestic sewage), municipal solid waste or refuse-derived fuel[4], and tire-derived fuel[5] (to the extent of the naturally occurring rubber) are all "renewable energy resources" and eligible to generate RECs for REPS purposes. Based on this precedent and record of a broad interpretation of "biomass resources", it is clear that wood, including chips derived from whole trees, must be considered a "renewable energy resource" under N.C. Gen. Stat. § 62-133.8(a)(8) as a matter of law.

B. The Registration Statements for Lee and Buck Steam Stations Meet the Regulatory Requirements of Commission Rule R8-66

As wood qualifies as a "renewable energy resource" N.C. Gen. Stat. § 62-133.8(a)(8), and Duke Energy Carolinas has satisfied the requirements of Commission Rule R8-66 for the registration statements of both Lee and Buck, the Lee Statement and the Buck Statement should be accepted and approved by the Commission. On March 1, 2010, Duke Energy Carolinas filed

[3] *Order on Request for Declaratory Ruling*, Docket No. SP-100, Sub 25 (February 24, 2010)
[4] *Order on Request for Declaratory Ruling,* Docket No. SP-100, Sub 23 (March 25, 2009)
[5] *Order Issuing Amended Certificates, Accepting Registration Statement and Issing Declaratory Ruling,* Docket No. SP-165, Sub 3 (December 17, 2009)

renewable energy facility registration statements for Buck Units 5 and 6 ("Buck Statement") and Lee Units 1,2 and 3 ("Lee Statement") for approval by the Commission. Pursuant to Commission Rule R8-66, registration statements must by supported by the following information and certifications:

> (1) The owner of each renewable energy facility . . . shall include in its registration statement the information set forth in paragraphs (i) through (v) and paragraph (xi) of subsection (b)(1) of Rule R8-64, a description of the technology used to produce electricity, and the facility's projected dependable capacity in megawatts by generating unit. . .
>
> (2) The owner of each renewable energy facility required to file Form EIA-923 with the Energy Information Administration (EIA), United States Department of Energy, shall include with its registration statement a copy of Schedules 1, 5, 6 and 9 from its most recent Form EIA-923 and shall file a copy of those Schedules with the Commission each year at the same time the information is provided to the EIA. . . .
>
> (3) The owner of each renewable energy facility shall certify in its registration statement and annually thereafter that it is in substantial compliance with all federal and state laws, regulations, and rules for the protection of the environment and conservation of natural resources. . . .
>
> (4) The owner of each renewable energy facility shall certify in its registration statement . . . that the facility satisfies the requirements of G.S. 62-133.8(a)(5) or (7) as a renewable energy facility or new renewable energy facility, that the facility will be operated as a renewable energy facility or new renewable energy facility, and, if the facility has been placed into service, the date when it was placed into service.
>
> (5) The owner of each renewable energy facility shall further certify in its registration statement and annually thereafter that any renewable energy certificates (whether or not bundled with electric power) sold to an electric power supplier to comply with G.S. 62-133.8 have not, and will not, be remarketed or otherwise resold for any other purpose, including another renewable energy portfolio standard or voluntary purchase of renewable energy certificates in North Carolina or any other state or country, and that the electric power associated with the certificates will not be offered or sold with any representation that the power is bundled with renewable energy certificates. The owner shall also annually report whether it sold any renewable energy certificates (whether or not bundled with electric power) during the prior year and, if so, how many and to whom.

(6) The owner of each renewable energy facility shall certify in its registration statement and annually thereafter that it consents to the auditing of its books and records by the Public Staff insofar as those records relate to transactions with North Carolina electric power suppliers, and agrees to provide the Public Staff and the Commission access to its books and records, wherever they are located, and to the facility.

(7) Each registration statement shall be signed and verified by the owner of the renewable energy facility or by an individual duly authorized to act on behalf of the owner for the purpose of the filing.

Walking sequentially through the filing requirements of Commission Rule R8-66, the Lee and Buck Statements both include all of the relevant background and operation information set forth in R8-64(b)(1)(i) – (v) and (xi). Both Lee and Buck Statements include the relevant Form 923 EIA data for the respective facilities, and both statements included certifications from Carol Goolsby, Vice President, Regulated Renewables and Hydro Generation, Duke Energy Carolinas, attesting to the fact that the facilities were in substantial compliance with State and federal laws, regulations, and rules for the protection of the environment and conservation of natural resources; that the facilities will be operated as "renewable energy facilities"; and that the RECs associated with these facilities sold to any electric power supplier will not be re-marketed or re-sold. Finally, the Lee and Buck Statements were executed by Ms. Goolsby and contained additional certifications consenting to auditing by Public Staff and the Commission.

On March 8, 2010, Public Staff filed a letter with the Commission stating that it had reviewed the Buck Statement and that based on its review, it recommended that the Buck Statement be deemed complete, accepted by the Commission, and Buck be approved as a new renewable energy facility under Commission Rule R8-66. On March 12, 2010, Public Staff filed a corresponding letter with the Commission stating that it had reviewed the Lee Statement and that based on its review of that filing, it recommended that the Lee Statement be deemed

complete, be accepted by the Commission, and Lee also be approved as a new renewable energy facility under Commission Rule R8-66.

Based on the above, it is apparent that Duke Energy Carolinas has satisfied the regulatory requirements of Commission Rule R8-66 with respect to the registration statements for Lee and Buck. The registration statements for Lee and Buck meet the substantive requirements for registration as new renewable energy facilities, as confirmed by the Public Staff, and thus the Company submits that the Commission should approve the subject registration statements as filed.

CONCLUSION

Duke Energy Carolinas respectfully requests that the Commission issue an Order finding that wood fuel, including wood chips from whole trees, qualifies as a "renewable energy resource" under N.C. Gen. Stat. § 62-133.8(a)(7). The Company also requests that the Commission issue an Order accepting the registrations as new renewable energy facilities of the co-firing facilities at Lee Steam Station in Williamson, South Carolina and Buck Steam Station in Salisbury, North Carolina.

Respectfully submitted this 24th day of May, 2010.

Robert W. Kaylor
Law Office of Robert W. Kaylor, P.A.
3700 Glenwood Ave., Suite 330
Raleigh, North Carolina 27612
Telephone: 919.828.5250

Charles A. Castle, Senior Counsel
Duke Energy Corporation
Post Office Box 1006 / EC03T
Charlotte, North Carolina 28201-1006
Telephone 704.382.4499
alex.castle@duke-energy.com

ATTORNEYS FOR DUKE ENERGY CAROLINAS, LLC

BEFORE THE NORTH CAROLINA UTILITIES COMMISSION

DOCKET NO. E-7, SUB 939
DOCKET NO. E-7, SUB 940

In the Matter of the Registration Statements of Buck and Lee Steam Stations as Renewable Energy Facilities Pursuant to Commission Rule R8-66	)	**DIRECT TESTIMONY OF OWEN A. SMITH**

Q: PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A: My name is Owen A. Smith, and my business address is 526 South Church Street, Charlotte, North Carolina.

Q: WHAT IS YOUR POSITION WITH DUKE ENERGY CORPORATION?

A: I am Managing Director, Renewable Strategy and Compliance for Duke Energy Corporation ("Duke Energy").

Q: PLEASE BRIEFLY SUMMARIZE YOUR EDUCATIONAL BACKGROUND AND PROFESSIONAL AFFILIATIONS.

A: I received a Bachelor of Arts from East Carolina University and a Master's degree in Business Administration from Wake Forest University. I serve on the Board of Directors of the Solar Electric Power Association ("SEPA").

Q: PLEASE DESCRIBE YOUR BUSINESS BACKGROUND AND EXPERIENCE.

A: I joined Duke Energy Corporation in 2002 as a Commercial Associate. I have held positions in Corporate Strategy, Treasury, Mergers & Acquisitions, Market Research, and Renewable Energy Strategy. I have been accountable for the renewable energy strategy of Duke Energy's regulated utilities, including Duke

Energy Carolinas, LLC ("Duke Energy Carolinas" or "Company"), since November of 2007.

Q: WHAT ARE YOUR RESPONSIBILITIES IN YOUR CURRENT POSITION?

A: I am responsible for the development and execution of strategies and compliance plans related to renewable energy for Duke Energy's regulated utility businesses, including Duke Energy Carolinas and our utility operating companies in Indiana, Ohio, and Kentucky. This includes pursuing renewable generation initiatives, customer programs, and compliance with renewable energy requirements.

Q: HAVE YOU PREVIOUSLY TESTIFIED BEFORE THE NORTH CAROLINA UTILITIES COMMISSION?

A: Yes, I recently appeared to present testimony in support of Duke Energy Carolinas' Application for Approval of Renewable Energy and Energy Efficiency Portfolio Standard ("REPS") Cost Recovery, in Docket No. E-7, Sub 872, and in support of the Company's 2009 Integrated Resource Plan, including its 2009 REPS Compliance Plan, in Docket No. E-100, Sub 124.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?

A. The purpose of my testimony is to (1) describe Duke Energy Carolinas' strategy for compliance with its general North Carolina REPS obligations in the near and long term; (2) describe the role and importance of woody biomass in the Company's plan to meet its obligations; and (3) the practical impact of a limiting interpretation of "biomass resource", as defined in G.S. 62-133.8, on the Company's REPS compliance strategy and costs and its overall integrated resource planning.

Q. WHAT IS DUKE ENERGY CAROLINAS' STRATEGY FOR COMPLIANCE WITH THE GENERAL REPS REQUIREMENTS?

A. The Company's 2009 REPS Compliance Plan, filed in Docket No. E-100, Sub 124, outlined the Company's overall approach to REPS compliance for 2009 through 2011. Duke Energy Carolinas has developed a balanced approach of utilizing: (1) existing or new Duke Energy Carolinas-owned assets, (2) the purchase of energy from renewable energy resources available in the market, (3) the purchase of unbundled renewable energy certificates ("RECs") from both in-state and out-of-state suppliers, and (4) cost-effective energy efficiency savings, as approved by the Commission in Docket No. E-7, Sub 831, to satisfy its REPS requirements. At present, the Company intends to adhere to this strategy over the longer term as well.

Q. WHAT ROLE DOES BIOMASS PLAY IN THE COMPANY'S EXECUTION OF ITS REPS COMPLIANCE STRATEGY?

A. Biomass currently plays an extremely important role in Duke Energy Carolinas' plans to meet its general REPS compliance obligations in both the near and long term. Biomass generation resources, in its various forms, represent cost-effective renewable energy options for REPS compliance purposes as well as carbon neutral generation options in the impending federally-regulated carbon-constrained generation environment. Additionally, North Carolina is blessed with abundant forest resources, whereas certain inherent limitations exist regarding the development of other resources qualifying to meet the general REPS portfolio standards that I discuss further below. Thus, biomass represents a renewable resource with significant development potential for renewable energy options in

this State. Also, biomass resources can be dispatchable, like fossil resources, and provide the potential for baseload-type capacity from a renewable resource that are simply not available with intermittent resources.

Q. WITHIN THE CATEGORY OF BIOMASS RESOURCES, AS DEFINED IN SENATE BILL 3, HOW IMPORTANT IS WOOD-FIRED BIOMASS TO DUKE ENERGY CAROLINAS' REPS COMPLIANCE STRATEGY?

A. Since the passage of Senate Bill 3, wood-fired biomass has played a significant role in Duke Energy Carolinas' REPS compliance strategy. Wood-fired biomass represents the renewable resource with the most readily achievable, scalable development potential within North Carolina. The Company's strategy for using wood biomass to comply with its REPS obligations includes efforts to co-fire wood fuel with fossil fuel at existing Company facilities and to repower units at certain Company facilities to burn only wood fuel to generate electricity. The Company's efforts along these lines are being undertaken as a series of projects with smaller projects occurring first to gain operational and fuel procurement experience before building towards larger projects.

Consistent with Duke Energy Carolinas' overall REPS compliance strategy described above, the Company's strategy for wood biomass utiltization will also include power purchase agreements and unbundled REC purchases with third party suppliers. Based on the Company's analysis of the developing renewable marketplace, wood biomass provides a cost-effective resource with the potential to deliver the millions of RECs that will be necessary for Duke Energy Carolinas to achieve REPS compliance over the near and long term.

Q. IS DUKE ENERGY CAROLINAS' OPERATION OF EXISTING COMPANY RESOURCES TO UTILIZE WOOD BIOMASS FUEL IN THE PUBLIC INTEREST?

A. Yes. Both the co-firing of wood fuel and the conversion of existing units to wood biomass facilities are intended to benefit Duke Energy Carolinas' customers and provide a cost-effective mechanism for REPS compliance through the utilization of existing generation assets. It is broadly accepted that wood biomass is one of the more cost effective forms of renewable generation, and that wood biomass is also one of the few renewable resources that is dispatchable, not intermittent in nature like solar power or wind power, and can operate at a baseload-type capacity factor. Further, it is simply less expensive to produce renewable energy by utilizing existing generation facilities than to construct new generation facilities. In other words, the Company can make certain modifications to existing fossil generation assets to enable them to produce electricity utilizing wood biomass fuel, and the costs of these modifications can be materially lower than the costs that would be associated with constructing an entirely new wood biomass generation facility.

This proposed strategy of utilizing existing Company resources will also provide enhanced operational flexibility that could otherwise be lost. Specifically, by operating wood biomass generating facilities directly, the Company will have the ability to manage fuel and operational costs in a manner that would likely not be possible through long-term contracts with thirdparties. Biomass fuel costs are likely to fluctuate over time, and by being the operator of wood biomass facilities, the Company would retain the flexibility to stop

procuring biomass fuel if prices escalated beyond a reasonable point. The Company believes that such operational flexibility likely would not be possible, at least not without some form of risk premium, in the case of contracts with thirdparties for new, also known as "greenfield", wood biomass facilities due to the financing requirements of those parties.

In sum, this proposed strategy of utilizing existing Company assets is in the public interest as it provides a scalable, cost-effective, and operationally flexible method of generating renewable electricity that is valuable to the Company and its customers in the context of both REPS and a carbon-constrained regulatory future.

Q. HOW DOES WOOD-FIRED BIOMASS COMPARE TO OTHER RESOURCES AS AN OPTION TO COMPLY WITH THE COMPANY'S GENERAL REPS REQUIREMENTS?

A. Wood-fired biomass compares favorably to other resource options in terms of cost-effectiveness and achieveable development potential. At present, landfill gas represents the most cost effective, in-state REPS-eligible resource available in the marketplace; however, there are only so many landfills and therefore, the potential for development of that resource is effectively capped. Wind resource development in North Carolina is inherently limited by the natural wind conditions of the State, as well as by specific legal or operational constraints. Commercial wind development is currently prohibited in the mountains of western North Carolina under the Ridge Law and, while Duke Energy Carolinas has embarked on a project to test the viability of coastal wind in the Pamlico Sound, coastal and off-shore wind projects are years away from delivering

material quantities of energy to North Carolina retail customers and corresponding RECs to electric power suppliers and may never develop in scale due to cost and operational concerns.

Moreover, although solar generation exists as a scalable renewable resource option, it is simply not cost competitive with wood biomass and would likely be constrained by a lack of availability of suitable land that would be needed to support the farms and arrays necessary to attempt to match the capacity and output of a handful of biomass generation facilities.

For instance, a reasonable estimate of the land requirements for solar photovoltaic projects is approximately 8 acres per megawatt of capacity (as measured in alternating current). Our experience suggest that, in the Company's North Carolina footprint, this metric is best suited for smaller photovoltaic projects of perhaps 4 megawatts or less in capacity. The acreage requirements for solar are impacted by slope, orientation, topography, and the presence of features including but not limited to trees or flood plains. Further, the economics of a solar project are influenced by the cost of such land and the costs associated with interconnecting the project to the electrical grid in an appropriate manner. The ideal solar project site would be a tract of land that is (1) large, (2) flat or sloping slightly to the south, (3) clear of trees or other obstacles, (4) not in a flood plain, (5) close to an attractive interconnection point to the electrical grid, and (6) inexpensive. In our experience in North Carolina, this combination of attributes does not exist.

The Company's 15.5 MW (AC) power purchase agreement (PPA) with SunEdison is an example of an attractive project that effectively balances these

attributes to achieve the best economics possible. After an exhaustive search for large available tracts of land, the best available project site was chosen, which is a 357 acre site that includes large portions that are relatively flat and clear, but also includes portions that are rolling hills, as well as wooded areas and a pond. Taken in totality, this project requires just over 23 acres per megawatt (AC) of solar capacity (357 / 15.5 = 23.03). This metric is obviously materially different than what may be achievable for much smaller scale projects, or for projects in other regions of the country with different topography, population density, and other conditions. The point that I am illustrating here is that it is reasonable to assume that there will be limited opportunities to develop large scale solar projects based on land availability. It is reasonable to assume that smaller scale projects could be more easily sited and take fuller use of a given site, but obviously it would require many more such small scale projects, again causing concerns of land availability, and also introducing diseconomies of scale by forgoing the advantages inherent in larger scale projects. Further, a typical solar photovoltaic project has an annual capacity factor that is much less than that of a wood biomass plant. A reasonable estimate would be to assume that a wood biomass plant would have a capacity factor that is approximately 4 times that of a solar project. Using this assumption, as well as the 23 acres per megawatt datapoint that is based on the Company's experience with the SunEdison project, it would require 7,820 acres to construct enough solar generating capacity to equal the annual generation output of a single 85 MW wood biomass plant (85*4*23=7,820). Eighty-five MW is a relevant example, as it is a plausible project size under consideration as the Company contemplates repowering Dan

River Unit 3 to be a wood biomass facility. It should be noted that the 7,820 acres of the hypothetical solar project is approximately 20 times larger than the Dan River site of approximately 380 acres. Obviously, it is reasonable to assume that tracts of land comparable to the one imagined for this hypothetical solar project are not available in abundance if at all, may not be economical to purchase or lease, and may require substantial grading or clear cutting of forests to make it suitable for use as a solar project site.

All of these facts taken together, when considered in the context of the per-account cost limitations of Senate Bill 3, point to wood-fired biomass as a primary option for large scale resource development for REPS compliance purposes.

Q. HOW WOULD A LIMITING INTERPRETATION OF THE DEFINITION OF "BIOMASS RESOURCE" IMPACT THE COMPANY'S REPS COMPLIANCE STRATEGY AND RESOURCE INVESTMENT PLANS?

A. Duke Energy Carolinas would be forced to significantly alter its REPS compliance strategy, with respect to the general requirements set forth in G.S. 62-133.8(b), if the definition of "biomass resource" was interpreted as a matter of law to exclude all other wood fuel sources except for "wood waste". A limiting definition of "biomass resource" will likely increase cost, introduce additional fuel risk, and force the Company to either spend more incremental costs on biomass or consider more expensive resource options, thereby implicating the statutory per-account cost caps at an earlier stage.

As illustrated by the testimony of Company Witness Stewart, there is already limited "wood waste" supply in the marketplace, and such a limiting

interpretation would create an artificial premium for that supply. Even if collections of "wood waste" increase to a certain extent, the additional capital investment required of loggers and harvesting operations to collect that additional material will increase the cost of the "wood waste" product. Moreover, as "wood waste" is by definition a residual fuel source, any increase in the supply of that source would be subject entirely to the dynamics and fluctuations of the primary harvest market and the pulp, paper and housing industries that drive that market. Very simply, one can't collect residues from a logging harvest if that primary harvest doesn't occur.

Also, as the supply of "wood waste" will be geographically dispersed, risks and limitations related to economical transport of fuel will further constrain actual supply availability for existing and potential biomass facilities. Given the collection rates of "wood waste" identified by Company Witness Stewart, the fuel supply radius for a wood-fired biomass facility would have to be extended simply to provide enough fuel to run the facility. Depending upon the transport distances in relation to the generation facility sites, there may simply not be enough "wood waste" fuel available to support the relative needs at Company-owned or third party sites.

Q. HOW DOES A LIMITING INTERPRETATION OF "BIOMASS RESOURCES" POTENTIALLY IMPLICATE THE STATUTORY PER-ACCOUNT COST CAPS?

A. As I discussed above, wood-fired biomass is the most cost-effective, scalable renewable resource option currently available in North Carolina. A strict limitation on eligible wood biomass fuel would impact the cost of the qualifying

fuel resources, thereby reducing the cost-effectiveness of wood-fired biomass and limiting the potential for large-scale development. If wood-fired biomass were rendered less cost-effective by a restrictive fuel definition, the Company would have to consider other resources that may not have been cost competitive with wood-fired biomass under a broader, more inclusive definition of eligible fuel. By considering less cost-competitive resources out of necessity, the Company's incremental REPS costs of compliance will increase. Possible increases could be dramatic as, at present, there is not a ready substitute for wood-fired biomass in terms of actual megawatt-hour energy output, due to its baseload comparable capacity factors. Thus, even as other resources may become more cost competitive, those costs would likely have to be compounded due to the additional capacity the Company would likely need to be procure from other resource types to match the gross projected output of a wood-fired biomass plant. With these likely increases in incremental costs, the Company's compliance strategy will have to be adjusted accordingly to ensure that it does not exceed the incremental spending limitations of Senate Bill 3.

Q. **WHAT ADJUSTMENTS TO THE COMPANY'S RENEWABLE COMPLIANCE STRATEGY WOULD YOU FORESEE IF A LIMITING INTERPRETATION OF "BIOMASS RESOURCE" WAS IMPOSED?**

A. Although the Company firmly believes that a limiting interpretation of "biomass resource" is not the intent of Senate Bill 3, Duke Energy Carolinas has contemplated what the ramifications of a limiting interpretation might be, as the Company considers this to be a part of prudent planning for our compliance obligations. Under a more limiting definition of "biomass resource," Duke

Energy Carolinas would still evaluate and pursue opportunities to utilize wood biomass resources in our fossil stations, but the Company believes that the cost effective production from such projects would be materially constrained. Further, biomass opportunities from "Greenfield" projects with third parties would also face upward pressures on costs and also could be limited in cost effectiveness or availability. This would lead the Company to evaluate other alternatives. One such alternative would be to pursue additional solar projects.

There are many solar developers interested in doing business in the State, and the technology is mature. However, it should be noted that the solar set-aside requirements in 2021 (when the REPS obligation reach full maturity) is merely 1.6% of the total REPS obligation in terms of total megawatt hours (0.2% / 12.5% = 1.6%), so an expansion of solar activity beyond the set aside requirement would need to be quite aggressive in order to have any material impact. As noted above, there are significant questions about the ability to cost effectively develop large quantities of solar projects in the State, and it is our belief that an aggressive pursuit of vast quantities of solar energy would result in high cost projects, or may simply not be possible beyond a certain point due to a lack of large tracts of suitable land or rooftops. This would likely cause us to hit the Company's statutory per-account cost caps well before meeting the REPS energy targets, and would thus result in more fossil-fired generation to meet load than would otherwise be the case.

One other alternative strategy would be to pursue cost effective land-based wind projects from regions of the country that have abundant wind resources. Under Senate Bill 3, such projects could qualify as "in-state" if the electricity is

delivered into the State, which may be achievable through contracts for transmission from other regions. This strategy is one that the Company is not currently pursuing, although Duke Energy Carolinas is routinely approached by wind developers and transmission providers that claim to be able to deliver cost effective projects with this strategy. Such projects would likely entail some pricing risks, and transmission availability could be a constraint. The Company also believes that meeting our "in-state" REPS requirements with projects that are either within our service area or within the boundaries of North Carolina are more appropriate methods of compliance and more in the interests of our customers and communities. However, if scalable "in state" resources such as wood biomass are constrained in their usefulness for REPS compliance, Duke Energy Carolinas will need to assess the viability of other, less attractive, compliance options such as this.

Q. **IS A LIMITING INTERPRETATION OF "BIOMASS RESOURCE" CONSISTENT WITH THE INTENT AND GOALS OF SENATE BILL 3?**

A. No. A limiting interpretation of the definition of "biomass resource" will stifle the development of an important renewable resource in this State by effectively capping the potential of biomass as a significant source of carbon neutral REPS-compliant generation and economic development in North Carolina.

As discussed above, an exclusive definition of "biomass resource" will likely increase incremental cost per REC, thereby reducing the number of RECs that can be procured under the statutory limitations of the cost caps. The cost caps may provide an off-ramp for compliance purposes, but they do not reduce overall system-wide demand for energy. As such, for every megawatt-hour of

renewable energy that is not procured for REPS compliance due to the invocation of the cost caps, Duke Energy Carolinas must generate or procure a corresponding megawatt-hour of non-incremental, likely non-renewable, energy from its other system resources to meet demand. In this way, the elimination of cost-effective renewable options for Duke Energy Carolinas will only lead to continued use of fossil generation to provide energy that could be delivered from a renewable resource.

Q. SHOULD THE DEFINITION OF "BIOMASS RESOURCE" IN G.S. 62-133.8 BE INTERPRETED TO INCLUDE WOOD FUEL OTHER THAN "WOOD WASTE"?

A. Yes, a broad, inclusive interpretation of "biomass resource" is appropriate and consistent with the intent and letter of Senate Bill 3. Senate Bill 3 was intended to be a vehicle for the development of renewable resources in North Carolina and to interpret the definition of "biomass resource" to exclude a resource so fundamental to the achievement of the State's renewable energy potential would contravene the basic purpose of the law.

Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. Yes.

BEFORE THE NORTH CAROLINA UTILITIES COMMISSION

DOCKET NO. E-7, SUB 939
DOCKET NO. E-7, SUB 940

In the Matter of the Registration Statements of Buck and Lee Steam Stations as Renewable Energy Facilities Pursuant to Commission Rule R8-66	)	**DIRECT TESTIMONY OF TRACY BEER**

Q: PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A: My name is Tracy Beer, and my business address is 526 South Church Street, Charlotte, North Carolina.

Q: WHAT IS YOUR POSITION WITH DUKE ENERGY CORPORATION?

A: I am Renewable Energy Strategy Manager within the Renewable Strategy and Compliance for Duke Energy Corporation ("Duke Energy").

Q: PLEASE BRIEFLY SUMMARIZE YOUR EDUCATIONAL BACKGROUND AND PROFESSIONAL AFFILIATIONS.

A: I received a Bachelor of Science and a Master of Science in Civil Engineering from Clemson University. I am a registered Professional Engineer in North and South Carolina.

Q: PLEASE DESCRIBE YOUR BUSINESS BACKGROUND AND EXPERIENCE.

A: I joined Duke Energy Corporation in 1997 as an Associate Engineer in the Environmental Engineering group. I have also held positions in Environmental Policy and Environmental Strategy. I have held my current position as Manager of Renewable Energy Strategy since November 2007.

Q: WHAT ARE YOUR RESPONSIBILITIES IN YOUR CURRENT POSITION?

A: I support the development and execution of strategies and compliance plans related to renewable energy for Duke Energy Carolinas. I am primarily responsible for project development and commercial execution of Company-owned biomass projects, including fuel supply. I have also been involved in development of Duke Energy Carolinas-owned solar and wind projects as well as evaluation of third party renewable energy projects.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?

A. The purpose of my testimony is to (1) describe the test burns and production trials conducted at Buck and Lee Steam Stations in 2009; (2) describe the Company's plan for biomass development; and (3) the practical impact of a limiting interpretation of "biomass resource", as defined in G.S. 62-133.8, on the Company's plan for investment in biomass. I will also describe the information included in the registration statements filed in this docket for Buck and Lee Steam Stations pursuant to Commission Rule R8-66.

Q. PLEASE DESCRIBE THE CO-FIRING TEST BURNS CONDUCTED AT BUCK AND LEE STEAM STATIONS IN 2009.

A. Lee Steam Station is a thermal electric generating station located in Williamson, South Carolina with a total maximum net dependable capacity ("MNDC") of 370 MW. A biomass co-firing production trial began at Lee in July of 2009, and continued through the end of last year, to evaluate the use of wood as a fuel for energy production in combination with coal. This trial generated approximately 1,303 megawatt-hours of energy, which would result in the generation of approximately 1,303 corresponding biomass Renewable Energy Certificates ("RECs"). For the co-firing test burns, Duke

Energy Carolinas blended coal with three-quarter inch sized wood chips to accommodate the requirements of the boilers at the facility.

Buck Steam Station is a thermal electric generating station located in Salisbury, North Carolina with a total MNDC of 369 MW. Similar to Lee, woody biomass co-firing test burns were conducted at this facility between August 17 and September 9, 2009. This test burn generated 2,254 megawatt-hours of energy, resulting in the creation of 2,254 corresponding biomass RECs. At Buck, the test was conducted in two phases using two wood biomass fuel types. First, the coal was blended with sawdust. In the second phase, the coal was blended with one-half inch sized wood chips for the test burns, again to accommodate the operational specifications of the facility's boilers.

Q. WHAT WERE THE SOURCES OF THE WOOD FUEL FOR THE TEST BURNS AT BUCK AND LEE?

A. For the test burns at Buck, the Company sourced the sawdust from an aggregator who obtained the material from local sawmills. The wood chips were derived from trees harvested during an on-site ash basin land clearing project. The ash basin project was planned prior to the biomass co-firing test and was unrelated to the biomass co-firing test. The fuel was chipped on-site to meet the specifications for the facility. For the production trial at Lee, the Company sourced the wood fuel from a local logger who produced the material using standard in-woods chipping processes and equipment consistent with typical forestry practices.

Q. WAS THE LAND CLEARING PROJECT AT BUCK SPECIFICALLY AUTHORIZED AND COMPLETED TO HARVEST FUEL FOR THE BUCK TEST BURNS?

A. No. The land clearing project at Buck was previously authorized as part of an unrelated ash basin construction and renovation project. The land would have been cleared if the Buck test burns had not been conducted.

Q. IF THE TEST BURNS HAD NOT BEEN CONDUCTED AT BUCK, WHAT WOULD DUKE ENERGY CAROLINAS HAVE DONE WITH THE HARVESTED WOOD?

A. The contractor performing the ash basin project likely would have burned the wood on-site, transported it to landfill for disposal, or possibly sold the wood into the market.

Q. WOULD YOU CHARACTERIZE THE WOOD USED FOR THE BUCK TEST BURNS AS WASTE?

A. Yes.

Q. WHAT ARE DUKE ENERGY CAROLINAS' PLANS FOR BIOMASS DEVELOPMENT ACTIVITIES IN 2010?

A. The Company intends to build upon the operational experience gained from the 2009 biomass runs and further develop the biomass fuel supply procurement to produce bankable RECS for compliance with the 2012 NCREPs requirement. At the time of submittal of this testimony, the company is conducting an additional co-firing test of one unit at Buck and conducting a full co-firing production run on all three units at Lee. An additional co-firing test burn is being planned for Allen Steam Station. Duke Energy Carolinas will also continue its phased internal technical assessments and economic evaluations regarding potential development of biomass resources through co-firing and repowering projects. The Company-owned biomass implementation strategy is a multi-year effort that has begun with smaller co-firing projects and will, if successful, build

towards long-term repowering projects. At full implementation and build-out, Duke Energy Carolinas-owned "brownfield" biomass projects are expected to produce over 1 million RECs annually.

Q. WHAT SOURCES OF WOOD FUEL DOES DUKE ENERGY CAROLINAS INTEND TO USE IN ITS FACILITIES?

A. Duke Energy Carolinas intends to use those cost-effective wood fuels qualifying as "biomass resources" under Senate Bill 3. Under the statute, Commission Rules and relevant orders on the registration statements of other renewable energy facilities, the Company believes that a variety of wood products may be used to generate energy and RECs to meet its REPS compliance obligations. As a matter of prudency and out of the abundance of caution given the uncertainty arising out of the proceedings in this docket, however, the wood fuel procured for the test burns and production runs in 2010 will all qualify as "wood waste".

In December 2009, the Company issued a Request for Information ("RFI") for Biomass Fuel Supplies and received 26 responses for a variety of biomass resources. The predominant biomass fuel that was offered was derived from whole tree chips. The results of the RFI support and reinforce our belief that a limiting interpretation of "biomass resource" in a manner that would not include wood chips from whole trees would materially constrain the Company's biomass opportunities.

Q. CAN THE COMPANY USE "ENERGY CROPS" TO MEET THE WOOD FUEL NEEDS TO SUPPORT ITS BIOMASS IMPLEMENTATION PLANS?

A. No, at least not at the present time. Energy crops, which are plants, trees and other crops planted specifically for use as energy fuel, are simply not presently available in the

marketplace in quantities to sustainably support any type of biomass operations within Duke Energy Carolinas service territory. For energy crops to be a viable fuel source, potential developers first need operational facilities with a demonstrated and projectable appetite for such fuel. It presents a "chicken and egg"-type dilemma for energy crop development in that facility investments will require a dedicated fuel source to support the production necessary to generate the energy and revenue to make the investment economical, while fuel investments, especially for energy crops which have variable growing periods, will need off-take commitments from generation facilities to support any financing relating to such investments. Essentially, for energy crop development to take place in areas that can economically serve North Carolina, there need to be more operational biomass facilities sending signals to the market that they need long-term fuel supply.

As part of its biomass implementation strategy, Duke Energy Carolinas continues to explore strategies including possible cultivation of perennial energy crops and trees planted and managed for biomass production as well as contracted supply arrangements with developers for such crops and trees. Energy crops are a qualifying "biomass resource" under Senate Bill 3 and the Company fully intends to economically use such resources once they are viable and available. However, because most land within our service territory is held in small tracts by private landowners, it is unlikely that perennial energy crops could serve as the sole fuel source for a biomass generation project. Furthermore, perennial energy crops are physically and chemically different from woody biomass and have different operational impacts on boilers and other plant systems. They also require different fuel handling systems. These differences must be accounted for in

the design and engineering of the biomass project. As such, energy crops are best suited to repowering projects because those boilers would be retrofitted specifically for biomass fuels and would be capable of accepting a wider variety of biomass fuel sources.

Q. WILL DUKE ENERGY CAROLINAS' BIOMASS IMPLEMENTATION PLANS AND STRATEGY CHANGE IF THE DEFINITION OF "BIOMASS RESOURCE" IS INTERPRETED TO EXCLUDE ALL OTHER WOOD PRODUCTS EXCEPT "WOOD WASTE"?

A. Yes. If only "wood waste" qualifies as a "biomass resource", Duke Energy Carolinas will not likely pursue its Company-owned biomass strategy to full implementation. As such, it will be forced to pursue alternative, less cost-effective resources to satisfy its energy and REC needs to meet the Company's near term and long term REPS compliance obligations.

Q. PLEASE EXPLAIN WHY A LIMITING INTERPRETATION OF "BIOMASS RESOURCE" TO EXCLUDE ALL WOOD RESOURCES EXCEPT "WOOD WASTE" WOULD HAVE SUCH A SIGNIFICANT IMPACT ON DUKE ENERGY CAROLINAS' PLANS.

A. A limiting interpretation of eligible wood "biomass resources" would have a significant impact on Duke Energy Carolinas' plans because it will drastically reduce the amount of available fuel, reduce (and in some cases, completely eliminate) the economic benefit of the planned investments to the Company and its customers and cause the Company to seek additional, less cost-competitive avenues for REPS compliance. Specifically, repowering projects are less likely to be implemented. As described by Company Witness Stewart, in today's marketplace, only approximately 6% of forest residues are

collected within our service area. Most are left at the harvest site because they are considered uneconomic to transport and have low quality for utilization due to size, dirt, and bark content. Using Witness Stewart's assessment of residues available to Duke Energy Carolinas under a limited interpretation of "biomass resources" as a guide, the Company estimates that limiting eligible wood fuel to "wood wastes" would result in more than a projected 80% reduction in Renewable Energy Certificates ("RECs") produced by Company-owned "brownfield" assets. In terms of actual REC totals, this would reduce the Company's projected totals at full implementation from more than 1 million RECs to approximately 220,000 RECs. This result is based upon Company Witness Stewart's estimate of 275,000 tons of residue material available to Duke assuming maximum residue collection rate of 50%, and the assumption that approximately 25% of residues would be available to Duke Energy Carolinas. The Company estimates that for every $10/MWhr, or per REC, of premium replacement cost for these RECs, the Company will incur an additional $8 million per year in REPS compliance costs.

A limiting interpretation of "biomass resource" to exclude all other wood sources except "wood waste" may create a premium for these qualifying residue materials which would incentivize increased collection and utilization. However, even assuming aggressive adoption by loggers, utilization will never be 100%, as illustrated by the analysis contained within Stewart Exhibit 2 and as described in greater detail in the testimony of Company Witness Stewart. The maximum adoption rate has been assumed to be 50% by both the authors of Stewart Exhibit 2 and Company Witness Stewart, so even considering the aggressive projected adoption and collection rates for forest

residues, under a limited interpretation of "biomass resource", eligible wood fuel supply will still be constrained.

Supply constraints will both limit the potential for the Company's development of wood-fired biomass resources due to availability and cost. Naturally, if there isn't enough fuel supply, those supply resources that are available will become more costly. Market participants will be forced to expand the sourcing area and bear increased fuel transportation risks and/or seek RECs from alternative resources that have become more cost competitive with wood biomass due to the cost pressures described above. Under a limiting interpretation of "biomass resource", wood biomass as a potential resource for development becomes less and less economic, and the cost-effective benefits to Duke Energy Carolinas' customers are lost.

Q. HAS DUKE ENERGY CAROLINAS PROVIDED ALL INFORMATION AND DOCUMENTATION REQUIRED BY COMMISSION RULE R8-66 TO SUPPORT THE APPROVAL OF THE REGISTRATION STATEMENTS FOR LEE AND BUCK?

A. Yes, the registration statements filed with the Commission pursuant to Commission Rule R8-66 for Lee and Buck include all of the information necessary to support their approval under the Rule. The registration statements for Lee and Buck include all of the relevant background and operation information set forth in R8-64(b)(1)(i) – (v) and (xi). The registration statements for Lee and Buck also include the relevant Form 923 EIA data for the respective facilities, and both statements included certifications from Carol Goolsby, Vice President, Regulated Renewables and Hydro Generation, Duke Energy Carolinas, attesting to the fact that the facilities were in substantial compliance with State and

federal laws, regulations, and rules for the protection of the environment and conservation of natural resources; that the facilities will be operated as "renewable energy facilities"; and that the RECs associated with these facilities sold to any electric power supplier will not be re-marketed or re-sold. Finally, the registration statements for Lee and Buck were executed by Ms. Goolsby and contained additional certifications consenting to the auditing of the Company's books and records by Public Staff and the Commission.

Public Staff, in letters filed with the Commission on March 8 and March 12, respectively, recommended that the registration statements filed by Duke Energy Carolinas for Lee and Buck be deemed complete, accepted by the Commission, and the respective facilities should be approved as a new renewable energy facilities under Commission Rule R8-66.

Q. DOES THIS CONCLUDE YOUR PRE-FILED DIRECT TESTIMONY?

A. Yes.

BEFORE THE NORTH CAROLINA UTILITIES COMMISSION

DOCKET NO. E-7, SUB 939
DOCKET NO. E-7, SUB 940

In the Matter of the Registration Statements of Buck and Lee Steam Stations as Renewable Energy Facilities Pursuant to Commission Rule R8-66	)	**DIRECT TESTIMONY OF PETER STEWART**

Q: PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A: My name is Peter Stewart, and my business address is 14045 Ballantyne Corporate Place, Charlotte, North Carolina.

Q: BY WHOM ARE YOU EMPLOYED AND WHAT IS YOUR POSITION?

A: I am President and Chief Executive Officer of Forest2Market, an international forestry industry analyst group.

Q: PLEASE BRIEFLY SUMMARIZE YOUR EDUCATIONAL BACKGROUND AND PROFESSIONAL AFFILIATIONS.

A: I received a Bachelor degree in Forestry from Texas A&M University and a Masters degree in Forest Economics from the University of Georgia. I am a board member and executive committee member of the Forest Resources Association, an industry trade association that represents landowners, wood suppliers and forest product manufacturers.

Q: PLEASE DESCRIBE YOUR BUSINESS BACKGROUND AND EXPERIENCE.

A: I started Forest2Market in 2000, after more than ten years working in the commercial forestry industry, to provide market price and industry trend information for the forest, wood products and bioenergy industries. Forest2Market is a neutral and independent

third-party reporting service providing forestry market and industry data analysis to the full range of participants in the forest products and resources marketplace. Our customers include the majority of the traditional forest products companies (pulp, paper, lumber and panel manufacturers), investor and private landowners, and domestic and foreign bioenergy companies. Our Delivered Raw Material Price Benchmark data contains price and volume details for 80% of the wood fiber transactions conducted in the U.S. South and approximately 60% of the wood fiber transactions in the Pacific Northwest.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?

A. The purpose of my testimony is to provide the North Carolina Utilities Commission with the results of Forest2Market's analysis of the harvested "wood waste" biomass fuel supply within the potential procurement area for Duke Energy Carolinas and to describe the practical impacts of a limiting definition of "biomass resource", excluding all wood fuel products except "wood waste", on Duke Energy Carolinas' ability to use wood-fired biomass for North Carolinas Renewable Energy and Energy Efficiency Portfolio Standard ("REPS") compliance purposes.

Q. PLEASE DESCRIBE THE EXHIBITS TO YOUR TESTIMONY.

A. My testimony includes two exhibits: Stewart Exhibit No. 1 outlines the Duke Energy Carolinas' Potential Procurement Area for wood biomass fuel supply. Stewart Exhibit No. 2 is a copy of "The Effect of Policy-based Bioenergy Demand on Southern Timber Markets: A Case Study of North Carolina," by Robert C. Abt, et al, which is a report, published in February 2010, based on research conducted on the topic of forest biomass supply availability in North Carolina.

Q. HOW WOULD FOREST2MARKET DEFINE "WOOD WASTE" IN A BIOENERGY CONTEXT?

A. For purposes of my analysis, I refer to those materials that would generally qualify as "wood waste", meaning limbs, tops, harvest slash and residues, non-commercial thinnings and other byproducts or residual wood resulting from forest management activities, as "forest residues." "Wood waste" can also include residual materials from wood processing operations like sawdust and trimmings, as well as finished, unadulterated wood products like pallets. These processing residues are not included in this analysis as they are not available in significant volumes in the marketplace due to the fact that they are generally already used to support existing manufacturing and industrial operations. Based on my experience and knowledge of the marketplace, "forest residues" represents the most significant potential source of wood fuel from those materials that could be characterized as "wood waste" for bioenergy purposes.

Q. HOW HAVE YOU CALCULATED THE TOTAL FOREST RESIDUES INVENTORY DATA FOR THE DUKE ENERGY CAROLINAS SERVICE TERRITORY?

A. Forest residues are a by-product of timber harvest. Forest residues inventory data was derived from a combination of Forest2Market consumption data and the mathematical relationship between the volume of logs harvested and the volume of in-woods biomass that is recoverable. The most accurate way to measure the total potential forest residues available to the market is to calculate the residual material associated with a harvest.

Q. WHAT IS THE TYPICAL RATIO OF FOREST RESIDUES TO MERCHANTABLE TIMBER AVAILABLE FOLLOWING A TIMBER HARVEST?

A. Forest2Market internal research and analysis, corroborated by recent industry literature and our institutional timberland owner customers, indicates that the ratio of forest residues to merchantable timber is approximately 1:7; meaning that 1 ton of in-woods forest residues are available per 7 tons of stem material (trees) in any given harvest. In other words, the annual quantity of available forest residues is, on average, 14% of the annual quantity of harvested merchantable forest material, if 100% of the residues were collected. This ratio represents the maximum percentage of in-woods forest material that could be considered "wood waste" under a more restrictive definition of "biomass resources" under Senate Bill 3. This relationship is likely to be slightly higher for hardwood and natural stands and lower for pine stands and plantation stands, and these numbers do vary based on harvest terrain, forest type, species, age and size. This ratio, multiplied by percentage of harvest volume where associated forest residues might be chipped, yield the potential supply of this material.

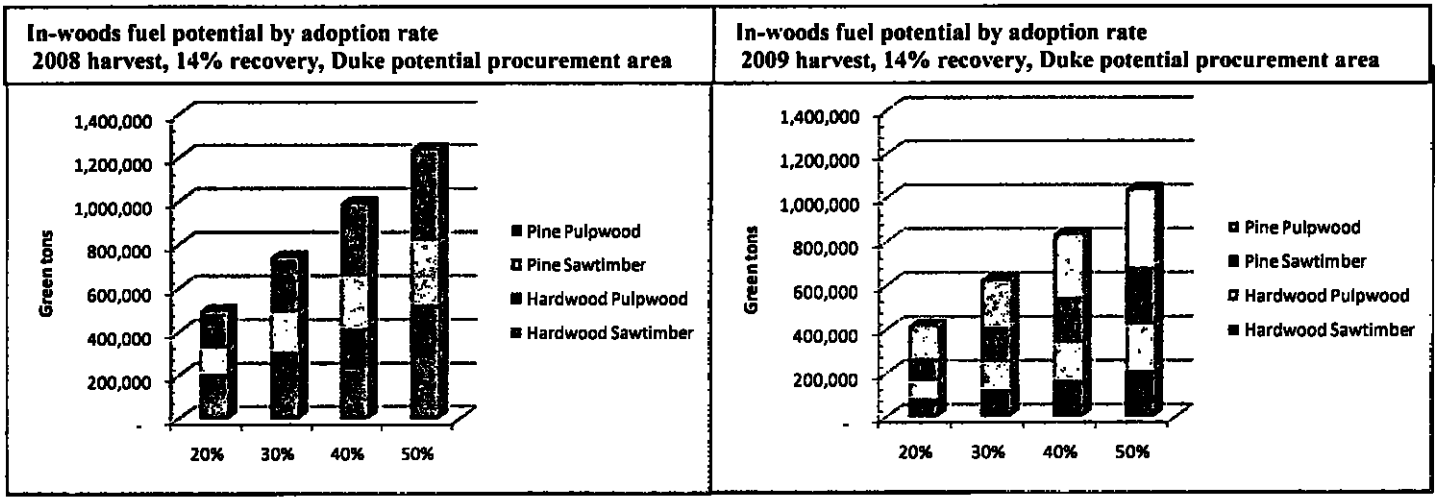
Q. HOW MUCH FOREST RESIDUE MATERIAL IS ACTUALLY COLLECTED TODAY?

A. My analysis estimates that due to the lack of a viable market for these products, less than 6% of available forest residue material is actually collected today within Duke Energy Carolina's potential procurement area, as illustrated in Stewart Exhibit 1. Statewide, the average collection rate is approximately 14%. The reason for the difference is because approximately 61% of the forest residues collected in 2009 were collected from the

Northeast Coastal counties – outside of Duke Energy Carolinas' potential procurement area and where the North Carolina pulp and paper industry has a strong presence. Across the rest of North Carolina, the lack of a market for this fuel does not create any economic incentive or market signal to logging crews to invest in the equipment necessary to collect, chip and transport this material. The speed of adoption by loggers will directly affect the market availability of this fuel.

Stewart Table 1 set forth below illustrates the tons of forest residues available as logger adoption rates increase. As stated above, Forest2Market currently estimates that loggers collect only 6% of available forest residues from harvest sites within Duke Energy Carolina's potential procurement area. I estimate that the logger adoption rate of residue collection will approach 50% over time, as markets for this material become more robust, however any increase in logger adoption rates related to forest residues collection is subject to numerous variables and the relative strength of the primary timber harvest market. A 50% adoption rate means that the top volume logging crews within the supply area, which would cumulatively harvest approximately 50% of the available forest material, have begun collection, processing and transportation of forest residues. The adoption rate is capped at 50% predominately because we believe the economic return on the investment necessary to buy the collection and delivery equipment needed to move the material to a market will not be present for most loggers.

Stewart Table 1



	2008 in-woods potential by harvested timber type Harvested Area = Duke Energy Potential Procurement Zone				2009 in-woods potential by harvested timber type Harvested Area = Duke Energy Potential Procurement Zone			
Adoption	Hardwood Sawtimber	Hardwood Pulpwood	Pine Sawtimber	Pine Pulpwood	Hardwood Sawtimber	Hardwood Pulpwood	Pine Sawtimber	Pine Pulpwood
20%	114,359	96,819	117,086	167,139	85,978	83,015	105,974	139,886
30%	171,539	145,229	175,629	250,708	128,967	124,523	158,961	209,829
40%	228,719	193,638	234,172	334,277	171,956	166,031	211,947	279,772
50%	285,898	242,048	292,715	417,847	214,944	207,538	264,934	349,715

It is important to note the volumes of available forest residues shown, span the entire Duke Energy Carolinas potential procurement area, as illustrated in Stewart Exhibit 1. Not all of this material can be delivered to any single Duke Energy Carolinas biomass generation facility at an economical rate nor can it be expected that Duke Energy Carolinas could procure 100% of the material. For practical purposes, we would assume that Duke Energy Carolinas would have access to 25% of the material, or approximately 275,000 tons of material annually, based on the average of available supply from 2008 and 2009. A maximum economical truck haul distance for forest residues is less than 80 miles. Per ton truck haul rates for forest residues ranges between $0.10 and $0.17 per ton mile. For every 10 additional delivery miles, the cost of wood fuel increases $1.70 per ton.

Q. WHAT WERE THE GEOGRAPHIC BOUNDARIES OF THE POTENTIAL FUEL SUPPLY AREA FOR THE ANALYSIS?

A. My analysis estimated the wood supply potentially available to Duke Energy Carolinas based on data for the counties of North Carolina and South Carolina within the Duke Energy service territory and counties of North Carolina, South Carolina, Virginia and Georgia outside the service territory and within an economic haul distance of a Duke Energy Carolinas generation facility. These counties are shown and referred to as the potential procurement area in Stewart Exhibit 1.

Q. HAVE YOU REVIEWED THE BIOMASS FUEL SUPPLY ESTIMATES SET FORTH IN THE LA CAPRA REPORT SUBMITTED TO THE COMMISSION IN 2007?

A. Yes, the 2006 technical evaluation conducted for the North Carolina Utilities Commission by La Capra Associates, GDS Associates and Sustainable Energy Advantage is often cited as a source of information about available forest biomass fuel in North Carolina.

Q. DO THE FOREST BIOMASS FUEL ESTIMATES IN LA CAPRA REPORT ACCURATELY REFLECT THE SUPPLY OF FOREST RESIDUES IN NORTH CAROLINA, AND THE POTENTIAL PROCUREMENT AREA?

A. Based on my analysis, La Capra's assessment of the amount of forest residues that would be practically available on an annual basis in North Carolina is substantially inflated. In 2006, La Capra estimated the availability of forest residues in North Carolina, on an annual average basis, to be 7,910,736 green tons. By comparison, in 2009, the total number of green tons harvested in North Carolina was 16,235,644 according to

Forest2Market's Delivered Price Benchmark, which cross-references information from both mills and suppliers. When the total number of green tons harvested in 2009 are compared to La Capra's annual average estimates for available green tons of forest residues, the recovery rate equates to approximately 48.7%. The data source for the 2006 La Capra estimates is unclear; thus, the most recent 2009 annual harvest data is used here for comparison. This comparison of the 2006 La Capra annual average estimates of available forest residues to the 2009 total harvest is shown below in Stewart Table 2.

Stewart Table 2

La Capra Study Estimate of Harvest-Related Forest Residues Wood Fuel		
	Green Tons*	**Dry Tons***
Softwood	3,788,610	1,894,305
Hardwood	4,122,126	2,061,063
TOTAL	**7,910,736**	**3,955,368**
Total tons harvested in NC in 2009	**16,235,644**	**8,117,822**
La Capra harvest-related forest residues as a percentage of 2009 total harvest	**48.7%**	

Thus, if we follow the projected annual average forest residue supply resources set forth by La Capra, just under 1 ton of harvest-related forest residue would be available for renewable energy production for every 2 tons of stem material harvested in 2009 in North Carolina. Based on Forest2Market's market analysis and experience, this number is substantially inflated. As stated above, my analysis estimates the theoretical availability of residues is 14 percent of total harvest, if 100% of are collected (1 ton of biomass for each 7 tons of stem material). This ratio is reduced to 7% when a more realistic projected logger adoption collection rate of 50% is applied. In reality, the actual volume of residues collected in 2009 in North Carolina was 305,918 green tons, or 2% of

the 2009 harvest. The La Capra estimate for annual average forest residue volumes is nearly 26 times the actual collection volume in 2009 and nearly seven times more than Forest2Market's estimated collection volumes under the practical ceiling for logger adoption rates. Table 3 below compares the ratio of available forest residues to total harvest and the volume of forest residues in North Carolina using both the La Capra and Forest2Market methods.

Stewart Table 3

	La Capra	Forest2Market		
	2006 Estimate Compared to 2009 Harvest	100% Collection of 2009 Harvest	50% Collection of 2009 Harvest	Actual 2009 Collection Rates
Ratio of Residues as Compared to 2009 Total Harvest	48.7%	14%	7%	2%
Volume of Residues (Green Tons)	7,910,736	2,272,990	1,136,495	305,918

Q. ARE YOU FAMILIAR WITH THE RECENT BIOMASS FUEL SUPPLY STUDY CONDUCTED BY NORTH CAROLINA STATE UNIVERSITY?

A. Yes. The research conducted on the topic of forest biomass availability in North Carolina, "The Effect of Policy-based Bioenergy Demand on Southern Timber Markets: A Case Study of North Carolina," by Robert C. Abt et al, ("NC State Study") provides reasonable estimates of current forest-related biomass availability. The methodology of the NC State study is transparent and its process for determining practically available biomass can be evaluated according to forestry industry standards. The NC State Study is attached hereto as Stewart Exhibit 2.

Q. DO YOU AGREE WITH THE CONCLUSIONS REACHED BYTHE NC STATE STUDY AUTHORS RELATING TO AVAILABLE FOREST RESIDUE SUPPLY?

A. Yes, Forest2Market agrees with the conclusion that forest residues could not supply enough fuel to allow utilities to meet the REPS in the short term or long term. The NC State Study estimate collection and utilization rates that are consistent with current market conditions, with gradual projected increases over time, starting at 10% for pine and 8% for hardwoods in 2012, and assuming that higher utilization rates will be observed only after higher pricing provides an incentive for loggers to improve efficiency. The NC State Study's utilization rate peaks at 66% for pine and 50% for hardwoods in 2025, staying at that level through the end of its projection. The methodology used by the Study is consistent with that applied by Forest2Market in its supply analysis.

Forest2Market does differ with the Study with respect to our opinion of how practical or cost effective it will be to harvest non-growing stock, or small, non-merchantable trees, which the Study estimates at 60% of the total available biomass. For this reason, Forest2Market's overall assessment of the total potential fuel supply is more conservative than that reached by the Study.

Q. BASED ON YOUR ANALYSIS, WILL THE PROJECTED FOREST RESIDUES SUPPLY ALONE SUPPORT DUKE ENERGY CAROLINAS' PLANNED CO-FIRING AND REPOWERING PLANS?

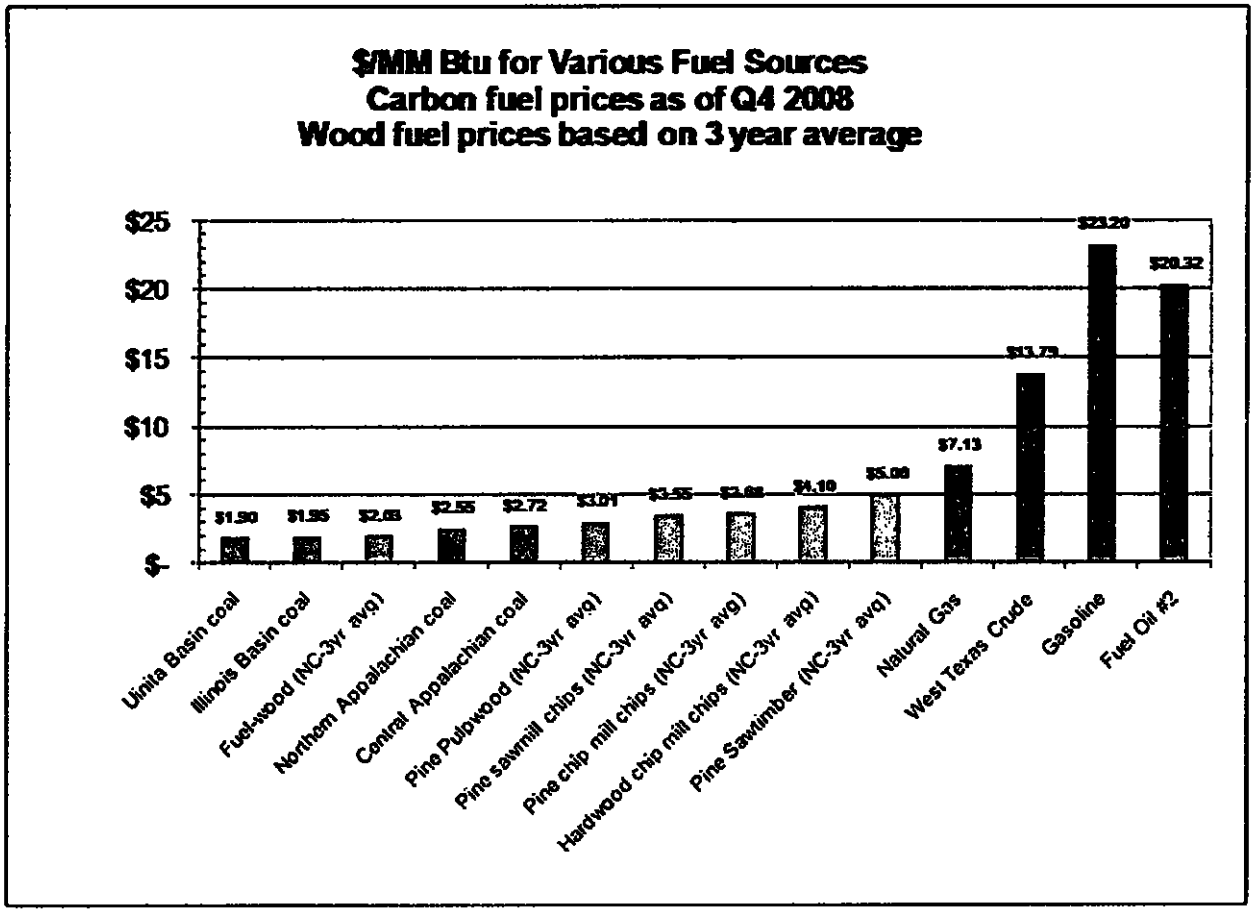
A. No, the volume of forest residues available in the projected procurement area will simply not support the fuel needs of Duke Energy Carolinas' co-firing or repowering generation projects. The sustained availability of forest residues depends entirely upon increased

collection and utilization rates from loggers and sustained forest primary harvest volumes to support the lumber and pulp and paper industries. Currently, strong collection and utilization rates simply do not exist, and the two industries that drive the primary timber harvests in this State, housing and pulp/paper, are under economic duress, thereby significantly reducing demand due reduced operational capacity.

Q. IF ADDITIONAL HARVESTED WOOD FUELS ARE ELIGIBLE TO BE USED AS "BIOMASS RESOURCES", WOULD BIOENERGY FACILITIES COMPETE WITH THE LUMBER, PULP AND PAPER INDUSTRIES FOR FUEL?

A. The eligibility of all harvested wood as a "biomass resource" under Senate Bill 3 should not result in direct competition between bioenergy facilities and the softwood lumber and plywood industries due to the simple issue of cost. Based on my analysis of the delivered cost of various wood fuel sources, only the pulpwood fuel market is likely to be impacted by an interpretation of "biomass resource" that includes harvested wood other than forest residues. Stewart Table 4 set forth below compares the 3 year average delivered price of timber products against carbon based fuel costs. Results are shown in dollars per million BTU's.

Stewart Table 4



Pine sawtimber at $5.06 per MMBtu is the most expensive wood fuel source available; selling on a Btu basis at a 20% premium to hardwood chip mill chips ($4.10/MMBtu) and a 40% premium to pine pulpwood ($3.01/ MMBtu). Private landowners, who own 87% of the land in forestry in North Carolina, are not likely to sell sawtimber at lower pulpwood (small trees) prices. Given the constraints of the per-account cost caps relating to each utility's renewable energy procurement under Senate Bill 3, the utilities will also not have the appetite for higher prices for fuel that sawtimber and hardwood chips will demand in the marketplace.

Q. IF ADDITIONAL HARVESTING OCCURS AS A RESULT OF A BROAD INTERPRETATION OF "BIOMASS RESOURCE", ALLOWING USE OF ADDITIONAL HARVESTED WOOD FUEL FOR REPS COMPLIANCE, WILL NORTH CAROLINA'S FOREST RESOURCES BE DEPLETED?

A. Based on the latest annual growth to drain ratios for North Carolina's forest inventory, the State's resources in the projected procurement area could support significant additional harvesting and still produce more trees than are harvested. A comparison of the rate at which wood is produced in the forest and the rates at which it is destroyed by natural causes or removed by man, referred to as growth to drain ratio, should be the most important feature of any forest inventory. It provides a measure of under-utilization or overexploitation of a forested area. If overexploitation persists, destruction of the forest and loss of future production will follow. On the other hand, under-utilization indicates failure to make full use of the productive power of the forest soil.

The United States Forest Service within the Department of Agriculture conducts routine analysis of forest growth and drain, making the results available in its online database. Utilizing this database, the growth removal ratios for the Duke Energy Carolinas' potential procurement area were evaluated by softwood and hardwood species. The results are illustrated in Stewart Table 5 below and reveal the potential procurement area has an under-utilized forest.

Stewart Table 5

Micromarket 3 (MM 3) has a harvest ratio of 47% softwood species and 53% hardwood species. Overall growth to removal ratio (GRR) for MM 3 is positive at 1.24 (1.10 for softwood species and 1.36 for hardwood species). All 6 micromarkets and the Western Counties area have underutilized forests inventories with GRRs ranging for 1.18 to 2.86.

	Softwood		Hardwood		
Micromarket	HA Species Ratio	FIA Growth-Removal Ratio	HA Species Ratio	FIA Growth-Removal Ratio	HA Growth-Removal Ratio
3	0.47	1.10	0.53	1.36	1.24
5	0.55	1.08	0.45	1.32	1.18
6	0.55	1.08	0.45	1.32	1.18
7	0.66	1.20	0.34	1.40	1.27
8	0.66	1.20	0.34	1.40	1.27
10	0.77	1.31	0.23	1.45	1.35
Western Counties	0.27	2.29	0.73	3.07	2.86

All 6 micromarkets and the Western Counties area in the Duke Energy Carolinas project procurement area have underutilized forests inventories with growth to drain ratios ranging for 1.18 to 2.86 (a ratio over 1.0 indicates the forest is growing faster than it is being harvested or destroyed naturally). Two eastern wood basins (micromarkets 5 and 7) within an economical haul distance of the Buck Steam Station also have positive growth to drain values, as shown in the above table. Based on this data, concerns regarding actual depletion of the State's forest resources through increased harvesting activities appear unfounded.

Q. DOES THIS CONCLUDE YOUR PRE-FILED DIRECT TESTIMONY?

A. Yes.

Docket No. E-7, Subs 939 and 940

Stewart Exhibit 1

Duke Energy Carolinas Potential Procurement Area

Quantification of wood supply potentially available to Duke Energy was estimated based on data for the counties of North Carolina and South Carolina within the Duke Energy service area and counties of North Carolina, South Carolina, Virginia and Georgia outside the service area and within an economic haul distance of a Duke Facility. These counties are shown below and referred to in this document as the "Potential Procurement Area".

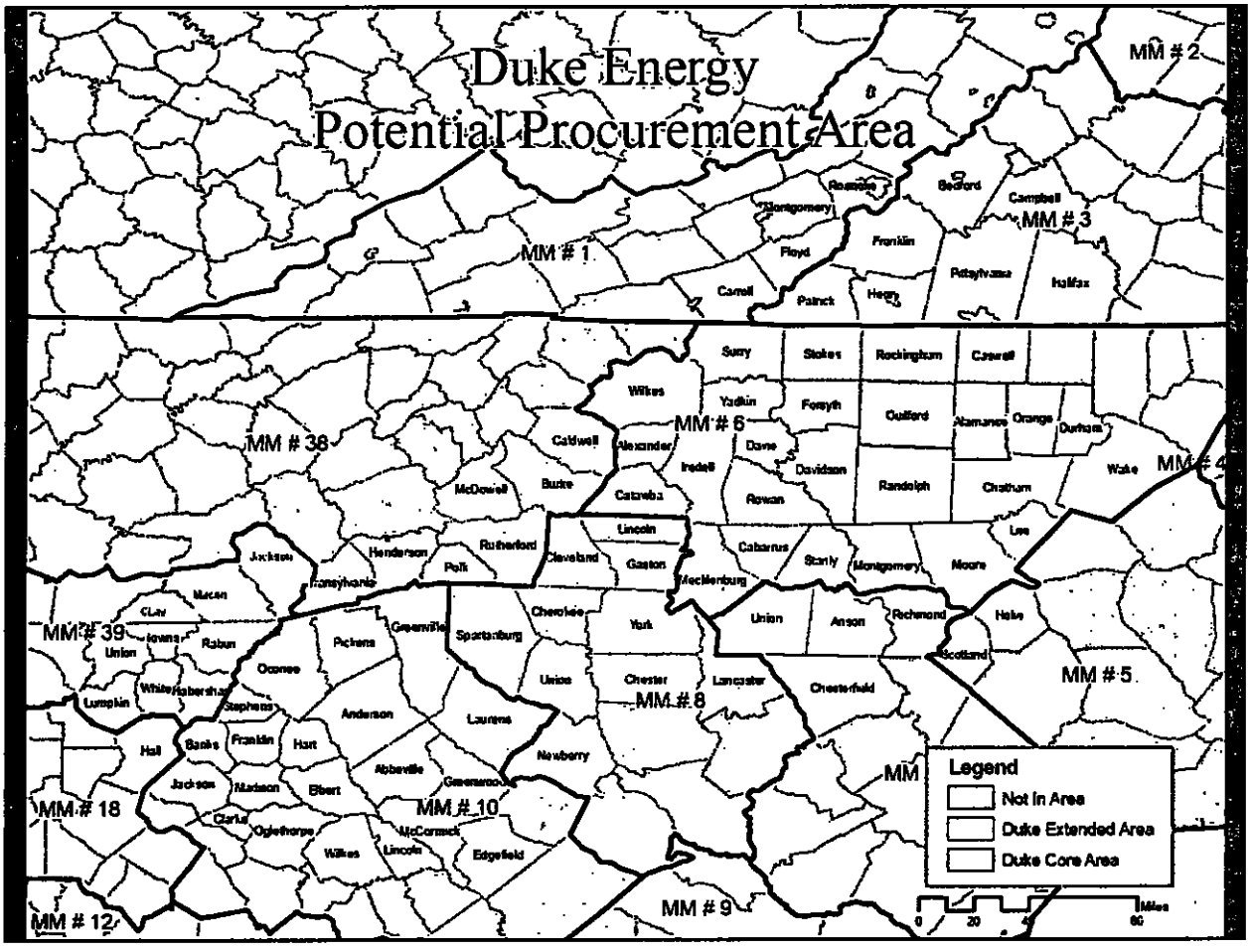
Counties in the Duke Energy Service Area	
North Carolina	Alamance
	Alexander
	Burke
	Cabarrus
	Caldwell
	Caswell
	Catawba
	Cleveland
	Davidson
	Davie
	Durham
	Forsyth
	Gaston
	Guilford
	Henderson
	Iredell
	Lincoln
	McDowell
	Mecklenburg
	Orange
	Polk
	Rockingham
	Rowan
	Rutherford
	Stanly
	Stokes
	Surry
	Transylvania
	Union
	Wilkes
	Yadkin
South Carolina	Abbeville
	Anderson
	Cherokee
	Chester
	Greenville
	Greenwood
	Lancaster
	Laurens
	Newberry
	Oconee
	Pickens
	Spartanburg
	Union
	York

Counties within Economic Haul Distance	
Georgia	Banks
	Clark
	Elbert
	Franklin
	Habersham
	Hall
	Hart
	Jackson
	Lincoln
	Lumpkin
	Madison
	Oglethorpe
	Rabun
	Stephens
	Towns
	Union
	White
	Wilkes
North Carolina	Andon
	Chatham
	Clay
	Haywood
	Hoke
	Jackson
	Lee
	Macon
	Montgomery
	Moore
	Randolph
	Richmond
	Scotland
	Wake
South Carolina	Chesterfield
	Edgefield
	McCormick
Virginia	Bedford
	Campbell
	Carroll
	Floyd
	Franklin
	Halifax
	Henry
	Montgomery
	Patrick
	Pittsylvania
	Roanoke

Leveraging the wood basin analysis conducted by Forest2Market that resulted in the geographic description of 39 natural wood basins (micromarkets) in the U.S. South. The Potential Procurement Area can be accurately described by a combination of micromarkets as shown in the following maps and by an area of forest in the western North Carolina and northeastern Georgia counties of:

- Burke, NC
- Caldwell, NC
- Clay, NC
- Haywood, NC
- Henderson, NC
- Jackson, NC
- McDowell, NC
- Macon, NC
- Polk, NC
- Rutherford, NC
- Transylvania, NC
- Habersham, GA
- Rabun, GA
- Towns, GA
- Union, GA
- White, GA

These counties collectively are referred to as the Western Counties in this Exhibit.



General Description of the Duke Energy Carolinas Potential Procurement Area

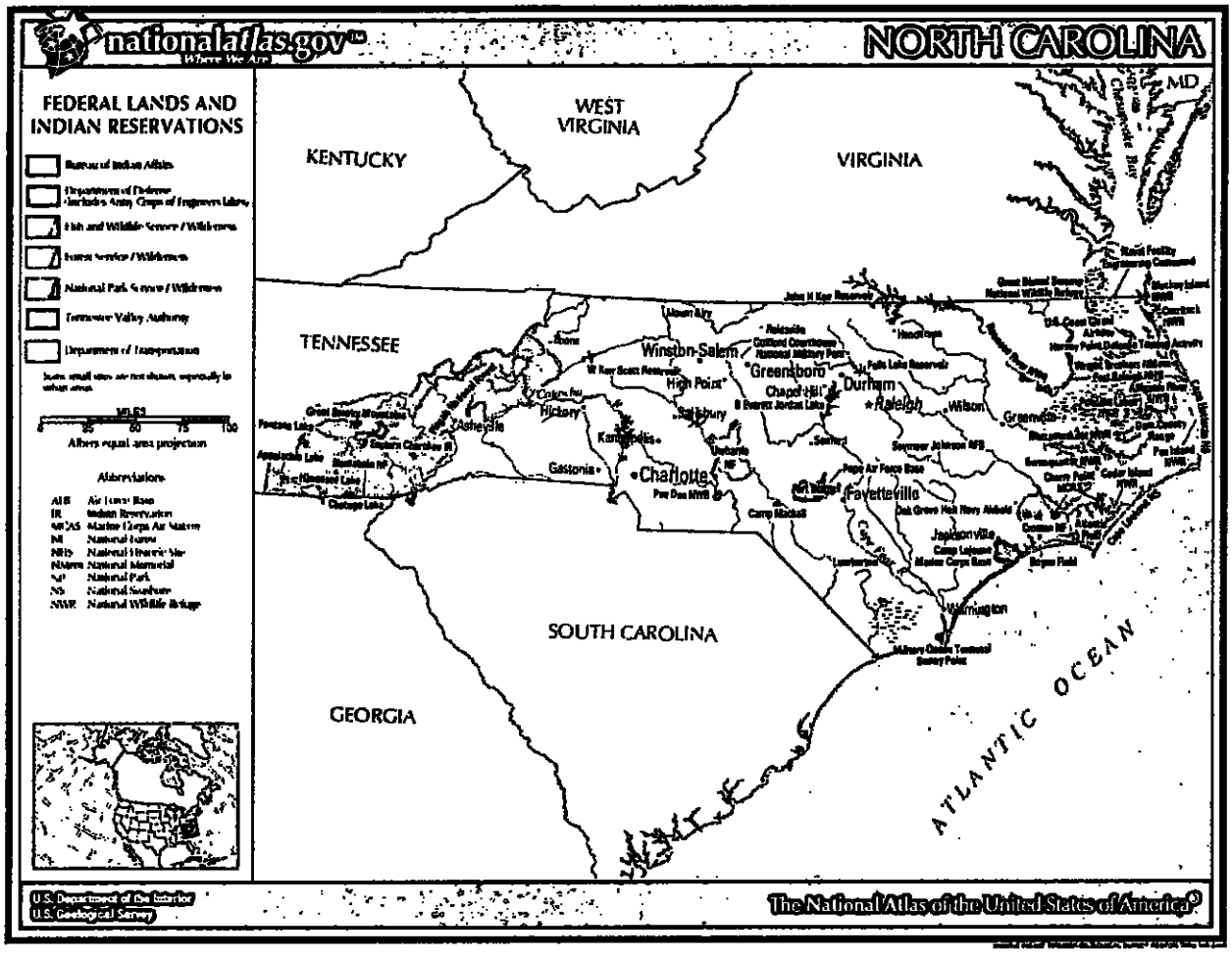
The Duke Energy Carolinas potential procurement area consists of underutilized forests characterized by a mix of softwood and hardwood. In general the eastern sandy soil areas (eastern MM#6, MM#5 and MM#7) are predominately pine forests, the piedmont is mix of pine and hardwood (western MM#3 and MM#6; MM#8) the western (mountainous) areas favor hardwood. On the whole, the area is characterized by mixed hardwood / pine forest and hardwood forests. The far western and southwestern areas encompass areas of steep terrain.

The relatively high concentration of hardwood forest disadvantages Duke Energy Carolinas over other operators with access to commercial pine plantation forests. Managed hardwoods plantations are not as common as pine plantations. Pre-commercial thinning operations are rare today however, if commercial forestry begins managing for the production of energy crops, it is likely to include only pine plantation. Therefore, hardwood forests are not likely to contribute wood biomass from such regimes.

Duke Energy Carolinas is also disadvantaged by steep terrain in the western and southwestern region of this procurement zone. Steep terrain can inhibit the economical collection, chipping and hauling of logging slash.

Lastly, the Potential Procurement Area contains three of the four National Forests in North Carolina. Combined the National Forests in the area are approximately 1.1 million acres. In 2009, 1,061 acres were harvested from these 3 National Forests combined – a harvest rate of 0.01%, which is significantly lower than average. The Great Smokey Mountain national park covers an additional one-

quarter million acres of North Carolina. The map set forth below for illustrates the geographic coverage of the National Forests.



Effect of Policy-based Bioenergy Demand On Southern Timber Markets: A Case Study of North Carolina

Robert C. Abt[a], Karen L. Abt[b], Frederick W. Cubbage[c] and Jesse D. Henderson[d]

Abstract

Key factors driving renewable energy demand are state and federal policies requiring the use of renewable feedstocks to produce energy (renewable portfolio standards) and liquid fuels (renewable fuel standards). However, over the next decade, the infrastructure for renewable energy supplies is unlikely to develop as fast as both policy- and market-motivated renewable energy demands. This will favor the use of existing wood as a feedstock in the first wave of bioenergy production. The ability to supply wood over the next decade is a function of the residual utilization, age class structure, and competition from traditional wood-users. Using the North Carolina Renewable Portfolio Standard as a case study, combined with assumptions regarding energy efficiency, logging residual utilization, and traditional wood demands over time, we simulate the impacts of increased woody biomass demand on timber markets. We focus on the dynamics resulting from the interaction of short run demand changes and long term supply responses. We conclude that logging residuals alone will be unable to meet bioenergy demands from North Carolina's Renewable Portfolio Standard. Thus, small roundwood (pulpwood) will be

[a] Corresponding author: Professor, Department of Forestry and Environmental Resources, North Carolina State University, Raleigh, NC 27695-8008; bob_abt@ncsu.edu; (919) 515-7791
[b] Research Economist, Southern Research Station, US Forest Service, PO Box 12254, Research Triangle Park, NC 27709; kabt@fs.fed.us
[c] Professor, Department of Forestry and Environmental Resources, North Carolina State University, Raleigh, NC 27695-8008; fred_cubbage@ncsu.edu
[d] Graduate student, Department of Forestry and Environmental Resources, North Carolina State University, Raleigh, NC 27695-8008; jdhende2@ncsu.edu

used to meet remaining bioenergy demands, resulting in increased timber prices and removals; displacement of traditional products; higher forest landowner incomes; and changes in the structure of the forest resource.

Keywords: renewable electricity portfolio standard, biomass supply, timber markets, logging residuals, timber supply projections

1.0 Introduction

Interest in renewable sources of energy has historically been correlated with the price of oil. More recently, the recognition of carbon's role in climate change and a national security interest in reducing dependence on imported oil has solidified interest in renewable energy. The policy response includes renewable portfolio standards (RPS) (or renewable electricity standards) for electricity and renewable fuel standards (RFS) for liquid transportation fuels at both state and national levels. However, limited infrastructure to use solar, wind or other renewables, the potential to co-fire wood in coal plants, and a seemingly plentiful supply of forest residues, has led to a focus on woody biomass as a key renewable feedstock in the short run. At the same time, a decade of reduced forest planting and the current recession are reducing the availability of residuals in the short run and the supply of pulpwood in the longer run. We use the term pulpwood to refer to roundwood of insufficient size or quality to be used for sawtimber.

Many studies of using wood for energy focus on the use of wood residuals from logging and manufacturing [1, 2, 3, 4, 5, and 6]. This focus has minimized concern about the impact of wood-for-energy on traditional wood-using industries. However, in a supply analysis evaluating the effect of national RPS and RFS on North Carolina, Virginia and South Carolina, Galik et al. [7] estimates that considerably less logging residual volume is available than was assumed in previous studies, partly due to differing estimates of available residuals (residuals are only produced when harvest occurs), and partly due to differing assumed levels of utilization of these logging residuals. Galik et al. [7] also

found that residuals alone will meet biomass energy demand in the presence of a national RPS or RFS only until 2012 in the Mid-Atlantic region. These analyses have not addressed the impacts of increased bioenergy demand on traditional wood-using industries or focused on the differences between short-run and long-run impacts.

North Carolina was the first southeastern state to enact an RPS [8], and while North Carolina's RPS is less ambitious than many of the federal proposals; it nevertheless has the potential to affect the traditional wood-using industry, long a mainstay of the state's economy. In this paper, we developed a hypothetical portfolio of renewable energy for the State, and estimated the proportion of renewable demand that is likely to be met by woody biomass, either through residuals or pulpwood. We then modeled the effects of the RPS on wood prices and traditional wood users in North Carolina.

2.0 Modeling Approach

Woody biomass supply was modeled using the Sub Regional Timber Supply (SRTS) model [9], which has been used in assessments of forest resources in the US South ([9, 10, 11,] and the US Northeast [12]. SRTS is currently supported and used by a consortium of 19 forest resource-based companies, energy firms, and consultants who are members of the Southern Forest Resource Assessment Consortium at NC State University. The model develops supply estimates from a supply function based on local harvest and inventory, and an exogenous demand scenario. In this paper, demand

scenarios were developed using demands from existing traditional users and potential bioenergy users.

SRTS uses the U.S. Forest Service, Forest Inventory and Analysis (FIA) dataset of inventory, growth, removals, and acreage by forest type, private ownership category, species group, and age class to model inventory change by product for small areas (typically the 58 FIA survey units in the southern region) [13]. The product inventory is assumed to shift a resource supply curve by owner and region. This detailed subregional supply is equilibrated with a regional demand curve. In each year, product demand is shifted based on the user-defined scenario and supply is shifted by the biological accounting module. The market clearing price and harvest are calculated; harvest is passed to the biological accounting module; and inventory is updated for the next period's equilibrium calculation. Product inventory and harvest are estimated by applying diameter distributions and cull factors to harvest and inventory by age class.

2.1 Existing Forest Product Demand

In order to model the effect of increased energy demand, the model was first solved for an assumed base level of demand for the Piedmont and Coastal Plain regions of North Carolina and the border counties of in Virginia and South Carolina as shown in Figure 1. Inclusion of border counties allows the model to draw resources from these areas, but also includes demand for wood from those counties.

Initial demand for standing timber was based on the most recent FIA growing stock removal levels derived from the annual surveys in each state in the South. We assume a drop in demand for all wood products of 30 % from 2005 to 2009, with a rebound occurring from 2010 to 2013 of equal magnitude. Existing demands return to the 2002-2006 average levels and stay at that level throughout the projection period.

2.2 NC RPS Biomass Demand

The policy-driven demand for woody biomass to generate energy is in addition to the demands from the existing traditional wood users. North Carolina's RPS legislation requires that the renewable energy proportion of total energy supply increases in a series of steps that achieve 12.5% of the total energy portfolio by 2021. For this analysis, we focus solely on the already-enacted NC RPS. We develop a hypothetical renewable energy portfolio by making pragmatic assumptions regarding the role of energy efficiency, the role of residuals in meeting that demand, and the outlook for traditional wood markets. We do not consider the impacts of national renewable electricity or fuels standards on North Carolina.

The North Carolina Renewable Portfolio Standard requirements are summarized in Table 1. The requirements designate a percentage of retail electricity sales that must come from renewable sources, and this percentage changes over time in discrete steps. Sources of energy that qualify as part of this portfolio include solar electric, solar thermal, wind, biomass, hydropower, geothermal, ocean current, and wave energy, in addition to energy

efficiency measures and combined heat and power facilities. A renewable facility is only eligible if it was placed into service after January 1, 2007. This requirement will ensure the development of renewable energy beyond the 4.5% capacity already in place in North Carolina [16]. The final requirement of the RPS is 12.5% of 2020 retail sales in 2021 and thereafter. As such, the size of the portfolio is assumed to remain unchanged after 2021.

In order to construct a hypothetical portfolio, electric power generation data was retrieved from the Energy Information Administration [16]. The average generation for 2004-2006 was used as a baseline estimate for 2005, and future power generation was projected with an annual growth rate of 1.9% as suggested by La Capra Associates [17]. The renewable requirement in the RPS is amplified by the increases in demand. For example, if growth in demand occurs 1.9% per year between 2012 and 2015, the 6% RPS requirement requires more than a doubling of renewable capacity.

Conversely, increased energy efficiency reduces retails and lowers requirements for future renewable capacity. CEO Jim Rogers of North Carolina-based Duke Energy recently proclaimed that energy efficiency is "the key" to his company's ability to change to cleaner sources of energy [18]. Prior to 2021, no more than 25% of RPS requirements for electric public utilities can be met with energy efficiency measures, and after 2021, up to 40% of the portfolio can stem from energy efficiency. The energy efficiency requirements for independent producers are different; there is no cap for energy efficiency's share, and efforts that exceed the requirements of one year can be used as

140 credits for the following year. Energy efficiency was treated as an annual reduction in
141 consumption, resulting in a dampened growth rate of 0.4%.
142
143 This analysis assumes that energy efficiency constitutes the maximum allowable 25% of
144 the hypothetical renewable portfolio up to 2021. After this date, we opted to hold
145 efficiency at 25% of the renewable portfolio, since these levels already represent
146 unprecedented efficiency success. Because the RPS legislation only lays out requirements
147 for specific years, the size of the portfolio is constant in the intervening years. Still, we
148 assume utilities steadily build renewable capacity in anticipation of future increases in
149 renewable requirements.
150
151 The RPS also includes minimum requirements for electricity generated from solar as well
152 as swine and poultry waste biomass as shown in Table 1 and Figure 2. The listed
153 percentages are taken on retail sales. The set-asides for solar and swine equate to
154 approximately 2% each of the RPS by 2018, whereas poultry waste accounts for 6% of
155 the RPS in 2018. In addition to these set-asides, we used the North Carolina Biomass
156 Roadmap [19] to make assumptions about the proportion of biomass that will be supplied
157 by other agricultural (waste and energy crops) and municipal waste biomass. We assume
158 that 50% of the available agriculture and municipal wastes are available for energy by the
159 end of the forecast period (2036), starting from 0% in 2011. The remainder of the
160 biomass is assumed to come from forest biomass, including both logging residuals and
161 pulpwood harvested to meet bioenergy demands.
162

163 The role of pulpwood in meeting the NC RPS will depend on how the North Carolina
164 Utilities Commission defines renewable biomass. In March of 2008, the Commission
165 established rules to implement the RPS [20]. The precise definition of renewable
166 biomass, however, was left undecided. The Commission effectively put off the decision
167 on which kinds of timber would qualify as biomass by allowing the decisions on qualified
168 biomass to be made on a case-by-case basis. Potential definitions could include only
169 residuals and waste, or could include any, all or none of the following: roundwood
170 harvested through thinning, roundwood harvested from pine plantations, and roundwood
171 harvested from all stands.
172
173 Although we assume the recession does not directly reduce renewable energy demands, it
174 does affect future pulpwood supply. For example, the reduction in demand for housing
175 and paper products lowers price and delays harvest and subsequent planting. This creates
176 a smaller cohort of young trees and will affect the prices and harvest quantities for 10-20
177 years after the recession. Also, because the beginning of the RPS demands in 2012
178 coincides with the recovery, price increases will be exacerbated by the sudden increase in
179 overall timber demands.
180
181 **2.3 Timber Supply**
182
183 The SRTS model was used to simulate the impact of renewable energy demand on forest
184 product markets and land use change [9]. In addition to demand scenarios over time for
185 each product, the SRTS simulation framework requires supply and demand price

186 elasticities. Empirical studies have shown that timber supply and demand are price
187 inelastic [21]. For these projections we assumed a supply-price elasticity of 0.3 for all
188 products and owners. We assumed demand-price elasticities of -0.5 for all products.
189 Bioenergy demand was assumed to be insensitive to price in the short run, since wood is
190 likely to be a small proportion of input costs for large utilities. Regulated utilities may
191 also have the ability to pass higher costs on to consumers.
192
193 Moving from the wood requirements shown in Figure 2 to pulpwood market impacts
194 requires assumptions about the availability of logging residuals to meet bioenergy
195 demand. Estimates of logging residuals are calculated by applying FIA logging residual
196 factors by species and residual size class to growing stock removals from the SRTS
197 model. These factors are based on state-level field studies of typical logging jobs
198 conducted by FIA [14]. For North Carolina, these studies suggest that residuals constitute
199 approximately 21 % of total harvest for pine and 36 % for hardwood. For both species
200 groups, approximately 60 % of logging residuals is non-growing stock, or less than 10.2
201 cm in diameter. Applying these factors to harvest provides a gross estimate of residuals
202 from every harvest in the region.
203
204 Because logging residual utilization response to demand is unknown, we assumed
205 increasing utilization over time, starting at 10% for pine and 8% for hardwoods in 2012,
206 the first year of the portfolio. This initial rate is far lower than utilization rates used in
207 previous studies [1, 2, 3, 4], which assume rates of 60 to 70% in the short run. We
208 assume these higher utilization rates will be observed only after higher pulpwood prices

provide an incentive to improve efficiency. Our utilization rate peaks at 66% for pine and 50% for hardwoods in 2025, staying at that level through the end of the projection. This difference in utilization rates by species group reflects both different growing conditions (often wetter or steeper sites) and harvesting technologies for hardwoods. These percentages reflect averages over all harvested sites in each subregion. In reality, sites near energy producers may experience higher utilization rates, while more distant sites may continue using existing practices.

We calculate net available residuals from the base run by multiplying the utilization rate times the gross estimate of residuals. After netting base residuals from biomass demand, the split between hardwood and pine pulpwood markets was made by assuming that each species group would receive the same percentage increase in harvest. Because hardwood harvests generate a higher level of residuals, the net increase in hardwood pulpwood harvest was lower than the increase needed in pine.

Once available base residuals from existing harvest have been fully utilized (to the extent possible by current technologies and industries) by the bioenergy producers, the model allows pulpwood harvest from standing timber to meet bioenergy demand. Residuals from this additional energy harvest are assumed to have a utilization level of 14% in 2012 rising to 90% by 2024. This assumes that harvests conducted for the sole purpose of bioenergy demand will be located closer to energy plants, and thus utilization will be higher. The increased level of residual utilization will be driven by pulpwood price

231 increases, but these price increases will also lead to reduced residuals from conventional
232 logging as traditional users harvest less.
233
234 The implementation of SRTS used here also includes endogenous land use change by
235 linking to a an updated version of Hardie et al. [22]. This model includes county level
236 timberland reductions due to urbanization and allows rural land to move between forest
237 and agriculture uses based on relative rents. We allowed the model to react to pine
238 pulpwood prices, but held agriculture rents constant. Because the land use model does not
239 describe changes across forest types, in these scenarios we assume that land is converted
240 into forestry through the addition of pine plantations when pulpwood prices rise, and that
241 land is converted out of all forest types proportionately when pulpwood prices decline
242 [9].
243
244 **3.0 Results**
245
246 Based on the market interactions between timber supply and demand, the SRTS model
247 develops estimates of stumpage price change, growing stock removals, and inventory for
248 4 products (pine pulpwood, pine sawtimber, hardwood pulpwood, and hardwood
249 sawtimber) for each of the 4 subregions included in the supply region. Market results are
250 presented by setting the initial year of the projection, 2006, to an index value of 100.
251 From this starting point the model moves through time based on demand scenarios and
252 supply shifts from inventory changes due to harvest, growth, age class distributions and
253 land use change. The selected demand scenarios were (1) base demands derived from

254 average removals from 2002-2006, a recession, and recovery to previous demand levels,
255 and (2) the base demand scenario, including the recession, plus the RPS demands derived
256 from the hypothetical portfolio, where woody biomass is assumed to supply
257 approximately 55% of the biomass portion of the renewable portfolio in the long run and
258 even higher percentages in the short run.
259
260 Base demand projections, shown in Figures 3a-3d, do not include any new demand from
261 the RPS policy. In the base model run, post-recession demand by product is constant over
262 time. Prices and harvest shift by product and region over time due to supply shifts
263 induced by inventory changes. The four markets show decreases in removals and prices
264 from the base year due to the recession, with prices returning to pre-recession levels in all
265 but the pine sawtimber market. In the pine pulpwood market (Figure 3a), price, inventory
266 and removals all decline during the recession, with prices returning to 2006 levels by
267 2015. Pine pulpwood inventory and removals remain below 2006 levels due to reduced
268 supply.
269
270 Reduced planting from 5 to 15 years ago leads to fewer hectares in the pulpwood age
271 classes early in the projection (Figure 4). Compared to the area in the 16-25 year age
272 class at the beginning of the projection, there is a greater than 20 % drop in area coming
273 into that age class in the coming decade (Figure 4). While the 0-5 year age class has
274 more area, the recession early in the projection lowers harvest and prices and keeps
275 planting low for the first 5 years of the projection. This reduces area in the pulpwood age
276 classes by 30% in 2020. With no demand change, the inward shift in supply due to

277 reduced pulpwood inventory leads to lower harvest and higher prices (Figure 3a).
278 Planting increases when prices rise due to the recession recovery assumed to begin in
279 2011. This inventory moderates prices as it reaches merchantability after 2026.
280
281 In the pine sawtimber market (Figure 3b), inventory accumulates due to the recession and
282 prices remain low. Hardwood pulpwood market projections (Figure 3c) are similar to
283 pine pulpwood in the first decade. Hardwood pulpwood price dynamics are affected by
284 the large quantities of hardwood pulpwood that come from low-grade sawtimber size
285 material which is not responsive to pulpwood price. This leads to higher pulpwood price
286 increases as the model finds a market-clearing price based only on the small diameter
287 resource. Unlike pine, higher prices do not lead to a planting response, so prices remain
288 higher through the projection. Hardwood sawtimber, shown in Figure 3d, shows a
289 recession and recovery response, although inventories continue to accumulate throughout
290 the projection.
291
292 For the RPS policy runs (Figures 5a to 5d), the demands for sawtimber were held
293 constant, and the demands for pulpwood were increased only by the amount of biomass
294 demand not met by logging residuals from the base projection. Residuals alone do not
295 fulfill the RPS demand even in the first year of the requirement, where additional harvest
296 of nearly 4.5 million green metric tons would be needed to fulfill the forest biomass
297 contribution to renewable energy demands shown in Figure 2.
298

299 Figures 5a and 5c show that prices for pulpwood increase dramatically beginning in
300 2012, as both economic recovery and bioenergy demands increase removals. Because
301 supply is price inelastic (0.3), price changes are much larger than removals changes. The
302 harvest response is further reduced by the inventory decline noted in the base run. The
303 inventory decline is exacerbated due to the increased biomass harvest levels. The
304 significant price increases lead to a large planting response and a 20 % increase in
305 plantation area over base run levels. These plantations become merchantable at age 15
306 and lead to reductions in pine pulpwood prices and increases in pine pulpwood inventory
307 beginning in 2028. Hardwood pulpwood prices remain higher than the baseline since the
308 increased removals lead to inventory declines with no management response.
309
310 The SRTS model does not include cross-price effects between pulpwood and sawtimber,
311 and thus there is no direct substitution between these two product types in the projections.
312 However, Figures 5b and 5d both show changes in sawtimber price, inventory and
313 harvest even though base sawtimber demands remain unchanged. This is because
314 increased demand for pulpwood, starting in 2012, reduces the amount of timber that is
315 allowed to grow to sawtimber size (in 10+ years), ultimately leading to reduced
316 sawtimber inventories and higher sawtimber prices even assuming constant demand
317 (compared to the base runs of Figures 3b and 3d). Figures 5b and 5d show the long-term
318 effects of reduced sawtimber inventories, with prices increasing for both sawtimber
319 products by the end of the projection relative to the base run. Since sawtimber prices are
320 usually 4 to 6 times higher than pulpwood prices, the pulpwood price impacts projected

321 here would not be expected to lead to the use of sawtimber for bioenergy. The change in
322 relative prices, however, could lead to product allocation changes at the margin.
323
324 These price increases imply significant changes for forest landowners and traditional
325 wood users over the projection period. The large increase in demand would increase
326 wood prices, benefiting forest landowners who are suppliers in the timber market and
327 leading to more intensive management, possibly including fertilization, competition
328 control and/or thinning. On the other hand, these price increases will adversely affect the
329 traditional forest industry. Since bioenergy demand is assumed to be completely
330 insensitive to wood prices in the short run, while traditional industry demand is assumed
331 to be price responsive (demand price elasticity = -0.5), price increases lead to harvest
332 reduction by the traditional industry but not by the energy producers.
333
334 Figure 6 shows the source of all forest products that are projected to be used to meet the
335 NC RPS. Sources include pine and hardwood residuals from the base run; pine and
336 hardwood pulpwood harvest change (additional harvest due to bioenergy demands); pine
337 and hardwood displacement (reduced harvest from traditional users now being used in
338 bioenergy); and residuals from new bioenergy harvests. The highest point of woody
339 biomass removals for electricity occurs in 2021, which is followed by a slight decline in
340 removals as other sources continue to increase while RPS requirements level off. The
341 decline to about 14 million green metric tons continues through the end of the projection.
342 During this period of level consumption, base residuals constitute nearly half of the total
343 consumption, while the largest part of the remainder comes from the displacement of

344 traditional industry harvests for both pine and hardwood pulpwood. The higher residual
345 utilization on biomass harvests makes up the final portion. By the end of the projection,
346 pine pulpwood harvest increases and displacement is reduced due to the surge in
347 plantation area reaching merchantability.
348
349 **4.0 Conclusions**
350
351 Some factors that may alleviate biomass demand impacts as projected here include (1)
352 long-run price responsiveness of biomass demand; (2) silvicultural responses favoring
353 production of biomass feedstock, possibly at the expense of solid-wood products; (3)
354 accelerated development and deployment of new technologies and substitute feedstocks;
355 (4) decline of traditional wood product demand in the base scenario; and, finally (5)
356 conservative assumptions regarding logging residual utilization, energy efficiency and
357 other productivity. Alternatively, we have not included potential demand for wood in this
358 region driven by European Union renewable energy policy nor have we included
359 potential increases in agricultural rents which would lead to lower planting rates. We
360 have also assumed that policies will allow use of pulpwood as a renewable energy source.
361
362 Using wood to produce energy provides opportunities to reduce the nation's use of fossil
363 fuels. Beyond reduced fossil carbon emissions, the benefits from this substitution could
364 include increased forest landowner incomes, increased forest land area, and reduced fuel
365 imports. However, the short-run use of woody biomass will be constrained by the price
366 inelastic nature of timber supply, the age class structure of the inventory, and competition

with traditional wood-using industries. This case study focuses on the timing of first order impacts and the interaction between biological, market, and policy factors. The model matches the current regional resource outlook with a pragmatic view of wood's evolving role in the NC RPS.

Overall, this analysis suggests that the use of pulpwood for electric power generation is essential for attainment of RPS goals. While many studies have considered the quantities required from different sources, our focus is on timing, particularly in the early years of the policy. Significant short run impacts are driven by; 1) the lack of infrastructure for many alternative renewable feedstocks; 2) near-term wood supply constraints due to reduced planting in the last decade; and 3) a recession that will further dampen planting and future supply.

The dominant impacts of increased demand and constrained supply in a price-inelastic market are large price increases and relative small harvest changes. While this may ameliorate concerns of "over-harvesting", higher prices may lead to a significant displacement of traditional wood consumers by bioenergy wood consumers. Forest landowners benefit from higher prices, thus providing an incentive for planting, keeping current land in forests and more intensive management, all of which will increase long-term supply. This intensive management response, along with an assumed trend of increased capacity of alternative renewables, returns prices, inventory, and harvest to historically observed levels by the end of the projection.

While the policy and resource situation examined here is specific to North Carolina, the importance of policy timing, market characteristics, the structure of the current forest resource, and the long-term nature of supply response are important factors in any bioenergy policy assessment. Further research will be focused on the impact of the spatial distribution of demand (e.g., co-firing potential) relative to resource supply and the impact of alternative views of traditional forest product markets over time.

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Acknowledgments: Funding for this research was provided by NC State University, the Southern Forest Resource Assessment Consortium (SOFAC), the USDA Forest Service, and Sun Grant(DOT).

Table 1. Required elements of North Carolina's Renewable Portfolio Standard.

Table 1. Required elements of North Carolina's Renewable Portfolio Standard.

	Renewable requirements by utility type		Renewable set-asides		
Year	Public	Municipal and Membership	Solar	Swine Waste	Poultry Waste
	As a percentage of the previous year's retail sales		*As a percentage of the given year's retail sales*		*MW h*
2010			0.02		
2012	3	3	0.07	0.07	170,000
2015	6	6	0.14	0.14	700,000
2018	10	10	0.20	0.20	900,000
2021 and thereafter	12.5	10	0.20	0.20	900,000

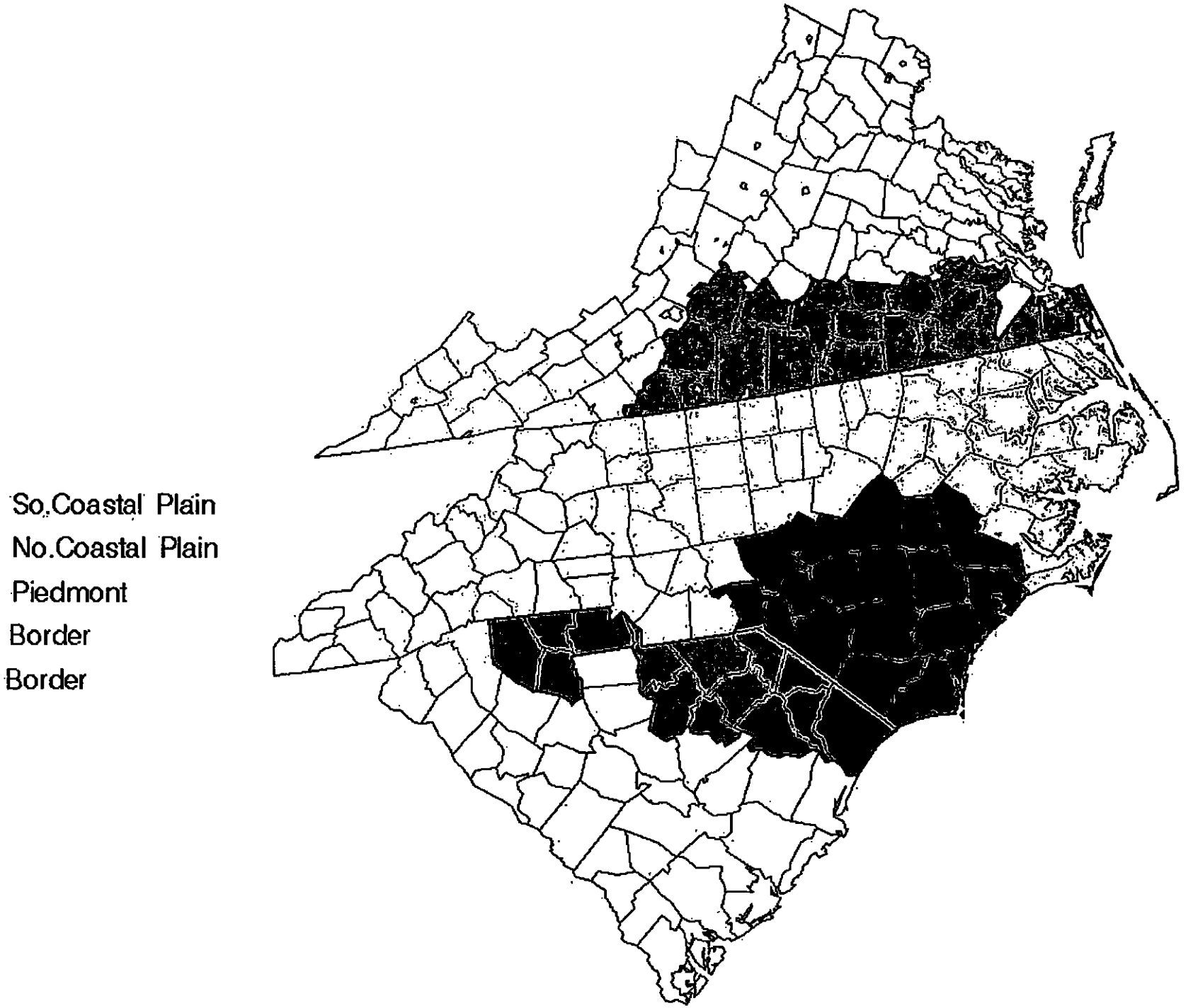
3

4

5 Figure 1. Subregions in North Carolina, Virginia and South Carolina assumed to contribute to

6 biomass demands from NC RPS.

7


So.Coastal Plain
No.Coastal Plain
Piedmont
Border
Border

8

9 Figure 2. Hypothetical North Carolina Renewable Portfolio Standard allocation.

10

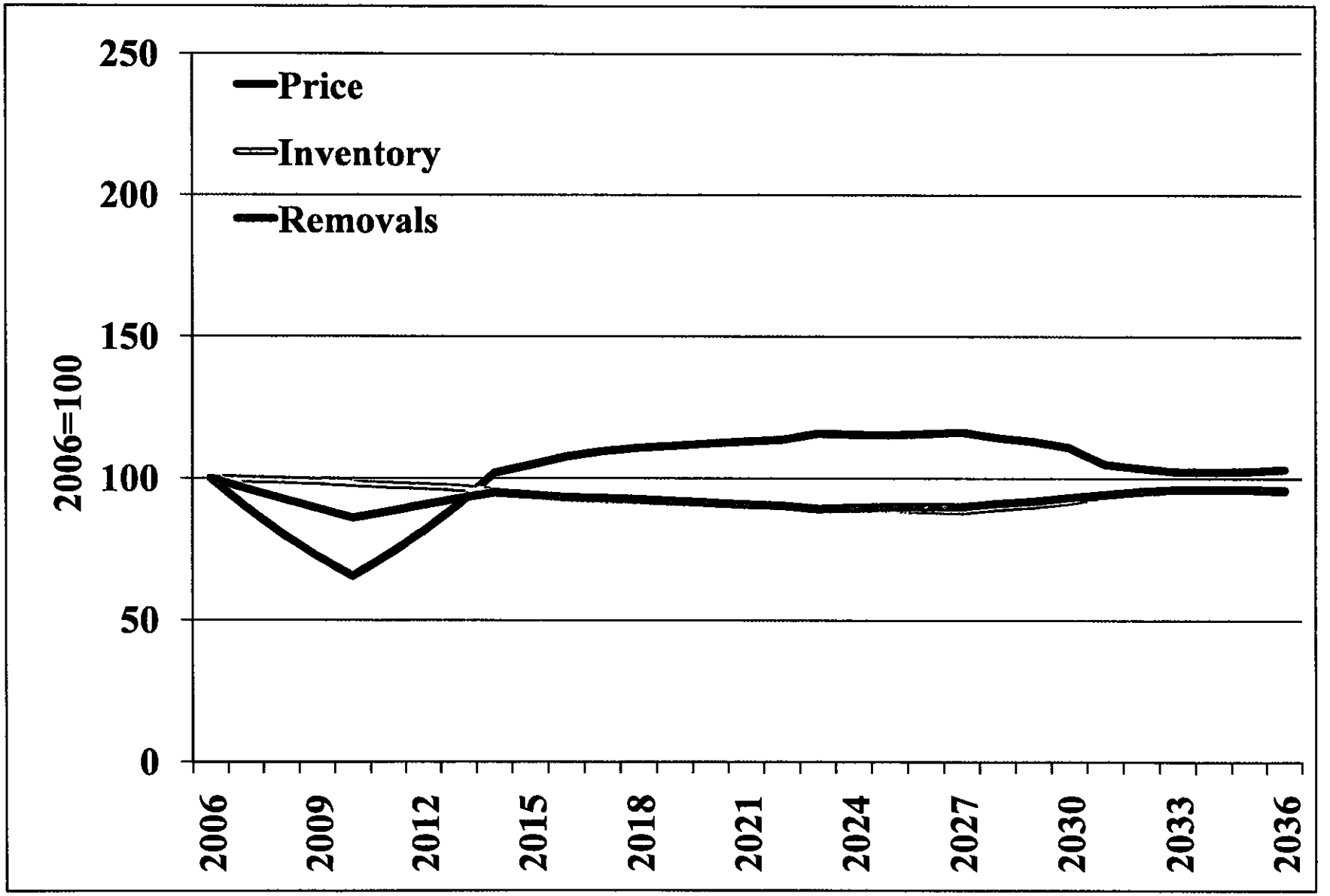
11

12 Figure 3. Projected removals, inventory and price changes without RPS biomass demand (2005

13 =100) by a) pine pulpwood, b) pine sawtimber, c) hardwood pulpwood, and d) hardwood

14 sawtimber.

15


250
200
150
100
50
0
2006=100
Price
Inventory
Removals
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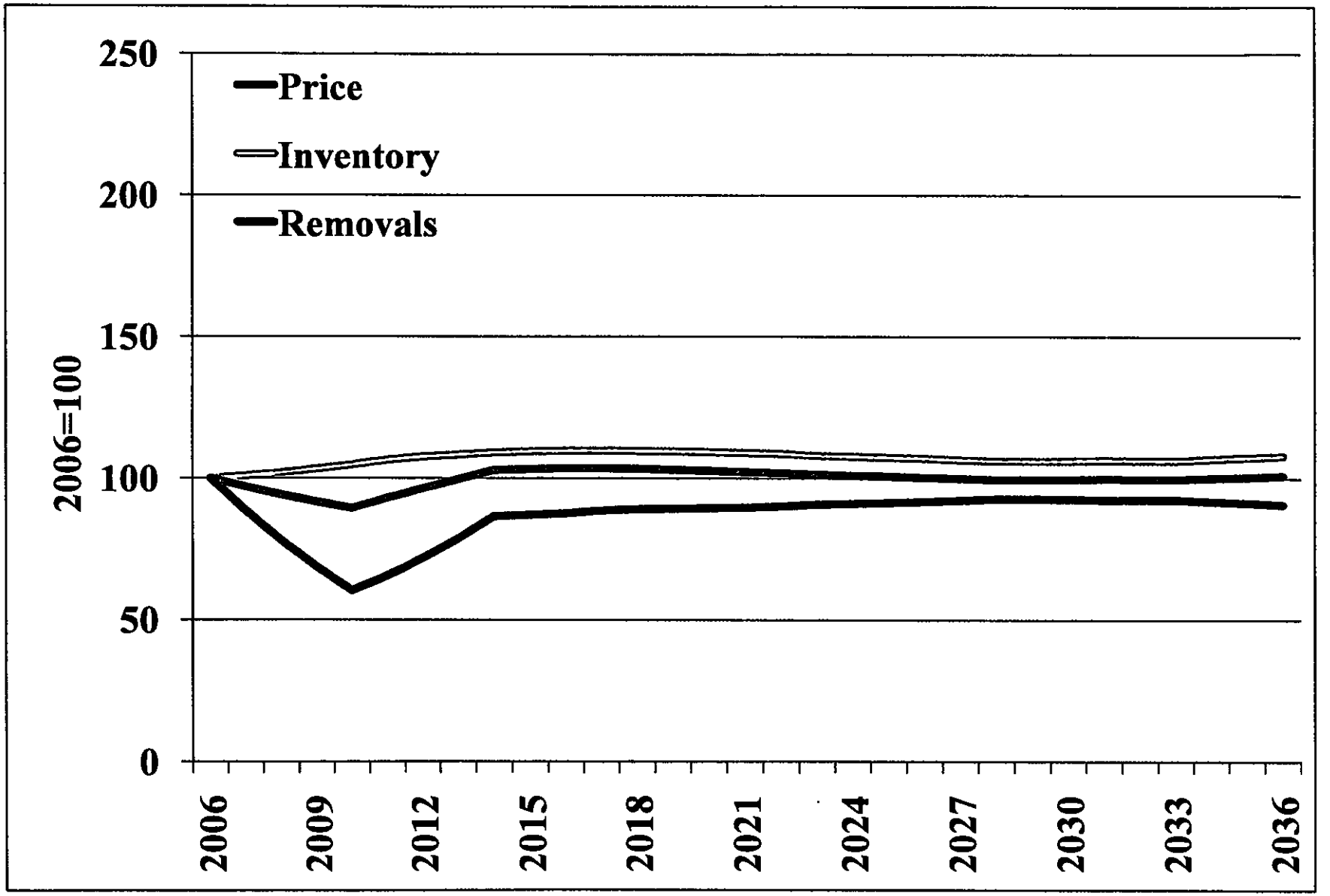
2009
2012
2015
2018
2021
2024
2027
2030
2033
2036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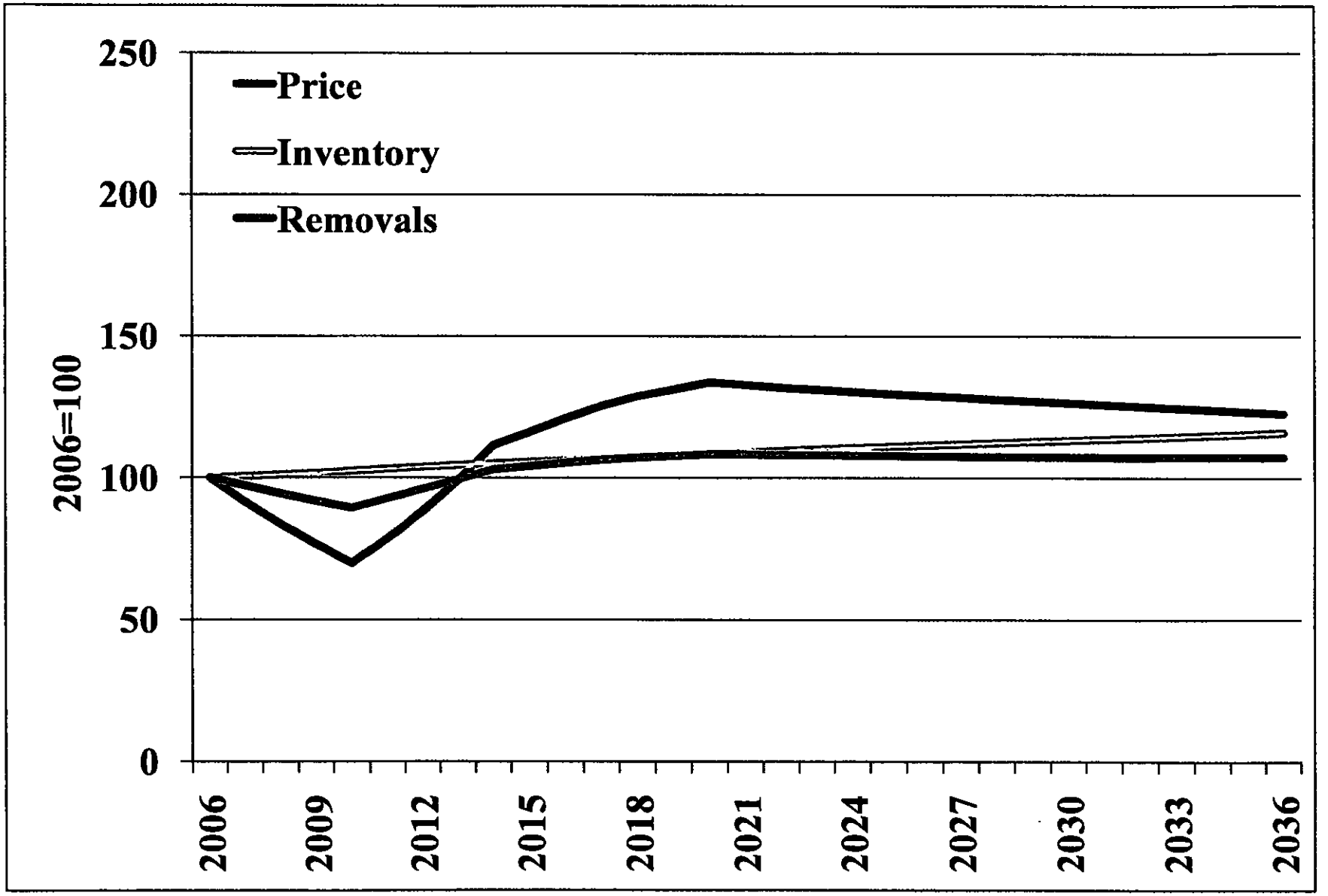
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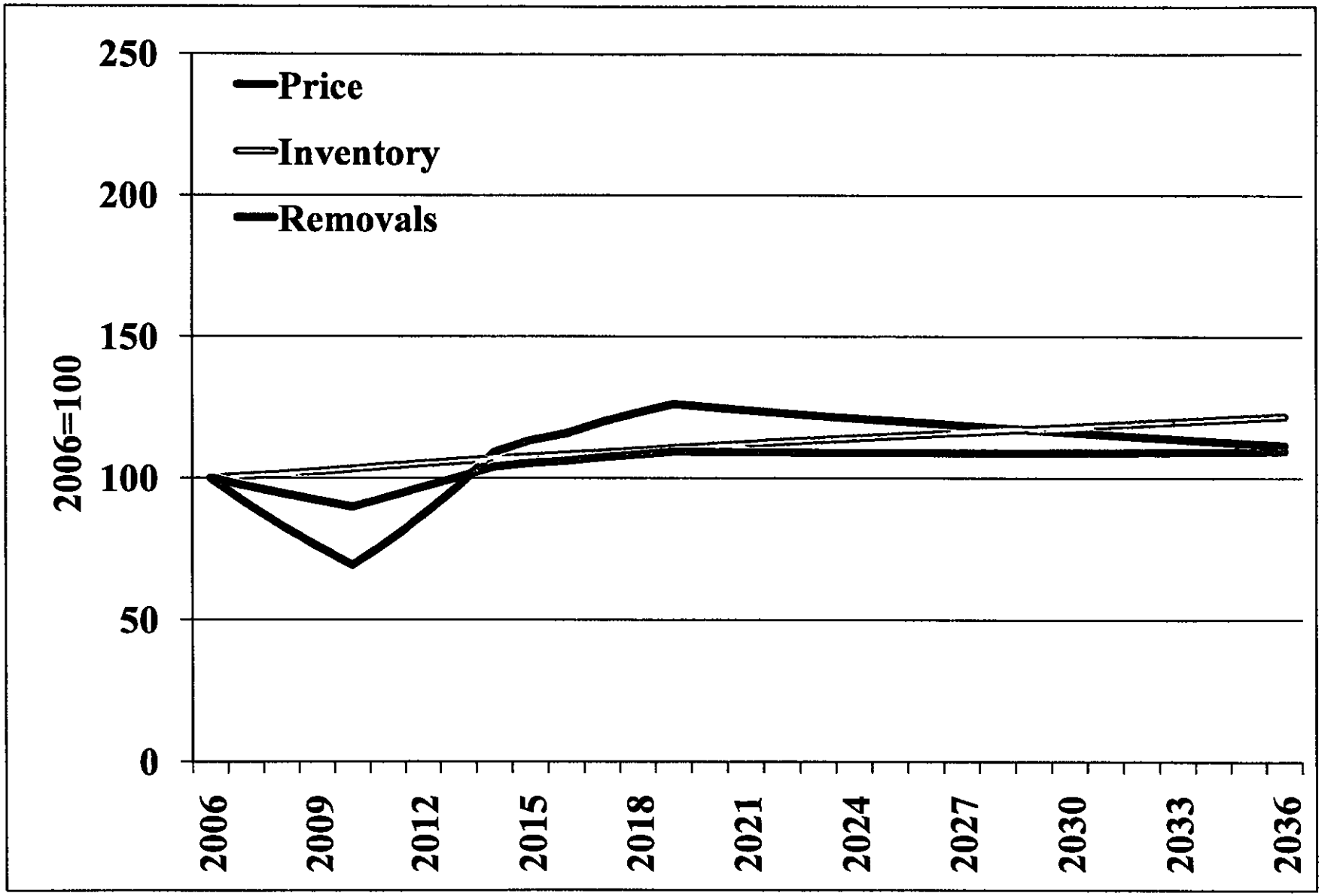
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0
2006=100
Price
Inventory
Removals
2006
2009
2012
2015
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2021
2024
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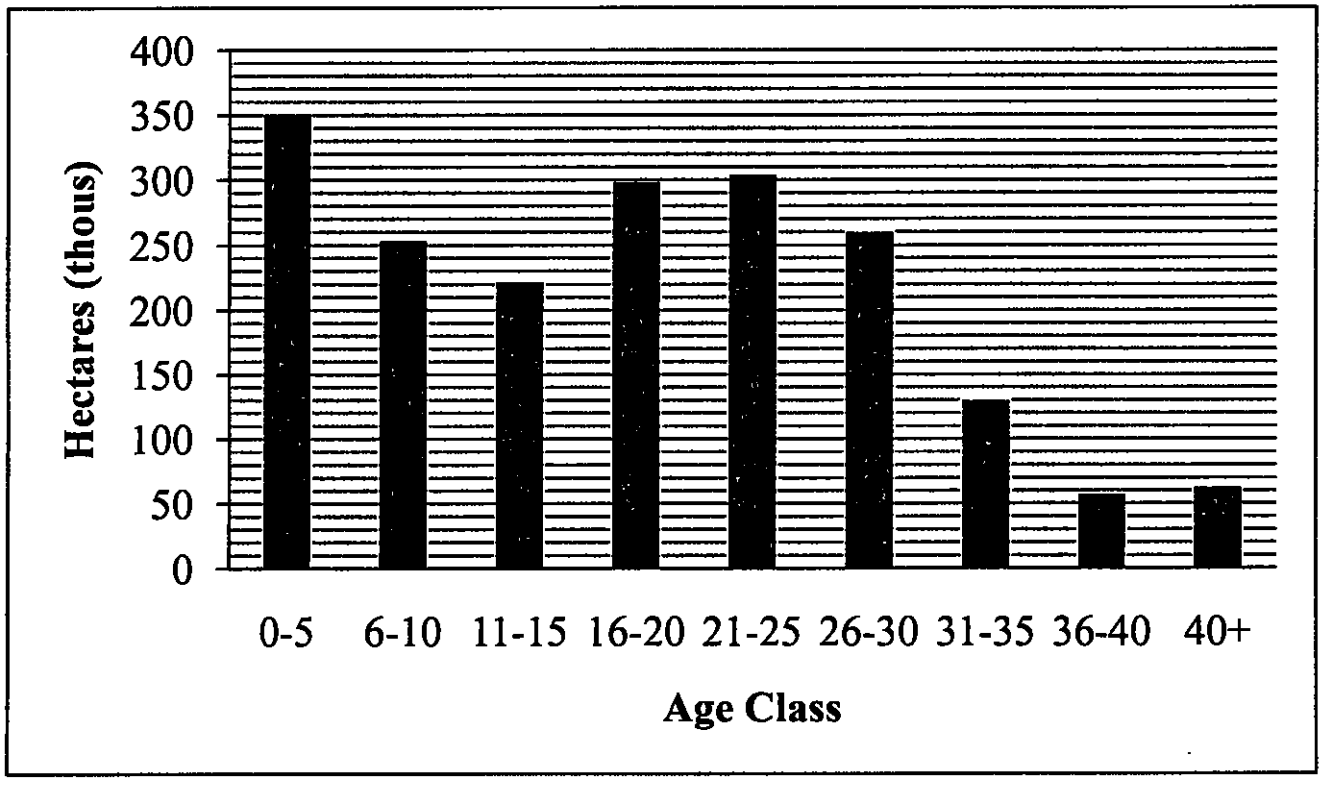
2033
2036

16

17 Figure 4. Starting age class distribution of pine plantations in the study area.

18


400
350
300
250
200
150
100
50
0
Hectares (thous)
0-5
6-10
11-15
16-20
21-25
26-30
31-35
36-40
40+
Age Class

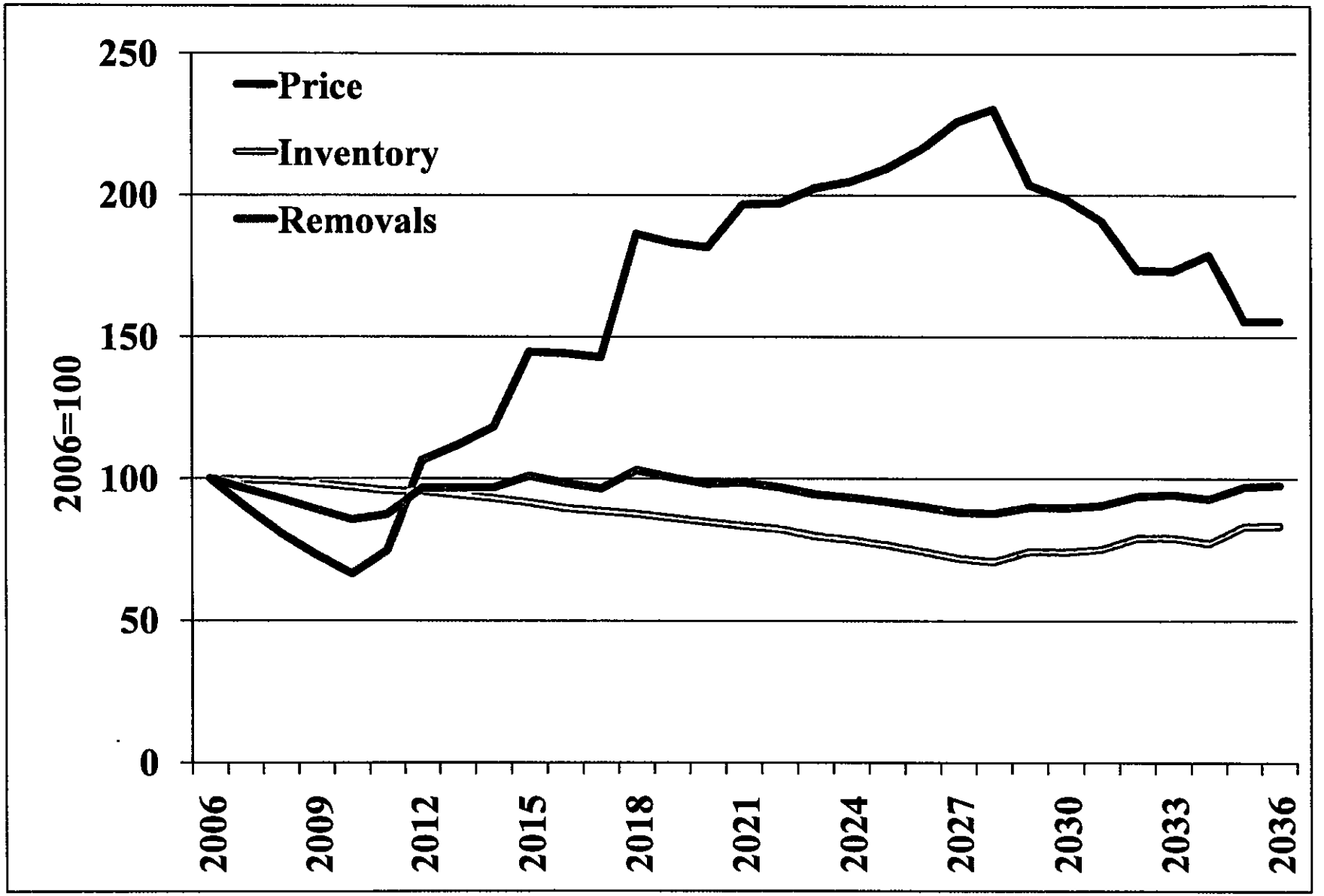
19

20 Figure 5. Projected removals, inventory and price changes with RPS biomass demand (2005

21 =100) by a) pine pulpwood, b) pine sawtimber, c) hardwood pulpwood, and d) hardwood

22 sawtimber.

23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2006=100
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Removals
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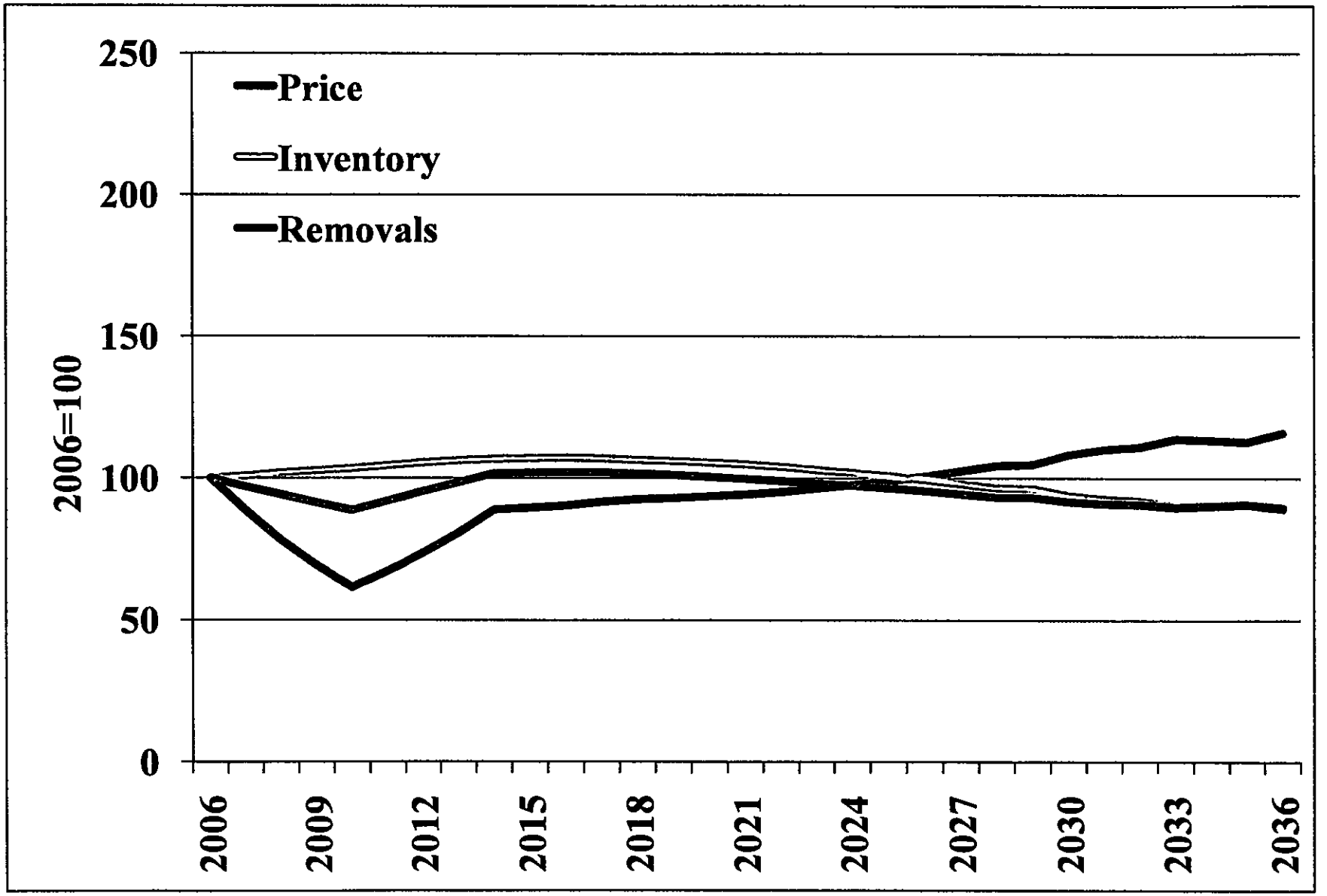
250
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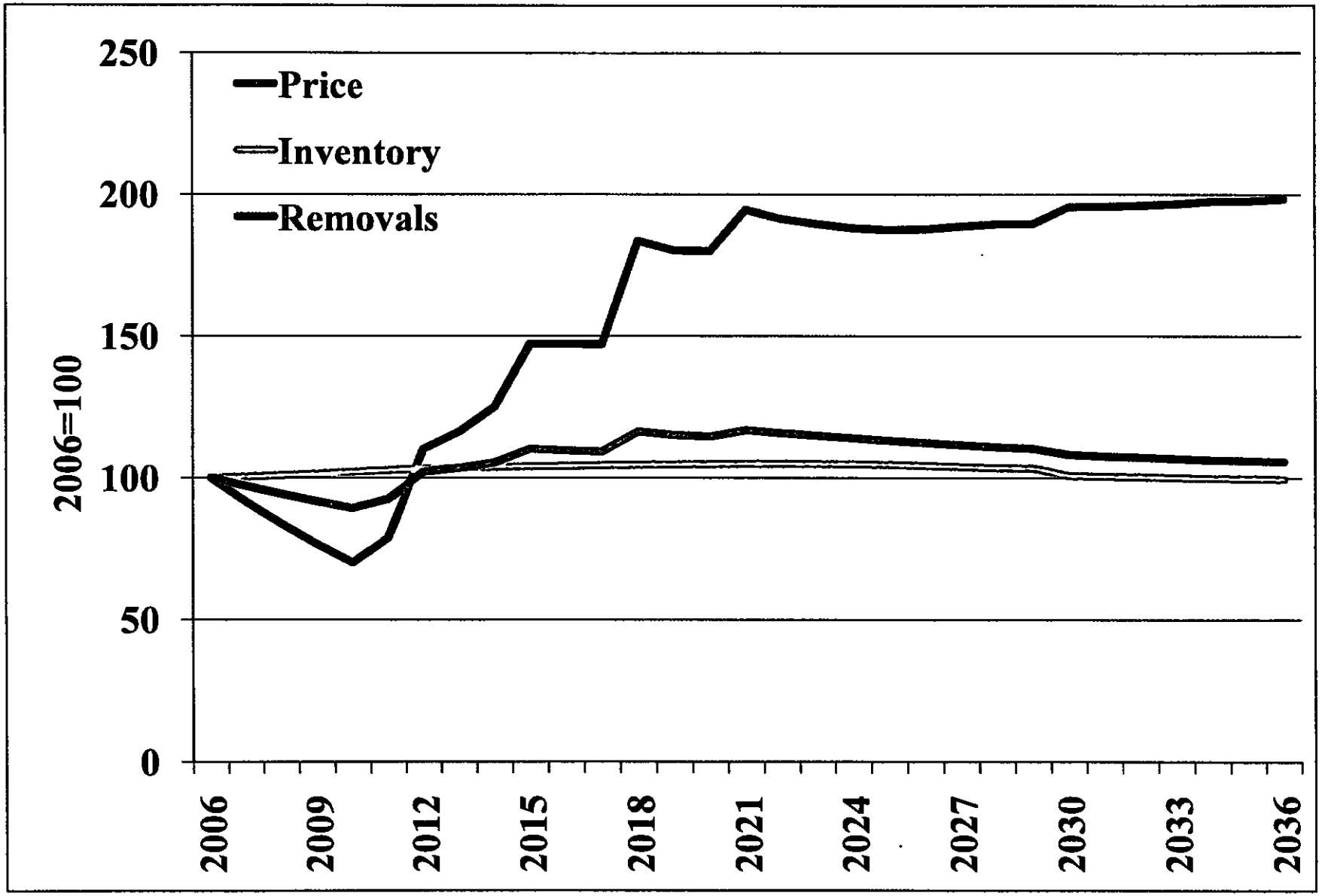
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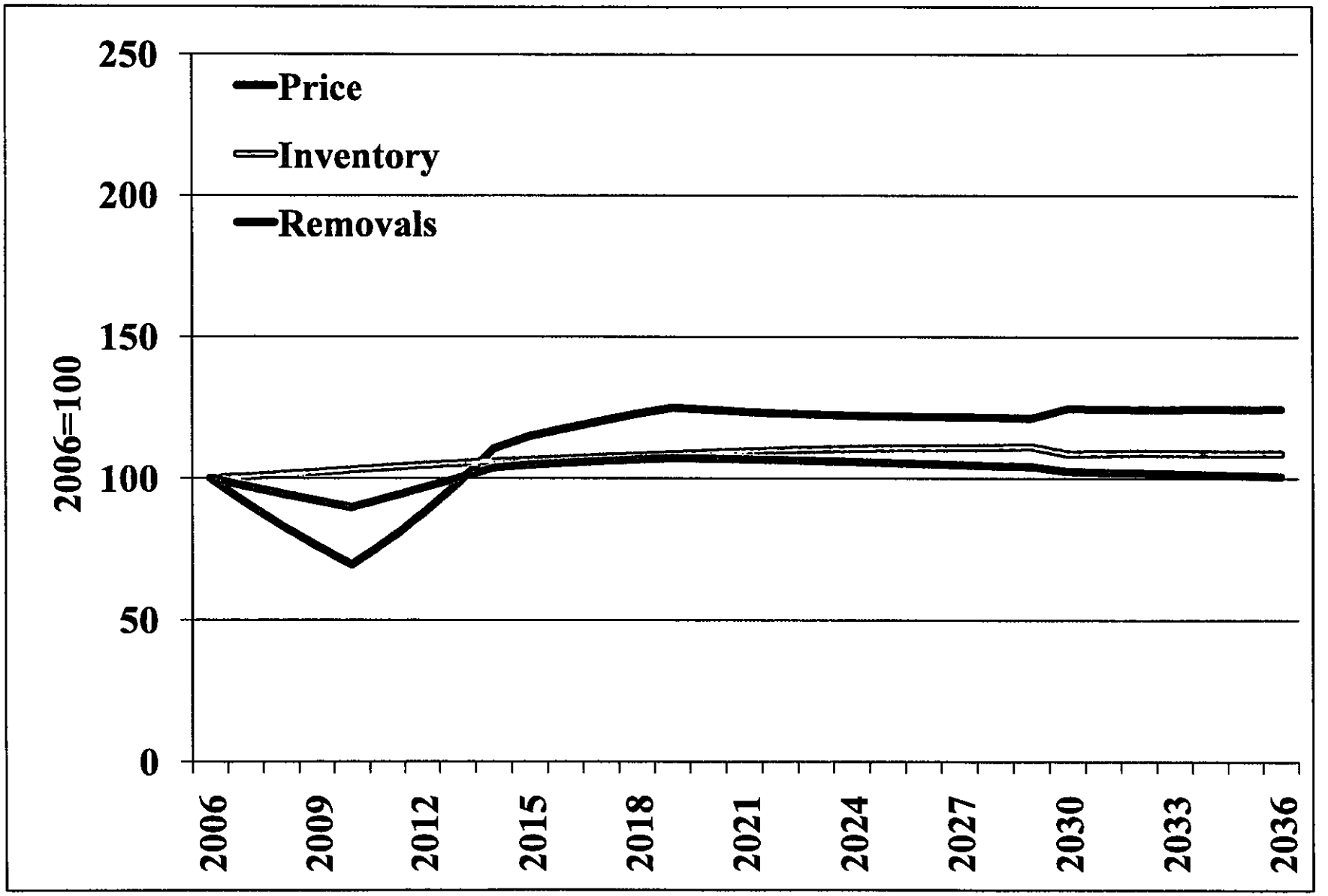
250
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2006=100
Price
Inventory
Removals
2006
2009
2012
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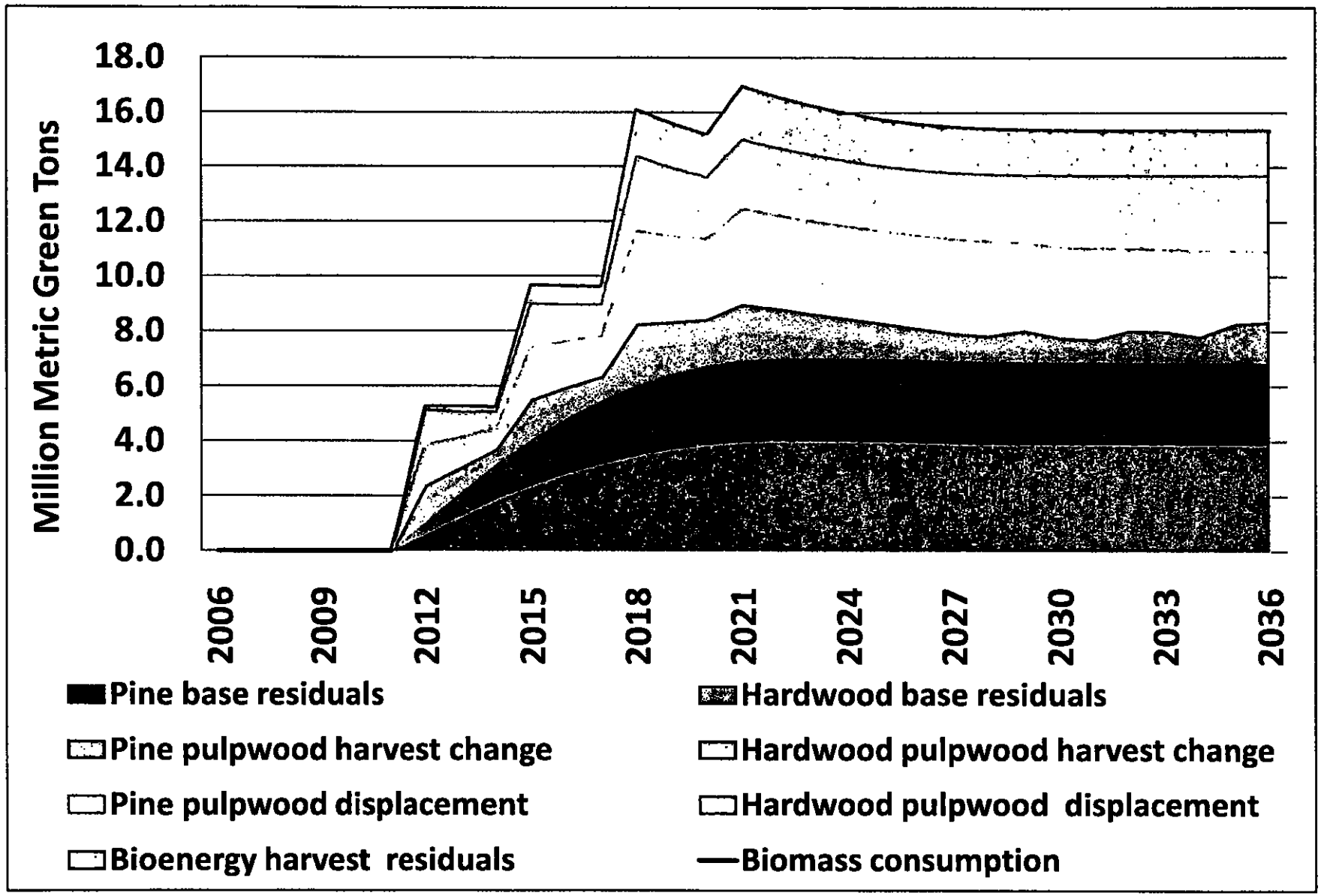
2036

24

25 Figure 6. Projected biomass sources to meet NC RPS demands from 2006 to 2036.

26


Million Metric Green Tons
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
2006
2009
2012
2015
2018
2021
2024
2027
2030
2033
2036
Pine base residuals
Hardwood base residuals
Pine pulpwood harvest change
Hardwood pulpwood harvest change
Pine pulpwood displacement
Hardwood pulpwood displacement
Bioenergy harvest residuals
Biomass consumption