Washington State Department of Ecology
Industrial Footprint Project

A Review of Sustainability Incentive Programs for the Pulp and Paper Sector

Prepared in Support of Project Task 8

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I. Introduction

The purpose of this paper is to review what the federal government and/or individual states are doing to incentivize the pulp and paper industry to attain environmentally friendly performance that transcends the level of mere regulatory compliance. This paper acknowledges the Washington State Department of Ecology’s (“DOE's”) desire to explore its own options for voluntary initiatives with the pulp and paper industry, and assumes that the experiences of other states will be used to inform that end. However, because few states have developed incentive programs specifically geared towards the pulp and paper industry, this paper is drafted in such a way as to provide a framework within which DOE may decide what type of voluntary initiatives, *i.e.*, voluntary agreements or other incentives, may be appropriate for Washington’s pulp and paper industry even with few examples to guide that assessment. This paper also provides a means for predicting the effectiveness of complementary voluntary agreements, which are defined herein as the appropriate initiative model for DOE within this context.

While some argue that voluntary environmental initiatives, whether they are incentives or other agreements, may actually lead to “inferior policy results,”¹ this paper makes no attempt to comment on this debate nor does it discuss potential pitfalls of adopting voluntary environmental initiatives. Rather, this paper assumes that any environmental initiative incited by DOE for the pulp and paper industry within Washington State will be designed to enhance environmental performance and will not be undertaken in lieu of lesser regulatory control. Thus, this paper discusses only performance enhancing purposes of environmental initiatives and the potential benefits those initiatives may provide.

II. Domestic Industry Overview

The pulp and paper industry converts wood or recycled fiber into pulp and primary forms of paper. The paper and allied products industry comprises two types of facilities: 1) pulp and paper mills, which process raw wood fiber or recycled fiber to make pulp and/or paper; and 2) converting facilities that use these primary materials to manufacture more specialized products such as paperboard boxes, writing paper, and sanitary paper.²

Pulp mills separate the fibers of wood or from other materials, such as rags, linters, wastepaper, and straw in order to create pulp. Mills may use chemical, semi-chemical, or mechanical processes, and may create co-products such as turpentine and tall oil. Paper mills primarily are engaged in manufacturing paper from wood pulp and other fiber pulp, but may also manufacture converted paper products.³

The pulp and paper industry produces primary products, such as commodity
grades of wood pulp, printing and writing papers, sanitary tissue, industrial-type papers, and containerboard and boxboard, using cellulose fiber from timber or purchased or recycled fibers. Simply put, paper is manufactured by applying a watery suspension of cellulose fibers to a screen, which allows the water to drain and leaves the fibrous particles behind in a sheet.\(^4\)

The United States is the world’s leading economy and the world’s largest consumer of paper and paperboard products.\(^5\) The American per capita paper consumption is roughly 700 pounds annually. Producing roughly 30% of the world’s paper and paperboard,\(^6\) the United States is also the world’s leading producer of paper, and its immense production volume reflects the size and wealth of the domestic market, and the relative abundance and low cost of raw materials and other crucial inputs.

The U.S. pulp and paper industry, which is comprised of pulp, paper, and paperboard mills as well as paper products suppliers, is characterized by very large facilities. Of the 514 pulp and paper mills reported by the Bureau of the Census in 1998, 67% had 100 or more employees. Across all of these facilities that same year, 172,000 employees produced $59 billion in shipments. More recently in 2000, the industry employed 182,000 individuals and produced $79 billion in shipments. Between 1990 and 2002, paper consumption in the U.S. increased from 84.9 to 97.3 million tons.\(^7\)

Although year-to-year fluctuations occur, the industry has been relatively free from the cyclical volatility experienced by such primary industries as mining, metals, and wood products. The pulp and paper industry has been called a bellwether for the national economy. Due to the relative abundance and low cost of raw materials and other crucial inputs like wood, energy, and water, Washington State has become a leader in the nation’s pulp and paper industry. The first paper mill on the West Coast was built in 1883 near Camus, Washington. This mill, which was financed by H.L. Pittock, the founder of the Oregonian newspaper, had a daily capacity of six tons of newsprint. The expansion of the state’s infant pulp and paper industry was initially stunted by Washington’s distance from Eastern markets. Consequently, production at this and other early pulp and paper mills was largely oriented toward meeting the regional demand for newsprint.

During the interwar years, the national pulp and paper industry experienced spectacular growth, fueled by increased consumer demand and significant product and process developments. In Washington State, 15 new facilities were built, and by 1939 pulp production jumped from 134,000 tons to 1.4 million tons a year. Newsprint and packaging papers still dominated the state’s product portfolio, however. Increased demand for paper grades made from sulfate pulp resulted in a growing supply of rayon, cellophane, and white paper. Over the next fifty years, the Washington State pulp and paper industry grew steadily, making it an increasingly important component of the state’s economy.
In recent years, many of the same forces affecting the state’s lumber and wood products industry have applied to the pulp and paper industry. For instance, the 1990-91 recession not only softened demand for paper, but also resulted in a smaller supply of wood chips, the chief ingredient for pulp, as Washington’s sawmills curtailed production. The rising cost of chips, coupled with stable paper prices, damaged the state industry’s competitiveness and cut deeply into profits. Environmental laws have also affected pulp and paper’s processing and limits placed on timber harvesting have similarly affected wood chip supply.

The last few years have been especially difficult for the Washington pulp and paper industry. With increased worldwide capacity and sluggish demand, paper prices plummeted. Although state pulp and paper manufacturers have survived the latest downside of the industry business cycle, some plants have closed including specialty pulp mills in Port Angeles and Vancouver.

The pulp & paper industry in Washington is largely composed of large mills and plants that produce pulp, paper, paperboard, containers, and converted paper products. Three of the subsectors (pulp mills, paper mills, and paperboard mills) account for about one third of the total 141 establishments, averaging 220 workers per establishment. By contrast, paperboard containers and boxes (e.g., corrugated and solid fiber boxes, sanitary food containers, folding paperboard boxes) and miscellaneous converted paper products (coated and laminated paper, bags, envelopes) subsectors averages 63 employees per establishment. Nearly 70% of all pulp & paper workers are found in establishments with 500 or more employees.

Processes in the manufacture of paper and paperboard can, in general terms, be split into three steps: 1) pulp making; 2) pulp processing; and 3) paper/paperboard production. First, a stock pulp mixture is produced by digesting a material into its fibrous constituents via chemical, mechanical, or a combination of chemical and mechanical means. In the case of wood, the most common pulping material, chemical pulping actions release cellulose fibers by selectively destroying the chemical bonds in the glue-like substance, called lignin, which binds the fibers together. After the fibers are separated and impurities have been removed, the pulp may be bleached to improve brightness and processed to a form suitable for paper making equipment. At the paper making stage, the pulp can be combined with dyes, strength building resins, or texture adding filler materials, depending on the intended end product. Afterwards, the mixture is dewatered, leaving the fibrous constituents and pulp additives on a wire or wire-mesh conveyor. Additional additives may be applied after the sheet-making step. The fibers bond together as they are carried through a series of presses and heated rollers. The final paper product is usually spooled on large rolls for storage.8

Although the details of the processes entailed in the manufacture of paper are voluminous, this paper focuses only on the details of the pulping process, as this is the process – in addition to the initial procurement of raw materials9 – that causes the
The greatest amount of environmental concern for the pulp and paper industry and regulators alike. The pulping process, which is discussed in some depth in the following section, includes the manufacture, processing, and bleaching of pulp.

III. The Pulping Process

Pulping is the process of dissolving wood chips into individual fibers by chemical, semi-chemical, or mechanical methods. The particular pulping process used affects the strength, appearance, and intended use characteristics of the resultant paper product. There are more than a dozen different pulping processes in use in the U.S., each with its own set of process inputs, outputs, and resultant environmental concerns. The bleached and unbleached “kraft” processes are used to manufacture the majority of paper products. Together, these processes account for 83% of the pulp produced in the United States.

While a variety of technologies and chemicals are used to manufacture paper, most systems contain the following process sequence, which includes the pulping process, seen here at stages 2 – 4:

- **First** → Fiber furnish preparation and handling, which includes the debarking, slashing, and chipping of wood logs, followed by the screening of wood chips and/or secondary fibers.

- **Second** → Pulping or pulp manufacture, which includes the chemical, semi-chemical, or mechanical breakdown of pulping material into fibers.

- **Third** → Pulp processing, which includes the removal of pulp impurities and the cleaning and thickening of the pulp fiber mixture.

- **Fourth** → Pulp bleaching, which includes the addition of chemicals in a staged process of reaction and washing, which in turn increases whiteness and brightness of pulp if necessary.

- **Fifth** → Pulp drying and baling, which, at non-integrated pulp mills, includes the drying and bundling of pulp into bales for transport to a paper mill.

- **Sixth** → Stock preparation, which includes the mixing, refining, and addition of wet additives to add strength, gloss, and texture to the paper product if necessary.

Because most of the pollutant releases associated with pulp and paper mills occur within the pulping process, this paper explains stages 2 – 4 and their associated chemical inputs in order to facilitate a better understanding of the sections that follow on pollution and pollution prevention.
A. Pulp Manufacture

Pulp manufacturing, also known as the pulping stage, is where the processed furnish- whether wood or another fiber source- is digested into its fibrous constituents. The bonds between fibers may be broken chemically, mechanically, or by a combination of the techniques called semi-chemical pulping. Although chemical pulping is most prevalent, the choice of pulping technique is dependent on the type of furnish and the desired qualities of the finished product.

1. Chemical Pulping

Chemical pulps are typically manufactured into products that have high quality standards or require special properties. Chemical pulping degrades wood by dissolving the lignin bonds holding the cellulose fibers together. Generally, this process involves the cooking and/or digesting of wood chips in aqueous chemical solutions at elevated temperatures and pressures. The two major types of chemical pulping currently used in the U.S. are kraft pulping and sulfite pulping. These processes differ primarily in the chemicals used for digesting.

a. Kraft Pulping

Kraft pulping is very popular, and produced approximately 83% of all U.S. pulp tonnage during 2000. The success of the process and its widespread adoption are due to several factors. First, because the kraft cooking chemicals are selective in their attack on wood constituents, the pulps produced are notably stronger than those from other processes. The kraft process is also flexible, in so far as it is amenable to both hard and soft woods and can tolerate contaminants frequently found in wood, such as resins. Lignin removal rates are high in the kraft process. At up to 90%, lignin removal rates in turn allow high levels of bleaching without pulp degradation. Finally, the chemicals used in kraft pulping are readily recovered within the process. This makes the kraft process very economical and reduces potential environmental releases.

The kraft process uses a sodium-based alkaline pulping solution, called white liquor, which consists of sodium sulfide (Na$_2$S) and sodium hydroxide (NaOH) in 10% solution. The white liquor is mixed with wood chips in a digester reaction vessel. The output products from the digester are separated wood fibers now in the form of pulp and a liquid, called black liquor, that contains the dissolved lignin solids in a solution of reacted and un-reacted pulping chemicals. The black liquor undergoes a chemical recovery process to regenerate white liquor for the first pulping step. Overall, the kraft process converts approximately 50% of input furnish into pulp.
b. Sulfite Pulping

Sulfite pulping was used for approximately 2% of U.S. pulp production in 2000. Sulfite pulping is much more limited than kraft pulping in that it must utilize predominately softwood of which only non-resinous species are generally pulped. The sulfite pulping process relies on acid solutions of sulfurous acid (H$_2$SO$_3$) and bisulfite ion (HSO$_3^-$) to degrade the lignin bonds between wood fibers.

While sulfite pulps have less color than kraft pulps and can be bleached more easily, they are not as strong. The efficiency and effectiveness of the sulfite process is also dependent on the type of wood furnish and the absence of bark. For these reasons, the use of sulfite pulping has declined in comparison to kraft pulping over time.

2. Mechanical Pulping

Mechanical pulping accounted for 9% of U.S. pulp production in 2000. Mechanically produced pulp is of low strength and quality, and is thus used principally for newsprint and other non-permanent paper goods. Although mechanical pulping relies on physical pressure instead of chemicals to separate furnish fibers, chemicals are sometimes added at the various stages of refining. Mechanical pulping typically results in high pulp yields, up to 95% when compared to chemical pulping yields of 45 – 50% percent, but energy usage is also high. To offset its structural weakness, mechanical pulp is often blended with chemical pulp.

3. Semi-Chemical Pulping

Semi-chemical pulping comprised 6% of U.S. pulp production in 2000. Semi-chemical pulp is often very stiff, making this process common in corrugated container manufacture. This process primarily uses hardwood as furnish.

The major process difference between chemical pulping and semi-chemical pulping is that the latter uses lower temperatures, more dilute cooking liquor or shorter cooking times, and mechanical disintegration for fiber separation. At most, the digestion step in the semi-chemical pulping process consists of heating pulp in sodium sulfite (Na$_2$SO$_3$) and sodium carbonate (Na$_2$CO$_3$). Depending on the process used, the yield of semi-chemical pulping ranges from 55 – 90%, but pulp residual lignin content is also high so bleaching is more difficult.
B. Pulp Processing

After pulp production, pulp processing removes impurities, such as uncooked chips, and recycles any residual cooking liquor via the washing process. Pulps are processed in a wide variety of ways, depending on whether they were generated via the chemical, mechanical, or semi-chemical pulp manufacturing method. Some pulp processing steps that remove pulp impurities include screening, defibering, and deknotting. Pulp may also be thickened by removing a portion of the water. At additional cost, pulp may be blended to ensure product uniformity. If pulp is to be stored for long periods of time, drying steps are necessary to prevent fungal or bacterial growth.

Residual spent cooking liquor from chemical pulping is washed from the pulp using brown stock washers. Efficient washing is critical to maximize return of cooking liquor to chemical recovery, as well as to minimize carryover of cooking liquor into the bleach plant, because excess cooking liquor increases consumption of bleaching chemicals. Specifically, the dissolved organic compounds, such as lignins and hemicelluloses, contained in the liquor will bind to bleaching chemicals, and thus increase bleach chemical consumption. In addition, these organic compounds function as precursors to chlorinated organic compounds like dioxins and furans, increasing the probability of their formation. The most common washing technology is rotary vacuum washing, carried out sequentially in two or four washing units. Other washing technologies include diffusion washers, rotary pressure washers, horizontal belt filters, wash presses, and dilution/extraction washers.

Pulp screening then removes any remaining oversized particles like bark fragments and oversized and/or uncooked chips. In open screen rooms, wastewater from the screening process goes to wastewater treatment prior to discharge. In closed loop screen rooms, wastewater from the process is reused in other pulping operations, and ultimately enters the mill’s chemical recovery system. Centrifugal cleaning is used after screening to remove relatively dense contaminants like sand and dirt. Rejects from the screening process are either repulped or disposed of as solid waste.

Importantly, pulp processing also includes chemical recovery. Currently, the two most common chemical recovery systems are the kraft and sulfite systems, the former being used much more commonly than the latter. The system of chemical recovery used by any given pulp and paper mill is a complex part of that facility, and is subject to a variety of environmental regulations. Chemical recovery is a crucial component of the chemical pulping process: it recovers process chemicals from the spent cooking liquor for reuse. The chemical recovery process has important financial and environmental benefits for pulp and paper mills. Economic benefits include savings on chemical purchase costs due to regeneration rates of process chemicals approaching 98% and energy generation from pulp residue burned in a recovery furnace. Environmental
benefits include the recycle of process chemicals and lack of resultant discharges to the environment.

1. The Kraft Chemical Recovery System

The kraft chemical recovery system is widely used today. Although newer technologies are always under development, the basic kraft chemical recovery process has not been fundamentally changed since its patent issue in 1884. The kraft chemical recovery process consists of the following general steps: 1) black liquor concentration; 2) recovery boiler; 3) recausticizing; and 4) calcining.

a. Black Liquor Concentration

Residual weak black liquor from the pulping process is concentrated by evaporation to form a “strong black liquor.” After the evaporation process, solids concentration can range from 60 – 80%. In some older facilities, the liquor then undergoes oxidation for odor reduction. The oxidation step is necessary to reduce odor created when hydrogen sulfide is stripped from the liquor during the subsequent recovery boiler burning process. Almost all recovery furnaces installed since 1968 have non-contact evaporation processes that avoid these problems, so oxidation processes are not usually seen in mills with modern recovery furnaces. Common modern evaporator types include multiple effect evaporators as well as a variety of supplemental evaporators. Odor problems with the kraft process have been the subject of control measures.

b. Recovery Boiler Burning

The strong black liquor from the evaporators is burned in a recovery boiler. In this crucial step in the overall kraft chemical recovery process, organic solids are burned for energy, and the process chemicals are removed from the mixture in molten form. Molten inorganic process chemicals, such as smelt, flow through the perforated floor of the boiler to water-cooled spouts and dissolving tanks for recovery in the recausticizing step. Energy generation from the recovery boiler, however, is often insufficient for total plant needs. Hence facilities augment recovery boilers with fossil-fuel-fired and wood-waste-fired boilers to generate steam and often electricity. Industry-wide, the utilization of pulp wastes, bark, and other papermaking residues supplies 58% of the energy requirements of pulp and paper companies.

c. Recausticizing

Smelt is recausticized to remove impurities left over from the furnace and to convert Na$_2$CO$_3$ into active NaOH and Na$_2$S. The recausticization procedure begins with the mixing of smelt with “weak” liquor to form green liquor, named for its characteristic color. Contaminant solids, called dregs, are removed from the green liquor, which is
mixed with lime (CaO). After the lime mixing step, the mixture, now called white liquor due to its new coloring, is processed to remove a layer of lime mud (CaCO₃) that has precipitated. The primary chemicals recovered are caustic NaOH and Na₂S. The remaining white liquor is then used in the pulp cooking process. The CaCO₃ is treated to regenerate lime in the calcining process.

d. Calcining

In the calcining process, the CaCO₃ is removed from the white liquor is burned to regenerate CaO for use in the CaO mixing step. The vast majority of mills use CaO kilns for this process, although a few mills use fluidized bed systems in which the reactants are suspended by upward-blowing air.

2. Sulfite Chemical Recovery Systems

Although there are a variety of sulfite chemical pulping recovery systems used today, these systems are much less frequently employed than is the kraft recovery system. For this reason, sulfite chemical recovery systems are not fully discussed here. Basically, sulfite chemical recovery systems allow for the recovery of heat and sulfur from all liquors, but allow for the base chemical recovery from only the magnesium and sodium base processes.

C. Pulp Bleaching

Bleaching is defined as any process that chemically alters pulp to increase its brightness. Bleached pulps create papers that are whiter, brighter, softer, and more absorbent than unbleached pulps. Of the approximately 72 million tons of pulp production capacity in the U.S. in 2000, about 50% is ultimately bleached. Any type of pulp may be bleached, but the type of fiber furnish and pulping processes used, as well as the desired qualities and end use of the final product, greatly affect the type and degree of pulp bleaching possible.

1. Bleaching of Chemically Processed Pulp

Chemical pulp bleaching has undergone significant process changes since approximately 1990. At that time, nearly every chemical pulp mill that used bleaching incorporated elemental chlorine (Cl₂) into some of its processes. Because of environmental and health concerns about dioxins, U.S. pulp mills now use elemental chlorine free (ECF) and total chlorine free (TCF) bleaching technologies. Chemicals commonly involved in both technologies include NaOH, Oxygen (O₂), Ozone (O₃), hydrogen peroxide (H₂O₂), sulfur dioxide (SO₂), and sulfuric acid (H₂SO₄). The difference between ECF and TCF is that ECF may include chlorine dioxide (ClO₂) and hypochlorite (HClO, NaOCl, and Ca(OCl)₂) based technologies. In 2001, ECF technologies were used
for about 95% of bleached pulp production, TCF technologies for about 1%, and elemental chlorine was used for about 4% of production.

Chemical pulp is bleached in traditional bleach plants where the pulp is processed through 3 – 5 stages of chemical bleaching and water washing. The number of cycles is dependent on the whiteness desired, the brightness of initial stock pulp, and plant design. Bleaching stages generally alternate between acid and alkaline conditions. Chemical reactions with lignin during the acid stage of the bleaching process increase the whiteness of the pulp. The alkaline extraction stages dissolve the lignin/acid reaction products. At the washing stage, both solutions and reaction products are removed. Chemicals used to perform the bleaching process must have high lignin reactivity and selectivity to be efficient. Typically, 4 – 8% of pulp is lost due to bleaching agent reactions with the wood constituents cellulose and hemicellulose, though these losses can be as high as 18%.

2. **Bleaching of Mechanically Processed Pulps**

Mechanical pulp bleaching utilizes \( \text{H}_2\text{O}_2 \) and/or sodium hydrosulfite \((\text{Na}_2\text{SO}_3)\). Bleaching chemicals are either applied without separate equipment during the pulp processing stage or in bleaching towers. Full bleaching of mechanical pulps is generally not practical.

3. **Bleaching of Semi-Chemically Processed Pulps**

Semi-chemical pulp bleaching utilizes \( \text{H}_2\text{O}_2 \) in a bleach tower.

IV. **Pollution**

To get through all of these processes and procure the raw materials for use in these processes, the pulp and paper industry uses enormous amounts of energy and releases great magnitudes of pollution. Across all U.S. facilities, the pulp, paper, and allied products industry is the largest consumer of process water and the third largest consumer of energy (behind the chemicals and metals industries). This high use of water and energy, as well as the chemical inputs described above, lead to a variety of environmental concerns.

Papermaking is energy intensive. Approximately 35 million British thermal units ("Btu") are used on average to produce one ton of paper. Although many plants to some extent generate their own power from the burning of liquor waste, none are self-sustaining. Other energy sources are always needed to make up the remainder of the mills’ energy needs. Most draw large amount of electricity from public utilities. Some even build their own power plants, which can be a significant contributor to area air
pollution and to the hidden damages due to fuel extraction, such as oil drilling, oil spills, coal mining, pipelines, transmission lines, etc.\textsuperscript{12} 

The pulp and paper industry is projected to use 8,921 million kilowatt-hours ("kWh") of electricity and 54,300 million Btu of fossil fuels annually by 2010.\textsuperscript{13} The pulp manufacturing process is the major source of environmental concern for this industry. For example, a bleached kraft pulp mill requires 4,000-12,000 gallons of water and 14 – 20 million Btu of energy per ton of pulp. In general, the pulping process pollutes the environment through air emissions, wastewater discharges, and solid/hazardous wastes.\textsuperscript{14}

Air emissions from pulping processes and power generation facilities release odors, particulates, or other pollutants into the atmosphere, which contribute to human health problems and global warming. These same processes generate large volumes of wastewaters, which adversely affect freshwater or marine ecosystems and contaminate drinking supplies. Furthermore, residual wastes from wastewater treatment processes contribute to existing local and regional disposal problems. Major sources of pollutant releases in pulp and paper manufacture are at the pulping and bleaching stages respectively. As such, non-integrated mills, \textit{i.e.}, those mills without pulping facilities on-site, are not significant environmental concerns when compared to integrated mills or pulp mills.

During calendar 2000, the pulp and paper industry released and transferred, \textit{i.e.}, shipped off-site, a total of approximately 263 million pounds of toxic chemicals. This represents approximately 2.5\% of the total pounds of chemicals released and transferred by all facilities of any industry reporting to the Toxic Release Inventory ("TRI") that year. The pulp and paper industry releases 66\% of its total TRI poundage to the air, approximately 22\% into water and publicly-owned wastewater treatment works ("POTWs"), and 9\% onto land, either on or off site.

\textbf{A. Air}

Air pollution results from many anthropogenic sources, both stationary (point sources) and mobile (nonpoint sources). Although mobile sources of fuel related air pollution are certainly not negligible, much of the air pollution emitted into the atmosphere can be attributed to stationary sources, such as smoke stacks of power plants, municipal waste incinerators, and manufacturing facilities like pulp and paper mills.\textsuperscript{15} Pulp and paper mills are large sources of standard air pollutants, such as carbon dioxide, nitrous oxides, sulfur dioxides, carbon monoxides, and particulates. These contribute to ozone warnings, acid rain, global warming, and respiratory problems. Moreover, many mills are large enough to have their own coal-fired power plants, raising additional concerns about mercury, arsenic, and radioactive emissions.\textsuperscript{16}

The major sources of air pollutant releases from various pulp and paper
processes are: fine particulates and nitrogen oxides from the kraft recovery furnace; coarse particulates from fuel and coal-fired burners; sulfur oxides and ammonia from sulfite mill operations; reduced sulfur gases from the kraft pulping and recovery processes; volatile organic compounds (“VOCs”) from pulp drying; and nitrogen oxides from all combustion processes. In the kraft pulping process, which is the most significant source of air pollutants in the pulp and paper industry, sulfur oxides are a minor issue in comparison to the odor problems created by four reduced sulfur gasses, called together total reduced sulfur (“TRS”).

TRS gasses include hydrogen sulfide, methyl mercaptan, dimethyl sulfide, and dimethyl disulfide. The TRS emissions are released primarily from wood chip digestion, black liquor evaporation, and chemical recovery boiler processes. TRS compounds create odor nuisance problems at lower concentrations than sulfur oxides. Odor thresholds for TRS compounds are approximately 1,000 times lower than that for sulfur dioxide. Humans can detect some TRS compounds in the air as a “rotten egg” odor at as little as one part per billion (“ppb”).

B. Water

The pulp and paper industry is the largest industrial process water user in the U.S. In 2000, a typical pulp and paper mill used 4,000 – 12,000 gallons of water per ton of pulp produced. General water pollution concerns for pulp and paper mills are effluent solids, biochemical oxygen demand (“BOD”), and color. Toxicity concerns historically occurred from the potential presence of chlorinated organic compounds such as dioxins, furans, and others (collectively referred to as adsorbable organic halides, or “AOX”) in wastewaters after the chlorination/extraction sequence. With the substitution of chlorine dioxide for chlorine, effluent loads of the chlorinated compounds decreased dramatically.

Due to the large volumes of water used in pulp and paper processes, virtually all U.S. mills have primary and secondary wastewater treatment systems installed to remove particulate and BOD produced in the manufacturing processes. These systems also provide significant removal- approximately 30 – 70% - of other important parameters such as AOX and chemical oxygen demand (“COD”).

Still pulp and paper mills continue to be major sources of effluent pollutants including solids, concentrated and un-concentrated BOD, color, reduced sulfur compounds, and chlorinated organic compounds. These pollutants are generally carried by wastewaters resulting from wood processing, chemical recovery condensates, pulp screening, kraft bleaching, and/or fiber and liquor spills.

Beyond complications caused by effluent pollutants, the large amount of water required by pulp and paper mills is frequently taken from diminishing groundwater supplies. In the Green Bay area of Wisconsin, for example, the aquifer drawdown
caused by excessive high capacity wells of the paper industry is a major cause of municipal water woes, forcing local taxpayers to build expensive pipelines 30 miles to Lake Michigan. Exorbitant water consumption by Wisconsin’s paper industry has, in part, actually necessitated that state’s Aquifer Storage and Recovery Proposal.17

C. Solid Waste

Papermaking produces significant residual waste streams made up of wastewater treatment sludges, lime mud, lime slaker grits, green liquor dregs, boiler and furnace ash, scrubber sludges, and wood processing residuals. Because of the tendency for chlorinated organic compounds to partition from effluent to solids, wastewater treatment sludge is a significant environmental concern for the pulp and paper industry.

Wastewater treatment sludge is the largest volume residual waste stream generated by the pulp and paper industry. Sludge generation rates vary widely among mills. For example, bleached kraft mills surveyed as part of EPA’s 104-Mill Study reported sludge generation that ranged from 14 – 140 kilogram (“kg”) of sludge per ton of pulp. Total sludge generation for these 104 mills was 2.5 million dry metric tons per year, or an average of approximately 26,000 dry metric tons per year per plant. Pulp making operations are responsible for the bulk of sludge wastes, although treatment of papermaking effluents also generates significant sludge volumes. For the majority of pulp and integrated mills that operate their own wastewater treatment systems, sludges are generated onsite. A small number of pulp mills, and a much larger proportion of papermaking establishments, discharge effluents to POTWs.

Potential environmental hazards from wastewater sludges are associated with trace constituents like chlorinated organic compounds that partition from the effluent into the sludge. It should be noted, however, that recent trends away from elemental chlorine bleaching have reduced these hazards. A continuing concern is the very high pH (>12.5) of most residual wastes. When these wastes are disposed of in an aqueous form, they may meet the Resource Conservation and Recovery Act’s (“RCRA’s”) definition of a corrosive hazardous waste.

Landfill and surface impoundment disposal are most often used for wastewater treatment sludge, but a significant number of mills dispose of sludge through land application. When land filling costs are relatively cheap (defined as less than $20 per ton), the industry has little incentive for making more efficient use of its materials. Thus, paper mill sludges can consume large percentages of local landfill space each year. When disposed of by being spread on cropland, concerns are raised about trace contaminants building up in soil or running off into area lakes and streams. Some pulp and paper companies actually burn their sludge in incinerators, compounding what can become serious air pollution problems.18
D. Process Inputs and Pollutant Outputs

Kraft chemical pulping and chlorine-based, i.e., hypochlorite or chlorine dioxide, bleaching are both commonly used and typically significant pollutant outputs. Kraft pulping processes produced approximately 83% of total U.S. pulp tonnage during 1998. Roughly 60% of this amount is bleached in some manner. Pollutant outputs from mechanical, semi-chemical, and secondary fiber pulping are small when compared to kraft chemical pulping.

When paper is made via kraft chemical pulped bleached paper production, the variety of pollution outputs is staggering. Recall that there are six main stages involved in the manufacture of paper: 1) fiber furnish preparation and handling; 2) pulping or pulp manufacture; 3) pulp processing; 4) pulp bleaching; 5) pulp drying and baling; and 6) stock preparation. During the total of these stages, BOD, total dissolved solids (“TSS”), color, COD, AOX, VOCs, dissolved lignin, carbohydrates, inorganic chlorine compounds, particulate wastes, other organic compounds, inorganic dyes, and acetone are released as water pollutants. Additionally, VOCs, TRS, organo-chlorine compounds, SO$_2$, NO$_x$, fly ash, fine and coarse particulates, alcohols, terpenes, and phenols are emitted as air pollutants. Further, dirt, grit, combustible and incombustible fiber, bark, resins, fatty acids, sludge, bottom ash, dregs, and other solids are released as solid and/or hazardous waste.

V. Pollution Prevention Opportunities

Whether the pulp and paper industry, as a collective, has historically been, or is now, in compliance with the myriad federal and state laws governing the variety of pollution outputs described above is well beyond the scope of this paper. Again, this paper assumes the goal of DOE is to induce the industry to perform above the floor of legal compliance. Thus, this section discusses pollution prevention generally, without addressing specific areas where performance shortfalls currently exist. Rather, this paper presumes that because the pulp and paper industry is an inherent heavy polluter, any and all pollution prevention techniques are worthy of exploration and/or implementation.

When attempting to reduce pollution, prevention is always preferable to remediation. Pollution prevention within any given industry may be best achieved where creative pollution prevention techniques, which simultaneously improve efficiency, increase profits, and minimizing environmental impacts, are developed and implemented. The pulp and paper industry could prevent pollution by reducing material inputs, engaging in environmentally-friendly harvest, re-engineering processes to reuse by-products, improving management practices, and/or employing substitution of toxic
chemicals. Each of these pollution prevention opportunities can be undertaken by either employing state-of-the-art technologies, by recycling, or by engaging in the sustainable procurement of raw materials.

A. Technology

Industry’s ability to meet and/or transcend regulatory compliance depends largely on the availability and cost effectiveness of pollution reducing technologies. In a world where pollution reduction costs are high, however, this can in some instances be quite challenging. This is especially true for the worldwide problem of air pollution. Just within the last decade, for example, the cost of air pollution annually in most of Europe has been between 1 – 3 % of the gross domestic product (“GDP”). In China, that cost has been at least 5 % GDP. Considering the global impact of air pollution, however, these costs are a small fraction of the economic damage that such pollution will inflict on every nation of the earth.19

Several items are, in fact, commonly used as air pollution control devices by industry and/or transportation devices. These devices can either destroy contaminants or remove them from an exhaust stream before it is emitted into the atmosphere. These include, but are not limited to, particulate control, scrubbers, NOX control, VOC abatement, acid gas/SO2 control, mercury control, dioxin and furan control, and other miscellaneous associated equipment.20 Because adoption of state-of-the-art technologies in the pulp and paper industry could reduce energy consumption by 29% from current average practices, implementing advanced technologies could actually cut the industry’s carbon dioxide emissions by 1,049,000 tons.21

There are several ways cutting edge pulping technologies can reduce energy use, and thus help to curb environmental damage. For instance, continuous digesters, displacement heating, anthraquinone pulping, and thermomechanical pulping with heat recovery can reduce energy use at the pulping stage of paper production by about 26% from current average practices. Other modern technologies, such as displacement bleaching, can reduce energy use at the bleaching stage by 30% while simultaneously reducing energy use at the chemical recovery stage by about 37%. Finally, state-of-the-art technologies such as top-wire formers and improved mechanical and thermal water removal techniques can reduce energy use at the papermaking stage by an approximate 32%.22

Many technologies to reduce energy consumption and industry-specific pollution output already exist. Pulp and paper mills have made significant investments in pollution control technologies and processes. According to industry sources, the pulp and paper industry spent $26.5 billion in 2000 constant dollars from 1970-2000 on environmental capital expenditures.23 Improving chemical recovery systems has been an industry focus.
Chemical recovery and recycling systems in the chemical pulping process significantly reduce pollutant outputs while providing substantial economic return due to recovery of process chemicals. An efficient chemical recovery system is a crucial component of chemical pulping mill operation, as the chemical recovery process regenerates process chemicals, reducing natural resource usage and associated costs, as well as discharges to the environment and producing energy. Many recent pollution prevention efforts in the pulp and paper industry have focused on reducing the releases of toxics, in particular, chlorinated compounds.

Pollution prevention techniques have proven to be more effective in controlling these pollutants than conventional control and treatment technologies. Most conventional, end-of-pipe treatment technologies are not effective in destroying many chlorinated compounds and often merely transfer the pollutants to another environmental medium. Efforts to prevent chlorinated releases have, therefore, focused on source reduction and material substitution techniques such as defoamers, bleaching chemical, and/or wood chip substitution to reduce the industry's use and releases of chlorinated compounds.

Such source reduction efforts and material substitutions usually require substantial changes in the production process. In addition to the major process changes aimed at reducing toxics releases, the industry is implementing a number of pollution prevention techniques to reduce water use and pollutant releases (BOD, COD, and TSS), such as dry debarking, recycling of log flume water, improved spill control, bleach filtrate recycle, closed screen rooms, and improved storm water management.

Because the pulp and paper industry is highly capital intensive and uses long established technologies with long equipment lifetimes, major process-changing pollution prevention opportunities are expensive and require long time periods to implement. The pulp and paper industry is a dynamic one, however, that constantly makes process changes and material substitutions to increase productivity and cut costs. The trend towards materials substitutions is reflected in an increasing demand for alternative pulping and bleaching chemicals and in the participation of many facilities in voluntary environmental programs.

There are several pre-developed pollution prevention opportunities for the pulp and paper industry aimed at reducing toxics releases. These process changes may lead to reductions in conventional pollutants like BOD$_5$, TSS, COD, and AOX, as well as reduce water use, sludge volumes, and air emissions. The strategies include extended delignification, oxygen delignification, ozone delignification, anthraquinone catalysis, black liquor spill control and prevention, enzyme treatment of pulp, improved brownstock and bleaching stage washing, improved chipping and screening, oxygen-reinforced/peroxide extraction, and improved chemical controls and mixing. Each is discussed briefly here.
1. **Extended Delignification**

Extended delignification further reduces the lignin content of the pulp before it moves to the bleach plant. Because the amount of bleaching chemicals required to achieve a certain paper brightness is proportional to the amount of lignin remaining in the pulp after the pulping process, extended delignification can reduce the amounts of bleaching chemicals needed. A number of different extended delignification processes have been developed. These processes involve increasing the cooking time, adding the cooking chemicals at several points throughout the cooking process, regulating the cooking temperatures, and carefully controlling the concentration of hydrogen sulfide ions and dissolved lignin. Importantly, the process changes do not degrade the cellulose which would normally accompany increased cooking time.

Extended delignification processes have been developed for both batch and continuous pulping processes. The lignin content of the brownstock pulp has been reduced by between 20 – 50% with no losses in pulp yield or strength using such processes. Consequently, chlorinated compounds generated during bleaching are reduced in approximate proportion to reductions in the brownstock lignin content. In addition, the same changes have resulted in significant reductions in BOD₅, COD, and color. One study demonstrated a 29% decrease in BOD₅ resulting from an extended delignification process. Facility energy requirements have been shown to increase slightly with extended delignification. However, off-site power requirements, which are associated with decreased chemical use, have been estimated to more than offset the on-site increases.

2. **Oxygen Delignification**

Oxygen delignification also reduces the lignin content in the pulp, and today is considered a standard stage in the production of bleached chemical pulp. The process involves the addition of an oxygen reactor between the kraft pulping stages and the bleach plant. The brownstock pulp from the digester is first washed, and then mixed with sodium hydroxide or oxidized cooking liquor. The pulp is fluffed, deposited in the oxygen reactor, steam heated, and injected with gaseous oxygen wherein it undergoes oxidative delignification. The pulp is then washed again to remove the dissolved lignin before moving to the bleaching plant. Oxygen delignification can reduce the lignin content in the pulp by as much as 50%, resulting in a potentially similar reduction in the use of chlorinated bleaching chemicals and chlorinated compound pollutants.

The process can be used in combination with other process modifications, which can collectively completely eliminate the need for chlorine-based bleaching agents. In
addition, unlike bleach plant filtrate, the effluent from the oxygen reactor can be recycled through the pulp mill recovery cycle, further reducing the non-pulp solids going to the bleaching plant, as well as the effluent load from the bleach plant. The net effect is reduced effluent flows and less sludge generation. Facility energy requirements have been shown to increase with oxygen delignification. However, the decrease in off-site power requirements, which are associated with decreased chemical use, have been estimated to exceed the on-site increases resulting in a decrease in overall energy requirements. Also, the recovered energy and reduced chemical use offset the cost.

3. Ozone Delignification

As a result of a considerable research effort, ozone delignification, i.e., ozone bleaching, is now being used in a limited number of pulp mills. The technology has the potential to eliminate the need for chlorine in the bleaching process. Ozone delignification is performed using processes and equipment similar to that of oxygen delignification. The ozone process, however, must take place at a very low pH (1.0 to 2.0), requiring the addition of sulfuric acid to the pulp prior to the ozonation. In addition to low pH, a number of process conditions are critical for ozone delignification: organic materials must be almost completely washed out of the brownstock pulp; temperatures must stay at about 20 °C; and ozone reactive metals must be removed prior to the ozonation stage.

Oxygen delignification and/or extended delignification processes are considered a prerequisite for successful ozone bleaching. When used in combination, the two processes can result in a high quality bright pulp that requires little or no chlorine or chlorine dioxide bleaching. Overall emissions from the combination of the oxygen and ozone processes are substantially lower than conventional processes because effluents from each stage can be recycled. Pilot systems consisting of ozone delignification in combination with oxygen delignification and oxygen extraction have shown reductions in BOD₅ of 62%, COD of 53%, color of 88%, and organic chlorine compounds of 98%.

Ozone is unstable, however, and will decompose to molecular oxygen. Thus, ozone must be generated on site and fed immediately to the pulp reactor. Ozone generation systems are complex, and account for a high percentage of the total costs. Although facility energy use will increase due to the on site production of ozone, this energy will be offset by the energy that would normally be used to produce chlorine and chlorine dioxide.

4. Anthraquinone Catalysis

The addition of anthraquinone- a chemical catalyst produced from coal tar- to the pulping liquor has been shown to speed up the kraft pulping reaction and increase yield by protecting cellulose fibers from degradation. The anthraquinone accelerates the fragmentation of lignin, allowing it to be broken down more quickly by the pulping
chemicals. This, in turn, lowers the amount of lignin in the prechlorination pulp, thus reducing the amount of bleaching chemicals needed. Anthraquinone catalysts are increasingly being used in combination with oxygen delignification and extended delignification to overcome boiler capacity bottlenecks arising from these delignification processes.

5. **Black Liquor Spill Control and Prevention**

The mixture of dissolved lignin and cooking liquor effluent from the pulping reactor and washed pulp is known as black liquor. Raw black liquor contains high levels of BOD, COD, and organic compounds. Spills of black liquor can result from overflows, leaks from process equipment, or from deliberate dumping by operators to avoid a more serious accident. Spills of black liquor can have impacts on receiving waters, are a source of air emissions, and can shock the microbial action of wastewater treatment systems. Black liquor losses also result in the loss of the chemical and heat value of the material.

Systems needed to control black liquor spills are a combination of good design, engineering, and, most importantly, operator training. A few elements of an effective spill control system include physical isolation of pieces of equipment, floor drainage systems that allow spills to be collected, backup black liquor storage capacity, sensors that provide immediate warning of potential or actual spills, and enclosed washing and screening equipment.

6. **Enzyme Treatment of Pulp**

Biotechnology research has resulted in the identification of a number of microorganisms that produce enzymes capable of breaking down lignin in pulp. Although the technology is new, it is believed that a number of mills are currently conducting enzyme treatment trials. The microorganisms capable of producing the necessary enzymes are called xylanases. Xylanases for pulp bleaching trials are available from several biotechnology and chemical companies.

Since enzymes are used as a substitute for chemicals in bleaching pulp, their use will result in a decrease in chlorinated compounds released somewhat proportional to the reduction in bleaching chemicals used. Enzymes are also being used to assist in the deinking of secondary fiber. Research at the Oak Ridge National Laboratories has identified cellulase enzymes that will bind ink to the smaller fiber particles facilitating recovery of the ink sludge. Use of enzymes may also reduce the energy costs and chemical use in retrieving ink sludge from deinking effluent.

7. **Improved Brownstock and Bleaching Stage Washing**

Liquor solids remaining in the brownstock pulp are carried over to the bleach
plant where they compete with the remaining lignin in the pulp for reaction with the bleaching chemicals. Improved washing, therefore, can reduce the required amount of bleaching chemicals and the subsequent reductions in chlorinated compounds as well as conventional pollutants. Modern washing systems with improved solids removal and energy efficiency are beginning to replace the conventional rotary vacuum washers. State-of-the-art washing systems include atmospheric or pressure diffusion washers, belt washers, and pulp presses.

Opportunities for reduced effluent flows and water use are also present in the bleaching plant. Acid filtrates from hypochlorite or chlorine dioxide stages can be used as dilution and wash water for the first bleaching stage. Similarly, second extraction stage filtrates can be used as dilution and wash water in the first extraction stage. Most new mills are designed with these counter-current washing systems, and some mills are retrofitting their existing wash systems.

8. Improved Chipping and Screening

The size and thickness of wood chips is critical for proper circulation and penetration of the pulping chemicals. Chip uniformity is controlled by the chipper and screens that remove under and oversized pieces. Standard equipment normally does not sort chips by thickness, although it has been demonstrated that chip thickness is extremely important in determining the lignin content of pulp. Therefore, improper chip thicknesses can result in increased use of bleaching chemicals and the associated chlorinated compounds and conventional pollutants. Some mills are beginning to incorporate equipment that will separate chips according to their thickness as well as by length and width.

9. Oxygen and/or Peroxide Reinforced Extraction

Oxygen reinforced extraction and peroxide reinforced extraction processes used separately or together have been shown to reduce the amount of elemental chlorine and chlorine dioxide needed in the bleaching process while also increasing pulp brightness. Gaseous elemental oxygen (in the case of oxygen-reinforced extraction) and aqueous hydrogen peroxide (in the case of peroxide extraction) are used as a part of the first alkaline extraction stage to facilitate the solubilization and removal of chlorinated and oxidized lignin molecules. Oxygen-reinforced extraction has seen widespread adoption by the industry in recent years. It is estimated that up to 80% of mills in the U.S. are using oxygen-reinforced extraction. The use of peroxide extraction is also increasing. As of 1987, it was estimated that 25% of domestic mills were using peroxide extraction.
10. Improved Chemical Controls and Mixing

The formation of chlorinated organics can be minimized by avoiding excess concentrations of chlorine-based bleaching chemicals within reactor vessels. This can be accomplished by carefully controlling the chemical application rates and by ensuring proper mixing of chemicals within the reactor. Modern chemical application control and monitoring systems and high-shear mixers have been developed which decrease formation of chlorinated organic compounds.

B. Recycling

The pulp and paper industry has also worked to increase the amount of secondary and recycled fibers used for the pulping process. Secondary fibers, which comprise the next most common furnish constituent to wood furnish, consist of pre- and post-consumer fibers. Although secondary fibers are not used in as great a proportion as wood furnish, approximately 80% of pulp and paper manufacturers use some secondary fibers in their pulp production, and approximately 200 mills-approximately 40% of total number- rely exclusively on secondary fibers for their pulp furnish.

Secondary fiber use is increasing in the pulp and paper industry due to consumer demand for products made from recycled paper. Recovered fiber accounted for 75% of the industry’s increase in fiber consumption between 1990 and 2000. The utilization of secondary fibers, expressed as the ratio of recovered paper consumption to the total production of paper and paperboard, is climbing slowly. Due to losses of fiber substance and strength during the recycling process, a 50% utilization rate is considered the present maximum overall utilization rate for fiber recycling. According to industry sources, the pulp and paper industry has already met its 1995 goal of 40% recycling and reuse of all paper consumed in the U.S. Currently, the industry has set a new goal of recovering 50% of all paper consumed in the U.S. for recycle and reuse.

C. Sustainable Procurement of Raw Materials

Beyond the immediate and obvious consequences of their purchases, concerned consumers, retailers, investors, communities, and other groups want to know how their buying decisions impact the environment and forest-based communities. They also want to know whether the products they buy are produced sustainably, i.e., consumers want to know whether purchasing products today will adversely affect the availability of similar products or environmental values for future generations. Whether the forests that yield raw materials for the pulp and paper industry are being sustainably managed is a major factor in purchaser decision-making.25

Sustainable forest management integrates economic, social, and environmental aspects of management into an appropriate balance that meets the needs of today’s
society without jeopardizing future generations. The economic aspect is a suitable mix of wood products and non-wood products like plants and animals, which do not diminish the productive capacity of the forest. Social aspects include respect for labor and indigenous rights, the health and safety of forest workers, sharing of economic benefits, and protection of sites of spiritual or historic value. Environmental aspects can include soil protection, biodiversity, maintenance of air and water quality, and aesthetics.

Concerns over sustainable procurement have led some organizations that buy pulp and paper products to consider factors beyond the traditional attributes of price, service, quality, and availability when making purchasing decisions. Because the environmental and social aspects of wood and pulp and paper products are becoming part of the purchasing equation, sustainable procurement provides yet another opportunity for pollution prevention.

VI. Establishing Pollution Prevention Initiatives

Because, as noted above, there is no shortage in pollution prevention opportunities for the U.S. pulp and paper industry, there is ample opportunity for both government and industry to spearhead voluntary agreements and/or other environmental initiative programs in order to implement these opportunities. Indeed, both have done so on the federal and state levels alike. This section highlights the activities undertaken by the pulp and paper industry and public agencies to voluntary improve the industry’s environmental performance. While this section is not meant to be exhaustive, it provides a wide array of instructive examples as to how government and industry leaders are applying the technological and recycling tools available to achieve better environmental performance and even transcend the floor of legal compliance.

A. Government-Led Environmental Programs and Activities

The U.S. federal government has developed a number of programs and activities seeking to raise the bar of environmental performance. These programs generally fall within one or more of five categories, including technical assistance, visibility, cost savings, and regulatory flexibility. Because the U.S. Environmental Protection Agency (“EPA”) is largely responsible for setting, monitoring, and enforcing many of our nation’s pollutant outputs, EPA has taken the lead on many of the programs discussed below. Established pollution prevention agreements are numerous, thus this section describes each just briefly. For the reader’s convenience, an endnote citing to the relevant program’s website follows the description of each example as guidance for finding additional information on each.
1. National Environmental Performance Track

EPA’s National Environmental Performance Track Program is a regulatory flexibility program designed to motivate and reward top environmental performance. By encouraging a systematic approach to managing environmental responsibilities, taking extra steps to reduce and prevent pollution, and being good corporate neighbors, the program is rewarding companies that strive for environmental excellence. Performance Track recognizes and drives environmental excellence by encouraging facilities with strong environmental records to go above and beyond their legal requirements. Members typically set four public, measurable goals to improve the quality of our nation’s air, water, and land. At the same time, many participating companies are finding that they are saving money and improving productivity. Currently, the program has about 500 members, five of which are participating pulp and paper mills.

EPA rewards Performance Track members by developing regulatory and administrative actions that only apply to member facilities. These include air, water, and waste incentives, coordination with state programs, and low priority for routine inspections. For example, members receive reduced frequency of reporting under the Maximum Achievable Control Technology (“MACT”) provisions of the Clean Air Act (“CAA”), such that semi-annual reports may be submitted annually. In some circumstances, EPA may even permit members to submit an annual certification in lieu of any annual reporting. Also, EPA will expedite review of National Pollution Discharge Elimination System (“NPDES”) permits held by Performance Track members pursuant to the Clean Water Act (“CWA”) and also allow members to accumulate their hazardous waste without a first obtaining a permit under the Resource Conservation and Recovery Act (“RCRA”).

2. WasteWise Program

The WasteWise Program was started in 1994 by EPA’s Office of Solid Waste and Emergency Response. This technical assistance and visibility program is aimed at reducing municipal solid wastes by promoting waste minimization, recycling collection, and the manufacturing and purchase of recycled products. WasteWise is a free, voluntary, EPA program through which organizations eliminate costly municipal solid waste and select industrial wastes, benefiting their bottom line and the environment. WasteWise is a flexible program that allows partners to design their own waste reduction programs tailored to their needs. As of 2001, the program had about 1,175 companies as members, including 21 pulp and paper partners.

Members agree to identify and implement actions to reduce their solid wastes, and must provide EPA with their waste reduction goals along with yearly progress reports. EPA in turn provides their Technical Assistance Team to member companies and allows the use of the WasteWise logo for promotional purposes. Generating public
awareness of the benefits of EPA’s partners’ waste reduction activities is a major focus of the program. EPA draws attention to the WasteWise Program itself as well as individual partner accomplishments through a variety of activities like awards programs and partner forums.27

3. **Project XL**

Project XL, which stands for “eXcellence and Leadership,” is a national pilot program that allows state and local governments, businesses, and federal facilities to develop with EPA innovative strategies to test better or more cost effective ways of achieving environmental and public health protection. In exchange to businesses undertaking a Project XL experiment, EPA will issue regulatory, program, policy, or procedural flexibilities. Thus, this is primarily a regulatory flexibility program.

Under Project XL, private businesses, federal facilities, business sectors, and state and local governments are conducting experiments that address the following eight Project XL selection criteria: 1) produce superior environmental results beyond those that would have been achieved under current and reasonably anticipated future regulations or policies; 2) produce benefits such as cost savings, paperwork reduction, regulatory flexibility or other types of flexibility that serve as an incentive to both project sponsors and regulators; 3) attain stakeholder support; 4) achieve innovation/pollution prevention; 5) produce lessons or data that are transferable to other facilities; 6) demonstrate feasibility; 7) establish accountability through agreed upon methods of monitoring, reporting, and evaluations; and 8) avoid shifting the risk burden, i.e., do not create worker safety or environmental justice problems as a result of the experiment. As of 2002, three pulp and paper companies (Georgia-Pacific, International Paper, and Weyerhaeuser) had undertaken projects under Project XL.28

4. **Energy Star**

In 1991, EPA introduced Green Lights, a cost savings program designed for businesses and organizations to proactively combat pollution by installing energy efficient lighting technologies in their commercial and industrial buildings. In April 1995, Green Lights expanded into Energy Star Buildings- a strategy that optimizes whole building energy efficiency opportunities. The energy needed to run commercial and industrial buildings in the United States produces 19% of U.S. carbon dioxide emissions, 12% of nitrogen oxides, and 25% of sulfur dioxide- all at a cost of $110 billion a year. If implemented in every U.S. commercial and industrial building, the Energy Star Buildings upgrade approach could prevent up to 35% of the emissions associated with these buildings and cut the nation’s energy bill by up to $25 billion annually.

The more than 7,000 participants include corporations, such as pulp and paper mills, small businesses, universities, health care facilities, nonprofit organizations, school districts, and federal and local governments. Energy Star has successfully delivered
energy and cost savings across the country, saving businesses, organizations, and consumers more than $5 billion a year. Over the past decade, Energy Star has been a driving force behind the more widespread use of such technological innovations as LED traffic lights, efficient fluorescent lighting, power management systems for office equipment, and low standby energy use.

Manufacturers can become partners in Energy Star by pledging to undertake the following steps: 1) Measure, track, and benchmark their organization’s energy performance by using tools such as those offered by Energy Star; 2) develop and implement a plan to improve energy performance in their facilities and operations by adopting the strategy provided by Energy Star; 3) educate their staff and the public about our partnership with Energy Star, and highlight our achievements with the Energy Star label, where available.29

5. **National Industrial Competitiveness through Energy, Environment, and Economics**

The U.S. Department of Energy administers a cost savings grant program called The National Industrial Competitiveness through Energy, Environment, and Economics (“NICE ”). By providing grants of up to 50% of the total project cost, the program encourages industry to reduce industrial waste at its source and become more energy efficient and cost competitive through waste minimization efforts. Grants are used by industry to design, test, demonstrate, and assess the feasibility of new processes and/or equipment with the potential to reduce pollution and increase energy efficiency. The program is open to all industries, though priority is given to proposals from participants in the chemicals, agriculture, aluminum, pulp and paper, glass, metal casting, mining, petroleum, and steel industries.30

6. **EPA Audit Policy**

The EPA Audit Policy, which is formally titled “Incentives for Self-Policing: Discovery, Disclosure, Correction and Prevention of Violations,” has been in effect since 1995. It is a regulatory flexibility program that seeks to safeguard human health and the environment by providing incentives for regulated entities to come into compliance with the federal environmental laws and regulations. The policy was designed to provide major incentives for regulated entities that voluntarily discover, promptly disclose, and expeditiously correct noncompliance, rendering formal EPA investigation and enforcement action unnecessary. The Audit Policy reflects the input of industry, trade associations, state environmental program practitioners, and public interest groups.

Disclosures to EPA are often preceded by consultations between EPA and the regulated entity, so that mutually acceptable disclosure details, and compliance and audit schedules can be discussed. If policy conditions are met, most penalties may be waived, and further civil or criminal prosecution may not be pursued.
Incentives for self-policing under the Audit Policy include no gravity-based penalties for disclosing entities that meet all nine Policy conditions, including “systematic discovery” of the violation through an environmental audit or a compliance management system. Gravity-based penalties are that portion of the penalty over and above the economic benefit. In general, civil penalties that EPA assesses are comprised of two elements: the economic benefit component and the gravity-based component. The economic benefit component reflects the economic gain derived from a violator’s illegal competitive advantage. Gravity-based penalties are that portion of the penalty over and above the economic benefit. They reflect the egregiousness of the violator’s behavior and constitute the punitive portion of the penalty. EPA retains its discretion to collect any economic benefit that may have been realized as a result of noncompliance. For those entities that meet all of the conditions except for “systematic discovery” of the violation through an environmental audit or a compliance management system, EPA will reduce gravity-based penalties by up to 75%.

Other incentives for self-policing under EPA’s Audit Policy include EPA’s waiver of recommendation for criminal prosecution for entities that disclose violations of criminal law and meet all applicable conditions under the policy. “Systematic discovery” is not required to be eligible for this incentive, although the entity must be acting in good faith and adopt a systematic approach to preventing recurring violations. EPA generally does not focus its criminal enforcement resources on entities that voluntarily discover, promptly disclose and expeditiously correct violations, unless there is potentially culpable behavior that merits criminal investigation. When a disclosure that meets the terms and conditions under the Audit Policy results in a criminal investigation, EPA generally will not recommend criminal prosecution for the disclosing entity, although EPA may recommend prosecution for culpable individuals and other entities. 31

7. Small Business Compliance Policy

The Small Business Compliance Policy is a cost savings program intended to promote environmental compliance among small businesses (those with 100 or fewer employees) by providing incentives for voluntary discovery, prompt disclosure, and prompt correction of environmental problems and/or violations. The Policy accomplishes this in two ways: by setting forth guidelines for EPA to apply in reducing or waiving penalties for small businesses that come forward to disclose and make good faith efforts to correct violations; and by deferring to State, local, and/or Tribal governments that offer these incentives. EPA will eliminate or significantly reduce penalties for small businesses that voluntarily discover violations of environmental law and promptly disclose and correct them. A wide range of resources are available to help small businesses learn about environmental compliance and take advantage of the Small Business Compliance Policy. These resources include training, checklists, compliance guides, mentoring programs, and other activities. 32
B. Industry Led Environmental Programs and Activities

Like the federal government, the pulp and paper industry itself has sponsored many pollution prevention agreements and/or other programs. Again, these examples do not constitute an exhaustive complication of all such agreements, but are included here for illustrative purposes. The last three examples of the list, Wisconsin’s Pollution Prevention Partnership, Wisconsin’s Paper Council Environmental Management System, and the Maine Pulp and Paper Association Environmental Stewardship Program will likely be particularly useful to DOE when contemplating a pollution prevention initiative for Washington State.

1. Global Environmental Management Initiative

The Global Environmental Management Initiative (“GEMI”) is made up of group of leading companies dedicated to fostering environmental excellence by business. GEMI is a non-profit organization founded in 1990, which promotes a worldwide business ethic for environmental management and sustainable development. GEMI seeks to provide a forum for leading companies to explore ways to improve their own performance, while aiding and inspiring other organizations to do the same. In 2001, GEMI’s membership consisted of about 40 major corporations including the pulp and paper company Georgia-Pacific.

GEMI has structured its efforts along three main “pathways” to demonstrate how environmental and other performance can impact growth and profitability. These include the “economic value pathway,” which highlights direct, tangible value drivers like cost reductions; the “intangible value pathway,” which focuses on intangible drivers, such as supply chain efficiency; and the “stakeholder value pathway,” which emphasizes environmental and social value drivers that result indirectly in improved business outcomes. Hence, GEMI is both a cost savings and visibility program.

2. 50% Paper Recovery Goal

As discussed briefly in Section V(B) above, at the beginning of this decade, the U.S. paper industry made a public commitment to expand paper recovery and recycling by establishing a goal to recover 40% of all the paper Americans used in 1995. That program involved a wide array of tools to encourage efficient paper recovery as well as a major financial commitment by U.S. papermakers to expand recycling capacity at their mills. The public-private partnership that evolved between EPA and the American Forest & Paper Association has been successful. The pulp and paper industry met its goal one year ahead of schedule. Given the success of this initiative, the industry renewed its commitment to recycling in 2003 by raising the paper recovery goal to 55% by 2012 of all U.S. paper consumed. The current rate of paper recovery in the U.S. is 48.1%. Meeting recycling goals achieves both cost savings and visibility for the pulp and paper industry.
3. **100% Recycled Paperboard Alliance**

The 100% Recycled Paperboard Alliance ("RPA-100%") is a group of leading North American recycled paperboard manufacturers representing nearly two-thirds of the recycled paperboard industry, and a sponsor of America Recycles Day. RPA-100% encourages packaged goods and companies to use 100% recycled paperboard, and educates consumers about the importance of buying recycled. Almost fifty companies have joined a new initiative from the 100% Recycled Paperboard Alliance, displaying the “100% Recycled Paperboard” symbol on their brand name and private label products. Like the 50% Paper Recovery Goal, the 100% Recycled Paperboard Alliance offers participating companies cost savings and visibility.

4. **Agenda 2020**

In 1994, the American Forest and Paper Association joined with the U.S. Department of Energy to launch Agenda 2020, an innovative, collaborative research program, which promotes technical assistance and cost savings. Through Agenda 2020, a consortium of research institutions, industry, and national laboratories is developing new technologies, processes, and measurements to manufacture products more efficiently and cost-effectively while reducing environmental impacts of operations and maximizing the efficient use and reuse of resources. To meet these objectives, Agenda 2020 has identified six technology focus areas for collaborative research efforts. These six task groups represent a broad cross section of the forest products industry: 1) sustainable forest management; 2) environmental performance; 3) energy performance; 4) improved capital effectiveness; 5) recycling; and 6) sensors and controls.

Particularly noteworthy is the effort within the Agenda 2020 partnership to develop biomass gasification technologies. If fully commercialized, these technologies could make the U.S. forest products industry totally energy self reliant and generate a surplus of 22 gigawatts of power to the grid, which is the equivalent of one half of California’s peak summertime electric use. The carbon displacement from biomass gasification could be even more dramatic, transforming the industry from emitting 24 million tons of carbon each year to displacing at least 18 million tons of greenhouse gas from fossil fuels.

Black liquor is one biomass fuel created during the chemical pulping process. Gasification converts these pulping extractives and other forms of biomass into combustible gases that can be efficiently burned like natural gas. If fully commercialized, these technologies could produce enormous energy and environmental benefits. The first commercial-scale black liquor plant is being built by Georgia-Pacific in Big Island, VA. It is slated to go on-line in 2003. Other commercialization tests will continue over the next 10 years if adequately funded. Industry participants are putting up 50% of the investment capital for these demonstration projects.
5. Wisconsin Pollution Prevention Partnership

The Pollution Prevention Partnership ("P3") between the Wisconsin pulp and paper industry and the Wisconsin Department of Natural Resources ("WDNR") was introduced in 1993. This program features voluntary reductions in environmental releases, evidence of a willingness by one of Wisconsin’s largest industries to transcend legal compliance. P3 is a massive undertaking as it involves 25 firms and 42 facilities.

The program is designed to find cost-effective ways to reduce potentially harmful byproducts from the paper industry’s manufacturing process. The program encompasses all three points of pulp and paper pollution: air emissions, wastewater discharges, and solid/hazardous wastes. P3 sets voluntary reduction goals for seven target substances: chlorine, chloroform, formaldehyde, hydrogen sulfide, methanol, phosphorus, and xylene. P3 is coordinated by the Wisconsin Paper Council, the industry's trade association, in cooperation with the WDNR.

Latest data compiled under P3 reveals that from 1993 – 2000, environmental releases due to the manufacturing process were down nearly 60%. During that same period, production increased by almost 1,099,000 tons, or almost 13%. Calculated on a per ton of production basis, Wisconsin’s paper industry’s process related pollutant releases declined from 11.67 pounds per ton of production in 1992 to 4.27 pounds in 2000. This is a decrease of 7.4 pounds or 63.4%. Specifically, chlorine emissions have dropped by 77% since 1992, while chloroform emissions have dropped by 67%. Moreover, formaldehyde emissions have dropped by 52%, hydrogen sulfide emissions by 38%, xylene emission by 30%, and methanol emissions by 28%.

Significant reductions in the amount of waste that is land filled in Wisconsin have also been realized under P3. The amount of waste material, i.e. bio-solids, ash, and wood waste, that is land filled annually declined from 1,915,785 tons in 1992 to 921,994 tons in 2000, for a 52% improvement.

This magnitude of pollutant output reductions was likely achieved in Wisconsin because participation in P3 is virtually industry wide. Because Wisconsin is the U.S.’s largest paper producer and pulp and paper companies there constitute the largest manufacturing sector in the state,34 industry wide participation has almost limitless potential.


6. Wisconsin Paper Council Environmental Management System

On the heels of the Pollution Prevention Partnership’s successes, Wisconsin papermakers rolled out another innovative program in 1999, the Wisconsin Paper Council Environmental Management System (“WPC EMS”). Early in 1999, the Board of Directors of the Wisconsin Paper Council unanimously adopted a framework for the WPC EMS. Since then, a task force has developed a Guidance Manual and conducted an implementation workshop. Like P3, the WPC EMS is a voluntary program.

The WPC EMS is based on and designed to meet the intent of the international standard, ISO 14001, which one standard in the ISO 14000 family. The WPC EMS is a management system, i.e., a structured framework to achieve environmental goals and objectives. It is tailored to meet the diverse needs of Wisconsin’s pulp and paper industry.

The WPC EMS starts with a strong commitment by top management to environmental responsibility. It includes clearly defined, measurable policies, goals and objectives. It establishes procedures, responsibilities and controls to ensure that the goals and objectives become reality. The WPC EMS also calls for documentation of these efforts. In addition, the WPC EMS requires planned, periodic audits to ensure that the system is functioning properly. It requires top management review and appropriate corrective actions, if necessary.

The WPC EMS is a company-wide program involving all employees at all levels of the operation. Employee training and effective communication are essential. In essence, the WPC EMS requires a facility to analyze its entire operations to determine which aspects could adversely impact the environment, to prioritize these concerns, and to set goals to eliminate or minimize the impact, where appropriate. The WPC EMS is a continuous process meant to enhance cost savings and visibility.

Some companies will use the WPC EMS as a prelude to ISO 14001 certification, some companies will use it to meet the intent of ISO 14001, and still others will use it as a tool to enhance an existing management system. WPC EMS is a cost savings and visibility program. Wisconsin’s paper industry believes there are numerous benefits to be derived from the WPC EMS including improved pollution prevention, waste reduction, environmental and financial performance, and an enhanced industry image. 36
7. Maine Pulp and Paper Association Environmental Stewardship Program


MPPA member mills, for example, continue to invest in new air pollution control technology, process improvement measures and energy efficiency projects to reduce air emissions. Based on these investments, criteria air pollutants like carbon monoxide, nitrous oxides, sulfur oxides, volatile organic compounds, and particulate matter have decreased by over 30% from 1993 to 2004. This represents a decline in emissions per ton of product generated from 23 pounds per ton of production (market pulp/paper) to 16 pounds per ton. Hazardous air pollutant emissions in Maine have shown a similar trend, declining by approximately 38% over the same time period. This emission rate now represents approximately one pound per ton of product generated.

Concerns over emissions of certain greenhouse gases, such as carbon dioxide and methane, are increasingly becoming an issue for Maine citizens. In 2003, the Maine Legislature approved a climate change law that establishes reduction goals for greenhouse gases, and Maine has been participating with other northeast states in developing a regional cap-and-trade program to reduce greenhouse gases. As a result of energy efficiency improvements and increased use of “carbon-neutral” biomass fuels, Maine’s pulp and paper sector has reduced greenhouse gas emissions by 30% from 1990 levels, significantly exceeding the State’s year 2020 reduction goal of 10%.

As for wastewater discharges, process improvements and new control technologies in mill treatment plants have resulted in significant decreases in discharges to Maine’s rivers. BOD and TSS contaminants in process wastewaters have declined by approximately 47% since 1993. Investments in ECF bleaching technology at MPPA member Kraft mills have virtually eliminated the formation of dioxins in bleach plant effluent and significantly decreased the amount of contaminants that affect wastewater color. The total amount of pollutants (BOD, TSS, color, and toxics) discharged per ton of product generated has decreased by 35% between 1993 and 2004.

Most MPPA member companies own and operate their own landfills, which are primarily used for disposal of manufacturing residues from wastewater treatment processes and fuel combustion residuals. While market conditions and regulatory activities can influence how solid waste from the mills is managed each year, member companies have continually reduced the amount of solid waste that is disposed in
landfills. From 1993 – 2004, the amount of solid waste disposed of in Maine was reduced by 26%. Much of the solid waste reduction progress is attributable to process changes that prevent the solid waste from being generated in the first place, finding ways to utilize wood waste to generate steam and electricity, and pulp production from recycled paper. The amount of solid waste that is beneficially reused increased from 375 pounds per ton of production in 1993 to 417 pounds per ton in 2004.

VII. Potential Pollution Prevention Initiatives for Washington State

As demonstrated herein, there are large varieties of extant and possible voluntary environmental agreements and other such initiatives directly applicable to the U.S. pulp and paper industry. In an effort to aid DOE in contemplating its own pulp and paper initiative within Washington State, this paper now turns to explore initiatives generally. The purpose of this section is to provide a framework in which DOE can analyze potential agreement types in comparative form, while considering the strength of the current regulatory framework and tailoring that analysis to fit the motivations of the industry as a whole.

Before beginning the discussion on initiatives, it must be noted that this paper assumes a dichotomous categorization, which differentiates between strong and weak environmental laws and enforcement agencies, to be proper. This is true because voluntary environmental initiatives and/or agreements can serve two very different functions in environmental regulatory policy: to support or to bridge gaps. Initiatives may provide “support” for existing government efforts in a system where laws and the will to enforce those laws are strong. These efforts are labeled “complementary voluntary environmental agreements,” and aspire to attain more ambitious environmental objectives than those existing under the current regulations. Initiatives that “bridge gaps” between environmental regulations and desired performance, on the other hand, are appropriate only for governmental paradigms in which the regulatory framework is rudimentary or otherwise weak. Because the United States has a strong environmental regulatory scheme in place, this paper explores only voluntary complementary agreements.

A. Inciting Industry Participation

When contemplating the development of new pollution prevention initiatives, the question immediately arises: “Why would industry bind itself to more stringent environmental provisions?” Arguably, the most prominent reason is the threat of implementing another regulatory program, which can be viewed as a “regulatory threat.” However, apart from the regulatory threat motivation, external as well as internal drivers influence such a decision.

Relevant external drivers can be divided into three sub-categories. First, industries may gain significant economic advantages from the regulatory authorities for
taking part in environmental agreements. Long-term planning and additional flexibility in implementing compliance requirements are examples of such benefits. In addition, as has been shown in extant initiatives, direct incentives such as subsidies, grants, technological assistance, and even regulatory relief may be offered by the regulatory authorities to the participating mills. Business considerations such as green consumerism, pressure by clients on the production chain, and/or maintaining a positive environmental image constitute a second external driver for joining voluntary agreements or other initiatives to go beyond compliance. Community pressure is the third external driver of industry to join environmental initiatives.

Internal drivers are further divided into three categories. The organizational culture within plants may influence environmental decisions in two fundamental ways. The environmental perception of the plant is influenced by human factors. Managers who are environmental champions may lead a general change in the attitude of the company towards environmental issues. In general, companies that grant extensive latitude to plant managers are more likely to adopt more courageous environmental decisions. Improved relationships with company employees may be another internal factor for joining voluntary initiatives. Another factor influencing the choices of plants to join environmental agreements involves indirect economic benefits, which may result due to changes in the production process. Again, as illustrated above, voluntary agreements have also led to innovative solutions for meeting environmental objectives.

In order to achieve more ambitious goals via voluntary initiatives, however, industry must be aware of the advantages that such an initiative confers. This is also true regarding the threat of regulatory action. A regulatory threat will only be effective if the voluntary agreement offers the industry real advantages to the alternative.

B. Policy Instruments

Voluntary incentives may be developed and implemented utilizing a variety of policy instruments. Each of these instruments falls into one of three categories: 1) economic incentives, i.e., direct taxes granting or eliminating tax breaks, subsidies, granting of regulatory exemptions, and/or making pricing more efficient; 2) public investment, i.e., research and development, education, new infrastructure, maintenance of existing infrastructure, and/or withholding investment in greenhouse gas generating activities; and 3) regulation, i.e., efficiency standards, zoning, building codes, fuel use requirements, speed limits, and/or travel restrictions. 38

For the pulp and paper industry, it seems that much public investment has already been made into research and development, and that the industry, to some extent, is perfectly capable of implementing effective pollution preventing technologies and/or recycling programs to increase environmental performance if such tools are made economically attractive. It is also clear that U.S. environmental regulation of pulp and paper pollutant outputs is already comprehensive. 39 Thus, this paper considers it
advisable for DOE to explore the third type of policy instrument—economic incentives—as a means for encouraging the pulp and paper industry to voluntarily cut across-the-board pollution outputs beyond the mere floor of regulatory compliance.

C. Economic Incentives

For the past 30 years, the command and control regulatory approach has dominated environmental management in the U.S. Many regulators, businesses and industry, non-governmental organizations (“NGOs”), communities, and others now see value in developing a new approach, one that builds upon the strengths of the regulatory framework, but also emphasizes flexibility and encourages innovation. Economic incentives do just that.  

The use of economic incentives has been gaining momentum both nationally and worldwide for its broad success in “harnessing the power of the market” for environmental protection. Market-based or economic incentives may take the form of voluntary agreements or aspects of laws or regulations, but may generally be defined as providing financial rewards to industry for polluting less, while imposing costs to industry of polluting more. Economic incentives therefore supply the necessary impetus to polluters to cut pollution even beyond the threshold of legal compliance.

Economic incentives are based on the idea that it is possible to confront business and industry with the same kinds of incentives it faces in its own markets for labor, capital, and raw materials. This means that economic incentives harness the same motivation businesses have for creating efficiency and use that motivation in order to drive competition for protection of the environment. Properly employed, markets can be used to implement a more sustainable economy. Under such market based approaches, the market will ideally better reflect the environmental costs and benefits of business, while at the same time promoting environmental protection.

1. Advantages of Economic Incentives

An incentive based approach offers advantages that distinguish it markedly from the command and control regulatory approach. These advantages include flexibility, encouragement of technological innovation, improved relationships between the private and public sector, better management of point sources, and substantial cost savings.

Economic incentives are premised on the notion that traditional regulatory approaches to pollution control are not only expensive, but do not provide an incentive to go beyond compliance. While still requiring strict adherence to environmental standards, economic incentives tend to be more goal oriented and are more flexible regarding the methods used to achieve those goals. Industry can choose to meet a limit any way it believes is appropriate. Rather than being required to install a specific
technology, for example, it can choose to reduce its pollution through energy conservation, product or process reformulation, end-of-pipe pollution control, or any other means.

By granting industry more flexibility in deciding how to reach targets, economic incentives provide an ongoing motivation to constantly seek technological advances that make compliance even cheaper, resulting not only in improved environmental performance but in substantial cost savings as well. One study done for EPA in 1999 estimated that the potential savings from widespread use of economic incentives at the federal, state, and local level could be almost $50 billion, or one quarter of the approximately $200 billion per year currently spent on environmental pollution management in the U.S. In addition to cost savings, innovative environmental strategies also stand to make industry more competitive.

Market based approaches to environmental regulation can also ease tensions between the government and industry by removing the confrontational nature of traditional regulations. A 1999 report from the GEMI, which was discussed at Section VI(B)(1) above, found that almost all businesses participating in an economic incentive program spoke appreciatively of the spirit of trust and cooperation between government officials and the private sector that utilized these new programs. The implication is that this new spirit of cooperation will lead to more efficient problem solving and consequently, better environmental performance.

2. Types of Incentives

There are several types of economic incentives. In the interest of brevity, this paper includes a discussion of only the most well known and tested of these: unit-based pricing, environmental taxes, and marketable permits.

a. Unit Based Pricing

The first type of economic incentive is in the form of charges, fees or taxes, or unit-based pricing. These are prices paid for discharges of pollutants to the environment, based on the quantity and/or quality of the pollutants at issue. In order to be most effective, the charge is levied directly on the quantity of pollution, in the form of an emissions tax or charge. Product charges can occur at different usage points, either as the product is manufactured, consumed, or disposed.

An excellent example of unit-based pricing is the Pay as You Throw (“PAYT”) initiative, which provides a method of managing solid waste. These types of programs are already at work in 3,000 communities nationwide. Rather than paying one flat fee for solid waste disposal, residents in PAYT communities pay per pound or gallon of garbage disposed. A PAYT program offers residents an incentive to recycle and reduce waste, helps communities cover solid waste costs through accurately charging residents for solid waste services, and gives residents more control over their garbage bill and by
charging only for the services they use. PAYT could also be changing households’ purchasing decisions toward products that come with less packaging.

b. Environmental Taxes

The second type of market-based environmental tool comes in the form of environmental taxes. The basic premise is that whatever is taxed, society automatically gets less of. Therefore, instead of focusing taxes on activities deemed good for society, such as income or savings, the government should tax things society want less of, such as pollution or waste. Because it imposes no cost for environmental degradation, the current U.S. tax system tells industry and consumers that polluting- even egregious polluting- is acceptable. In contrast, an environmental tax shift would change that message. A tax shift would provide incentives for better environmental management while continuing to raise revenue and reduce other taxes, such as income and/or labor, which could in turn stimulate our economy.

Preliminary experience with market oriented environmental taxes abroad offers much hope. Countries from Canada to China have levied thousands of environmental taxes on everything from gasoline and pesticides to sulfur and carbon emissions. Only a few dozen standouts have been implemented with tax rates high enough to spark better performance, but these few do provided evidence of the effectiveness of the approach when properly pursued.

In Britain, for example, excise duties have been adjusted so that the price of leaded gas has risen increasingly, relative to the price of unleaded. Partly as a result, lead emissions from the exhausts of British cars fell by 70% in the decade to 1990. When Sweden introduced a charge of $6,000 per ton on nitrous oxide emissions from power stations in 1992, average emissions fell 35% within two years. Within 18 months, a Swedish tax on the sulfur content of diesel fuel resulted in a ten fold increase in the share of “clean” diesel in total diesel consumption.

c. Marketable Permits

The third market oriented environmental policy is Marketable or tradable permits, also referred to as a “cap-and-trade” system. These are similar to charges and taxes, but differ in that they operate by fixing an aggregate quantity of emissions rather than by charging a price for each unit of emissions. The rationale is based on setting an absolute quantity of pollution to be allowed, and then giving or selling polluters rights, or “permits,” to pollute up to that given limit. Polluters can trade these permits with each other if they wish, treating them like any other commodity in the marketplace. Those who can clean up effectively and cheaply can then profit by selling spare permission to pollute to those for whom cleaning up would be more expensive. The key point is that tradable permits allow government to set the precise amount of pollution that it is prepared to allow. Setting maximum pollution limits is, of course, something
government already does with regulation, but cannot accomplish with a tax. Environmental groups could also, in theory, buy up permits, retire them, and thus reduce the amount of pollution allowed.

The most successful example of tradable permits has been in the overwhelming success of the 1990 Clean Air Act (“CAA”) Amendments, which are discussed below. An ambitious tradable permit system was created under which more than 100 large coal-fired power plants were given initial emissions reductions. The goal was to reduce emissions of sulfur dioxide by 50% in the eastern half of the U.S. These facilities were given the ability to purchase excess emissions reductions generated by other plants that found it easy to reduce their sulfur dioxide, along with the choice of meeting their emissions reductions targets themselves. This cap-and-trade approach resulted in sulfur dioxide reductions that have been both larger and faster than required by law. Furthermore, the annual savings to electricity ratepayers nationally (compared to the previous traditional approach) range from 50 – 80%, amounting to savings of $1 – 6 billion annually.

Similar cap-and-trade permits are being used in state and local governments nationwide to reduce other types of pollution. One such project in the Pacific Northwest is the pollutant trading system in Idaho, which uses economic incentives to lower pollution emissions into the Boise River.

D. Ex Ante Evaluation

There are two basic ways to potentially evaluate the efficacy of environmental initiatives: ex ante and ex post, i.e., either before or after the initiative is in place. The significance of ex ante analysis lies in its predictive capability. Presumably, if external and other objective indicators have the ability to predict the success of voluntary agreements, unsuccessful policy initiatives can be avoided. Ex ante prediction provides policy makers with two significant advantages. First, it can improve the ability to choose the most suitable policy tool for the relevant situation. Second, once voluntary agreements have been chosen as the appropriate policy, these “predictors of success” can help craft a better accord.

Because DOE is just now contemplating developing a pulp and paper pollution prevention initiative, an ex ante evaluation is both appropriate and advisable. Even without an initiative already drafted, DOE can utilize the factors of ex ante evaluation to better craft appropriate initiative(s) within the Washington State pulp and paper context. Again, because this paper assumes that only complementary agreements are appropriate within this context, only predictors of success for complementary agreements are discussed herein.

There are four indicators of success utilized in the ex ante evaluation of
complementary agreements- three direct and one indirect. The indirect indicators are: 1) the relative power of environmental authorities; 2) the industrial sector; and 3) the general public. The direct indicator is substantive commitments required under the agreement. Each is discussed in turn below.

1. Relative Power of Environmental Authorities

A preliminary condition for effective voluntary agreements and/or other initiatives in countries like the U.S., which have powerful authorities, is a credible alternative regulatory program that will be immediately implemented in the event achievement of the environmental objectives of the agreement or initiative fails. The effectiveness of the threat can be measured both by the alacrity of policy makers to use the instrument (in cases of noncompliance) and by the severity of the regulatory response.

This paper makes no judgment as to whether the current rate of federal enforcement against industry polluters or the penalties sought pursuant to conviction are currently adequate. This author is confident, however, that relevant federal authorities are well-equipped to take swift environmental enforcement action if provided the political will to do so. This author is also confident that the penalties available to federal prosecutors via the federal regulatory scheme are similarly adequate in order to achieve reasonable deterrence from recidivism.

This paper will, however, provide a brief and generalized discussion of the major federal regulations that will likely always apply to any given mill facility within the pulp and paper industry. The purpose of this section is to highlight the applicable federal requirements, state their generalized purpose, and to provide citations for more detailed information. As the reader will recall, the pollutant output of the pulp and paper industry includes air emissions, wastewater discharges, and solid/hazardous wastes. The regulatory discussion below is informed by those outputs.

a. The Clean Air Act

The Clean Air Act (“CAA”) of 1970, codified as 42 U.S.C. 7401 et seq., was targeted primarily at reducing emissions of certain common contaminants responsible for widespread air pollution problems. Examples include acid gas emissions from power plants and paper mills and urban smog resulting from automobiles, fossil fuel combustion, and solvent emissions from manufacturing. Like most environmental command and control statutes, the CAA is voluminous. Therefore, only those provisions most pertinent to the regulatory threat posed by the CAA to the pulp and paper industry are discussed here. They are Titles I, III, V, and VII.
i. National Ambient Air Quality Standards and State Implementation

The core provisions of the CAA, set forth in Title I, require EPA to identify pollutants that, in its judgment, cause or contribute to air pollution that may endanger public health or welfare, as well as to set National Ambient Air Quality Standards ("NAAQS") for each of these pollutants at levels adequate to protect public health. The states and EPA must collect data on ambient air quality for each pollutant for which a NAAQS has been set, and classify regions of the country based on whether their air quality meets, i.e., “attains,” the NAAQS. Once an area is classified, responsibility for meeting the standards rests primarily with the states, which are required to adopt state implementation plans ("SIPs") that specify the measures they will implement to achieve and maintain compliance with the NAAQS.

In the years immediately following enactment of the 1970 CAA, both EPA and the states made some progress toward reducing emissions of NAAQS pollutants. It quickly became apparent, however, that many areas of the country would not achieve attainment by the deadlines in the Act. To address this problem, Congress amended the CAA in 1977, establishing new programs to help states achieve the NAAQS and address other air pollution concerns. Among other things, Congress enacted subpart D of Title I of the CAA, which required states with nonattainment areas to implement specific measures designed to reduce emissions from existing and newly constructed or modified sources and implement other programs to address nonattainment contaminants and assist states in tracking progress toward achieving the NAAQS. As part of this effort, Congress revised the timetable for bringing areas failing to achieve the NAAQS into compliance, establishing a deadline of 1987 for ozone and carbon monoxide nonattainment areas. To protect air quality in areas of the country that were already meeting the NAAQS, Congress enacted a “prevention of significant deterioration” program requiring new or modified major stationary sources located in attainment areas to install emission controls and analyze the impact of their emissions on the ambient air. As part of the 1977 CAA Amendments, Congress also established a program to protect national parks and wilderness areas from visibility impairment due to manmade pollution.

The new programs helped many areas of the country reduce emissions of NAAQS contaminants. However, significant problems remained, particularly with respect to ozone, carbon monoxide, and particulate matter pollution. EPA, the states, environmental groups and others also identified gaps in the CAAs regulatory fabric. After several failed attempts, Congress amended the CAA in 1990, overhauling the basic framework of the Act and enacting several new programs to address air pollution concerns such as acid rain and stratospheric ozone depletion.
ii. Regulating Hazardous Air Pollutants

Although the focus of the 1970 CAA was on the NAAQS/SIP process, Congress enacted other provisions to address specific air pollution concerns. Among other things, Congress directed EPA to adopt standards of performance for new and modified stationary sources in particular source categories. Congress also directed EPA to develop risk-based standards for sources of certain hazardous air pollutants.

Hazardous air pollutants are regulated under a markedly different regime than so-called “criteria contaminants,” meaning pollutants such as particulate matter and SO\textsubscript{2} that are emitted in large quantities by many types of sources, including pulp and paper mills. When Congress enacted the CAA it recognized that hazardous air pollutants (“HAPs”) pose a significant health and environmental risk and established a separate program to regulate these pollutants. This program, known as the National Emission Standards for Hazardous Air Pollutants (“NESHAP”) program, required EPA to list HAPs that might cause, or contribute to, an increase in serious irreversible or incapacitating reversible illness. For each listed pollutant, EPA was required to establish emission standards that provided for an ample margin of safety to protect public health. The original NESHAP program, although well-intentioned, was largely a failure. Practical and political difficulties associated with developing risk-based standards slowed issuance of NESHAPs to a crawl. After almost 20 years, EPA had listed only eight pollutants as hazardous and had established standards for specific sources of seven of these pollutants.

To accelerate development of emission standards for HAPs, Congress completely overhauled the NESHAP program when it enacted Title III of the CAA Amendments of 1990. The new program, set forth at CAA § 112, 42 U.S.C.A. § 7412, calls for the development of technology-based standards for the control of HAPs. Section 112 lists 188 regulated HAPs, and requires EPA to develop a list of categories of sources that emit these HAPs in significant quantities. EPA must then develop maximum achievable control technology (“MACT”) standards for new and existing sources in these categories based on the degree of emission control achievable through the application of technologies that are used by the best performing sources in a given source category, with stricter standards for new sources. Only if these technology-based MACT standards prove inadequate to protect public health or the environment, will EPA be required to implement risk-based standards. To ensure that the MACT standards were developed quickly, the statute required EPA to issue standards over a ten-year period.

iii. Operating Permits

Also of great importance in the CAA 1990 Amendments is Title V, which establishes a comprehensive operating permit system, modeled in part on the National Pollutant Discharge Elimination System (“NPDES”) permit program under the Clean Water Act. Prior to the enactment of Title V, the CAA did not require existing air
contamination sources to have operating permits, although certain new and modified sources were required to obtain permits under the Prevention of Significant Deterioration (“PSD”) and nonattainment New Source Review (“NSR”) programs. In the absence of operating permits, facility owners and state enforcement authorities often had difficulty identifying what regulations applied to facility operations. Facilities often were not required to monitor compliance with these regulations or report monitoring results to regulators. As a result, assessing the compliance status of many facilities posed a significant challenge.

In enacting Title V of the CAA, Congress attempted to address this issue by requiring all facilities with sources regulated under the CAA (primarily “major sources”) to obtain facility-wide operating permits. As part of the application process, facilities are required to identify all federally enforceable air regulations, including those adopted by states as part of their SIPs, for inclusion in the permit. Once the facility receives its Title V air permit, it must monitor compliance with all applicable regulatory requirements as specified in the permit and report the results to federal and state authorities at least every six months. Once a year, the owner or operator of the facility must certify compliance with all applicable requirements.

The goal of the Title V permit program is to create a single document containing all of a facility's air emission requirements and establish mechanisms for tracking compliance with those requirements. As noted at the outset, the model for this approach is the NPDES permit program under the federal Clean Water Act, which establishes effluent limitations and then requires facilities to monitor compliance and report the results in “discharge monitoring reports.” This self-reporting system provides EPA and citizens with a simple means of determining whether a facility is complying with its wastewater discharge permit, greatly simplifying enforcement.

As with the NPDES program, the self-reporting required under Title V of the CAA increases the potential for enforcement. For this and other reasons, the design of both the Title V permit program and individual Title V permits is crucial. Both EPA and the states have struggled to implement Title V permit programs that satisfy the CAA requirements without unduly burdening facilities with excessive information demands or limiting their ability to respond quickly to competitive opportunities. One compliance issue of particular concern is the development of appropriate emission monitoring strategies. Under Title V, facilities are expected to include in their permits all monitoring and recordkeeping requirements mandated by the applicable requirements governing their operations. However, many older federal and state emission control regulations contain no provisions for monitoring compliance or contain only limited monitoring requirements. Under these circumstances, the permit issuer is expected to require “periodic monitoring” sufficient to demonstrate compliance with the underlying applicable requirement. For over a decade, EPA has struggled to clarify the principles to be applied when implementing Title V's periodic monitoring requirement. This effort has culminated in EPA's current initiative to revise inadequate monitoring requirements,
thus minimizing the need to develop case-by-case periodic monitoring conditions.

An additional concern of many facilities is the impact of Title V on their ability to make changes without obtaining a formal Title V permit modification, a burdensome and time-consuming process. The Title V regulations exclude from full permit review certain changes in facility operations that do not have federal implications. These provisions have been criticized both by environmental groups and industry, albeit on different grounds. For more than a decade, EPA has struggled without success to develop a scheme for modifying Title V permits that satisfies the competing concerns of these groups. In keeping with these efforts, EPA also has issued regulations and guidance designed to incorporate “operational flexibility” into Title V permits – in essence, to design permits that allow facilities to make common changes, such as changes in inputs or production processes, without requiring a permit modification.

The Title V permitting program applies in addition to previously established federal preconstruction permit requirements under the PSD and nonattainment NSR programs. These and other programs impose additional requirements on new and modified sources that must be incorporated into permits issued under Title V. In addition, many state and local governments had existing permit programs that needed to be reconciled with Title V or apply independent of Title V.

iv. Enforcement

Like other federal environmental statutes, the CAA imposes administrative, civil, and criminal penalties for noncompliance. The CAA Amendments of 1990 fundamentally changed EPA and state enforcement programs, and increased both civil and criminal penalties for noncompliance with the CAA. The 1990 Amendments also significantly increased the amount of publicly available information on the compliance status of facilities, simplifying both government and citizen enforcement.

One of EPA’s primary problems with enforcing the CAA prior to the 1990 Amendments was the narrow scope of its enforcement powers. Court action was usually necessary to impose civil penalties or obtain meaningful compliance orders. EPA had no power to collect penalties administratively, except under CAA § 120, which authorized EPA to recoup the economic benefit a source gained from noncompliance. These economic benefit penalties were often difficult to collect, and did not effectively deter violators because they did not include a “gravity-based” component to penalize the violator for his/her alleged wrongdoing. Criminal enforcement provisions of the Act were also relatively weak, with even serious violations punishable only as misdemeanors.

With respect to citizen enforcement, public involvement under the 1970 CAA was limited by the extreme difficulty in obtaining information to document violations and by the narrow scope of relief that could be obtained. As a result of these and other
features of the CAA’s enforcement provisions, most pre-1990 enforcement actions had to be pursued by the United States Department of Justice in federal court, an expensive and time-consuming process.

Subsequent to the 1977 CAA Amendments, Congress established stronger tools for administration and enforcement of other environmental statutes such as the Clean Water Act. The 1990 Amendments updated EPA’s enforcement powers under the CAA to provide it with comparable civil, criminal, and administrative enforcement authority. The 1990 Amendments: 1) broadened the scope of violations that can result in civil or criminal penalties; 2) established a new framework for agency imposition of administrative penalties; 3) clarified the scope of personal liability for corporate officers and employees; 4) increased potential monetary fines and jail terms; 5) designated most criminal violations of the Act as felonies; and 6) widened the scope of citizen suits and provided a “bounty” on CAA violations.

Other changes to the CAA greatly enhanced the potential for enforcement of the Act. Perhaps the most important such change was the enactment of CAA Title V, the federal operating permit program. Many facilities regulated under the CAA must now obtain a federally enforceable operating permit listing all of the air pollution regulations applicable to the facility, together with provisions for monitoring compliance with those requirements. Title V sources must then report their compliance status to the permitting authority at least every six months and must formally certify compliance at least annually. In essence, Title V facilities are now required to monitor their compliance with applicable federal air regulations and self-report violations to state and federal regulators. In addition, source-specific standards adopted after 1990, such as the new NESHAPs under CAA Title III, typically contain comprehensive emission monitoring and reporting requirements. These and other changes to the Act significantly enhance the potential for both government and citizen enforcement by making information about the compliance status of particular facilities more accessible.

Section 113(a)(1) of the CAA identifies the types of conduct that may give rise to an enforcement action under the CAA. Under that section, EPA may issue a notice of violation when the Administrator finds that any person has violated or is in violation of any requirement or prohibition of an implementation plan or permit. A copy of the notice must be served on the state in which the violating facility is located to provide the state with an opportunity to pursue the alleged violation. Any time 30 days after issuance of the notice EPA may issue a compliance order, impose an administrative penalty, or bring a civil action, regardless of the length of the violation.

EPA also plays an oversight role in regard to state enforcement programs. The CAA allows EPA to issue a public notice that violations of applicable implementation plans, permit programs or other requirements are so widespread that they appear to result from a failure by the state to enforce the plan or permit program effectively. The issuance of such a notice can, in effect, compel states to improve their enforcement
program. Under CAA § 113(a)(3), EPA may issue a notice of violation to enforce compliance and penalty orders for both past and ongoing violations of: any requirement or provision of Titles I and III of the Act (air pollution prevention and control); any violations of § 303 of the Act, (emergency compliance orders); Title IV (acid deposition control); Title V (state permit programs); or Title VI (stratospheric ozone protection); or for failure to pay any fee owed to the government under the Act (other than a fee under Title II, emission standards for mobile sources). EPA has the option of seeking an administrative penalty or compliance order, commencing a civil action, or requesting that the Attorney General commence a criminal action.

When EPA chooses to pursue an alleged CAA violation in court, the offending party may face steep monetary penalties or a lengthy prison term. Under CAA § 113(b), EPA may seek civil penalties of up to $32,500 per day and injunctive relief for both past and ongoing violations of any provision of a state implementation plan or permit and any requirement or prohibition of Titles I or III – VI. EPA also can seek civil penalties for attempts to construct or modify sources without obtaining the necessary PSD or nonattainment NSR permits. In the case of actions based on alleged SIP violations, EPA must wait 30 days after notifying the alleged violator and the state in which the violation occurred before proceeding, unless EPA has assumed exclusive authority for enforcing the SIP.

Prior to the 1990 Amendments, the criminal enforcement provisions of the CAA were weak relative to other federal environmental statutes. Even intentional releases of air pollutants that resulted in death or serious injury were subject to a maximum prison term of only one year, relatively small fines or both. When it amended the enforcement provisions of the Act in 1990, Congress enacted criminal penalties for violations of the Clean Air Act comparable to those under other recently amended environmental statutes. Accordingly, in most cases, criminal violations were upgraded from a misdemeanor to a felony for knowing violations, with terms of up to 15 years in prison for knowingly releasing hazardous air pollutants that place another person in imminent danger of death or serious injury.

b. The Clean Water Act

Like the CAA, the Federal Water Pollution Control Act, i.e., the Clean Water Act (“CWA”), 33 U.S.C. §§ 1251 et seq., is a comprehensive programmatic and regulatory creation. Designed “to restore and maintain the chemical, physical, and biological integrity of the Nation’s waters,” the CWA was passed in 1972 to replace ineffective state regulation of pollution with a comprehensive national system involving federal-state sharing of responsibilities. The goal of the CWA was to eliminate discharge of pollutants by 1985, with an interim goal of swimmable, fishable waters by 1983.42

Pollution control standards under the CWA are of two general types. Effluent standards limit the quantity of pollutants discharged from the source, while ambient
water quality standards limit the concentration of pollutants in the stream. Because it is often difficult to identify the exact source of pollution in applying water quality standards, the CWA utilizes effluent standards that are based on available control technology. Although the CWA regulates both point and non-point sources, the program’s principal control mechanism is to place limits on discharge of pollutants from “point sources.”

The CWA defines a “point source” as “any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged” – a definition which clearly contemplates industrial plants or mills of the pulp and paper industry. Because wastewater discharges from pulp and paper facilities are considered “point source pollution,” only the control of point sources under the CWA is discussed herein.

i. Regulating Point Sources Through the NPDES

The CWA makes it unlawful for any point source to discharge a pollutant into navigable waters of the United States without a permit from either EPA or a state authorized to administer its own permit program. Thus, points sources engaged in a discharge of a pollutant may avoid violating the CWA by operating in compliance with a permit issued by EPA. The permit program, codified at CWA § 402, is called the National Pollutant Discharge Elimination System (“NPDES”) permit program.

To obtain an NPDES permit, the applicant must comply with federal effluent standards. The effluent standards of Section 301 originally required use of the best practicable technology currently available (“BPT”) by July 1, 1977, and use of the best available technology economically achievable (“BAT”) by July 1, 1983. The 1977 CWA Amendments authorized extensions of the 1977 BPT deadline to as late as July 1, 1983, and of the 1983 BAT deadline to July 1, 1984. The 1987 amendments further extended deadlines for meeting BAT standards to March 31, 1989, but also broadened the coverage of the CWA to include toxics and “non-conventional” pollutants. These amendments also created a new class of “conventional pollutants,” including suspended solids, coliform bacteria, BOD, and acidity, for which best conventional control technology (“BCT”) must be achieved by the same date. Special effluent standards apply to new sources.

The CWA authorizes EPA to delegate to the states the power to administer this § 402 permit program, provided the state applying for such permission meets certain conditions. In the event of such a delegation, the state is responsible for ruling on § 402 permit applications, although EPA retains veto power over individual permits, and retains concurrent authority with the state to enforce state-issued permits.
Administration of water quality standards is left to the states, which are free to impose stricter controls than required by federal effluent limitations. States must designate uses (domestic, fishery, etc.) and develop water quality standards that are sufficient to support those uses. The states must then impose effluent limitations on NPDES permits in order to achieve the standards. Some states adopted their own ambient water quality standards before passage of the CWA. Congress authorized these states to continue to promulgate water quality standards, but if they are inadequate in light of conditions and uses of the waterway, EPA may impose its own standards.

CWA § 303 requires states to identify “water quality‐limited” segments of streams, i.e., those where effluent limitations have proved inadequate to preserve water quality for the uses designated by the state, and to establish “total maximum daily loads” (“TMDLs”) for each such pollutant, allocating among users the total allowable waste load. If the state fails to do so, EPA may establish stricter effluent limits on point sources in order to maintain ambient water quality.

Because the Section 402 NPDES permit process also requires compliance with water quality standards, new water uses that degrade water quality – either by adding pollutants or reducing dilutive capacity of the stream by depleting flows – must comply with CWA § 303. Section 303 provides for the establishment of numerical water quality criteria, such as maximum dissolved solids concentrations. If maintenance of greater river flow is needed to ensure the requisite level of water quality, the state could condition an NPDES permit on a level of instream flow as well as limiting the input of pollutants.

ii. Enforcement

The central enforcement powers under CWA § 309 are patterned closely after the air pollution model. EPA has the power to impose administrative compliance orders, to seek injunctive relief directly in the courts, or to make referrals for criminal prosecution. Section 309(d) offers an important additional remedy for water pollution violations not available under the CAA – civil monetary penalties of up to $10,000 per day imposed in judicial (not administrative) proceedings. Either discharging pollutants without a permit or failing to comply with any condition or limitation in an existing permit can spark an enforcement action.43

The CWA mimics the CAA by imposing on EPA the obligation to correct violations by issuance of a compliance order or commencement of a civil action. The 1972 version of the CWA sharply confined this discretion by imposing a thirty-day limit on compliance that proved to be unpalatable to EPA. As amended in 1977, the CWA now declares that an order “shall specify a time for compliance not to exceed thirty days in the case of the violation of an interim compliance schedule or operation and maintenance requirement and not to exceed a time the Administrator determines to be reasonable in the case of a violation of a final deadline, taking into account the seriousness of the violation and any good faith efforts to comply with applicable requirements.” The 1977 Amendments
supplemented this “reasonableness” escape-route by provisions authorizing “good faith” extensions. Still another extension provision was approved for sources whose cleanup plans included diversion to a publicly owned treatment works the upgrading of which is delayed by a lack of federal monies. These three changes in 1977 were instituted in the belief that the statutory compliance deadlines were ironclad, and that relief should be extended to a handful of sources caught short by circumstances beyond their control. Rather than generalized variances based on economic or technical barriers, the compliance extensions are better viewed as timing accommodations to rescue sources running into insurmountable difficulties.

Apart from the traditional agenda of enforcement powers, the CWA anticipates enforcement in other ways, both by formal and informal means. The NPDES permit program is an enforcement device of considerable moment that leads to prescription for individual sources of substantive obligations and compliance schedules. The withholding of construction grants occasionally is used as an enforcement device, and was so even before the enactment of the 1972 Amendments.

EPA is authorized “to commence a civil action for appropriate relief, including a permanent or temporary injunction, for any violation for which he is authorized to issue a compliance order” under CWA § 309(a). EPA is also authorized to seek civil penalties for violations. Civil enforcement actions typically combine requests for injunctive relief and demands for monetary penalties. Under Subsection 309(a)(1), successful enforcement is linked to a determination of whether there is a violation of a “condition or limitation” in a permit. Section 309(d) provides for judicially imposed civil penalties that ought to be imposed on a strict liability basis in light of the absence of language of culpability and the liability-without-fault analogues found elsewhere in the law.

Under CWA § 309(c)(1), the federal crime of water pollution is defined broadly to reach violations of the key effluent limitation provisions or of permit conditions or limitations implementing those sections. Culpability requirements for criminal conviction under the CWA are relatively low and penalties are stiff. Thus, like the CAA, the CWA poses a substantial regulatory threat to the pulp and paper industry.

Even first time CWA offenders may face a maximum penalty of $25,000 per day of violation and one year’s imprisonment. For subsequent violations, those maximum are doubled. Formal water pollution law is structured to make criminal prosecution a plausible risk to be heeded, not a remote cataclysm to be ignored. That prosecutions and convictions are now becoming routine may be a harbinger of a closing of the gap between promise and performance that has long been the destiny of environmental criminal law.
c. The Resource Conservation and Recovery Act

An increase in chemical reclamation and reuse practices in lieu of land disposal of waste was a major objective of the Resource Conservation and Recovery Act ("RCRA"), codified at 42 U.S.C. §§ 6901-6991l. The sponsors of RCRA sought a “cradle to grave” oversight of how waste is generated, managed, processed and disposed. The House Report on RCRA observed that: “Unless neutralized or otherwise properly managed in their disposal, hazardous wastes present a clear danger to the health and safety of the population and to the quality of the environment. In addition, much of the hazardous waste disposed of in an environmentally sound manner is in interstate commerce without adequate monitoring of its movement or disposition.” Those findings were the basis on which the 1976 legislation was adopted.44

In sum, “RCRA was enacted to provide a ‘comprehensive environmental statute that governs the treatment, storage, and disposal of solid and hazardous waste.’” The primary purpose of RCRA is to “reduce the generation of hazardous waste and to ensure the proper treatment, storage, and disposal of that waste which is nonetheless generated, ‘so as to minimize the present and future threat to human health and the environment.’” RCRA applies only to claims concerning present and future threats to human health and the environment, as opposed to claims seeking to recover the costs of environmental cleanup activities, which are more properly asserted under the Comprehensive Environmental Response, Compensation, and Liability Act ("CERCLA"), 42 U.S.C. §§ 9601 et seq.

RCRA was created with the specific congressional intention that states would continue their historic primary roles in the handling and disposal of waste. Federal standards would establish the minimum requirements and would encourage uniformity across all states. So the states were directed to petition federal EPA for a state RCRA “authorization,” and once authorized, the state would manage its own programs. Some states have opted not to implement their own RCRA program, and in those instances, EPA regulates hazardous waste within those states. Every state RCRA program must be conducted “at least as stringent as the federal floor” RCRA program. States apply for authorization and authorization criteria were determined by Congress and implemented under EPA rules.

Under RCRA, each producer of hazardous waste must apply for and receive a generator number from EPA. RCRA begins its cradle to grave requirements with the facility where the waste stream begins, typically a factory or refinery. The two methods by which a waste becomes a “hazardous waste” are by the listing of a category in a rule that will apply prospectively to all wastes within that category or by tests of the actual waste to determine if they meet a characteristic that makes the waste “hazardous” for purposes of RCRA. This paper discusses only the first of two methods, under which the listing of a particular waste as “hazardous waste” in an EPA final regulation brings a waste under the complicated regulatory scheme of RCRA.
i. Regulating Hazardous Wastes

EPA has listed about 800 wastes as hazardous and thus subject to RCRA. The decisions about listing regulations are extremely important for the future cost structure of industrial operations, and so have received very close attention for years. Though a non-listed waste could still be a “hazardous waste” because of its characteristics, most industries are eager to avoid the RCRA listing of their waste stream materials.

Before a listing of a waste can be made by an EPA regulation, the waste must meet one of several criteria. Toxicity is the first measure, applying a set of levels that reflected the EPA understanding of toxic effects of chemicals in animals as it was in 1992 and before. A waste will be listed if it is shown in “scientific studies to have toxic, carcinogenic, mutagenic or teratogenic effects.” Listing also is required when a waste exhibits any of the characteristics such as reproductive toxicity that are included in EPA’s RCRA rules. Chemical wastes that are persistent, bioaccumulative, and that have the potential to migrate in soil when not properly managed, are also included. EPA must also consider, among other factors, “the nature and severity of the human health and environmental damage that has occurred as a result of the improper management of wastes containing the constituent” and actions “taken by other governmental agencies or regulatory programs based on the health or environmental hazard posed by the waste or waste constituent.”

RCRA is the main federal law designed to protect the public from mishandling of hazardous wastes and to guard against the creation of new Superfund sites. Subchapter III of RCRA and the regulations promulgated thereunder establish a comprehensive regulatory program for generators and transporters of hazardous waste and for owners and operators of facilities that treat, store or dispose of hazardous wastes. RCRA requires that hazardous waste be properly managed at processing and transporting stages, thereby reducing the need for corrective action at a future date. The cradle to grave journey of hazardous waste starts somewhere and moves somehow, ending up in a facility that treats or disposes of the waste. Although this paper discusses only the requirements for actions taken at the starting point, where the waste is “generated” at a particular pulp and paper facility, the reader should be aware that the RCRA requirements also extend to the proper movement of waste by a transporter to a treatment, storage, or disposal site.

A RCRA generator is “any person, by site, whose act or process produces hazardous waste identified or listed in Part 261 of this chapter or whose act first causes a hazardous waste to become subject to regulation.” There are several categories of RCRA hazardous waste generators defined by the quantity of hazardous wastes generated per month. Large quantity generators (“LQG”), for example, generate 1,000 kilograms (2200 lbs.) or more of hazardous waste a month or more than 1 kilogram per month of acutely hazardous waste. Small quantity generators (“SQG”) generate
between 100 and 1,000 kilograms of hazardous waste per month. A third category is the conditionally exempt small quantity generators ("CESQs") that generate less than or equal to 100 kilograms (220 lbs.) per month of hazardous waste, less than or equal to 1 kilogram per month of acutely hazardous waste or less than or equal to 100 kilograms per month of acutely hazardous spill residue or soil. Each facility must certify, if asked, that it is below the levels and qualifies for the exemption.

This paper does not explore the detailed requirements for each category, as the author assumes most pulp and paper facilities are LQGs. Please note, however, that generators of any category must be cognizant of the requirements for managing quantities of acutely hazardous waste. Generators must also be cautious as exceeding the quantities of hazardous waste generated per month and the length of time waste accumulates on site as exceedances may trigger additional and onerous obligations with which a facility might not be prepared or able to comply. Failure to comply with the generator requirements subjects a person to requirements and penalties found in RCRA § 3008.

ii. Enforcement

Again, the goal of RCRA and its regulations is to help ensure that the management and disposal of hazardous waste occurs in a manner protective of human health and the environment. Compliance with RCRA and RCRA regulations is critical to achieving these goals. EPA and authorized states use various means to help ensure, or enforce, compliance. Compliance monitoring including inspections, record reviews, samplings, and other activities help the regulators determine a facility’s compliance with RCRA. This compliance monitoring program includes education and voluntary incentive programs. While EPA and authorized states encourage compliance through various programs, enforcement actions against non-complying facilities is also critical to help reduce the risks associated with mismanagement of hazardous waste. Courts have been generally supportive of enforcement cases that further the statutory purpose of the hazardous waste laws.

Enforcement actions help bring a facility into compliance and deter future violations. While EPA and states have a variety of enforcement tools, such as taking administrative action and/or pursuing civil and criminal judicial actions, in reality, most of RCRA enforcement occurs through the administrative process. Administrative actions may be informal written notification of a violation and the need to come into compliance with regulations as well as notification of enforcement actions that may occur if the facility does not come into compliance. Formal administrative actions occur when there are significant violations or non-compliance with informal actions.

EPA will take civil judicial actions in cases involving repeat violators, significant violations or when there is serious environmental damage. The actions are filed in U.S. district courts and prosecuted by the Department of Justice. EPA can ask the court to
order compliance, order a corrective action, require monitoring and analysis, or enjoin activities that pose an “imminent hazard,” as well as seek penalties for non-compliance.

EPA may also pursue a criminal action for persons responsible for knowing and serious violations. RCRA criminal actions will be successful only if the prosecutor can establish one or more of the following elements: 1) knowing transportation of a RCRA waste to a facility that has no active RCRA permit; 2) knowing treatment, storage, or disposal of a RCRA waste either with no permit, or in knowing violation of a “material condition or requirement” of a permit or of an interim status rule; 3) knowing falsification of a statement or omission of material information in a permit, waste manifest, report, or other document regarding RCRA compliance; 4) knowing generation, storage, treatment, transportation, disposal, exportation, or otherwise handling of hazardous waste; 5) knowing transportation without a manifest of any hazardous waste; 6) knowing violation of export requirements; 7) knowing handling of used oil that is a hazardous waste without full compliance.

It should be noted that the regulatory threat stemming from RCRA is somewhat less than that stemming from either the CAA or the CWA. EPA uses the RCRA civil and criminal enforcement tools sparingly, and states use it even less frequently. Notwithstanding the limited use of criminal enforcement, serious, repeated, or intentional violators of RCRA can be sentenced to prison terms, probation, or criminal fines.

2. The Industrial Sector

The second category of predictors for evaluation is linked to the characteristics of the relevant industrial sector. A strong representative organization, which can spearhead negotiations, has proven to be an important precondition of the success of environmental initiatives. The cohesion between the companies within the industry, as well as their homogeneity, may improve the chances for achieving a better, and more effective, voluntary agreement.

Under this evaluation criterion, the pulp and paper industry is a good target for initiatives. Homogeneity between companies is high, and cohesion is maintained through various trade and professional organizations serving the pulp and paper industry. One or more of these trade organizations could effectively serve as the representative in initiative negotiations. Electronic contact information for several pulp and paper trade organizations is provided herein.

a. Trade and Professional Organizations

All trade and professional organizations serving the pulp and paper industry are lead by the American Forest and Paper Association (“AFPA”), formerly the American Paper Institute (“API”). AFPA has been actively involved in a number of recent
rulemakings under CAA, CWA, and RCRA, which will affect their members.\textsuperscript{45}

The National Forest Products Association merged with the American Paper Institute (``API'') in 1993 to become the American Forest and Paper Association (``AF&PA''). AF&PA is the national trade association for the forest, pulp, paper, paperboard, and wood products industry. The organization focuses on information gathering and dissemination, research on industry technical issues, and represents the industry in regulatory and legislative matters.

The AF&PA takes an active role by representing its members before governmental agencies. Some current environmental initiatives include Agenda 2020, 50\% Paper Recovery Goal (each discussed in Section VI(B) above), and the Sustainable Forestry Initiative. The AF&PA publishes a variety of documents for and about its membership. Some relevant publications include the annual industry wide reviews include Capacity Report and Statistics of Paper, Paperboard, and Wood Pulp, The Paper, Paperboard, and Wood Pulp Monthly Statistical Summary, and The Dictionary of Paper, published every ten years. Circulation for these publications is listed at 1,000. The AF&PA holds an annual meeting every March in New York City.\textsuperscript{46}

Founded in 1943, the National Council of the Paper Industry for Air and Stream Improvement (``NCASI'') presently conducts research on environmental problems related to industrial forestry and the manufacture of pulp, paper, and wood products. NCASI produces technical documents on environmental issues facing the pulp and paper industry and conducts industry conferences. Publications include a biweekly bulletin on general issues and a variety of technical bulletins (40 per year). NCASI also holds an annual March convention in New York City.\textsuperscript{47}

The Technical Association of the Pulp and Paper Industry (``TAPPI'') represents executives, managers, engineers, research scientists, superintendents, and technologists in the pulp, packaging, paper, and allied industries. Founded in 1915, TAPPI is split into eleven divisions, which include environmental, research and development, paper and board manufacture, and pulp manufacture. Though its headquarters are in Atlanta, TAPPI is also divided into 27 regional groups.

Overall, TAPPI provides a variety of services to its members. TAPPI conducts conferences on topics such as forest biology, environment, packaging, and pulp manufacture in addition to a more general annual conference. TAPPI also develops testing methodologies for process control and laboratory analysis. The main annual project of the TAPPI Environmental division consists of an environmental issues industry conference. In 1995, TAPPI launched a campaign to educate the public on industry environmental facts. TAPPI publications include an annual Membership Directory, a monthly TAPPI Journal, and the publication of research results.\textsuperscript{48}
The Paper Industry Management Association ("PIMA") is a professional organization of pulp, paper mill, and paper converting production executives. The association has provided management oriented information to its membership since 1919. This association goal is embodied by their publications an annual Handbook of the industry, a monthly PIMA Magazine dedicated to improving efficiency and productivity, and the annual PIMA Pulp and Paper Mill Catalog reference for industry management.49 This catalog contains information regarding equipment, raw materials, and chemical products, in addition to a trade name directory, a listing of manufacturers and suppliers, and a listing of reports relevant to pulp and paper manufacture.

b. Industry Leaders

Together, these professional organizations represent all U.S. pulp and paper companies, including the top leaders. In 2002, the leading 20 forest and paper products companies in the U.S. were in rank order: International Paper; Georgia-Pacific; Weyerhaeuser; Kimberly-Clark; Procter & Gamble; Smurfit-Stone; Boise; Mead Westvaco; Temple-Inland; Sonoco; AbitibiBowater Inc.; Louisiana-Pacific; Packaging Corp. or America; Universal Forest Products; Rock-Tenn; Potlatch; Riverwood; Plum Creek Timber; Rayonier; and Caraustar.

According to the 2003 PricewaterhouseCoopers Global Forest & Paper Industry Survey, eight of the top 20 forest and paper products companies worldwide are located in the U.S. In fact, the top four companies globally were all American. In rank order, the companies are: 1) International Paper with $24,976,000,000 in net sales for 2002; 2) Georgia-Pacific with 23,271,000,000; 3) Weyerhaeuser with 16,771,000,000; and 4) Kimberly-Clark with 13,566,000,000 in net sales.50 Indeed, the global pulp and paper industry is dominated by North American (United States and Canada), northern European (Finland and Sweden), and East Asian countries (such as Japan).51

3. General Public

The third category of predictors is based on salient societal characteristics. Strong public awareness and involvement in environmental issues contribute to successful environmental agreements both by ensuring more ambitious goals and by creating incentives for the industry to comply. The involvement of NGOs in the design and drafting of the agreement adds both transparency and better prospects for public support, while ensuring that there is authentic representation of uncompromising environmental interests.

Transparency with regards to both the content and the ultimate outcomes of a voluntary agreement or other initiative contribute to public oversight and possible criticism, thus increasing the potential for public pressure upon industry. Trust and cooperation between environmental authorities and industry also tend to contribute to an effective initiative. In addition to being integral to the creation of an effective
environmental agreement, trust is often also an outcome of such an agreement. Thus, when suspicion had previously dominated the dynamics between the regulating and regulated entity, agreements and/or initiatives offer the hope of a healthier future relationship.

4. **Substantive Commitments of the Agreement**

The final ex ante predictor of success is the one and only internal category: the content of the initiative or agreement itself. Setting ambitious goals with a suitable compliance mechanism are the two basic conditions for an effective environmental initiative. Having a clear set of nonnegotiable environmental targets is a key factor for maintaining high environmental standards in any pollution prevention agreement.

In this sense, quantitative objectives should be established (either in absolute figures or as a percentage) as part of environmental agreements. In addition, a mechanism for updating and amending the agreement’s objects in the event of scientific or technological progress is essential. Furthermore, as touched on earlier, in order to achieve more ambitious goals, industry must be aware of the advantages that voluntary initiatives provide. The agreement can offer an effective tool for achieving this purpose. For instance, setting collective targets for the pulp and paper industry or establishing the degree of flexibility to be tolerated in achieving those targets should be specified in the agreement.

Setting proper monitoring details and establishing swift mechanisms for sanctions are crucial conditions as well. To ensure proper monitoring, timetables-including quantified milestones- must be set. Sanction schedules can be integrated within any associated environmental permit system, thus ensuring compliance via another binding regulatory tool. Other, less punitive, disincentives can be applied as well, such as ensuring bad publicity or raising questions about the credibility of the company.

Finally, a decision to opt for environmental initiatives over conventional regulations needs to be a transparent and informed one. Therefore, an environmental agency should publicly specify its reasons for preferring environmental initiatives and/or agreements over other possible instruments.

**VIII. Conclusion**

When environmentally friendly performance that transcends mere regulatory compliance is either needed or simply desired in order to better abate pollutant outputs and the environmental consequences thereof, government structures with strong environmental regulatory frameworks, such as that of the United States, may benefit from developing and implementing voluntary, complementary pollution prevention initiatives. In order to effectively structure a successful initiative, policy makers must be informed of the relevant industrial processes, pollution outputs and media, extant
regulatory scheme, available and/or appropriate policy instruments, and the local environmental sentiment. This paper sought to address all of these aspects for the pulp and paper industry, as well to as provide some useful examples of extant industry-specific initiatives. In so doing, this paper will perhaps provide DOE with a useful framework within which to design its own pollution prevention imitative for the State of Washington.

1 Cary Coglianese, *Is Consensus and Appropriate Basis for Regulatory Policy?* In *Environmental Contracts — Comparative Approaches to Regulatory Innovation in the United States and Europe* 93, 95 – 97 (Eric W. Orts & Kurt Deketelaere eds., 2001) (discussing a variety of reasons inferior policy results may occur, including absence of candor in the dialogue preceding agreement or a limited range of issues that the sides actually embrace).


3 See id.

4 See id.

5 See http://www.wa.gov/esd/lmea/sprepts/indprof/pulp.htm. Unless otherwise noted, all further information from Section II was derived from this source.


7 See id.

8 See id. Note that because the majority of the content of Sections III – V of this paper came from this EPA report, further citations are provided only when made to other materials. For the purposes of clarity, all internal citations from the EPA report itself have been omitted.

9 Although potential incentives for curbing environmental degradation stemming from the procurement of raw materials is discussed later in this paper, the process of procurement itself is not addressed herein, but rather is addressed in one or more separate documents also being submitted to Washington State Department of Ecology as part of this project.

10 Note that the kraft process actually derives its name from the German word “kraft,” meaning “strength.”

11 The author notes the inherent confusion caused by the terms “pulping process” and “pulp processing.” To be clear, the “pulping process” is the overarching process that includes the three stages of pulp manufacturing, pulp processing, and pulp bleaching.
While the author would have liked to have used less ambiguous terminology in this discussion, such changes were avoided in order to appropriately track industry lingo.

12 See http://www.cwac.net/paper_industry/.
14 See http://www.cwac.net/paper_industry/.
15 See http://en.wikipedia.org/wiki/Air_pollution#Sources_of_air_pollution.
16 See http://www.cwac.net/paper_industry/.
17 See id.
18 See id.
19 See http://en.wikipedia.org/wiki/Air_pollution#Sources_of_air_pollution.
20 See id.
21 See
22 See id.
25 All information in this subsection was obtained from World Business Council for Sustainable Development & World Resources Institute, Sustainable Procurement of Wood and Paper-based Products: An Introduction, which may be found at http://www.wbcsd.org/DocRoot/sfKM0ITPZMRbbmu8UJLe/Forestproductsprocurement.pdf.
26 For more information, visit www.epa.gov/performancetrack/.
27 For more information, visit www.epa.gov/wastewise.
28 For more information, visit www.epa.gov/projectxl/.
29 For more information, visit www.energystar.gov/default.shtml.
30 For more information, visit www.oit.doe.gov/nice3.
31 For more information, visit www.epa.gov/compliance/resources/policies/incentives/auditing/index.html.
32 For more information, visit www.epa.gov/smallbusiness/.
33 See http://findarticles.com/p/articles/mi_hb4321/is_200305/ai_n15067611.
34 See http://www.cwac.net/paper_industry/.
35 For more information, visit www.wipapercouncil.org/p3.htm;
www.wipapercouncil.org/pollutio.htm; and www.wipapercouncil.org/eighth.htm.
36 For more information, visit http://www.wipapercouncil.org/eighth.htm.
37 See Dorit Kerret and Alon Tal, Greenwash or Green Gain? Predicting the Success and Evaluating the Effectiveness of Environmental Voluntary Agreements, 14 Penn St. Envtl.
L. Rev. 31, 46 (2005). Note that because the majority of the content of Section VII of this paper came from this law review article, further citations are provided only when made to other materials. For the purposes of clarity, all internal citations from the article itself have been omitted.


39 On the federal level, these largely include the Clean Air Act, Clean Water Act, and Resource Conservation and Recovery Act. These statutes are discussed in the section that follows.

40 See http://www.pprc.org/pubs/newsletter/news1004.html. Note that because the majority of the content of Section VII(B) of this paper came from this newsletter, further citations are provided only when made to other materials. For the purposes of clarity, all internal citations from the newsletter itself have been omitted.

41 See David Wooley & Elizabeth Morss, *The Clean Air Act Handbook* (2007). All information contained herein regarding the CAA was taken directly from this source.


43 See William H. Rogers Jr., *Roger’s Environmental Law* (2007). All information about the CWA discussed in this subsection is taken from this source.

44 See James T. O’Reily & Caroline Broun, *RCRA and Superfund: A Practical Guide 3d* (2007). All information concerning RCRA provided herein was taken from this source.

45 AFPA can be reached at www.afandpa.org.

46 AF&PA can also be reached at www.afandpa.org

47 NCASI can be reached at www.ncasi.org.

48 TAPPI can be reached at www.tappi.org.

49 PIMA can be reached at www.pima-online.org.
