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POTENTIAL IMPACTS OF ENERGY AND CLIMATE POLICIES ON THE U. S. PULP AND PAPER INDUSTRY

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POTENTIAL IMPACTS OF ENERGY AND CLIMATE POLICIES ON THE U. S. PULP AND PAPER INDUSTRY

Abstract. Many energy and climate policies are being debated in the United States that could have significant impact upon the future of the pulp and paper industry. Five of these policies are examined here in terms of their possible directional influences on biomass energy and paper production: (1) a national renewable electricity standard, (2) a U.S. greenhouse gas cap and trade system, (3) stronger renewable fuels standards, (4) expanded state incentives for biomass pilot plants, and (5) more favorable taxation of forest property. The observed trends reinforce the value of forest product diversification through the addition of biomass power generation and transportation fuels/chemicals production as co-products of the pulp and paper industry. Therefore, directing capital expenditures to the increasingly cost-competitive and expanding biopower and biofuels markets would appear to have merit in anticipation of the promulgation of new energy and climate legislation. Accelerated investments in new facilities such as biorefineries and cogeneration units and in energy-efficiency upgrades would position the pulp and paper industry to profit from current trends and likely policy initiatives.

1. INTRODUCTION

The pulp and paper industry is at a turning point. Industry players not only need to address the demands of the changing global economy along with increasing competitiveness, but they must also consider new opportunities that come with policy changes and technological improvements in the field of energy. To strengthen energy security and mitigate climate change, new energy and climate policies are being designed, proposed, and implemented in the United States at every scale of government from the local and state to the regional and national. At the same time, countries around the world are implementing new government and business approaches to meet their growing demands for energy while energy prices, concerns about global climate change and energy security loom ever larger. As efforts to ensure energy security and sustainability increase in the United States and elsewhere, the emphasis on renewable energy resources is increasing.

Unique opportunities await the paper and pulp industry in this new policy environment. Being one of the most energy-intensive industrial sectors and the largest consumer of biomass resources, the pulp and paper industry has the opportunity to contribute to the further development and wider use of biomass. Therefore, it is imperative for industry stakeholders to be informed about relevant energy and climate policies, along with monitoring technology trends. Within this context of evolving policies and technologies, they can consider alternative future scenarios for their business models and product choices.

The objective of this white paper, then, is two-fold:

- to provide an update on the potential energy and climate policies relevant to the pulp and paper industry that are either actively being pursued in the United States or are pending before policymakers, and
- to identify directional changes in biomass energy generation and paper production that such policies might precipitate.

The timeline for this analysis is 2020 – short enough to forecast trends with some certainty but long enough to accommodate the possibility of a transformative policy environment.

This paper is organized into five sections. Section 2 provides an overview of the pulp and paper industry, focusing on its production capacity, changing industry structure, energy consumption, contribution to energy supplies, and emerging technologies. Section 3 introduces the energy and climate policies that will be examined and discusses the potential impact of these policies on the pulp and paper industry. Specifically, we will examine five policies:

- a national renewable electricity standard,
- a U.S. greenhouse gas (GHG) cap and trade system,
- stronger national renewable fuels standards,
- state incentives for biomass pilot plants,
- more favorable taxation of forest property.

Section 4 provides a brief overview of the policies that were not covered in detail, yet should be of interest to industry players. The paper ends with a synthesis of its policy findings (Section 5).

2. THE STATE OF THE PULP AND PAPER INDUSTRY

2.1. Industry Overview

The production capacity as well as the geographic concentration of the U.S. pulp and paper industry has changed significantly over time. Following a period of rapid expansion, the industry has grown much more slowly since 1970. Over the same period, capacity growth has shifted from the West to the Southeast, and the use of recycled fiber has expanded, especially since the late 1980s (Ince et al., 2001).

Even though the North American pulp and paper industry is no longer the low-cost global producer, it is still the largest producer and consumer of pulp and paper products (McNutt, 2007). As shown in Table 1, the value of paper and related products sold by U.S.

companies reached $154 billion in 2004, representing 3.6 percent of total U.S. manufacturing output that year. Ten years earlier, the value of U.S. industry sales was only $134 billion. Improvements in labor force productivity in the U.S. pulp and paper industry has caused the industry's 675,000 jobs in 1993 to shrink to 440,000 by 2004 (U.S. Census Bureau, 1993).

At the same time, the U.S. pulp and paper industry is unable to keep up with the growing domestic demand for its products. In 2003, the value of U.S. paper and allied product exports was $14.4 billion, while the value of its imports in the same year had risen to $17.7 billion (Table 1). This growing trade imbalance is also true of the forest products industry as a whole, which has shifted from being a slight net exporter of forest products in 1992 to having a trade deficit of about $13 billion today (Howard, 2003).

Table 1. U.S. Paper and Allied Products
(2003 data unless otherwise indicated)

Number of pulp, paper, board mills—2005	**438**
Employment (thousands)—2004	**440**
Value of shipments ($billion)—2004	**$154**
Value of Exports - all grades ($billion)	**$14.4**
Value of Imports - all grades ($billion)	**$17.7**
Paper/paperboard capacity (million tons)	**100.1**
Paper/paperboard production (million tons)	**89.8**
Paper/paperboard exports (million tons)	**11.9**
Paper/paperboard imports (million tons)	**20.1**
Pulp capacity (million tons)	**68.2**
Pulp production (million tons)	**57.7**
Pulp exports (million tons)	**5.9**
Pulp imports (million tons)	**6.7**
Recovered paper consumption (million tons)—2005	**34.0**
Recovered paper recovery rate—2005	**51.5%**

Source: U.S. Department of Energy, 2006.

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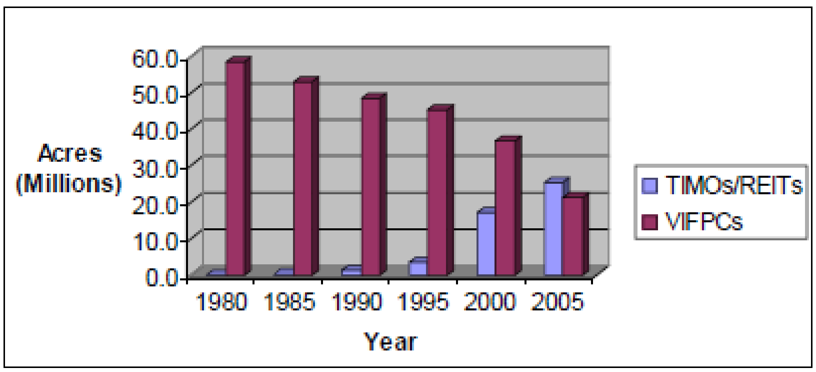
2.2. Changing Industry Structure

The concentration of production capacity among larger firms grew significantly from 1970 to 2000. In 1970, the top ten companies accounted for less than 35% of total paper, paperboard, and market pulp capacity, while by 2000, the top ten companies accounted for nearly half of the total capacity. Due to consolidation activities and elimination of older and smaller facilities, average mill capacity more than doubled from 1970 to 2000 (Ince et al., 2001).

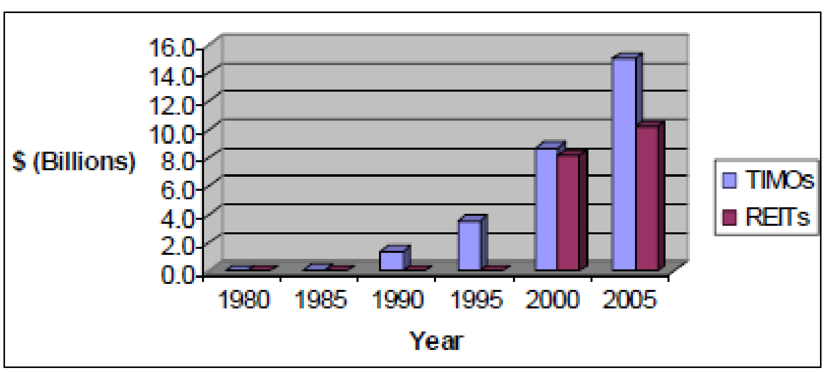
Forestland ownership has also changed markedly over the years. As shown in Figure 1, the acres of forestland held by vertically integrated forest product companies (VIFPCs) dropped from 58 million acres to 21 million acres in twenty-five years. The amount of forest held by the Timber Investment Management Organizations (TIMO) and Real Estate Investment Trusts (REIT) grew by more than 25 million acres.[1] Furthermore, the investment in forestland and timber by TIMOs and REITs grew to $25 billion in 2005 (Figure 2).

Figure 1. Trend in U.S. Forestland Ownership by TIMOs/REITs vs. VIFPCs



Source: Hickman, 2007.

Figure 2. Trend in U.S. Forestland Investments by TIMOs and REITs



Source: Hickman, 2007.

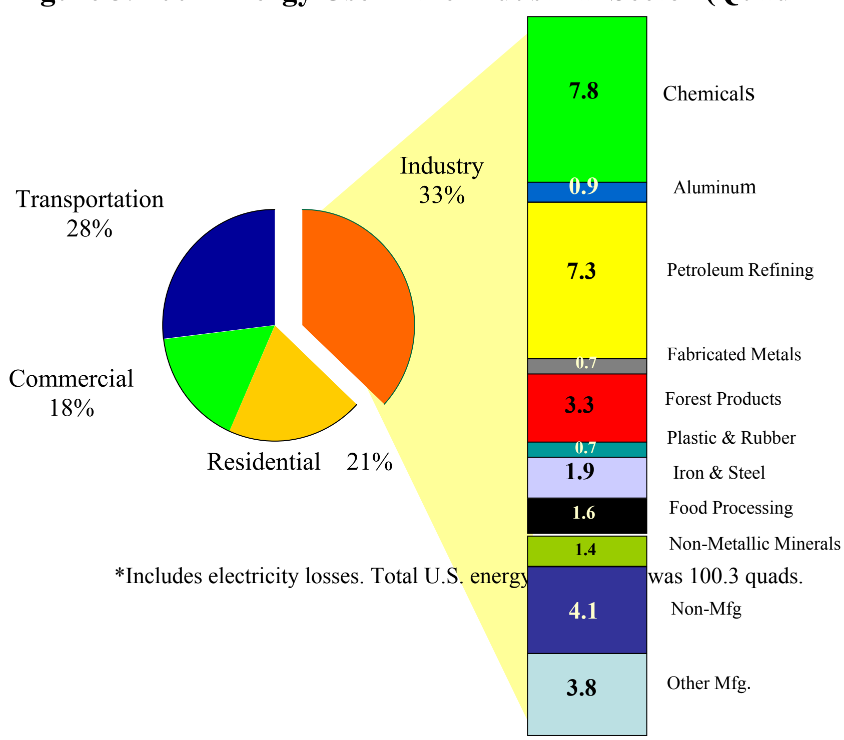
[1] TIMOs are entities that purchase, manage, and sell forestland and timber on behalf of institutional investors. REITs are entities that purchase, manage, and sell real estate or related assets on behalf of private investors.

Despite the concern among some industry players, financial analysts do not consider TIMOs as an impediment to a healthy forest industry, because they argue that the TIMOs have the incentive to manage their forests productively and are willing to accept long-term supply agreements for pulpwood (Wilde, 2005).

2.3. Energy Consumption of the Pulp and Paper Industry

The pulp and paper sector of the forest products industry is both capital- and energy-intensive. Energy is the third largest manufacturing cost for the forest and paper products industry (American Forest and Paper Association, 2007). According to the Energy Information Administration (EIA) (2004), the forest products industry consumed 3.3 quadrillion Btu (Quads) of energy in 2004, placing it third after the chemical and petroleum refining industries in terms of energy use (Figure 3). In the pulp and paper sector, paper and paperboard mills consume the most energy and more than half of the energy source is derived from net steam and other energy used to produce heat and power or as feedstock/raw material inputs, as shown in Table 2 (EIA, 2002). Steam is needed mainly for paper drying, but it is also used for pulp digesting and other uses. Electricity is required in increasing quantities to run equipment such as pumps and fans, and to light and cool buildings, among other uses.

Figure 3. 2004 Energy Use in the Industrial Sector (Quadrillion Btu)*



Source: DOE/EIA Monthly Energy Review 2004 (preliminary) and estimates extrapolated from EIA's Manufacturing Energy Consumption Survey (MECS), 2002.

Table 2. First Use of Energy for all Purposes (Fuel and Non-Fuel), in 2002 (Trillion Btu)[2]

	Net Electricity[a]	Residual & Distillate Fuel Oil	Natural Gas	LPG and NGL[b]	Coal, Coke & Breeze	Net Steam and Other Energy[c]	Total
Newsprint Mills	38	V	16	*	W	27	**94**
Paper Mills, except Newsprint	78	51	206	1	143	523	**1,002**
Paperboard Mills	56	38	188	*	84	542	**908**
Pulp Mills	5	W	24	*	W	175	**224**
Total: Paper	223	113	504	6	240	1,276	**2,363**

Source: EIA, 2002, Data Table 1.2

[a] Net electricity is defined as the sum of purchases, transfers in, and generation from noncombustible renewable resources, minus quantities sold and transferred out. It excludes electricity inputs from onsite cogeneration or generation from combustible fuels since that energy is counted under generating fuel such as coal.
[b] LPG and NGL are the acronyms for liquefied petroleum gas and natural gas liquids, respectively.
[c] Includes net steam (the sum of purchases, generation from renewables, and net transfers), and other energy used to produce heat and power or as feedstock/raw material inputs.

Being one of the most energy-intensive industrial sectors, the pulp and paper industry has been the subject of many studies focusing on the potential for energy-efficiency improvements. A recent McKinsey study for the DOE Industrial Technology Program identifies the pulp and paper industry as one of the two (iron and steel industry being the other) largest opportunities to reduce energy in the industrial sector. Figure 4 indicates that the pulp and paper industry can reduce energy consumption by 0.6 quads (25 percent) by 2020 by accelerating the adoption of proven technologies and process improvements.

As shown in Figure 5, most of the savings are expected to come from papermaking, multi-process improvements, steam efficiencies, and fiber substitution. In papermaking, drying is the largest energy consumer, requiring large amounts of steam and fuel for water evaporation (U.S. Department of Energy, 2005, p. 70).

[2] W refers to data withheld to avoid disclosing data for individual establishments and * refers to estimates less than 0.5 trillion Btu.

Figure 4. Opportunities to reduce energy consumed in industry (at>10% IRR)

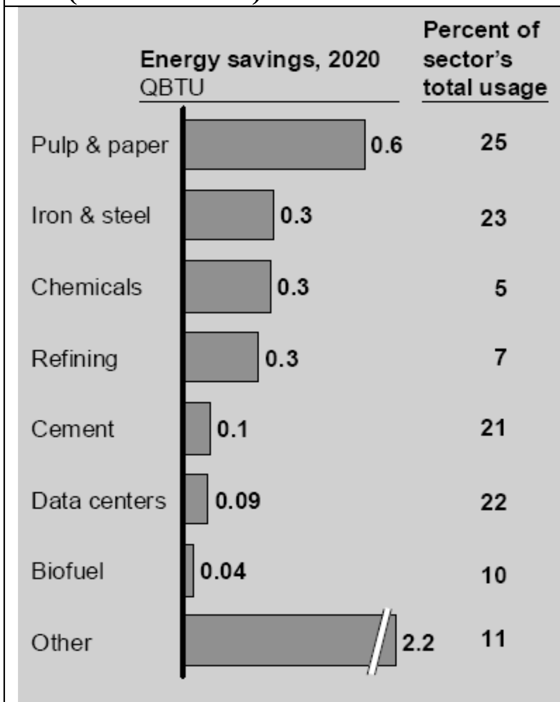
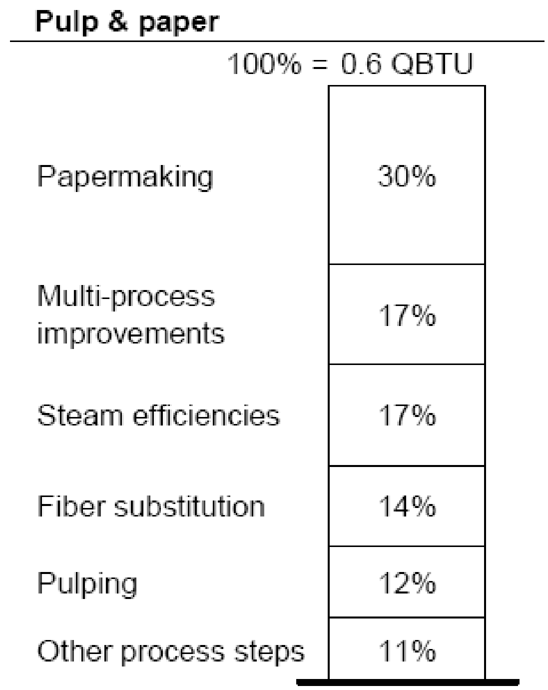


Figure 5. Opportunities to reduce energy consumed in the pulp and paper industry



Source: (Source: McKinsey & Company, 2008)

Several energy-effective methods of paper drying have been developed, many of which are cost-effective today. One of these, a systems approach, involves using waste heat from heat-generating processes including power generation and ethanol production, as the energy source for evaporation (Thorp, et al., 2007). Advanced water removal technologies can also substantially reduce energy use in drying and concentration processes (U.S. Department of Energy Climate Change Technology Program, 2005). ORNL and BCA, Inc. (2005) estimate that membrane and advanced filtration methods could significantly reduce the total energy consumption of the pulp and paper industry. High-efficiency pulping technology that redirects green liquor to pretreat pulp and reduce lime kiln load and digester energy intensity is another energy-saving method for this industry (U.S. Department of Energy Climate Change Technology Program, 2005). Modern lime kilns are available with external dryer systems and modern internals, product coolers and electrostatic precipitators (Jacobs Engineering and Institute of Paper Science and Technology, 2006).

The *Pulp and Paper Industry Energy Bandwidth Study* concluded that applying current design practices for the most modern mills can reduce energy consumption of the pulp and paper industry by 25.9%, and implementation of advanced technologies could reduce mill energy consumption by even more (41%) (Jacobs Engineering and Institute of Paper Science and Technology, 2006). Of course, care is needed to avoid unrealistic assessments of the savings potential in older plants arising from comparing new, state-of-the-art paper mills to long-existing ones. The largest potential energy savings in the industry are estimated to be in: paper drying, liquor evaporation, and lime kilns.

Martin et al. (2000) studied the opportunities to improve energy efficiency in the U.S. pulp and paper industry. Their case study results indicate that the technical potential for primary energy savings amounts to 31%, without accounting for an increase in recycling. The cost-effective savings potential is 16%. When recycling is included, the technical potential increases to 37% and cost-effective savings potential remains the same.

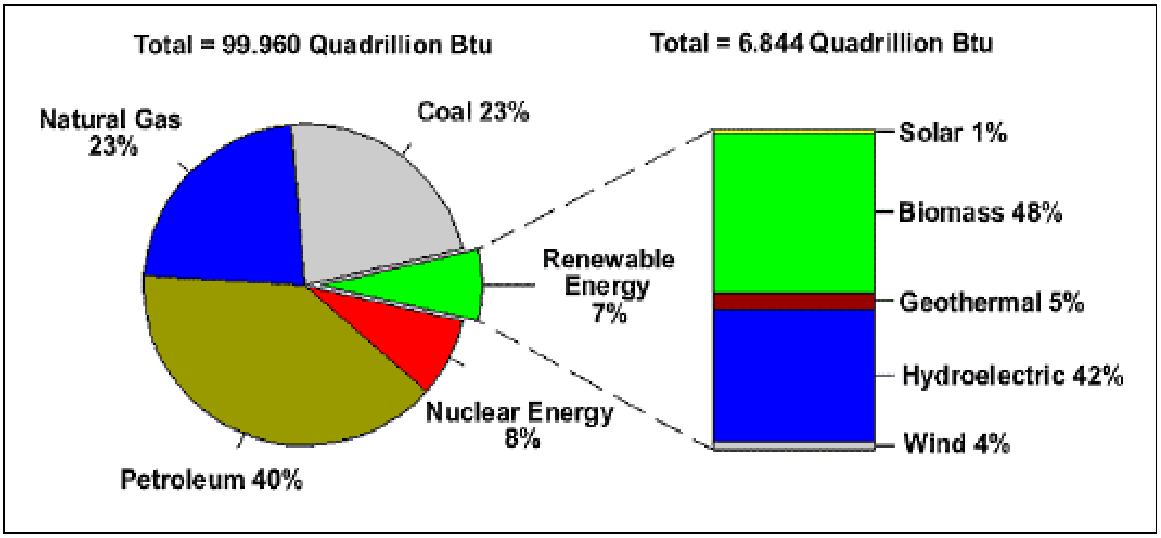
With rising fossil fuel costs and the likelihood of regional or national carbon markets sometime in the future, taking advantage of the energy efficiency opportunities identified in the studies mentioned above would appear to be quite compelling, subject of course to the availability of capital and the timing of stock turnover and facility upgrades.

2.4. Contributions to the Nation's Energy Supplies

Approximately seven percent of the nation's energy supply in 2006 was provided by renewable resources (Figure 6). Almost half of this came from biomass. Wood, wood waste, and black liquor from pulp mills is the single largest source accounting for more than two-thirds of total biomass energy consumption (ORNL, 2006).

In 2005, the pulp and paper industry contributed 1.22 quadrillion Btu of energy to the nation's energy resources, or slightly more than 1 percent of the nation's energy budget (Table 3). Approximately 0.920 quads were provided in the form of useful thermal output, while 0.300 quads were provided in the form of electricity (representing a net generation of 27,250 million kWh). This significant contribution of the pulp and paper industry to the U.S. energy budget is the result of a thirty-year trend in the industry away from conventionally purchased fossil fuels toward self-generated, mostly biomass fuels. Self-generated sources of energy are now providing nearly 60% of the industry's energy needs, up from only 40% in the early 1970s (Murray, et al. 2006). This trend has been encouraged by rising energy prices for natural gas and petroleum, by environmental regulations, and by new and emerging technologies.

Figure 6. The Role of Renewable Energy Consumption in the Nation's Energy Supply, 2006



Source: EIA, 2007a.

Table 3. Biomass Energy Consumption and Electricity Net Generation for Paper and Allied Products, 2005

	Biomass Energy Consumption (Trillion Btu)			Million kWh
Energy Source	**Total**	**For Useful Thermal Output**	**For Electricity**	**For Electricity**
Black Liquor	860	655	205	17,899
Wood/Wood Waste Solids	324	239	86	8,481
Wood/Wood Waste Liquids	8	6	2	197
Other[3]	28	20	7	675
Total	1,220	920	300	27,252

Source: EIA, 2005, Table 8 (rounded).
[a] Source of factors to convert from million kWh of electricity to trillion Btu of "source" energy: *Annual Energy Outlook 2007* (Tables A2, A8 and A18). Conversion factor = 10.39 trillion Btu per million kWh.

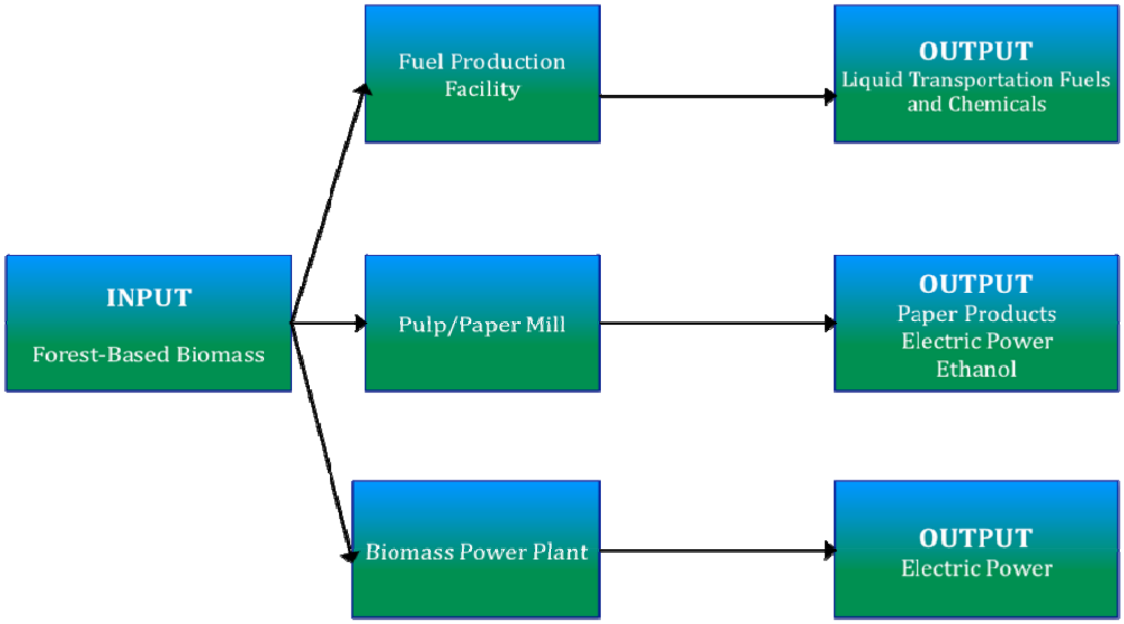
[3] "Other" includes agricultural byproducts/crop, landfill gas, municipal solid waste, other biomass gas, liquids, and solids, sludge waste, and tires.

There are also biomass power plants outside of the pulp and paper industry that use forest-based biomass for power generation. “More than 200 companies outside the wood products and food industries generate biomass power in the United States. Where power producers have access to very low cost biomass supplies, the choice to use biomass in the fuel mix enhances their competitiveness in the marketplace. This is particularly true in the near term for power companies choosing to co-fire biomass with coal to save fuel costs and earn emissions credits. An increasing number of power marketers are starting to offer environmentally friendly electricity, including biomass power, in response to consumer demand and regulatory requirements” (DOE, 2007). The Southern Company estimates that co-firing biomass with coal in existing coal-fired boilers to generate electricity is one of the least-cost renewable power options available in the territory it serves in the Southeast (Haynes, 2007). Indeed, the Georgia Power Company’s 150 MW coal-fired power plant in Newnan uses 1% biomass.

In the future, it is also anticipated that ethanol production facilities will use forest-based biomass input more widely. For example, Range Fuels has just been awarded a permit to construct an ethanol plant in Treutlen County, Georgia; the first phase of construction is expected to be completed in 2008 (Range Fuels Press Release, 2007). At this plant, wood waste is to be converted to a synthetic gas and to create power and ethanol using existing combined cycle generator technology. In this case, forest-based biomass would replace natural gas in existing generators. In early 2008 KL Process Design Group’s first cellulosic ethanol plant became operational. The facility located in Wyoming uses waste wood (KL Process Design Group Press Release, 2008)

Figure 5 provides a simplified schematic of outputs from forest-based biomass inputs. It highlights three potential product lines (paper products, electric power, and ethanol), which can be produced as single products or as part of a biorefinery with multiple outputs.

Figure 5. Simplified Schematic of Outputs from Forest-Based Biomass Inputs*



*This schematic does not include all possible outputs, but rather highlights those emphasized in this policy study. For instance, outputs could include a range of alternative chemical products such as methanol and butenol.

2.5. Emerging Energy Technologies in the Pulp and Paper Industry

The wealth creation of the pulp and paper industry is significant and it is evolving. A 2007 comparison between bioenergy production and the pulp and paper industry operating in Europe shows that even though both sectors start using the same raw material, the total value added by bioenergy production is less than 34 billion euro, while the total value added by the pulp and paper industry is over 260 billion euros. Similarly, bioenergy production provides 0.229 million jobs, while pulp and paper industry provides 2.95 million jobs (CEPI, 2007). These shares are shifting toward bioenergy production; however, it is unclear how the composition of final products will equilibrate in the long-run.

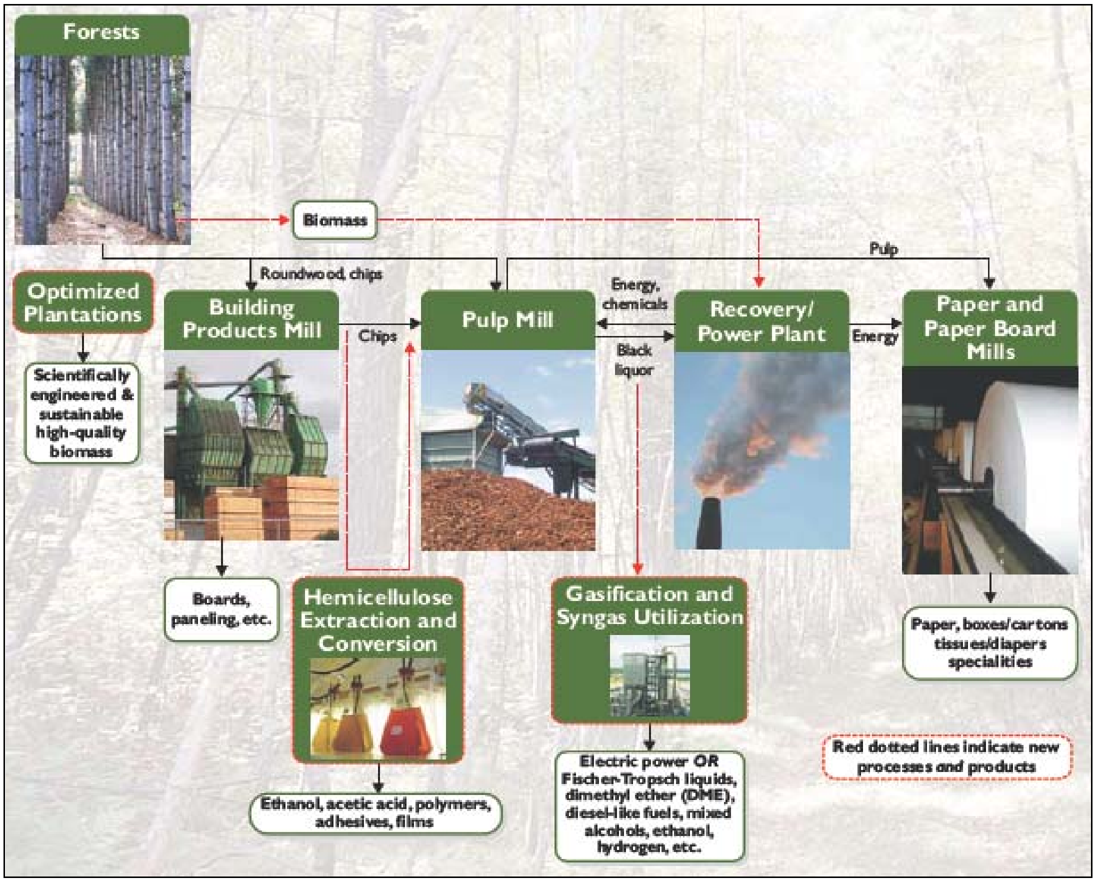
The fact that the pulp and paper sector has the capability of combining all three economic activities – the production of paper products, ethanol and other transportation fuels, as well as electric power – places the industry in a unique position. This vision has been well illustrated in the Forest Products Industry Technology Roadmap prepared by the Agenda 2020 Technology Alliance, as shown in Figure 6 (DOE, 2006). The biorefinery vision portends an industry capable of processing multiple biomass resources into a range of final products.

Several emerging technologies are likely to affect the viability of the biorefinery vision. Murray, et al. (2006) spotlight several of these emerging technologies that may revolutionize the way the forest products industry buys and sells energy and may transform the industry's production processes and product mix:

- **Fluidized bed biomass boilers** can more efficiently convert lower-quality biomass fuels such as bark and pulp and paper mill sludge into energy.
- **Closed-loop drying and energy systems** at wood products facilities provide both greater energy efficiency and environmental control.
- **Cogeneration systems** allow lumber mills to convert biomass to energy for both on-site use and for sale to the grid.
- **Biomass gasification** systems would produce gas fuel from the gasification of wood residuals and pulp mill sludges.
- **Black liquor gasification combined cycle** (BGCC) uses heat to convert the organic compounds in black liquor to a synthetic gas that can be used to power a gasification unit, and the rest can be fired in a gas turbine with the exhaust used to raise steam that can be passed through a steam turbine to generate additional electric power.

Biomass gasification systems are the core technologies for the biorefinery concept because they offer mills the possibility of increasing the electricity generation from captive self-generated fuels up to 50%. If these technologies prove to be economically and commercially viable, they could make substantial reductions in GHG emissions compared to conventional technology. The suite of technologies listed above, in combination with best practices already available to the pulp and paper industry, caused McKinsey & Company to identify the pulp and paper industry as one of the four U.S. industrial with the largest potential for reducing GHG emissions over the next 25 years. Specifically, McKinsey & Company (Creyts, et al., 2007, p. 52) list black liquor gasification, new drying processes, and paper recycling as key process improvements that could make the current industry more efficient.

Figure 6. Integrated Biorefinery



Source: U.S. Department of Energy, 2006.

The 2006 report prepared by Murray et al. at RTI International (2006) for the Department of Energy identified a range of factors that might influence the consumption of biomass energy in the forest products industry through 2010. Recognizing the difficulty of predicting exact magnitudes of overall effects, the authors instead focus on expected directional changes in future biomass consumption in the forest products industry based on individual technological, economic, and policy factors, as shown in Table 4. For example, the consumption of spent black liquor is expected to remain flat, but could increase with the successful full-scale implementation of BLG at kraft pulp mills. Similarly, the quantity of wood residuals consumed in the forest products industry is expected to increase unless electric utilities become strong competitors for biomass fuel.

Table 4. Expected Changes in Biomass Energy Consumption and Contributing Factors

Type of Biomass	Expected Directional Changes through 2010		Primary Factors Contributing to Increased Biomass Consumption	Primary Factors Contributing to Decreased Biomass Consumption
	Quantity of Biomass Fuel Generated	Quantity of Biomass Fuel Consumed		
Spent (black) liquor	Flat	Flat	Successful full-scale implementation of BLG at kraft mill	Foreign competition leading to mill closures and production curtailments
Wood residuals	Increase	Increase	(1) Increases in fossil fuel prices (2) Disruptions in availability of fossil fuels (3) Financial incentives for using renewable energy fuels (4) Successful full-scale implementation of wood gasification at pulp mill	(1) Lower fossil fuel prices, especially natural gas (2) Competition for biomass fuel (e.g., from utilities)
Pulp and paper wastewater treatment sludge	Increase	Increase	(1) Increases in fossil fuel prices (2) Disruptions in availability of fossil fuels (3) Increased use of recycled fiber in papermaking (4) Decreases in landfill space; increases in landfill costs	(1) Lower fossil fuel prices, especially natural gas (2) Internal and external competition for sludge (e.g., recycling of fiber to process; sale of sludge to end-users, such as asphalt roofing manufacturers)

Source: Murray et al., 2006.

Building on this framework, the following section examines the potential directional impact of some of the energy policies on forest-based biomass input, product outputs, and the technologies utilized in the pulp and paper industry.

3. ENERGY AND CLIMATE CHANGE POLICIES

The field of energy policy has become more dynamic than ever nationally and internationally. There are numerous state initiatives as well as federal initiatives in every subfield of energy policy. In this paper we review five of these policies. These are namely, a national renewable electricity standard, a U.S. carbon cap and trade system, stronger renewable fuels standards, state incentives for biomass pilot plants, and taxation of forest property based on current use. In our view, these policies are highly relevant to the pulp and paper sector; therefore, it is important for the industry and its stakeholders to track the most recent developments. In the following sections, we provide brief reviews of these policies and discuss their potential marginal impacts on the pulp and paper industry. We then summarize the effects of these policies by using a 5-point scale system in our policy tables: double arrows (↑↑ or ↓↓) represent stronger effects, single arrows (↑ or ↓) indicate weaker effects. In areas where we do not expect to see any major changes, we use the symbol (-).

3.1. National Renewable Electricity Standard

3.1.1. Policy Description

A renewable electricity standard (RES) is a legislative mandate requiring electricity suppliers (often referred to as "load serving entities") in a given geographical area to employ renewable resources to produce a certain amount or percentage of power by a fixed date. Typically, electricity suppliers can either generate their own renewable energy or buy renewable energy credits. This policy therefore blends the benefits of a "command and control" regulatory paradigm with a free market approach to environmental protection. Also called renewable portfolio standards (RPS), the term renewable electricity standard is preferred by many because it is easily distinguished from renewable fuels standards, which apply to transportation fuels.

In 1985, Iowa became the first state to implement a portfolio standard, mandating that utilities enter into power purchase agreements with renewable energy producers to "encourage the development of alternate energy production facilities…." In 1994, Minnesota passed similar legislation. In May, 1997, Maine passed a binding RPS mandate requiring all electric power retailers to generate 30 percent of their power from renewable resources by 2000. With an abundance of biomass and hydro resources in the state, its goal was easily met. The first state to actually use the term "RPS" was California, in legislation that was ultimately defeated in 1995 (Cooper and Sovacool, 2007). Today, California requires that utilities produce 20 percent of their electricity from renewable energy resources by 2010.

As currently promulgated by individual states, there is no universal definition for what a renewable resource is. The eligible sources typically include wind, solar, ocean, tidal, geothermal, biomass, landfill gas, and small hydro. However, waste coal generation qualifies in the state of Pennsylvania, and subsets of solar technologies are disallowed in other states. Other states have expanded the scope of their qualifying energy resources to include energy efficiency, and some of these allow combined heat and power (CHP) and other technologies that re-use waste heat (Brown, York and Kushler, 2007). One of the reasons that a national Renewable Electricity Standard has been proposed is to improve marketplace efficiency and accelerate the development of renewable resources by providing a common policy foundation. Renewable energy resources are seen by many as vital for energy security and environmental sustainability.

3.1.2. Policy Status

Currently, more than thirty states and the District of Columbia in the United States have implemented renewable portfolio standards with purchase obligations ranging from 8% to 30%. The design elements of these RES programs including the deadlines to meet the established standards vary widely from state to state as shown in Table 5.

More states, including Indiana, Louisiana, Nebraska, and Utah are considering similar programs as well (Cooper and Sovacool, 2007). Trading of renewable energy certificates (RECs) are expected to lead to the integration of RES programs among states. These certificates, also known as green tags, are trading commodities that represent the environmental attributes of energy generated from renewable resources and can be used to meet the RPS requirements or to offset carbon emissions, if allowed by the regulators. Even though there is no national registry for RECs yet, regional tracking systems exist.

Table 5. State Renewable Portfolio Standards

State	RPS	State	RPS
AZ	15% by 2025	MT	15% by 2015
CA	20% by 2010	NV	20% by 2015
CO	20% by 2020	NH	23.8% by 2025
CT	23% by 2020	NJ	22.5% by 2021
DE	20% by 2019	NM	20% by 2020
DC	11% by 2022	NY	24% by 2013
FL	7.5% by 2015	NC	12.5% by 2021
HI	20% by 2020	ND	10% by 2015
IL	25% by 2025	OR	25% by 2025
IA	105 MW	PA	18% by 2020
ME	10% by 2017	RI	16% by 2020
MD	9.5% by 2022	TX	5880 MW by 2015
MA	4% by 2009	VT	10% by 2012
MI	7% by 2016	VA	12% by 2022
MN	25% by 2025	WA	15% by 2020
MO	11% by 2020	WI	10% by 2015

Source: DSIRE, 2008.

While the existing RPS programs aim to promote renewable resource generation at a state-wide level, the attempts to establish a federal RPS have not been successful yet, but the issue is still active on the agenda. House Bill 3221 (HR 3221) adopted on August 4, 2007 included an RPS. However, an RPS was not included in the Senate version and during the effort to reconcile the two bills, the RPS was dropped. Utilities in the Southeast were among the most ardent critics of the RPS, claiming that it would increase electricity rates because of their limited renewable resources. While the resulting bill, H. R. 6, The Energy Independence and Security Act of 2007 signed by President Bush on December 19, does not include an RPS, it is likely that the policy will be proposed again in different draft legislation. Thus, it is instructive to review the proposed policy design features.
In its original version, the HR 3221 required each utility to provide at least 15% of its electricity sales through the use of renewable energy resources by 2020. Utilities were required to meet a 2.75% goal by 2010 and gradually reach the 15% goal by 2020. Up to 4 percent of the 15 percent requirement could be met with energy efficiency measures. Eligible renewable resources include solar (photovoltaics and solar water heating), wind, ocean, tidal, geothermal, biomass, landfill gas, and incremental hydro. According to the bill, municipal utilities and rural electric cooperatives would be exempt from the RPS requirement.

Table 6. Timeline of HR 3221 RPS Requirements

Year	Required %	Year	Required %
2010	2.75%	**2016**	7.5%
2011	2.75%	**2017**	8.25%
2012	3.75%	**2018**	10.25
2013	4.5%	**2019**	12.25%
2014	5.5%	**2020**	15%
2015	6.5%	**2021-2039**	15%

Beginning in 2010, for each calendar year retail electric suppliers would meet the RPS requirements by submitting some combination of the following to the designated authority:

- federal renewable energy credits,
- federal energy efficiency credits (up to 27 percent of the requirements in any calendar year),
- certification of the renewable energy generated and electricity savings pursuant to the funds associated with state compliance payments, and
- alternative compliance payments.

In this scheme, a federal renewable energy credit may be sold, exchanged, or banked for use within the next three years of issuance. Renewable energy credit borrowing would also be allowed, provided that the electric supplier submit a plan demonstrating that the retail electric supplier would earn sufficient federal renewable energy credits within the next three calendar years.

Existing and emerging state or regional tracking systems are to be utilized by the Secretary of Energy to establish an implementation program within a year to verify and issue federal renewable energy credits to generators of renewable energy, track their sale, and exchange and retirement. The Secretary would also determine regulations regarding the measurement and verification of electricity savings, including procedures and standards for defining and measuring electricity savings that would be eligible to receive credits, procedures and standards for third-party verification of reported electricity savings, and others by June 30, 2009. The administration of the energy efficiency credits could be delegated to the states, upon request.

3.1.3. Implications for the Pulp and Paper Industry

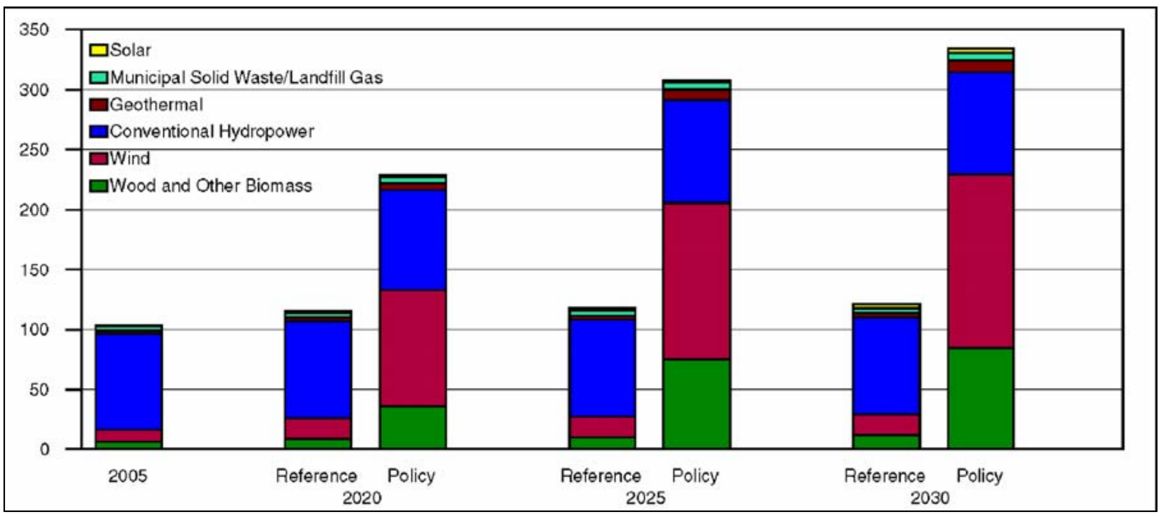
RES is one of the major policy tools used to expand renewable resource capacity. EIA estimates that 5,317 MW of new renewable capacity was added to the nation's energy portfolio from 2002 through 2006 (EIA, 2007a). The exact impact of the RPS policies on this capacity increase is rather inconclusive. Wiser et al. (2007) cautions against the existing estimates of additional renewable capacity, because different design elements of the programs and the impact of other policies used to promote renewable generation capacity complicates forecasts.

The U.S. is rich in renewable resources and the existing RPS programs have certainly not exhausted their full potential. The EIA predicts that improved technology, higher fossil fuel prices, and extended tax credits will accelerate the use of renewable resources (EIA, 2007b). According to the EIA estimates, total renewable generation, including CHP and end-use generation, is projected to grow by 1.5 percent per year, from 357 billion kilowatt-hours in 2005 to 519 billion kilowatt-hours in 2030 (EIA, 2007b). Furthermore, EIA estimates that state renewable energy programs will result in a national total of 61 billion kilowatt-hours of additional non-hydropower renewable generation in 2030 relative to the reference case, a 29-percent increase. Most of the additional generation is expected to come from biomass resources, with smaller increases for wind, municipal waste, and geothermal generation, which together account for 8 percent of the projected increase.

The Role of Biomass: Even though the proposed federal RPS bill would implement a 15-percent RPS to be reached by 2020, some states are already considering extending the standard to 33-percent by 2020. The EIA's latest report analyzing the impacts of implementing a 25-percent RPS and 25-percent renewable fuels standards (RFS) by 2025 concludes that the RPS would lead to a shift in power production to renewable fuels, particularly biomass and wind. In fact, biomass consumption increases from less than 30 million tons in 2005 to 571 million tons in 2030, thereby pushing the prices up due to insufficient supply. In this scenario, the price of biomass rises from approximately $1.70 per million Btu (roughly $30 per ton) in 2005 to about $5.10 per million Btu (over $88 per ton) in 2030 (EIA, 2007c). Figure 7 shows the increasing role for biomass in EIA's model runs for 25-percent RPS by 2025 and beyond.

The pulp and paper industry meets approximately 60% of its energy requirements by utilizing black liquor, bark, and other wood residues (ORNL, 2005). Murray et al. (2006) expect that the quantity of biomass fuel generated by the forest products industry will either remain the same or increase through 2010, as shown in Table 4.

Figure 7. Renewable Generation Capacity by Energy Resource for 2005-2030 (gigawatts)



Source: EIA, 2007c.

Expected Directional Changes: In order to comply with an RES, states and electricity suppliers need to assess the availability of their renewable energy stock. Especially states without adequate solar or wind resources (such as many in the Southeast) would likely seek to utilize their biomass stock. Increasing demand for electricity derived from biomass would lead to allocation of more biomass feedstock for electricity generation, which would put an upward pressure on prices of forest-based biomass feedstock. Consequently, in the short run, the input available for ethanol production and paper production would decline, lowering paper output, all else being constant. Given that forest-based biomass is not widely used today for ethanol production, the implementation of an RES is not expected to have a major impact on ethanol production. Decline in production of paper would cause product prices to increase. These changes occurring in the short-run might provide incentives for pulp and paper mill operators to convert conventional mills to biorefineries, in order to keep their businesses profitable through biomass technology advancement and product diversification. Industry input indicates that capital rationing may prevent such investments.

In addition, the pulp and paper industry could provide energy efficiency (i.e., "white") credits to meet RES goals by implementing system changes and improving the efficiency of their operations. Because the economic efficiency potential in the pulp and paper industry is dominated by steam and other thermal loads and not electricity, the opportunity to participate in a national market for energy efficiency credits would appear to be limited.

Table 7. Expected Directional Changes of an RES on Biomass Energy and Paper Production

Primary Factors Contributing to the Expected Directional Changes through 2020							
		Biomass Power		Ethanol		Paper Products	
INPUT (Forest-based)	Price	↑↑	Higher input prices due to increased demand for biomass power	↑↑	Higher forest-based input prices due to increased demand for biomass power	↑↑	Higher input prices due to higher demand for biomass power
	Quantity Available	↑↑	Increased production of timber to meet higher demand for biomass power	-	No significant impact anticipated	↓	Possible reduction in available biomass due to increased demand for biomass power
TECHNOLOGY	Tech Advance	↑	Accelerated investment in R&D and facility upgrades, especially to improve electric efficiencies	-	No significant impact anticipated	↑	Accelerated investment in facility upgrades, especially to improve electric efficiencies
	System Change	↑↑	Increased investment in new biomass power facilities	-	No significant impact anticipated	↑	Increased investment in new facilities such as biorefinery and cogeneration units
OUTPUT	Price	-	Economies of scale and technology advances accompanied with increasing input prices	-	No significant impact anticipated	↑	Increased price of paper and paper products due to higher input prices
	Quantity Produced	↑↑	Increased production of biomass power due to legislated goals	-	No significant impact anticipated	↓	Decline in domestic paper production due to higher input price

Note: The EIAS Act of 2007 included a renewable fuels standard requiring the production of 36 billion of renewable fuels by 2022. This column refers to directional change above and beyond that will occur from that mandate.

3.2. GHG Cap and Trade System

3.2.1. Policy Description

A GHG cap-and-trade system is a market-based policy tool that limits economy-wide greenhouse gas emissions. Sources covered under the program receive allowances that determine the amount of emissions they can produce. Based on that amount, they can design their own emission control strategy, which might include adopting new technology, purchasing offsets, or trading in the emissions market. Because emissions trading uses markets to determine how to deal with the problem of pollution, it is often touted as an example of effective free market environmentalism. While the cap is usually set by a political process, individual companies are free to choose how or if they will reduce their emissions. In theory, firms will choose the least-cost way to comply with the pollution regulation, creating incentives that reduce the cost of achieving a pollution reduction goal.

3.2.2. Policy Status

In 2007, the Senate introduced two GHG cap and trade proposals that have received considerable bipartisan support. They include:

- The Low Carbon Economy Act of 2007: introduced on July 11 by Senators Bingaman and Specter (S.1766)
- America's Climate Security Act of 2007: introduced on August 2 by Senators Lieberman and Warner (S.2191)

Neither of these proposals was incorporated into the Energy Independence and Security Act signed by President Bush on December 19, 2007. However, it is likely that bills such as these will continue to be actively debated in 2008.

Table 8. Cap-and-Trade Proposals Debated by the 110th Congress

Bill	**Lieberman-Warner S.2191**	**Bingaman-Specter S.1766**
Scope	All 6 GHGs Economy-wide, "hybrid" – upstream for transportation fuels; downstream for electric utilities and large sources --Regulates approximately 80% of economy	All 6 GHGs Economy-wide, "hybrid" – upstream for natural gas and petroleum; downstream for electric utilities and large sources --Regulates approximately 85% of economy
Emission Targets	Beginning in 2012, GHG emissions are capped at 2005 levels, 10% below 2005 by 2020, 30% below 2005 by 2030.	Beginning in 2012, GHG emissions are capped and begin declining, 2006 emission levels by 2020, 1990 levels by 2030 (i.e., 20% below 2006 levels).
Offsets	--15% limit on use of domestic offsets (e.g., for carbon sequestration and other emission reductions from sources not covered under the cap-and-trade system) --15% limit on use of international offsets	--10% limit on use of domestic offsets (e.g., for carbon sequestration and other emission reductions from sources not covered under the cap-and-trade system) --President may implement use of international offsets subject to 10% limit.
Allocation	Increasing auction 5% set-aside of allowances for agricultural and forests	Increasing auction Some sector allocations are specified 5% set-aside of allowances for agricultural
Cost Controls	--Creates a Carbon Market Efficiency Board to monitor the carbon trading market and manage price volatility --Allows banking	--Sets a predetermined price at which the government will sell additional allowances, thereby effectively capping compliance costs. --$12/ton CO2 (safety valve) and increasing 5%/yr above inflation --Allows banking
Early Action	5% of allowances for early action in 2012, phasing to zero in 2017	From 2012-2020, 1% of allowances allocated to those registering GHG reductions prior to enactment
Technology	--Bonus allocation for carbon capture and storage --Funds and incentives for technology, adaptation, and mitigating effects on poor --Subject to 3-year review	--Bonus allocation for carbon capture and storage --Funds and incentives for technology R&D --Target subject to 5-yr review of new science and actions by other nations

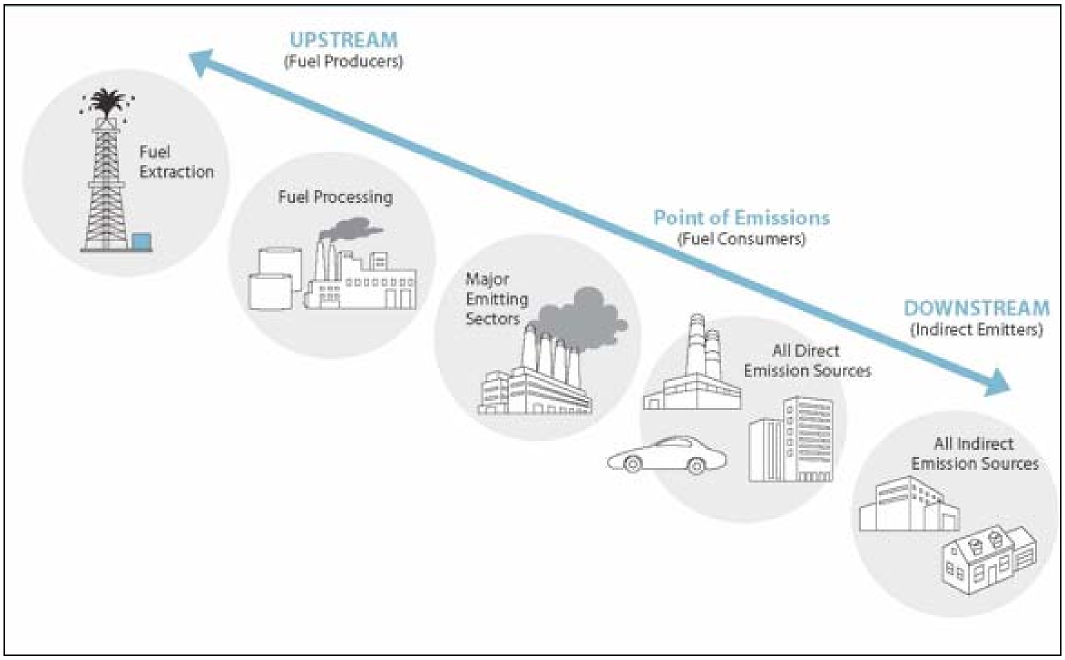
Source: Pew Center, 2007a, and National Commission on Energy Policy, 2007.

As Table 8 shows, these proposals are similar along many dimensions, but also have some distinctions based on such design features as the point of regulations. As Figure 8 shows, GHG emissions can be regulated upstream, downstream, or anywhere in-between. For instance, the Bingaman-Specter Bill proposes upstream regulation for oil and natural gas, downstream regulation for coal (specifically, facilities that use at least 5,000 tons of coal per year). This would result in regulating:

- petroleum refineries (~200) and refined product importers,
- natural gas processing plants (~500), LNG facilities, natural gas importers,
- coal mines (~800-900).

With a somewhat more downstream approach, a greater number of entities must be regulated in the Lieberman-Warner bill.

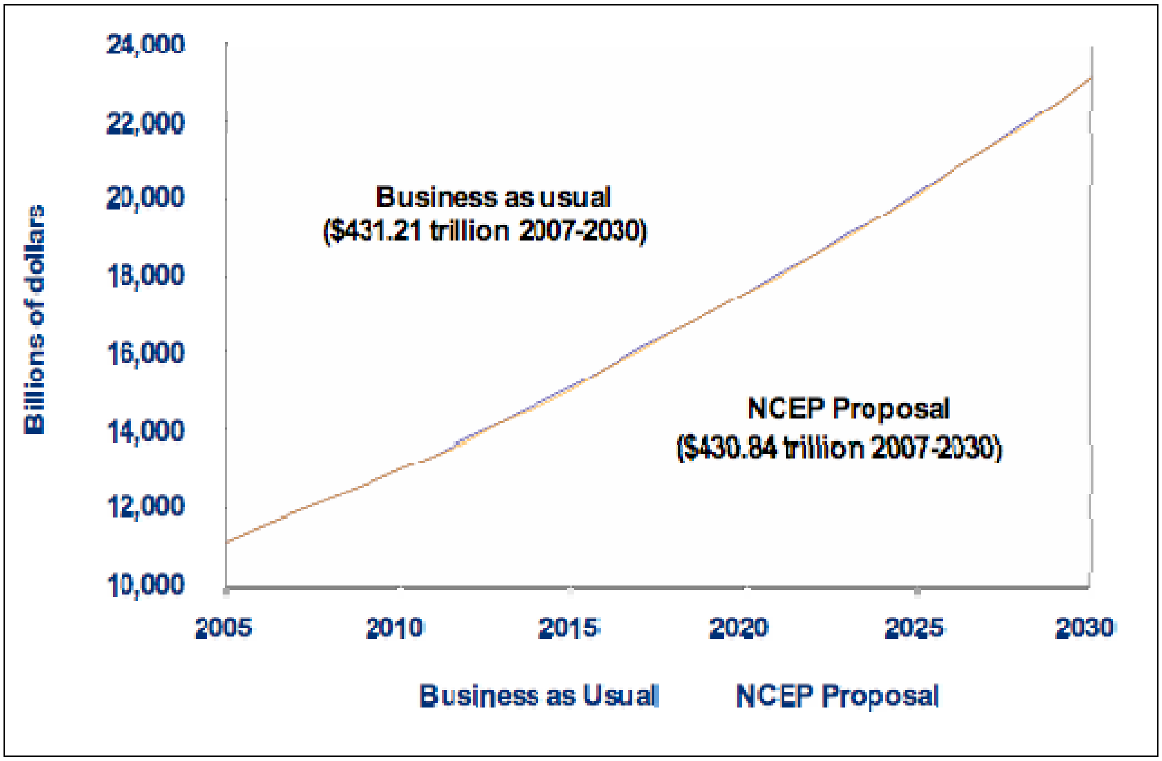
Figure 8. Possible Points of Regulation for GHG Cap and Trade Systems



Source: National Commission on Energy Policy, 2005.

The EIA analyzed the effects of the Bingaman (NCEP) proposal (the precursor to the Bingaman-Spector bill) in March 2006 at the request of Senator Salazar. EIA found that the 2005 Bingaman proposal had "no material impact on the economy" overall. In 2020, GDP is estimated to be 0.07% below business-as-usual. In addition, EIA estimated that consumer energy price would likely increase, from 4% to 7% in 2020.

Figure 9. Impact of GHG Cap and Trade System on GDP Growth



Source: National Commission on Energy Policy, 2007.

In addition to federal legislation, several regional and state carbon cap and trade systems have been launched or are under development. For example:

- Seven northeastern states (Connecticut, Delaware, Maine, New Hampshire, New Jersey, New York, and Vermont) are currently participating in the Regional Greenhouse Gas Initiative (RGGI), which is focused on capping power plant carbon emissions. RGGI began in 2003 and intends to grow in scope, to include other gases, and in size, to include other states (i.e., Massachusetts, Rhode Island, and Maryland) and perhaps Canadian provinces (RGGI, 2006). The program sets a cap on emissions of carbon dioxide from power plants, beginning with current levels in 2009, and then reduces emissions 10% by 2019. RGGI allows sources to trade emissions allowances.

- The state of California launched a GHG reduction plan with the September 2006 adoption of the Global Warming Solution Act (AB 32), which has a goal of reducing emissions to 1990 levels by 2020. This legislation requires that the state monitor and enforce emissions reductions from those sources deemed feasible to observe (California Air Resources Board, 2007). The California Air Resources

Board will develop emission control measures and reduction strategies. Toward this end, the Board is currently working with different agencies and sectors, including agriculture, electricity, forest, manufacturing, oil and gas refining, transportation, and waste management. The Board will adopt a scoping plan by January 2009 that will lay out the strategies needed to meet emission goals set by AB 32. Specific regulations will be adopted by 2011 and reduction strategies will be effective by January 1, 2012. Market-based compliance mechanisms such as a cap-and-trade system as well as other regulatory actions are under consideration.

- The Western Climate Initiative members, Arizona, California, New Mexico, Oregon, Washington, Utah, and Canadian provinces of British Columbia and Manitoba, seek to set a regional emissions target and establish a market-based system such as a cap-and-trade program covering multiple economic sectors by August 2008.

3.2.3. Implications for the Pulp and Paper Industry

Under a cap-and-trade system, fossil energy prices are expected to rise, making biomass energy resources (both biomass power and ethanol) more cost-competitive (See Table 10). More competitive prices would increase demand for biomass energy resources, thereby expanding the overall demand for biomass feedstocks and placing upward pressure on forest-based input prices.

More input would be allocated for biomass-derived electricity generation because of increasing electric power prices. Given the currently negligible contribution of forest-based input to ethanol production in the United States, we do not anticipate large changes occurring in the ethanol production sector resulting from a cap and trade system. Indeed, the modest impact of a GHG cap and trade system on gasoline prices relative to electricity prices was one of the motivations for expanding requirements for ethanol fuel production in the recently enacted Energy Independence and Security Act.[4]

[4] Note that $50/metric ton of carbon corresponds to 12.5 cents per gallon of gasoline, 1.3 cents per kilowatt-hour for electricity produced with a 34 percent efficient coal plant, or 0.5 cents per kWh produced from natural gas at 53 percent efficiency – Interlaboratory Working Group, 1997, p. 1.16.

Table 9. The Impact of a Carbon Cap-and-Trade System on Fossil Energy Prices

Carbon Tax/Penalty ($/MtC)	Natural Gas ($/ccf)	Coal ($/short ton)	Residual fuel oil (No. 6) ($/gal)	Kerosene ($/gal)	Liquid propane gas ($/gal)	Distillate fuel oil ($/gal)	Motor Gasoline ($/gal)
$25	$0.04 0.49%	$13.00 52.20%	$0.08 5.83%	$0.07 (2.45%)	$0.04 (1.82%)	$0.07 (3.13%)	$0.06 (2.77%)
$50	$0.07 0.98%	$26.00 104.39%	$0.16 11.66%	$0.13 (4.89%)	$0.08 (3.65%)	$0.14 (6.26%)	$0.12 (5.55%)
$75	$0.11 1.47%	$39.00 156.59%	$0.24 17.48%	$0.20 (7.34%)	$0.12 (5.47%)	$0.21 (9.39%)	$0.18 (8.32%)
$100	$0.15 1.96%	$53.00 208.79%	$0.32 23.31%	$0.27 (9.79%)	$0.16 (7.30%)	$0.28 (12.52%)	$0.24 (11.09%)

Carbon Tax/ Penalty ($/MtC)	Electricity ($/MWh)		
	Average	CCGT	Coal
$25	$4.43 (4.17%)	$2.50 (2.36%)	$6.50 (6.13%)
$50	$8.85 (8.35%)	$5.00 (4.72%)	$13 (12.26%)
$75	$13.28 (12.52%)	$7.50 (7.08%)	$19.50 (18.40%)
$100	$17.70 (16.70%)	$10.00 (9.43%)	$26 (24.53%)

Notes:
1. Percentage increases are based on 2007 average prices of $25.16/short ton for coal, $7.6/ccf for natural gas, $2.72/gal for kerosene, $2.15/gal for liquid propane gas, $2.21/gal for distillate fuel oil (diesel), $1.38/gal for residual fuel oil, $2.18/gal for motor gasoline, and 10.6 cents/kwh for average residential electricity price (Source: Short-Term Outlook, EIA)

The increased demand for biopower would decrease the input available for paper production, lowering the outputs of paper and allied products. Decline in production of paper, in turn, would cause product prices to increase further, which might further dampen the quantity demanded. These short-run changes might delay the capital investments in paper production system improvements, but might precipitate biomass technology advancement, such as conversions of conventional mills to biorefineries in order to capitalize on the higher valued biopower and ethanol products or more co-firing by the power producers and utilities.

Table 10. Expected Directional Changes of a U.S. GHG Cap and Trade System on Biomass Energy and Paper Production

Primary Factors Contributing to the Expected Directional Changes through 2020							
		Biomass Power		Ethanol		Paper Products	
INPUT (Forest-Based)	Price	↑↑	Higher forest-based input prices due to increased demand for biomass power	↑↑	Higher forest-based input prices due to increased demand for biomass power	↑↑	Higher forest-based input prices due to increased demand for biomass power
	Quantity Available	↑↑	Increased production of timber to meet higher demand for biomass power	↓	Possible reduction in available biomass due to increased demand for biomass power	↓	Possible reduction in available biomass due to increased demand for biomass power
TECHNOLOGY	Tech Advance	↑	Increased investment in R&D and facility upgrades to support increased biopower production	--	Decline in major facility upgrades except energy efficiency improvements	--	Decline in major facility upgrades except energy efficiency improvements
	System Change	↑↑	Accelerated investment in new facilities such as biorefineries and cogeneration units	↑	Accelerated conversion to biorefinery facilities	↑	Some investment in new facilities such as biorefinery and cogeneration units
OUTPUT	Price	-	Higher demand for biomass power will produce economies of scale and reductions in biomass power production costs and prices, but increasing input prices will create a counter-effect	-	Slightly lower production costs and price for ethanol due to economies of scale from increased demand, but increasing input prices will create a counter-effect	↑↑	Higher price of paper due to higher input prices
	Quantity Produced	↑↑	Greater production of electricity from biomass resources	↑	Slight increase in production of ethanol from forest-based resources	↓↓	Decline in domestic production due to higher prices for paper products and shift to biomass power generation

3.3. Renewable Fuels Standards

3.3.1. Policy Description

A renewable fuels standard (RFS) is a policy instrument used to expand the displacement of gasoline and diesel with renewable fuels. Such fuels are defined in the Energy Policy Act of 2005 as a motor vehicle fuel that is produced from plant or animal products or wastes, as opposed to fossil fuel sources. The two most common motor vehicle fuels made from renewable sources are ethanol and biodiesel.

3.3.2. Policy Status

The national renewable fuels standard created by the Energy Policy Act of 2005 required the production of 7.5 billion gallons of ethanol by 2012. The U.S. EPA is the designated agency to coordinate with the U.S. Department of Energy, the U.S. Department of Agriculture, and stakeholders to design and implement this national program. The EPA is also responsible for establishing a credit-trading program. Renewable fuels that are not blended into gasoline, such as biodiesel and biogas, will be permitted to participate in the RFS trading program.

Table 11. Gallons of Renewable Transportation Fuels Required by EISA 2007

Year	Renewable fuel (billions gallons) (including B, C, and D)	Advanced biofuel (billions gallons) B	Cellulosic biofuel (billions gallons) C	Biomass-based diesel (billions gallons) D
2006	4.0	-	-	-
2007	4.7	-	-	-
2008	9.0	-	-	-
2009	11.1	0.6	-	0.5
2010	12.95	0.95	0.1	0.65
2011	13.95	1.35	0.25	0.8
2012	15.2	2	0.5	1
2013	16.55	2.75	1	
2014	18.15	3.75	1.75	
2015	20.5	5.5	3	
2016	22.25	7.25	4.25	
2017	24.0	9.0	5.5	
2018	26.0	11	7	
2018	28.0	13	8.5	
2020	30.0	15	10.5	
2021	33.0	18	13.5	
2022	36.0	21	16	

Source: EISA, 2007.

There are also numerous state renewable fuels standards, as shown in Table 12.

The Energy Independence and Security Act signed by President Bush on December 19, 2007, goes beyond the EPAct 2005 requirements. It sets a mandatory renewable fuels standard requiring the production of 36 billion of renewable fuels by 2022 – a four-fold increase from the 2008 level. In addition, it requires that by 2020 the United States produce 21 billion gallons of advanced biofuels, such as cellulosic ethanol as part of the 36 billion gallon requirement.[5] This will accelerate the effort to develop cost-effective processes for converting forest-based biomass to ethanol.

Table 12. State Initiatives to Establish Renewable Fuels Standards

State	Renewable Fuels Standard	Enacted
California	All gasoline produced at California refineries to contain 10% ethanol by December 31, 2009.	**June 2007**
Hawaii	85% of gasoline to contain 10% ethanol by April 2006.	**Sept. 2004**
Iowa	25% of motor fuel to come from renewable sources (E10, E85, biodiesel by 2020).	**May 2006**
Louisiana	All gasoline to contain 2% ethanol; 2% of all diesel to be biodiesel. To go into effect six months after there are 50 million gallons of ethanol in annual production or 10 million gallons of biodiesel in the state, unless the Louisiana Commission on Weights and Measures determines there is not sufficient supply or distribution capabilities in the state.	**June 2006**
Minnesota	All gasoline to contain 20% ethanol by 2013.	**May 2005**
Missouri	All gasoline except premium grade gasoline to contain 10% ethanol by 2008.	**July 2006**
Montana	All gasoline (except 91-octane) to contain 10% ethanol.	**May 2005**
Oregon	All gasoline to contain 10% ethanol after Oregon ethanol production reaches 40 million gallons per year; All diesel fuel to contain 2% biodiesel after the production of biodiesel from sources in Oregon, Washington, Idaho and Montana reaches 5 million gallons per year. To be increased to 5% when production reaches 15 million gallons per year.	**July 2007**
Washington	All gasoline to contain 2% ethanol by 2008. To be increased up to 10% if no adverse ozone pollution levels result and sufficient raw materials are available within the state; 2% of all diesel sold to be biodiesel by 2008. To be increased to 5% if there is sufficient in-state biodiesel production.	**July 2006**

Source: Pew Center on Global Climate Change, 2007b.

In addition the policies on renewable fuel standards, initiatives promoting the use of alternative fuel vehicles are expected to increase demand for alternative fuels. For instance, Executive Order 13423, Strengthening Federal Environmental, Energy, and Transportation Management, signed by President Bush in January 2007, requires agencies with 20 or more vehicles to decrease petroleum consumption by 2% per year relative to their 2005 baseline through 2015. It also requires agencies to increase alternative fuel use by 10% per year relative to the previous year.

[5] http://energy.senate.gov/public/_files/HR6EnergyBillSummary.pdf

Table 13. Expected Directional Changes of a stronger RFS on Biomass Energy and Paper Production

Primary Factors Contributing to the Expected Directional Changes through 2020							
		Biomass Power		**Ethanol**		**Paper Products**	
INPUT (Forest-based)	Price	↑	No significant impact anticipated	↑↑	Increase in forest-based input prices due to higher ethanol demand	↑	Possible long-term rise in prices for forest-based inputs for paper production
	Quantity Available	-	No significant impact anticipated	↑	Increased production of timber to meet higher demand for ethanol and biodiesel	↓	Possible reduction in available biomass due to increased demand for ethanol and biodiesel
TECHNOLOGY	Tech Advance	-	No significant impact anticipated	↑	Facility upgrades and expansions as demand for ethanol increases	-	No significant impact anticipated
	System Change	-	No significant impact anticipated	↑	Possible conversion of pulp and paper mills to biorefineries and accelerated investment in new ethanol plants	↑	Possible conversion of pulp and paper mills to biorefineries
OUTPUT	Price	-	No significant impact anticipated	↑	Ethanol prices may increase in the short-run as RFS goals cause rapid expansion of production	↑	Possible small increase in paper prices due to higher input prices
	Quantity Produced	-	No significant impact anticipated	↑↑	Greater ethanol production; uncertain how much will come from forest-based biomass	↓	Possible small reduction in paper production due to higher input prices

1.1.1. Implications for the Pulp and Paper Industry

A stronger RFS would increase the demand for ethanol production nationwide. Its impact on forest-based biomass input prices and products would at first be limited because forest-based biomass input is not widely used for ethanol production. Near-term RFS goals are likely to be met by the increased production of corn-based ethanol. In the long-run, however, RFS requirements could result in significant technological breakthroughs in the production of ethanol from forest-based biomass as pilot plants (such as the Range Fuels project) get underway and possibly benefit from "learning by doing." In addition, technology advances from research activities funded by the U.S. Department of Energy and others could make forest-based ethanol cost-competitive with corn-based ethanol, resulting in competing demands and higher prices for forest-based resources.

1.2. State Incentives for Biomass Pilot Plants

1.2.1. Policy Description

In order to promote wider use of forest-based biomass for electric power generation and ethanol production, states have started to implement a wide range of policies intended to support the construction of biomass pilot plants. These incentives vary depending on the specific needs and potential of the individual states. They include streamlining the application process, offering fiscal subsidies for facility construction, and providing production tax credits.

1.2.2. Policy Status

Georgia is one of the states with a significant potential for forest-based biomass. In order to better take advantage of its biomass resource, Georgia has been following a multi-faceted biomass policy and offering assistance for interested parties. First, Georgia Environmental Facilities Authority, Georgia Forestry Commission and Georgia Department of Economic Development joined forces and established the Georgia Bioenergy Partnership with the goal to develop a bioenergy market in Georgia. Second, state grants and tax incentives provide financial incentives for investors. For instance, Savannah-based Herty Advanced Materials Development Center approved a $1 million investment of state funds to expand biofuel development facilities in Georgia. Third, legislation passed to reduce sales taxes on ethanol and biodiesel companies. Finally, the state has improved its administrative procedures in order to facilitate the permitting process. Georgia Environmental Protection Division has started to expedite the permitting process for biofuels facilities (90 days or less). The state has also developed a “one-stop shop” concept, which facilitates communication among the representatives of local, state and federal government and companies (Georgia Forestry Commission, 2007).

1.2.3. Implications for the Pulp and Paper Industry

The impact of state incentives for biomass pilot plants on the pulp and paper industry depends on the facility types that will receive these incentives. If these facilities use forest-based biomass as an input to produce biomass power and ethanol, then the pulp and paper industry will face an input supply constraint, which will impact the production levels and price of paper products. However, the industry might also take advantage of these incentives and implement system upgrades or conversion to integrated facilities such as biorefineries.

Table 14. Expected Directional Changes of State Tax Incentives for Biomass Pilot Plants on Biomass Energy and Paper Production

Primary Factors Contributing to the Expected Directional Changes through 2020							
		Biomass Power		Ethanol		Paper Products	
INPUT (Forest-based)	Price	↑	Increase in forest-based input prices due to higher biomass power and ethanol demand	↑	Increase in forest-based input prices due to higher biomass power and ethanol demand	↑	Increase in forest-based input prices due to higher biomass power and ethanol demand
	Quantity Available	↑	Increased production of forest-based bioresources to meet growing demand for biomass power and ethanol	↑	Increased production of forest-based bioresources to meet growing demand for biomass power and ethanol	↓	Possible reduction in available biomass due to shift to biomass power and ethanol production
TECHNOLOGY	Tech Advance	↑	Accelerated investment in R&D and facility upgrades	↑	Accelerated investment in R&D and facility upgrades	-	No significant impact anticipated
	System Change	↑↑	Accelerated investment in new facilities such as biorefinery and cogeneration units	↑↑	Accelerated investment in new facilities such as biorefinery and cogeneration units	↑	Accelerated investment in new facilities such as biorefinery and cogeneration units
OUTPUT	Price	-	Technology advances, higher input prices	-	Technology advances, higher input prices	↑	Small increase in price of paper products due to higher priced inputs
	Quantity Produced	↑	More power plants and more biomass power production	↑	More ethanol facilities and more ethanol production; uncertain how much will be from forest-based inputs	↓	Decline in domestic production due to lower demand resulting from higher output prices

1.3. Taxation of Forest Property

1.3.1. Policy Description

Property taxation is a fiscal tool that generates funding for many public services such as public education, public safety, and fire protection. The type of the property taxes levied on forest land is important, because it might affect the behavior of the landowner by promoting sustainable forest management or providing incentives to allocate forests to competing uses such as the development of housing subdivisions. Some studies find that forestland owners can expect to pay 60-115 percent of earnings of their properties in taxes and the property tax burden is much greater on forestlands than on agricultural land. However, determining the exact impact of forest taxation depends on many factors such as the rate of the tax, location and reason for ownership; and therefore, study results are rather mixed (Pierce, 2003).

A property tax is defined as a tax on property measured by the property's value. State forest property tax can be classified into five types (National Timber Tax website, 2007):

- Ad valorem property tax is collected based the value of the land and the trees and is the most common type.
- Flat property tax is based on a uniform rate per acre regardless of the value of the timber.
- Exemption programs excuse the landowner from taxation.
- Severance tax is a flat tax on a specific unit of volume of timber harvested (i.e., board feet, cubic feet, cords, tonnage, etc.).
- Yield tax is based on the value of the harvested timber.

1.3.2. Policy Status

Property taxes play an important role in forest industry's business decisions, because property tax rates can vary greatly. For instance, the average property tax on farmland in Alabama was $1.23 in 1993 while it was $4.93 in Georgia (Newman, et al., 2000). Currently, states impose a variety of property taxes, but ad valorem tax is the most common type.

Table 15. Forest Property Taxation

	Ad Valorem	Flat Tax	Exemption	Severance Tax	Yield Tax
States	**All except AK, AZ, MA, MI, MN, MO, NH, ND, WI**	**AZ, IN, MA, MI, MN, MO, NH, NY, ND, OH, WI,**	**AK, DE, IA, RI**	**AL, AZ, AR, CA, GA, MT, NC, VA**	**ID, IL, MA, MI, MO, NH, NM, NY, WV, WI**

Source: National Timber Tax Website, 2007.

Figure 10 Type of State Property Tax

Source: Brown and Chandler, 2008.

There are many pending state initiatives that aim to provide forest owners an incentive to keep their land as forests. For instance, Glenn Richardson of Georgia proposes a constitutional amendment to repeal all ad valorem taxes.

1.3.3. Implications for the Pulp and Paper Industry

Federal income tax policies are considered to be one of the explanatory factors for the divestiture of U.S. forest product companies in recent years. For the traditional vertically integrated forest product companies, any profits obtained from the sale of timber are taxed at the corporate level (35%) as well as at the stockholder level when dividends are disbursed (15%). As a result, "investors who own both manufacturing plants and forestland often recoup as little as 50 cents out of every dollar of profit made from cutting trees whereas investors who own just forestland can earn at least 85 cents out of every dollar" (Hickman, 2007).

Any relief from existing state property tax obligations in the form of reduced tax rates would encourage landowners to keep their lands as forests and consequently to prevent forest lands from being converted to other uses, which would reduce forest-based biomass feedstock. Given that the use of forest-based biomass feedstock for ethanol production is currently limited, we do not anticipate major changes in ethanol production as a result of such a policy in the short-run. With the increase in supply and decline in prices, U.S. paper products and biomass power would be more competitive. That might lead to increased investments at paper mills and at biomass power plants, possibly including cogeneration units.

Table 16. Expected Directional Changes of Lower Taxation of Forest Property on Biomass Energy and Paper Production

Primary Factors Contributing to the Expected Directional Changes through 2020							
		Biomass Power		Ethanol		Paper Products	
INPUT (Forest-Based)	Price	↓↓	Lower forest-based input prices due to higher input supply	↓↓	Lower forest-based input prices due to higher input supply	↓↓	Lower forest-based input prices due to higher input supply
	Quantity Available	↑↑	Higher input supply due to forestland availability	↑↑	Higher input supply due to forestland availability	↑↑	Higher input supply due to forestland availability
TECHNOLOGY	Tech Advance	-	No significant impact anticipated	-	No significant impact anticipated	-	No significant impact anticipated
	System Change	↑	Possible investment in new biomass power facilities	-	No significant impact anticipated	↑	Possible investment in cogeneration units
OUTPUT	Price	-	No significant impact anticipated	-	No immediate impact anticipated	↓↓	Lower price for paper products due to lower input prices
	Quantity Produced	↑↑	Increased production of biomass power due to lower input prices	-	No immediate impact anticipated due to technical barriers to ethanol production from forest-based biomass	↑↑	Increase in domestic paper production due to lower input prices

2. OTHER ENERGY AND CLIMATE POLICIES

Numerous additional policies impact the cost-competitiveness, obstacles and opportunities facing the forest products industry, biopower production, and the ethanol and green chemicals industry. We did not study these in detail but rather offer the following short overview.

The EPAct 2005 extended the production tax credit (PTC) of 1.9 cents/kWh for renewable power to facilities put in production by the end of 2007. It has subsequently been extended until the end of 2008. This tax credit provides a significant incentive for co-firing coal with biomass to produce electricity. EPAct 2005 also authorized a program of loan guarantees for "innovative energy technologies" that avoid, reduce or sequester air pollutants or GHG and that have a *"reasonable prospect of repayment of the principal and interest on the* *obligation by the borrower.”*[6] The program applies to biomass power projects as well as other advanced coal (IGCC), hydrogen fuel cells, biomass, advanced nuclear, and efficient end-use technologies. There is no cap on the amount of project debt to be guaranteed. The full, faith and credit of the U.S. government can be applied to guarantee up to 80% of total project cost.

The current market for bio-ethanol is also highly dependent on existing <u>fiscal incentives</u> (Yacobucci, 2007). For example, the U.S. government provides the domestic ethanol industry with a 51 cent per gallon excise tax credit.[7] EPact 2005 included a 30% federal income tax credit (worth up to $30,000) for businesses that add one or more E85 pumps to their fueling stations.

In addition, there is an <u>import tax on ethanol</u>, which is of particular relevance to the pulp and paper industry. This tariff is an example of a policy that raises the cost of ethanol blends produced by domestic refineries. In 1980, the U.S. Congress imposed a 54 cent per gallon tariff on imported ethanol to promote energy independence.[8] With the refinery phase-out of MTBE in 2007 along with the renewable fuel portfolio mandated in the 2007 Energy Independence and Security Act, the demand for ethanol is even greater than expected, and it is not clear if the domestic supply will be sufficient (Brown and Chandler, 2008). The import tariff prevents refineries from buying ethanol from wherever it is cheapest on the global market, as from Brazil where ethanol production from sugarcane costs are 40 to 50 percent less than U.S. ethanol production from corn (Yacobucci, 2007). If the import tariff were to be lifted, there would be less competitive pressure on domestic forest-based biomass for ethanol production, to the benefit of the paper industry.

Markets for <u>renewable energy credits</u> are emerging in the United States, which means that MWh of biopower can be bought and sold in the marketplace presumably at a premium above the average cost of electricity. Markets for <u>carbon offsets</u> from terrestrial sequestration are also emerging, which may encourage forest owners to sustainably maintain their forests in order to qualify for this revenue stream.

Looking into the future, any of these policies could be discontinued or expanded, and entirely new energy and climate policies could also be promulgated. Paper industry leaders who anticipate and respond appropriately to policy opportunities will have a marketplace advantage.

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[6] www.lgprogram.energy.gov

[7] Volumetric Ethanol Excise Tax Credit (VEETC) as part of American Jobs Creation Act of 2004 (P.L. 108-357).

[8] Omnibus Reconciliation Act of 1980. P.L. 96-598

3. CONCLUSIONS

From the universe of energy and climate policies being debated in the United States, we have analyzed five policy initiatives with potentially large impacts on the U.S. pulp and paper industry. These include: a federal renewable electricity standard, a U.S. GHG cap and trade system, stronger federal renewable fuels standards, state incentives for biomass pilot projects, and taxation of forest property based on current use. Table 16 summarizes our assessment of the expected directional changes these five policies might exert on the price and supply of forest-based biomass inputs and outputs including paper and allied products as well as biomass power and ethanol. Our conclusions are based on the application of "first principles" of economics and policy analysis and do not derive from any detailed original modeling. Also, they refer to marginal effects—that is, directional influences relative to a "business-as-usual" or "reference case" forecast that assumes no new policy interventions. The industry would benefit from a modeling exercise focused on refining and quantifying the anticipated directional changes of the policy scenarios outlined here.

All but one of the policies examined here are anticipated to increase the price and supply of timber and other forest-based biomass inputs, relative to a business-as-usual scenario. The one exception (taxation of forest property based on current use) would also increase the supply of available forest-based biomass inputs, but it would do this in conjunction with placing downward rather than upward pressure on the price of forest-based inputs (Table 17).

These same four policies are also anticipated to inflate the price of paper products because of the upward pressure they would exert on the cost of forest-based inputs. In turn, the higher output prices would likely reduce the final demand for domestically produced paper products, which is already affected by the growth of electronic communication and increasing competition from foreign suppliers. The one policy exception (reduced forest property taxes) would have the opposite directional influence: it would decrease output prices, which would lead to increased domestic paper production.

All five policies are similar in their favorable (or at worst neutral) influence on biopower and ethanol production. Final prices for these bioenergy products would generally remain the same. While their sales would increase as the result of legislated production goals, resulting economies of scale, and incentives to "learn by doing," cost of the raw materials would push the prices in the opposite direction.

These trends reinforce the value of forest product diversification through the generation of biomass power and the production of transportation fuels and chemicals as co-products of the pulp and paper industry. Directing capital expenditures to the increasingly cost-competitive and expanding biopower and biofuels markets would appear to have merit in anticipation of the promulgation of new energy and climate policies. Accelerated investments in new facilities such as biorefineries and cogeneration units would position the pulp and paper industry to profit from current trends and likely policy initiatives. In contrast, the higher input prices faced by the paper industry would tend to forestall new facility upgrades dedicated to paper production alone, expect those that also increase the energy efficiency of operations, given the likely rise in fossil fuel energy prices. A broader product portfolio could help the industry remain competitive with global markets in an increasingly carbon-constrained world.

Table 17. Summary of Energy and Climate Policy Impacts: Expected Directional Changes

	Federal Renewable Electricity Standard	**U.S. GHG Cap and Trade**	**Stronger Federal Renewable Fuels standards**	**State Incentives for Biomass Pilot Plants**	**Taxation of Forest Property Based on Current Use**
Point of Impact	Electricity suppliers	Mostly "upstream" sources of GHGs	Refiners and other fuel producers	Biomass energy producers	Forestland owners
Status	Federal – Pending; States – in place in 33 states	Federal – Pending; Regional – Pending	Federal – just enacted; States – in place in 9 states	In place in numerous states	Variable; four states exempt forest owners from property taxes
Short-term Impact on Inputs:					
Price of Forest-Based Inputs	↑↑	↑↑	↑	↑	↓↓
Short-term Impact on Outputs:					
Price of Paper Products	↑	↑↑	↑	↑	↓↓
Production of Paper Products	↓	↓↓	↓	↓	↑↑
Price of Biomass Power	-	-	-	-	-
Production of Biomass Power	↑↑	↑↑	-	↑	↑↑
Price of Ethanol	-	-	↑	-	-
Production of Ethanol	-	↑	↑↑	↑	-

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