Economic and Regional Impact Analysis of the Treatment of Biomass Energy Under the EPA Greenhouse Gas Tailoring Rule

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Executive Summary

This study assesses potential economic impacts to renewable energy and wood biomass markets and regional impacts on the production of renewable energy to meet national energy goals associated with EPA's final Prevention of Significant Deterioration (PSD) and Title V Greenhouse Gas Tailoring Rule (Tailoring Rule). The stated intent of the Tailoring Rule is to reduce the number of facilities required to obtain New Source Review and Title V operating permits under the Clean Air Act based on greenhouse gas (GHG) emissions. However, the rule discourages capital investment in wood-based renewable electricity generation through two mechanisms. First, the rule treats carbon emissions from biomass combustion identically to fossil fuels emissions, thereby expanding the rule's reach to include fuel sources previously considered to not emit net carbon. Second, EPA's permitting process under the Tailoring Rule places three discrete economic burdens on regulated entities: 1) costs associated with obtaining permits; 2) increased capital costs for facility investments due to delays while obtaining permits; and 3) costs associated with technology requirements, such as Best Available Control Technology (BACT).

Key conclusions of the analysis include:

I. Economic Impacts on the Renewable Energy and Biomass Markets

Nationwide the Tailoring Rule captures in the PSD permitting program 87% of the currently operating and announced wood-to-electricity projects and 92% of cogeneration facilities at forest products mills in the continental US. **Of these projects and facilities, the Tailoring Rule puts 134 projects directly "at-risk" for cancellation or delays with the following impacts by the year 2021:**

- **5,384 fewer MW of renewable electricity generation in the US;**
- **11,844 to 26,380 fewer renewable energy jobs;**
- **$18.0 billion fewer dollars of capital investment in renewable electricity generation; and**
- **53.8 million tons of wood biomass per year removed from the renewable energy marketplace.**

Economic modeling indicates that a 10% increase in capital and variable costs associated with compliance technologies can reduce an independent power producers' ability to pay for wood raw material by 40-45%, assuming the producer is seeking to avoid increasing kilowatt hour costs. Such costs often determine the economic viability of a project. For example, year-to-date public information confirms that 23 developing projects representing 1,519 megawatts of potential electrical capacity have delayed plans, are on hold, or have idled. Reasons cited by project developers for delayed plans or closures include low electricity prices/market conditions, uncertainty surrounding federal policies, such

as the Tailoring Rule[1] (including extended permitting timelines and other administrative requirements[2]), state-level RPS guidelines and difficulties securing financing.

II. Regional Impacts on Renewable Energy Production

State-level analysis and projections of renewable energy generation through 2021 indicate up to 19 states would fail to satisfy a national renewable energy target of 15% notwithstanding the impacts of the Tailoring Rule**. Because of the Tailoring Rule's potential to delay or stop the development of woody biomass electricity projects, up to 30 states would fail to meet a 15% renewable target in 2021 if the Rule is implemented in its present form.** Investment delays or curtailments in wood electricity projects under the Tailoring Rule will create particular challenges for states located in wood-rich regions with limited renewable energy options[3]—such as the South and Northeast—to meet any national renewable energy goal.

About Forisk Consulting

Forisk provides research and educational services to executives and analysts making decisions related to timber REITs, timberlands, and wood-using energy and manufacturing facilities. Forisk specializes in understanding and quantifying local wood and timber markets throughout the United States.

About the National Alliance of Forest Owners (NAFO)

NAFO is an organization of private forest owners committed to advancing federal policies that promote the economic and environmental values of privately-owned forests at the national level. NAFO membership encompasses more than 79 million acres of private forestland in 47 states. Working forests in the U.S. support 2.5 million jobs.

[1] Other federal policy concerns cited include the uncertainty of federal energy legislation and EPA's Boiler MACT regulation.

[2] EPA estimates that applying for and obtaining a PSD permit costs approximately $84,500 per applicant in administrative costs alone and applying for and obtaining a Title V permit costs $46,350. These estimates are likely low because of the novelty of GHG permitting.

[3] A number of western states, for example, derive a significant amount of energy credited toward state renewable energy standards from hydropower.

Introduction

This study assesses potential economic impacts to renewable energy and wood biomass markets and regional impacts on the production of renewable energy to meet national energy goals associated with the Environmental Protection Agency's (EPA) final Prevention of Significant Deterioration (PSD) and Title V Greenhouse Gas Tailoring Rule (Tailoring Rule). The Tailoring Rule creates disincentives to invest in and expand renewable energy capacity associated with wood-to-electricity generation. As written, the Tailoring Rule treats biomass carbon emissions as identical to fossil fuel emissions without considering the net impact of the biogenic carbon cycle. In addition, the rule fails to specify the guidelines, costs and technologies required to quantify compliance, satisfy obligations with the PSD permitting program, and secure financing to advance renewable energy project development. The purpose of this research is to estimate potential costs at the project and economic levels using explicit and verifiable assumptions and analysis and to determine associated state and regional impacts on renewable energy production capability toward national renewable energy goals.

The EPA's Tailoring Rule concerns two Clean Air Act stationary source permitting programs: the Prevention of Significant Deterioration (PSD) pre-construction permit program and the Title V operating permit program. PSD pre-construction permits must be obtained before constructing or modifying a major source of air pollutants, and require the covered source to adopt the Best Available Control Technology (BACT) for each regulated pollutant it emits. Title V operating permits must be held by each major source of air pollutants, and must catalog emissions standards to which the source is subject. Whether a source qualifies as "major" depends on whether it emits quantities of a pollutant over certain thresholds, prescribed by the Clean Air Act and agency regulations. The purpose of EPA's Tailoring Rule was to prescribe the thresholds for emissions of carbon dioxide and five other greenhouse gases, which EPA will be adding to these permitting programs on January 2, 2011.

Implementation of the Tailoring Rule as released includes two primary phases:

- Phase 1: as of January 2011, facilities already subject to New Source Review and Title V permitting for emitting other pollutants will be required to include GHG considerations in permit applications if they increase emissions by 75,000 tons or more per year of carbon dioxide equivalent.[4]
- Phase 2: effective July 2011 and through June 30, 2013, Tailoring Rule requirements will cover (1) new construction projects that emit in excess of 100,000 tons per year GHG and (2) existing facilities that increase GHG emissions by at least 75,000 tons per year, whether or not these facilities trigger permitting for emitting other pollutants. Facilities emitting at least 100,000 tons per year of GHG will also be required to account for these emissions in Title V Clear Air Act operating permits.[5]

[4] Corresponds to 7.5 to 15 MW of electrical generation, depending on fuel types and efficiency.

[5] Emissions of 100,000 tons per year of GHG correspond to 10 to 20 MW of electrically generation or 100 to 195 MMBtu per hour (depending on fuel type and efficiency). The "carbon dioxide equivalent" approach under the rule captures other greenhouse gases such as nitrous oxide (N_2O) and methane (CH_4).

EPA estimates that, between July 2011 and June 2013, 550 sources will be required to obtain operating permits for the first time due to GHG emissions. EPA expects approximately 900 new projects and facility modifications per year will require New Source Review permitting due to GHG emissions. A number of industry groups have challenged the Tailoring Rule and other GHG policies adopted by EPA in federal court. These groups dispute the EPA estimates as overly conservative.

The final Tailoring Rule, for the first time in US policy, treats carbon emissions from biomass combustion the same as fossil fuel combustion in assessing the thresholds. The established domestic and international practice is that carbon dioxide emissions from biomass combustion are not counted toward regulatory thresholds, because such emissions do not raise global concentrations of carbon dioxide. The logic is that all plant materials are ultimately derived from carbon dioxide drawn from the atmosphere by growing plants. When plant biomass materials are burned, the carbon dioxide emitted contains the same carbon that was sequestered by the plant feedstock. Thus, the combustion of biofuels does not result in net carbon dioxide emissions; rather it is part of a natural carbon cycle that is typically considered "carbon neutral."

In setting new thresholds for emission of carbon dioxide under the PSD and Title V programs, EPA's proposed Tailoring Rule maintained the government's traditional position of not counting carbon dioxide emissions from biomass combustion. However, in the final Tailoring Rule, EPA reversed this policy and provided that CO_2 emissions from biomass combustion would count toward the rule's applicability thresholds for the PSD and Title V permitting programs. See 75 Fed. Reg. 31,514 (Jun. 3, 2010). EPA further declared for the first time that it would count CO_2 emissions from biomass combustion toward the PSD and Title V thresholds, without regard to the carbon sequestration occurring in the natural carbon cycle, beginning on January 2, 2011, when GHG permitting begins.

Compliance costs of Tailoring Rule requirements for regulated facilities. EPA's permitting process for GHG imposes extensive permitting and Best Available Control Technology (BACT) compliance requirements. Using data on the current PSD program, EPA estimates that applying for and obtaining a PSD permit costs approximately $84,500 per applicant in administrative costs, and delays the onset of construction by a year. Tailoring Rule, 75 Fed. Reg. at 31,534–35. Similarly, EPA estimates that applying for and obtaining a Title V permit costs $46,350. *Id*. at 31,563. These estimates are likely low because of the novelty of GHG permitting. More importantly, EPA BACT requirements, which the agency has not yet specified for biomass energy emissions, could have significant cost implications associated with technology requirements and permitting delays. EPA stated that the unprecedented nature of GHG permitting means it may take longer to "develop control recommendations" (i.e. BACT) and to respond to "comments from various stakeholders, [and] from citizens groups to equipment vendors, who will seek to participate in the permit process." 75 Fed. Reg. at 31,540. The uncertainty surrounding these recommendations further discourages capital investment and increases overall project costs.

Renewable energy benchmark for conducting economic impact analysis. The United States does not yet have a nation-wide standard requiring a certain percentage of electricity from renewable sources, although Congress has considered several approaches to such a standard (see Appendix 1 for details).

While the future of federal policy remains uncertain, renewable energy targets enjoy bi-partisan Congressional support, and the White House has publicly stated support of renewable energy standards generally.[6] To provide context for how the Tailoring Rule could slow the development of renewable energy projects, this analysis benchmarks results against a 15% national renewable energy target by 2021, as well as an 11% target implied should utilities improve their energy efficiency.[7]

Project Analysis

Forisk estimated potential carbon dioxide emissions of announced and operating woody biomass power plants to determine which projects could be affected by the Tailoring Rule (Appendix 2 summarizes the methodology.) This analysis does not estimate emissions of the other five greenhouse gases regulated by the Tailoring Rule including nitrous oxide, methane, hydrofluorocarbons, perfluorocarbons, and sulfurhexafluoride, if they are not reported to the EPA.[8] Potential GHG emissions at bioenergy projects could be higher than estimated.

Figure 1 identifies the number of operating and announced wood-to-electricity projects that could be covered by the regulatory requirements proposed under the Tailoring Rule for GHG emissions. The baseline biomass project data (the "Bio Plant/Co-Fire" columns in Figure 1) originates from Forisk's Wood Bioenergy database, which tracks operating and announced wood bioenergy projects in the continental United States. Of the 434 projects in that database, 208 (48%) are electricity producers and co-firing projects ranging in size from 0.12 MW to 1,125 MW. **The Tailoring Rule directly applies to ~87% of publicly known operating and announced wood bioenergy projects** in the continental US.

Figure 1. Woody biomass electricity plants affected by the Tailoring Rule[9].

Status	Total			Affected by TR		
	Bio Plant/Co-Fire	FP Industry	Total	Bio Plant/Co-Fire	FP Industry	Total
Operating	64	125	189	55	115	170
Under Construction	9	2	11	6	2	8
In Development	134	17	151	119	15	134
Unknown	1		1	1		1
Total	208	144	352	181	132	313

Note: assumes projects with CO_2 emissions 100,000+ tons/year are impacted and assumes that power plant upgrades or additions to existing facilities that will increase carbon dioxide emissions by 75,000+ tons/year are impacted.
Source: Wood Bioenergy US (2010), eGRID (2005).

In addition to biomass power plants, the Tailoring Rule affects biomass cogeneration projects at forest products manufacturing facilities (the "FP Industry" columns in Figure 1). The EPA estimates that 386

[6] During the November 4, 2010 White House briefing, Press Secretary Robert Gibbs noted, "There's been bipartisan support and bipartisan proposals for things like the renewable-electricity standard….."
[7] Target in Renewable Electricity Promotion Act of 2010 (Bingaman-Brownback Bill), a stand-alone bill for establishing a national RES. Bill allows utilities to meet targets in part by improving energy efficiency up to 26.7%.
[8] CO_2e emissions are calculated from reported values of nitrous oxide and methane as reported in EPA's eGRID database.
[9] Includes operating projects and announced that are expected to be operational by 2020.

pulp and paper manufacturing facilities operate in the US (2010). GHG emissions from these facilities are sourced from the combustion of on-site fuels and as by-products of the manufacturing process or wastewater treatment. The EPA states that "almost all direct GHG emissions from pulp and paper manufacturing are the result of fuel combustion, and CO_2 emissions from stationary fuel combustion represent the majority of GHG emissions from pulp and paper mills." Cogeneration plants at industrial sized sawmills (100 MMBF a year or more) are also subject to the Tailoring Rule. The capacities of the sawmill cogeneration projects evaluated ranged from 2.5 MW to 72.9 MW, with an average of 20.2 MW.

Forest products mills (pulp/paper facilities and sawmills) with corresponding power plants in EPA's eGRID database and projects in *Wood Bioenergy US* totaled 144 mills in the US (Figure 1). Of these cogeneration facilities, 132 do or are expected to generate 75,000 tons or more per year of GHG emissions[10]. **The Tailoring Rule directly applies to ~92% of cogeneration plants at forest products mills** in the continental US that use wood as a raw material.

Economic Analysis

This economic analysis of potential impacts from the Tailoring Rule includes:

1. Potential effects on capital allocation and renewable energy jobs from delaying or canceling projects at risk;
2. Quantitative wood-electricity cost model ; and
3. Qualitative assessment of project delays related to regulatory concerns.

The capital allocation analysis quantifies potential impacts on jobs, renewable energy capacity, wood demand and investment from increasing the costs and risks of moving forward with announced, pre-construction wood electricity projects. The cost model assesses the economic implications from increasing capital (fixed) and operating (variable) costs on wood-to-electricity projects from increased permitting timelines and from complying with potential BACT requirements under the GHG Tailoring Rule. The project delay assessment documents instances and potential trends associated with investor and firm responses to perceptions and concerns of regulatory actions associated with developing additional renewable energy capacity in the US.

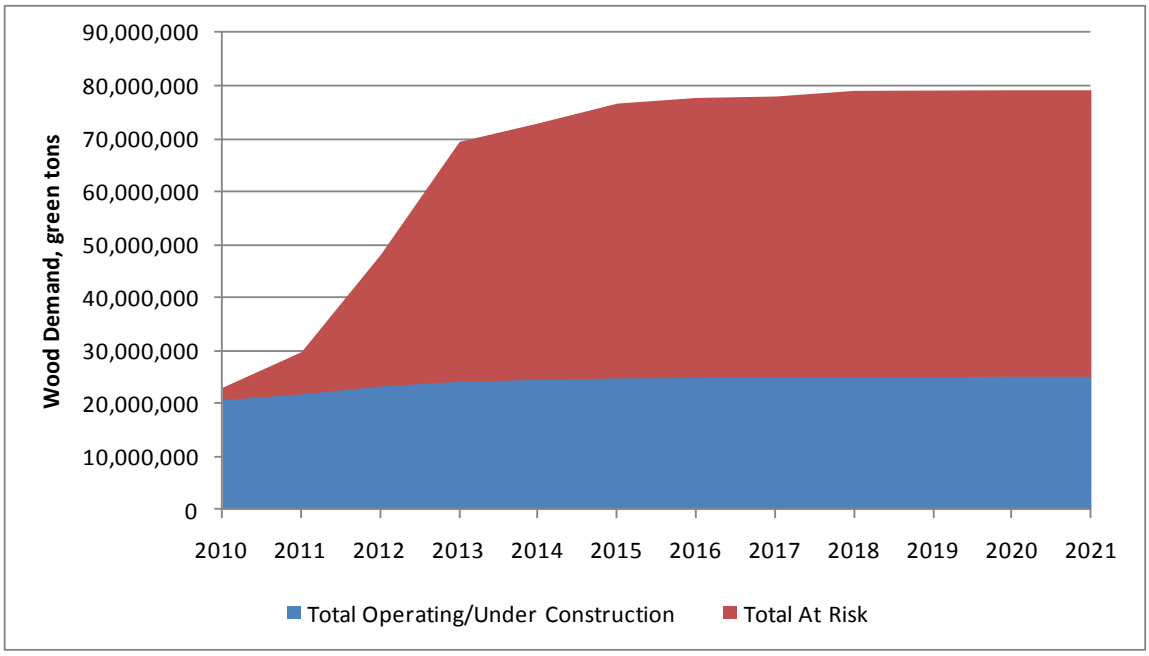
Direct economic impacts on potential wood-consuming electricity projects from Tailoring Rule compliance would flow through to per unit costs of generating biomass power from increasing fixed and variable costs at the project level. However, current guidance from the EPA does not include specifics regarding what constitutes compliance or BACT to control GHG emissions for various boiler and project types. This raises two questions for developing and upgrading wood-consuming projects:

1. What could be the impact on foregone capital investment and renewable jobs from canceling or delaying renewable energy projects currently in development?
2. What could be the magnitude of potential economic impacts on projects from complying with BACT, given that the specific technological standards have yet to be determined?

[10] Expressed as carbon dioxide equivalent (CO_2e).

To answer the first question, we screen stand alone wood-to-electricity projects, wood co-firing projects, and wood cogeneration projects at forest industry mills across the US to identify projects that are "at risk" for cancelation or delays by satisfying the Tailoring Rule. We used the list of announced and operating projects in *Wood Bioenergy US* as the baseline. In short, pre-construction, idled and closed plants were classified as "at risk", while operating and projects under construction were assumed to advance, regardless of Tailoring Rule implications. Appendix 3 details the assumptions behind identifying projects that are at risk. Figure 2 summarizes the potential magnitude on wood purchases of reducing investment in known and announced wood-to-electricity projects in the US.

Figure 2. Wood Consumption for Electricity At Risk via Tailoring Rule, 2010-2021[11]



Source: Forisk Consulting, *Wood Bioenergy US*.

Tracking and evaluating the progress of wood bioenergy markets and projects over time remains challenging for investors and legislators. Forisk developed a wood bioenergy market screening methodology to assess project viability, and documented this method in a white paper published by the National Alliance of Forest Owners (Mendell and Lang 2010). The basic methodology for the screen relies on two criteria for wood-consuming projects:

- Technology: projects that employ currently viable technology pass the technology screen. These include pelletizing technology and wood-to-electricity projects.
- Status: projects that are operational, under construction, or received or secured two or more necessary elements for advancing towards operations pass the status screen.

[11] The figure contains announced and operating facilities in the Wood Bioenergy US database. Includes announced expansions at pulp/paper and sawmill cogeneration facilities. Operating pulp/paper and sawmill cogeneration facilities are generally excluded.

Of the 244 electricity plants and projects in the *Wood Bioenergy US database* and included in Figure 2, 134 (55%) are at risk. Of the 134 projects at risk, 59 pass Forisk's screening methodology for identifying viable projects. This analysis includes both the projects that pass Forisk's screening process and those that do not, because uncertainty regarding compliance costs under the Tailoring Rule will factor into the likelihood that projects will ultimately pass the Forisk screens.

The total implications from the "at risk" projects by the year 2021 include:

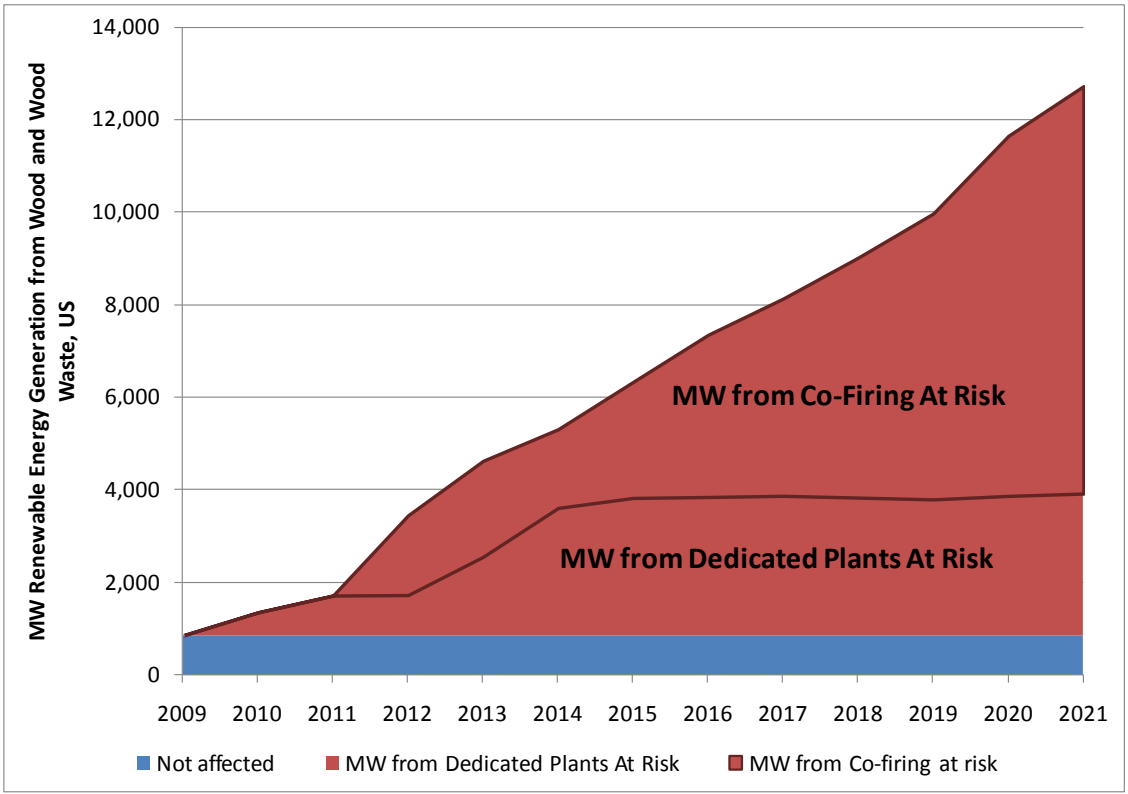
- **5,384 fewer MW of renewable electricity generation in the US;**
- **11,844 to 26,380 fewer renewable energy jobs (of which at least 3,769 would be direct, core jobs);**
- **$18.0 billion fewer dollars of capital investment in renewable electricity generation; and**
- **53.8 million fewer tons of wood biomass consumed per year at renewable energy plants.**

To put the 53.8 million tons into context, this represents a 10-12% increment to the volume of wood consumed by the US forest products industry in a given year.[12] Much of this additional volume would likely include underutilized forest or wood residues. Appendix 4 includes a detailed breakdown of the economic analysis.

Electricity generating capacity subject to the Tailoring Rule. EIA projections suggest that US renewable energy generation from wood will total 12,730 MW in 2021 (Figure 3). Dedicated energy plants would contribute nearly 30% of the renewable energy from wood while co-firing with wood represents almost 70% of the projected renewable energy generation from wood. The EIA projections imply that dedicated energy plants will add 3,065 MW of wood based energy by 2021 and new co-firing projects will add 8,803 MW of wood based energy by 2021, all of which is subject to be impacted by the Tailoring Rule.

[12] Forisk forecasts wood use by the US forest products of 534 million tons in 2020 (versus 521.9 million in 2005 and 446.4 million in 2010). Source: ForiskForecast.

Figure 3. Projections of Energy from Wood at Risk via Tailoring Rule from EIA Projections, 2010-2021



Source: EIA, 2010 and Forisk Consulting.

At the project level, what could be the cost of BACT to forest owners and wood biomass markets? To answer this question, we adapted a cost of energy model from EPA in Excel to (1) estimate the cost to produce electricity from wood and (2) estimate the sensitivity on per unit wood-to-electricity costs from increasing capital and operating costs from efforts to comply with requirements to increase efficiency or reduce GHG emissions. Two boiler types were evaluated: Stoker and Circulating Fluidized Bed (CFB). Appendix 5 details the inputs of the Excel model.

Figures 4 and 5 summarize the model results. Cells in yellow are model outputs. The total $/kWh cost of $0.107 (10.7 cents) provides a useful benchmark in comparisons with other energy generation types. For example, according to EIA, average retail electricity prices in the US in 2010 through August across sectors (residential, commercial, industrial and transportation) were 9.91 cents per kilowatt hour, with prices ranging from below 5 cents to above 20 cents across sectors and states.[13]

What could be impact on capital and variable costs for projects seeking to comply with BACT for new or upgraded facilities? Discussions with forest industry managers and bioenergy industry developers working on boiler upgrades and new projects estimate capital and variable cost impacts of five to 20 percent, depending on the combination of boiler types, boiler size, timelines, fuel types and quality, emissions control technology and variable costs. These estimates are consistent with the wide range of

[13] http://www.eia.doe.gov/electricity/epm/table5_6_b.html

options and costs summarized by the EPA's October 2010 assessment of available and emerging technologies for reducing GHG emissions from boilers (EPA 2010).

Figure 4. Estimate of per unit electricity generation from wood.

	New, Stoker Boiler, Wood	New, CFB Boiler, Wood
Capacity (MW)	50	50
Capacity Factor (%)	75	75
Operating Hours	6570	6570
Heat Input (BTU/kWh)	12200	11350
"Overnight" Capital Cost ($/MW)	3,390,000	3,495,000
Capital Recovery Charge	10.6%	10.6%
Fixed O&M ($/MW)	88,400	91,000
Capital Recovery Required ($/MWh)	54.69	56.39
Fixed O&M Recovery Required ($/MWh)	13.46	13.85
Fuel Cost ($/MWh)	35.47	32.99
Variable O&M ($/MWh)	3.60	4.10
Total Cost ($/MWh)	107.21	107.33
Total Cost ($/kWh)	0.107	0.107

Source of model: EPA GHG Mitigation DB

Figure 5. Wood fuel cost calculation.

Wood Fuel Cost	
Stumpage ($/ton)	10
Logging & Hauling ($/ton)	15
Heat Factor (BTU/ton)	8,600,000
Total Delivered price ($/ton)	25
Cost per MMBTU ($/MMBTU)	2.91

To estimate the impact on per unit renewable energy generation from wood due to increased costs, four progressive cost scenarios – ranging from 5% to 20% increases in capital and variable costs – are incorporated into the model. Figure 6 summarizes the results of this analysis. Per unit electricity costs increase about 5.6% for each 10% increase in capital and variable costs for both Stoker and CFB boilers.

Figure 6. Total Wood Electricity Cost ($/kWh) by Scenario.

Cost Scenario	Stoker Boiler	CFB Boiler	*Increase from 0.107*
5% increase, Capital & Variable	0.11	0.11	*2.80%*
10% increase, Capital & Variable	0.113	0.113	*5.61%*
15% increase, Capital & Variable	0.116	0.116	*8.41%*
20% increase, Capital & Variable	0.119	0.119	*11.21%*

To assess the potential impact on wood markets, we model the implied impact on power generators' ability to pay for wood by asking the question, "as capital and variable costs increase, what can renewable energy producers pay for wood (stumpage) and maintain 10.7 cents per kilowatt hour cost?" While results vary by boiler type, **results indicate that a 10% increase in capital and variable costs could reduce the renewable electricity producer's ability to pay stumpage fees to forest owners by 40-45%** from the baseline and maintain constant kilowatt hour costs. A 20% increase in capital and variable costs reduces potential stumpage payments by 85-95% per ton and still maintain constant kilowatt hour costs. Figure 7 summarizes these results.

Figure 7. Stumpage Price Paid to Forest Owners at 10.7 cents per KWh, $/ton

Cost Scenario	Stoker Boiler	CFB Boiler
5% increase, Capital & Variable	$8.00	$7.50
10% increase, Capital & Variable	$6.00	$5.50
15% increase, Capital & Variable	$4.00	$3.00
20% increase, Capital & Variable	$1.50	$0.50

These results rely on the assumed costs, conversions and technologies in the model, and would vary based on the specific project and wood fuel characteristics. They also assume that maintaining static kilowatt hour costs is a primary objective and do not account for the impacts on reducing GHG emissions and the cost/benefits associated with various control technologies. Finally, this type of analysis does not reflect how costs can be passed on to consumers in utility-based energy programs. While the "ability to pay for wood" more directly applies to independent developers, especially as developers seek financing, the ability to pay for electricity clearly affects consumers.

In addition to the modeled power generation costs, economic impacts may result in projects extending timelines or cancelling efforts due to uncertainty associated with pending regulatory decisions or the actual or perceived flexibility of regulations once in place. Forisk's tracking of operating and announced wood-consuming energy projects indicates that general uncertainty associated with financial markets and regulatory/legislative decisions significantly affect investments in wood bioenergy markets. For example, as of October 26, 2010, Forisk's database included 434 projects focused on producing wood pellets, electricity or liquid fuels, such as cellulosic ethanol. Based on Forisk's screening methodology, 270 are or are expected to be operating and consuming wood to generate energy products by the year 2020.

Pellet, cellulosic ethanol and wood-to-electricity projects face distinct challenges. However, wood-to-electricity projects confront most directly the uncertainty associated with pending state and federal legislative and regulatory decisions associated with renewable energy standards, air quality and boiler technologies, carbon accounting, and qualifying raw material definitions.

While tracking projects, we communicate with project managers, investors and agencies. For wood-to-electricity projects, primary concerns over the past 20 months included (1) financing and (2) legislative or regulatory uncertainty. **For example, year-to-date public information confirms that 23 developing**

projects representing 1,519 megawatts of potential electrical capacity have delayed plans, are on hold, or have idled. Additional firms have been impacted, but have chosen to remain anonymous. Reasons for delayed plans or closures include low electricity prices/market conditions, awaiting a federally mandated RES, awaiting the EPA Boiler MACT and Tailoring Rule decisions, extended permitting timelines, state-level RPS guidelines and difficulties securing financing.

Over the past two months, several firms specified uncertainty associated with EPA regulations in delaying or cancelling potential capital investment. Southern Company and Oglethorpe Power in Georgia have both delayed or extended co-fired and new construction projects. Oglethorpe estimates a 5% cost increase from the need to delay construction from 2014 to 2015 of a project in Warren County. On November 30, 2010, Xcel Energy announced the intent to stop plans to build a biomass power plant on the shore of Lake Superior in Ashland, Wisconsin. The firm cited cost increases, declining costs for alternative energy generation options, and "considerable regulatory uncertainty at the state and federal level." In the traditional forest products sector, Anthony Forest Products decided on November 19, 2010 not to rebuild its Atlanta, Texas sawmill, which was destroyed by fire in February. According to the firm's public statement, the board of directors based its decision on the business risk associated with lumber markets and EPA's proposed rules related to the production of biomass energy.

Regional Analysis

This portion of the analysis evaluates current and potential renewable energy generation at the state and regional level to identify where in the US renewable energy development could be constrained through increased compliance costs under the Tailoring Rule. The analysis utilizes two data sources: (1) the Annual Energy Outlook 2010, published by the Energy Information Administration (EIA), and (2) Forisk's *Wood Bioenergy US*, which is a database of operating and announced bioenergy facilities that utilize wood as a feedstock. As of October 26, 2010, Forisk's database included 434 projects focused on producing wood pellets, electricity or liquid fuels, such as cellulosic ethanol.

The two datasets provide different views of the developing biomass energy market, both of which provide important points of reference. EIA projects the growth of renewable energy generation required to satisfy existing legislation and state energy targets (i.e. RPS requirements). EIA assumes that project developers will spend the capital investment needed to build new biomass plants or convert boilers to co-fire biomass with coal to satisfy these projections, regardless of current development activity. Forisk projections from *Wood Bioenergy US* estimate renewable energy generation from wood resources based on publicly-announced projects in development and plants currently operating. Forisk projections are more conservative in the long run than the EIA's projections in that Forisk only projects renewable energy generation from wood-using projects that have been announced (i.e. are currently in the pipeline) or from plants currently operating.

Figure 8 summarizes EIA results of projected renewable energy generation for retail markets in the US (2010). This data accounts for existing legislation and state energy targets. EIA's projections indicate the US would barely meet a 15% renewable electricity standard by 2021 given the assumed mix of

renewable energy types, cogeneration projects and facility expansions. However, wood-to-electricity generation is expected to grow more than seven-fold by 2021 to become an increasingly critical portion of US renewable energy portfolio.

Figure 8. Projected Renewable Electricity Generation as Percent of Total, US[14]

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Renewable Electricity, % of total US	11.8%	13.0%	14.1%	14.3%	14.5%	14.5%	14.6%	14.6%	14.6%	14.7%	14.8%
Renewable from Wood/related, % of total US	0.3%	0.6%	0.9%	1.0%	1.2%	1.3%	1.5%	1.6%	1.8%	2.0%	2.2%
Rewewable from Wood/related, % of renewable	2.7%	4.9%	6.1%	6.9%	8.0%	9.2%	10.0%	11.0%	12.0%	13.8%	14.8%

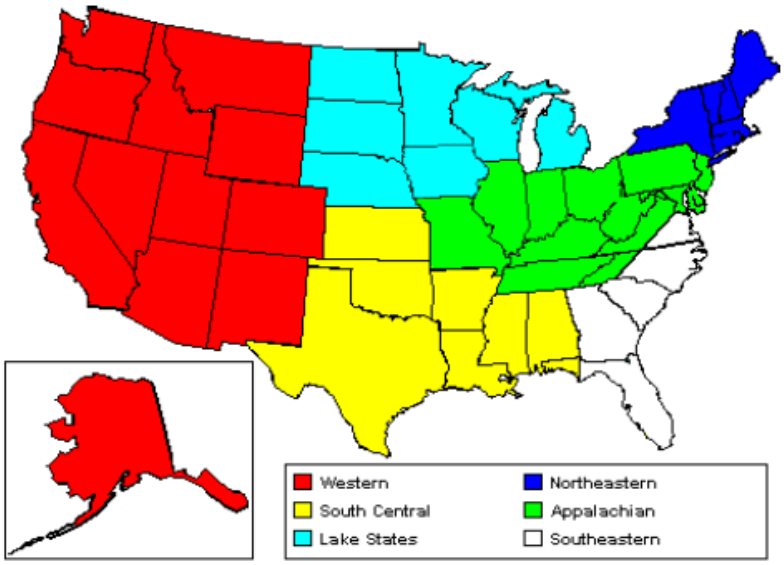
States that lack renewable energy targets similar to those considered for federal policy are, in many instances, well-positioned to substantially increase electricity generation from renewable sources to meet such a target. In some cases, such as in Georgia, Florida and Mississippi, states are already experiencing significant movement toward increased production and utilization of biomass for energy. State-level decisions of what energy types to pursue will depend upon available renewable resources in the state as well as the cost to build and operate each type of electric generating facility. To analyze implications at the state and regional level, this analysis projects renewable energy generation in total and from woody biomass by state through 2021. Appendix 6 details the methodology.

The study regions are comprised from the Forest Resource Association's (FRA) regions outlined in Figure 9 below and include:

- West;
- Lake States;
- Appalachian;
- Northeast; and
- South (Southeast + South Central).

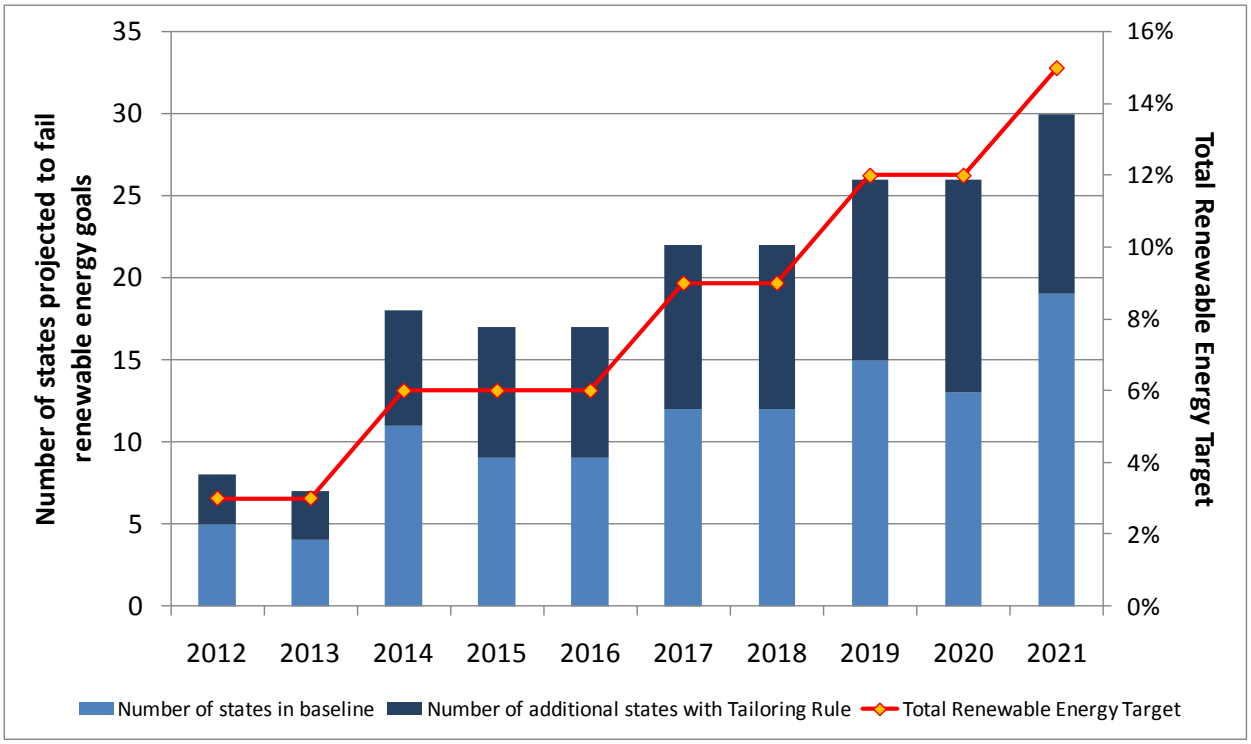
[14] EIA's projection includes facilities whose primary purpose is to generate electricity for retail markets.

Figure 9. Regions Used in Study



The state-level forecasts reveal that by 2021, 19 of the 50 states and Washington, D.C. would fail to meet a 15% renewable electricity target (Figure 10). Of the 19 states, 11 would be located in the Appalachian region. Because of the Tailoring Rule's potential to delay or stop the development of woody biomass electricity projects, up to 30 states would fail to meet a 15% renewable target in 2021 if the Rule is implemented in its present form. A stop to wood electricity development affects states in the South to the greatest degree. Only three states in the South fail a 15% RES in 2021 if electricity generation from wood expands as projected from EIA data; this number could grow to 11 if the Tailoring Rule halts wood bioenergy electricity projects. The Lake States and Northeast are also affected by the Tailoring Rule. Two additional states in the Lake States and one state in the Northeast would fail a 15% RES in 2021 if the Tailoring Rule halts wood electricity project development. Appendix 7 details the impacted states.

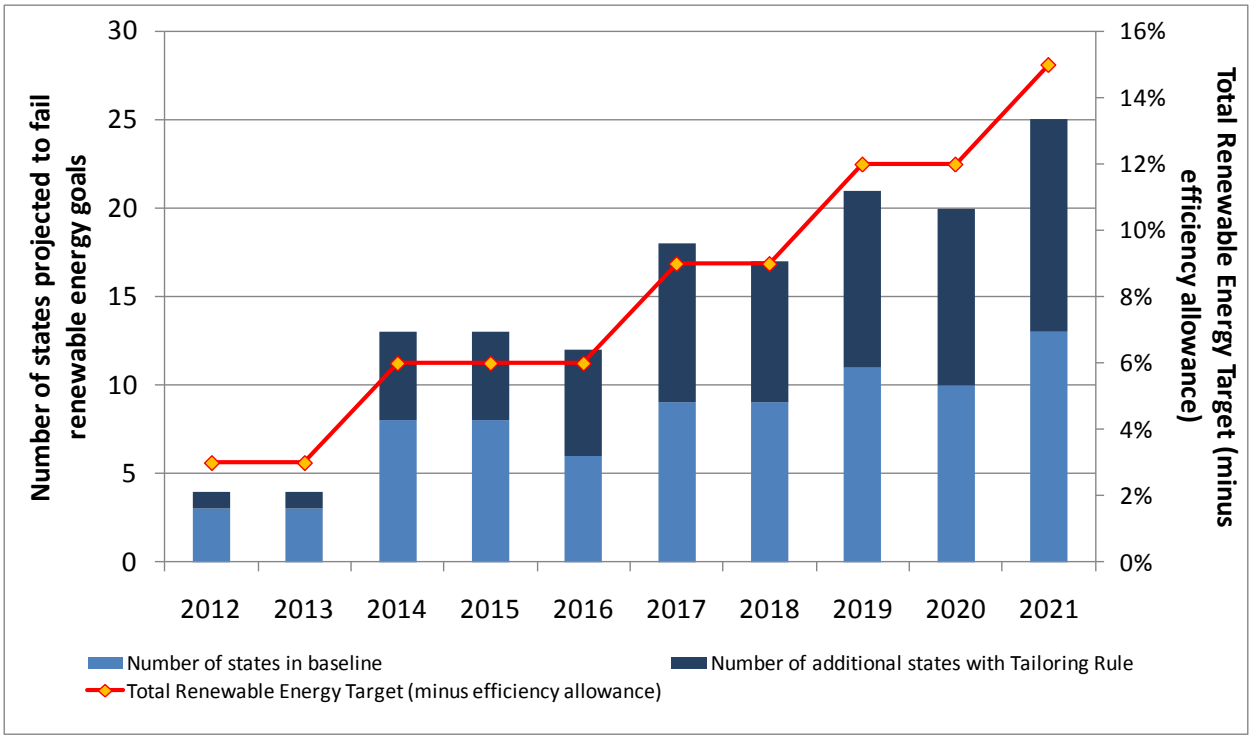
Figure 10. Number of States that Fail to Achieve 15% Renewable Electricity Generation, 2012-2021



Source: EIA, Forisk Consulting.

The proposed stand-alone RES standard in the Bingaman-Brownback Bill (introduced in September 2010) gives utilities credit for improving energy efficiency up to 26.7% of renewable goals, which results in an implied 11% RES target. Figure 11 projects state-level forecasts against an 11% renewable energy standard. The analysis assumes that all affected states maximize the opportunity to improve energy efficiency. The results indicate that by 2021, 13 of the 50 states and Washington, D.C. would still fail to meet an 11% renewable electricity target. Of the 13 states, 9 would be located in the Appalachian region, 3 in the West, and one in the Lake States. Again, this number increases to 25 states under the Tailoring Rule given the adverse impact of the rule on project development in states that will rely on expanding wood biomass electricity generation to satisfy a 11% standard by 2021. Appendix 7 details the impacted states.

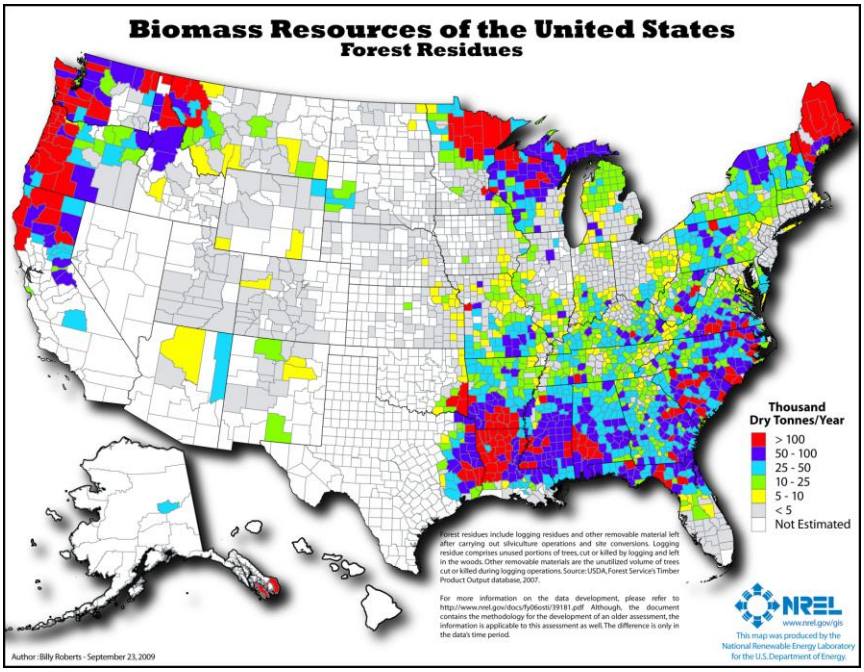
Figure 11. Number of States that Fail to Achieve 11% Renewable Electricity Generation, 2012-2021



Source: EIA, Forisk Consulting.

For states considering wood bioenergy projects, available wood for energy largely depends upon the location of forests. Most US forest resources are located in the South, Northeast, Northwest, and portions of the Lake States and Appalachia (Figure 12). While the map only shows one type of forest biomass, forest residues, it highlights those regions with the highest forest management activity and corresponding biomass energy production potential.

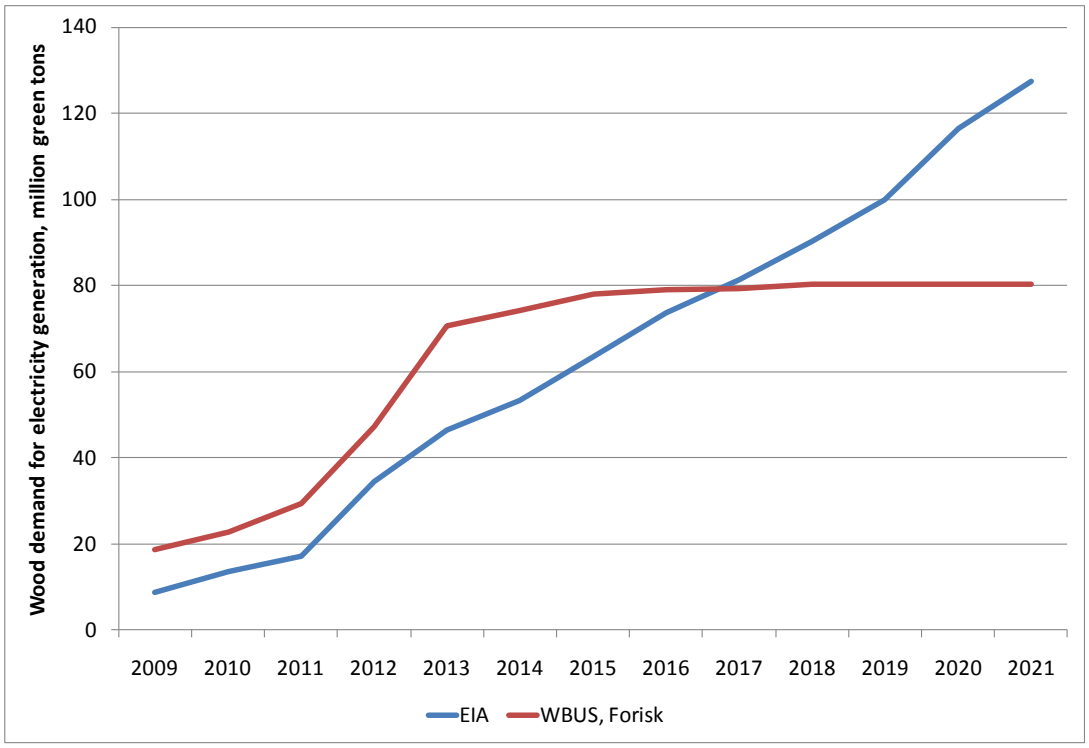
Figure 12. Forest Residue Supply, 2007



Source: NREL.

The projections from EIA imply that wood use for electricity generation in the US will increase from 8.6 million green tons per year in 2009 to 127.8 million green tons per year in 2020 to satisfy renewable energy targets (Figure 13). These projections are independent of any assessment of the volume and availability of wood raw materials in the US, and the status and capacity of announced wood bioenergy projects. According to Forisk projections from all projects in *Wood Bioenergy US*, wood consumption for electricity totaled 18.7 million tons per year in 2009 and this increases to 80.4 million if all projects come online by 2021. The two projections differ for the following reasons: (1) the methodologies differ: EIA projects renewable energy generation based on current legislation and state renewable energy targets while Forisk projects wood electricity generation based on project announcements; (2) the EIA projection include only retail electricity while Forisk's projection includes all wood electricity announcements; (3) the EIA includes increased wood use from co-firing while Forisk does not project beyond current announcements. Appendix 8 details the methodology for these projections.

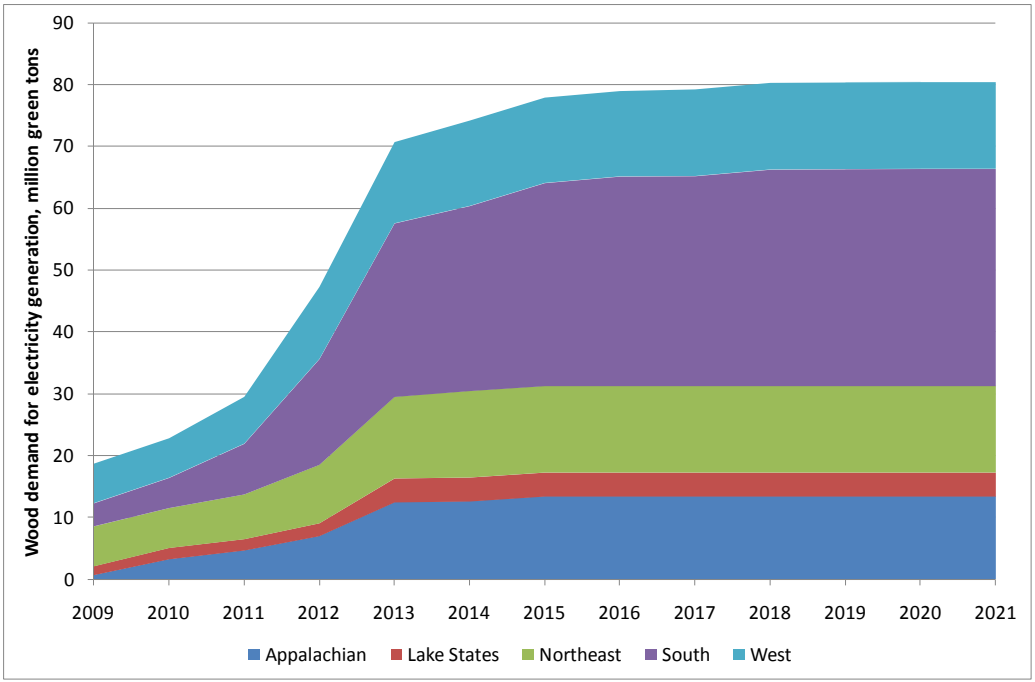
Figure 13. Estimated Wood Use by Electricity Plants, 2009-2020



Source: EIA, Forisk Consulting

By 2021, the South is projected to consume 43.7% of the wood used for electricity generation in the United States (Figure 14). The West and Northeast tie for second place, each consuming 17.4% of the wood to produce electricity in 2021 in the US.

Figure 14. Estimated Wood Use by Announced and Operating Electricity Facilities in WBUS, 2009-2020.



Source: Wood Bioenergy US, Forisk Consulting

EIA projections are based on expected levels of renewable energy capacity to satisfy state-level RPS standards and increases in demand. Forisk projections are based on analysis of actual operating and announced projects as of October 2010. The Forisk analysis implies that (1) regardless of the desire for more wood bioenergy capacity, the number and size of projects required to satisfy renewable standards and market expectations are not in the pipeline and (2) any policy, such as the Tailoring Rule, that slows the development of renewable energy will further increase the gap between renewable energy targets and viable renewable energy projects.

The EIA outlook projects co-firing woody biomass at coal-fired power plants to be a substantial type of woody biomass electricity generation over the next ten years. By 2020, the EIA projects biomass co-firing to comprise 70% of the electricity generated from woody biomass. Forisk's analysis indicates that a major shift and acceleration of capital allocation and project development would be required to achieve these projections. **The Tailoring Rule has the potential to halt the development of woody biomass electricity projects, which are projected to contribute as much as 15% of the renewable energy generation in the US by 2021**. If the Tailoring Rule curtails or stops investment in wood electricity projects, then states located in wood-rich regions – the South and Northeast—will be particularly challenged to meet any federal renewable energy targets.

Other risks exist. The **EIA projections assume that woody biomass will qualify as a renewable energy source** to satisfy state and potentially federal energy targets. The Tailoring Rule, by regulating biomass greenhouse gas emissions by the same standards as fossil fuels, sets a precedent for biomass to be considered, from an emissions standpoint, no different than coal or other fossil fuels.

Conclusions

This study assesses potential economic impacts to renewable energy and wood biomass markets associated with the EPA's Tailoring Rule for greenhouse gas emissions (GHG). In its current form, the Tailoring Rule treats biomass combustion emissions equivalently to fossil fuel emissions, and thus captures biomass facilities within the PSD permitting program. This adversely impacts compliance costs and the ability to secure financing and advance renewable energy project development. Specifically, the Tailoring Rule could put "at-risk" 134 projects with total implications by the year 2021 of:

- 5,384 fewer MW of renewable electricity generation in the US;
- 11,844 to 26,380 fewer renewable energy jobs (of which at least 3,769 would be direct, core jobs);
- $18.0 billion fewer dollars of capital investment in renewable electricity generation; and
- 53.8 million fewer tons of wood biomass consumed per year at renewable energy plants.

Additionally, because of the Tailoring Rule's potential to delay or stop the development of woody biomass electricity projects, up to 30 states would fail to meet a 15% renewable target in 2021 if the Rule is implemented in its present form. Investment delays or curtailments in wood electricity projects under the Tailoring Rule will create particular challenges for states located in wood-rich regions with limited renewable energy options—such as the South and Northeast—to meet any national renewable energy goal.

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Appendix 1: Proposed Renewable Electricity Standards (RES)

Current and potential requirements – implemented through state "Renewable Portfolio Standards" (RPS) and federal "Renewable Electricity Standards" (RES) – on electricity providers provide incentives and drivers to pursue and build-out wood-to-electricity plants and wood-cogeneration projects. In 2009 and 2010, members of Congress proposed three national RES levels, which would require certain retail electricity suppliers to provide a minimum percentage of the electricity they sell from renewable energy sources. None of these bills are expected to pass, though the RES levels in the Senate Bills have bi-partisan support and the White House has publicly stated support of renewable energy standards generally. The three RES standards are:

- **The American Clean Energy and Security Act of 2009,** also known as the **Waxman-Markey Bill**, which passed the House in June 2009. Under the RES proposed in Waxman-Markey, utilities would be required to produce 6% of total electricity from renewable sources by 2012 and 20% by 2020. Eligible renewable sources include wind, solar, geothermal, renewable biomass, biogas and biofuels derived exclusively from renewable biomass, qualified hydropower commissioned after 1992, and marine and hydrokinetic sources.
- **The American Clean Energy and Leadership Act of 2009,** also known as the **Bingaman-Murkowski Bill,** would require utilities to produce 3% of their supplies from renewable energy sources or energy efficiency in 2011 and 15% by 2021.
- **Renewable Electricity Promotion Act of 2010,** also known as the **Bingaman-Brownback Bill**, introduced a stand-alone bill for establishing a national RES. The RES in this bill is nearly identical to that proposed in the Bingaman-Murkowski Bill in 2009. Utilities could meet the standards through multiple ways in addition to producing the specified amount of electricity. These alternatives include efficiency savings; purchase renewable energy or efficiency savings; purchase renewable energy credits or energy efficiency credits; or make alternative compliance payments. In particular, we note that the bill allows 26.7% of the annual requirement to be met by energy efficiency and have incorporated this option in the analysis.

Figure 15 below provides year-by-year requirements for comparison, along with the implied RES required assuming utilities satisfy the energy efficiency requirements.

Figure 15. Proposed RES by Bill and by Year

Bill	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Waxman-Markey (House)		6.0%	6.0%	9.5%	9.5%	13.0%	13.0%	16.5%	16.5%	20.0%	20.0%
Bingaman-Murkowski (Senate)	3.0%	3.0%	3.0%	6.0%	6.0%	6.0%	9.0%	9.0%	12.0%	12.0%	15.0%
Bingaman-Brownback (Senate)		3.0%	3.0%	6.0%	6.0%	6.0%	9.0%	9.0%	12.0%	12.0%	15.0%
Bingaman-Brownback (Senate) minus efficiency		2.2%	2.2%	4.4%	4.4%	4.4%	6.6%	6.6%	8.8%	8.8%	11.0%

Appendix 2: Methodology for Estimated CO_2 Emissions

The following methodology was used to estimate carbon dioxide emissions of biomass power plants:

1. Wood use, in green tons per year, came from the *Wood Bioenergy US* database
2. CO_2 rate for wood power plants of 215.69 lbs CO_2 emissions/MMBTU input heat (Manomet 2010)
3. Heat factor of 8.6 MMBTU/ton of green wood (ORNL, Forisk Consulting)

To determine the CO_2 emissions of each project, in tons per year, the following formula was used:

Wood use (green tons per year) * 8.6 MMBTU/ton green wood * [(215.69 lbs CO_2/MMBTU)/2000 lbs per ton].

The following methodology was used to estimate CO_2e emissions at pulp and paper mills:
Forisk analyzed a subset of pulp and paper mills in the US. The Wood Demand Database maintained by Forisk includes wood-using facilities (that consume roundwood or woods chips). Facilities in the Wood Demand Database were matched with power plant data in the EPA eGRID database. The eGRID database reports greenhouse gas emissions from 2005 but omits emissions from biogenic sources as they were considered carbon-neutral. In cases, the unadjusted estimates of carbon dioxide emissions contained GHG emissions from wood sources. Reported N_2O and CH_4 emissions were converted to CO_2e[15] using the methodology outlined by the EPA in its guidance on the Tailoring Rule. Forisk estimated carbon dioxide emissions from wood fuels as described in above and compared the calculated emissions to the reported emissions. CO_2e estimates of N_2O and CH_4 were added to the reported CO_2 values and the estimated CO_2 values. The higher estimate of GHG emissions was used to determine if the Tailoring Rule would apply (either calculated or reported). In addition, projects were added from Forisk's Wood Bioenergy US database, including cogeneration projects in development and operating projects not included in eGRID. Carbon dioxide emissions were estimated from wood use for these projects as well.

[15] Carbon dioxide equivalents

Appendix 3: Analysis and "At Risk" Methodology

Analysis of the Tailoring Rule comprised three components: regional, project level and economic.

- **Regional analysis** includes the assessment by state and five (5) core regions of the potential impacts of national RES standard levels. The purpose is to identify those states and regions with the greatest need and "hurdles" to satisfy potential RES standards and determine those potentially impacted by regulations that could affect the ability to build up RES-satisfying renewable electricity capacity. Ultimately, this addresses the question, "how might the Tailoring Rule affect the contribution of wood biomass to meet future energy demand and renewable electricity requirements?"
- **Project level analysis** includes the identification and screening of potential sources of bioenergy to identify which types, sizes and locations of projects could be most directly affected by Tailoring Rule standards and put "at risk" (see below). The three types of bioenergy production include (1) currently operating projects/boilers at forest industry pulpmills and operating biomass power plants 50+MW in size; (2) bioenergy production at industrial sawmills[16]; and (3) proposed/announced wood bioenergy projects in the US expected to consume 50,000+ tons per year of woody biomass.
- **Economic analysis** includes estimated/assumed cost impacts from Tailoring Rule compliance and potential effects on the build-out of future wood-to-electricity power generation capacity. These impacts are quantified nationally with respect to potential capital allocation to renewable energy, renewable electricity generating capacity, renewable energy jobs and wood biomass consumption.

The methodology applied to identify and screen "at risk" projects associated with increased capital and variable costs from Tailoring Rule relies on specific, transparent assumptions.

1. Assumed Tailoring Rule impacts developing projects to a greater degree than operating projects.
2. Removed operating plants from the "at risk" group with the assumption that operating plants will continue to run unless the Tailoring Rule increases costs dramatically. These plants already have energy customers and will likely not shutter due to uncertainty with the Tailoring Rule alone.
3. Removed plants currently under construction from the "at risk" group. The thinking is that firms building plants will continue to do so and will attempt to manage Tailoring Rule compliance once required to renew air permits.
4. Included all plants in the pre-construction phase as "at risk" as these projects are most likely to delay or be cancelled due to increased investment costs and uncertainty from the Tailoring Rule.
5. Included all plants that are idled, shut-down, or on-hold as "at risk". The idea is that additional costs or uncertainty from the Tailoring Rule will contribute to the decision to shut down or remain idled.[17]

[16] With respect to sawmills, we note that cogeneration plants at sawmills are viewed primarily as ways to generate additional cash flow, especially in markets where mill residue values decreased due to loss of customers (Anderson 2010). This contrasts with pulp/paper mills where cogen plants reduce on-site electricity and fuel costs. Sawmills are not optimal customers from on-site cogen plants as they typically operate on shifts (not 24 hours), while pulp/paper mills run 24/7.

[17] Examples of such projects include sawmill cogeneration efforts at Sierra Pacific, the biomass conversion at Southern Company's Plant Mitchell, and projects associated with SunMark Energy and Modesto Irrigation District.

Assumptions applied in the “at risk” analysis could vary significantly due to situations such as:

- If the costs to comply with the Tailoring Rule exceed estimates and expectations, some operating plants may choose to shut-down if they cannot finance additional investment. This would further increase estimated impacts on renewable energy capacity, investment and jobs.
- If the costs to comply with the Tailoring Rule are minimal and compliance straight-forward, many projects viewed as “at risk” would be considered viable. This would reduce the projected impacts on capital investment, renewable energy projects and jobs.
- Plants currently under construction may delay construction timelines to evaluate potential impacts of the Tailoring Rule or obtain additional financing to comply with the rule. This would delay the development of renewable electricity capacity.
- If the Tailoring Rule leads to a political decision that woody biomass does not qualify as a renewable fuel under a federal energy standard, then all plants under construction or in pre-construction are at risk. Operating biomass plants may also shut down, sell, or change fuel type.

Appendix 4: Screening and Impact from At Risk Projects

To evaluate the impacts on jobs, MW of renewable energy, and wood use Forisk used the following methodology:

- Determined wood use over time of projects "at risk" by the Tailoring Rule from the Forisk Wood Bioenergy US database.
- Converted wood use to MW of capacity by applying the factor 10,000 tons of wood per MW.
- Converted wood use to core and total jobs by applying job factors for biopower developed by RISI (2010): 0.07 core jobs per 1,000 short tons of wood; 0.22 total jobs per 1,000 short tons of wood. Core jobs are directly linked to primary production, while total jobs include other aspects of the supply chain such as logging and wood procurement.
- For comparison, we (1) estimated total jobs impacted using the 4.9 total jobs per MW estimate from the National Renewable Energy Laboratory (NREL) by Morris (1999) and (2) estimated a job factor per MW of electric capacity from the Biomass Power Association (BPA) (2010). According to the BPA, biomass generates 8,500 MW of electricity per year and employs 14,000 people. This implies a job ratio of 1.65 jobs per MW. The BPA estimate falls between the core and total job estimates from RISI, indicating that the RISI estimates represent lower and upper bounds of jobs impacted by the Tailoring Rule. We report a range of jobs impacted based on the RISI and NREL factors.
- The implied capital investment at risk by the Tailoring Rule was calculated by data in the Wood Bioenergy US database. The average cost of $3.43 million/MW is from all announced electricity projects (including CHP) from the Wood Bioenergy US database as of October 18, 2010 that include a capital cost estimate. As of October 2010, capital cost estimates for 41 wood to electricity projects were included in the database with a range from 3 MW to 100 MW of capacity. The average was calculated by dividing the capital cost (in million $) by the MW capacity of each project. The dataset includes operating and proposed projects (six of the 41 projects included are operating) and includes five cogeneration projects at pulp/paper mills or sawmills. Capital costs ranged from $0.77 million/MW to $12.50 million/MW. For comparison, the capital costs estimated by the EPA in the GHG Mitigation Database (2010) was $3.39 million/MW for a 50 MW plant with a stoker boiler and $3.495 million/MW for a 50 MW plant with a circulating fluidized bed boiler.
- To calculate the implied capital investment, the MW of at risk plants was multiplied by the average capital cost of $3.43 million/MW.

Figure 16 outlines the detailed impacts.

Figure 16. Job, Capital Investment, and Wood Use Impacts from the Tailoring Rule.

	2010	2011	2016	2021
Biomass Power Plant				
Tons	0	2,240,625	42,964,785	44,174,785
MW	0	224	4,296	4,417
Core Jobs	0	157	3,008	3,092
Total Jobs (RISI)	0	493	9,452	9,718
Tota Jobs (NREL)	0	1,098	21,053	21,646
Co-Fire with Coal				
Tons	2,250,000	4,982,000	6,701,500	6,701,500
MW	225	498	670	670
Core Jobs	158	349	469	469
Total Jobs (RISI)	495	1,096	1,474	1,474
Total Jobs (NREL)	1,103	2,441	3,284	3,284
Cogen at Pulp/Paper				
Tons	0	120,000	2,110,000	2,110,000
MW	0	12	211	211
Core Jobs	0	8	148	148
Total Jobs (RISI)	0	26	464	464
Total Jobs (NREL)	0	59	1,034	1,034
Cogen at Sawmill				
Tons	90,000	600,000	850,000	850,000
MW	9	60	85	85
Core Jobs	6	42	60	60
Total Jobs (RISI)	20	132	187	187
Total Jobs (NREL)	44	294	417	417
Total at Risk				
Tons	2,340,000	7,942,625	52,626,285	53,836,285
MW	234	794	5,263	5,384
Core Jobs (RISI)	164	556	3,684	3,769
Total Jobs (RISI)	515	1,747	11,578	11,844
Total Jobs (NREL)	1,147	3,892	25,787	26,380
Jobs from BPA	386	1,311	8,683	8,883
Tons pass screens	2,340,000	6,492,625	25,197,125	25,197,125
Implied Capital Investment (million $)	$782	$2,653	$17,577	$17,981

Appendix 5: Wood Electricity Cost Model

The core Excel model comes from the EPA GHG Mitigation Database. It evaluates the cost to produce electricity from wood, absent transmission and distribution costs, from new facilities using two boiler types: Stoker and Circulating Fluidized Bed (CFB). Model inputs include:

- Capacity: plants are assumed to be 50 MW in size.
- Capacity factor: assumes 75% utilization.
- Operating hours per year: assumes 6570 (equivalent to 75% of all hours per year).
- Heat input (Btu/kWh): higher heat rates are associated with less efficiency. As such, the Stoker boiler has a higher heat input than the CFB boiler.
- Capital cost: broken down as "overnight" capital cost on a $/MW basis
- Capital recovery charge (%): per EPA, assumes 10.6%
- Fixed O&M ($/MW): fixed operations and maintenance
- Variable O&M ($/MWh): variable operations and maintenance
- Fuel Cost ($/MWh): estimated fuel costs include four inputs: stumpage price for wood on a $/ton basis; logging and hauling costs on a $/ton basis[18]; a heat factor on a BTU/ton basis[19]; and the heat input rate of the respective boilers.

[18] Stumpage costs are added to logging and hauling costs to estimate the total delivered costs of the wood raw material. We assume $10 per ton for longwood pulpwood and minimum hauling distances.

[19] Heat factor conversion source is Oak Ridge National Laboratory conversions sheet, http://bioenergy.ornl.gov/papers/misc/energy_conv.html. The mid-range value of 8600 BTU/dry lb is converted to BTU/green ton assuming 50% moisture content of green wood.

Appendix 6: Methodology for Projecting Renewable Energy by State

The following methodology was used to project renewable energy by state and type through 2020:

- National electricity (heat and power) generation forecasts were adopted from the Energy Information Administration (EIA) Energy Outlook for 2010 for each type of generating source**.** The EIA projections include effects of federal tax credits, state requirements for renewable electricity generation, and the loan guarantee program in EPACT2005 and ARRA[20].
- Most currently available (2008) state-level electricity generation profiles and volumes were obtained from EIA to provide a baseline and distribution of renewable energy generation across US regions.
- EIA's US-wide energy forecast was scaled down to the state level by applying forecasted growth rates for electricity generation by type to existing generating capacity type (both renewable and non-renewable) in each state through 2030.
- Renewable electricity generation, as a percent of total electricity generation, was calculated from the forecasted numbers for each state and US region.
- State-level generation was compared to RES standards outlined in the Bingaman-Brownback Bill as an example of a potential federal RES.

[20] http://www.eia.doe.gov/oiaf/aeo/electricity.html

Appendix 7: States that Fail Renewable Energy Targets in 2021

		Tailoring Rule		Baseline	
Region	State	Total Renewable Target (15%)	Renewable Target minus Efficiency (11%)	Total Renewable Target (15%)	Renewable Target minus Efficiency (11%)
Appalachian	DC	x	x	x	x
Appalachian	IL	x	x	x	x
Appalachian	IN	x	x	x	x
Appalachian	KY	x	x	x	x
Appalachian	MD	x		x	
Appalachian	MO	x	x	x	x
Appalachian	NJ	x	x	x	x
Appalachian	OH	x	x	x	x
Appalachian	PA	x	x	x	x
Appalachian	TN	x	x	x	
Appalachian	WV	x	x	x	x
Lake States	MI	x	x		
Lake States	NE	x	x	x	x
Lake States	WI	x	x		
Northeast	NH	x			
South	AL	x	x		
South	AR	x	x		
South	FL	x	x		
South	GA	x	x		
South	KS	x		x	
South	LA	x	x		
South	MS	x	x		
South	NC	x	x	x	
South	SC	x	x	x	
South	TX	x			
South	VA	x	x		
West	AZ	x	x	x	x
West	NV	x		x	
West	UT	x	x	x	x
West	WY	x	x	x	x

Note: The column "Tailoring Rule" indicates states that fail the renewable energy target if the Tailoring Rule halts wood electricity development.

Appendix 8: Methodology for Projecting Wood-Based Renewable Electricity by Region

The following methodology was used to project renewable electricity generation from wood regions in the US:

- Projections are from the Annual Energy Outlook 2010. This data includes existing legislation and state energy targets. The data includes electricity-only and combined heat and power plants whose primary business is to sell electricity, or electricity and heat, to the public. By this definition cogeneration facilities at manufacturing facilities (such as pulp and paper mills) are excluded unless they sell power to the grid. Wood demand for electricity was calculated using the following methodology:
    1. Converted EIA projections of electricity generation by wood and other biomass in billion kilowatthours to megawatthours.
    2. Converted megawatthours to megawatts by dividing by 7446 operating hours per year. This assumes an 85% capacity factor applied to a total of 8760 operating hours (365 days per year x 24 hours per day.)
    3. Multiplied megawatts by 10,000 green tons per megawatt to obtain wood use.
- Forisk projections of wood demand from announced and existing bioenergy plants are from the Wood Bioenergy US database. Wood Bioenergy US includes wood demand at announced upgrades or additions to manufacturing cogeneration facilities but currently excludes most pulp and paper mill cogeneration.