**SCREENING STUDY
FOR WASTE BIOMASS TO ETHANOL
PRODUCTION FACILITY USING THE AMOCO
PROCESS IN NEW YORK STATE**

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A NYSERDA Report in Brief

Report: Screening Study to Site a Biomass-to-Ethanol Production Facility
Report 95-13

Project Manager: Judy Jarnefeld

Contractor: Stone & Webster Engineering Corporation

Background: In 1994, the New York City Department of Sanitation (NYCDOS) intended to solicit proposals for a City-based recycling facility using mixed waste paper. Because Amoco was interested in manufacturing ethanol from biomass, it proposed to do a siting screen in NYC, after which the study was expanded to include upstate locations as well.

Objectives: The objective was to identify and evaluate two sites in New York City and three sites in other New York State urban centers that would be appropriate for construction and long-term operation of a financially attractive and environmentally sound waste biomass-to-ethanol production facility using Amoco's biomass conversion technology (the "Amoco Process").

R&D Results: Siting information was gathered and used to identify two sites in New York City: Arthur Kill and Procter & Gamble, and 23 sites in four upstate urban centers (Buffalo, Rochester, Syracuse, and Albany). Many site and business issues applied generically to all areas of the State. For example, process requirements affecting site selection and economic evaluation included minimum feedstock supply and quality; product and waste yields; emission characteristics; acreage and preferred shape of site; generic equipment costs; and utility, chemical, transportation, and storage requirements. Community issues included zoning, permitting, and environmental impacts.

Minimum feedstock supply for an economical plant was determined to be 500 tons/day (tpd). Wood, paper sludge, and yard waste were considered as supplements. Feedstocks in each of the four upstate regions were available to support a 500-tpd plant, but no larger; New York City could support a plant twice that size. Financial evaluations included cost of site work, utility hookups, and tipping fees. Capital costs were similar for all feedstocks studied. For both upstate and New York City, two approaches were studied: on-site oxidation of the solid by-product to generate energy, or transportation off site. In New York City, total capital cost, including the process island, balance of plant, site improvements, and land costs, were \$139 million for on-site and \$102 million for off-site oxidation. For a 1000-tpd plant in NYC, economies of scale provide costs of \$223 million and \$169 million, respectively. Upstate, the costs are \$113 to \$117 million with on-site oxidation, and \$84 to \$88 million without oxidation. (Labor costs varied among regions.) For Syracuse, the most economical upstate region, a biomass tipping fee of \$35.59/ton was required to reach an ethanol sale price of \$1.20/gallon. In New York City, \$38/ton is needed to reach \$1.20/gallon at the 500-tpd size, while only \$6/ton is needed for the 1000-tpd plant.

The NYCDOS solicitation has not yet been issued, as markets for scrap paper have changed since 1994. This change in plans makes construction of an ethanol facility by Amoco in New York City unlikely, as paper supplies would be difficult to secure without NYCDOS aid. Upstate results, without economic development incentives, also did not appear compelling.

Copies Available: A limited number of copies of the full report are available from New York State Energy Research and Development Authority, 2 Empire State Plaza, Suite 1901, Albany, New York 12223-1253; (518) 465-6251, ext. 241.

**SCREENING STUDY FOR WASTE BIOMASS TO ETHANOL
PRODUCTION FACILITY USING THE AMOCO
PROCESS IN NEW YORK STATE**

Final Report

Prepared for

**THE NEW YORK STATE
ENERGY RESEARCH AND DEVELOPMENT AUTHORITY**

Project Manager
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ABSTRACT

This report evaluates the economic feasibility of locating biomass-to-ethanol waste conversion facilities in New York State. Part I of the study evaluates 74 potential sites in New York City and identifies two preferred sites on Staten -- the Proctor & Gamble and the Arthur Kill sites - for further consideration. Part II evaluates upstate New York and determines that four regions surrounding the urban centers of Albany, Buffalo, Rochester, and Syracuse provide suitable areas from which to select specific sites for further consideration. A separate Appendix provides supplemental material supporting the evaluations.

A conceptual design and economic viability evaluation were developed for a minimum-size facility capable of processing 500 tons per day (tpd) of biomass consisting of wood or paper, or a combination of the two for upstate regions. The facility would use Amoco's biomass conversion technology and produce 49,000 gallons per day of ethanol and approximately 300 tpd of lignin solid by-product. For New York City, a 1000-tpd processing facility was also evaluated to examine effects of economies of scale.

The reports evaluate the feasibility of building a biomass conversion facility in terms of city and state economic, environmental, and community factors. Given the data obtained to date, including changing costs for feedstock and ethanol, the project is marginally attractive. A facility should be as large as possible and located in a New York State Economic Development Zone to take advantage of economic incentives. The facility should have on-site oxidation capabilities, which will make it more financially viable given the high cost of energy.

KEY WORDS

Amoco biomass-to-ethanol conversion process;

Recycling recovered paper;

Minimum facility requirements;

Site selection;

Pro forma analysis;

Business assessment of feedstock supplier;

Business assessment of ethanol user

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**SCREENING STUDY FOR WASTE BIOMASS TO ETHANOL
PRODUCTION FACILITY USING THE AMOCO
PROCESS IN NEW YORK STATE**

PART I.

NEW YORK CITY

SUMMARY

DESCRIPTION OF STUDY

Objective of Study

The objective of this study is to identify and evaluate two sites in New York City that could be appropriate for the construction and long-term operation of a financially attractive and environmentally sound waste biomass-to-ethanol production facility using Amoco's biomass conversion technology.

Background

New York City Department of Sanitation (NYCDOS) is planning to solicit proposals for a facility to use waste paper as feedstock to minimize waste and foster economic development for both residents and businesses. The solicitation for such a facility in one of the City's five boroughs is expected to be issued in 1995. Furthermore, legislation proposed by the US Environmental Protection Agency (EPA) may require that at least 30 percent of the oxygenates contained in cleaner-burning gasoline will have to be made from renewable resources (which include waste biomass products).

These two events prompted the formation of a study group composed of Stone & Webster Engineering Corporation, Stone & Webster Development Corporation, the New York State Energy Research and Development Authority (NYSERDA), the National Renewable Energy Laboratory (NREL), Amoco Corporation, NYNEX, and Champion International Corporation to explore the potential for a New York City biomass processing facility designed to produce ethanol, which could be used for transportation fuels. This study for the City (Part I) is followed by a study of sites in upstate New York (Part II). The business assessment studies provided by NYNEX and Champion International can be found in Section 9, Vol. III. Appendices are located in Vol. IV.

SITE SELECTION

Facility Requirements

The processing facility design for converting biomass to ethanol requires seven principal processing steps, including waste paper/wood storage, pretreatment, enzymatic hydrolysis, fermentation, distillation, anaerobic digestion and solids/liquid separation.

Minimum facility requirements were prepared to identify the Amoco process characteristics that would affect site selection and economic evaluation. These requirements for two types of cellulose-bearing feedstock materials (paper and wood) included feedstock quantity required, ethanol production rate, solids by-product characteristics, environmental emission characteristics, utilities, personnel, land area, and power reliability. A feedstock quantity of 500 tons per day (tpd) was determined to be the minimum economic facility size. This size facility would result in 49,000 gallons per day (gpd) of ethanol and approximately 360 tpd of lignin by-product. Since the solids by-product of the process has a significant heating value, the study evaluated two approaches: on-site oxidation for local cogeneration of steam and power, and off-site transport of the solids by-product to a solids burning boiler or incinerator. Utility requirements and power generation requirements were developed for each approach as part of a conceptual flow diagram that integrates the processing steps.

Site Cost Estimates

Capital cost estimates were prepared for the basic process island as well for integration with the balance of plant requirements of a generic installation in New York City. These costs were subsequently made site specific for the two preferred sites.

The capital cost of the process island has been estimated to be \$68 million for a 500 tpd plant and \$108 million for a 1000-tpd plant in New York City. The capital cost of the

process island would be approximately the same for paper and wood feedstock.

The total capital cost for a biomass-to-ethanol facility, including the process island, the balance of plant, site improvements, and land costs for processing 500 tpd of feedstock was determined to be \$139 million or \$2837/gpd of ethanol with on-site oxidation of the solids by-product, and \$102 million or \$2082/gpd with no on-site oxidation. The total capital cost for a plant processing 1000 tpd of feedstock was determined to be \$223 million or \$2276/gpd of ethanol with on-site solids by-product oxidation, and \$169 million or \$1724/gpd without on-site oxidation. These costs show a saving due to economies of scale of \$561/gpd with on-site oxidation, and \$358/gpd without on-site oxidation. The costs were determined to be the same for paper and wood feedstocks.

Site Screening and Evaluation

An initial inventory of 74 sites was developed to be screened to meet Amoco's minimum facility requirements and as a basis for discussions with New York City and utility agencies as to their availability. Following discussions with the agencies, sites were excluded that were either not available or did not meet minimum facility requirements. This process resulted in an inventory of 24 sites.

To identify two preferred sites in New York City for further detailed economic studies, numerous environmental and community related issues were reviewed, screened, and selected as key threshold and evaluation criteria. To qualify for further evaluation, sites were required to meet five threshold criteria, including size, shape, natural resources, availability, and zoning. Thirteen evaluation criteria, which enabled comparison of sites, were grouped into four categories: land use, environmental receptors, transportation, and economic factors. The evaluation criteria were also weighted using the Paired Comparison Technique (PCT), a scientific method for ranking sites by comparing only two sites at a time.

The site selection process resulted in the identification of two preferred sites that ranked among the top five sites. These sites, the Proctor & Gamble (P&G) and Arthur Kill sites are privately owned and located on Staten Island. Privately owned sites are recommended because of the reduced permitting time over a publicly owned parcel, which can only be acquired after lengthy Uniform Land Use Regulatory Procedures (ULURP) are completed by New York City.

COST ESTIMATES FOR PREFERRED SITES

Capital costs for a 500-tpd plant constructed at either of the two preferred sites were estimated for the conditions of on-site as well as off-site oxidation of the solids by-product. The cost of a plant with on-site solids by-product oxidation at the P&G site is \$135 million, whereas the comparable cost at the Arthur Kill site is \$129 million. Similarly, the cost of a plant without on-site oxidation at the P&G site is \$101 million, compared to the cost at the Arthur Kill site of \$95 million. The principal cost difference between the two sites is the cost of land. The Arthur Kill site is owned by Con Edison which is prepared to make the site available at virtually no cost in support of the City's interest in a manufacturing facility to recycle paper.

FINANCIAL EVALUATION

Pro Formas

A financial comparison analysis or pro forma was conducted for the biomass-to-ethanol facility to evaluate financial viability and risk. Twelve options were evaluated for each feedstock type of waste paper and waste wood. Two sizes were evaluated to determine the effect of economies of scale: 500 tpd and 1000 tpd. Within each size, two basic plant configurations were distinguished: a biomass facility with an on-site oxidation plant that converts solids by-product to power and steam for use within the facility; and a biomass facility that disposes of the solids by-product off-site and purchases all facility

energy needs from local utilities. The market price for ethanol was assumed to fall within a range of \$1.20 to \$1.50. A required return of 20 percent on equity, after taxes, was used for 10- and 20-year life cost evaluations.

Sensitivity analysis was conducted to show the effects of capital costs as well as O&M costs on the financial evaluation. The effects of economic incentives from city, state, and federal sources were evaluated.

The pro forma evaluation determined the required feedstock tipping fee for the waste paper options and the required ethanol price for the wood waste options. For a paper waste 500 tpd plant, the required tipping fee ranges from \$38 to \$97/ton, showing that revenue from feedstock tipping is necessary for a financially viable project, producing ethanol for \$1.20 to \$1.50. Similarly, for the 1000-tpd plant, tipping revenues are required, although for a smaller fee. The required tipping fee ranges from \$6 to \$67/ton, demonstrating the significant economies of scale in capital and operating costs. For the wood waste options, the required ethanol prices always exceed \$1.50. The 1000-tpd plant, with on-site oxidation of the by-product, produces ethanol for the least cost (\$1.87) when the wood feedstock cost is \$20/ton.

The sensitivity analysis indicates that reductions in capital cost of a 500-tpd paper-to-ethanol plant on the order of 30 to over 100 percent are needed if the project is to be viable on ethanol sales alone at \$1.20. If ethanol can be sold for \$1.50, the necessary capital cost reductions are less onerous, ranging from 7 to 80 percent. The 1000-tpd plants require smaller capital cost reductions.

As with the capital cost reductions, O&M costs would have to be reduced by 50 to over 100 percent for ethanol sales at \$1.20 to adequately and profitably cover the project costs. A reduction of 10 to 70 percent is required when ethanol can be sold for \$1.50.

Sensitivity of the required ethanol price to variations in capital cost and in total O&M

cost were evaluated for the wood waste options for prices of \$20 and \$40/ton. The results indicate that reductions of 25 to over 100 percent are needed if wood costs \$20/ton, and 50 to over 100 percent are needed if wood costs \$40/ton. Similar results occur for the O&M costs.

Economic cost incentives may reduce tipping fees by as much as \$30 to \$40/ton; but to achieve these benefits, a facility must be located in an Economic Development Zone to take advantage of State-allowed investment credits.

The conclusion of the pro forma analysis is that there is a limited "window of opportunity" for a project such as this, sited in New York City. The project should be as large as possible and be able to take advantage of economic incentives. The facility with an on-site by-product oxidation plant appears to be more financially viable, because of the high energy costs in the area.

Business Interests

Potential business interests in the proposed waste biomass-to-ethanol production facility were identified from land owners, feedstock suppliers, end product users, solid waste by-product consumers, and the financial community.

Con Ed has offered its site at the Arthur Kill in Staten Island in support of the City's interest for a manufacturing facility to recycle paper.

The principal feedstock supplier is anticipated to be New York City through the Department of Sanitation's collection of recyclable waste paper. The City currently collects paper materials from all City residences and from over 5,000 institutions, including City agencies, public schools, non-profits, and municipal hospital. By June 1, 1995, the City intends to add residential mixed paper (RMP) to the recycling program, which is estimated to increase the total volume of available waste paper to between 1,300

and 2,200 tons per day. The City has prepared a draft RFP (PIN: 82794AD00069) for manufacturing facilities located within the City to process the waste paper to a usable product including ethanol, and has offered City-owned sites and tax incentives for such a facility. Amoco has gained the interest of the City for its process. The date for issuance of a final RFP is currently in question after a 12-month delay, mostly resulting from the changing political climate within the City.

NYNEX Corporation has indicated an interest in considering the use of the ethanol end product as an additive in its vehicle fleet as a response to the mandated use of oxygenated gasoline required by the Federal Clean Air Act by January 1995. In New York City, NYNEX has 4,000 vehicles, including distribution trucks, vans, bucket trucks, and sedans, at 35 locations throughout the five boroughs. NYNEX is currently evaluating a number of alternative fuels for its vehicle fleet, including ethanol.

Various utilities and companies that burn municipal solid waste (MSW) were interviewed to gauge interest in processing the solid waste by-product from the Amoco process as a fuel source. Companies that burn MSW such as American ReFuel would consider the by-product in the same light as municipal waste and require a tipping fee on the order of \$50/ton. Public Service Electric and Gas of New Jersey expressed reservations about processing the by-product from New York City because of political uncertainties involved in accepting out-of-state waste, new permitting requirements, and unknown effects on the existing boilers. Burning in existing municipal incinerators within the City was considered as inappropriate due to the political resistance within the City to incinerate waste materials.

Based on the financial pro forma runs, it was decided to delay contacting the financial community for equity interests at this time. An improved capital cost structure for building a facility in New York City is required to ensure attractive returns on investments commensurate with operating requirements, including stable feedstock costs/tipping fees for recycle paper.

BUSINESS ASSESSMENTS

Feedstock Supplier

Champion International perceived the Amoco process as a recycling process that competes with present practices by the paper industry. The paper industry has achieved national paper recovery rates of approximately 40 percent. The economics of achieving this rate is demonstrated by the industry's ability to absorb current recycled paper price increases to over \$100/ton in New York State. Champion indicated that such instability in price makes it currently unfavorable to recycle paper via the Amoco process. The company recommended that paper mill sludge would be a more suitable feedstock, particularly in New York State where approximately 400 dry tons/day of paper sludge are generated and landfilled.

Feedstock Supplier/Ethanol-User

NYNEX approached the business assessment of the Amoco process as a potential user of ethanol for its vehicle fleet and as a potential supplier of feedstock in the form of old telephone directories (OTD).

With approximately 4,000 of NYNEX's 12,000 New York State vehicles located at 35 sites throughout the five boroughs of New York City, an Amoco ethanol facility located in the City would appear to offer efficiencies for providing fuel to at least one-third of the NYNEX New York fleet. However, questions related to transportation, storage, and the Amoco intermediate distribution process itself remain to be answered.

Currently, old telephone books are included in the residential curbside program and are a mandatory item in the City's commercial recycling program. Waste paper markets are presently very strong, with prices in the \$70 to \$100/ton range. Therefore, it appears unlikely that OTD will be a feedstock source for the Amoco process in New York City.

Regarding the NYNEX decision on alternative fuels for its vehicle fleet, review of EPA reports confirmed the benefits/costs associated with alternative fuels. However, more research is needed to determine such issues as optimum engine configuration, fuel metering systems, and fuel storage technology.

SECTION 1

INTRODUCTION

OBJECTIVE

The objective of this study is to identify and evaluate two sites in New York City that could be appropriate for the construction and long-term operation of a financially attractive and environmentally sound waste biomass-to-ethanol production facility using Amoco's biomass conversion technology (the Amoco process).

STUDY BACKGROUND

The New York City Department of Sanitation (NYCDOS) is interested in projects that would minimize waste and foster economic development for both residents and businesses. In New York City, the largest curbside recycling program in the country serves 3 million residences and expects to collect 1300 to 2200 tons per day (tpd) of waste paper by the year 1995. NYCDOS intended to solicit proposals in 1994 for a manufacturing facility, to be located in one of the City's five boroughs, that would use waste paper as feedstock. However, because of political and budgetary decisions related to the collection of residential mixed paper (RMP), the solicitation has been put on hold. NYCDOS is working to develop a plan for collecting RMP by July 1995. A new proposal solicitation for a recycling facility for recovered paper will be prepared at that point. In addition to waste paper, 1 million tons per year of waste wood chips are collected in metropolitan New York City.

A second factor supporting development of a waste-to-energy facility's legislation proposed by the US Environmental Protection Agency (EPA), which may require that at least 30 percent of the oxygenates contained in cleaner-burning gasoline will have to be made from renewable resources (which include waste biomass products). Thus the market for biomass products such as ethanol are expected to increase substantially.

For these reasons, Amoco, together with NREL, NYNEX, Champion International, and Stone & Webster Engineering Corporation have been exploring the potential for a New York City biomass processing facility designed to produce ethanol, which could be used for transportation fuels. Amoco has developed its biomass conversion technology through 15 years of research and development (R&D) and pilot plant work by its own staff, NREL, and other collaborators. Efforts are underway to assess project feasibility in conjunction with large-scale paper, forest products, and agricultural operations. Application of Amoco's process is particularly facilitated in localities, such as New York City, with a waste paper recycling program.

STUDY ORGANIZATION

The study was managed by Stone & Webster Engineering Corporation (SWEC) with technical support from Amoco, Stone & Webster Development Corporation, NYNEX, Champion International, National Renewable Energy Laboratory (NREL), the New York State Energy and Research and Development (NYSERDA), and other parties. The following identifies participation of the team members in selection of preferred sites and evaluation of project viability in New York City.

Stone & Webster Engineering Corporation provided the overall management of the study and preparation of this report. In addition, SWEC was responsible for site selection (Section 2), including screening potential sites in New York City, defining site improvement requirements and costs, defining key site evaluation criteria, and evaluating and ranking sites to determine the preferred two sites. SWEC also developed refined budgetary capital and operating costs for the two preferred sites (Section 3) and identified potential business interests (Section 4).

Amoco defined process-related requirements for the biomass-to-ethanol production facility (Section 2) and estimated capital and operating costs for the island of process equipment for 500 and 1000 tpd of feedstock (Section 2).

Stone & Webster Development Corporation prepared financial pro formas for the construction and long-term operation of an Amoco process facility (Section 4).

Champion International prepared a business assessment as a feedstock supplier (Section 9)

NYNEX prepared a business assessment as a potential ethanol user and a provider of old telephone directories or feedstock (Section 9).

SECTION 2

NEW YORK CITY SITE SELECTION

The study gathered and reviewed New York City siting data available within Stone & Webster Engineering Corporation and elsewhere, and determined design requirements of the Amoco process for prospective sites. The preferred sites were selected based on developed criteria and Amoco process requirements. Financial evaluations were performed to determine the economics of developing a project in New York City.

FACILITY REQUIREMENTS FOR SITE SELECTION

Technology Overview

A processing facility for converting biomass to ethanol requires a number of processing steps (depicted later in Figures 2-1 through 2-5):

- **Waste Paper/Wood Storage.** In the first step, feedstock (paper or wood) is cleaned of contaminants and shredded prior to further processing.
- **Pretreatment.** This step sterilizes the feedstock and prepares it for further processing by hydrolysis agents.
- **Enzymatic Hydrolysis.** The feedstock is hydrolysed by adding acid and enzymes. This operation converts cellulose to glucose.
- **Fermentation.** In this step, glucose is converted to ethanol by applying microorganisms in a fermentation process similar to the corn-to-ethanol process. Typically, about half of the glucose is converted to carbon dioxide and half to ethanol. Small amounts of glucose are converted to microorganism cell mass.
- **Distillation.** The ethanol is recovered using a distillation technology commonly employed by the corn-to-ethanol industry. This is followed by the use of

molecular sieves to break up the water-ethanol mixture.

- **Anaerobic Digestion.** Solids emanating from the distillation process are subjected to digestion by anaerobic bacteria to generate methane off-gas and the solids/liquid product. The methane off-gas may be used to supply energy required by the Amoco process.
- **Solids/Liquid Separation.** In the final step, unreacted solids are separated from liquids. The solids may be used as fuel to supply process heat and power or sold to others for use as fuel. The liquids are subjected to digestion by aerobic bacteria and discharged for reuse in the process.

Facility Requirements

Minimum generic facility characteristics that would affect site selection and economic evaluation were identified. These requirements included feedstock type, feedstock quantity, ethanol production rate, solids by-product characteristics, environmental emission characteristics, utilities, personnel, land area, and power reliability. The facility requirements are summarized in Table 2-1 for two types of cellulose-bearing feedstock materials: paper and wood. A feedstock quantity of 500 tpd was selected as representing a minimum economic facility size. A site plan of the prototype biomass-to-ethanol facility is shown in Figure 2-1.

TABLE 2-1 Facility Requirements

1. Feedstock Type	Waste paper Wood chips Mixture of waste paper and wood	
2. Feed Stock Quantity	500 tpd dry (Maximum moisture content of feedstock that will not downgrade ethanol production rate is 60%.)	
3. Ethanol Production Rate	49,000 gallons per day (98 gal/ton feed) for either waste paper or wood chips feedstock	
4. Solid By-product Characteristics:		
Solids By-product Rate	<u>Waste Paper</u> 360 tons per day @ 66% solids	<u>Wood Chips</u> 290 tons per day @ 66% solids
Solids By-product Composition	See Table 2-2	Prorated based on solids by-product rate
Solids By-product Heating Value	6100 Btu/lb (dry) 4100 Btu/lb (wet)	6100 Btu/lb (dry) 4100 Btu/lb (wet)

TABLE 2-1 (Continued)

5. Environmental Emission Characteristics	Refer to Table 2-2 for composition of emission streams for waste paper feedstock. Emissions for wood chips would be similar in quality to emissions from waste paper feedstock.		
6. Process Island Utility Requirements	<u>Waste Paper</u>	<u>Wood Chips</u>	
	Power :	5 MW	4.5 MW
	Steam :	35,000 lb/hr @ 650 PSIA, 600 °F	47,000 lb/hr @650 psia, 600 °F
	Cooling Water:	7200 gpm @ 44mm Btu/hr.	6800 gpm @ 41.5 mm Btu/hr
	Chilling Water:	900 gpm @ 9 mm Btu/hr	500 gpm @5 mm Btu/hr
	Water Treatment:	100 gpm	100 gpm
	Makeup Water:	68 gpm	68 gpm

TABLE 2-1 (Continued)

7. Personnel Requirements	<u>Based on Solids By-product Oxidation On-site</u>	<u>Based on Off-site Oxidation of Solids</u>
	86 workers consisting of: 55 hourly workers 10 shipping/receiving/security 10 office management 6 engineering 5 laboratory	66 workers consisting of: 40 hourly workers 10 shipping/receiving/security 7 office management 5 engineering 4 laboratory
8. Land Requirements	10 acres (1.5 acres for process island; balance for site requirements) Refer to Figure 2-1 for plot configuration.	
9. Power Reliability	High power reliability must be maintained. Prolonged outages may reduce ethanol yield and may result in difficulties in re-suspending solids in fermenter vessels.	

TABLE 2-1 (Continued)

<p>10. Other Considerations</p>	<p>Safety : Transportation: Water Hardness: Storage: Shape of Site: Special Soil Drainage Characteristics :</p>	<p>Incorporated safety considerations in design for flammable waste paper and ethanol, as well as for handling and containing chemicals. No special requirements. No special requirements. No special requirements. Rectangular shape is preferred. No particular soil drainage characteristics are required. Underlying soil should support equipment.</p>
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Table 2-2 Solids By-product, Liquid, Gas Emissions Composition.
(Flow rate in lb/hr)

COMPONENTS	WASTE SOLIDS	SCRUBBED FERMENTER OFF-GAS	ANAEROBIC GAS	DISTILLATION VENT	DISCARD WATER
Garbage	4900				100
Ash	3000				1700
Lignin	7000				100
Furfural & acetaldehyde	100				500
Calcium sulfate	400				
Cell mass	4400				100
Ethanol				65	
Carbon Dioxide		12500	1150	150	
Oxygen		28200			
Nitrogen		98700			
Methane			1750		
Water	10200		450	30	47600
TOTAL	30000	139400	3350	245	50000

Solids By-Product

The solids by-product consists primarily of lignin, which has a significant heating value and can therefore be used as a fuel to generate steam and/or power. Combustion of the lignin with an estimated heating value of 6100 Btu/lb dry (4100 Btu/lb wet) material will generate approximately 120 million Btu/hr. In addition, gas leaving the anaerobic digestion operation within the Amoco process contains approximately 50 percent methane and, upon combustion, can contribute an additional 40 million Btu/hr of heat value. The solids by-product produced by the Amoco process represents approximately 50 percent of the dry feedstock. The composition of solids by-product emissions is summarized in Table 2-2.

With this much heat available from both by-products of the Amoco process, the study evaluated the economic benefits of two approaches for disposing of the solids by-product:

Approach A: Local cogeneration of steam and power through on-site gasification of the lignin and combustion of the methane containing off-gases.

A flow diagram depicting this approach is shown in Figures 2-2 and 2-4. This approach requires a higher capital investment but makes the plant self-sufficient with respect to process steam and power, and results in a net export of power. Gasification is the preferred processing method for the solids by-product because of the opposition by public and regulatory agencies to direct combustion of solids fuels within New York City.

Approach B : Transportation of the solids by-product to an off-site solids fuel burning facility.

A flow diagram depicting this approach is shown in Figure 2-3 and 2-4. This approach involves little capital investment but requires high operating costs in the form of tipping fees at solids fuel burning facilities outside the City limits. These include utilities, industrial facilities, and cogeneration

plants burning municipal solid waste (MSW). The market value of the solids by-product is discussed in the economic pro formas in Section 4.

Utilities

Utility requirements for the Amoco process are power, steam, cooling and chilled water, and makeup water. To make the site selection more flexible and independent of the availability of cooled water, a closed-loop cooling tower and chiller were selected to supplement the Amoco process. A once-through cooling system would limit the siting of the facility to areas adjacent to large water bodies. Power and steam requirements are based on Approaches A and B. In Approach A, a combination of gasification of lignin, combustion of by-product gases, and cogeneration can provide the required steam and power, and result in a net export of power. In Approach B, power would be purchased and steam produced through a package boiler fueled by the methane containing off-gases from the Amoco process. Natural gas would be purchased to supplement the fuel requirements.

See Attachments 2-1 through 2-3 in the Appendix for additional details about facility requirements.

ETHANOL SITING STUDY

780 Ft

560 Ft

0 50' 100' 200' 300' 400'

AMOCO PROCESS PLOT

FIGURE 2-1

ETHANOL SITING STUDY

Waste Paper Feedstock

AMOCO PROCESS FLOW SCHEMATIC
(ON SITE OXIDATION OF SOLIDS BYPRODUCT)

FIGURE 2-2

ETHANOL SITING STUDY Waste Paper Feedstock

AMOCO PROCESS FLOW SCHEMATIC
(SOLIDS BYPRODUCT TRANSPORTED OFF SITE)

FIGURE 2-3

ETHANOL SITING STUDY

Wood Feedstock

AMOCO PROCESS FLOW SCHEMATIC
(ON SITE OXIDATION OF SOLIDS BYPRODUCT)

FIGURE 2-4

SITE SCREENING

An inventory of 74 sites, including three sites identified by the NYC Department of Sanitation, was developed for purposes of screening sites to meet Amoco's minimum facility requirements and as a basis for discussing site availability with various City agencies. This inventory is shown in Table 2-3 by Borough along with description, block number, acreage, manufacturing zone (M Zone), type of ownership, and owner, if known.

Following discussions with the NYC Department of General Services (Division of Real Estate Services), Con Edison, Brooklyn Union Gas, NYC Department Economic Development, and NYC Department of Sanitation, sites were excluded that were either not available or did not meet the minimum requirements. The list of 24 remaining sites is shown in Table 2-4 by Borough and includes comments on most of the sites where additional information was obtained during data gathering.

PROCESS EQUIPMENT COST ESTIMATE

This section provides estimates of capital budgets for process island equipment designed for feedstock quantities of 500 and 1000 tpd. The estimates reflect the size, shape, and orientation of the Amoco process island, as well as the feedstock quality defined in Table 2-1 (Facility Requirements).

The capital cost estimate for a 500-tpd process island has been estimated by Amoco to be \$47 million, based on building a facility in the Gulf Coast region of the United States (see Attachment 2-3a in the Appendix). This cost estimate was upgraded to \$68 million to reflect the higher labor rates of New York City. Similarly, a capital cost estimate for the process island of a 1000-tpd plant in New York City was estimated to be \$108 million. The capital cost of the process island is approximately the same for paper and wood feedstock.

The operating cost estimate for 500-tpd and 1000-tpd process islands is discussed in Section 4 (financial pro formas).

Table 2-3

**74 Site Inventory by NYC Borough
for Bioconversion of Biomass-to-Ethanol Facility**

<u>Borough</u>	<u>Map</u>	<u>Description</u>	<u>Block</u>	<u>Size-ac</u>	<u>M Zone</u>	<u>Type</u>	<u>Owner</u>
Brooklyn	1	Revere Sugar Plant	598/612/6	19	3	Private	
Brooklyn	2	Eastern District Terminal	2294/2332	23	3	Private	
Brooklyn	4	E 83rd St & Foster Ave.	7920	16	1	Public	P&T
Brooklyn	5	D & Remsen	7920	6	1	Public	P&T
Brooklyn	10	Brooklyn Navy Yard		5	3	Public	
Brooklyn	11	Pier 7	710	5	3	Public	P&T
Brooklyn	19	East Williamsburg-Varick Ave		6	3	Private	
Brooklyn	20	Mill Basin		6	2	Private	
Brooklyn	21	Sunset Park		7	1	Private	
Brooklyn	23	Erie Basin	612	30	3	Public	PA NYNJ
Brooklyn	24	Gowanus Canal/Carroll Gardens	471	6	3	Public	DRP
Brooklyn	26	Newtown Creek	2491	6	3	Private	
Brooklyn	27	Bayridge Marine Terminal	5806/5804	25	2	Public	NYC EDC
Brooklyn	30	Sunset Park/Bush Terminal	725	26	3	Public	NYC EDC
Brooklyn	31	Kentile	990	16	2	Private	
Brooklyn	32	S. Brooklyn Marine Terminal	662	35	3	Public	NYC EDC
Brooklyn	33	Brooklyn Navy Yard	2023	22	3	Public	NYC EDC
Brooklyn	34	DOS Site/Erie Basin	614	16	3	Public	PA NYNJ
Brooklyn	35	Postal Facility/SW	1020	8	2	Public	US P.O.
Brooklyn	36	English Kills	2974	5	3	Private	
Brooklyn	37	Flushing ave	2994	8	1	Private/P	NYC EDC
Brooklyn	38	Bushwick Place	3056	6	3	Private	LIRR
Brooklyn	39	4901 1st Ave	771	7	3	Public	NYC EDC
Bronx	5	Zerega Industrial	3579	6	2	Public	PDC
Bronx	6	Zerega Industrial Park	3576	10	1	Public	PDC
Bronx	7	Oakpoint Yards	2604	27	3	Private/Public	
Bronx	10	Foot of Lafayette, Bx River	2770	8	1	Public	P&T
Bronx	11	Bounded by Viele, Ryawa, & Hunts Pt	2778	5	3	Public	P&T
Bronx	12	W. of Foot of Farragut	2780	52	3	Public	P&T
Bronx	13	E. of Foot of Hunts Pt. Ave	2781	5	3	Public	P&T
Bronx	15	Bartow Ave.	5141	10	1	Public	
Bronx	18	Barretto Point	2771/2777	15	3	Public	P&T
Bronx	24	Ferry Point at Sengar Place	5610	7	1	Private	
Bronx	25	Ferry Point at Lafayette Ave	5560	6	1	Private	
Bronx	26	Harlem River Valley Yards	2319	19	1	Public	MTA, NYC,
Bronx	27	Port Morris	2319	6	2	Private	
Bronx	50	Harlem Rail Yards	2543	19	3	Public	NYS DOT

Queens	2 College Pt., 112-15 14th Ave		5	1 Public	
Queens	3 Newtown Creek	68	5	3 Private	LIRR
Queens	4 College Point	4381/4382	7	3 Public	PDC
Queens	5 Maspeth	2602/2603	24	3 Private	
Queens	7 Phelps Dodge	2527	30	3 Public	US P.O.
Queens	8 PA NYNJ, Amsstel Blvd.	16075	16	1 Public	NYC
Queens	9 Beach 80th St.	16103	7	1 Public	NYC
Queens	20 Maspeth (Near Grand Ave.)		5	3 Private	
Queens	22 Maspeth One	2600	8	3 Private	
Queens	23 West JFK		218	1 Public	NYC
Queens	24 Rockaway	16166	9	2 Private	LILCO
Queens	26 West JFK-S. Conduit Blvd.(DOS)		5	1 Public	
Staten Island	4		100	1 Public	
Staten Island	5 Charleston Section,Sharrots Rd.	7328	8	1 Private	
Staten Island	6 Newark Bay	1301/1306	45	2 Private	P&T
Staten Island	7 Richmond Terrace	1116	12	1 Private	
Staten Island	8 Gulf Ave.	1895/1885	40	3 Private	
Staten Island	10		40	3 Private	
Staten Island	12		26	3 Public	
Staten Island	13 North S.I., Richmond Terrace	185	7	1 Private	
Staten Island	14 South Ave/Forest	1707	7	1 Private	
Staten Island	15 Forest Avenue	1380	10	2 Private	
Staten Island	17 Rossville Marine Terminal	7162	65	3 Private	
Staten Island	18		12	3 Public	
Staten Island	19		10	3 Public	
Staten Island	20		14	3 Public	
Staten Island	21		19	3 Public	
Staten Island	22		35	3 Public	
Staten Island	23 Baxter St. S. of C	7446	12	1 Public	DRP
Staten Island	24 Claude St/Burr Ave	7452	12	1 Public	DRP
Staten Island	25 Arthur Kill Rd/N. of	7487	8	1 Public	DRP
Staten Island	26		37	3 Public	
Staten Island	28		115	2 Public	
Staten Island	29		31	3 Public	
Staten Island	32 Drumgoole Rd	7481	15	1 Public	DRP
Staten Island	35 Arthur Kill	2705/2758	140	3 Private	Con Ed
Staten Island	36 Proctor & Gamble		35	3 Private	

Table 2-4

**Sites Screened for Area & Availability for Bioconversion Facility
Resulting in 24-Site Inventory by Borough**

<u>Location</u>	<u>Description</u>	<u>Block</u>	<u>Size</u>	<u>M Zon</u>	<u>Type</u>	<u>Owner</u>	<u>Comments</u>
BROOKLYN							
BK01	Revere Sugar Plant	598/604/60	19	3	Private		Surrounded by residential
BK02	Eastern District Termi	2294/2301/	23	3	Private		Potential opposition from neighborhood
BK04	E 83rd St & Foster Av	7920	16	1	Public	P&T	
BK27	Bayridge Marine Term	5806/5804	25	2	Public	NYC EDC	Terminal plans but may be available
BK30	Sunset Park/Bush Ter	725	26	3	Public	NYC EDC	Offered by DOS/EDC for paper recycling proposal
BK31	Kentile	990	16	2	Private		
BK32	S. Brooklyn Marine Te	662	35	3	Public	NYC EDC	
BK34	DOS Site/Erie Basin	614	16	3	Public	PA NYNJ	One of several MRF sites in NW BK wasteshed
BRONX							
BX06	Zerega Industrial Park	3576	10	1	Public	NYC PDC	Potential community board resistance
BX07	Oakpoint Yards	2604	27	3	Private/Public		Large pile of solid waste on site, DOC plans for prison barge
BX18	Barretto Point	2771/2777	15	3	Public	P&T	Offered by DOS/EDC for paper recycling proposal
BX50	Harlem Rail Yards	2543	19	3	Public	MTA, NYC,	Leased to HR Ventures by NYSDOT
QUEENS							
QN05	Maspeth	2600	24	3	Private		
QN07	Phelps Dodge	2527	30	3	Public	US P.O.	Former DEP compost site
STATEN ISLAND							
SI06	Newark Bay	1301/1306/	45	2	Public/Pri	P&T	Former DEP compost site
SI15	Forest Avenue	1380	10	2	Private		
SI17	Rossville Marine Term	7446	65	3	Private		DOC occupies portion of the site
SI21	Bement Ave	184	19	3	Public		
SI22	Howland Hook	1202	35	3	Public		
SI23	Baxter St.S. of Cady	7446	12	1	Public	DRP	
SI24	Claude St/Burr Ave	7452	12	1	Public	DRP	
SI32	Drumgoole Rd	7481	15	1	Public	DRP	
SI35	Arthur Kill	2705/2715/	140	3	Private	Con Ed	Adjacent power plant
SI36	Proctor & Gamble	1400	35	3	Private		Former soap & detergent plant

SITE IMPROVEMENT COST ESTIMATES

This subsection identifies the required additional costs for developing a site to supplement the project island costs developed in the previous subsection, and reports the total costs of the biomass-to-ethanol conversion facility.

The total cost is broken down into four cost components: the process island, the balance of plant, site improvement, and land cost. The cost of the process island is the cost determined for New York City in the previous subsection. The balance of plant cost includes the costs of buildings, auxiliary utilities including power distribution, and auxiliary systems to the process island such as water treatment, preparation of cooling and chilled water supply, and solid oxidation (gasification) of the solid waste by-product. An alternative cost estimate was prepared for the case of no on-site oxidation of the waste materials. The site improvement costs include costs for preparing the site for the facility, including demolition, piling, lighting, and fire prevention systems. The land cost was appraised based on a site requirement of 10 acres.

The total cost for a facility processing 500 tpd of feedstock was determined to be \$139 million or \$2837/gpd (gallons per day) of ethanol product with on-site oxidation of the solids by-product, and \$102 million or \$2082/gpd with no on-site oxidation. These costs are summarized in Tables 2-5 through 2-7 for on-site solids by-product oxidation and in Tables 2-8 through 2-10 without on-site oxidation. See Attachments 2-4 through 2-5 in the Appendix for additional details. The costs were determined to be the same for paper and wood feedstocks.

The total cost for a facility processing 1000 tpd of feedstock was determined to be \$223 million or \$2276/gpd of ethanol with on-site solids by-product oxidation, and \$169 million or \$1724/gpd without on-site oxidation. These costs represent a saving of \$561/gpd with on-site oxidation, and \$358/gpd without on-site oxidation based on economies of scale.

Table 2-5

Budget Estimate for Biomass-to-Ethanol Facility
With On-site Oxidation.
Part 1 - NY City Project Evaluation.

SUMMARY

DESCRIPTION	TOTAL COST
PROCESS ISLAND	\$68,192,000
BALANCE OF PLANT	\$50,295,000
SITE IMPROVEMENT	\$11,411,000
LAND COST	\$10,000,000
TOTAL PRESENT PLANT COST	\$139,898,000

Table 2-6

Budget Estimate for Biomass-to-Ethanol Facility with On-site Oxidation.
Part 1 – NY City Project Evaluation (500 tpd) – 10 Acre.

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
BALANCE OF PLANT				
Building (Admin.,Control,Lab.)	1	ls	\$1,620,000	\$1,620,000
Maint./Shop Bldg.	1	ls	\$1,470,000	\$1,470,000
Plant Air Supply	1	ls	\$400,000	\$400,000
Aerobic Watertreatment	1	ls	\$1,500,000	\$1,500,000
Chilled/Cooling Water Supply	1	ls	\$700,000	\$700,000
Boiler Feed Water	1	ls	\$400,000	\$400,000
Solid Oxidation/Power & Distribution	1	ls	\$30,000,000	\$30,000,000
Conveying Syst. to Oxidation	1	ls	\$1,500,000	\$1,500,000
Sub-Total Cost				\$37,590,000
Start-up Cost	1	ls	\$563,850	\$563,850
Engineering - 10%	1	ls	\$3,759,000	\$3,759,000
SUB TOTAL				\$41,912,850
CONTINGENCY - 20%	1	ls	\$8,382,570	\$8,382,570
TOTAL PRESENT DAY COST - BOP				\$50,295,420

Table 2-7

Budget Estimate for Biomass-to-Ethanol Facility with On-site Oxidation.

Part 1 - NY City Project Evaluation - Site Improvement Requirements (500 tpd) - 10 Acre.

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
Demolition	1	ls	\$500,000	\$500,000
Site Clearing & Grubbing	1	ls	\$50,000	\$50,000
Sewer and Drainage	1	ls	\$915,000	\$915,000
Access Roadways and Parking	1	ls	\$800,000	\$800,000
Piling	1	ls	\$2,000,000	\$2,000,000
Dewatering	1	ls	\$500,000	\$500,000
Make-up Water & Potable Water	1	ls	\$600,000	\$600,000
Sewer Hook-ups for Bathroom	1	ls	\$100,000	\$100,000
Fire Water	1	ls	\$1,400,000	\$1,400,000
Sprinkler System	1	ls	\$1,000,000	\$1,000,000
Fencing	1	ls	\$70,000	\$70,000
Misc. Site Work	1	ls	\$200,000	\$200,000
Site Lighting	1	ls	\$510,000	\$510,000
Sub-Total Cost				\$8,645,000
Engineering - 10%	1	ls	\$864,500	\$864,500
Sub-Total Cost				\$9,509,500
CONTINGENCY - 20%	1	ls	\$1,901,900	\$1,901,900
TOTAL PRESENT DAY COST				\$11,411,400

Assumption: No Enviromental Remediation on Site.

Table 2-8

Budget Estimate for Biomass-to-Ethanol Facility without Oxidation.
Part 1 - NY City Project Evaluation.

SUMMARY

DESCRIPTION	TOTAL COST
PROCESS ISLAND	\$68,192,000
BALANCE OF PLANT	\$16,600,000
SITE IMPROVEMENT	\$11,411,000
LAND COST	\$10,000,000
TOTAL PRESENT PLANT COST	\$106,203,000

Table 2-9

Budget Estimate for Biomass-to-Ethanol Facility without Oxidation.
 Part 1 - NY City Project Evaluation (500 tpd) - 10 Acre.

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
BALANCE OF PLANT				
Building (Admin.,Control,Lab.)	1	ls	\$1,620,000	\$1,620,000
Maint./Shop Bldg.	1	ls	\$1,470,000	\$1,470,000
Plant Air Supply	1	ls	\$400,000	\$400,000
Aerobic Watertreatment	1	ls	\$1,500,000	\$1,500,000
Chilled/Cooling Water Supply	1	ls	\$700,000	\$700,000
Boiler Feed Water	1	ls	\$400,000	\$400,000
Power & Distribution	1	ls	\$5,000,000	\$5,000,000
Boiler Package	1	ls	\$1,000,000	\$1,000,000
Steam Turbine	1	ls	\$250,000	\$250,000
Sub-Total Cost				\$12,340,000
Start-up Cost	1	ls	\$246,800	\$246,800
Engineering - 10%	1	ls	\$1,234,000	\$1,234,000
SUB TOTAL				\$13,820,800
CONTINGENCY - 20%	1	ls	\$2,764,160	\$2,764,160
TOTAL PRESENT DAY COST - BOP				\$16,584,960

Table 2-10

Budget Estimate for Biomass-to-Ethanol Facility without Oxidation.

Part 1 - NY City Project Evaluation - Site Improvement Requirements (500 tpd) - 10 Acre.

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
Demolition	1	ls	\$500,000	\$500,000
Site Clearing & Grubbing	1	ls	\$50,000	\$50,000
Sewer and Drainage	1	ls	\$915,000	\$915,000
Access Roadways and Parking	1	ls	\$800,000	\$800,000
P'iling	1	ls	\$2,000,000	\$2,000,000
Dewatering	1	ls	\$500,000	\$500,000
Make-up Water & Potable Water	1	ls	\$600,000	\$600,000
Sewer Hook-ups for Bathroom	1	ls	\$100,000	\$100,000
Fire Water	1	ls	\$1,400,000	\$1,400,000
Sprinkler System	1	ls	\$1,000,000	\$1,000,000
Fencing	1	ls	\$70,000	\$70,000
Misc. Site Work	1	ls	\$200,000	\$200,000
Site Lighting	1	ls	\$510,000	\$510,000
Sub-Total Cost				\$8,645,000
Engineering - 10%	1	ls	\$864,500	\$864,500
Sub-Total Cost				\$9,509,500
CONTINGENCY - 20%	1	ls	\$1,901,900	\$1,901,900
TOTAL PRESENT DAY COST				\$11,411,400

Assumption: No Enviromental Remediation on Site.

SITE EVALUATION CRITERIA

To identify two preferred sites for further detailed economic studies, numerous environmental and community related issues were reviewed, screened, and selected as key threshold and evaluation criteria. These criteria enabled an evaluation of the 24 sites shown in Table 2-4 by making distinctions among important site characteristics. For the NYC site selection, five threshold and 13 evaluation criteria were selected and are listed below (definitions of the criteria are shown in Attachment 2-6 in the Appendix, including the scores used to make distinctions between sites).

Threshold Criteria

These criteria are considered exclusionary criteria. That is, to qualify for further evaluation, a site must pass these five criteria:

- Size
- Shape
- Natural Resources
- Availability
- Zoning

Evaluation Criteria

These criteria were used to develop scores for comparing sites against each other. These criteria were also weighted using the Paired Comparison Technique (PCT). That is, some criteria were considered more important than others. For example, the criterion, "Sensitive Receptors Nearby" was considered significantly more important than the criterion of qualifying for "Eligibility for Incentives." The criteria are listed below by category:

- Land Use:
 - Industrial Waterfront Designation
 - Site Zoning
 - Adjacent Zoning

- Environmental Receptors:
 - Natural Resources
 - Homes Nearby
 - Sensitive Receptors

- Transportation:
 - Rail Access
 - Barge Access
 - Proximity to Truck Route

- Economic Factors:
 - Site Expansion
 - Development Time
 - Capital Cost Acquisition
 - Eligibility for Incentives

Weighting of Evaluation Criteria

Using a rational and scientific method for screening and ranking waste management sites has become an accepted practice for public agencies whose decision-making methods are often subject to intense public scrutiny. The Paired Comparison Technique (PCT) was an effective tool in weighting the criteria and ranking the sites as part of the lengthy and complicated site selection process for the New York City Sludge Management Plan. See Attachment 2-7 (Technical Paper "Implementation of a Hybrid Ranking Model: A Case Study in Selecting a Waste Management Plan with Multiple Sites," 1992) in the Appendix, for further details. The PCT is summarized below.

The PCT was developed by Dean and Nishry in the mid-1960s as a model for prioritizing engineering projects from a range of alternatives. Subsequently, the approach has been used in environmental studies and is particularly useful for site selection. The PCT (or some version of it) has also been used by the US Army Corps of Engineers and the US Department of Interior in evaluating alternatives for solid waste systems, proposed highway alternatives, and water resource assessment and planning.

The PCT breaks down the decision-making process so that decisions or preferences are assigned to a number of selected criteria affecting an alternative. Once alternatives are established, a list of important decision-making criteria must be defined and relative weights of importance assigned to them. The PCT becomes useful in that only two criteria are compared against each other at any one time, and a simple positive response, negative response, or equal-in-importance response is assigned. The term "forced decision analysis" has been coined to describe this procedure because a decision-maker is literally forced to make a decision between two alternatives. PCT enables decision makers to select and prioritize key siting criteria, and then, once the field is narrowed, strategically choose between a number of eligible sites in a rational and defensible way.

Stone & Webster personnel have used the PCT to weight siting criteria for several projects. Guidelines for performing the PCT are shown in Attachment 2-8 in the Appendix. Each participant scores the evaluation criteria and a consensus is developed. The final result is shown in Appendix Attachment 2-9 and summarized below:

Table 2-11. PCT Weight Siting for Biomass-to-Ethanol Facility.

Evaluation Criteria	Weight Percent
<hr/>	
Industrial Waterfront Designation	3.9
Site Zoning	9.9
Adjacent Zoning	9.4
Natural Resources	11.0
Homes Nearby	12.1
Sensitive Receptors	11.0
Rail Access	4.4
Barge Access	4.9
Proximity to Truck Route	11.0
Site Expansion	4.4
Development Time	10.4
Capital Cost Acquisition	4.9
Eligibility for Incentives	2.7

SITE RANKING AND FINAL SELECTION

A data base was prepared for the 24 sites listed in Table 2-4. The raw data are shown in Table 2-12 for the evaluation criteria associated with each site. Because the criterion Development Time is composed of six criteria, the raw data are shown separately for this criterion in Table 2-13 along with the scores for each site. All of the scores for ranking the remaining sites are shown in Table 2-14. Again, the PCT was used to compare the scores of each site for each criterion. The PCT process is automatically driven after the scores are established for each site and the results are normalized on a percentile basis with a perfect site scoring 100 percent. The ranking results are shown in Table 2-15.

Of the top five ranked sites, Arthur Kill and Proctor & Gamble sites on Staten Island, and the Maspeth site in the Queens are privately owned parcels. This high ranking occurred even though the criterion, capital cost of land acquisition, is scored lower for privately owned sites than publicly owned sites. Other more heavily weighted criteria offset this disadvantage. For example, the Arthur Kill and Proctor & Gamble sites had perfect scores for the criteria, site zoning (9.89% wt), adjacent zoning (9.34% wt), residential density (12.09% wt), and sensitive receptors nearby (10.99% wt). These four criteria out of the total of 13 criteria accounted for 42.31 percent of the score.

It is recommended that privately owned sites be pursued initially because of the reduced permitting time over a publicly owned parcel, which can only be acquired after lengthy Uniform Land Use Regulatory Procedures (ULURP) are completed by NYC. Also, because wood chips were burned in the previous Proctor & Gamble facility and can be used in the Amoco process, this location is particularly desirable. In regard to the Arthur Kill site, Con Ed currently operates a 700-MW power plant adjacent to the site. Thus, like the P&G site, the land use has been known as heavy industrial. Also, Con Edison has offered this site as one of several potential paper recycling sites to be identified in the forthcoming NYC Department of Sanitation proposal. For these reasons, both of these sites are recommended. The Proctor & Gamble site is shown in Figure 2-6 and a site description fact sheet is in Table 2-16. The Arthur Kill site location map is shown in Figure 2-7 and the site description fact sheet is in Table 2-17.

Raw Data for Siting Criteria

NO.	SITE	INDUST	SITE ZONE	ADJ ZONE	NAT RES	RES DENS No.	SENS RECEP NRBY No.	RAIL ACCES	BARGE ACCES	PROX TRUCK ROUTE Ft.	SITE EXPA acres	DEV TIME #Imped	CAP	ELGI
		WATER DESIG											COST ACQU	IBLE INCE TIVE
BK01	Revere Sugar	Yes	M-3/1	Residnt<400'	No	10,846	14	No rail	Yes	2800	19	2	Market	Yes
BK02	Eastern District Terminal	No	M-3	Res 400-800'	No	10,394	10	No rail	Yes	4400	23	2	Market	Yes
BK04	E 83rd St & Foster Ave	Yes	M-1	Res <400'	No	17,038	10	Active rail	No	9600	16	2	Non-M	No
BK27	Bayridge Marine	Yes	M-2	Residnt<400'	No	10,183	0	Intermodal	Yes	800	25	3	Non-M	Yes
BK30	Sunset Park/Bush Terminal	Yes	M-3	All indust	Yes	21,815	1	Intermodal	Yes	3200	26	5	Non-M	Yes
BK31	Kentile	Yes	M-2	Res 400-800'	No	10,827	9	No rail	Yes	1600	16	3	Market	Yes
BK32	S. Brooklyn Marine Terminal	Yes	M-3	All indust	No	11,154	1	No rail	Yes	3200	35	3	Non-M	Yes
BK34	Erie Basin/DOS Site	Yes	M-3	Residnt<400'	No	9,648	15	No rail	Yes	3600	16	1	Non-M	Yes
BX06	Zerega Industrial Park	Yes	M-1	Res<400'	No	18,240	6	No rail	No	2400	10	1	Market	No
BX07	Oakpoint Yards	Yes	M-3	All indust	No	5,203	2	Intermodal	Yes	3200	27	4	Mark/No	Yes
BX18	Barretto Point	Yes	M-3	All indust	No	224	0	No rail	Yes	7000	15	3	Non-M	Yes
BX50	Harlem Rail Yards	Yes	M-3	All indust	No	1,628	1	Active rail	No	600	19	3	Non-M	Yes
QN05	Maspeth	Yes	M-3	All indust	No	378	0	No rail	No	3600	24	1	Market	Yes
QN07	Phelps Dodge	Yes	M-3	Res 400-800	No	378	0	Intermodal	Yes	2200	30	5	Non-M	Yes
SI06	Newark Bay	Yes	M-2	Res 400-800'	Yes	4,009	0	No rail	Yes	6400	45	4	Market	Yes
SI15	Forest Avenue	Yes	M-2	All indust	Yes	3,510	0	No rail	No	1000	10	2	Market	Yes
SI17	Rossville Marine Terminal	No	M-3/2	All indust	No	0	0	No rail	Yes	1800	65	2	Market	No
SI21	Bement Ave	No	M-3	Res<400'	No	7,830	4	Intermodal	Yes	8800	19	2	Non-M	No
SI22	Howland Hook	Yes	M-3	All indust	No	817	0	Intermodal	Yes	6400	35	3	Non-M	No
SI23	Baxter St. S. of Cady Ave.	No	M-1	All indust	No	2,699	2	No rail	No	2200	12	1	Non-M	No
SI24	Claude St/Burr Ave	No	M-1	All indust	No	2,699	2	No rail	No	1600	12	1	Non-M	No
SI32	Drumgoole Rd	No	M-1	All indust	Yes	2,699	2	No rail	No	100	15	1	Non-M	No
SI35	Arthur Kill	No	M-3	All indust	Yes	1,619	0	Intermodal	Yes	0	140	3	Market	No
SI36	Proctor & Gamble	Yes	M-3	All indust	No	817	0	Active rail	No	2600	35	3	Market	Yes

Raw Data for Development Time Criteria.

NO.	SITE	Occupant Relocation	Dredging Permits	Extensive Approvals	Fed Land Acquisition	Extensive Cleanup	Multi-story Demolition	Total	Score
BK01	Revere Sugar		x				x	2	3
BK02	Eastern District Terminal		x				x	2	3
BK04	E 83rd St & Foster Ave			x			x	2	3
BK27	Bayridge Marine		x	x			x	3	2
BK30	Sunset Park/Bush Terminal	x	x	x		x	x	5	1
BK31	Kentile		x	x			x	3	2
BK32	S. Brooklyn Marine Terminal		x	x			x	3	2
BK34	Erie Basin/DOS Site			x				1	4
BX06	Zerega Industrial Park			x				1	4
BX07	Oakpoint Yards		x	x		x	x	4	1
BX18	Barretto Point		x	x		x		3	2
BX50	Harlem Rail Yards			x		x	x	3	2
QN05	Maspeth						x	1	4
QN07	Phelps Dodge		x	x	x	x	x	5	1
SI06	Newark Bay		x	x		x	x	4	1
SI15	Forest Avenue			x			x	2	3
SI17	Rossville Marine Terminal					x	x	2	3
SI21	Bement Ave			x		x		2	3
SI22	Howland Hook		x	x		x		3	2
SI23	Baxter St. S. of Cady Ave.			x				1	4
SI24	Claude St/Burr Ave			x				1	4
SI32	Drumgoole Rd			x				1	4
SI35	Arthur Kill		x			x	x	3	2
SI36	Proctor & Gamble		x			x	x	3	2

Conversion of Raw Data to Scores for Ranking Screened Sites.

NO.	SITE	INDUST				SENS				PROX			CAP		ELGIB FOR INCEN
		WATER	SITE	ADJ	NAT	RES	RECE	RAIL	BARG	TRUC	SITE	DEV	COST		
		DESIG	ZONE	ZONE	RES	DENS	NRBY	ACCE	ACCE	ROUT	EXPAN	TIME	ACQU		
BK01	Revere Sugar Plant	2	1	1	2	3	1	1	2	1	2	3	1	2	
BK02	Eastern District Terminal	1	3	2	2	3	1	1	2	1	3	3	1	2	
BK04	E 83rd St & Foster Ave	2	1	1	2	2	1	3	1	1	2	3	2	1	
BK27	Bayridge Marine	2	2	1	2	3	4	4	2	3	3	2	2	2	
BK30	Sunset Park/Bush Terminal	2	3	4	1	1	3	4	2	1	3	1	2	2	
BK31	Kentile	2	2	2	2	3	1	1	2	2	2	2	1	2	
BK32	S. Brooklyn Marine Terminal	2	3	4	2	3	3	1	2	1	4	2	2	2	
BK34	DOS Site/Erie Basin	2	3	1	2	4	1	1	2	1	2	4	2	2	
BX06	Zerega Industrial Park	2	1	1	2	2	2	1	1	1	1	4	1	1	
BX07	Oakpoint Yards	2	3	4	2	4	3	4	2	1	3	1	1	2	
BX18	Barretto Point	2	3	4	2	5	4	1	2	1	2	2	2	2	
BX50	Harlem Rail Yards	2	3	4	2	5	3	3	1	3	2	2	2	2	
QN05	Maspeth	2	3	4	2	5	4	1	1	1	3	4	1	2	
QN07	Phelps Dodge	2	3	2	2	5	4	4	2	1	3	1	2	2	
SI06	Newark Bay	2	2	2	1	5	4	1	2	1	4	1	1	2	
SI15	Forest Avenue	2	2	4	1	5	4	1	1	3	1	3	1	2	
SI17	Rossville Marine Terminal	1	2	4	2	5	4	1	2	2	4	3	1	1	
SI21	Bement Ave	1	3	1	2	4	3	4	2	1	2	3	2	1	
SI22	Howland Hook	2	3	4	2	5	4	4	2	1	4	2	2	1	
SI23	Baxter St. S. of Cady Ave.	1	1	4	2	5	3	1	1	1	2	4	2	1	
SI24	Claude St/Burr Ave	1	1	4	2	5	3	1	1	2	2	4	2	1	
SI32	Drumgoole Rd	1	1	4	1	5	3	1	1	3	2	4	2	1	
SI35	Arthur Kill	1	3	4	1	5	4	4	2	3	4	2	1	1	
SI36	Proctor & Gamble	2	3	4	2	5	4	3	1	1	4	2	1	2	

Table 2-15

Ranking of 24 NYC Sites for Bioconversion Facility.

WEIGHTED PERCENT PERFECT RAW SCORE		3.85%	9.89%	9.34%	10.99%	12.09%	10.99%	4.40%	4.95%	10.99%	4.40%	10.44%	4.95%	2.75%	100%
		2	3	4	2	5	4	4	2	3	4	4	2	2	
NO.	SITE	INDUST WATER DESIGN	SITE ZONE	ADJ ZONE	NAT RES	RES DENS	SENS RECEP NRBY	RAIL ACCES	BARGE ACCES	PROX TRUCK ROUTE	SITE EXPAN	DEV TIME	CAP COST ACQ	ELGIB FOR INCEN	PAIRED COMPAR SCORE PRCNT
BX50	Harlem Rail Yards	2	3	4	2	5	3	3	1	3	2	2	2	2	80.8
SI35	Arthur Kill	1	3	4	1	5	4	4	2	3	4	2	1	1	79.4
SI22	Howland Hook	2	3	4	2	5	4	4	2	1	4	2	2	1	79.1
QN05	Maspeth	2	3	4	2	5	4	1	1	1	3	4	1	2	77.4
SI36	Proctor & Gamble	2	3	4	2	5	4	3	2	1	4	2	1	2	76.7
SI17	Rossville Marine Termin	1	2	4	2	5	4	1	2	2	4	3	1	1	75.3
BX18	Barretto Point	2	3	4	2	5	4	1	2	1	2	2	2	2	74.6
BK27	Bayridge Marine	2	2	1	2	3	4	4	2	3	3	2	2	2	73.1
SI15	Forest Avenue	2	2	4	1	5	4	1	1	3	1	3	1	2	72.2
QN07	Phelps Dodge	2	3	2	2	5	4	4	2	1	3	1	2	2	71.9
SI32	Drumgoole Rd	1	1	4	1	5	3	1	1	3	2	4	2	1	67.8
SI24	Claude St/Burr Ave	1	1	4	2	5	3	1	1	2	2	4	2	1	67.2
BK32	S. Brooklyn Marine Term	2	3	4	2	3	3	1	2	1	4	2	2	2	65.3
BX07	Oakpoint Yards	2	3	4	2	4	3	4	2	1	3	1	1	2	63.3
SI23	Baxter St. S. of C	1	1	4	2	5	3	1	1	1	2	4	2	1	62.2
SI21	Bement Ave	1	3	1	2	4	3	4	2	1	2	3	2	1	60.7
BK34	DOS Site/Erie Basin	2	3	1	2	4	1	1	2	1	2	4	2	2	60.6
SI06	Newark Bay	2	2	2	1	5	4	1	2	1	4	1	1	2	56.1
BK30	Sunset Park/Bush Termi	2	3	4	1	1	3	4	2	1	3	1	2	2	54.0
BK02	Eastern District Terminal	1	3	2	2	3	1	1	2	1	3	3	1	2	53.8
BK31	Kentile	2	2	2	2	3	1	1	2	2	2	2	1	2	51.5
BK01	Revere Sugar	2	1	1	2	3	1	1	2	1	2	3	1	2	44.7
BK04	E 83rd St & Foster Ave	2	1	1	2	2	1	3	1	1	2	3	2	1	42.8
BX06	Zerega Industrial Park	2	1	1	2	2	2	1	1	1	1	4	1	1	41.5

Scale 1:15,624 (at center)

1000 Feet

500 Meters

Figure 2-6

SITE LOCATION MAP
Procter & Gamble
SITE SI-36

Table 2-16

Fact Sheet for Site SI 36, Procter and Gamble.

BOROUGH: Staten Island

STREET ADDRESS: Western Avenue and Richmond Terrace

BLOCK/LOT: 1400, 1309, 1338

ZONING: M3-1, heavy manufacturing

VALUE: \$38 million

EXISTING BUILDINGS: Yes

LOCATION: Near Port Ivory

SIZE OF LAND: 125 acres

CURRENT USE: Vacant

ROAD ACCESS: I-278 is the nearest through truck route.

RAIL ACCESS: Active rail on site

WATERFRONT ACCESS: Yes.

UTILITIES: Electric, water, gas, sewers. A boiler for steam exists on the site.

LAND USE HISTORY: For 83 years, the site was used by Procter and Gamble to produce soaps, laundry detergent, liquid cleaners, and orange juice. Their factory closed in February 1992.

Scale 1:15,624 (at center)

1000 Feet

500 Meters

Figure 2-7

SITE LOCATION MAP
Arthur Kill
SITE SI-35

Table 2-17

Fact Sheet for Site SI 35, Arthur Kill.

BOROUGH: Staten Island

STREET ADDRESS: West Shore Expressway

BLOCK/LOT: 2705, 2758

ZONING: M3-1, heavy manufacturing

VALUE: Not appraised yet

EXISTING BUILDINGS: Yes

LOCATION: Along the Arthur Kill, on the west shore of Staten Island

SIZE OF LAND: 140 acres

CURRENT USE: Con Edison uses a portion of the site for a power plant.

ROAD ACCESS: The nearest through truck route is Route 440.

RAIL ACCESS: Rail exists on the site, and connects to intermodal means such as barge and truck.

WATERFRONT ACCESS: Yes

UTILITIES: Electric, water, and sewer are available. There is also a gas pipeline on the site for Con Edison's use. Steam can be gotten from the power plant, although it is only operational about 30% of the time.

LAND USE HISTORY: The site continues to be used for a power plant. In the past it has also been used for dumping coal ash.

SECTION 3

CAPITAL AND OPERATING COST ESTIMATES FOR PREFERRED SITES

This section refines the capital costs for a 500-tpd plant constructed at either of two preferred sites, Proctor and Gamble (P&G) and Arthur Kill. It addresses the options of on-site and off-site oxidation of the solids by-product.

The capital costs for the two sites in terms of the process island, balance of plant, site improvements, and land costs are shown in Tables 3-1 through 3-6 for the P&G site and in Tables 3-7 through 3-12 for the Arthur Kill site. Supporting information for these costs is found in the Appendix as Attachments 3-1 through 3-4.

The cost of a complete plant (including solids by-product oxidation) at the P&G site is \$134.5 million, whereas the comparable cost at the Arthur Kill site is \$128.8 million. Similarly, the cost of a plant without on-site oxidation at the P&G site is \$101 million, compared to the cost of the Arthur Kill site of \$95.4 million. The principal cost difference between the two sites is the cost of land. The Arthur Kill site is owned by Con Edison, which intends to cooperate with developing a New York City project and will make the site available for virtually no cost.

Tables 3-13 through 3-16 show more detailed breakdown of capital costs in terms of direct and indirect costs.

The operating costs for the plants are reflected in Section 4 (financial pro formas).

Table 3-1

Budget Estimate for Biomass-to-Ethanol Facility
 With On-site Oxidation.
 Part 1 - NY City Project Evaluation.
 Site - Proctor & Gamble

SUMMARY

DESCRIPTION	TOTAL COST
PROCESS ISLAND	\$68,192,000
BALANCE OF PLANT	\$49,960,900
SITE IMPROVEMENT	\$11,345,400
LAND COST	\$5,000,000
TOTAL PRESENT PLANT COST	\$134,498,300

Table 3-2

Budget Estimate for Biomass-to-Ethanol Facility
 With On-site Oxidation.
 Part 1 - NY City Project Evaluation (500 tpd) - 10 Acre.
 Site - Proctor & Gamble

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
BALANCE OF PLANT				
Building (Admin.,Control,Lab.)	1	ls	\$1,620,000	\$1,620,000
Maint./Shop Bldg.	1	ls	\$1,470,000	\$1,470,000
Plant Air Supply	1	ls	\$400,000	\$400,000
Aerobic Watertreatment	1	ls	\$1,500,000	\$1,500,000
Chilled/Cooling Water Supply	1	ls	\$700,000	\$700,000
Boiler Feed Water	1	ls	\$400,000	\$400,000
Solid Oxidation/Power/Distribution	1	ls	\$30,000,000	\$30,000,000
Boiler Package	1	ls	\$1,000,000	\$1,000,000
Steam Turbine	1	ls	\$250,000	\$250,000
Sub-Total Cost				\$37,340,000
Start-up Cost	1	ls	\$560,100	\$560,100
Engineering - 10%	1	ls	\$3,734,000	\$3,734,000
SUB TOTAL				\$41,634,100
CONTINGENCY - 20%	1	ls	\$8,326,820	\$8,326,820
TOTAL PRESENT DAY COST - BOP				\$49,960,920

Table 3-3

Budget Estimate for Biomass-to-Ethanol Facility with On-site Oxidation.

Part 1 - NY City Project Evaluation - Site Improvement Requirements (500 tpd) - 10 Acre.

Site - Proctor & Gamble

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
Demolition	1	ls	\$500,000	\$500,000
Site Clearing & Grubbing	1	ls	\$50,000	\$50,000
Sewer and Drainage	1	ls	\$915,000	\$915,000
Access Roadways and Parking	1	ls	\$800,000	\$800,000
Piling	1	ls	\$2,000,000	\$2,000,000
Dewatering	1	ls	\$500,000	\$500,000
Make-up Water & Potable Water	1	ls	\$600,000	\$600,000
Sewer Hook-ups for Bathroom	1	ls	\$100,000	\$100,000
Fire Water	1	ls	\$1,400,000	\$1,400,000
Sprinkler System	1	ls	\$1,000,000	\$1,000,000
Fencing	1	ls	\$70,000	\$70,000
Gas Pipeline (Allow.)	1	ls	\$150,000	\$150,000
Site Lighting	1	ls	\$510,000	\$510,000
Sub-Total Cost				\$8,595,000
Engineering - 10%	1	ls	\$859,500	\$859,500
Sub-Total Cost				\$9,454,500
CONTINGENCY - 20%	1	ls	\$1,890,900	\$1,890,900
TOTAL PRESENT DAY COST				\$11,345,400

Assumption: No Environmental Remediation on Site.

Table 3-4

Budget Estimate for Biomass-to-Ethanol Facility without Oxidation.
Part 1 - NY City Project Evaluation.
Site - Proctor & Gamble

SUMMARY

DESCRIPTION	TOTAL COST
PROCESS ISLAND	\$68,192,000
BALANCE OF PLANT	\$16,510,900
SITE IMPROVEMENT	\$11,345,400
LAND COST	\$5,000,000
TOTAL PRESENT PLANT COST	\$101,048,300

Table 3-5

Budget Estimate for Biomass-to-Ethanol Facility without Oxidation.

Part 1 - NY City Project Evaluation (500 tpd) - 10 Acre.

Site - Proctor & Gamble

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
BALANCE OF PLANT				
Building (Admin.,Control,Lab.)	1	ls	\$1,620,000	\$1,620,000
Maint./Shop Bldg.	1	ls	\$1,470,000	\$1,470,000
Plant Air Supply	1	ls	\$400,000	\$400,000
Aerobic Watertreatment	1	ls	\$1,500,000	\$1,500,000
Chilled/Cooling Water Supply	1	ls	\$700,000	\$700,000
Boiler Feed Water	1	ls	\$400,000	\$400,000
Power & Distribution	1	ls	\$5,000,000	\$5,000,000
Boiler Package	1	ls	\$1,000,000	\$1,000,000
Steam Turbine	1	ls	\$250,000	\$250,000
Sub-Total Cost				\$12,340,000
Start-up Cost	1	ls	\$185,100	\$185,100
Engineering - 10%	1	ls	\$1,234,000	\$1,234,000
SUB TOTAL				\$13,759,100
CONTINGENCY - 20%	1	ls	\$2,751,820	\$2,751,820
TOTAL PRESENT DAY COST - BOP				\$16,510,920

Table 3-6

Budget Estimate for Biomass-to-Ethanol Facility without Site Oxidation.

Part 1 - NY City Project Evaluation - Site Improvement Requirements (500tpd) - 10 Acre.

Site - Proctor & Gamble

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
Demolition	1	ls	\$500,000	\$500,000
Site Clearing & Grubbing	1	ls	\$50,000	\$50,000
Sewer and Drainage	1	ls	\$915,000	\$915,000
Access Roadways and Parking	1	ls	\$800,000	\$800,000
Piling	1	ls	\$2,000,000	\$2,000,000
Dewatering	1	ls	\$500,000	\$500,000
Make-up Water & Potable Water	1	ls	\$600,000	\$600,000
Sewer Hook-ups for Bathroom	1	ls	\$100,000	\$100,000
Fire Water	1	ls	\$1,400,000	\$1,400,000
Sprinkler System	1	ls	\$1,000,000	\$1,000,000
Fencing	1	ls	\$70,000	\$70,000
Gas Pipeline (Allow.)	1	ls	\$150,000	\$150,000
Site Lighting	1	ls	\$510,000	\$510,000
Sub-Total Cost				\$8,595,000
Engineering - 10%	1	ls	\$859,500	\$859,500
Sub-Total Cost				\$9,454,500
CONTINGENCY - 20%	1	ls	\$1,890,900	\$1,890,900
TOTAL PRESENT DAY COST				\$11,345,400

Assumption: No Enviromental Remediation on Site.

Table 3-7

Budget Estimate for Biomass-to-Ethanol Facility with On-Site Oxidation.
Part 1 - NY City Project Evaluation.
Site - Arthur Kill

SUMMARY	
DESCRIPTION	TOTAL COST
PROCESS ISLAND	\$68,192,000
BALANCE OF PLANT	\$49,960,900
SITE IMPROVEMENT	\$10,685,000
LAND COST	\$0
TOTAL PRESENT PLANT COST	\$128,837,900

Table 3-8

Budget Estimate for Biomass-to-Ethanol Facility with On-Site Oxidation.

Part 1 - NY City Project Evaluation (500 tpd) - 10 Acre.

Site - Arthur Kill

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
BALANCE OF PLANT				
Building (Admin.,Control,Lab.)	1	ls	\$1,620,000	\$1,620,000
Maint./Shop Bldg.	1	ls	\$1,470,000	\$1,470,000
Plant Air Supply	1	ls	\$400,000	\$400,000
Aerobic Watertreatment	1	ls	\$1,500,000	\$1,500,000
Chilled/Cooling Water Supply	1	ls	\$700,000	\$700,000
Boiler Feed Water	1	ls	\$400,000	\$400,000
Solid Oxidation/Power & Distribution	1	ls	\$30,000,000	\$30,000,000
Boiler Package	1	ls	\$1,000,000	\$1,000,000
Steam Turbine	1	ls	\$250,000	\$250,000
Sub-Total Cost				\$37,340,000
Start-up Cost	1	ls	\$560,100	\$560,100
Engineering - 10%	1	ls	\$3,734,000	\$3,734,000
SUB TOTAL				\$41,634,100
CONTINGENCY - 20%	1	ls	\$8,326,820	\$8,326,820
TOTAL PRESENT DAY COST - BOP				\$49,960,920

Table 3-9

Budget Estimate for Biomass-to-Ethanol Facility with On-Site Oxidation.

Part 1 - NY City Project Evaluation - Site Improvement Requirements (500 tpd) - 10 Acre.

Site - Arthur Kill

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
Demolition	1	ls	\$0	\$0
Site Clearing & Grubbing	1	ls	\$50,000	\$50,000
Sewer and Drainage	1	ls	\$915,000	\$915,000
Access Roadways and Parking	1	ls	\$800,000	\$800,000
Piling	1	ls	\$2,000,000	\$2,000,000
Dewatering	1	ls	\$500,000	\$500,000
Make-up Water & Potable Water	1	ls	\$600,000	\$600,000
Sewer Hook-ups for Bathroom	1	ls	\$100,000	\$100,000
Fire Water	1	ls	\$1,400,000	\$1,400,000
Sprinkler System	1	ls	\$1,000,000	\$1,000,000
Fencing	1	ls	\$70,000	\$70,000
Gas Pipeline (Allow.)	1	ls	\$150,000	\$150,000
Site Lighting	1	ls	\$510,000	\$510,000
Sub-Total Cost				\$8,095,000
Engineering - 10%	1	ls	\$809,500	\$809,500
Sub-Total Cost				\$8,904,500
CONTINGENCY - 20%	1	ls	\$1,780,900	\$1,780,900
TOTAL PRESENT DAY COST				\$10,685,400

Assumption: No Environmental Remediation on Site.

Table 3-10

Budget Estimate for Biomass-to-Ethanol Facility without Oxidation.
Part 1 - NY City Project Evaluation.
Site - Arthur Kill

SUMMARY

DESCRIPTION	TOTAL COST
PROCESS ISLAND	\$68,192,000
BALANCE OF PLANT	\$16,510,000
SITE IMPROVEMENT	\$10,685,000
LAND COST	\$0
TOTAL PRESENT PLANT COST	\$95,387,000

Table 3-11

Budget Estimate for Biomass-to-Ethanol Facility without Oxidation.

Part 1 - NY City Project Evaluation (500 tpd) - 10 Acre.

Site - Arthur Kill

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
BALANCE OF PLANT				
Building (Admin.,Control,Lab.)	1	ls	\$1,620,000	\$1,620,000
Maint./Shop Bldg.	1	ls	\$1,470,000	\$1,470,000
Plant Air Supply	1	ls	\$400,000	\$400,000
Aerobic Watertreatment	1	ls	\$1,500,000	\$1,500,000
Chilled/Cooling Water Supply	1	ls	\$700,000	\$700,000
Boiler Feed Water	1	ls	\$400,000	\$400,000
Power & Distribution	1	ls	\$5,000,000	\$5,000,000
Boiler Package	1	ls	\$1,000,000	\$1,000,000
Steam Turbine	1	ls	\$250,000	\$250,000
Sub-Total Cost				\$12,340,000
Start-up Cost	1	ls	\$185,100	\$185,100
Engineering - 10%	1	ls	\$1,234,000	\$1,234,000
SUB TOTAL				\$13,759,100
CONTINGENCY - 20%	1	ls	\$2,751,820	\$2,751,820
TOTAL PRESENT DAY COST - BOP				\$16,510,920

Table 3-12

Budget Estimate for Biomass-to-Ethanol Facility without Oxidation.

Part 1 - NY City Project Evaluation - Site Improvement Requirements (500 tpd) - 10 Acre.

Site - Arthur Kill

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
Demolition	1	ls	\$0	\$0
Site Clearing & Grubbing	1	ls	\$50,000	\$50,000
Sewer and Drainage	1	ls	\$915,000	\$915,000
Access Roadways and Parking	1	ls	\$800,000	\$800,000
Piling	1	ls	\$2,000,000	\$2,000,000
Dewatering	1	ls	\$500,000	\$500,000
Make-up Water & Potable Water	1	ls	\$600,000	\$600,000
Sewer Hook-ups for Bathroom	1	ls	\$100,000	\$100,000
Fire Water	1	ls	\$1,400,000	\$1,400,000
Sprinkler System	1	ls	\$1,000,000	\$1,000,000
Fencing	1	ls	\$70,000	\$70,000
Gas Pipeline (Allow.)	1	ls	\$150,000	\$150,000
Site Lighting	1	ls	\$510,000	\$510,000
Sub-Total Cost				\$8,095,000
Engineering - 10%	1	ls	\$809,500	\$809,500
Sub-Total Cost				\$8,904,500
CONTINGENCY - 20%	1	ls	\$1,780,900	\$1,780,900
TOTAL PRESENT DAY COST				\$10,685,400

Assumption: No Environmental Remediation on Site.

Table 3-13

Biomass-to-Ethanol Facility
Cost Estimate.

Proctor & Gamble
W/ Oxidizer
(in millions)

SITWORK	\$8.8
CONCRETE	\$8.7
STRUCTURAL	\$5.1
EQUIPMENT	\$28.3
PIPING	\$9.4
ELECTRICAL	\$11.2
BUILDINGS	\$2.4
INSTRUMENTS	\$3.2
INSULATION	\$2.3
LAND	\$5.0
S/T	\$84.4
CONST. INDIRECTS	\$11.4
START-UP	\$0.6
CONSTRUCTION MGT.	\$2.0
ENGINEERING	\$12.1
CONTINGENCY	\$19.3
ENV. PERMITTING	\$3.3
INSURANCE	\$0.6
TAXES	\$0.9
PLANT CLOSURE	\$0.0
S/T	\$50.2
TOTAL	\$134.5

Table 3-14

Biomass-to-Ethanol Facility
Cost Estimate.

Proctor & Gamble
W/O Oxidizer
(in millions)

SITework	\$8.3
CONCRETE	\$6.5
STRUCTURAL	\$3.8
EQUIPMENT	\$19.6
PIPING	\$5.1
ELECTRICAL	\$7.3
BUILDINGS	\$2.4
INSTRUMENTS	\$2.7
INSULATION	\$1.8
LAND	\$5.0
S/T	\$62.6
CONST. INDIRECTS	\$8.1
START-UP	\$0.2
CONSTRUCTION MGT.	\$2.0
ENGINEERING	\$9.6
CONTINGENCY	\$13.7
ENV. PERMITTING	\$3.3
INSURANCE	\$0.6
TAXES	\$0.9
PLANT CLOSURE	\$0.0
S/T	\$38.4
TOTAL	\$101.0

Table 3-15

Biomass-to-Ethanol Facility
Cost Estimate.

Arthur Kill
W/ Oxidizer
(in millions)

SITEWORK	\$8.3
CONCRETE	\$8.7
STRUCTURAL	\$5.1
EQUIPMENT	\$28.3
PIPING	\$9.4
ELECTRICAL	\$11.2
BUILDINGS	\$2.4
INSTRUMENTS	\$3.2
INSULATION	\$2.3
LAND	\$0.0
S/T	\$78.9
CONST. INDIRECTS	\$11.4
START-UP	\$0.6
CONSTRUCTION MGT.	\$2.0
ENGINEERING	\$12.1
CONTINGENCY	\$19.1
ENV. PERMITTING	\$3.3
INSURANCE	\$0.6
TAXES	\$0.9
PLANT CLOSURE	\$0.0
S/T	\$49.9
TOTAL	\$128.8

Table 3-16

Biomass-to-Ethanol Facility
Cost Estimate.

Arthur Kill
W/O Oxidizer
(in millions)

SITWORK	\$7.9
CONCRETE	\$6.5
STRUCTURAL	\$3.8
EQUIPMENT	\$19.6
PIPING	\$5.1
ELECTRICAL	\$7.3
BUILDINGS	\$2.4
INSTRUMENTS	\$2.7
INSULATION	\$1.8
LAND	\$0.0
S/T	\$57.2
CONST. INDIRECTS	\$8.0
START-UP	\$0.2
CONSTRUCTION MGT.	\$2.0
ENGINEERING	\$9.6
CONTINGENCY	\$13.5
ENV. PERMITTING	\$3.3
INSURANCE	\$0.6
TAXES	\$0.9
PLANT CLOSURE	\$0.0
S/T	\$38.1
TOTAL	\$95.3

SECTION 4

FINANCIAL EVALUATION FOR PREFERRED SITES

FINANCIAL PRO FORMAS

Introduction

Stone & Webster Development Corporation (SWDC) has evaluated the biomass-to-ethanol project for financial viability and risk from the point of view of a project developer. The project was evaluated by determining the pricing necessary to generate revenues that would provide an acceptable return on owner's equity, and comparing the required pricing to expected market prices.

In this section, the project and its components (i.e., feedstock, output, sizes) are described to the extent necessary for input to the financial analysis. The financial structure of a potential investing company is then defined and its revenue requirements from tipping fees or from ethanol sales are determined, which in turn yield the required return on equity for the developer/equity partners. A financial cash flow statement (pro forma) is presented to demonstrate profitability. Finally, the results of sensitivity analyses are presented to provide assessments of project risks.

Project Description

A Master Input List was set up to accept data in the form used by the pro forma analysis for numerous cases. This table (Table 4-1) allows a side-by-side comparison of data for various sizes, feedstock, product options, etc.

The first page of the Master Input Table covers twelve options evaluated for wastepaper as the feedstock. The data needed for the evaluation included plant size, performance, capital cost, and operating costs. Two sizes were evaluated to determine the effect of economies of scale: 500 tpd on a dry basis (595 tpd wet, as-tipped), and 1000 tpd dry (1190 tpd wet). Within each size,

two basic plant configurations were distinguished. One configuration is a biomass facility with a gasification plant that will convert the lignin produced by the conversion process to power and steam to be used within the facility and excess power, which is sold off-site to a utility (Options 1 and 7). The other configuration is a biomass facility that disposes of the waste lignin off-site and purchases all facility energy needs from local utilities (Options 2 and 8).

The shading on Table 4-1 indicates direct data input. Nearly all of the data was provided by other study participants via Stone & Webster Engineering Corporation. Stone & Webster Development Corporation provided some unit pricing, including average annual labor rate, maintenance cost, power purchase and sales rates, water and sewer charges, and natural gas price.

The next four options (3 to 6 and 9 to 12) vary two parameters: market price for ethanol, and lignin disposal cost. The market price for ethanol is expected to fall within a range of \$1.20 to \$1.50/gal. This is the price an end-user or blender will pay and does not reflect the \$0.55/gal tax credit that they can take. Lignin disposal is expected to cost the facility from zero (whereby a purchase price exactly offsets the transportation cost) to \$50/ton.

In all 12 wastepaper options, no price was set for the feedstock, either as a tipping fee or as an expense. The value of the feedstock is the variable to be solved in the pro forma evaluation.

On the second page of Table 4-1 the same 12-option arrangement was set up using wood waste as feedstock (Options 13-24). The differences between the two facilities were ash and lignin production rates, power production with gasification, power and natural gas consumption without gasification, and water consumption. In addition, rather than setting an ethanol price and solving for the value of the feedstock, the market value of wood waste was specified, leaving the value of ethanol to be determined. This reorientation was done to incorporate the results of research into sources and prices of feedstock that was performed concurrently with the financial evaluation. The research revealed that, rather than receiving a tipping fee for the waste, the facility would more likely have to pay \$20 to \$40/ton for the feedstock.

The options are numbered and briefly described as follows:

- wastepaper**
1. 500 tpd (dry), with gasification, ethanol @ \$1.20/gal
 2. 500 tpd, without gasification, lignin disposal @ \$50/ton, ethanol @ \$1.20/gal
 3. 500 tpd, with gasification, ethanol @ \$1.50/gal
 4. 500 tpd, without gasification, lignin disposal @ \$50/ton, ethanol @ \$1.50/gal
 5. 500 tpd, without gasification, lignin disposal @ \$0/ton, ethanol @ \$1.20/gal
 6. 500 tpd, without gasification, lignin disposal @ \$0/ton, ethanol @ \$1.50/gal
 7. 1000 tpd, with gasification, ethanol @ \$1.20/gal
 8. 1000 tpd, without gasification, lignin disposal @ \$50/ton, ethanol @ \$1.20/gal
 9. 1000 tpd, with gasification, ethanol @ \$1.50/gal
 10. 1000 tpd, without gasification, lignin disposal @ \$50/ton, ethanol @ \$1.50/gal
 11. 1000 tpd, without gasification, lignin disposal @ \$0/ton, ethanol @ \$1.20/gal
 12. 1000 tpd, without gasification, lignin disposal @ \$0/ton, ethanol @ \$1.50/gal

wastewood	13.	500 tpd (dry), with gasification, wood @ \$20/ton
	14.	500 tpd, without gasification, lignin disposal @ \$50/ton, wood @ \$20/ton
	15.	500 tpd, with gasification, wood @ \$40/ton
	16.	500 tpd, without gasification, lignin disposal @ \$50/ton, wood @ \$40/ton
	17.	500 tpd, without gasification, lignin disposal @ \$0/ton, wood @ \$20/ton
	18.	500 tpd, without gasification, lignin disposal @ \$0/ton, wood @ \$40/ton
	19.	1000 tpd, with gasification, wood @ \$20/ton
	20.	1000 tpd, without gasification, lignin disposal @ \$50/ton, wood @ \$20/ton
	21.	1000 tpd, with gasification, wood @ \$40/ton
	22.	1000 tpd, without gasification, lignin disposal @ \$50/ton, wood @ \$40/ton
	23.	1000 tpd, without gasification, lignin disposal @ \$0/ton, wood @ \$20/ton
	24.	1000 tpd, without gasification, lignin disposal @ \$0/ton, wood @ \$40/ton

The specific case data evaluated were automatically transferred to the pro forma evaluation when the analyst entered an Option Number on Table 4-2, Case Input. The Case Input table documents the assumptions and input used in the analysis for each option evaluated. Most of the schedule, economic, and financial input was unchanged among the options evaluated and was entered on this table once at the beginning of the screening evaluation by the analyst.

Table 4-2 is illustrated with data for Option 1, a 595-tpd (wet) plant with gasification, using wastepaper as the feedstock, and selling ethanol for \$1.20/gal. Much of the data on this table is repeated from the Master Input Table, but is tallied into total capital and operating costs. The total capital cost includes escalation and interest charges to yield a total installed cost as of the

commercial operation date. In this case, the total present day cost of \$139,898,000 increased to \$168,598,000 due to escalation and interest. The operating costs are tallied as both fixed and variable annual costs and as costs per gallon of ethanol produced. For Option 1, the annual operating budget is over \$7 million for fixed costs, including labor, maintenance, and insurance, and over \$3 million for variable costs, including ash disposal, chemicals, water, and sewer charges. The corresponding unit costs are \$0.49/gal and \$0.22/gal for a total of \$0.71/gal of ethanol produced.

Table 4-2 also includes input for schedule, economic data such as inflation, escalation, and taxes, and financial data. The commercial operation date was assumed to be 4 years from now, which includes 2 years for construction. The economic life is 20 years per NYSERDA's requirement. A 10-year life was also evaluated; the results of which are presented in the subsection Sensitivity Analysis. The plant is expected to operate at full capacity 83 percent of the time. Assumptions for long-term inflation at 4 percent and nominal escalation ranging from 4 percent for most cost components to 5.5 percent for natural gas were included in this table.

Taxes included federal and state income taxes at 35 percent and 9 percent, respectively, and 8.25 percent gross receipts tax, which included both state and city rates. Property taxes were not included at this time because this would be site-specific. Tax depreciation was determined separately for several categories: buildings and structures, biomass conversion equipment, and balance of plant, in accordance with the 1986 Tax Reform Act.

Additional tax and economic development incentives were considered separately under the sensitivity analysis. Entering an "affirmative" on this table incorporates the economic incentives listed on Table 4-5.

Financial Analysis

Financial Structure. Developers of third party projects will generally seek to avoid carrying debt for the project on their own corporate balance sheets. They will attempt to create a financial structure which stands by itself, with debt backed only on the project's physical assets

and the strength of its contractual relationships. This debt would be "nonrecourse" to the developer, in that lenders cannot seek payment from the developer in the event of a project failure. To a large extent, the credit of the purchaser of the project's product and of the feedstock supplier are the basis for financing, because it is these parties' commitments to make payments on a take-if-tendered basis that assures the lender that funds will be available for debt service.

Some projects are developed with long-term feedstock (fuel) and output (i.e., power, steam) contracts that provide some cash flow certainty; this project may be able to contract long-term for feedstock (wastepaper, wood waste) but may not have a long-term contract for the output (ethanol), thus increasing the project's financial risk. Other contractual obligations ensure that the facility will be available: the lump-sum turnkey contractor guarantees that the facility will be built at a certain cost and date and that it will perform as required initially; the operation contractor guarantees that the facility will be adequately maintained so that the service can continue to be tendered.

When the contracting parties are financially strong and the project is basically sound, a high level of financial leverage is possible. Many projects in the process and energy sectors are financed with debt covering 80 percent or more of project cost. These are based mostly on the financial strength of the entity purchasing the project's output. In the case of an ethanol plant, the degree of financial leverage that can be obtained will depend on the strength of the entities supplying waste for feedstock and purchasing the ethanol. A debt level of 80 percent would provide for enough equity to mitigate these risks to some extent and is typical of many nonrecourse financings.

Lenders generally are limiting loan terms to about 10 to 15 years for financing most projects. This is shorter than the 20-year economic life being evaluated and results in the need for higher revenues during the loan period. In general, the loan amortization period must be 1 to 2 years shorter than the term of the product off-take and feedstock contracts. Because ethanol is a commodity, the revenues for this project will be unit prices (\$/gal, \$/ton, etc) set by the marketplace; little opportunity exists to structure revenues to alleviate cash flow constraints

during this period. The developer will probably focus attention on the debt structure to ease cash flow problems. Assuming bank financing (as opposed to taxable or tax-exempt bonds), interest rates are currently about 8 to 10 percent.

Equity in the project would generally be of two types: 1) general partner or active equity provided by the developer and/or equipment suppliers, construction contractor, or operating contractor; and 2) limited partner or passive equity that might be packaged for syndication by an investment banker. While the active equity holders may derive additional benefits from the project in terms of normal profits on services provided, the passive investor obtains a return solely from the cash flows of the project and associated tax benefits. The overall discounted cash flow/internal rate of return required for all equity participants is typically in the range of 20 percent or more, after-tax, for projects similar in market risk level to this biomass-to-ethanol project.

Revenue Requirements. All of the costs of the project and, in the case of wastepaper as feedstock, revenues based on market prices for ethanol have been estimated. Tipping fees must make up the revenue shortfall, if any, to the extent that will yield the developer's/equity partners' target return on equity. The evaluation was set up to calculate the required cost per ton of feedstock in January 1994 dollars, escalating with inflation. Note that a negative tipping fee would indicate an expense for the project operator and not revenue. This can occur either by design (the maximum allowable tipping fee for a feedstock is negative) or by chance (the revenues from the sale of ethanol are more than adequate to cover the cost of the project and provide the equity partners' required target rate of return).

In the case of wood waste as feedstock, no revenues from tipping fees are available; the feedstock is an expense. A market price for the feedstock was input and all revenue requirements had to be borne by ethanol sales less a small amount of revenue generated by power sales when applicable. A required price per gallon of ethanol in 1994 dollars, escalating with inflation, was calculated.

Pro Forma Statements. SWDC has developed a pro forma financial cash flow statement for a hypothetical developer of a biomass-to-ethanol production facility.

A cash flow statement is presented on Table 4-3 for a Option 1. Revenues from the sale of ethanol are projected and tipping fees are included in revenues as appropriate. If the project operator were to pay for any of the feedstock, that cash flow would be entered under Expenses. Gross margin is obtained by subtracting expenses from revenues, both of which are based on projected volume. Taxable income is determined by subtracting interest and tax depreciation from gross margin. Income tax is simply taxable income multiplied by an effective income tax rate of 40.9 percent, which combines the 35 percent federal tax rate and the 9 percent deductible state tax rate.

Tax credits have not been included in this analysis but will be included in the sensitivity analysis under an economic incentives scenario. Depreciation is added back to income after tax, and after-tax items such as plant cost, loan proceeds, and principal payments are included to determine net cash flow available to equity participants. Cash flow is negative in 1997, indicating an investment of equity, and again in 2004 through 2007, indicating cash flow problems after the 5-year tax depreciation period has expired for the biomass portion of the plant. Other than these years, cash flow is positive in each year.

The debt service coverage ratio (DSCR), defined as the gross margin divided by principal and interest payment, is inadequate during the first 2 years. Obtaining financing is dependent, in part, upon demonstrating that the cash flows are sufficient to produce a minimum DSCR of at least 1.10 and average DSCR of at least 1.30 over the life of the loan. The shortfall is small and of short duration and, therefore, could be handled by changing the financing terms or by increasing the equity contribution. Any changes, however, can affect the equity return and so must be addressed carefully as the project is developed. The internal rate of return on this equity cash flow stream is 20 percent, as required, due to the calculated tipping fee of \$71.08/ton of feedstock. This is greatly in excess of the \$20/ton tipping fee originally considered as feasible.

Initial Results. The pro forma evaluation was performed for the remaining 11 wastepaper options to determine the required feedstock tipping fee and for all 12 wood waste options to determine the required ethanol price. Printouts of the Case Input (Table 4-2) and pro forma statement (Table 4-3) for each of those analyses are included in the Appendix as Attachments. Table 4-4 presents a summary of the results. For the 500 tpd (dry) plant, the required tipping fee ranges from \$38 to \$97/ton, showing that revenue from feedstock tipping is necessary for a financially viable project that produces ethanol for \$1.20 to \$1.50/gal. Similarly, for the 1000 tpd plant, tipping revenues are required, although for a smaller fee. The required tipping fee ranges from \$6 to \$67/ton, demonstrating the significant economies of scale in capital and operating costs.

For the wood waste options, the required ethanol prices always exceed \$1.50/gal. The 1000 tpd plant with gasification produces ethanol for the least cost, \$1.87/gal, when the feedstock cost is \$20/ton.

The other results on Table 4-4 are discussed in the following.

Sensitivity Analysis. Given the results described above and recognizing that some uncertainty exists with costs that served as the basis of the evaluation, the results were tested to determine if there exists an opportunity for this project.

The figures supporting this analysis are in the Appendix as Attachments Figures 4-1 through 4-16.

Capital Costs. Attached Figure 4-1 presents the effect on the required tipping fee of varying the capital cost for the wastepaper options with ethanol selling at \$1.20/gal. It is evident that significant reductions in capital cost, on the order of 30 to more than 100 percent, are needed if the project is to be viable on ethanol sales alone.

If ethanol can be sold for \$1.50/gal, the necessary capital cost reductions are not as onerous, ranging from 7 to 80 percent. The 1000 tpd plants

require the smallest capital cost reductions (see Attachment Figure 4-2).

Operating and Maintenance (O&M) Costs. As with the capital cost reductions, O&M costs would have to be reduced by 50 to over 100 percent for the ethanol sales at \$1.20/gal to adequately and profitably cover the project costs (see Attachment Figure 4-3). A more modest reduction of 10 to 70 percent is required when ethanol can be sold for \$1.50/gal, as shown on Figure 4-4.

Several O&M cost components contribute significantly to the total cost: labor, power, lignin disposal, and chemicals. Each of those costs were varied independently to determine the effect they have on the financial results (see Attachment Figures 4-5 through 4-12).

Sensitivity of the required ethanol price to variations in capital cost and in total O&M cost were evaluated for the wood waste options to determine what magnitude of reductions are needed to produce ethanol competitively. The results for the capital cost evaluation given wood waste prices at \$20/ton and \$40/ton, respectively (see Attachment Figures 4-13 and 4-14). Reductions of 25 to over 100 percent are needed if wood costs \$20/ton, and 50 to over 100 percent are needed if wood costs \$40/ton. Similar results occur for the O&M costs (see Attachment Figures 4-15 and 4-16).

Economic Incentives. Economic incentives listed in the "Draft RFP to Recycle Recovered Paper at a Manufacturing Facility Located in New York City" were reviewed for applicability to the wastepaper project. The incentives are summarized by their potential effect on cash flow, and are presented on Table 4-5. The incentives include low cost financing, various tax credits, reduced energy costs, waivers of various taxes, and capital cost grants.

Of all of the 23 economic incentives listed, only a few could be included directly in the analysis. The others were excluded for one of several reasons:

- Waiver of a tax that had not been included in the evaluation
- No change to applicable baseline value
- Not enough project data available to estimate value of the incentive
- Incentive not applicable to this project.

In particular, the Small Producer Ethanol Production credit of \$0.10/gal was not included because it is available only until the Year 2000, nor was the Electricity from Certain Renewables credit of \$0.15/kWh included because this project does not meet the closed-loop biomass definition required. Closed-loop biomass requires that the feedstock be produced solely for the purpose of generating power, and not as a waste from some other process.

The remaining incentives (energy discounts, low cost financing, wage tax credits, and investment tax credits) were incorporated into the pro forma evaluation for Options 1, 2, 7, and 8 to determine if they provide a significant improvement in the project's viability. Table 4-4 presents the resulting required tipping fee for comparison to the tipping fees required without the incentives. For all options, the required tipping fee is reduced by \$30 to \$40/ton. The tipping fee for the 1000 tpd plant with gasification, selling ethanol for \$1.20/gal, drops to -\$2/ton, signifying that revenue is no longer required from tipping. (The pro forma statements for these four options are included in the Appendix as Attachment Tables 4-6 through 4-9.)

Economic Life. NYSERDA required that a 10-year economic life also be evaluated. The shorter time period increases the revenue required in the early years needed to recapture the investment and earn an adequate return. The 10-year evaluation was performed for Options 1, 2, 7, and 8 for wastepaper, and for Options 13, 14, 19, and 20 for wood waste. The results are shown on Table 4-4. The required tipping fee increases substantially, up \$15 to \$20/ton. (The pro forma statements are included as in the Appendix as Attachment Tables 4-10 through 4-17.)

Conclusions

The project is marginally attractive, given the data to date. There is a limited opportunity for a project such as this, sited in New York City. The project should be as large as possible, and located in an Economic Development Zone to take advantage of economic incentives. The facility with a gasification plant appears to be more financially viable, because of the high energy costs in the area.

BUSINESS INTERESTS

This section identifies potential business interests in the Amoco waste biomass-to-ethanol production facility from land owners, feedstock suppliers, end product users, solid waste product consumers, and the financial community.

Land Owners

Con Ed has offered sites at electrical utility locations to support the City's interest in a manufacturing facility to recycle paper. One such location is the preferred site at the Arthur Kill on Staten Island. The City has also offered City-owned sites for such a facility (see Feedstock Suppliers).

TABLE 4-1
MASTER INPUT TABLE
FEEDSTOCK - WASTEPAPER

PAGE 1 OF 2

OPTION NO. :		1	2	3	4	5	6	7	8	9	10	11	12
UNITS		1	2	3	4	5	6	7	8	9	10	11	12
Plant Size	tpd(wet)	2	595	595	595	595	595	1190	1190	1190	1190	1190	1190
Plant Site		3	1	1	1	1	1	1	1	1	1	1	1
Ethanol Production Rate	gal/ton (wet)	4	82.35	82.35	82.35	82.35	82.35	82.35	82.35	82.35	82.35	82.35	82.35
Additional Byproducts ? CO2	gpd	5	49,000	49,000	49,000	49,000	49,000	98,000	98,000	98,000	98,000	98,000	98,000
Lignin	cf/ton (wet)	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Production Rate	tons/ton (wet)	7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Conversion Efficiency		8	0	1	0	1	1	0	1	0	1	1	1
Percent of Feed Rate		9	0.00	0.61	0.00	0.61	0.61	0.00	0.61	0.00	0.61	0.61	0.61
Feedstock - Waste Paper	Percent of Feed Rate	10	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
- OTD	Conversion Efficiency	11	24.29	24.29	24.29	24.29	24.29	24.29	24.29	24.29	24.29	24.29	24.29
- Wood Waste	Percent of Feed Rate	12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Conversion Efficiency		13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Percent of Feed Rate		14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Conversion Efficiency		15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Percent of Feed Rate		16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Market Prices - Ethanol	\$/gal	17	\$1.20	\$1.20	\$1.50	\$1.50	\$1.20	\$1.20	\$1.20	\$1.50	\$1.50	\$1.20	\$1.50
- CO2	\$/cf	18	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
- Lignin	\$/ton	19	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Maximum Allowable Tipping Fee (if applicable)		20											
- Waste Paper	\$/ton	21											
- OTD	\$/ton	22											
- Wood Waste	\$/ton	23											
Capital Cost of Facility	Scaling Factor (if appl)	24											
Land	\$1000	25	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000	\$15,911	\$15,911	\$15,911	\$15,911	\$15,911
Buildings	\$1000	26	\$11,411	\$11,411	\$11,411	\$11,411	\$11,411	\$11,411	\$18,156	\$18,156	\$18,156	\$18,156	\$18,156
Development Costs	\$1000	27	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Plant:		28											
Biomass Conversion	\$1000	29	\$68,192	\$68,192	\$68,192	\$68,192	\$68,192	\$68,192	\$108,498	\$108,498	\$108,498	\$108,498	\$108,498
Balance of Plant	\$1000	30	\$50,295	\$16,600	\$50,295	\$16,600	\$16,600	\$16,600	\$80,023	\$26,412	\$80,023	\$26,412	\$26,412
Working Capital		31	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Annual Operating Costs		32											
Fixed:		33											
Labor	\$50,000 /yr avg. per person	34	\$4,300	\$3,300	\$4,300	\$3,300	\$3,300	\$3,300	\$4,300	\$3,300	\$4,300	\$3,300	\$3,300
Fixed Maintenance @ 1% of capital		35	\$86	\$66	\$86	\$66	\$66	\$66	\$86	\$66	\$86	\$66	\$66
Variable:		36	\$1,300	\$960	\$1,300	\$960	\$960	\$960	\$2,070	\$1,530	\$2,070	\$1,530	\$1,530
Variable Maintenance		37	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000
Waste Disposal - Pretreatment		38	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000
- Fermentation		39	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000
- Solids Separation	\$65 /ton of ash	40	\$0.054	\$0.000	\$0.054	\$0.000	\$0.000	\$0.000	\$0.054	\$0.000	\$0.054	\$0.000	\$0.000
Ash production rate	lb/hr	41	3,400	0	3,400	0	0	0	6,800	0	6,800	0	0
Lignin production rate	tpd	42	0	360	0	360	360	360	0	720	0	720	720
Chemicals		43	\$0.160	\$0.160	\$0.160	\$0.160	\$0.160	\$0.160	\$0.160	\$0.160	\$0.160	\$0.160	\$0.160
Utilities		44											
Power @ \$0.10 /kwh		45	\$0.000	\$0.245	\$0.000	\$0.245	\$0.245	\$0.000	\$0.245	\$0.000	\$0.245	\$0.245	\$0.245
Purchased Power	MW	46	0	5	0	5	5	0	10	0	10	10	10
Water @ \$1.50 /kgal		47	\$0.003	\$0.006	\$0.003	\$0.006	\$0.006	\$0.003	\$0.006	\$0.003	\$0.006	\$0.006	\$0.006
Makeup Water	gpm	48	68	138	68	138	138	136	276	136	276	276	276
Natural Gas @ \$8.50 /MBtu		49	\$0.000	\$0.073	\$0.000	\$0.073	\$0.073	\$0.000	\$0.073	\$0.000	\$0.073	\$0.073	\$0.073
Fuel Consumption	MBtu/hr	50	0	17.5	0	17.5	17.5	0	35	0	35	35	35
Steam		51	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000
Waste Water @ \$1.50 /kgal sewer rate		52	\$0.004	\$0.004	\$0.004	\$0.004	\$0.004	\$0.004	\$0.004	\$0.004	\$0.004	\$0.004	\$0.004
Discharge Rate	gpm	53	100	100	100	100	100	200	200	200	200	200	200
Additional Revenue - Power Sales	\$0.03 /kwh	54	\$0.103	\$0.000	\$0.103	\$0.000	\$0.000	\$0.103	\$0.000	\$0.103	\$0.000	\$0.000	\$0.000
Excess Capacity for Sale	MW	55	7	0	7	0	0	14	0	14	0	0	0

Note: Shaded cells are input cells. Shaded cells for Options 3 through 24 highlight variations from Options No.1 and 2.

Stone & Webster Development Corporation

TABLE 4-1
MASTER INPUT TABLE
FEEDSTOCK -- WOOD WASTE

PAGE 2 OF 2

OPTION NO. :			13	14	15	16	17	18	19	20	21	22	23	24
UNITS			1	2	3	4	5	6	7	8	9	10	11	12
Plant Size	tpd(wet)	2	595	595	595	595	595	595	1190	1190	1190	1190	1190	1190
Plant Site		3	1	1	1	1	1	1	1	1	1	1	1	1
Ethanol Production Rate	gal/ton (wet)	4	82.35	82.35	82.35	82.35	82.35	82.35	82.35	82.35	82.35	82.35	82.35	82.35
Additional Byproducts ? CO2	gpd	5	49,000	49,000	49,000	49,000	49,000	49,000	98,000	98,000	98,000	98,000	98,000	98,000
Lignin	cf/ton (wet)	6	0	0	0	0	0	0	0	0	0	0	0	0
Production Rate		7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(Yes = 1, No = 0)		8	0	1	0	1	1	1	0	1	0	1	1	1
Production Rate	tons/ton (wet)	9	0.00	0.49	0.00	0.49	0.49	0.49	0.00	0.49	0.00	0.49	0.49	0.49
Feedstock -- Waste Paper	Percent of Feed Rate	10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Conversion Efficiency	lb/gal	11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
- OTD	Percent of Feed Rate	12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Conversion Efficiency	lb/gal	13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
- Wood Waste	Percent of Feed Rate	14	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Conversion Efficiency	lb/gal	15	24.29	24.29	24.29	24.29	24.29	24.29	24.29	24.29	24.29	24.29	24.29	24.29
Market Prices -- Ethanol	\$/gal	16	tbid	tbid	tbid	tbid	tbid	tbid	tbid	tbid	tbid	tbid	tbid	tbid
- CO2	\$/cf	17	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
- Lignin	\$/ton	18	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Maximum Allowable Tipping Fee (if applicable)		19												
- Waste Paper	\$/ton	20	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
- OTD	\$/ton	21	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
- Wood Waste	\$/ton	22	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
Capital Cost of Facility	Scaling Factor (if appl)	23												
Land	\$1000	24	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000	\$15,911	\$15,911	\$15,911	\$15,911	\$15,911	\$15,911
Buildings	\$1000	25	\$11,411	\$11,411	\$11,411	\$11,411	\$11,411	\$11,411	\$18,156	\$18,156	\$18,156	\$18,156	\$18,156	\$18,156
Development Costs	\$1000	26	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Plant:		27												
Biomass Conversion	\$1000	28	\$68,192	\$68,192	\$68,192	\$68,192	\$68,192	\$68,192	\$108,498	\$108,498	\$108,498	\$108,498	\$108,498	\$108,498
Balance of Plant	\$1000	29	\$50,295	\$16,600	\$50,295	\$16,600	\$16,600	\$16,600	\$80,023	\$26,412	\$80,023	\$26,412	\$26,412	\$26,412
Working Capital		30	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Annual Operating Costs		31												
Fixed:		32												
Labor	\$1000	33	\$4,300	\$3,300	\$4,300	\$3,300	\$3,300	\$3,300	\$4,300	\$3,300	\$4,300	\$3,300	\$3,300	\$3,300
Fixed Maintenance @ 1% of capital	No. of people	34	86	66	86	66	66	66	86	66	86	66	66	66
Variable:	\$1000	35	\$1,300	\$960	\$1,300	\$960	\$960	\$960	\$2,070	\$1,530	\$2,070	\$1,530	\$1,530	\$1,530
Variable Maintenance	\$/gal	36	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000
Waste Disposal -- Pretreatment	\$/gal	37	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000
- Fermentation	\$/gal	38	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000
- Solids Separation	\$/gal	39	\$0.043	\$0.000	\$0.043	\$0.000	\$0.000	\$0.000	\$0.043	\$0.000	\$0.043	\$0.000	\$0.000	\$0.000
Ash production rate	lb/hr	40	2,700	0	2,700	0	0	0	5,400	0	5,400	0	0	0
\$50/ton of lignin	\$/gal	41	\$0.000	\$0.296	\$0.000	\$0.296	\$0.000	\$0.000	\$0.000	\$0.296	\$0.000	\$0.296	\$0.000	\$0.000
Lignin production rate	tpd	42	0	290	0	290	290	290	0	580	0	580	580	580
Chemicals	\$/gal	43	\$0.160	\$0.160	\$0.160	\$0.160	\$0.160	\$0.160	\$0.160	\$0.160	\$0.160	\$0.160	\$0.160	\$0.160
Utilities		44												
Power @ \$0.10/kwh	\$/gal	45	\$0.000	\$0.220	\$0.000	\$0.220	\$0.220	\$0.220	\$0.000	\$0.220	\$0.000	\$0.220	\$0.220	\$0.220
Purchased Power	MW	46	0	4.5	0	4.5	4.5	4.5	0	9	0	9	9	9
Water @ \$1.50/kgal	\$/gal	47	\$0.003	\$0.007	\$0.003	\$0.007	\$0.007	\$0.007	\$0.003	\$0.007	\$0.003	\$0.007	\$0.007	\$0.007
Makeup Water	gpm	48	68	162	68	162	162	162	136	324	136	324	324	324
Natural Gas @ \$8.50/MBtu	\$/gal	49	\$0.000	\$0.240	\$0.000	\$0.240	\$0.240	\$0.240	\$0.000	\$0.240	\$0.000	\$0.240	\$0.240	\$0.240
Fuel Consumption	MBtu/hr	50	0	57.6	0	57.6	57.6	57.6	0	115.2	0	115.2	115.2	115.2
Steam	\$/gal	51	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000
Waste Water @ \$1.50/kgal sewer rate	\$/gal	52	\$0.004	\$0.004	\$0.004	\$0.004	\$0.004	\$0.004	\$0.004	\$0.004	\$0.004	\$0.004	\$0.004	\$0.004
Discharge Rate	gpm	53	100	100	100	100	100	100	200	200	200	200	200	200
Additional Revenue -- Power Sales	\$/gal	54	\$0.059	\$0.000	\$0.059	\$0.000	\$0.000	\$0.000	\$0.059	\$0.000	\$0.059	\$0.000	\$0.000	\$0.000
Excess Capacity for Sale	MW	55	4	0	4	0	0	0	8	0	8	0	0	0

Note: Shaded cells are input cells. Shaded cells for Options 3 through 24 highlight variations from Options No. 1 and 2.

Stone & Webster Development Corporation

03/27/95
11:18 AM

BIOMASS-TO-ETHANOL PRODUCTION FACILITY
PROFORMA FINANCIAL STATEMENT
THIRD PARTY CONTRACTOR/ DEVELOPER

TABLE 4-3: REQUIRED TIPPING FEE
OPTION NO.: 1
500 TPD (Dry) of 100.0% WASTE PAPER, WITH GASIFICATION; ETHANOL @ \$1.20/GAL.

Stone & Webster Development Corporation

Page 1 of 2

End of Year	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Years from P.D.	4	5	6	7	8	9	10	11	12	13	14
Operating Year	0	1	2	3	4	5	6	7	8	9	10
ANNUAL CAPACITY FACTOR		83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%
ANNUAL FEEDSTOCK QUANTITY		180,255	180,255	180,255	180,255	180,255	180,255	180,255	180,255	180,255	180,255
CASH FLOW STATEMENT											
REVENUE											
Ethanol		\$21,673	\$22,540	\$23,441	\$24,379	\$25,354	\$26,368	\$27,423	\$28,520	\$29,661	\$30,847
CO2		0	0	0	0	0	0	0	0	0	0
Lignin		0	0	0	0	0	0	0	0	0	0
Power		1,858	1,932	2,009	2,090	2,173	2,260	2,351	2,445	2,542	2,644
Tipping Fee- Waste Paper	\$71.08	15,589	16,213	16,861	17,536	18,237	18,967	19,725	20,514	21,335	22,188
- OTD	\$0.00	0	0	0	0	0	0	0	0	0	0
- Waste Wood	\$0.00	0	0	0	0	0	0	0	0	0	0
Total Revenue		\$39,120	\$40,685	\$42,312	\$44,004	\$45,765	\$47,595	\$49,499	\$51,479	\$53,538	\$55,680
LESS O&M EXPENSES											
Labor - Supervisory		\$5,232	\$5,441	\$5,659	\$5,885	\$6,120	\$6,365	\$6,620	\$6,884	\$7,160	\$7,446
Fixed Maintenance Materials		1,582	1,645	1,711	1,779	1,850	1,924	2,001	2,081	2,165	2,251
Insurance		2,056	2,138	2,224	2,313	2,405	2,502	2,602	2,706	2,814	2,927
Property Taxes		0	0	0	0	0	0	0	0	0	0
Variable Maintenance		0	0	0	0	0	0	0	0	0	0
Waste Disposal - Pretreatment		0	0	0	0	0	0	0	0	0	0
- Fermentation		0	0	0	0	0	0	0	0	0	0
- Solids Separation (Ash or Lignin)		1,001	1,046	1,093	1,143	1,194	1,248	1,304	1,363	1,424	1,488
Chemicals		2,890	3,005	3,126	3,251	3,381	3,516	3,656	3,803	3,955	4,113
Power	Economic Incentive Reduction: 0%	0	0	0	0	0	0	0	0	0	0
Water		54	56	59	61	63	66	69	71	74	77
Waste Water		80	83	86	90	93	97	101	105	109	113
Steam		0	0	0	0	0	0	0	0	0	0
Natural Gas	Economic Incentive Reduction: 0%	0	0	0	0	0	0	0	0	0	0
Feedstock - Waste Paper	\$0.00	0	0	0	0	0	0	0	0	0	0
- OTD	\$0.00	0	0	0	0	0	0	0	0	0	0
- Waste Wood	\$0.00	0	0	0	0	0	0	0	0	0	0
Gross Receipts Tax (Income Tax Deductible)		3,227	3,356	3,491	3,630	3,776	3,927	4,084	4,247	4,417	4,594
Total O&M Expenses		\$16,121	\$16,771	\$17,447	\$18,151	\$18,883	\$19,644	\$20,436	\$21,260	\$22,117	\$23,009
GROSS MARGIN		\$22,998	\$23,913	\$24,865	\$25,854	\$26,882	\$27,951	\$29,063	\$30,219	\$31,421	\$32,671
INTEREST		(13,488)	(12,642)	(11,711)	(10,687)	(9,560)	(8,321)	(6,958)	(5,459)	(3,810)	(1,996)
TAX DEPRECIATION		(18,928)	(31,110)	(20,263)	(13,648)	(13,367)	(8,374)	(3,400)	(3,177)	(3,141)	(3,141)
TAXABLE INCOME		(\$9,417)	(\$19,838)	(\$7,109)	\$1,519	\$3,955	\$11,257	\$18,706	\$21,583	\$24,471	\$27,535
TAXES: Income		3,847	8,104	2,904	(621)	(1,616)	(4,598)	(7,641)	(8,817)	(9,996)	(11,248)
Tax Credits	\$0 Investment \$0 Wages	0	0	0	0	0	0	0	0	0	0
INCOME AFTER TAX		(\$5,570)	(\$11,734)	(\$4,205)	\$899	\$2,339	\$6,658	\$11,064	\$12,766	\$14,474	\$16,287
TAX DEPRECIATION		18,928	31,110	20,263	13,648	13,367	8,374	3,400	3,177	3,141	3,141
PLANT COST	(\$168,598)										
LOAN	\$134,878										
PRINCIPAL PAYMENTS		(8,463)	(9,309)	(10,240)	(11,264)	(12,391)	(13,630)	(14,993)	(16,492)	(18,141)	(19,955)
NET CASH FLOW		(\$33,720)	\$4,894	\$10,066	\$5,818	\$3,282	\$3,316	\$1,402	(\$529)	(\$548)	(\$528)
CUMULATIVE CASH FLOW		(\$33,720)	(\$28,825)	(\$18,759)	(\$12,941)	(\$9,659)	(\$6,343)	(\$4,941)	(\$5,470)	(\$6,018)	(\$6,544)
CUMULATIVE IRR		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DEBT COVERAGE RATIO		1.048	1.089	1.133	1.178	1.225	1.273	1.324	1.377	1.431	1.488
CUM NPV	20.0%	(\$33,720)	(\$29,641)	(\$22,650)	(\$19,284)	(\$17,701)	(\$16,368)	(\$15,899)	(\$16,046)	(\$16,174)	(\$16,361)

BIOMASS-TO-ETHANOL PRODUCTION FACILITY PROFORMA FINANCIAL STATEMENT THIRD PARTY CONTRACTOR / DEVELOPER		TABLE 4-3: REQUIRED TIPPING FEE OPTION NO. 1 500 TPD (Dry) of 100.0% WASTE PAPER, WITH GASIFICATION; ETHANOL @ \$1.20/GAL.										Stone & Webster Development Corporation Page 2 of 2	
End of Year		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017		
Years from P.D.		15	16	17	18	19	20	21	22	23	24		
Operating Year		11	12	13	14	15	16	17	18	19	20		
ANNUAL CAPACITY FACTOR		83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%		
ANNUAL FEEDSTOCK QUANTITY		180,255	180,255	180,255	180,255	180,255	180,255	180,255	180,255	180,255	180,255		
CASH FLOW STATEMENT	(\$1000's)												
REVENUE													
Ethanol		\$32,081	\$33,364	\$34,699	\$36,087	\$37,530	\$39,031	\$40,593	\$42,216	\$43,905	\$45,661		
CO2		0	0	0	0	0	0	0	0	0	0		
Lignin		0	0	0	0	0	0	0	0	0	0		
Power		2,750	2,860	2,974	3,093	3,217	3,346	3,479	3,619	3,763	3,914		
Tipping Fee- Waste Paper	\$71.08	23,076	23,999	24,959	25,957	26,996	28,075	29,198	30,366	31,581	32,844		
- OTD	\$0.00	0	0	0	0	0	0	0	0	0	0		
- Waste Wood	\$0.00	0	0	0	0	0	0	0	0	0	0		
Total Revenue		\$57,907	\$60,223	\$62,632	\$65,137	\$67,743	\$70,452	\$73,271	\$76,201	\$79,249	\$82,419		
LESS O&M EXPENSES													
Labor - Supervisory		\$7,744	\$8,054	\$8,376	\$8,711	\$9,059	\$9,422	\$9,799	\$10,191	\$10,598	\$11,022		
Fixed Maintenance Materials		2,341	2,435	2,532	2,634	2,739	2,848	2,962	3,081	3,204	3,332		
Insurance		3,044	3,165	3,292	3,424	3,561	3,703	3,851	4,005	4,165	4,332		
Property Taxes		0	0	0	0	0	0	0	0	0	0		
Variable Maintenance		0	0	0	0	0	0	0	0	0	0		
Waste Disposal - Pretreatment		0	0	0	0	0	0	0	0	0	0		
- Fermentation		0	0	0	0	0	0	0	0	0	0		
- Solids Separation (Ash or Lignin)		1,555	1,625	1,698	1,774	1,854	1,938	2,025	2,116	2,211	2,311		
Chemicals		4,277	4,449	4,627	4,812	5,004	5,204	5,412	5,629	5,854	6,088		
Power Economic Incentive Reduction:		0	0	0	0	0	0	0	0	0	0		
Water		80	83	87	90	94	97	101	105	110	114		
Waste Water		118	123	127	133	138	143	149	155	161	168		
Steam		0	0	0	0	0	0	0	0	0	0		
Natural Gas Economic Incentive Reduction:		0	0	0	0	0	0	0	0	0	0		
Feedstock - Waste Paper	\$0.00	0	0	0	0	0	0	0	0	0	0		
- OTD	\$0.00	0	0	0	0	0	0	0	0	0	0		
- Waste Wood	\$0.00	0	0	0	0	0	0	0	0	0	0		
Gross Receipts Tax (Income Tax Deductible)		4,777	4,968	5,167	5,374	5,589	5,812	6,045	6,287	6,538	6,800		
Total O&M Expenses		\$23,936	\$24,902	\$25,906	\$26,951	\$28,038	\$29,168	\$30,345	\$31,569	\$32,842	\$34,167		
GROSS MARGIN		\$33,970	\$35,321	\$36,726	\$38,187	\$39,705	\$41,284	\$42,926	\$44,633	\$46,407	\$48,253		
INTEREST		(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)		
TAX DEPRECIATION		(3,141)	(3,141)	(3,141)	(3,141)	(3,141)	(3,141)	(3,141)	(3,141)	(3,141)	(9,732)		
TAXABLE INCOME		\$30,829	\$32,181	\$33,585	\$35,046	\$36,564	\$38,143	\$39,785	\$41,492	\$43,267	\$38,521		
TAXES: Income		(12,594)	(13,146)	(13,720)	(14,316)	(14,937)	(15,582)	(16,252)	(16,949)	(17,674)	(15,736)		
Tax Credits	\$0 Investment \$0 Wages	0	0	0	0	0	0	0	0	0	0		
INCOME AFTER TAX		\$18,236	\$19,035	\$19,866	\$20,730	\$21,628	\$22,562	\$23,533	\$24,542	\$25,592	\$22,785		
TAX DEPRECIATION		3,141	3,141	3,141	3,141	3,141	3,141	3,141	3,141	3,141	9,732		
PLANT COST													
LOAN													
PRINCIPAL PAYMENTS		0	0	0	0	0	0	0	0	0	0		
NET CASH FLOW		\$21,376	\$22,176	\$23,007	\$23,870	\$24,769	\$25,703	\$26,674	\$27,683	\$28,733	\$32,517		
CUMULATIVE CASH FLOW		\$14,304	\$36,480	\$59,487	\$83,357	\$108,126	\$133,828	\$160,502	\$188,185	\$216,918	\$249,435		
CUMULATIVE IRR		6.46%	11.13%	13.64%	15.64%	16.93%	17.88%	18.61%	19.17%	19.61%	20.00%		
DEBT COVERAGE RATIO		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		
CUM NPV	20.0%	(\$13,484)	(\$10,997)	(\$8,847)	(\$6,987)	(\$5,380)	(\$3,990)	(\$2,787)	(\$1,748)	(\$848)	\$0		

**Biomass-to-Ethanol Production Facility
to be Located in New York City (Phase I)**

**Table 4-4
Results of Financial Evaluation**

03/27/95

Capacity, tpd	500 -----> -----> 500						1000 -----> -----> 1000					
Gasification ?	Y	N	Y	N	N	N	Y	N	Y	N	N	N
Lignin Disposal Cost, \$/ton	N/A	\$50	N/A	\$50	\$0	\$0	N/A	\$50	N/A	\$50	\$0	\$0
Option Number	1	2	3	4	5	6	7	8	9	10	11	12
Feedstock	Paper -----> -----> Paper						Paper -----> -----> Paper					
Ethanol Price, \$/gal (Input)	\$1.20	\$1.20	\$1.50	\$1.50	\$1.20	\$1.50	\$1.20	\$1.20	\$1.50	\$1.50	\$1.20	\$1.50
Required Tipping Fee, \$/ton (Result)	\$71.08	\$97.19	\$46.38	\$72.49	\$62.54	\$37.84	\$31.03	\$67.43	\$6.33	\$42.72	\$32.78	8.08
Option Number	13	14	15	16	17	18	19	20	21	22	23	24
Feedstock	Wood -----> -----> Wood						Wood -----> -----> Wood					
Cost of Wood, \$/ton (Input)	\$20	\$20	\$40	\$40	\$20	\$40	\$20	\$20	\$40	\$40	\$20	\$40
Required Ethanol Price, \$/gal (Result)	\$2.36	\$2.75	\$2.62	\$3.01	\$2.41	\$2.67	\$1.87	\$2.39	\$2.14	\$2.65	\$2.05	\$2.31
Economic Incentives Applied												
Paper – Required Tipping Fee (\$/ton)	\$29.33		\$57.30									

TABLE 4-5
ECONOMIC
INCENTIVES TABLE

ECONOMIC DEVELOPMENT INCENTIVES:

EFFECTS:	POWER	NAT. GAS	LABOR	FINANCING	CAPITAL COST	TAXES	APPLICABLE? (NO. YEARS?)	COMMENTS
A. Financing Assistance								
1. Tax-Exempt Bond Project Financing								
a. Triple-Tax Exempt D/A Bonds for SW Projects				7%		0% Sales Tax	Yes	Industrial projects: Max. \$10 million
b. Tax Exempt D/A Bonds for Industrial Projects				8%			No	Market rates; no advantage
2 Direct Loan Financing							No	
B. Tax and Infrastructure Incentives								
1. Industrial and Commercial Incentive Program (ICP)						0% Property Tax	No	No property tax included in analysis
2. Commercial Rent Tax Reduction for Leased/Rent Property							No	Applies to renters
3. Infrastructure Assistance (Effect: Reduce Capital Cost)					\$?		No	No excessive site remediation requirements included in capital cost estimate.
C. Reduced Energy Costs								
1. Energy Costs Savings Program (ECSP)	-30%	-20%					Yes	
2. Flatstick Power Program	-30%						No	Available until 1988.
3. Deep Discount Program	-50%						No	Flatstick Power Program not available to combine
4. New York City Sales Tax and Energy Credits	-4.00%						Yes	Refund of taxes on power reduce power costs.
5. New York State Sales Tax Credit	-4.20%	-4.20%					Yes	Refund of taxes on energy reduce energy costs.
6. Economic Development Gas Rate (EDGAR)		-25%					Yes	If located in Brooklyn Union Gas EDGAR territory.
D. Other Incentives								
1. Relocation Employment Assistance Program (REAP)						\$500 /employee tax credit	No	Not enough information available to determine if project would qualify.
2. Economic Development Zones (EDZ) - Port Morris, Bronx East NY, Brooklyn, So. Jamaica, Queens, East Harlem, Manhattan.						\$2,500 /employee credit \$1,250	Yes	Assume ~ 20% of employees are targeted.
a. Wage Tax Credits							No	Waiver of 4% sales tax on material purchased with EDZ cannot be determined at this time.
b. Sales Tax					\$?		No	The 3% discount can be combined with other programs.
c. Utility Tax Credits and Discounts	-12%	-25%					Yes	1
d. Investment Tax Credit	-3%	-3%				10% of invest. 50% of ITC	Yes	3
e. Land Tax Abatement							No	Assuming project meets employment requirements
3. Real Estate Tax Escalation Credit							No	No property tax included in analysis.
OTHER ECONOMIC INCENTIVES:								
A. Ethanol Production Tax Credit (Federal)						\$0.10 /gal tax credit	No	Applicable to renters only.
B. Electricity from Certain Renewable Resource Tax Credit (Federal)						\$0.015 /kwh tax credit	No	Available only through the Year 2000.
							No	Does not qualify as Closed-Loop Biomass.

POWER				NAT. GAS				LABOR				FINANCING				CAPITAL COST				TAXES			
reduction for				reduction for				years				Interest rate				0				\$128,750 Wage TC (Gain) \$68,750 (w/o Gas) 10% Investment TC 50% of ITC			
-41.5%				-32.5%				6				7%								5 Yrs			
years				years				years				years								5 Yrs			
																				1 Yrs			
																				3 Yrs			

SUMMARY: TOTAL COMBINED ECONOMIC INCENTIVES

Feedstock Suppliers

The principal feedstock supplier is anticipated to be New York City through the Department of Sanitation's collection of recyclable waste paper. The City currently collects paper materials from all City residences and from over 5,000 institutions, including City agencies, public schools, non-profits, and municipal hospital. By June 1, 1995, the City intends to add residential mixed paper (RMP) to the recycling program, which is estimated to increase the total volume of available waste paper to between 1,300 and 2,200 tons per day. The City has prepared a draft RFP (PIN: 82794AD00069) for manufacturing facilities located within the City to process the waste paper to a usable product including ethanol, and has offered City-owned sites and tax incentives for such a facility. Amoco has gained the interest of the City for its process. The date for issuing of a final RFP is currently in question after a 12-month, delay mostly resulting from the changing political climate within the City.

Alternative feedstock suppliers within the City include the haulers of wood chips. Three such haulers were contacted. Details on these haulers, including quantities and price for wood, are found in Attachment 4-2 of the Appendix. Interest in supplying materials to an Amoco facility are subject to negotiation. A long-term reliable supply of feedstock may be a problem.

End Product Users

NYNEX Corporation has indicated an interest in considering the use of the ethanol end product as an additive in its vehicle fleet as a response to the mandated use of oxygenated gasoline required by the Federal Clean Air Act by January 1995. In New York City, NYNEX has 4,000 vehicles, including distribution trucks, vans, bucket trucks, and sedans, at 35 locations throughout the five boroughs. NYNEX is currently evaluating a number of alternative fuels for its vehicle fleet, including ethanol.

Solid Waste By Product Consumers

Various utilities and companies that burn municipal solid waste (MSW) were interviewed to

gauge interest for processing the solid waste byproduct from the Amoco process as a fuel source.

Companies that use MSW such as American ReFuel would consider the byproduct in the same light as municipal waste. After discounting for the benefits of lower ash content, a reasonable fee for processing the byproduct would be \$50/ton.

Burning in existing municipal incinerators within the City was considered as inappropriate due to the political resistance within the City to incinerate waste materials.

Public Service Electric and Gas, which burns coal to generate electrical power in New Jersey, expressed the following reservations about incineration:

- Political uncertainties in New Jersey for accepting waste material from New York City
- New permitting requirements for the plant
- Additional knowledge would have to be acquired regarding the physical characteristics as well as the elemental composition of impurities in the by-product that may affect boiler operation
- A test-burn in the boiler would be necessary before acceptance
- A fee would be charged for the by-product to reflect potential burner modifications as well as additional equipment for storing and processing the by-product.

Transporting the by-product to companies with solid fuel burning facilities in upstate New York has the additional disadvantage of increased transportation costs.

Interviews with Con Ed indicated that the oil burning power plant at the Arthur Kill was an inappropriate depository for the by-product because of its low (30 percent) on-stream annual operating factor.

Financial Community

Based on the financial pro forma runs in this section, it was decided to delay contacting the financial community for equity interests at this time. An improved capital cost structure for building a facility in New York City is required to ensure attractive returns on investments commensurate with operating requirements, including stable feedstock costs/tipping fees for recycle paper.

**SCREENING STUDY FOR WASTE BIOMASS TO ETHANOL
PRODUCTION FACILITY USING THE AMOCO
PROCESS IN NEW YORK STATE**

PART II.

NEW YORK STATE

SUMMARY

DESCRIPTION OF STUDY

Objective of Study

The objective of this study is to identify and evaluate four regions in upstate New York that could be appropriate for the construction and long-term operation of a financially attractive and environmentally sound waste biomass-to-ethanol production facility using Amoco's biomass conversion technology.

Background

Interest exists in the large urban regions of Buffalo, Rochester, Syracuse, and Albany in upstate New York in projects that would minimize waste and foster economic development for both residents and businesses. Furthermore, legislation proposed by the Environmental Protection Agency (EPA) may require that at least 30 percent of the oxygenates contained in cleaner-burning gasoline will have to be made from renewable resources (which include waste biomass products).

These considerations prompted the formation of a study group composed of Amoco, the National Renewable Energy Laboratory (NREL), NYNEX, Champion International Corporation, and Stone & Webster Engineering Corporation to explore the potential for an upstate New York biomass processing facility designed to produce ethanol, which could be used for transportation fuels. This study for upstate New York (Part II) follows a similar study for New York City (Part I). The business assessment studies provided by NYNEX and Champion International can be found in Section 9, Vol. III. Appendices are located in Vol. IV.

SITE SELECTION

Facility Requirements

The processing facility design for converting biomass to ethanol requires seven technological processing steps, including waste paper/wood storage, pretreatment, enzymatic hydrolysis, fermentation, distillation, anaerobic digestion and solids/liquid separation.

Minimum facility requirements were prepared to identify the Amoco process characteristics that would affect site selection and economic evaluation. These requirements for three types of cellulose-bearing feedstock materials (paper, wood, and combined wood/paper) included feedstock quantity required, ethanol production rate, solids by-product characteristics, environmental emission characteristics, utilities, personnel, land area and power reliability. A feedstock quantity of 500 tons per day (tpd) was determined to be a minimum economic facility size. Since the solids by-product of the process has a significant heating value, the study evaluated two approaches: on-site oxidation for local cogeneration of steam and power, and off-site transport of the solids by-product to an existing waste-to-energy plant.

Site Cost Estimates

Capital cost estimates were prepared for the basic process island as well as for integration with the balance of plant requirements of a generic installation in the regions of Buffalo, Rochester, Syracuse, and Albany in upstate New York.

The capital cost of the process island has been estimated to be approximately \$ 55 million for a 500-tpd plant in the four upstate regions. The capital cost of the process island would be approximately the same for paper, wood, and combined wood/paper feedstock.

The total cost for a 500-tpd biomass-to-ethanol facility, including the process island, the balance of plant with on-site oxidation of the solids by-product, site improvements and land costs was determined to range from \$113 million or \$2306/gpd of ethanol to \$117 million or \$2388/gpd of ethanol, depending on the upstate region. For a similar size ethanol facility with no on-site oxidation the total cost was determined to range from \$84 million or \$1714/gpd to \$88 million or \$1796/gpd.

Site Screening

The site screening process for an Amoco biomass-to-ethanol conversion facility in upstate New York required the identification of regions within the State that could support a nominal 500-tpd facility, the quantification of feedstock sources, and the identification of potential sites. This process resulted in the determination that each of the regions of Buffalo, Rochester, Syracuse, and Albany could support a biomass-to-ethanol facility; and that regional feedstock availability would restrict the ethanol facility to a 500-tpd size.

A total of 23 potential sites were identified in the four upstate regions. To qualify for inclusion in the inventory, the sites were required to meet 13 evaluation criteria, which were grouped into four categories, including siting, utility, accessibility, and economic requirements.

COST ESTIMATES FOR SITES

Capital costs for a 500-tpd plant constructed in one of the four upstate regions were estimated for the conditions of on-site as well as off-site oxidation of the solids by-product. The cost of a plant with on-site solids by-product oxidation ranged between \$113 and \$117 million, while the cost of a plant without on-site oxidation ranged between \$84 and \$88 million. The principal cost difference among the sites was the labor cost, which varied by region.

FINANCIAL EVALUATION

Pro Formas

A financial comparison, or pro forma, analysis was conducted for the biomass-to-ethanol facility to evaluate financial viability and risk. Thirty options were evaluated for the mixed feedstock consisting of the waste paper and wood in a ratio of 1:1. The evaluation was performed for a plant size of 500-tpd for four regions in New York State: Albany, Buffalo, Rochester, and Syracuse. Within each region two basic plant configurations were distinguished: a biomass facility with an on-site oxidation plant that converts solids by-product to power and steam used within the facility; and a biomass facility that disposes of the solids by-products off-site and purchases all facility energy needs from local utilities. A market price for the mixed feedstock was assumed at \$20 and \$40/ton. A required return of 20 percent on equity, after taxes, was used for 10-and 20-year life evaluations. For the most economical region, Syracuse, additional financial evaluations were performed to determine required feedstock tipping fees for ethanol sales prices of \$1.20 and \$1.50/gal.

Sensitivity analysis was conducted to show the effects of capital costs as well as O&M costs on the financial evaluation. The effects of the economic incentives were evaluated for the Syracuse region. The results are, however, typical for all New York State regions.

The pro forma evaluations determined that the required ethanol price would be approximately \$1.97/gal for a feedstock price of \$20/ton, and \$2.23/gal for a feedstock price of \$40/ton. For the Syracuse region, the required tipping fee ranges from \$35.59 to \$14.59/ton for the ethanol price range of \$1.20 to \$1.50/gallon.

Sensitivity of the required ethanol price to variations in capital cost and total O&M cost were evaluated for the mixed feedstock options for prices of \$20 and \$40/ton. The

results indicate that reductions of 35 to 80 percent in capital cost are needed if feedstock costs \$20/ton, and 60 to over 100 percent if feedstock costs \$40/ton. Similar results occur for the O&M costs.

Just as with the capital cost reductions, O&M costs would have to be reduced by 40 percent to 70 percent for the feedstock price of \$20/ton to adequately and profitably cover the project costs. A reduction of 80 to over 100 percent is required when the feedstock can be purchased for \$40/ton.

The sensitivity analysis indicates that reductions in capital cost of the plant for the Syracuse region, on the order of 40 to more than 80 percent, are needed if the project is to be viable on ethanol sales alone at \$1.20/gal. If ethanol can be sold for \$1.50/gal, the necessary capital cost reductions are less onerous, ranging from 7 to 50 percent. Similar results occur for the O&M costs.

Economic cost incentives may reduce tipping fees by as much as \$34 to \$36/ton. The reduction in ethanol price ranges from \$0.29 to \$0.38/gal.

The conclusion of the pro forma analysis is that there is a limited opportunity for a project such as this, sited in New York State. The project should be sited to take advantage of economic incentives. The facility with an on-site by-product oxidation plant appears to be more financially viable, than one with off-site dispensation of the lignin.

Business Interests

Potential business interests in the proposed waste biomass-to-ethanol production facility were identified from land owners, feedstock suppliers, end product users, solid waste by-product consumers, and the financial community.

New York State Electrical & Gas Corporation (NYSEG) has expressed an interest in the biomass-to-ethanol facility by offering sites at power plant locations.

Operation Oswego County Inc. and the County of Oswego Industrial Development Agency have expressed strong interest in financing an engineering feasibility study for retrofitting the Miller Brewery site to an Amoco ethanol facility.

Interest from feedstock suppliers includes lumber mills, paper mills, and municipalities. Lumber by-products would be the main source of feedstock because of plentiful supply and ease of accessibility. The lumber would be supplemented by paper sludge (especially in the Albany region) and three different types of municipal solid waste, consisting of paper products, yard waste, and construction and demolition wood.

NYNEX Corporation has indicated a strong interest in using the ethanol end product as a gasoline additive in its vehicle fleet as a response to the mandated use of oxygenated gasoline by January 1995, as required by the Federal Clean Air Act.

Based on the financial pro forma analysis, it was decided to delay contacting of the financial community for equity interests at this time. An improved capital cost structure for building a facility in New York State is required to ensure attractive returns on investments commensurate with operating requirements, including stable feedstock costs/tipping fees for recycle paper.

BUSINESS ASSESSMENTS

Feedstock Supplier

Champion International perceives the Amoco process as a recycling process that competes with present practices by the paper industry. The paper industry has achieved national paper recovery rates of approximately 40 percent. The economics of achieving

this rate is demonstrated by the industry's ability to absorb current recycle paper price increases to over \$100/ton in New York State. Such instability in price makes it currently unfavorable to recycle paper via the Amoco process. The Company recommends that paper mill sludge would be a more suitable feedstock, particularly in New York State where approximately 400 dry tons/day of paper sludge are generated and landfilled.

Feedstock Supplier/Ethanol User

NYNEX approached the business assessment of the Amoco process as a potential user of ethanol for its vehicle fleet and as a potential supplier of feedstock in the form of old telephone directories (OTD).

With approximately 8,000 of NYNEX's 12,000 New York State vehicles located outside New York City, an Amoco ethanol facility located in upstate New York would appear to offer efficiencies for providing fuel to approximately two-third of the NYNEX New York fleet. However, questions related to transportation, storage, and the Amoco intermediate distribution process itself remain to be answered.

More than 40 counties in upstate New York have some form of old telephone book recycling program. Waste paper markets are currently very strong, with prices in the \$70 to \$100/ton range. Therefore, the viability of an ethanol facility as an alternative end-use market for telephone books is completely dependent on current market conditions.

Regarding the NYNEX decision on alternative fuels for its vehicle fleet, review of EPA reports confirmed the benefits/costs associated with alternative fuels. However, more research is needed to determine such issues as optimum engine configuration, fuel metering systems, and fuel storage technology.

SECTION 5

INTRODUCTION

OBJECTIVE

The objective of this study is to identify and evaluate four urbanized regions of Buffalo, Rochester, Syracuse, and Albany in upstate New York that could be appropriate for the construction and long-term operation of a financially attractive and environmentally sound waste biomass-to-ethanol production facility using Amoco's biomass conversion technology (the Amoco process).

STUDY BACKGROUND

Interest exists at upstate New York regions in projects that would minimize waste and foster economic development for both residents and businesses. The large urban regions of Buffalo, Rochester, Syracuse, and Albany, each produce a substantial volume of municipal paper and wood wastes, industrial wood wastes, and paper sludge waste from upstate paper mills.

A second factor supporting development of a waste-to-energy is legislation proposed by the Environmental Protection Agency (EPA) that may require that at least 30 percent of the oxygenates contained in cleaner-burning gasoline to be made from renewable resources (which include waste biomass products). Thus the market for biomass products, such as ethanol, are expected to increase substantially.

For these reasons, Amoco, together with NREL, NYNEX, Champion International, and Stone & Webster Engineering Corporation have been exploring the potential for an upstate New York biomass processing facility designed to produce ethanol which could be used for transportation fuels. Amoco has developed its biomass conversion technology through 15 years of research and development (R&D) and pilot plant work by its own staff, NREL and other collaborators.

Efforts are underway to assess project feasibility in conjunction with large-scale paper, forest products and agricultural operations.

STUDY ORGANIZATION

The study was managed by Stone & Webster Engineering Corporation (SWEC) with technical support from Amoco Corporation, Stone & Webster Development Corporation, NYNEX, Champion International, National Renewable Energy Laboratory (NREL), the New York State Energy Research & Development Authority (NYSERDA), and other parties. The following identifies participation of the team members in selection of preferred sites and evaluation of project viability in upstate New York.

Stone & Webster Engineering Corporation provided the overall management of the study and preparation of this report. In addition, SWEC was responsible for site selection (Section 7), including screening potential sites in upstate New York, defining site improvement requirements and costs, defining key site evaluation criteria, and evaluating sites in the four upstate regions. SWEC also developed refined budgetary capital and operating costs for the two preferred sites (Section 7) and identified potential business interests (Section 8).

Amoco defined process-related requirements for the biomass-to-ethanol production facility (Section 6), estimated capital and operating costs for the island of process equipment for 500 and 1000 tons per day (tpd) of feedstock (Section 6) and provided general technical guidance to the project.

Stone & Webster Development Corporation prepared financial pro formas for the construction and long-term operation of an Amoco process facility at the preferred sites (Section 8).

Champion International prepared a business assessment as a feedstock supplier (Section 9).

NYNEX prepared a business assessment as a potential ethanol user and a provider of old

telephone directories as feedstock (Section 9).

Section 6

UPSTATE NEW YORK SITE SELECTION

The study gathered and reviewed upstate New York siting data available within Stone & Webster Engineering Corporation and elsewhere, and determined design requirements of the Amoco process for prospective sites. The preferred sites were selected based on developed criteria and Amoco process requirements. Financial evaluations were performed to determine the economics of developing a project in upstate New York.

FACILITY REQUIREMENTS FOR SITE SELECTION

Technology Overview

A processing facility for converting biomass to ethanol requires a number of processing steps (depicted later in Figures 6-2 through 6-7).

- **Waste Paper/Wood Storage.** In the first step, feedstock (paper or wood) is cleaned of contaminants and shredded prior to further processing.
- **Pretreatment.** This step sterilizes the feedstock and prepares it for further processing by hydrolysis agents.
- **Enzymatic Hydrolysis.** The feedstock is hydrolysed by adding acid and enzymes. This operation converts cellulose to glucose.
- **Fermentation.** In this step, glucose is converted to ethanol by applying microorganisms in a fermentation process similar to the corn-to-ethanol process. Typically, about half of the glucose is converted to carbon dioxide and half to ethanol. Small amounts of glucose are converted to microorganism cell mass.
- **Distillation.** The ethanol is recovered using a distillation technology commonly employed by the corn-to-ethanol industry. This is followed by the use of molecular sieves to break up the water-ethanol mixture.

- **Anaerobic Digestion.** Solids emanating from the distillation process are subjected to digestion by anaerobic bacteria to generate methane off-gas and the solids/liquid product. The methane off gas may be used to supply energy required by the Amoco process.
- **Solids/Liquid Separation.** In the final step, unreacted solids are separated from liquids. The solids may be used as fuel to supply process heat and power or sold to others for use as fuel. The liquids are subjected to digestion by aerobic bacteria and discharged for reuse in the process.

Facility Characteristics

Minimum generic facility characteristics that would affect site selection and economic evaluation were identified. These characteristics included feedstock type, feedstock quantity, ethanol production rate, solids by-product characteristics, environmental emission characteristics, utilities, personnel, land area, and power reliability. The facility characteristics are summarized in Table 6-1 for three types of cellulose-bearing feedstock materials: paper, wood, and combined

TABLE 6-1 Facility Characteristics

1. Feedstock Type	Waste paper Wood chips Mixture of waste paper and wood		
2. Feed Stock Quantity	500 tpd dDry (Maximum moisture content of feedstock that will not downgrade ethanol production rate is 60 %.)		
3. Ethanol Production Rate	49,000 gallons per day (98 gal/ton feed) for either waste paper or wood chips feedstock		
4. Solid Byproduct Characteristics:	<u>Waste Paper</u>	<u>Wood Chips</u>	<u>Wood/Paper at 1:1 Ratio</u>
Solids By-product Rate	360 tons per day @ 66% solids	290 tons per day @ 66% solids	325 tons per day @ 66% solids
Solids By-product Composition	See Table 6-2	See Table 6-3	See Table 6-4
Solids Byproduct Heating Value	6100 Btu/lb (dry) 4100 Btu/lb (wet)	6100 Btu/lb (dry) 4100 Btu/lb (wet)	6100 Btu/lb (dry) 4100 Btu/lb (wet)
5. Environmental Emission Characteristics	Refer to Tables 6-2 through 6-4 for composition of emission streams.		

6. Process Island Utility Requirements	<u>Waste Paper</u>	<u>Wood Chips</u>	<u>Wood/Paper at 1:1 Ratio</u>	
	Power :	5 MW	4.5 MW	4.8 MW
	Steam :	35,000 lb/hr @ 650 PSIA, 600°F	47,000 lb/hr @650 psia, 600 °F	42,000 lb/hr @650 psia, 600°F
	Cooling Water:	7200 gpm @ 44mm Btu/hr	6800 gpm @41.5mm btu/hr	7,000 gpm @ 43 mm btu/hr
	Chilling Water:	900 gpm @9mm btu/hr	500 gpm @5mm btu/hr	700 gpm @7mm btu/hr
	Water Treatment:	100 gpm	100 gpm	100 gpm
	Makeup Water:	68 gpm	68 gpm	68 gpm
7. Manpower Requirements	<u>Based on Solid Byproduct Oxidation on Site</u>		<u>Based on Offsite Oxidation of Solids</u>	
	86 workers consisting of: 55 hourly workers 10 shipping/receiving/security 10 office management 6 engineering 5 laboratory		66 workers consisting of: 40 hourly workers 10 shipping/receiving/security 7 office management 5 engineering 4 laboratory	
8. Land Requirements	10 acres (1.5 acres for process island; balance for site requirements) Refer to Figure 7-1 for plot configuration.			

9. Power Reliability	High power reliability must be maintained. Prolonged outages may reduce ethanol yield and may result in difficulties in re-suspending solids in fermenter vessels.
10. Other Considerations	<div> <p>Safety:</p> <p>Transportation:</p> <p>Water Hardness:</p> <p>Storage:</p> <p>Shape of Site:</p> <p>Special Soil Drainage Characteristics :</p> </div> <div> <p>Incorporated safety considerations in design for flammable waste paper and ethanol, as well as for handling and containing chemicals.</p> <p>No special requirements.</p> <p>No special requirements.</p> <p>No special requirements.</p> <p>Rectangular shape is preferred.</p> <p>No particular soil drainage characteristics are required. Underlying soil should support equipment.</p> </div>

TABLE 6-2 Solids By-product, Liquid, Gas Emissions Composition for Paper Feedstock.
(flow rate in lb/hr)

COMPONENTS	WASTE SOLIDS	SCRUBBED FERMENTER OFF-GAS	ANAEROBIC GAS	DISTILLATION VENT	DISCARD WATER
Garbage	4900				100
Ash	3000				1700
Lignin	7000				100
Furfural & acetaldehyde	100				500
Calcium sulfate	400				
Cell mass	4400				100
Ethanol				65	
Carbon Dioxide		12500	1150	150	
Oxygen		28200			
Nitrogen		98700			
Methane			1750		
Water	10200		450	30	47600
TOTAL	30000	139400	3350	245	50000

TABLE 6-3 Solids By-product, Liquid, Gas Emissions Composition for Wood Feedstock.
(flow rate in lb/hr)

COMPONENTS	WASTE SOLIDS	SCRUBBED FERMENTER OFF-GAS	ANAEROBIC GAS	DISTILLATION VENT	DISCARD WATER
Garbage	3920				100
Ash	2400				1700
Lignin	5600				100
Furfural & acetaldehyde	80				500
Calcium sulfate	320				
Cell mass	3520				100
Ethanol				64	
Carbon Dioxide		13740	542	147	
Oxygen		30990			
Nitrogen		108470			
Methane			825		
Water	8160		213	29	47600
TOTAL	24000	153200	1580	240	50000

TABLE 6-4 Solids By-product, Liquid, Gas Emissions Composition for Wood/Paper Feedstock in 1:1 Ratio.

COMPONENTS	WASTE SOLIDS	SCRUBBED FERMENTER OFF-GAS	ANAEROBIC GAS	DISTILLATION VENT	DISCARD WATER
Garbage	4410				100
Ash	2700				1700
Lignin	6300				100
Furfural & acetaldehyde	90				500
Calcium sulfate	360				
Cell mass	3920				100
Ethanol				65	
Carbon Dioxide		13120	846	148	
Oxygen		29600			
Nitrogen		103580			
Methane			1288		
Water	9220		331	29	47600
TOTAL	27000	146300	2465	242	50000

wood/paper. A nominal feedstock quantity of 500 dry tpd was selected as representing a minimum economic facility size. A site plan of the prototype biomass-to-ethanol facility is shown in Figure 6-1.

Solids By-Product

The solids by-product consists primarily of lignin which has a significant heating value and can therefore be used as a fuel to generate steam and/or power. Combustion of the lignin with an estimated heating value of 6100 btu/lb dry (4100 btu/lb wet) material will generate approximately 120 million btu/hr. In addition, gas leaving the anaerobic digestion operation within the Amoco Process contains approximately 50 percent methane and upon combustion, can contribute an additional 40 million btu/hr of heat value. The solids by-product produced by the Amoco process represents approximately 50 percent of the feedstock. The composition of solids by-product emissions is summarized in Tables 6-2 through 6-4.

With this much heat available from both by-products of the Amoco process, the study evaluated the economic benefits of two approaches for disposing of the solids by-product.

Approach A: Cogeneration of steam and power through on-site gasification of the lignin and combustion of the methane containing off gases.

Flow diagrams depicting this approach for paper, wood and combined wood/paper feedstocks are shown in Figures 6-2, 6-4 and 6-6, respectively. This approach requires a higher capital investment but makes the plant self-sufficient with respect to process steam and power, and results in a net export of power. For consistency with Part I of the study, gasification was selected as the processing step for the lignin by-product.

Approach B : Transportation of the solids by-product to an off-site solids fuel burning facility.

Flow diagrams depicting this approach for paper, wood and combined wood/paper feedstocks are shown in Figures 6-3, 6-5 and 6-7, respectively. This approach involves little capital investment but requires high operating costs in the form of tipping fees at solids fuel burning facilities. These include utilities, industrial facilities, and cogeneration plants burning solid fuels. The market value of the solids by-product is discussed in the economic pro formas (Section 8).

Utilities

Utility requirements for the Amoco process are power, steam, cooling and chilled water, and makeup water. To make the site selection more flexible and independent of the availability of cooled water, a closed-loop cooling tower and chiller were selected to supplement the Amoco process. A once-through cooling system would limit the siting of the facility to areas adjacent to large water bodies. Power and steam requirements are based on Approaches A and B. In Approach A, a combination of gasification of lignin, combustion of by-product gases, and on-site cogeneration can provide the required steam and power, and results in a net export of power. In Approach B, power would be purchased and steam produced through a package boiler fueled by the methane containing off-gases from the Amoco process. Natural gas would be purchased to supplement the fuel requirements.

Feedstock Sources in Upstate New York

Research was performed to determine the availability of cellulose-bearing feedstock in the major urban regions of Buffalo, Rochester, Albany, and Syracuse. The results are shown in Figure 6-8. Such research was necessary to confirm that a minimum quantity of 500 tpd (dry basis) feedstock is available in each of the four upstate regions. Based on the results, a combined feedstock of wood and paper in a 1:1 ratio was determined to be the basis for Part II of this study. Paper sources in the feedstock inventory include waste sludge from paper mills.

ETHANOL SITING STUDY

AMOCO PROCESS PLOT

FIGURE 6-1

ETHANOL SITING STUDY Waste Paper Feedstock

AMOCO PROCESS FLOW SCHEMATIC
(ON SITE OXIDATION OF SOLIDS BYPRODUCT)

FIGURE 6-2

ETHANOL SITING STUDY Waste Paper Feedstock

AMOCO PROCESS FLOW SCHEMATIC
(SOLIDS BYPRODUCT TRANSPORTED OFF SITE)

FIGURE 6-3

ETHANOL SITING STUDY Wood Feedstock

AMOCO PROCESS FLOW SCHEMATIC
(ON SITE OXIDATION OF SOLIDS BYPRODUCT)

ETHANOL SITING STUDY

Wood Feedstock

AMOCO PROCESS FLOW SCHEMATIC

FIGURE 6-5

ETHANOL SITING STUDY

WOOD/PAPER RATIO - 1/1

AMOCO PROCESS FLOW SCHEMATIC
(ON SITE OXIDATION OF SOLID BYPRODUCT)

FIGURE 6-8

ETHANOL SITING STUDY**WOOD/PAPER RATIO - 1/1** **AMOCO PROCESS FLOW SCHEMATIC**

(SOLID BYPRODUCT TRANSPORTED OFF SITE)

FIGURE 6-7

THE DRY TON PER DAY CELLULOSE GENERATION FIGURES
ARE BASED ON 1994 DATA COMPILATION BY
TONE & WEBSTER FROM NYSDEC NYSDER, CHAMPION
BIOCYCLE

1- BUFFALO	0.32 DRY TONS PER SQUARE MILE
2- ROCHESTER	0.26 DRY TONS PER SQUARE MILE
3- SYRACUSE	0.14 DRY TONS PER SQUARE MILE
4- ALBANY	0.13 DRY TONS PER SQUARE MILE

NOTES

COUNTY FIGURES EXCLUDE CELLULOSE FROM LUMBER
AGGREGATED FIGURES FOR FEEDSTOCK ZONES INCLUDE THEM

DRY TONS PER DAY OF CELLULOSE AVAILABLE IN FEEDSTOCK ZONES FOR THE ETHANOL FACILITY

0 25 50 miles

Stone & Webster
Environmental
Services

FEEDSTOCK ZONES
EXCLUDED BECAUSE
OF LOW FEEDSTOCK

1

DRY TONS PER DAY
OF CELLULOSE
FOR COUNTY
(EXCLUDING LUMBER)

+ 400 TPO
LUMBER

LUMBER AVAILABLE
IN FEEDSTOCK ZONE

508

DRY TONS PER DAY
OF CELLULOSE FOR
(EG BUFFALO)
FEEDSTOCK ZONE
INCLUDING LUMBER

FACILITY SITING ZONE

% OF THE WASTE STREAM
BROKEN DOWN BY CELLULOSE
SOURCE FOR EACH FEEDSTOCK
ZONE

% PAPER SLUDGE

% C&D WOOD

% YARD WASTE

% MSW PAPER

% LUMBER

BIOMASS to ETHANOL PLANT SITING STUDY

FIGURE 6-8

See Attachments 2-1 through 2-3 in the Appendix for additional details about facility requirements.

SITE SCREENING

Introduction

The siting study for an Amoco biomass-to-ethanol conversion facility in upstate New York identifies regions within the State that could support a facility that processes a minimum of 500 dry tpd of feedstock. The primary method for evaluating whether a region could support an ethanol facility required the identification of feedstock sources, potential by-product users, and available cost-effective transportation corridors, as well as location near densely populated urban centers. The study for New York City (Part I) differed from this study in that it involved one populated region having a government-controlled feedstock source (paper) rather than several regions with diverse feedstock sources. Thus, the upstate New York study consisted of three steps: identifying potential regions, quantifying feedstock, and locating specific sites.

Identification of Regions

For a region to support a minimum 500-tpd Amoco biomass-to-ethanol facility, logistical concerns had to be evaluated; e.g., location of feedstock sources, proximity to solid waste-burning facilities, cost-effective transportation corridors, and proximity to urban centers and densely populated areas. At the early stage of the study, the feedstock source considered was sludge from paper mills, and the solids-burning facilities for the lignin by-product were considered to be waste-to-energy plants. Paper mills were targeted because of their large number in upstate New York, as well as for their reliability as sources of waste paper sludge. The location of paper mills and waste-burning facilities is shown in Figure 6-9.

Zones that have reasonable access to both paper mill sludge and solids-burning facilities were

determined by overlapping areas that were 20 miles to a paper mill with areas that were 20 miles to a waste-to-energy plant. The resulting zones are shown in Figure 6-10. Transportation was defined according to major corridors extending north along the Hudson River, westward through the State, and along the Great Lakes, as shown in Figure 6-11. Areas of concentrated population around major cities are shown in Figure 6-12.

Boundaries for the regions able to support a biomass-to-ethanol facility were determined by overlapping the results as shown in Figure 6-13. Only in five major regions were all of the criteria met. These regions were Albany, Syracuse, Binghamton, Rochester, and Buffalo. Certain parts of New York State, including the area north of Albany and Syracuse and the southern portion of the state, were excluded from the screening process at this point. Areas south of Delaware, Greene and Columbia counties were also excluded as regions not truly part of upstate New York. The areas left over, however, maintained distinct boundaries, and were termed ethanol facility siting zones.

Feedstock Quantification

Gathering Data. The sources of feedstock for the ethanol facility in the identified regions were determined to include: paper mill sludge; lumber by-products such as wood chips, sawdust, bark, or any other types of lumber waste; and municipal solid waste, including paper products, yard waste, and construction and demolition wood.

The amount of information available for industrial and municipal solid waste varied greatly because of the difference in public monitoring and management. More information was available for municipal solid waste than for other sources. For example, for each kind of municipal solid waste studied, it was possible to quantify and compare the amount of waste generated to the amount recycled. Information on the two industrial wastes (paper sludge and lumber by-products) was more closely guarded. The related industries tend to take responsibility for their own waste, either disposing of it themselves or putting it on the market for recycling.

Stone & Webster Environmental Services

- FACILITY SITING ZONE**
20 MILES TO BOTH A WASTE BYPRODUCT CONSUMER (e.g. an incinerator or NYSEG plant) AND A CELLULOSE SOURCE (e.g. a papermill)
- WASTE BURNER PLANT LOCATION
- ▲ NYSEG PLANT
- ◻ URBAN AREA
- ◻ PAPERMILL LOCATION

BIOMASS to ETHANOL PLANT SITING STUDY

FIGURE 6-9

FACILITY SITING ZONE WITH NYSEG PLANTS, WASTE INCINERATORS, PAPER MILLS & MAJOR URBAN AREAS

0 25 50 miles

Stone & Webster
Environmental
Services

BIOMASS to
ETHANOL
PLANT SITING STUDY

FIGURE 6-10

Stone & Webster
Environmental
Services

RAIL

TRUCK ROUTE

CANAL

RIVER

BIMODAL CORRIDOR

TRIMODAL CORRIDOR

15 MILES TO AIRPORT

URBAN AREA

BIOMASS to
ETHANOL
PLANT SITING STUDY

FIGURE 6-11

● URBAN CENTER

**Stone & Webster
Environmental
Services**

200-500 people
per square kilometer
518 -1295 people per square mile
ave 2330 pounds of cellulose per
square mile (116 tons)

100-200
259-518 people,
ave 776 pounds 38 tons

50-100
129-259 people,
ave 388 pounds, 19 tons

25-50
65-129 people,
ave 194 pounds, 09 tons

10-25
26-65 people,
ave 68 pounds, 03 tons

1-10
126 people,
ave 26 pounds, 01 tons

ABOVE WASTE GENERATION FIGURE
ASSUME AN AVERAGE OF 2 POUNDS
OF CELLULOSE PER PERSON
EXCLUDING RECYCLING & INCINERATION

**BIOMASS to
ETHANOL
PLANT SITING STUDY**

FIGURE 6-12

**POPULATION DENSITY &
POTENTIAL BIOMASS
GENERATION CONTOURS
FOR NEW YORK STATE**

FACILITY SITING ZONE

20 MILES TO BOTH A WASTE
BYPRODUCT CONSUMER
(e.g. an incinerator or NYSEG plant)
AND A CELLULOSE SOURCE
(e.g. a papermill)

URBAN AREA

BIOMASS to
ETHANOL
PLANT SITING STUDY

FIGURE 6-13

20 MILE ACCESS ZONES TO BOTH BIOMASS SUPPLIERS & BYPRODUCT END USERS

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FACILITY SITING ZONE

20 MILES TO BOTH A WASTE
BYPRODUCT CONSUMER
(eg an incinerator or NYSEG plant)
AND A CELLULOSE SOURCE
(eg a papermill)

5

GENERALIZED
FEEDSTOCK ZONE COUNTY AREAS EXCLUDED
BECAUSE OF LOW FEEDSTOCK

COUNTY LINE

BIOMASS to ETHANOL PLANT SITING STUDY

FIGURE 6-14

GENERALIZED FEEDSTOCK ZONES BY MAJOR URBAN CENTERS

1 LONG ISLAND (excluded)	6 WATERTOWN
2 NEW YORK CITY (excluded)	7 BINGHAMTON
3 Poughkeepsie (excluded)	8 SYRACUSE
4 ALBANY	9 ROCHESTER
5 PLATTSBURGH	9 BUFFALO

NOTE
GENERALIZED FEEDSTOCK ZONES FOLLOW COUNTY BOUNDARIES
TO SIMPLIFY CALCULATIONS OF FEEDSTOCK SUPPLY
FOR THE FACILITY SITING ZONES

ETHANOL FACILITY SITING ZONES & GENERALIZED FEEDSTOCK ZONES

Table 6-5 Paper Sludge Daily Volume By Feedstock Zone and County

ALBANY ZONE

COUNTY	NUMBER OF MILLS	PAPER SLUDGE DRY TONS/DAY
Albany	1	0
Columbia	1	0
Greene	0	0
Rensselaer	3	1
Saratoga	4	84
Schenectady	0	0
Warren	1	70
Washington	3	41
TOTAL	13	196

SYRACUSE ZONE

COUNTY	NUMBER OF MILLS	PAPER SLUDGE DRY TONS/DAY
Oswego	3	9
Onondaga	2	0
Cayuga	0	0
Madison	0	0
TOTAL	5	9

ROCHESTER ZONE

COUNTY	NUMBER OF MILLS	PAPER SLUDGE DRY TONS/DAY
Monroe	2	0
West Finger Lakes	0	0
TOTAL	2	0

BUFFALO ZONE

COUNTY	NUMBER OF MILLS	PAPER SLUDGE DRY TONS/DAY
Erie	0	0
Niagara	2	12
GLOW	1	1
TOTAL	3	13

Table 6-6 Paper Sludge Daily Volume by Town, County, Company and Tipping Fee

ALBANY ZONE

TOWN (COUNTY)	COMPANY	PAPER SLUDGE TONS/DAY	TIPPING FEE	COMMENTS
Cohoes (Albany)	Mohawk Paper Mill Inc. Tel: (518) 237-1740 Contact: George Milner			Company discharges paper sludge to the municipal waste water treatment facility.
Chatham (Columbia)	The Columbia Corp. Tel: (518) 392-4000 Contact: Doug Bockstanz			Company recycles all paper waste.
Walloomsac (Rensselaer)	The Columbia Corp. Tel: (518) 686-7357 Contact: Lawrence Beayon			Company recycles all paper waste.
Hoosick Falls (Rensselaer)	Lydall Inc. Tel: (518) 686-7313 Contact: Bill Van Dusen	1 wet (35% solids) 0.35 dry		Paper sludge goes to local landfill which charges a large tipping fee. Interested in alternative solution.
Castleton-On-Hudson (Rensselaer)	Fort Orange Paper Co. Tel: (518) 732-7722 Contact: Arnie Schneider			Company is a recycler of paper, including own paper sludge. Only non-fibrous materials (ie. plastics) go to a local landfill, which charges \$75/wet ton.
Glen Falls (Warren)	Finch, Pruyn & Co. Inc. Tel: (518) 793-2541 Contact: Phil Arthur	220 wet (32% solids) 70 dry		Company landfill almost full, now engaged in public hearing process for permitting a new landfill.
Corinth (Saratoga)	International Paper Co. Tel: (518) 654-9031 Contact: Stuart Field	40 wet (40% solids) 16 dry		Company landfill almost full. A new landfill has been permitted and construction should start in 1995.
South Glens Falls (Saratoga)	Encore Paper Co. Tel: (518) 793-5684 Contact: Jeff Davis	270 wet (30% solids) 80 dry	\$6 per wet ton	Paper sludge (50% clay) goes to a local landfill, which is near closure. Interested in alternative solution.

Table 6-6 (continued)

Battenville (Washington)	Bio-Tech Mills Inc. Tel: (518) 692-7957 Contact: Marvin Ferris	40 wet (50% solids) 20 dry	\$0	Paper sludge goes to a landfill that charges no tipping fee.
Greenwich (Washington)	Hollingsworth & Vose Co. Tel: (518) 695-3266 Contact: Tom Nash	10 wet (15% solids) 1.5 dry	\$6 per wet ton	Two mills. One mill's waste goes to a county landfill and one to a company landfill which will be closed within the next 2 years. Interested in alternative solution.
Greenwich Washington)	Stevens & Thompson Paper Co. Tel: (518) 692-2211 Contact: Ray Stocker	55 wet (35% solids) 19 dry	\$8 per wet ton	The paper sludge is used as cover at a local landfill. Interested in alternative solution.
Rock City Falls (Saratoga)	Cottrell Paper Co. Inc. Tel: (518) 885-1702 Contact: Ben Cottrell	2 wet (20% solids) 0.5 dry	\$20 wet ton	Paper sludge goes to a local composter. Interested in alternative solution.
Waterford (Saratoga)	Mohawk Paper Mills Inc. Tel: (518) 237-1740 Contact: George Milner	6 wet (50% solids) 3 dry	\$18 per wet ton	Paper sludge goes to a local composter. Interested in alternative solution.

Potential Total Daily Volume: 196 dry tons

Table 6-6 (continued)

SYRACUSE ZONE

TOWN (COUNTY)	COMPANY	PAPER SLUDGE TONS/DAY	TIPPING FEE	COMMENTS
Oswego (Oswego)	International Paper Co. Tel: (315) 343-1581 Contact: Robert Shenefiel			Paper sludge goes into the municipal wastewater treatment system.
Pulaski (Oswego)	Schoeller Technical Papers Inc. Tel: (315) 298-5133 Contact: Bob Geary	5 wet (35% solids) 2 dry		Company landfill at closure stage. Interested in alternative solution.
Fulton (Oswego)	Armstrong World Industries Inc. Tel: (315) 592-0451 Contact: Frank Page	11 wet (65% solids) 7 dry	\$50 per wet ton	Paper sludge goes to county landfill. A high proportion (50%+) of the solids consists of mineral content (ie. will not burn).
Marcellus Falls (Onondaga)	Martisco Paper Co. Inc. Tel: (315) 673-2071 Contact: G.E. Maynard			Company recycles most of its paper sludge. A very small amount goes to the landfill.
Fayetteville (Onondaga)	McIntyre Paper Co. Inc. Tel: (315) 637-3166 Contact: Patrick Carney			All waste is recycled into the paper process.

Potential Total Daily Volume: 9 dry tons

Table 6-6 (continued)

ROCHESTER ZONE

TOWN (COUNTY)	COMPANY	PAPER SLUDGE TONS/DAY	TIPPING FEE	COMMENTS
Rochester (Monroe)	Eastman Kodak Co. Tel: (716) 722-9136 Contact: Tom Wiedo			Paper sludge is treated in-house and the solid residues are burned.
Rochester (Monroe)	Flower City Tissue Mills Co. Tel: (716) 458-9200			No contact

Potential Total Daily Volume: 0 dry tons

BUFFALO ZONE

TOWN (COUNTY)	COMPANY	PAPER SLUDGE TONS/DAY	TIPPING FEE	COMMENTS
Niagara Falls (Niagara)	Cascades Niagara Falla Inc. Tel: (716) 285-3681 Contact: Ray O'Keefe	20 wet (40% solids) 8 dry	\$60 per wet ton	Paper sludge goes to county landfill. The company is interested in an alternative source of disposal.
Lockport (Niagara)	Buffalo Paperboard Corp. Tel: (716) 434-2045 Contact: Bill McCandish	10 wet (35% solids) 3.5 dry	\$60 per wet ton	Paper sludge goes to local landfill. Sludge contains a high proportion of plastics (ie, 85%).
Oakfield (Genesee)	United States Gypsum Co. Tel: (716) 948-5221 Contact: Greg Gelder	3 wet (20% solids) 1 dry		Company recycles paper sludge and landfills the remaining waste in a company landfill. (County landfill charges \$60/wet ton tipping fee.)

Potential Total Daily Volume: 13 dry tons

Although information on the recycling of industrial waste was difficult to find, statistics on its generation were obtained. Such data were based on industry standards for waste produced per employee or on the amount of raw materials consumed. Both the Department of Economic Development and the Department of Environmental Conservation perform these calculations and release the results.

There was also a difference in the degree of disaggregation of the data. Paper sludge data were the most finely broken down, as they were collected by contacting approximately 40 paper mills in the identified regions. Information on municipal solid waste and lumber by-products, however, was grounded into larger geographical units; municipal solid waste information was reported by county, and lumber by-product data was reported by administrative regions of the Department of Environmental Conservation. As the kinds of waste materials were expanded beyond paper sludge, the area from which the feedstock could be obtained was also enlarged. The boundaries of the original ethanol facility siting zones were pushed out not only to ensure an adequate amount of feedstock, but also to reflect the way in which the data had been aggregated. The resulting boundaries followed either the county lines or the borders of Department of Environmental Conservation's administrative regions. The expanded zones were referred to as generalized feedstock zones (see Figure 6-14.)

Analysis. An analysis of the feedstock data was performed to ensure that a minimum feedstock quantity per region would be available.

Paper Mill Sludge. Paper mill sludge daily volumes range from 80 dry tons per day for the large mills to less than 1 dry ton per day for the small mills. The total daily volume of available paper sludge by region is summarized in Table 6-5. The most common method of disposal (49 percent of mills) is landfilling and/or composting in public landfills that charge a tipping fee. The variation in tipping fees is broad, ranging from \$0 to 135 per ton. This paper sludge stream could be intercepted by charging a lower tipping fee. The largest mills (18 percent) operate

private landfills, some of which are close to closure. Some of the private landfill waste stream could also be captured by providing a low-cost alternative to developing new private landfills. A significant proportion (20 percent) of mills recycle their paper waste, 8 percent discharge paper sludge into local sewer treatment facilities, and one mill incinerates paper wastes. This waste stream is assumed to be unavailable as potential feedstock. A detailed breakdown of paper mill sludge volumes by mill, method of disposal, and tipping fee is shown in Table 6-6.

Municipal and Lumber Wastes. A comparison was made of waste generated to the amount presently recycled. A low level of recycling indicated room for market expansion. To measure whether the current level of recycling was high or low, it was compared to national average levels of recycling. Figure 6-15 shows an example of this kind of analysis. Tables 6-7 and 6-8 show the results when local recycling of paper and yard wastes are compared to recycling on a national basis.

In some instances, the amount being recycled locally was less than the national average, thereby indicating potential for growth. In other cases, the amount being recycled was greater than the national average, thereby indicating a glut of recycling at present and a possible decline in the future. A glut could result from an increase in public awareness about recycling or from the import of wastes from outside the region by local recycling facilities. Whatever the cause of a glut, it is not likely that a share of the paper recycling market could be captured there.

The estimate for growth in recycling is expressed as a positive figure in the tables, and the estimate for decline is expressed as a negative one. For example, Table 6-7 shows that Onondaga County (Syracuse) is recycling 56 percent of the paper generated, a rate 13 percent greater than the national average of 43 percent. It is estimated that the Syracuse area market is glutted by 13 percent and may decline in the future to reach an amount closer to the national average. The amount

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BIOMASS to
ETHANOL
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EXAMPLE OF EXISTING RECYCLING RATE
vs POTENTIAL RATE

Figure 6-15

Table 6-7
Indicators of Paper Waste Recycling Market
in Four Highest Ranking Counties in Unstate New York.

Based on Comparing Waste Generation to
Current and Potential Recycling

RATIO OF RECYCLING TO GENERATION BY PERCENTAGES

County/City	Percentage of Waste Generated That Is Being Recycled	National Average of Paper Recycling	Percentage Increase to Meet National Average	Potential for Growth in Recycling Market
Albany Co./Albany	16%	43%	27%	Yes
Onondaga Co./Syracuse	56%	43%	-13%	No
Monroe Co./Rochester	18%	43%	25%	Yes
Erie Co./Buffalo	9%	43%	34%	Yes

RATIO OF RECYCLING TO GENERATION IN TONS

County/City	Ratio of Recycling to Generation in Tons/Year	Ratio of Recycling to Generation in Tons/Day	Additional Tons/Day to Meet 43% National Average of Paper Recycled	Potential for Growth in Recycling Market
Albany Co./Albany	<u>20,426</u> 127,765	<u>56</u> 350	95	Yes
Onondaga Co./Syracuse	<u>92,070</u> 163,589	<u>252</u> 448	-58	No
Monroe Co./Rochester	<u>43,268</u> 247,107	<u>118</u> 677	169	Yes
Erie Co./Buffalo	<u>31,303</u> 337,607	<u>85</u> 924	314	Yes

Table 6-8
Indicators of Yard Waste Market
In Four Highest Ranking Counties in Upstate New York.
Based on Comparing Waste Generation to
Current Recycling

RECYCLING RATE AND REMAINING WASTE

County/City	Waste in Tons/Day			
	Waste Generated	Waste Recycled	Recycling Rate	Remaining Waste to be Disposed
Albany Co./Albany	77	23	29.9%	54
Onondaga Co./Syracuse	191	10	5.2%	181
Monroe Co./Rochester	145	21	14.5%	124
Erle Co./Buffalo	252	101	40.1%	151

Source: NYS DEC

Table 6-9
 Compilation of Waste in Ethanol Facility Siting Zones.
 Adjusted for Dry Tonnage
 In Upstate New York

AGENCY/CITY	UNIT OF WASTE	AMOUNT OF WASTE					TOTAL WASTE
		PAPER	CONSTRUCTION AND DEMOLITION WOOD	YARD	PAPER SLUDGE	LUMBER	
Albany Zone							
Albany Co./Albany	Tons/Year	27,740	7,884	9,773	0		45,397
Columbia Co.	Tons/Year	3,550	125	1,084	0		4,759
Greene Co.	Tons/Year	2,796	168	1,133	0		4,097
E. Rennselaer CSWMA	Tons/Year	191	360	854	365		1,770
Schenectady Co.	Tons/Year	10,876	2,920	(2,762)	0		11,034
Saratoga Co./Saratoga Springs	Tons/Year	(21,413)	1,405	6,485	31,025		17,502
Warren, Washington Co.	Tons/Year	8,407	536	5,644	40,150		54,737
Total for Albany Zone	Tons/Year	32,147	13,398	22,211	71,540	137,120	276,416
Total for Albany Zone	Tons/Day	88	37	61	196	376	757
Syracuse Zone							
Cayuga Co.	Tons/Year	3,572	(4,843)	1,652	0		381
Madison Co.	Tons/Year	1,836	325	1,645	0		3,806
Onondaga Co. RRA/Syracuse	Tons/Year	(16,936)	6,424	32,942	0		22,430
Oswego Co.	Tons/Year	3,295	2,953	3,272	3,285		12,805
Total for Syracuse Zone	Tons/Year	(8,233)	4,859	39,511	3,285	131,200	170,622
Total for Syracuse Zone	Tons/Day	(23)	13	108	9	359	467
Rochester Zone							
Monroe Co./Rochester	Tons/Year	49,348	22,776	22,583	0		94,707
W. Finger Lakes	Tons/Year	11,924	1,483	5,782	0		19,189
Total for Rochester Zone	Tons/Year	61,272	24,259	28,365	0	164,000	277,896
Total for Rochester Zone	Tons/Day	168	66	78	0	449	761
Buffalo Zone							
Erie Co./Buffalo	Tons/Year	91,688	13,724	27,653	0		133,065
Niagara Co.	Tons/Year	14,130	(1,482)	8,965	4,380		25,993
GLOW Region SWM	Tons/Year	2,931	1,977	6,565	365		11,838
Total for Buffalo Zone	Tons/Year	108,749	14,219	43,183	4,745	292,000	462,896
Total for Buffalo Zone	Tons/Day	298	39	118	13	800	1,268

Source: NYS DEC; NYS DED; Stone & Webster; Champion; BioCycle.

Table 6-10
Total Waste for Ethanol Facility Siting Zones.
Adjusted for Dry Tonnage
In Upstate New York

AGENCY/CITY	UNIT OF WASTE	AMOUNT OF WASTE					TOTAL WASTE
		PAPER	CONSTRUCTION AND DEMOLITION WOOD	YARD	PAPER SLUDGE	LUMBER	
Total for Albany Zone	Tons/Year	32,147	13,398	22,211	71,540	137,120	276,416
Total for Albany Zone	Tons/Day	88	37	61	196	376	757
Total for Syracuse Zone	Tons/Year	(8,233)	4,859	39,511	3,285	131,200	170,622
Total for Syracuse Zone	Tons/Day	(23)	13	108	9	359	467
Total for Rochester Zone	Tons/Year	61,272	24,259	28,365	0	164,000	277,896
Total for Rochester Zone	Tons/Day	168	66	78	0	449	761
Total for Buffalo Zone	Tons/Year	108,749	14,219	43,183	4,745	292,000	462,896
Total for Buffalo Zone	Tons/Day	298	39	118	13	800	1,268

Source: NYS DEC; NYS DED; Stone & Webster; Champlon; BioCycle.

NOTES

ERIE, MONROE, &
ONONDAGA COUNTY HAVE
HIGH WASTE GENERATION
RATES

HOWEVER THESE ARE
NYS AVERAGED FIGURES
WHICH DO NOT ACCOUNT
FOR LOCAL WASTE
VARIABLES SUCH AS
INDUSTRIAL CLUSTERS
UNIVERSITIES OR
WASTE IMPORT /
EXPORT FACTORS

IF TOTAL WASTE BY COUNTY
IS CRITERIA THEN ERIE COUNTY
HAS HIGHEST RANKING

IF WASTE GENERATION
PER SQUARE MILE IS
CRITERIA THEN
MONROE COUNTY HAS
HIGHEST RANKING

SOURCE

BIOCYCLE, April 1994, State of Garbage in America
New York residents share of the total waste stream is 7.5 pounds per person per day including construction and industrial waste. Of this 23% is recycled, 18% is incinerated. Of the 7.5 pounds, 59% is landfilled or 4.4 pounds per person per day. Of this 4.4 pounds 45% is cellulose (1990 US EPA uses 50%, NYSWMP uses 41%). This works out at 2 pounds of cellulose per person per day. This 2 pound figure is used to generate average cellulose generation by county in tons per day.

Stone & Webster Environmental Services

UPSTATE COUNTY WITH HIGH
CELLULOSE GENERATION

000

TONS PER DAY OF CELLULOSE
HEADED FOR EACH COUNTY'S
LANDFILLS (ROUGH ESTIMATE
EXCLUDING RECYCLING &
INCINERATION)

NOTE
THESE AVERAGE FIGURES ARE
FOR COMPARISON ONLY REFER
TO FIGURE 6.8 FOR ACTUAL
CELLULOSE GENERATION FIGURES

BIOMASS to ETHANOL PLANT SITING STUDY

FIGURE 6-16

feasible for recycling there is thus represented by a negative number (-16,936 tons per year, as shown in Table 6-9). The amount of paper available for recycling in the entire Syracuse Zone appears in Table 6-10 (-8233 tons per year and -23 tons per day).

For industrial waste, the comparison between amount generated and amount recycled was not possible because there were no statistics available on recycling of paper sludge and lumber by-products. The analysis instead had to be based upon the generation figures alone. Considering only the generation figures, it appeared that approximately 500 tons per day of combined paper sludge and lumber by-product waste were being created in each zone. The challenge would be to divert this waste stream from other forms of disposal and recycling towards the ethanol facility. An assumption was made that the diversion could be achieved by offering a cheaper or more profitable alternative to the existing method of disposal and recycling. In the case of paper sludge, supplying waste to the ethanol facility might be cheaper than landfilling. For lumber by-products, which have a market value, a higher rate for the sale of wood waste could be offered.

Findings. Table 6-9 shows the estimate for quantity of potential feedstock broken down by material and by county, and Table 6-10 shows the total for each zone. The quantity of tonnage has been adjusted for moisture content. The Plattsburgh and Binghamton Zones were dropped because their feedstocks either were not diversified enough or could not meet the threshold criteria of a nominal 500 tons per day. The remaining zones were Buffalo, Rochester, Albany, and Syracuse, which can provide 1268, 761, 757, and 467 tons of cellulose-bearing waste per day respectively (see Figure 6-8).

Another calculation was performed to verify these estimates. The original estimates were based on absolute quantities of waste per county. For the second round of estimates, an average per capita rate of cellulose generation was applied to the density of each county. The results are shown in Figure 6-16 for the central counties in each region: Erie County

disposes 944 tpd in the Buffalo region; Monroe County disposes 705 tpd in the Rochester region; Onondaga disposes 462 tpd in the Syracuse region; and Albany and Schenectady Counties combined dispose 434 tpd in the Albany region. These figures are smaller than those produced in the first round of calculations because they are estimated only for the county and not for the entire ethanol facility siting zone. They are also different because they are based on an average per capita rate of waste disposal that may not reflect regional differences.

However, the figures do reveal a trend about the ranking of regions in terms of feedstock availability. Both the first and second analyses show that the Buffalo area has the most potential waste and that the Rochester area contains the second largest quantity of feedstock. These two analyses, however, produce different results for the Albany and Syracuse areas. In the first estimate, Albany was clearly ahead of Syracuse, with 757 and 467 tons per day of waste respectively. In the second estimate, Albany and Syracuse had very similar estimates: 434 tons for the combined counties of Albany and Schenectady and 462 tons for the county of Onondaga.

Another important finding of the analysis was the mixture of cellulose sources required to make up a nominal 500 tpd facility. Lumber by-products proved to be the best source of cellulose-bearing feedstock, in terms of both quantity and availability. Lumber waste would need to be supplemented by the other types of cellulose sources, primarily paper sludge and municipal solid waste. The ratio of lumber to other wastes was determined to be approximately 1:1. The bar graphs in Figure 6-8 show the proportions of various wastes to each other in the different regions.

Location of Sites

Individual sites were identified in each of the ethanol facility siting zones through contacts with private developers, local economic development corporations, public utilities, and the Department of Economic Development. Sites were also identified by NYSERDA, Champion

International, and other members of the project team. A total of 23 sites were identified through these contacts. The Albany Zone contains nine potential sites, the most of any zone. The Buffalo Zone is second with five potential sites. The sites are listed in Table 6-11 by facility-siting zone, county/town, site name, acreage, ownership and relevant site information. The location of these sites can be seen in Figure 6-17.

More detailed information on the data that were considered in this analysis can be found in Attachments 6-1 through 6-7 in the Appendix.

Conclusions

Based on the screening process, any of the four regions surrounding the cities of Buffalo, Rochester, Albany, and Syracuse could support a nominal 500-ton-per-day facility. Individual sites for locating an ethanol facility within those regions were identified. Feedstock availability limited the ethanol facility to a size of 500 tons per day; a more economical size of 1000-tons-per-day facility was deemed not feasible.

In upstate New York, the ethanol facility would need to rely on a mixture of feedstock sources. Lumber by-products would be the main source of feedstock because of their plentiful supply and ease of accessibility. The lumber would be supplemented by paper sludge (especially in the Albany region) and three different types of municipal solid waste, consisting of paper products, yard waste, and construction and demolition wood.

Although the municipal solid waste per region is often more available than the quantity of paper sludge, paper sludge was considered to be more reliable, especially since paper mills often seek a cheaper alternative to private landfilling of waste. Municipal solid waste, on the other hand, requires extensive community cooperation and improved recycling practices. In all regions, a feedstock ratio of lumber by-products to supplementary waste of approximately 1:1 would be required.

Table 6-11 Potential Sites by Ethanol Facility Siting Zones, County and Town

ETHANOL FACILITY SITING (EFS) ZONES	COUNTY/TOWN	SITE NAME	SITE ACREAGE	RELEVANT SITE INFORMATION	OWNERSHIP
ALBANY	Albany/City of Albany	Kenwood Business Park (South Pearl Street)	27 acres available for subdivision		Herb Clark
	Albany/City of Albany	24 Erie Boulevard	9 acres		Brookford Corp.
	Albany/City of Albany	Mobil Property (Church Street)	13 acres		Mobil Corp.
	Albany/Town of Guilderland	Northeastern Industrial Park	35 acres available for subdivision		Galesi Group
	Schenectady/Town of Rotterdam	Rotterdam Industrial Park	10 acres		Galesi Group
	Albany/Town of Bethlehem	Texaco Site Route 144	55 acres	Tri-modal site with direct highway, rail and river access	Texaco Inc.
	Albany/Town of Colonie	4294A Albany Street	15 acres	Rail available	
	Albany/Town of Colonie	DH Estates 900-905 Fifth Street	100 acres	Former railroad yard	
	Saratoga/Town of Moreau	Moreau Industrial Park	2.7 to 27 acres available	Rail spur nearby may be available	
SYRACUSE	Oswego/Town of Volney	Miller Brewery Site Route 481	425 acres	Adjacent to Fulton Economic Development Zone - could be included	Miller Brewery

Table 6-11 (continued)

	Oswego/City of Oswego	Lake Ontario Industrial Park	2-7 acre parcels may be combined	Economic Development Zone	Oswego County
ROCHESTER	Monroe/Town of Brighton	Metro Park-Town Line Road	10 acres		
	Monroe/Town of Gates	Pixley Industrial Parkway	11 acres		
BUFFALO	Erie/Town of Lackawanna	Gateway Metro Port	10 acres	Economic Development Zone; deep water port.	
	Niagara/Town of Wheatfield	Summit Business Park	20-40 acres		
	Niagara/Town of Wheatfield	Inducon Industrial Commerce Park	2-80 acres	Five miles from solid fuel burning facility; rail available.	Inducon Corp.
	Niagara/Town of Lockport	Town of Lockport Industrial Park	1-50 acres		
	Niagara/Town of Somerset	NYSEG Kintigh Power Generating Station *	3,000 acres	Tri-modal site with highway, rail, and lake access; gas pipe located one mile west of site.	New York State Electric & Gas Corporation (NYSEG)
WATERTOWN	Jefferson/City of Watertown	City Center Drive Industrial Park	total 128 acres	Rail available	
	St. Lawrence/Town of Ogdensburg	Port of Ogdensburg Heavy Industrial Park	2-10+ acres	Economic Development Zone; Tri-modal site with highway, rail, and river access.	St. Lawrence County

Table 6-11 (continued)

PLATTSBURGH		No site information available			
OUTSIDE EFS ZONES	Tompkins/Town of Lansing	NYSEG Milliken Power Generating Station *	50 acres	Tri-modal site with highway, rail, and lake access.	NYSEG
	Yates/Town of Tory	NYSEG Greenidge Power Generating Station *	30 acres	Tri-modal site with highway, rail, and river access.	NYSEG
	Chenango/Town of Bainbridge	NYSEG Jennison Power Generating Station *	11 acres	Tri-modal site with highway, rail, and river access.	NYSEG

• NYSEG Sites

Stone & Webster Environmental Services

FACILITY SITING ZONE

20 MILES TO BOTH A WASTE
BYPRODUCT CONSUMER
(e.g. an incinerator or NYSEG plant)
AND A CELLULOSE SOURCE
(e.g. a papermill)

MAJOR URBAN CENTER

NYSEG
PLANT POTENTIAL
SITES

BIOMASS to ETHANOL PLANT SITING STUDY

FIGURE 6-17

PROCESS EQUIPMENT COST ESTIMATE

The objective of this section is to provide a capital and operating budgetary estimate for process island equipment designed for feedstock quantity of 500 tpd. The estimate reflects the size, shape and orientation of the Amoco process island, as well as the feedstock quality defined in Table 6-1 (Facility Requirements).

The capital cost estimate for a 500-tpd process island has been estimated by Amoco to be \$ 47 million, based on building a facility in the Gulf Coast region of the United States (see Attachment 2-4a in the Appendix). This cost estimate was upgraded to approximately \$55 million to reflect the higher labor rates in the four upstate regions of Buffalo, Rochester, Syracuse, and Albany. The capital cost of the process island is approximately the same for paper, wood, and combined wood/paper feedstocks.

The operating cost estimate for a 500-tpd process island is discussed in Section 8 (Financial Proformas).

SITE IMPROVEMENT COST ESTIMATES

This subsection identifies the required additional costs for developing a site to supplement the project island costs developed in the previous subsection (Process Equipment Cost Estimate) and reports the total costs of the biomass-to-ethanol conversion facility.

The total cost is broken down into four cost components: the process island, the balance of plant, site improvement, and land cost. The cost of the process island is the cost determined in the previous subsection. The balance of plant cost includes the costs of buildings, auxiliary utilities including power distribution, and auxiliary systems to the process island such as water treatment, preparation of cooling and chilled water supply, and solid oxidation (gasification) of the solid waste by-product. An alternative cost estimate was prepared for the case of no on-site oxidation of the waste materials. The site improvement costs include

costs for preparing the site for the facility, including demolition, piling, lighting, and fire prevention systems. The land cost was appraised based on a site requirement of 10 acres.

The total capital cost for a facility processing 500 tpd of feedstock, with on-site oxidation of the solids by-product, was determined to range from \$113 million or \$2306/gpd (gallons per day) of ethanol to \$117 million or \$2388/gpd of ethanol, depending on region. For a 500-tpd ethanol facility with no on-site oxidation the total cost was determined to range from \$84 million or \$1714/gpd to \$88 million or \$1796/gpd, depending on region. These costs are summarized in Tables 6-12 through 6-22 for on-site solids by-product oxidation and in Tables 6-23 through 6-35 without on-site oxidation for the four upstate regions of Buffalo, Rochester, Syracuse and Albany. See Attachments 7-1 through 7-8 in the Appendix for additional detail. The costs were determined to be the same for paper, wood, and combined wood/paper feedstocks.

SITE EVALUATION CRITERIA

The following is a summary of the site requirements for a biomass-to-ethanol facility:

Siting Requirements

Location:	Near urban center
Size:	10 acres minimum
Zoning:	Industrial
Current use:	Vacant

Utility Requirements

Water:	100 gpm
Electricity:	5 mm
Gas (optional):	20 Million Btu/hr

Accessibility Requirements

Expressway:	Necessary
Rail:	Desirable
Barge:	Desirable

Table 6-12

**Budget Estimate for Biomass-to-Ethanol Facility
With On-site Oxidation.**

PART 2 - NY STATE PROJECT EVALUATION
SITE - BUFFALO

SUMMARY

DESCRIPTION	TOTAL COST
PROCESS ISLAND	\$55,940,000
BALANCE OF PLANT	\$44,265,000
SITE IMPROVEMENT	\$9,467,000
LAND COST	\$7,500,000
<hr/>	
TOTAL PRESENT PLANT COST	\$117,172,000

Table 6-13

**Budget Estimate for Biomass-to-Ethanol Facility
With On-site Oxidation.
(500 tpd) – 10 Acre**

**PART 2 – NY STATE PROJECT EVALUATION
SITE – BUFFALO**

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
BALANCE OF PLANT				
Building (Admin.,Control,Lab.)	1	ls	\$1,435,320	\$1,435,320
Maint./Shop Bldg.	1	ls	\$1,302,420	\$1,302,420
Plant Air Supply	1	ls	\$354,400	\$354,400
Aerobic Watertreatment	1	ls	\$1,329,000	\$1,329,000
Chilled/Cooling Water Supply	1	ls	\$620,200	\$620,200
Boiler Feed Water	1	ls	\$354,400	\$354,400
Solid Oxidation/Power & Distribution	1	ls	\$26,580,000	\$26,580,000
Boiler Package	1	ls	\$886,000	\$886,000
Steam Turbine	1	ls	\$221,500	\$221,500
Sub-Total Cost				\$33,083,240
Start-up Cost	1	ls	\$496,249	\$496,249
Engineering - 10%	1	ls	\$3,308,324	\$3,308,324
SUB TOTAL				\$36,887,813
CONTINGENCY - 20%	1	ls	\$7,377,563	\$7,377,563
TOTAL PRESENT DAY COST - BOP				\$44,265,375

Table 6-14

**Budget Estimate for Biomass-to-Ethanol Facility
With On-site Oxidation.
(500 tpd) – 10 Acre**

PART 2 - NY STATE PROJECT EVALUATION - SITE IMPROVEMENT REQUIREMENTS
SITE - BUFFALO

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
Demolition	1	ls	\$0	\$0
Site Clearing & Grubbing	1	ls	\$44,300	\$44,300
Sewer and Drainage	1	ls	\$810,690	\$810,690
Access Roadways and Parking	1	ls	\$708,800	\$708,800
Piling	1	ls	\$1,772,000	\$1,772,000
Dewatering	1	ls	\$443,000	\$443,000
Make-up Water & Potable Water	1	ls	\$531,600	\$531,600
Sewer Hook-ups for Bathroom	1	ls	\$88,600	\$88,600
Fire Water	1	ls	\$1,240,400	\$1,240,400
Sprinkler System	1	ls	\$886,000	\$886,000
Fencing	1	ls	\$62,020	\$62,020
Gas Pipeline (Allow.)	1	ls	\$132,900	\$132,900
Site Lighting	1	ls	\$451,860	\$451,860
Sub-Total Cost				\$7,172,170
Engineering - 10%	1	ls	\$717,217	\$717,217
Sub-Total Cost				\$7,889,387
CONTINGENCY - 20%	1	ls	\$1,577,877	\$1,577,877
TOTAL PRESENT DAY COST				\$9,467,264
Land cost allowance:				\$7,500,000

Assumption: No Enviromental Remediation on Site.

Table 6-15

**Budget Estimate for Biomass-to-Ethanol Facility
With On-site Oxidation.**

PART 2 - NY STATE PROJECT EVALUATION
SITE - ROCHESTER

SUMMARY

DESCRIPTION	TOTAL COST
PROCESS ISLAND	\$54,972,600
BALANCE OF PLANT	\$43,832,000
SITE IMPROVEMENT	\$9,375,000
LAND COST	\$7,500,000
TOTAL PRESENT PLANT COST	\$115,679,600

Table 6-16

**Budget Estimate for Biomass-to-Ethanol Facility
With On-site Oxidation.
(500 tpd) – 10 Acre**

**PART 2 - NY STATE PROJECT EVALUATION
SITE - ROCHESTER**

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
BALANCE OF PLANT				
Building (Admin.,Control,Lab.)	1	ls	\$1,421,275	\$1,421,275
Maint./Shop Bldg.	1	ls	\$1,289,675	\$1,289,675
Plant Air Supply	1	ls	\$350,932	\$350,932
Aerobic Watertreatment	1	ls	\$1,315,995	\$1,315,995
Chilled/Cooling Water Supply	1	ls	\$614,131	\$614,131
Boiler Feed Water	1	ls	\$350,932	\$350,932
Solid Oxidation/Power & Distribution	1	ls	\$26,319,900	\$26,319,900
Boiler Package	1	ls	\$877,330	\$877,330
Steam Turbine	1	ls	\$219,333	\$219,333
Sub-Total Cost				\$32,759,502
Start-up Cost	1	ls	\$491,393	\$491,393
Engineering - 10%	1	ls	\$3,275,950	\$3,275,950
SUB TOTAL				\$36,526,845
CONTINGENCY - 20%	1	ls	\$7,305,369	\$7,305,369
TOTAL PRESENT DAY COST - BOP				\$43,832,214

Table 6-17

**Budget Estimate for Biomass-to-Ethanol Facility
With On-site Oxidation.
(500 tpd) – 10 Acre**

**PART 2 - NY STATE PROJECT EVALUATION - SITE IMPROVEMENT REQUIREMENTS
SITE - ROCHESTER**

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
Demolition	1	ls	\$0	\$0
Site Clearing & Grubbing	1	ls	\$43,870	\$43,870
Sewer and Drainage	1	ls	\$802,821	\$802,821
Access Roadways and Parking	1	ls	\$701,920	\$701,920
Piling	1	ls	\$1,754,800	\$1,754,800
Dewatering	1	ls	\$438,700	\$438,700
Make-up Water & Potable Water	1	ls	\$526,440	\$526,440
Sewer Hook-ups for Bathroom	1	ls	\$87,740	\$87,740
Fire Water	1	ls	\$1,228,360	\$1,228,360
Sprinkler System	1	ls	\$877,400	\$877,400
Fencing	1	ls	\$61,418	\$61,418
Gas Pipeline (Allow.)	1	ls	\$131,610	\$131,610
Site Lighting	1	ls	\$447,474	\$447,474
Sub-Total Cost				\$7,102,553
Engineering - 10%	1	ls	\$710,255	\$710,255
Sub-Total Cost				\$7,812,808
CONTINGENCY - 20%	1	ls	\$1,562,562	\$1,562,562
TOTAL PRESENT DAY COST				\$9,375,370
Land cost allowance:				\$7,500,000

Assumption: No Enviromental Remediation on Site.

Table 6-18

**Budget Estimate for Biomass-to-Ethanol Facility
With On-site Oxidation.**

PART 2 - NY STATE PROJECT EVALUATION
SITE - SYRACUSE

SUMMARY

DESCRIPTION	TOTAL COST
PROCESS ISLAND	\$53,199,300
BALANCE OF PLANT	\$43,000,000
SITE IMPROVEMENT	\$9,198,000
LAND COST	\$7,500,000
<hr/>	
TOTAL PRESENT PLANT COST	\$112,897,300

Table 6-19

Budget Estimate for Biomass-to-Ethanol Facility
With On-site Oxidation.
(500 tpd) – 10 Acre

PART 2 - NY STATE PROJECT EVALUATION
 SITE - SYRACUSE

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
BALANCE OF PLANT				
Building (Admin.,Control,Lab.)	1	ls	\$1,394,285	\$1,394,285
Maint./Shop Bldg.	1	ls	\$1,265,185	\$1,265,185
Plant Air Supply	1	ls	\$344,268	\$344,268
Aerobic Watertreatment	1	ls	\$1,291,005	\$1,291,005
Chilled/Cooling Water Supply	1	ls	\$602,469	\$602,469
Boiler Feed Water	1	ls	\$344,268	\$344,268
Solid Oxidation/Power & Distribution	1	ls	\$25,820,100	\$25,820,100
Boiler Package	1	ls	\$860,670	\$860,670
Steam Turbine	1	ls	\$215,168	\$215,168
Sub-Total Cost				\$32,137,418
Start-up Cost	1	ls	\$482,061	\$482,061
Engineering - 10%	1	ls	\$3,213,742	\$3,213,742
SUB TOTAL				\$35,833,221
CONTINGENCY - 20%	1	ls	\$7,166,644	\$7,166,644
TOTAL PRESENT DAY COST - BOP				\$42,999,865

Table 6-20

**Budget Estimate for Biomass-to-Ethanol Facility
With On-site Oxidation.
(500 tpd) – 10 Acre**

**PART 2 - NY STATE PROJECT EVALUATION - SITE IMPROVEMENT REQUIREMENTS
SITE - SYRACUSE**

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
Demolition	1	ls	\$0	\$0
Site Clearing & Grubbing	1	ls	\$43,040	\$43,040
Sewer and Drainage	1	ls	\$787,632	\$787,632
Access Roadways and Parking	1	ls	\$688,640	\$688,640
Piling	1	ls	\$1,721,600	\$1,721,600
Dewatering	1	ls	\$430,400	\$430,400
Make-up Water & Potable Water	1	ls	\$516,480	\$516,480
Sewer Hook-ups for Bathroom	1	ls	\$86,080	\$86,080
Fire Water	1	ls	\$1,205,120	\$1,205,120
Sprinkler System	1	ls	\$860,800	\$860,800
Fencing	1	ls	\$60,256	\$60,256
Gas Pipeline (Allow.)	1	ls	\$129,120	\$129,120
Site Lighting	1	ls	\$439,008	\$439,008
Sub-Total Cost				\$6,968,176
Engineering - 10%	1	ls	\$696,818	\$696,818
Sub-Total Cost				\$7,664,994
CONTINGENCY - 20%	1	ls	\$1,532,999	\$1,532,999
TOTAL PRESENT DAY COST				\$9,197,992
Land cost allowance:				\$7,500,000

Assumption: No Enviromental Remediation on Site.

Table 6-21

**Budget Estimate for Biomass-to-Ethanol Facility
With On-site Oxidation.**

PART 2 - NY STATE PROJECT EVALUATION
SITE - ALBANY

SUMMARY

DESCRIPTION	TOTAL COST
PROCESS ISLAND	\$53,683,000
BALANCE OF PLANT	\$43,250,000
SITE IMPROVEMENT	\$9,250,000
LAND COST	\$7,500,000
TOTAL PRESENT PLANT COST	\$113,683,000

Table 6-22

**Budget Estimate for Biomass-to-Ethanol Facility
With On-site Oxidation.
(500 tpd) – 10 Acre**

**PART 2 - NY STATE PROJECT EVALUATION
SITE - ALBANY**

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
BALANCE OF PLANT				
Building (Admin.,Control,Lab.)	1	ls	\$1,402,434	\$1,402,434
Maint./Shop Bldg.	1	ls	\$1,272,579	\$1,272,579
Plant Air Supply	1	ls	\$346,280	\$346,280
Aerobic Watertreatment	1	ls	\$1,298,550	\$1,298,550
Chilled/Cooling Water Supply	1	ls	\$605,990	\$605,990
Boiler Feed Water	1	ls	\$346,280	\$346,280
Solid Oxidation/Power & Distribution	1	ls	\$25,971,000	\$25,971,000
Boiler Package	1	ls	\$865,700	\$865,700
Steam Turbine	1	ls	\$216,425	\$216,425
Sub-Total Cost				\$32,325,238
Start-up Cost	1	ls	\$484,879	\$484,879
Engineering - 10%	1	ls	\$3,232,524	\$3,232,524
SUB TOTAL				\$36,042,640
CONTINGENCY - 20%	1	ls	\$7,208,528	\$7,208,528
TOTAL PRESENT DAY COST - BOP				\$43,251,168

Table 6-23

**Budget Estimate for Biomass-to-Ethanol Facility
With On-site Oxidation.
(500 tpd) – 10 Acre**

**PART 2 - NY STATE PROJECT EVALUATION - SITE IMPROVEMENT REQUIREMENTS
SITE - ALBANY**

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
Demolition	1	ls	\$0	\$0
Site Clearing & Grubbing	1	ls	\$43,300	\$43,300
Sewer and Drainage	1	ls	\$792,390	\$792,390
Access Roadways and Parking	1	ls	\$692,800	\$692,800
Piling	1	ls	\$1,732,000	\$1,732,000
Dewatering	1	ls	\$433,000	\$433,000
Make-up Water & Potable Water	1	ls	\$519,600	\$519,600
Sewer Hook-ups for Bathroom	1	ls	\$86,600	\$86,600
Fire Water	1	ls	\$1,212,400	\$1,212,400
Sprinkler System	1	ls	\$866,000	\$866,000
Fencing	1	ls	\$60,620	\$60,620
Gas Pipeline (Allow.)	1	ls	\$129,900	\$129,900
Site Lighting	1	ls	\$441,660	\$441,660
Sub-Total Cost				\$7,010,270
Engineering - 10%	1	ls	\$701,027	\$701,027
Sub-Total Cost				\$7,711,297
CONTINGENCY - 20%	1	ls	\$1,542,259	\$1,542,259
TOTAL PRESENT DAY COST				\$9,253,556
Land cost allowance:				\$7,500,000

Assumption: No Enviromental Remediation on Site.

Table 6-24

**Budget Estimate for Biomass-to-Ethanol Facility
Without Oxidation.**

PART 2 - NY STATE PROJECT EVALUATION
SITE - BUFFALO

SUMMARY

DESCRIPTION	TOTAL COST
PROCESS ISLAND	\$55,940,000
BALANCE OF PLANT	\$14,628,000
SITE IMPROVEMENT	\$9,467,000
LAND COST	\$7,500,000
<hr/> TOTAL PRESENT PLANT COST	<hr/> \$87,535,000

Table 6-25

**Budget Estimate for Biomass-to-Ethanol Facility
Without Oxidation.
(500 tpd) – 10 Acre**

**PART 2 - NY STATE PROJECT EVALUATION
SITE - BUFFALO**

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
BALANCE OF PLANT				
Building (Admin.,Control,Lab.)	1	ls	\$1,435,320	\$1,435,320
Maint./Shop Bldg.	1	ls	\$1,302,420	\$1,302,420
Plant Air Supply	1	ls	\$354,400	\$354,400
Aerobic Watertreatment	1	ls	\$1,329,000	\$1,329,000
Chilled/Cooling Water Supply	1	ls	\$620,200	\$620,200
Boiler Feed Water	1	ls	\$354,400	\$354,400
Power & Distribution	1	ls	\$4,430,000	\$4,430,000
Boiler Package	1	ls	\$886,000	\$886,000
Steam Turbine	1	ls	\$221,500	\$221,500
Sub-Total Cost				\$10,933,240
Start-up Cost	1	ls	\$163,999	\$163,999
Engineering - 10%	1	ls	\$1,093,324	\$1,093,324
SUB TOTAL				\$12,190,563
CONTINGENCY - 20%	1	ls	\$2,438,113	\$2,438,113
TOTAL PRESENT DAY COST - BOP				\$14,628,675

Table 6-26

**Budget Estimate for Biomass-to-Ethanol Facility
Without Oxidation.
(500 tpd) - 10 Acre**

**PART 2 - NY STATE PROJECT EVALUATION - SITE IMPROVEMENT REQUIREMENTS
SITE - BUFFALO**

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
Demolition	1	ls	\$0	\$0
Site Clearing & Grubbing	1	ls	\$44,300	\$44,300
Sewer and Drainage	1	ls	\$810,690	\$810,690
Access Roadways and Parking	1	ls	\$708,800	\$708,800
Piling	1	ls	\$1,772,000	\$1,772,000
Dewatering	1	ls	\$443,000	\$443,000
Make-up Water & Potable Water	1	ls	\$531,600	\$531,600
Sewer Hook-ups for Bathroom	1	ls	\$88,600	\$88,600
Fire Water	1	ls	\$1,240,400	\$1,240,400
Sprinkler System	1	ls	\$886,000	\$886,000
Fencing	1	ls	\$62,020	\$62,020
Gas Pipeline (Allow.)	1	ls	\$132,900	\$132,900
Site Lighting	1	ls	\$451,860	\$451,860
Sub-Total Cost				\$7,172,170
Engineering - 10%	1	ls	\$717,217	\$717,217
Sub-Total Cost				\$7,889,387
CONTINGENCY - 20%	1	ls	\$1,577,877	\$1,577,877
TOTAL PRESENT DAY COST				\$9,467,264
Land cost allowance:				\$7,500,000

Assumption: No Enviromental Remediation on Site.

Table 6-27

**Budget Estimate for Biomass-to-Ethanol Facility
Without Oxidation.**

PART 2 - NY STATE PROJECT EVALUATION
SITE - ROCHESTER

SUMMARY

DESCRIPTION	TOTAL COST
PROCESS ISLAND	\$54,972,600
BALANCE OF PLANT	\$14,485,600
SITE IMPROVEMENT	\$9,375,000
LAND COST	\$7,500,000
<hr/>	
TOTAL PRESENT PLANT COST	\$86,333,200

Table 6-28

**Budget Estimate for Biomass-to-Ethanol Facility
Without Oxidation.
(500 tpd) - 10 Acre**

**PART 2 - NY STATE PROJECT EVALUATION
SITE - ROCHESTER**

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
BALANCE OF PLANT				
Building (Admin.,Control,Lab.)	1	ls	\$1,421,226	\$1,421,226
Maint./Shop Bldg.	1	ls	\$1,289,631	\$1,289,631
Plant Air Supply	1	ls	\$350,920	\$350,920
Aerobic Watertreatment	1	ls	\$1,315,950	\$1,315,950
Chilled/Cooling Water Supply	1	ls	\$614,110	\$614,110
Boiler Feed Water	1	ls	\$350,920	\$350,920
Power & Distribution	1	ls	\$4,386,500	\$4,386,500
Boiler Package	1	ls	\$877,300	\$877,300
Steam Turbine	1	ls	\$219,325	\$219,325
Sub-Total Cost				\$10,825,882
Start-up Cost	1	ls	\$162,388	\$162,388
Engineering - 10%	1	ls	\$1,082,588	\$1,082,588
SUB TOTAL				\$12,070,858
CONTINGENCY - 20%	1	ls	\$2,414,172	\$2,414,172
TOTAL PRESENT DAY COST - BOP				\$14,485,030

Table 6-29

**Budget Estimate for Biomass-to-Ethanol Facility
Without Oxidation.
(500 tpd) – 10 Acre**

PART 2 - NY STATE PROJECT EVALUATION - SITE IMPROVEMENT REQUIREMENTS
SITE - ROCHESTER

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
Demolition	1	ls	\$0	\$0
Site Clearing & Grubbing	1	ls	\$43,870	\$43,870
Sewer and Drainage	1	ls	\$802,821	\$802,821
Access Roadways and Parking	1	ls	\$701,920	\$701,920
Piling	1	ls	\$1,754,800	\$1,754,800
Dewatering	1	ls	\$438,700	\$438,700
Make-up Water & Potable Water	1	ls	\$526,440	\$526,440
Sewer Hook-ups for Bathroom	1	ls	\$87,740	\$87,740
Fire Water	1	ls	\$1,228,360	\$1,228,360
Sprinkler System	1	ls	\$877,400	\$877,400
Fencing	1	ls	\$61,418	\$61,418
Gas Pipeline (Allow.)	1	ls	\$131,610	\$131,610
Site Lighting	1	ls	\$447,474	\$447,474
Sub-Total Cost				\$7,102,553
Engineering - 10%	1	ls	\$710,255	\$710,255
Sub-Total Cost				\$7,812,808
CONTINGENCY - 20%	1	ls	\$1,562,562	\$1,562,562
TOTAL PRESENT DAY COST				\$9,375,370
Land cost allowance:				\$7,500,000

Assumption: No Enviromental Remediation on Site.

Table 6-30

**Budget Estimate for Biomass-to-Ethanol Facility
Without Oxidation.**

PART 2 - NY STATE PROJECT EVALUATION
SITE - SYRACUSE

SUMMARY

DESCRIPTION	TOTAL COST
PROCESS ISLAND	\$53,199,300
BALANCE OF PLANT	\$14,213,000
SITE IMPROVEMENT	\$9,198,000
LAND COST	\$7,500,000
<hr/>	
TOTAL PRESENT PLANT COST	\$84,110,300

Table 6-31

Budget Estimate for Biomass-to-Ethanol Facility
Without Oxidation.
(500 tpd) – 10 Acre

PART 2 - NY STATE PROJECT EVALUATION
 SITE - SYRACUSE

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
BALANCE OF PLANT				
Building (Admin.,Control,Lab.)	1	ls	\$1,394,496	\$1,394,496
Maint./Shop Bldg.	1	ls	\$1,265,376	\$1,265,376
Plant Air Supply	1	ls	\$344,320	\$344,320
Aerobic Watertreatment	1	ls	\$1,291,200	\$1,291,200
Chilled/Cooling Water Supply	1	ls	\$602,560	\$602,560
Boiler Feed Water	1	ls	\$344,320	\$344,320
Power & Distribution	1	ls	\$4,304,000	\$4,304,000
Boiler Package	1	ls	\$860,800	\$860,800
Steam Turbine	1	ls	\$215,200	\$215,200
Sub-Total Cost				\$10,622,272
Start-up Cost	1	ls	\$159,334	\$159,334
Engineering - 10%	1	ls	\$1,062,227	\$1,062,227
SUB TOTAL				\$11,843,833
CONTINGENCY - 20%	1	ls	\$2,368,767	\$2,368,767
TOTAL PRESENT DAY COST - BOP				\$14,212,600

Table 6-32

**Budget Estimate for Biomass-to-Ethanol Facility.
Without Oxidation.
(500 tpd) – 10 Acre**

PART 2 - NY STATE PROJECT EVALUATION - SITE IMPROVEMENT REQUIREMENTS
SITE - SYRACUSE

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
Demolition	1	ls	\$0	\$0
Site Clearing & Grubbing	1	ls	\$43,040	\$43,040
Sewer and Drainage	1	ls	\$787,632	\$787,632
Access Roadways and Parking	1	ls	\$688,640	\$688,640
Piling	1	ls	\$1,721,600	\$1,721,600
Dewatering	1	ls	\$430,400	\$430,400
Make-up Water & Potable Water	1	ls	\$516,480	\$516,480
Sewer Hook-ups for Bathroom	1	ls	\$86,080	\$86,080
Fire Water	1	ls	\$1,205,120	\$1,205,120
Sprinkler System	1	ls	\$860,800	\$860,800
Fencing	1	ls	\$60,256	\$60,256
Gas Pipeline (Allow.)	1	ls	\$129,120	\$129,120
Site Lighting	1	ls	\$439,008	\$439,008
Sub-Total Cost				\$6,968,176
Engineering - 10%	1	ls	\$696,818	\$696,818
Sub-Total Cost				\$7,664,994
CONTINGENCY - 20%	1	ls	\$1,532,999	\$1,532,999
TOTAL PRESENT DAY COST				\$9,197,992
Land cost allowance:				\$7,500,000

Assumption: No Enviromental Remediation on Site.

Table 6-33

**Budget Estimate for Biomass-to-Ethanol Facility
Without Oxidation.**

PART 2 - NY STATE PROJECT EVALUATION
SITE - ALBANY

SUMMARY

DESCRIPTION	TOTAL COST
PROCESS ISLAND	\$53,683,000
BALANCE OF PLANT	\$14,287,000
SITE IMPROVEMENT	\$9,250,000
LAND COST	\$7,500,000
<hr/> TOTAL PRESENT PLANT COST	<hr/> \$84,720,000

Table 6-34

**Budget Estimate for Biomass-to-Ethanol Facility
Without Oxidation.
(500 tpd) – 10 Acre**

PART 2 - NY STATE PROJECT EVALUATION
SITE - ALBANY

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
BALANCE OF PLANT				
Building (Admin.,Control,Lab.)	1	ls	\$1,401,802	\$1,401,802
Maint./Shop Bldg.	1	ls	\$1,272,006	\$1,272,006
Plant Air Supply	1	ls	\$346,124	\$346,124
Aerobic Watertreatment	1	ls	\$1,297,965	\$1,297,965
Chilled/Cooling Water Supply	1	ls	\$605,717	\$605,717
Boiler Feed Water	1	ls	\$346,124	\$346,124
Power & Distribution	1	ls	\$4,326,550	\$4,326,550
Boiler Package	1	ls	\$865,310	\$865,310
Steam Turbine	1	ls	\$216,328	\$216,328
Sub-Total Cost				\$10,677,925
Start-up Cost	1	ls	\$160,169	\$160,169
Engineering - 10%	1	ls	\$1,067,793	\$1,067,793
SUB TOTAL				\$11,905,887
CONTINGENCY - 20%	1	ls	\$2,381,177	\$2,381,177
TOTAL PRESENT DAY COST - BOP				\$14,287,064

Table 6-35

**Budget Estimate for Biomass-to-Ethanol Facility
Without Oxidation.
(500 tpd) - 10 Acre**

PART 2 - NY STATE PROJECT EVALUATION - SITE IMPROVEMENT REQUIREMENTS
SITE - ALBANY

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
Demolition	1	ls	\$0	\$0
Site Clearing & Grubbing	1	ls	\$43,300	\$43,300
Sewer and Drainage	1	ls	\$792,390	\$792,390
Access Roadways and Parking	1	ls	\$692,800	\$692,800
Piling	1	ls	\$1,732,000	\$1,732,000
Dewatering	1	ls	\$433,000	\$433,000
Make-up Water & Potable Water	1	ls	\$519,600	\$519,600
Sewer Hook-ups for Bathroom	1	ls	\$86,600	\$86,600
Fire Water	1	ls	\$1,212,400	\$1,212,400
Sprinkler System	1	ls	\$866,000	\$866,000
Fencing	1	ls	\$60,620	\$60,620
Gas Pipeline (Allow.)	1	ls	\$129,900	\$129,900
Site Lighting	1	ls	\$441,660	\$441,660
Sub-Total Cost				\$7,010,270
Engineering - 10%	1	ls	\$701,027	\$701,027
Sub-Total Cost				\$7,711,297
CONTINGENCY - 20%	1	ls	\$1,542,259	\$1,542,259
TOTAL PRESENT DAY COST				\$9,253,556
Land cost allowance:				\$7,500,000

Assumption: No Enviromental Remediation on Site.

Economic Requirements

Tax or other economic incentives	Desirable
Ease of permitting	Desirable
Community acceptance	Desirable

All 23 sites met the preliminary site selection criteria, with the exception of one site that had nine acres. Four of the sites are located in or adjacent to Economic Development Zones, which provide tax and other incentives to businesses locating within their areas. Particular interest was expressed by NYSEG for locating an ethanol facility near its stations. The NYSEG facilities have an additional importance for siting an ethanol facility, because its solid-fuel burning plants may be used to consume the lignin by-product from the ethanol facility. Four of the sites are NYSEG sites. The location of the sites can be seen in Figure 6-17 and additional information about the sites is provided in Table 6-11. Interest was expressed by Oswego County about potentially using of the Miller Brewery site as an Amoco biomass-to-ethanol facility (see Section 8).

SITE RANKING AND FINAL SELECTION

This subsection of the siting study differs from the corresponding subsection of the New York City study in that a comparative evaluation and ranking was not performed. Such a ranking was considered unnecessary because the upstate regions are significantly larger and have a greater range of sites. Also, the sites vary widely in terms of location and characteristics.

Developing a biomass-to-ethanol facility would be possible in either the Buffalo, Rochester, Syracuse, or Albany zones. Each of these zones meets or exceeds the threshold criteria of supplying approximately 500 tons per day of cellulose-bearing feedstock for recycling purposes. These zones also contain an urban center, a relatively dense population, adequate transportation infrastructure, and solid waste-burning facilities for the lignin by-product.

Siting an ethanol facility in any of these zones would help distribute economic development more equitably throughout the state and resolve solid waste management problems in the upstate region.

Other areas that would be feasible for a biomass-to-ethanol facility and could benefit from proximity to such a waste-to-energy plant are the Long Island and Westchester regions. Although not included in this phase of the study, they may be considered in a future study. Each of these regions rivals the amount of solid waste generated in New York City. Individually, New York City, Westchester, and Long Island rank as the top three regions for commercial and industrial waste generation in the State, and together they far outweigh the rest of the regions (see Figure 6-18). Figure 6-19 demonstrates that waste generation has been concentrated historically in Long Island and Westchester as well as in New York City. Not only do Long Island and Westchester rank highly in terms of waste generation, but they also have fairly dense populations and transportation infrastructures that would facilitate the logistics of locating and transferring waste. These two regions could act as self-contained units, each supporting its own biomass-to-ethanol facility.

**NEW YORK STATE
COMMERCIAL/INDUSTRIAL WASTESTREAM = 7.9 million tons**

**NEW YORK STATE
COMMERCIAL / INDUSTRIAL WASTE STREAM**

**Stone & Webster
Environmental
Services**

**BIOMASS to
ETHANOL
PLANT SITING STUDY**

Figure 6-18

MAP PROVIDED FOR HISTORIC REFERENCE ONLY

Stone & Webster Environmental Services

TONS/YEAR/ SQ.MI.	TONS/DAY/ SQ.MI.
0.0 - 400.0	0.0 - 1.1
400.1 - 1200.0	1.2 - 3.2
1200.1 - 2000.0	3.3 - 5.4
2000.1 +	5.5 +

BIOMASS to
ETHANOL
PLANT SITING STUDY

TOTAL WASTE DENSITY IN NEW YORK STATE
1970 NYS SOLID WASTE MANAGEMENT PLAN

0 25 50 miles

Figure 6-19

SECTION 7

CAPITAL AND OPERATING COST ESTIMATES FOR PREFERRED SITES

This section defines the capital costs for a 500-tpd plant constructed in one of four regions: Buffalo, Rochester, Syracuse, and Albany. It addresses the options of on-site and off-site oxidation of the solids by-product. Unlike the Part I cost estimates that were determined for two specific sites in New York City, these estimates were determined for four urban regions, each of which contains multiple potential sites. As noted in Section 6 (Site Ranking and Final Selection), the selection of preferred regional sites was considered unnecessary because their variation in terms of location and characteristics made them easy to differentiate.

The capital costs in terms of the process island, balance of plant, site improvements, and land costs for all regions are shown in Tables 7-1 through 7-8. Supportive information for these costs is found in the Appendix as Attachments 7-1 through 7-8.

The operating costs for the plants are reflected in Section 8 (Financial Pro Formas).

Table 7 - 1

**Budget Estimate for Biomass-to-Ethanol Facility
With On-site Oxidation.**

PART 2 - NY STATE PROJECT EVALUATION
SITE - BUFFALO

SUMMARY

DESCRIPTION	TOTAL COST
PROCESS ISLAND	\$55,940,000
BALANCE OF PLANT	\$44,265,000
SITE IMPROVEMENT	\$9,467,000
LAND COST	\$7,500,000
<hr/>	
TOTAL PRESENT PLANT COST	\$117,172,000

Table 7 - 2

Budget Estimate for Biomass-to-Ethanol Facility
With On-site Oxidation.
(500 tpd) - 10 Acre

PART 2 - NY STATE PROJECT EVALUATION
 SITE - BUFFALO

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
BALANCE OF PLANT				
Building (Admin.,Control,Lab.)	1	ls	\$1,435,320	\$1,435,320
Maint./Shop Bldg.	1	ls	\$1,302,420	\$1,302,420
Plant Air Supply	1	ls	\$354,400	\$354,400
Aerobic Watertreatment	1	ls	\$1,329,000	\$1,329,000
Chilled/Cooling Water Supply	1	ls	\$620,200	\$620,200
Boiler Feed Water	1	ls	\$354,400	\$354,400
Solid Oxidation/Power & Distribution	1	ls	\$26,580,000	\$26,580,000
Boiler Package	1	ls	\$886,000	\$886,000
Steam Turbine	1	ls	\$221,500	\$221,500
Sub-Total Cost				\$33,083,240
Start-up Cost	1	ls	\$496,249	\$496,249
Engineering - 10%	1	ls	\$3,308,324	\$3,308,324
SUB TOTAL				\$36,887,813
CONTINGENCY - 20%	1	ls	\$7,377,563	\$7,377,563
TOTAL PRESENT DAY COST - BOP				\$44,265,375

Table 7 - 3

**Budget Estimate for Biomass-to-Ethanol Facility
With On-site Oxidation.
(500 tpd) - 10 Acre**

PART 2 - NY STATE PROJECT EVALUATION - SITE IMPROVEMENT REQUIREMENTS

SITE - BUFFALO

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
Demolition	1	ls	\$0	\$0
Site Clearing & Grubbing	1	ls	\$44,300	\$44,300
Sewer and Drainage	1	ls	\$810,690	\$810,690
Access Roadways and Parking	1	ls	\$708,800	\$708,800
Piling	1	ls	\$1,772,000	\$1,772,000
Dewatering	1	ls	\$443,000	\$443,000
Make-up Water & Potable Water	1	ls	\$531,600	\$531,600
Sewer Hook-ups for Bathroom	1	ls	\$88,600	\$88,600
Fire Water	1	ls	\$1,240,400	\$1,240,400
Sprinkler System	1	ls	\$886,000	\$886,000
Fencing	1	ls	\$62,020	\$62,020
Gas Pipeline (Allow.)	1	ls	\$132,900	\$132,900
Site Lighting	1	ls	\$451,860	\$451,860
Sub-Total Cost				\$7,172,170
Engineering - 10%	1	ls	\$717,217	\$717,217
Sub-Total Cost				\$7,889,387
CONTINGENCY - 20%	1	ls	\$1,577,877	\$1,577,877
TOTAL PRESENT DAY COST				\$9,467,264
Land cost allowance:				\$7,500,000

Assumption: No Enviromental Remediation on Site.

Table 7 - 4

**Budget Estimate for Biomass-to-Ethanol Facility
Without Oxidation.**

PART 2 - NY STATE PROJECT EVALUATION
SITE - BUFFALO

SUMMARY

DESCRIPTION	TOTAL COST
PROCESS ISLAND	\$55,940,000
BALANCE OF PLANT	\$14,628,000
SITE IMPROVEMENT	\$9,467,000
LAND COST	\$7,500,000
<hr/> TOTAL PRESENT PLANT COST	<hr/> \$87,535,000

Table 7 – 5

**Budget Estimate for Biomass-to-Ethanol Facility
Without Oxidation.
(500 tpd) – 10 Acre**

PART 2 – NY STATE PROJECT EVALUATION
SITE – BUFFALO

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
BALANCE OF PLANT				
Building (Admin.,Control,Lab.)	1	ls	\$1,435,320	\$1,435,320
Maint./Shop Bldg.	1	ls	\$1,302,420	\$1,302,420
Plant Air Supply	1	ls	\$354,400	\$354,400
Aerobic Watertreatment	1	ls	\$1,329,000	\$1,329,000
Chilled/Cooling Water Supply	1	ls	\$620,200	\$620,200
Boiler Feed Water	1	ls	\$354,400	\$354,400
Power & Distribution	1	ls	\$4,430,000	\$4,430,000
Boiler Package	1	ls	\$886,000	\$886,000
Steam Turbine	1	ls	\$221,500	\$221,500
Sub-Total Cost				\$10,933,240
Start-up Cost	1	ls	\$163,999	\$163,999
Engineering – 10%	1	ls	\$1,093,324	\$1,093,324
SUB TOTAL				\$12,190,563
CONTINGENCY – 20%	1	ls	\$2,438,113	\$2,438,113
TOTAL PRESENT DAY COST – BOP				\$14,628,675

Table 7 – 6

**Budget Estimate for Biomass-to-Ethanol Facility
Without Oxidation.
(500 tpd) – 10 Acre**

**PART 2 – NY STATE PROJECT EVALUATION – SITE IMPROVEMENT REQUIREMENTS
SITE – BUFFALO**

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
Demolition	1	ls	\$0	\$0
Site Clearing & Grubbing	1	ls	\$44,300	\$44,300
Sewer and Drainage	1	ls	\$810,690	\$810,690
Access Roadways and Parking	1	ls	\$708,800	\$708,800
Piling	1	ls	\$1,772,000	\$1,772,000
Dewatering	1	ls	\$443,000	\$443,000
Make-up Water & Potable Water	1	ls	\$531,600	\$531,600
Sewer Hook-ups for Bathroom	1	ls	\$88,600	\$88,600
Fire Water	1	ls	\$1,240,400	\$1,240,400
Sprinkler System	1	ls	\$886,000	\$886,000
Fencing	1	ls	\$62,020	\$62,020
Gas Pipeline (Allow.)	1	ls	\$132,900	\$132,900
Site Lighting	1	ls	\$451,860	\$451,860
Sub-Total Cost				\$7,172,170
Engineering – 10%	1	ls	\$717,217	\$717,217
Sub-Total Cost				\$7,889,387
CONTINGENCY – 20%	1	ls	\$1,577,877	\$1,577,877
TOTAL PRESENT DAY COST				\$9,467,264
Land cost allowance:				\$7,500,000

Assumption: No Enviromental Remediation on Site.

Table 7 - 7

**Budget Estimate for Biomass-to-Ethanol Facility
With On-site Oxidation.**

PART 2 - NY STATE PROJECT EVALUATION
SITE - ROCHESTER

SUMMARY

DESCRIPTION	TOTAL COST
PROCESS ISLAND	\$54,972,600
BALANCE OF PLANT	\$43,832,000
SITE IMPROVEMENT	\$9,375,000
LAND COST	\$7,500,000
<hr/>	
TOTAL PRESENT PLANT COST	\$115,679,600

Table 7 - 8

Budget Estimate for Biomass-to-Ethanol Facility
With On-site Oxidation.
(500 tpd) - 10 Acre

PART 2 - NY STATE PROJECT EVALUATION
SITE - ROCHESTER

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
BALANCE OF PLANT				
Building (Admin.,Control,Lab.)	1	ls	\$1,421,275	\$1,421,275
Maint./Shop Bldg.	1	ls	\$1,289,675	\$1,289,675
Plant Air Supply	1	ls	\$350,932	\$350,932
Aerobic Watertreatment	1	ls	\$1,315,995	\$1,315,995
Chilled/Cooling Water Supply	1	ls	\$614,131	\$614,131
Boiler Feed Water	1	ls	\$350,932	\$350,932
Solid Oxidation/Power & Distribution	1	ls	\$26,319,900	\$26,319,900
Boiler Package	1	ls	\$877,330	\$877,330
Steam Turbine	1	ls	\$219,333	\$219,333
Sub-Total Cost				\$32,759,502
Start-up Cost	1	ls	\$491,393	\$491,393
Engineering - 10%	1	ls	\$3,275,950	\$3,275,950
SUB TOTAL				\$36,526,845
CONTINGENCY - 20%	1	ls	\$7,305,369	\$7,305,369
TOTAL PRESENT DAY COST - BOP				\$43,832,214

Table 7 – 9

**Budget Estimate for Biomass-to-Ethanol Facility
With On-site Oxidation.
(500 tpd) – 10 Acre**

PART 2 - NY STATE PROJECT EVALUATION - SITE IMPROVEMENT REQUIREMENTS
SITE - ROCHESTER

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
Demolition	1	ls	\$0	\$0
Site Clearing & Grubbing	1	ls	\$43,870	\$43,870
Sewer and Drainage	1	ls	\$802,821	\$802,821
Access Roadways and Parking	1	ls	\$701,920	\$701,920
Piling	1	ls	\$1,754,800	\$1,754,800
Dewatering	1	ls	\$438,700	\$438,700
Make-up Water & Potable Water	1	ls	\$526,440	\$526,440
Sewer Hook-ups for Bathroom	1	ls	\$87,740	\$87,740
Fire Water	1	ls	\$1,228,360	\$1,228,360
Sprinkler System	1	ls	\$877,400	\$877,400
Fencing	1	ls	\$61,418	\$61,418
Gas Pipeline (Allow.)	1	ls	\$131,610	\$131,610
Site Lighting	1	ls	\$447,474	\$447,474
Sub-Total Cost				\$7,102,553
Engineering - 10%	1	ls	\$710,255	\$710,255
Sub-Total Cost				\$7,812,808
CONTINGENCY - 20%	1	ls	\$1,562,562	\$1,562,562
TOTAL PRESENT DAY COST				\$9,375,370
Land cost allowance:				\$7,500,000

Assumption: No Enviromental Remediation on Site.

Table 7 - 10

**Budget Estimate for Biomass-to-Ethanol Facility
Without Oxidation.**

**PART 2 - NY STATE PROJECT EVALUATION
SITE - ROCHESTER**

SUMMARY

DESCRIPTION	TOTAL COST
PROCESS ISLAND	\$54,972,600
BALANCE OF PLANT	\$14,485,600
SITE IMPROVEMENT	\$9,375,000
LAND COST	\$7,500,000
<hr/> TOTAL PRESENT PLANT COST	<hr/> \$86,333,200

Table 7 – 11

Budget Estimate for Biomass-to-Ethanol Facility
Without Oxidation.
(500 tpd) – 10 Acre

PART 2 – NY STATE PROJECT EVALUATION
SITE – ROCHESTER

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
BALANCE OF PLANT				
Building (Admin.,Control,Lab.)	1	ls	\$1,421,226	\$1,421,226
Maint./Shop Bldg.	1	ls	\$1,289,631	\$1,289,631
Plant Air Supply	1	ls	\$350,920	\$350,920
Aerobic Watertreatment	1	ls	\$1,315,950	\$1,315,950
Chilled/Cooling Water Supply	1	ls	\$614,110	\$614,110
Boiler Feed Water	1	ls	\$350,920	\$350,920
Power & Distribution	1	ls	\$4,386,500	\$4,386,500
Boiler Package	1	ls	\$877,300	\$877,300
Steam Turbine	1	ls	\$219,325	\$219,325
Sub-Total Cost				\$10,825,882
Start-up Cost	1	ls	\$162,388	\$162,388
Engineering – 10%	1	ls	\$1,082,588	\$1,082,588
SUB TOTAL				\$12,070,858
CONTINGENCY – 20%	1	ls	\$2,414,172	\$2,414,172
TOTAL PRESENT DAY COST – BOP				\$14,485,030

Table 7 – 12

**Budget Estimate for Biomass-to-Ethanol Facility
Without Oxidation.
(500 tpd) – 10 Acre**

**PART 2 - NY STATE PROJECT EVALUATION - SITE IMPROVEMENT REQUIREMENTS
SITE - ROCHESTER**

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
Demolition	1	ls	\$0	\$0
Site Clearing & Grubbing	1	ls	\$43,870	\$43,870
Sewer and Drainage	1	ls	\$802,821	\$802,821
Access Roadways and Parking	1	ls	\$701,920	\$701,920
Piling	1	ls	\$1,754,800	\$1,754,800
Dewatering	1	ls	\$438,700	\$438,700
Make-up Water & Potable Water	1	ls	\$526,440	\$526,440
Sewer Hook-ups for Bathroom	1	ls	\$87,740	\$87,740
Fire Water	1	ls	\$1,228,360	\$1,228,360
Sprinkler System	1	ls	\$877,400	\$877,400
Fencing	1	ls	\$61,418	\$61,418
Gas Pipeline (Allow.)	1	ls	\$131,610	\$131,610
Site Lighting	1	ls	\$447,474	\$447,474
Sub-Total Cost				\$7,102,553
Engineering - 10%	1	ls	\$710,255	\$710,255
Sub-Total Cost				\$7,812,808
CONTINGENCY - 20%	1	ls	\$1,562,562	\$1,562,562
TOTAL PRESENT DAY COST				\$9,375,370
Land cost allowance:				\$7,500,000

Assumption: No Enviromental Remediation on Site.

Table 7 – 13

**Budget Estimate for Biomass-to-Ethanol Facility
With On-site Oxidation.**

PART 2 - NY STATE PROJECT EVALUATION
SITE - SYRACUSE

SUMMARY

DESCRIPTION	TOTAL COST
PROCESS ISLAND	\$53,199,300
BALANCE OF PLANT	\$43,000,000
SITE IMPROVEMENT	\$9,198,000
LAND COST	\$7,500,000
<hr/>	
TOTAL PRESENT PLANT COST	\$112,897,300

Table 7 - 14

**Budget Estimate for Biomass-to-Ethanol Facility
With On-site Oxidation.
(500 tpd) - 10 Acre**

**PART 2 - NY STATE PROJECT EVALUATION
SITE - SYRACUSE**

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
BALANCE OF PLANT				
Building (Admin.,Control,Lab.)	1	ls	\$1,394,285	\$1,394,285
Maint./Shop Bldg.	1	ls	\$1,265,185	\$1,265,185
Plant Air Supply	1	ls	\$344,268	\$344,268
Aerobic Watertreatment	1	ls	\$1,291,005	\$1,291,005
Chilled/Cooling Water Supply	1	ls	\$602,469	\$602,469
Boiler Feed Water	1	ls	\$344,268	\$344,268
Solid Oxidation/Power & Distribution	1	ls	\$25,820,100	\$25,820,100
Boiler Package	1	ls	\$860,670	\$860,670
Steam Turbine	1	ls	\$215,168	\$215,168
Sub-Total Cost				\$32,137,418
Start-up Cost	1	ls	\$482,061	\$482,061
Engineering - 10%	1	ls	\$3,213,742	\$3,213,742
SUB TOTAL				\$35,833,221
CONTINGENCY - 20%	1	ls	\$7,166,644	\$7,166,644
TOTAL PRESENT DAY COST - BOP				\$42,999,865

Table 7 – 15

**Budget Estimate for Biomass-to-Ethanol Facility
With On-site Oxidation.
(500 tpd) – 10 Acre**

**PART 2 - NY STATE PROJECT EVALUATION - SITE IMPROVEMENT REQUIREMENTS
SITE - SYRACUSE**

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
Demolition	1	ls	\$0	\$0
Site Clearing & Grubbing	1	ls	\$43,040	\$43,040
Sewer and Drainage	1	ls	\$787,632	\$787,632
Access Roadways and Parking	1	ls	\$688,640	\$688,640
Piling	1	ls	\$1,721,600	\$1,721,600
Dewatering	1	ls	\$430,400	\$430,400
Make-up Water & Potable Water	1	ls	\$516,480	\$516,480
Sewer Hook-ups for Bathroom	1	ls	\$86,080	\$86,080
Fire Water	1	ls	\$1,205,120	\$1,205,120
Sprinkler System	1	ls	\$860,800	\$860,800
Fencing	1	ls	\$60,256	\$60,256
Gas Pipeline (Allow.)	1	ls	\$129,120	\$129,120
Site Lighting	1	ls	\$439,008	\$439,008
Sub-Total Cost				\$6,968,176
Engineering – 10%	1	ls	\$696,818	\$696,818
Sub-Total Cost				\$7,664,994
CONTINGENCY – 20%	1	ls	\$1,532,999	\$1,532,999
TOTAL PRESENT DAY COST				\$9,197,992
Land cost allowance:				\$7,500,000

Assumption: No Enviromental Remediation on Site.

Table 7 – 16

**Budget Estimate for Biomass-to-Ethanol Facility
Without Oxidation.**

PART 2 - NY STATE PROJECT EVALUATION
SITE - SYRACUSE

SUMMARY

DESCRIPTION	TOTAL COST
PROCESS ISLAND	\$53,199,300
BALANCE OF PLANT	\$14,213,000
SITE IMPROVEMENT	\$9,198,000
LAND COST	\$7,500,000
<hr/>	
TOTAL PRESENT PLANT COST	\$84,110,300

Table 7 – 17

Budget Estimate for Biomass-to-Ethanol Facility
Without Oxidation.
(500 tpd) – 10 Acre

PART 2 – NY STATE PROJECT EVALUATION
 SITE – SYRACUSE

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
BALANCE OF PLANT				
Building (Admin.,Control,Lab.)	1	ls	\$1,394,496	\$1,394,496
Maint./Shop Bldg.	1	ls	\$1,265,376	\$1,265,376
Plant Air Supply	1	ls	\$344,320	\$344,320
Aerobic Watertreatment	1	ls	\$1,291,200	\$1,291,200
Chilled/Cooling Water Supply	1	ls	\$602,560	\$602,560
Boiler Feed Water	1	ls	\$344,320	\$344,320
Power & Distribution	1	ls	\$4,304,000	\$4,304,000
Boiler Package	1	ls	\$860,800	\$860,800
Steam Turbine	1	ls	\$215,200	\$215,200
Sub-Total Cost				\$10,622,272
Start-up Cost	1	ls	\$159,334	\$159,334
Engineering – 10%	1	ls	\$1,062,227	\$1,062,227
SUB TOTAL				\$11,843,833
CONTINGENCY – 20%	1	ls	\$2,368,767	\$2,368,767
TOTAL PRESENT DAY COST – BOP				\$14,212,600

Table 7 – 18

**Budget Estimate for Biomass-to-Ethanol Facility
Without Oxidation.
(500 tpd) – 10 Acre**

**PART 2 – NY STATE PROJECT EVALUATION – SITE IMPROVEMENT REQUIREMENTS
SITE – SYRACUSE**

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
Demolition	1	ls	\$0	\$0
Site Clearing & Grubbing	1	ls	\$43,040	\$43,040
Sewer and Drainage	1	ls	\$787,632	\$787,632
Access Roadways and Parking	1	ls	\$688,640	\$688,640
Piling	1	ls	\$1,721,600	\$1,721,600
Dewatering	1	ls	\$430,400	\$430,400
Make-up Water & Potable Water	1	ls	\$516,480	\$516,480
Sewer Hook-ups for Bathroom	1	ls	\$86,080	\$86,080
Fire Water	1	ls	\$1,205,120	\$1,205,120
Sprinkler System	1	ls	\$860,800	\$860,800
Fencing	1	ls	\$60,256	\$60,256
Gas Pipeline (Allow.)	1	ls	\$129,120	\$129,120
Site Lighting	1	ls	\$439,008	\$439,008
Sub-Total Cost				\$6,968,176
Engineering – 10%	1	ls	\$696,818	\$696,818
Sub-Total Cost				\$7,664,994
CONTINGENCY – 20%	1	ls	\$1,532,999	\$1,532,999
TOTAL PRESENT DAY COST				\$9,197,992
Land cost allowance:				\$7,500,000

Assumption: No Enviromental Remediation on Site.

Table 7 - 19

**Budget Estimate for Biomass-to-Ethanol Facility
With On-site Oxidation.**

PART 2 - NY STATE PROJECT EVALUATION
SITE - ALBANY

SUMMARY

DESCRIPTION	TOTAL COST
PROCESS ISLAND	\$53,683,000
BALANCE OF PLANT	\$43,250,000
SITE IMPROVEMENT	\$9,250,000
LAND COST	\$7,500,000
<hr/>	
TOTAL PRESENT PLANT COST	\$113,683,000

Table 7 – 20

**Budget Estimate for Biomass-to-Ethanol Facility
With On-site Oxidation.
(500 tpd) – 10 Acre**

**PART 2 - NY STATE PROJECT EVALUATION
SITE - ALBANY**

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
BALANCE OF PLANT				
Building (Admin.,Control,Lab.)	1	ls	\$1,402,434	\$1,402,434
Maint./Shop Bldg.	1	ls	\$1,272,579	\$1,272,579
Plant Air Supply	1	ls	\$346,280	\$346,280
Aerobic Watertreatment	1	ls	\$1,298,550	\$1,298,550
Chilled/Cooling Water Supply	1	ls	\$605,990	\$605,990
Boiler Feed Water	1	ls	\$346,280	\$346,280
Solid Oxidation/Power & Distribution	1	ls	\$25,971,000	\$25,971,000
Boiler Package	1	ls	\$865,700	\$865,700
Steam Turbine	1	ls	\$216,425	\$216,425
Sub-Total Cost				\$32,325,238
Start-up Cost	1	ls	\$484,879	\$484,879
Engineering - 10%	1	ls	\$3,232,524	\$3,232,524
SUB TOTAL				\$36,042,640
CONTINGENCY - 20%	1	ls	\$7,208,528	\$7,208,528
TOTAL PRESENT DAY COST - BOP				\$43,251,168

Table 7 – 21

**Budget Estimate for Biomass-to-Ethanol Facility
With On-site Oxidation.
(500 tpd) – 10 Acre**

**PART 2 - NY STATE PROJECT EVALUATION - SITE IMPROVEMENT REQUIREMENTS
SITE - ALBANY**

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
Demolition	1	ls	\$0	\$0
Site Clearing & Grubbing	1	ls	\$43,300	\$43,300
Sewer and Drainage	1	ls	\$792,390	\$792,390
Access Roadways and Parking	1	ls	\$692,800	\$692,800
Piling	1	ls	\$1,732,000	\$1,732,000
Dewatering	1	ls	\$433,000	\$433,000
Make-up Water & Potable Water	1	ls	\$519,600	\$519,600
Sewer Hook-ups for Bathroom	1	ls	\$86,600	\$86,600
Fire Water	1	ls	\$1,212,400	\$1,212,400
Sprinkler System	1	ls	\$866,000	\$866,000
Fencing	1	ls	\$60,620	\$60,620
Gas Pipeline (Allow.)	1	ls	\$129,900	\$129,900
Site Lighting	1	ls	\$441,660	\$441,660
Sub-Total Cost				\$7,010,270
Engineering - 10%	1	ls	\$701,027	\$701,027
Sub-Total Cost				\$7,711,297
CONTINGENCY - 20%	1	ls	\$1,542,259	\$1,542,259
TOTAL PRESENT DAY COST				\$9,253,556
Land cost allowance:				\$7,500,000

Assumption: No Enviromental Remediation on Site.

Table 7 - 22

**Budget Estimate for Biomass-to-Ethanol Facility
Without Oxidation.**

PART 2 - NY STATE PROJECT EVALUATION
SITE - ALBANY

SUMMARY

DESCRIPTION	TOTAL COST
PROCESS ISLAND	\$53,683,000
BALANCE OF PLANT	\$14,287,000
SITE IMPROVEMENT	\$9,250,000
LAND COST	\$7,500,000
<hr/>	
TOTAL PRESENT PLANT COST	\$84,720,000

Table 7 - 23

**Budget Estimate for Biomass-to-Ethanol Facility
Without Oxidation.
(500 tpd) - 10 Acre**

PART 2 - NY STATE PROJECT EVALUATION
SITE - ALBANY

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
BALANCE OF PLANT				
Building (Admin.,Control,Lab.)	1	ls	\$1,401,802	\$1,401,802
Maint./Shop Bldg.	1	ls	\$1,272,006	\$1,272,006
Plant Air Supply	1	ls	\$346,124	\$346,124
Aerobic Watertreatment	1	ls	\$1,297,965	\$1,297,965
Chilled/Cooling Water Supply	1	ls	\$605,717	\$605,717
Boiler Feed Water	1	ls	\$346,124	\$346,124
Power & Distribution	1	ls	\$4,326,550	\$4,326,550
Boiler Package	1	ls	\$865,310	\$865,310
Steam Turbine	1	ls	\$216,328	\$216,328
Sub-Total Cost				\$10,677,925
Start-up Cost	1	ls	\$160,169	\$160,169
Engineering - 10%	1	ls	\$1,067,793	\$1,067,793
SUB TOTAL				\$11,905,887
CONTINGENCY - 20%	1	ls	\$2,381,177	\$2,381,177
TOTAL PRESENT DAY COST - BOP				\$14,287,064

Table 7 - 24

**Budget Estimate for Biomass-to-Ethanol Facility
Without Oxidation.
(500 tpd) - 10 Acre**

**PART 2 - NY STATE PROJECT EVALUATION - SITE IMPROVEMENT REQUIREMENTS
SITE - ALBANY**

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
Demolition	1	ls	\$0	\$0
Site Clearing & Grubbing	1	ls	\$43,300	\$43,300
Sewer and Drainage	1	ls	\$792,390	\$792,390
Access Roadways and Parking	1	ls	\$692,800	\$692,800
Piling	1	ls	\$1,732,000	\$1,732,000
Dewatering	1	ls	\$433,000	\$433,000
Make-up Water & Potable Water	1	ls	\$519,600	\$519,600
Sewer Hook-ups for Bathroom	1	ls	\$86,600	\$86,600
Fire Water	1	ls	\$1,212,400	\$1,212,400
Sprinkler System	1	ls	\$866,000	\$866,000
Fencing	1	ls	\$60,620	\$60,620
Gas Pipeline (Allow.)	1	ls	\$129,900	\$129,900
Site Lighting	1	ls	\$441,660	\$441,660
Sub-Total Cost				\$7,010,270
Engineering - 10%	1	ls	\$701,027	\$701,027
Sub-Total Cost				\$7,711,297
CONTINGENCY - 20%	1	ls	\$1,542,259	\$1,542,259
TOTAL PRESENT DAY COST				\$9,253,556
Land cost allowance:				\$7,500,000

Assumption: No Environmental Remediation on Site.

Table 7 – 25

Biomass-to-Ethanol Facility
Cost Estimate.

BUFFALO
W/ OXIDIZER
(IN MILLIONS)

SITEWORK	\$7.1
CONCRETE	\$7.4
STRUCTURAL	\$4.3
EQUIPMENT	\$24.1
PIPING	\$8.0
ELECTRICAL	\$9.5
BUILDINGS	\$2.1
INSTRUMENTS	\$2.7
INSULATION	\$1.9
LAND	\$7.5
S/T	\$74.7
CONST. INDIRECTS	\$9.7
START-UP	\$0.5
CONSTRUCTION MGT.	\$1.7
ENGINEERING	\$10.3
CONTINGENCY	\$16.3
ENV. PERMITTING	\$2.8
INSURANCE	\$0.5
TAXES	\$0.7
PLANT CLOSURE	\$0.0
S/T	\$42.5
TOTAL	\$117.2

Table 7 - 26

Biomass-to-Ethanol Facility
Cost Estimate.

BUFFALO
W/O OXIDIZER
(IN MILLIONS)

SITEWORK	\$6.6
CONCRETE	\$5.5
STRUCTURAL	\$3.2
EQUIPMENT	\$16.5
PIPING	\$4.3
ELECTRICAL	\$6.1
BUILDINGS	\$2.0
INSTRUMENTS	\$2.3
INSULATION	\$1.6
LAND	\$7.5
S/T	\$55.5
CONST. INDIRECTS	\$6.7
START-UP	\$0.2
CONSTRUCTION MGT.	\$1.7
ENGINEERING	\$8.0
CONTINGENCY	\$11.4
ENV. PERMITTING	\$2.8
INSURANCE	\$0.5
TAXES	\$0.7
PLANT CLOSURE	\$0.0
S/T	\$32.0
TOTAL	\$87.6

TABLE 7 – 27

Biomass-to-Ethanol Facility
Cost Estimate.

ROCHESTER
W/ OXIDIZER
(IN MILLIONS)

SITework	\$7.0
CONCRETE	\$7.3
STRUCTURAL	\$4.2
EQUIPMENT	\$23.8
PIPING	\$7.9
ELECTRICAL	\$9.4
BUILDINGS	\$2.0
INSTRUMENTS	\$2.6
INSULATION	\$1.9
LAND	\$7.5
S/T	\$73.8
CONST. INDIRECTS	\$9.5
START-UP	\$0.5
CONSTRUCTION MGT.	\$1.7
ENGINEERING	\$10.1
CONTINGENCY	\$16.0
ENV. PERMITTING	\$2.8
INSURANCE	\$0.5
TAXES	\$0.7
PLANT CLOSURE	\$0.0
S/T	\$41.9
TOTAL	\$115.7

TABLE 7 - 28

Biomass-to-Ethanol Facility
Cost Estimate.

ROCHESTER
W/O OXIDIZER
(IN MILLIONS)

SITWORK	\$6.5
CONCRETE	\$5.4
STRUCTURAL	\$3.1
EQUIPMENT	\$16.2
PIPING	\$4.2
ELECTRICAL	\$6.0
BUILDINGS	\$2.0
INSTRUMENTS	\$2.2
INSULATION	\$1.5
LAND	\$7.5
S/T	\$54.8
CONST. INDIRECTS	\$6.6
START-UP	\$0.2
CONSTRUCTION MGT.	\$1.7
ENGINEERING	\$7.9
CONTINGENCY	\$11.2
ENV. PERMITTING	\$2.8
INSURANCE	\$0.5
TAXES	\$0.7
PLANT CLOSURE	\$0.0
S/T	\$31.5
TOTAL	\$86.4

Table 7 – 29

Biomass-to-Ethanol Facility
Cost Estimate.

SYRACUSE
W/ OXIDIZER
(IN MILLIONS)

SITEWORK	\$6.8
CONCRETE	\$7.1
STRUCTURAL	\$4.1
EQUIPMENT	\$23.2
PIPING	\$7.7
ELECTRICAL	\$9.1
BUILDINGS	\$2.0
INSTRUMENTS	\$2.6
INSULATION	\$1.9
LAND	\$7.5
S/T	\$72.1
CONST. INDIRECTS	\$9.3
START-UP	\$0.5
CONSTRUCTION MGT.	\$1.7
ENGINEERING	\$9.9
CONTINGENCY	\$15.6
ENV. PERMITTING	\$2.7
INSURANCE	\$0.5
TAXES	\$0.7
PLANT CLOSURE	\$0.0
S/T	\$40.8
TOTAL	\$112.9

Table 7 – 30

Biomass-to-Ethanol Facility
Cost Estimate.

SYRACUSE
W/O OXIDIZER
(IN MILLIONS)

SITework	\$6.4
CONCRETE	\$5.3
STRUCTURAL	\$3.0
EQUIPMENT	\$15.8
PIPING	\$4.1
ELECTRICAL	\$5.8
BUILDINGS	\$2.0
INSTRUMENTS	\$2.2
INSULATION	\$1.5
LAND	\$7.5
S/T	\$53.5
CONST. INDIRECTS	\$6.5
START-UP	\$0.1
CONSTRUCTION MGT.	\$1.6
ENGINEERING	\$7.7
CONTINGENCY	\$10.9
ENV. PERMITTING	\$2.7
INSURANCE	\$0.5
TAXES	\$0.7
PLANT CLOSURE	\$0.0
S/T	\$30.6
TOTAL	\$84.1

Table 7 – 31

Biomass-to-Ethanol Facility
Cost Estimate.

ALBANY
W/ OXIDIZER
(IN MILLIONS)

SITWORK	\$6.9
CONCRETE	\$7.2
STRUCTURAL	\$4.2
EQUIPMENT	\$23.3
PIPING	\$7.8
ELECTRICAL	\$9.2
BUILDINGS	\$2.0
INSTRUMENTS	\$2.6
INSULATION	\$1.9
LAND	\$7.5
S/T	\$72.6
CONST. INDIRECTS	\$9.4
START-UP	\$0.5
CONSTRUCTION MGT.	\$1.7
ENGINEERING	\$10.0
CONTINGENCY	\$15.7
ENV. PERMITTING	\$2.7
INSURANCE	\$0.5
TAXES	\$0.7
PLANT CLOSURE	\$0.0
S/T	\$41.1
TOTAL	\$113.7

Table 7 - 32

Biomass-to-Ethanol Facility
Cost Estimate.

ALBANY
W/O OXIDIZER
(IN MILLIONS)

SITework	\$6.4
CONCRETE	\$5.3
STRUCTURAL	\$3.0
EQUIPMENT	\$15.9
PIPING	\$4.1
ELECTRICAL	\$5.9
BUILDINGS	\$2.0
INSTRUMENTS	\$2.2
INSULATION	\$1.5
LAND	\$7.5
S/T	\$53.8
CONST. INDIRECTS	\$6.5
START-UP	\$0.1
CONSTRUCTION MGT.	\$1.6
ENGINEERING	\$7.8
CONTINGENCY	\$11.0
ENV. PERMITTING	\$2.7
INSURANCE	\$0.5
TAXES	\$0.7
PLANT CLOSURE	\$0.0
S/T	\$30.9
TOTAL	\$84.7

SECTION 8

FINANCIAL EVALUATION FOR PREFERRED SITES

FINANCIAL PRO FORMAS

Introduction

Stone & Webster Development Corporation (SWDC) has evaluated the biomass-to-ethanol project for financial viability and risk from the point of view of a project developer. The project was evaluated by determining the pricing necessary to generate revenues that would provide an acceptable return on owner's equity, and comparing the required pricing to expected market prices.

In this section, the project and its variations (i.e., feedstock, output, sizes) are described to the extent necessary for input to the financial analysis. The financial structure of a potential developer is then defined and its revenue requirements from tipping fees or from ethanol sales are determined, which in turn yield the required return on equity for the developer/equity partners. A pro forma financial cash flow statement is presented to demonstrate profitability. Finally, the results of sensitivity analyses are presented to provide assessments of project risks.

Project Description

A Master Input Table was set up to accept data in the form used by the pro forma analysis for numerous cases and four site locations: Albany, Buffalo, Rochester, and Syracuse. This table (Table 8-1a, b, c, and d) allows a side-by-side comparison of data for the various site locations and various product options, etc. The data needed for the evaluation included plant size, performance, capital cost, and operating costs. The evaluation was performed for the plant size of 500 tpd on a dry basis (595 tpd wet), and the feedstock assumed was a mixed stock consisting of 50 percent waste wood and 50 percent waste paper.

Within each site location, two basic plant configurations were distinguished. A biomass facility with a gasification plant will convert the lignin produced by the conversion process to power and steam to be used within the facility. The power plant produces excess power, which is sold off-site to a utility. The other configuration is a biomass facility that disposes of the waste lignin off-site and purchases all facility energy needs from local utilities. This pair of configurations is designated Options 1 and 2, 7 and 8, 13 and 14, 19 and 20 for Albany, Buffalo, Rochester and Syracuse, respectively.

The shading on Table 8-1a, b, c, and d, indicates direct data input. Nearly all of the data were provided by other study participants via Stone & Webster Engineering Corporation. Stone & Webster Development Corporation provided some unit pricing, including average annual labor rate, maintenance cost, power purchase and sales rates, water and sewer charges, and natural gas price.

The next four options (3 to 6, 15 to 18 and 21 to 24, 9 to 12) vary two parameters: market value for mixed stock, and lignin disposal cost. The market price for mixed stock was specified as \$20 and \$40/ton, leaving the sales price of ethanol to be determined. Lignin disposal is expected to cost the facility from zero (whereby a purchase price exactly offsets the transportation cost) to \$50/ton.

The results of evaluation show that the lowest price for ethanol that allows an acceptable return on broker's equity is \$1.94/gal at a feedstock price of \$20/ton for the site in Syracuse. Therefore, this site location was selected for analysis of the tipping fee necessary to generate required revenues at specified ethanol prices (options 25 to 30). In the above mentioned case, rather than setting a feedstock value and solving for the ethanol price, the sales price of ethanol was specified at \$1.20 and \$1.50/gal, leaving the tipping fee for the waste to be determined. The input data for this case are presented on Table 8-1e.

The options are numbered and briefly described as follows:

Albany	1	500 tpd (dry), with gasification, mixed stock @ \$20/ton
	2	500 tpd, without gasification, lignin disposal @ \$50/ton, mixed stock @ \$20/ton
	3	500 tpd, with gasification, mixed stock @ \$40/ton
	4	500 tpd, without gasification, lignin disposal @ \$50/ton, mixed stock @ \$40/ton
	5	500 tpd, without gasification, lignin disposal @ \$0/ton, mixed stock @ \$20/ton
	6	500 tpd, without gasification, lignin disposal @ \$0/ton, mixed stock @ \$40/ton
Buffalo	7	500 tpd, with gasification, mixed stock @ \$20/ton
	8	500 tpd, without gasification, lignin disposal @ \$50/ton, mixed stock @ \$20/ton
	9	500 tpd, with gasification, mixed stock @ \$40/ton
	10	500 tpd, without gasification, lignin disposal @ \$50/ton, mixed stock @ \$40/ton
	11	500 tpd, without gasification, lignin disposal @ \$0/ton, mixed stock @ \$20/ton
	12	500 tpd, without gasification, lignin disposal @ \$0/ton, mixed stock @ \$40/ton
Rochester	13	500 tpd (dry), with gasification, mixed stock @ \$20/ton
	14	500 tpd, without gasification, lignin disposal @ \$50/ton, mixed stock @ \$20/ton
	15	500 tpd, with gasification, mixed stock @ \$40/ton
	16	500 tpd, without gasification, lignin disposal @ \$50/ton, mixed stock @ \$40/ton
	17	500 tpd, without gasification, lignin disposal @ \$0/ton, mixed stock @ \$20/ton
	18	500 tpd, without gasification, lignin disposal @ \$0/ton, mixed stock @ \$40/ton
Syracuse	19	500 tpd, with gasification, mixed stock @ \$20/ton
	20	500 tpd, without gasification, lignin disposal @ \$50/ton, mixed stock @ \$20/ton
	21	500 tpd, with gasification, mixed stock @ \$40/ton
	22	500 tpd, without gasification, lignin disposal @ \$50/ton, mixed stock @ \$40/ton
	23	500 tpd, without gasification, lignin disposal @ \$0/ton, mixed stock @ \$20/ton

24	500 tpd, without gasification, lignin disposal @ \$0/ton, mixed stock @ \$40/ton
25	500 tpd (dry), with gasification, ethanol @ \$1.20/gal
26	500 tpd, without gasification, lignin disposal @ \$50/ton, ethanol @ \$1.20/gal
27	500 tpd, with gasification, ethanol @ \$1.50/gal
28	500 tpd, without gasification, lignin disposal @ \$50/ton, ethanol @ \$1.50/gal
29	500 tpd, without gasification, lignin disposal @ \$0/ton, ethanol @ \$1.20/gal
30	500 tpd, without gasification, lignin disposal @ \$0/ton, ethanol @ \$1.50/gal

The specific case data evaluated were automatically transferred to the pro forma evaluation when the analyst entered an Option Number on the Case Input table. The Case Input table documents the assumptions and input used in the analysis for each option evaluated. Most of the schedule, economic, and financial input was unchanged among the options evaluated and was entered on this table once at the beginning of the screening evaluation by the analyst.

For example, Tables 8-2a, b, c, and d, are illustrated with data for Options 1, 7, 12, and 19 for the four selected locations, respectively, with a 595 tpd (wet) plant with gasification, using mixed stock (50 percent waste wood and 50 percent wastepaper) as the feedstock at \$20/ton. Much of the data on these tables is repeated from the Master Input Table, but is tallied into total capital and operating costs. The total capital cost includes escalation and interest charges to yield a total installed cost as of the commercial operation date. For example, for Option 1, the total present day cost of \$113,683,000 increased to \$137,183,000 because of escalation and interest. The operating costs are tallied as both fixed and variable annual costs and as costs per gallon of ethanol produced. For Option 1, the annual operating budget is over \$5 million for fixed costs including labor, maintenance, and insurance, and over \$3 million for variable costs including ash disposal, chemicals, water, and sewer charges. The corresponding unit costs are \$0.37/gal and \$0.22/gal, for a total of \$0.59/gal of ethanol produced.

The case data for required tipping fee evaluation (Option 25: Syracuse) is presented on Table 8-2e.

Tables 8-2a, b, c, d, and e, also include input such as schedule, inflation, escalation, taxes, and financial data. The commercial operation date was assumed to be 4 years from now, which includes 2 years for construction. The economic life is 20 years per NYSERDA's requirement. A 10-year life was also evaluated, the results of which are presented in Section 9 Sensitivity Analysis. The plant is expected to operate at full capacity 83 percent of the time. Assumptions for long-term inflation at 4 percent and nominal escalation ranging from 4 percent for most cost components to 5.5 percent for natural gas were included in these tables.

Taxes included federal and state income taxes at 35 percent and 9 percent, respectively, and 8.25 percent gross receipts tax, which included both state and city rates. Property taxes were not included at this time because this would be site-specific. Tax depreciation was determined separately for several categories: buildings and structures, biomass conversion equipment, and balance of plant, in accordance with the 1986 Tax Reform Act.

Financial Analysis

Financial Structure. Developers of third party projects will generally seek to avoid carrying debt for the project on their own corporate balance sheets. They will attempt to create a financial structure which stands by itself, with debt backed only on the project's physical assets and the strength of its contractual relationships. This debt would be nonrecourse to the developer, in that lenders should not seek payment from the developer in the event of a project failure. To a large extent, the credit of the purchaser of the project's product and of the feedstock supplier are the basis for financing because it is these parties' commitments to make payments on a take-if-tendered basis that assures the lender that funds will be available for debt service.

Some projects are developed with long-term feedstock (fuel) and output (i.e., power, steam) contracts that provide some cash flow certainty; this project may be able to contract long-term for feedstock (wastepaper, wood waste) but may not have a long-term contract for the output (ethanol) thus increasing the project's financial risk. Other contractual obligations ensure that

the facility will be available: the lump-sum turnkey contractor guarantees that the facility will be built at a certain cost and date and that it will perform as required initially; the operation contractor guarantees that the facility will be adequately maintained so that the service can continue to be tendered.

When the contracting parties are financially strong and the project is basically sound, a high level of financial leverage is possible. Many projects in the process and energy sectors are financed with debt covering 80 percent or more of project cost. These are based mostly on the financial strength of the entity purchasing the project's output. In the case of an ethanol plant, the degree of financial leverage that can be obtained will depend on the strength of the entities supplying waste for feedstock and purchasing the ethanol. A debt level of 80 percent would provide for enough equity to mitigate these risks to some extent and is typical of many nonrecourse financings.

Lenders generally are limiting loan terms to about 10 to 15 years for financing most projects. This is shorter than the 20-year economic life being evaluated, and results in the need for higher revenues during the loan period. In general, the loan amortization period must be 1 to 2 years shorter than the term of the product off-take and feedstock contracts. Because ethanol is a commodity, the revenues for this project will be unit prices (\$/gal, \$/ton, etc) set by the marketplace; little opportunity exists to structure revenues to alleviate cash flow constraints during this period. The developer will probably focus attention on the debt structure to ease cash flow problems. Assuming bank financing (as opposed to taxable or tax-exempt bonds), interest rates are currently about 8 to 10 percent.

Equity in the project would generally be of two types: 1) general partner or active equity provided by the developer and/or equipment suppliers, construction contractor, or operating contractor; and 2) limited partner or passive equity that might be packaged for syndication by an investment banker. While the active equity holders may derive additional benefits from the project in terms of normal profits on services provided, the passive investor obtains a return solely from the cash flows of the project and associated tax benefits. The overall discounted

cash flow internal rate of return required for all equity participants is typically in the range of 20 percent or more, after-tax, for projects similar in market risk level to this biomass-to-ethanol project.

Revenue Requirements. All of the costs of the project have been estimated. In the case when the price of mixed stock (50 percent wood waste and 50 percent waste paper) was set, no revenues from tipping fees are available; the feedstock is an expense. A market price for the feedstock was input and all revenue requirements had to be borne by ethanol sales less a small amount of revenue generated by power sales when applicable. A required price per gallon of ethanol in 1994 dollars, escalating with inflation was calculated.

In the case when ethanol price is specified (Options 25 to 30), tipping fees must make up the revenue shortfall, if any, to the extent that will yield the developer's/equity partners' target return on equity. The evaluation was set up to calculate the required cost per ton of feedstock in January 1994 dollars, escalating with inflation. Note that a negative tipping fee would indicate an expense for the project operator and not revenue. This can occur either by design (the maximum allowable tipping fee for a feedstock is negative) or by chance (the revenues from the sale of ethanol are more than adequate to cover the cost of the project and provide the equity partners' required target rate of return).

Pro Forma Statements. SWDC has developed a pro forma financial cash flow statement for a hypothetical developer of a biomass-to-ethanol production facility.

A cash flow statement for four specified locations is presented on Tables 8-3a, b, c, and d for Options 1, 7, 13, 19. Revenues from the sale of ethanol are projected. If the project operator were to pay for any of the feedstock, that cash flow would be entered under Expenses. Gross margin is obtained by subtracting expenses from revenues, both of which are based on projected volume. The revenues for Option 25, Table 8-3e, include tipping. Taxable income is determined by subtracting interest and tax depreciation from gross margin. Income tax is simply taxable income multiplied by an effective income tax rate of 40.9 percent which combines the 35 percent

federal tax rate and the 9 percent deductible state tax rate.

Tax credits have not been included in this analysis but will be included in the sensitivity analysis under an economic incentives scenario. Depreciation is added back to income after tax, and after-tax items such as plant cost, loan proceeds, and principal payments are included to determine net cash flow available to equity participants. Cash flow is negative in 1997, indicating an investment of equity, and again in 2004 through 2007, indicating cash flow problems after the 5-year tax depreciation period has expired for the biomass portion of the plant. Other than those years, cash flow is positive in each year.

The debt service coverage ratio (DSCR), defined as the gross margin divided by principal and interest payment, is inadequate during the first 2 years. Obtaining financing is dependent, in part, upon demonstrating that the cash flows are sufficient to produce a minimum DSCR of at least 1.10 and average DSCR of at least 1.30 over the life of the loan. The shortfall is small and of short duration and, therefore, could be handled by changing the financing terms or by increasing the equity contribution. Any changes, however, can affect the equity return and so must be addressed carefully as the project is developed.

Initial Results. The pro forma evaluation was performed for the remaining 20 options to determine the required ethanol price and for five options for the Syracuse site to determine the required feedstock tipping fee. Printouts of the Case Input and pro forma statement for each of those analyses are included in the Appendix under Attachment 8-1. Table 8-4 presents a summary of the results.

The required ethanol prices always exceed \$1.50/gal. The 500-tpd plant with gasification produces ethanol for the least cost (\$1.94/gal) when the feedstock cost is \$20/ton (Syracuse). For the 500-tpd (dry) plant, the required tipping fee ranges from \$4.85 to \$60.83/ton, showing that revenue from feedstock tipping is necessary for a financially viable project, producing ethanol for \$1.20 to \$1.50/gal.

The other results in Table 8-4 are discussed in the following subsection.

Sensitivity Analysis. Given the results described above and recognizing that some uncertainty exists with costs that served as the basis of the evaluation, the results were tested to determine if there exists an opportunity for this project.

The following examples of the sensitivity analysis of capital cost and operating and maintenance cost are given for the Syracuse site (which is the most profitable location).

Capital Costs. Attachment Figure 8-13 presents the effect on the ethanol sales price of varying the capital cost for the mixed stock at \$20/ton. It is evident that significant reductions in capital cost, on the order of 35 to 80 percent, are needed if the ethanol sale price is \$1.50/gas.

If a feedstock will be purchased at \$40/ton, the necessary capital cost reductions are even higher, ranging from 68 to more than 100 percent (Attachment Figure 8-14).

Operating and Maintenance (O&M) Costs. Just as with the capital cost reductions, O&M costs would have to be reduced by 40 to 70 percent for the feedstock price \$20/ton to adequately and profitably cover the project costs. Please refer to Attachment Figure 8-15. A more significant reduction of 80 to over 100 percent is required when feedstock can be purchased for \$40/ton.

Several O&M cost components contribute significantly to the total cost: labor, power, lignin disposal, and chemicals. For Options 25 to 30, each of those costs were varied independently to determine the effect they have on the financial results. The resulting graphs are shown in Attachment Figures 8-21 through 8-28.

Sensitivity of the required tipping fee to variations in capital cost and in total O&M cost were evaluated for Syracuse (Options 25 to 30) to determine what magnitude of reductions are needed to produce ethanol competitively. Attachment Figures 8-17 and 8-18 present the results for the capital cost evaluation given ethanol sales prices at \$1.20 and \$1.50/gal, respectively. Reductions of 45 to over 75 percent are needed if the project is to be viable at ethanol sales alone sold at \$1.20/gal. Similar results occur for the O&M costs (refer to Attachment Figures 8-19 and 8-20).

Economic Incentives Economic incentives listed in "Draft RFP to Recycle Recovered Paper at Manufacturing Facility Located in New York City" were reviewed for applicability to the wastepaper project in upstate New York. The incentives are summarized by their potential effect on cash flow, and presented on Table 8-6. The incentives include low cost financing, and various tax credits including power and natural gas sales tax credits, wage and investment tax credits. The others were excluded for one of the following reasons:

- Not enough project data available to estimate value of the incentive
- Incentive not applicable to this project.

The indicated incentives were incorporated into the pro forma evaluation for the Syracuse site location (Options 19, 20, 25, and 26) to determine if they provide a significant improvement in the project viability for two types of evaluation: required ethanol sales price for the feedstock price of \$20/ton, and required tipping fee for the ethanol sales price of \$1.20/gal. The results are presented on Table 8-4. The results would be similar for the other regions.

The pro forma statements for these four options are included as Attachment Tables 8-15, 8-16, 8-17, and 8-18.

Economic Life. NYSERDA required that a 10-year economic life also be evaluated. The shorter time period increases the revenue required in the early years needed to recapture the investment and earn an adequate return. The 10-year evaluation was performed for Options 1, 2, 7, 8, 13, 14, 19, 20, 25, and 26. The results are shown on Table 8-4. The pro forma statements are included as Attachment Tables 8-5 through 8-14.

Conclusions

The project is marginally attractive, given the data to date. There is a limited opportunity for a project such as this, sited in upstate New York. The project should be as large as possible, and located in an Economic Development Zone to take advantage of economic incentives. The facility with a gasification plant appears to be more financially viable, because of the high energy costs in the area.

TABLE 8-1a
MASTER INPUT TABLE

FEEDSTOCK - MIXED, 50% WOOD WASTE & 50% WASTE PAPER

OPTION NO. :			SITE LOCATION - ALBANY, NY					
UNITS			1	2	3	4	5	6
Plant Size	tpd (wet)	2	595	695	595	595	595	595
Plant Site		3	1	1	1	1	1	1
Ethanol Production Rate	gal/ton (wet)	4	82.35	82.35	82.35	82.35	82.35	82.35
Additional Byproducts ? CO2	gpd	5	49,000	49,000	49,000	49,000	49,000	49,000
		6	0	0	0	0	0	0
Lignin	cf/ton (wet)	7	0.00	0.00	0.00	0.00	0.00	0.00
		8	0	1	0	1	1	1
	tons/ton (wet)	9	0.00	0.55	0.00	0.55	0.55	0.55
Feedstock - Waste paper	Percent of Feed Rate	10	0.0	0.0	0.0	0.0	0.0	0.0
	Conversion Efficiency	11	0.0	0.0	0.0	0.0	0.0	0.0
- Wood Waste	Percent of Feed Rate	12	0.0	0.0	0.0	0.0	0.0	0.0
	Conversion Efficiency	13	0.0	0.0	0.0	0.0	0.0	0.0
- Mixed stock	Percent of Feed Rate	14	0.0	0.0	0.0	0.0	0.0	0.0
	Conversion Efficiency	15	100.0	100.0	100.0	100.0	100.0	100.0
	lb/gal	16	24.29	24.29	24.29	24.29	24.29	24.29
Market Prices - Ethanol	\$/gal	17						
- CO2	\$/cf	18	tpd	tpd	tpd	tpd	tpd	tpd
- Lignin	\$/ton	19	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
		20	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Maximum Allowable Tipping Fee (if applicable)		21						
- Waste Paper	\$/ton	22						
- Wood Waste	\$/ton	23						
- Mixed Stock	\$/ton	24						
		25	(\$20.00)	(\$20.00)	(\$40.00)	(\$40.00)	(\$20.00)	(\$40.00)
Capital Cost of Facility	Scaling Factor (if appl)	26						
Land	\$1000	27						
Buildings	\$1000	28	\$7,500	\$7,500	\$7,500	\$7,500	\$7,500	\$7,500
Development Costs	\$1000	29	\$9,250	\$9,250	\$9,250	\$9,250	\$9,250	\$9,250
Plant:		30	\$0	\$0	\$0	\$0	\$0	\$0
Biomass Conversion	\$1000	31	\$53,683	\$53,683	\$53,683	\$53,683	\$53,683	\$53,683
Balance of Plant	\$1000	32	\$43,250	\$14,287	\$43,250	\$14,287	\$14,287	\$14,287
		33						
Working Capital	LATER	34	\$0	\$0	\$0	\$0	\$0	\$0
		35						
Annual Operating Costs		36						
Fixed:		37						
Labor	\$35,000 /yr avg. per person	38						
	\$1000	39	\$3,010	\$2,310	\$3,010	\$2,310	\$2,310	\$2,310
	No. of people	40	88	68	88	68	68	68
Fixed Maintenance @	1% of capital	41	\$1,060	\$770	\$1,060	\$770	\$770	\$770
Variable:		42						
Variable Maintenance	\$/gal	43	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000
Waste Disposal - Pretreatment	\$/gal	44	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000
- Fermentation	\$/gal	45	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000
- Solids Separation	\$65 /ton of ash	46	\$0.049	\$0.000	\$0.049	\$0.000	\$0.000	\$0.000
	lb/hr	47	3,050	0	3,050	0	0	0
	\$50 /ton of lignin	48	\$0.000	\$0.332	\$0.000	\$0.332	\$0.000	\$0.000
	tpd	49	0	325	0	325	325	325
	Lignin production rate	50	\$0.160	\$0.160	\$0.160	\$0.160	\$0.160	\$0.160
Chemicals		51						
Utilities		52						
Power @	\$0.06 /kwh	53	\$0.000	\$0.141	\$0.000	\$0.141	\$0.141	\$0.141
	Purchased Power	54	0	4.8	0	4.8	4.8	4.8
Water @	\$1.96 /kgal	55	\$0.004	\$0.009	\$0.004	\$0.009	\$0.009	\$0.009
	Makeup Water	56	68	152	68	152	152	152
Natural Gas @	\$5.30 /MBtu	57	\$0.000	\$0.099	\$0.000	\$0.099	\$0.099	\$0.099
	Fuel Consumption	58	0	38	0	38	38	38
Steam	\$/gal	59	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000
Waste Water @	\$1.96 /kgal sewer rate	60	\$0.006	\$0.006	\$0.006	\$0.006	\$0.006	\$0.006
	Discharge Rate	61	100	100	100	100	100	100
Additional Revenue - Power Sales	\$0.03 /kwh	62	\$0.081	\$0.000	\$0.081	\$0.000	\$0.000	\$0.000
	Excess Capacity for Sale		5.5	0	5.5	0	0	0

Note: Shaded cells for Options 1 and 2 are input cells. Shaded cells for Options 3 through 6 highlight variations from Options 1 and 2.

TABLE 8-1b

MASTER INPUT TABLE

FEEDSTOCK — MIXED, 50% WOOD WASTE & 50% WASTE PAPER

		OPTION NO. :		SITE LOCATION — BUFFALO, NY					
		UNITS		7	8	9	10	11	12
Plant Size		tpd (wet)	1	595	595	595	595	595	595
Plant Site			2	1	1	1	1	1	1
Ethanol Production Rate		gal/ton (wet)	3	82.35	82.35	82.35	82.35	82.35	82.35
Additional Byproducts ? CO2	(Yes = 1, No = 0)	gpd	4	49,000	49,000	49,000	49,000	49,000	49,000
Lignin	Production Rate	cf/ton (wet)	5	0	0	0	0	0	0
	(Yes = 1, No = 0)		6	0	0	0	0	0	0
	Production Rate	tons/ton (wet)	7	0.00	0.00	0.00	0.00	0.00	0.00
			8	0	1	0	1	1	1
			9	0.00	0.55	0.00	0.55	0.55	0.55
Feedstock — Waste paper	Percent of Feed Rate	%	10	0.0	0.0	0.0	0.0	0.0	0.0
— Wood Waste	Conversion Efficiency	lb/gal	11	0.00	0.00	0.00	0.00	0.00	0.00
— Mixed stock	Percent of Feed Rate	%	12	0.0	0.0	0.0	0.0	0.0	0.0
	Conversion Efficiency	lb/gal	13	0.00	0.00	0.00	0.00	0.00	0.00
	Percent of Feed Rate	%	14	100.0	100.0	100.0	100.0	100.0	100.0
	Conversion Efficiency	lb/gal	15	24.29	24.29	24.29	24.29	24.29	24.29
Market Prices — Ethanol		\$/gal	16	td	td	td	td	td	td
— CO2		\$/cf	17	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
— Lignin		\$/ton	18	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Maximum Allowable Tipping Fee (if applicable)			19						
— Waste Paper	(Enter 1,000,000 if N/A)	\$/ton	20						
— Wood Waste		\$/ton	21						
— Mixed Stock		\$/ton	22						
Capital Cost of Facility	Scaling Factor (if appl)		23						
Land		\$1000	24	\$7,500	\$7,500	\$7,500	\$7,500	\$7,500	\$7,500
Buildings		\$1000	25	\$9,467	\$9,467	\$9,467	\$9,467	\$9,467	\$9,467
Development Costs		\$1000	26	\$0	\$0	\$0	\$0	\$0	\$0
Plant:			27						
Biomass Conversion		\$1000	28	\$55,940	\$55,940	\$55,940	\$55,940	\$55,940	\$55,940
Balance of Plant		\$1000	29	\$44,265	\$14,628	\$44,265	\$14,628	\$14,628	\$14,628
Working Capital	LATER		30	\$0	\$0	\$0	\$0	\$0	\$0
Annual Operating Costs			31						
Fixed:			32						
Labor	\$35,000 /yr avg. per person	\$1000	33	\$3,010	\$2,310	\$3,010	\$2,310	\$2,310	\$2,310
		No. of people	34	86	86	86	86	86	86
Fixed Maintenance @	1% of capital	\$1000	35	\$1,100	\$800	\$1,100	\$800	\$800	\$800
Variable:			36						
Variable Maintenance		\$/gal	37	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000
Waste Disposal — Pretreatment		\$/gal	38	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000
— Fermentation		\$/gal	39	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000
— Solids Separatio	\$65 /ton of ash	\$/gal	40	\$0.049	\$0.000	\$0.049	\$0.000	\$0.000	\$0.000
	Ash production rate	lb/hr	41	3,050	0	3,050	0	0	0
	\$50 /ton of lignin	\$/gal	42	\$0.000	\$0.332	\$0.000	\$0.332	\$0.000	\$0.000
	Lignin production rate	tpd	43	0	325	0	325	325	325
Chemicals		\$/gal	44	\$0.160	\$0.160	\$0.160	\$0.160	\$0.160	\$0.160
Utilities			45						
Power @	\$0.06 /kwh	\$/gal	46	\$0.000	\$0.141	\$0.000	\$0.141	\$0.141	\$0.141
	Purchased Power	MW	47	0	4.8	0	4.8	4.8	4.8
Water @	\$0.54 /kgal	\$/gal	48	\$0.001	\$0.002	\$0.001	\$0.002	\$0.002	\$0.002
	Makeup Water	gpm	49	68	152	68	152	152	152
Natural Gas @	\$5.30 /MBtu	\$/gal	50	\$0.000	\$0.099	\$0.000	\$0.099	\$0.099	\$0.099
	Fuel Consumption	MBtu/hr	51	0	38	0	38	38	38
Steam		\$/gal	52	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000
Waste Water @	\$0.73 /kgal sewer rate	\$/gal	53	\$0.002	\$0.002	\$0.002	\$0.002	\$0.002	\$0.002
	Discharge Rate	gpm	54	100	100	100	100	100	100
Additional Revenue — Power Sales	\$0.03 /kwh	\$/gal	55	\$0.081	\$0.000	\$0.081	\$0.000	\$0.000	\$0.000
	Excess Capacity for Sale	MW	56	5.5	0	5.5	0	0	0

Note: Shaded cells for Options 7 and 8 are input cells. Shaded cells for Options 9 through 12 highlight variations from Options 7 and 8.

Stone & Webster Development Corporation

TABLE 8-1c

MASTER INPUT TABLE

FEEDSTOCK - MIXED, 50% WOOD WASTE & 50% WASTE PAPER

		OPTION NO.		SITE LOCATION - ROCHESTER, NY					
		UNITS		13	14	15	16	17	18
Plant Size		TPD (wet)	1	595	595	595	595	595	595
Plant Site			2	1	1	1	1	1	1
Ethanol Production Rate		gal/ton (wet)	3	82.35	82.35	82.35	82.35	82.35	82.35
		GPD	4	49,000	49,000	49,000	49,000	49,000	49,000
Additional Byproducts ? CO2	(Yes = 1, No = 0)		5	0	0	0	0	0	0
	Production Rate	CF/ton (wet)	6	0.00	0.00	0.00	0.00	0.00	0.00
Lignin	(Yes = 1, No = 0)		7	0	1	0	1	1	1
	Production Rate	tons/ton (wet)	8	0.00	0.55	0.00	0.55	0.55	0.55
Feedstock - Waste paper	Percent of Feed Rate	%	9	0.0	0.0	0.0	0.0	0.0	0.0
- Wood Waste	Conversion Efficiency	lb/gal	10	0.00	0.00	0.00	0.00	0.00	0.00
- Mixed stock	Percent of Feed Rate	%	11	0.0	0.0	0.0	0.0	0.0	0.0
	Conversion Efficiency	lb/gal	12	0.00	0.00	0.00	0.00	0.00	0.00
	Percent of Feed Rate	%	13	100.0	100.0	100.0	100.0	100.0	100.0
	Conversion Efficiency	lb/gal	14	24.29	24.29	24.29	24.29	24.29	24.29
Market Prices - Ethanol		\$/gal	15	TBD	TBD	TBD	TBD	TBD	TBD
- CO2		\$/CF	16	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
- Lignin		\$/ton	17	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Maximum Allowable Tipping Fee (if applicable)		\$/ton	18						
- Waste Paper	(Enter 1,000,000 if N/A)	\$/ton	19						
- Wood Waste		\$/ton	20						
- Mixed Stock		\$/ton	21						
Capital Cost of Facility	Scaling Factor (if appl)		22						
Land		\$1,000	23	\$7,500	\$7,500	\$7,500	\$7,500	\$7,500	\$7,500
Buildings		\$1,000	24	\$9,375	\$9,375	\$9,375	\$9,375	\$9,375	\$9,375
Development Costs		\$1,000	25	\$0	\$0	\$0	\$0	\$0	\$0
Plant:			26						
Biomass Conversion		\$1,000	27	\$54,972	\$54,972	\$54,972	\$54,972	\$54,972	\$54,972
Balance of Plant		\$1,000	28	\$43,832	\$14,485	\$43,832	\$14,485	\$14,485	\$14,485
Working Capital	LATER		29	\$0	\$0	\$0	\$0	\$0	\$0
Annual Operating Costs			30						
Fixed:			31						
Labor	\$35,000 /yr avg. per person	\$1,000	32	\$3,010	\$2,310	\$3,010	\$2,310	\$2,310	\$2,310
		No. of people	33	88	66	88	66	66	66
Fixed Maintenance	@ 1% of capital	\$1,000	34	\$1,080	\$790	\$1,080	\$790	\$790	\$790
Variable:			35						
Variable Maintenance		\$/gal	36	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000
Waste Disposal - Pretreatment		\$/gal	37	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000
- Fermentation		\$/gal	38	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000
- Solids Separation	\$65 /ton of ash	\$/gal	39	\$0.049	\$0.000	\$0.049	\$0.000	\$0.000	\$0.000
Ash production rate		lb/hr	40	3,050	0	3,050	0	0	0
\$50 /ton of lignin		\$/gal	41	\$0.000	\$0.332	\$0.000	\$0.332	\$0.000	\$0.000
Lignin production rate		TPD	42	0	325	0	325	325	325
Chemicals		\$/gal	43	\$0.160	\$0.160	\$0.160	\$0.160	\$0.160	\$0.160
Utilities			44						
Power	@ \$0.06 /kwh	\$/gal	45	\$0.000	\$0.141	\$0.000	\$0.141	\$0.141	\$0.141
Purchased Power		MW	46	0	4.8	0	4.8	4.8	4.8
Water	@ \$1.03 /kgal	\$/gal	47	\$0.002	\$0.005	\$0.002	\$0.005	\$0.005	\$0.005
Makeup Water		GPM	48	68	152	68	152	152	152
Natural Gas	@ \$5.30 /MBtu	\$/gal	49	\$0.000	\$0.099	\$0.000	\$0.099	\$0.099	\$0.099
Fuel Consumption		MBtu/hr	50	0	38	0	38	38	38
Steam		\$/gal	51	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000
Waste Water	@ \$1.03 /kgal sewer rate	\$/gal	52	\$0.003	\$0.003	\$0.003	\$0.003	\$0.003	\$0.003
Discharge Rate		GPM	53	100	100	100	100	100	100
Additional Revenue - Power Sales	\$0.03 /kwh	\$/gal	54	\$0.081	\$0.000	\$0.081	\$0.000	\$0.000	\$0.000
Excess Capacity for Sale		MW	55	5.5	0	0	0	0	0

Note: Shaded cells for Options 13 and 14 are input cells. Shaded cells for Options 15 through 18 highlight variations from Options 13 and 14.

TABLE 8-1d

MASTER INPUT TABLE

FEEDSTOCK - MIXED, 50% WOOD WASTE & 50% WASTE PAPER

		OPTION NO. :	SITE LOCATION - SYRACUSE, NY					
		UNITS	19	20	21	22	23	24
Plant Size		tpd (wet)	595	595	595	595	595	595
Plant Site			1	1	1	1	1	1
Ethanol Production Rate		gal/ton (wet)	82.35	82.35	82.35	82.35	82.35	82.35
Additional Byproducts ? CO2	(Yes = 1, No = 0)	gpd	49,000	49,000	49,000	49,000	49,000	49,000
Lignin	(Yes = 1, No = 0)	cf/ton (wet)	0	0	0	0	0	0
Production Rate		tons/ton (wet)	0.00	0.55	0.00	0.55	0.55	0.55
Feedstock - Waste paper	Percent of Feed Rate	%	0.0	0.0	0.0	0.0	0.0	0.0
- Wood Waste	Conversion Efficiency	lb/gal	0.00	0.00	0.00	0.00	0.00	0.00
- Mixed stock	Percent of Feed Rate	%	0.0	0.0	0.0	0.0	0.0	0.0
	Conversion Efficiency	lb/gal	0.00	0.00	0.00	0.00	0.00	0.00
	Percent of Feed Rate	%	100.0	100.0	100.0	100.0	100.0	100.0
	Conversion Efficiency	lb/gal	24.29	24.29	24.29	24.29	24.29	24.29
Market Prices - Ethanol		\$/gal	tpd	tpd	tpd	tpd	tpd	tpd
- CO2		\$/cf	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
- Lignin		\$/ton	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Maximum Allowable Tipping Fee (if applicable)								
- Waste Paper	(Enter 1,000,000 if N/A)	\$/ton						
- Wood Waste		\$/ton						
- Mixed Stock		\$/ton	(\$20.00)	(\$20.00)	(\$40.00)	(\$40.00)	(\$20.00)	(\$40.00)
Capital Cost of Facility	Scaling Factor (if appl)							
Land		\$1000	\$7,500	\$7,500	\$7,500	\$7,500	\$7,500	\$7,500
Buildings		\$1000	\$9,198	\$9,198	\$9,198	\$9,198	\$9,198	\$9,198
Development Costs		\$1000	\$0	\$0	\$0	\$0	\$0	\$0
Plant:								
Biomass Conversion		\$1000	\$53,199	\$53,199	\$53,199	\$53,199	\$53,199	\$53,199
Balance of Plant		\$1000	\$43,000	\$14,213	\$43,000	\$14,213	\$14,213	\$14,213
Working Capital	LATER		\$0	\$0	\$0	\$0	\$0	\$0
Annual Operating Costs								
Fixed:								
Labor	\$35,000 /yr avg. per person	\$1000	\$3,010	\$2,310	\$3,010	\$2,310	\$2,310	\$2,310
Fixed Maintenance	@ 1% of capital	No. of people	86	68	86	68	66	66
Variable:		\$1000	\$1,050	\$770	\$1,050	\$770	\$770	\$770
Variable Maintenance			\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000
Waste Disposal - Pretreatment			\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000
- Fermentation			\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000
- Solids Separation	\$65 /ton of ash		\$0.049	\$0.000	\$0.049	\$0.000	\$0.000	\$0.000
Ash production rate		lb/hr	3,050	0	3,050	0	0	0
\$50 /ton of lignin			\$0.000	\$0.332	\$0.000	\$0.332	\$0.000	\$0.000
Lignin production rate		tpd	0	325	0	325	325	325
Chemicals			\$0.180	\$0.180	\$0.180	\$0.180	\$0.180	\$0.180
Utilities								
Power	@ \$0.08 /kwh	\$/gal	\$0.000	\$0.141	\$0.000	\$0.141	\$0.141	\$0.141
Purchased Power		MW	0	4.8	0	4.8	4.8	4.8
Water	@ \$0.81 /kgal	\$/gal	\$0.002	\$0.004	\$0.002	\$0.004	\$0.004	\$0.004
Makeup Water		gpm	68	152	68	152	152	152
Natural Gas	@ \$5.30 /MBtu	\$/gal	\$0.000	\$0.099	\$0.000	\$0.099	\$0.099	\$0.099
Fuel Consumption		MBtu/hr	0	38	0	38	38	38
Steam			\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000
Waste Water	@ \$0.39 /kgal sewer rate	\$/gal	\$0.001	\$0.001	\$0.001	\$0.001	\$0.001	\$0.001
Discharge Rate		gpm	100	100	100	100	100	100
Additional Revenue - Power Sales	\$0.03 /kwh	\$/gal	\$0.081	\$0.000	\$0.081	\$0.000	\$0.000	\$0.000
Excess Capacity for Sale		MW	5.5	0	5.5	0	0	0

Note: Shaded cells for Options 19 and 20 are input cells. Shaded cells for Options 21 through 24 highlight variations from Options 19 and 20.

Stone & Webster Development Corporation

TABLE 8-1a
MASTER INPUT TABLE

FEEDSTOCK - MIXED, 50% WOOD WASTE & 50% WASTE PAPER

		OPTION NO. :	SITE LOCATION - SYRACUSE, NY					
		UNITS	25	26	27	28	29	30
Plant Size		tpd (wet)	595	595	595	595	595	595
Plant Site			1	1	1	1	1	1
Ethanol Production Rate		gal/ton (wet)	82.35	82.35	82.35	82.35	82.35	82.35
		gpd	49,000	49,000	49,000	49,000	49,000	49,000
Additional Byproducts ? CO2	(Yes = 1, No = 0)		0	0	0	0	0	0
	Production Rate	cf/ton (wet)	0.00	0.00	0.00	0.00	0.00	0.00
Lignin	(Yes = 1, No = 0)		0	1	0	1	1	1
	Production Rate	tons/ton (wet)	0.00	0.55	0.00	0.55	0.55	0.55
Feedstock - Waste Paper	Percent of Feed Rate	%	0.0	0.0	0.0	0.0	0.0	0.0
	Conversion Efficiency	lb/gal	0.00	0.00	0.00	0.00	0.00	0.00
- Wood Waste	Percent of Feed Rate	%	0.0	0.0	0.0	0.0	0.0	0.0
	Conversion Efficiency	lb/gal	0.00	0.00	0.00	0.00	0.00	0.00
- Mixed Stock	Percent of Feed Rate	%	100.0	100.0	100.0	100.0	100.0	100.0
	Conversion Efficiency	lb/gal	24.29	24.29	24.29	24.29	24.29	24.29
Market Prices - Ethanol		\$/gal	\$1.20	\$1.20	\$1.50	\$1.50	\$1.20	\$1.50
- CO2		\$/cf	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
- Lignin		\$/ton	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Maximum Allowable Tipping Fee (if applicable)		\$/ton						
- Waste Paper	(Enter 1,000,000 if N/A)	\$/ton						
- OTD		\$/ton						
- Wood Waste		\$/ton						
Capital Cost of Facility	Scaling Factor (if appl)							
Land		\$1000	\$7,500	\$7,500	\$7,500	\$7,500	\$7,500	\$7,500
Buildings		\$1000	\$9,198	\$9,198	\$9,198	\$9,198	\$9,198	\$9,198
Development Costs		\$1000	\$0	\$0	\$0	\$0	\$0	\$0
Plant:								
Biomass Conversion		\$1000	\$53,199	\$53,199	\$53,199	\$53,199	\$53,199	\$53,199
Balance of Plant		\$1000	\$43,000	\$14,213	\$43,000	\$14,213	\$14,213	\$14,213
Working Capital			\$0	\$0	\$0	\$0	\$0	\$0
Annual Operating Costs								
Fixed:								
Labor	\$35,000 /yr avg. per person	\$1000	\$3,010	\$2,310	\$3,010	\$2,310	\$2,310	\$2,310
		No. of people	86	68	86	66	66	66
Fixed Maintenance	@ 1% of capital	\$1000	\$1,050	\$770	\$1,050	\$770	\$770	\$770
Variable:								
Variable Maintenance		\$/gal	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000
Waste Disposal - Pretreatment		\$/gal	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000
- Fermentation		\$/gal	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000
- Solids Separation	\$65 /ton of ash	\$/gal	\$0.054	\$0.000	\$0.054	\$0.000	\$0.000	\$0.000
	Ash production rate	lb/hr	3,400	0	3,400	0	0	0
	\$50 /ton of lignin	\$/gal	\$0.000	\$0.332	\$0.000	\$0.332	\$0.000	\$0.000
	Lignin production rate	tpd	0	325	0	325	325	325
Chemicals		\$/gal	\$0.160	\$0.160	\$0.160	\$0.160	\$0.160	\$0.160
Utilities								
Power	@ \$0.06 /kwh	\$/gal	\$0.000	\$0.141	\$0.000	\$0.141	\$0.141	\$0.141
	Purchased Power	MW	0	4.8	0	4.8	4.8	4.8
Water	@ \$0.81 /kgal	\$/gal	\$0.002	\$0.004	\$0.002	\$0.004	\$0.004	\$0.004
	Makeup Water	gpm	68	152	68	152	152	152
Natural Gas	@ \$5.30 /MBtu	\$/gal	\$0.000	\$0.099	\$0.000	\$0.099	\$0.099	\$0.099
	Fuel Consumption	MBtu/hr	0	38	0	38	38	38
Steam		\$/gal	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000	\$0.000
Waste Water	@ \$0.39 /kgal sewer rate	\$/gal	\$0.001	\$0.001	\$0.001	\$0.001	\$0.001	\$0.001
	Discharge Rate	gpm	100	100	100	100	100	100
Additional Revenue - Power Sales	\$0.03 /kwh	\$/gal	\$0.081	\$0.000	\$0.081	\$0.000	\$0.000	\$0.000
	Excess Capacity for Sale	MW	5.5	0	5.5	0	0	0

Note: Shaded cells for options 19 and 20 are input cells. Shaded cells for Options 21 through 24 highlight variations from Options 19 and 20.

TABLE 8-2a: CASE INPUT

03/30/95
 10:08 AM

CASE: 595 TPD (wet) of 100.0% MIXED STOCK (50% WASTE WOOD & 50% WASTE PAPER), WITH GASIFICATION;
 WOOD @ \$20/TON

INPUT:			
CASE:			
Option Number	1	TPD wet, as-tipped	
Plant Size (feedstock rate)	595	GPD	
Ethanol Production	49,000		
Plant Size	1		
Additional byproducts ?	CO2: 0	(0 = No, 1 = Yes)	
	Lignin: 0		
	Power: 1		
SCHEDULE:			
(Beginning of Year)			
Present Day	1994		
Start Construction	1998		
Centroid of Capital Expenditure	1997		
First Year of Operation	1998		
Economic Life	20 years		
Annual Operating Schedule	303 days/yr		
	83.0%	Mature Capacity Factor	
(Don't change this)	83.0%	First Year Capacity Factor	
TECHNICAL:			
Capital Cost of Facility	100%: Sensitivity Index		
Land	\$7,500 k		
Buildings	\$9,250 k		
Development Costs	\$0 k		
Plant:			
Biomass Conversion	\$53,683 k		
Balance of Plant	\$43,250 k		
Total Present Day Capital Cost	\$113,683 k		
Escalation to Centroid of Expenditure	\$13,300 k (Note: land not escalated)		
Interest During Construction	\$10,200 k		
Total Capital Cost at C.O.D. Date	\$137,183 k or \$230,560 per TPD		
Annual Operating Costs	100%: Sensitivity Index		
Fixed:			
Labor	100%: Sensitivity Index	\$0.203 /gal Ethanol	\$3,010 k/yr
Fixed Maintenance Materials	\$0.071	\$1,080 k/yr	
Insurance	1.0% of Capital Cost	\$1,370 k/yr	
Total Fixed O&M Cost	\$0.388 /gal Ethanol	\$5,440 k/yr	
Variable:			
Variable Maintenance	\$0.000 /gal Ethanol	\$0 k/yr	
Waste Disposal - Pretreatment	\$0.000	\$0	
- Fermentation	\$0.000	\$0	
- Solids Separation	\$0.049	\$721	
Chemicals	\$0.160	\$2,375	
Utilities			
Power	\$0.000	\$0	
Water	\$0.004	\$58	
Natural Gas	\$0.000	\$0	
Steam	\$0.000	\$0	
Waste Water	\$0.008	\$88	
Total Variable O&M Cost	\$0.218 /gal Ethanol	\$3,239 k/yr	
Total Fixed & Variable O&M	\$0.585 /gal Ethanol	\$8,679 k/yr	
Feedstock:	Blend		
Waste Paper	0.0%	0.0 lb/gal Ethanol	
Wood Waste	0.0%	0.0	
Mixed Stock	100.0%	0.0 lb/gal Average	
		Tippling Fee (Note)	
		***** /wet ton	
		(\$20.00)	
		Maximum Tippling Fee	

		(\$20.00)	
		Annual Quantities	
		0 wet tons / year	
		0	
		180,255 wet tons / year	
		180,255 wet tons / year	
Output:	(per ton of feedstock)	Unit Price	
Ethanol	82.35 gal/wet ton	\$1.98 /gal	14,844,550 gallons Ethanol / year
CO2	0.00 CF/wet ton	\$0.00 /CF	0 CF CO2 / year
Lignin	0.00 tons/wet ton	\$0.00 /ton	0 tons Lignin / year
Power	221.85 kwh/wet ton	\$0.03 /kwh	39,889,400 kwh / year
Note: The average tippling fee is calculated so that the project yields the Target Return on Equity. If value is positive, tippling fee is treated as revenue. If negative, tippling fee becomes feedstock charge and is an expense.			

TABLE 8-2b: CASE INPUT

INPUT:

CASE:	Option Number	7	
	Plant Size (feedstock rate)	595	TPD wet, as-tipped
	Ethanol Production	49,000	GPD
	Plant Site	1	
	Additional byproducts ?	0	(0 = No, 1 = Yes)
	CO2 :	0	.
	Lignin:	0	.
	Power:	1	.

SCHEDULE: (Beginning of Year)

Present Day	1994	
Start Construction	1996	
Centroid of Capital Expenditure	1997	
First Year of Operation	1998	
Economic Life	20	years
Annual Operating Schedule	303	days/yr
	83.0%	Mature Capacity Factor
(Don't change this)	83.0%	First Year Capacity Factor

TECHNICAL:

Capital Cost of Facility		100% Sensitivity Index		
Land		\$7,500	k	
Buildings		\$9,487	k	
Development Costs		\$0	k	
Plant:				
Biomass Conversion		\$55,940	k	
Balance of Plant		\$44,265	k	
Total Present Day Capital Cost		\$117,172	k	
Escalation to Centroid of Expenditure		\$13,700	k	(Note: land not escalated)
Interest During Construction		\$10,500	k	
Total Capital Cost at C.O.Date		\$141,372	k or	\$237,600 per TPD

Annual Operating Costs		100% : Sensitivity Index			
Fixed:					
Labor	100% : Sensitivity Index	\$0.203	/gal Ethanol	\$3,010	k/yr
Fixed Maintenance Materials		\$0.074	"	\$1,100	k/yr
Insurance	1.0% of Capital Cost	\$0.095		\$1,410	k/yr
Total Fixed O&M Cost		\$0.372	/gal Ethanol	\$5,520	k/yr
Variable:					
Variable Maintenance		\$0.000	/gal Ethanol	\$0	k/yr
Waste Disposal -- Pretreatment		\$0.000	"	\$0	"
• -- Fermentation		\$0.000	"	\$0	"
• -- Solids Separation		\$0.048	"	\$721	"
Chemicals		\$0.160	"	\$2,375	"
Utilities					
Power		\$0.000	"	\$0	"
Water		\$0.001	"	\$18	"
Natural Gas		\$0.000	"	\$0	"
Steam		\$0.000	"	\$0	"
Waste Water		\$0.002	"	\$32	"
Total Variable O&M Cost		\$0.212	/gal Ethanol	\$3,144	k/yr
Total Fixed & Variable O&M		\$0.584	/gal Ethanol	\$8,664	k/yr

Feedstock:	Blend		lb/gal Ethanol	Tipphg Fee (Note)	Wet ton	Maximum Tipphg Fee
Waste Paper	0.0%	0.0				
Wood Waste	0.0%	0.0				
Mixed Stock	100.0%	0.0	lb/gal Average	(\$20.00)		(\$20.00)

Output:	(per ton of feedstock)	Unit Price	Required	
Ethanol	82.35 gal/wet ton	\$1.99 /gal	14,844,550	gallons Ethanol/year
CO2	0.00 CF/wet ton	\$0.00 /CF	0	CF CO2 /year
Lignin	0.00 tons/wet ton	\$0.00 /ton	0	tons lignin /year
Power	221.85 kwh/wet ton	\$0.03 /kwh	39,989,400	kwh / year

ECONOMIC:

Inflation Rate (PI)	4.0%
Escalation Rates (Nominal)	
Capital Cost	4.0%
O&M Costs:	
Labor	4.0%
Maintenance Materials	4.0%
Insurance	4.0%
Waste Disposal – Pretreatment	4.5%
• – Fermentation	4.5%
• – Solids Separation	4.5%
Chemicals	4.0%
Utilities	
Power	4.0%
Water	4.0%
Natural Gas	5.5%
Steam	4.0%
Waste Water	4.0%
Feedstock:	4.0%
Output:	
Ethanol	4.0%
CO ₂	4.0%
Lignin	4.0%

Tax Data:

Federal income tax rate	35.0%	
State income tax rate	8.0%	
Effective rate	40.8%	
Local tax rate (Gross Receipts Tax)	8.25%	
Property Tax Rate	0.0%	\$/100
Estimated Annual Expense	\$0	k/yr
Ethanol Production Tax Credit	\$0.00	/gal for max. 15,000,000 gal/yr
Last year credit applies	2000	
Power from Certain Renew. Tax Credit		/kwh
Economic Development Incentives	0	(based on Table 2, Incentives Table)
Tax Depreciation		Life Rate
Buildings	31.5	100% decl. bal.
Development Costs	--	include in Biomass Conv.
Plant:		
Biomass Conversion	5	200% decl. bal.
Balance of Plant	20	150% decl. bal.
Book Depreciation	20	years

FINANCIAL:

Debt Structure:		
Debt Fraction	80%	
Financing Term	10	(Note: Must be $\leq$ Economic Life)
Interest Rate	10.0%	
Amortization of Loan	Level pm	
Short Term Construction Interest	8.0%	
Target Return on Equity	20%	

Note: The average tipping fee is calculated so that the project yields the Target Return on Equity. If value is positive, tipping fee is treated as revenue. If negative, tipping fee becomes feedstock charge and is an expense.

CASE: 595 TPD (wet) of 100.0% MIXED STOCK (50% WASTE WOOD & 50% WASTE PAPER) @ \$20/TON;
 WITH GASIFICATION

INPUT:				ECONOMIC:			
CASE: Option Number		13		ECONOMIC: Inflation Rate (PP)		4.0%	
Plant Size (feedstock rate)		595	TPD wet, as-tipped	Escalation Rates (Nomha)			
Ethanol Production		49,000	GPD	Capital Cost		4.0%	
Plant Site		1		O&M Costs:			
Additional byproducts?		CO2: 0	(0 = No, 1 = Yes)	Labor		4.0%	
		Lignin: 0		Maintenance Materials		4.0%	
		Power: 1		Insurance		4.0%	
SCHEDULE: (Beginning of Year)				Waste Disposal - Pretreatment		4.5%	
Present Day		1994		- Fermentation		4.5%	
Start Construction		1996		- Solids Separation		4.5%	
Centroid of Capital Expenditure		1997		Chemicals		4.0%	
First Year of Operation		1998		Utilities			
Economic Life		20	years	Power		4.0%	
Annual Operating Schedule		303	days/yr	Water		4.0%	
		83.0%	Mature Capacity Factor	Natural Gas		5.5%	
		83.0%	First Year Capacity Factor	Steam		4.0%	
				Waste Water		4.0%	
				Feedstock:		4.0%	
				Output:			
				Ethanol		4.0%	
				CO2		4.0%	
				Lignin		4.0%	
TECHNICAL:				Tax Data:			
Capital Cost of Facility		100%	Sensitivity Index	Federal income tax rate		35.0%	
Land		\$7,500	k	State income tax rate		9.0%	
Buildings		\$9,375	k	Effective rate		40.8%	
Development Costs		\$0	k	Local tax rate (Gross Receipts Tax)		8.25%	
Plant:				Property Tax Rate		0.0%	/ \$100
Biomass Conversion		\$54,872	k	Estimated Annual Expense		\$0	k/yr
Balance of Plant		\$43,832	k	Ethanol Production Tax Credit		\$0.00	/gal for max. 15,000,000 gal/yr
Total Present Day Capital Cost		\$115,678	k	Last year credit applies		2000	
Escalation to Centroid of Expenditure		\$13,500	k (Note: land not escalated)	Power from Certain Renew. Tax Credit			/kwh
Interest During Construction		\$10,300	k	Economic Development Incentives		0	(based on Table 2, Incentives Table)
Total Capital Cost at C.O. Date		\$139,479	k or \$234,418 per TPD	Tax Depreciation			Life Rate
Annual Operating Costs		100%	Sensitivity Index	Buildings		31.5	100% decl. bal.
Fixed:				Development Costs		--	Include in Biomass Conv.
Labor		100%	Sensitivity Index	Plant:			
Fixed Maintenance Materials		\$0.073	/gal Ethanol	Biomass Conversion		5	200% decl. bal.
Insurance		\$0.094	/gal Ethanol	Balance of Plant		20	150% decl. bal.
Total Fixed O&M Cost		\$0.369	/gal Ethanol	Book Depreciation		20	years
Variable:				FINANCIAL:			
Variable Maintenance		\$0.000	/gal Ethanol	Debt Structure:			
Waste Disposal - Pretreatment		\$0.000	/gal Ethanol	Debt Fraction		80%	
- Fermentation		\$0.000	/gal Ethanol	Financing Term		10	(Note: Must be <= Economic Life)
- Solids Separation		\$0.049	/gal Ethanol	Interest Rate		10.0%	
Chemicals		\$0.160	/gal Ethanol	Amortization of Loan		Level pmt	
Utilities				Short Term Construction Interest		8.0%	
Power		\$0.000	/gal Ethanol	Target Return on Equity		20%	
Water		\$0.002	/gal Ethanol				
Natural Gas		\$0.000	/gal Ethanol				
Steam		\$0.000	/gal Ethanol				
Waste Water		\$0.003	/gal Ethanol				
Total Variable O&M Cost		\$0.214	/gal Ethanol				
Total Fixed & Variable O&M		\$0.583	/gal Ethanol				
Feedstock:				Tipping Fee			
Blend				(Note)			
Waste Paper		0.0%	0.0 lb/gal Ethanol	Maximum Tipping Fee			
Wood Waste		0.0%	0.0 lb/gal Ethanol	Annual Quantities			
Mixed Stock		100.0%	0.0 lb/gal Average	0		wet tons / year	
				0		wet tons / year	
				180,255		wet tons / year	
				180,255		wet tons / year	
Output:							
Ethanol		82.35	gal/wet ton	Unit Price			
CO2		0.00	CF/wet ton	\$1.97		/gal Required	14,844,550 gallons Ethanol / year
Lignin		0.00	tons/wet ton	\$0.00		/CF	0 CF CO2 / year
Power		221.85	kwh/wet ton	\$0.00		/ton	0 tons lignin / year
				\$0.03		/kwh	39,989,400 kwh / year

Note: The average tipping fee is calculated so that the project yields the Target Return on Equity. If value is positive, tipping fee is treated as revenue. If negative, tipping fee becomes feedstock charge and is an expense.

CASE: 595 TPD (wet) of 100.0% MIXED STOCK (50% WASTE WOOD & 50% WASTE PAPER) @ \$20/TON;
 WITH GASIFICATION

INPUT:				ECONOMIC:	
CASE: Option Number	19	TPD wet, as-tipped		Inflation Rate (PP)	4.0%
Plant Size (feedstock rate)	595	GPD		Escalation Rates (Nominal)	
Ethanol Production	49,000			Capital Cost	4.0%
Plant Site	1			O&M Costs:	
Additional byproducts ?	CO2: 0	(0 = No, 1 = Yes)		Labor	4.0%
	Lignin: 0			Maintenance Materials	4.0%
	Power: 1			Insurance	4.0%
SCHEDULE: (Beginning of Year)				Waste Disposal - Pretreatment	4.5%
Present Day	1994			- Fermentation	4.5%
Start Construction	1996			- Solids Separation	4.5%
Centroid of Capital Expenditure	1997				
First Year of Operation	1998			Chemicals	4.0%
Economic Life	20 years			Utilities	
Annual Operating Schedule	303 days/yr			Power	4.0%
	83.0% Mature Capacity Factor			Water	4.0%
	83.0% First Year Capacity Factor			Natural Gas	5.5%
				Steam	4.0%
				Waste Water	4.0%
TECHNICAL:				Feedstock:	4.0%
Capital Cost of Facility	100%: Sensitivity Index			Output:	
Land	\$7,500 k			Ethanol	4.0%
Buildings	\$9,198 k			CO2	4.0%
Development Costs	\$0 k			Lignin	4.0%
Plant:					
Biomass Conversion	\$53,189 k			Tax Data:	
Balance of Plant	\$43,000 k			Federal income tax rate	35.0%
Total Present Day Capital Cost	\$112,897 k			State income tax rate	9.0%
Escalation to Centroid of Expenditure	\$13,200 k (Note: land not escalated)			Effective rate	40.9%
Interest During Construction	\$10,100 k			Local tax rate (Gross Receipts Tax)	8.25%
Total Capital Cost at C.O.D. Date	\$136,197 k or \$228,903 per TPD			Property Tax Rate	0.0% /\$100
Annual Operating Costs	100%: Sensitivity Index			Estimated Annual Expense	\$0 k/yr
Fixed:				Ethanol Production Tax Credit	\$0.00 /gal for max. 15,000,000 gal/yr
Labor	100%: Sensitivity Index \$0.203 /gal Ethanol	\$3,010 k/yr		Last year credit applies	2000
Fixed Maintenance Materials	\$0.071	\$1,050 k/yr		Power from Certain Renew. Tax Credit	/kwh
Insurance	1.0% of Capital Cost \$0.092	\$1,360 k/yr		Economic Development Incentives	0 (based on Table 2, Incentives Table)
Total Fixed O&M Cost	\$0.365 /gal Ethanol	\$5,420 k/yr		Tax Depreciation	
Variable:				Buildings	31.5 100% decl. bal.
Variable Maintenance	\$0.000 /gal Ethanol	\$0 k/yr		Development Costs	-- Include in Biomass Conv.
Waste Disposal - Pretreatment	\$0.000	\$0		Plant:	
- Fermentation	\$0.000	\$0		Biomass Conversion	5 200% decl. bal.
- Solids Separation	\$0.049	\$721		Balance of Plant	20 150% decl. bal.
Chemicals	\$0.160	\$2,375		Book Depreciation	20 years
Utilities					
Power	\$0.000	\$0		FINANCIAL:	
Water	\$0.002	\$24		Debt Structure:	
Natural Gas	\$0.000	\$0		Debt Fraction	80%
Steam	\$0.000	\$0		Financing Term	10 (Note: Must be <= Economic Life)
Waste Water	\$0.001	\$17		Interest Rate	10.0%
Total Variable O&M Cost	\$0.211 /gal Ethanol	\$3,137 k/yr		Amortization of Loan	Level pm
Total Fixed & Variable O&M	\$0.576 /gal Ethanol	\$8,557 k/yr		Short Term Construction Interest	8.0%
				Target Return on Equity	20%
Feedstock:	Blend				
Waste Paper	0.0%	0.0 lb/gal Ethanol	***** /wet ton	Maximum Tipping Fee	*****
Wood Waste	0.0%	0.0	*****		*****
Mixed Stock	100.0%	0.0 lb/gal Average	(\$20.00)		(\$20.00)
				Annual Quantities	
				0 wet tons / year	
				0	
				180,255 wet tons / year	
				180,255 wet tons / year	
Output:	(per ton of feedstock)	Unit Price			
Ethanol	82.35 gal/wet ton	\$1.94 /gal Required	14,844,550 gallons Ethanol / year		
CO2	0.00 CF/wet ton	\$0.00 /CF	0 CF CO2 / year		
Lignin	0.00 tons/wet ton	\$0.00 /ton	0 tons lignin / year		
Power	221.85 kwh/wet ton	\$0.03 /kwh	39,989,400 kwh / year		

Note: The average tipping fee is calculated so that the project yields the Target Return on Equity. If value is positive, tipping fee is treated as revenue. If negative, tipping fee becomes feedstock charge and is an expense.

INPUT:			
CASE: Option Number <input type="text" value="25"/> (Enter an integer based on Table 1, Master Input Table)			
Plant Size (feedstock rate)	<input type="text" value="595"/>	TPD wet, as-tipped	
Ethanol Production	<input type="text" value="49,000"/>	GPD	
Plant Size	<input type="text" value="1"/>		
Additional byproducts?	CO ₂ : <input type="text" value="0"/> (0 = No, 1 = Yes)		
	Lignin: <input type="text" value="0"/>		
	Power: <input type="text" value="1"/>		
SCHEDULE: (Beginning of Year)			
Present Day	<input type="text" value="1994"/>		
Start Construction	<input type="text" value="1996"/>		
Control of Capital Expenditure	<input type="text" value="1997"/>		
First Year of Operation	<input type="text" value="1998"/>		
Economic Life	<input type="text" value="20"/> years		
Annual Operating Schedule	<input type="text" value="303"/> days/yr		
	<input type="text" value="83.0%"/> Mature Capacity Factor		
	<input type="text" value="83.0%"/> First Year Capacity Factor		
TECHNICAL:			
Capital Cost of Facility	<input type="text" value="100%"/> Sensitivity Index		
Land	<input type="text" value="\$7,500"/> k		
Buildings	<input type="text" value="\$9,188"/> k		
Development Costs	<input type="text" value="\$0"/> k		
Plant:			
Biomass Conversion	<input type="text" value="\$53,189"/> k		
Balance of Plant	<input type="text" value="\$43,000"/> k		
Total Present Day Capital Cost	<input type="text" value="\$112,897"/> k		
Escalation to Control of Expenditure	<input type="text" value="\$13,200"/> k (Note: land not escalated)		
Interest During Construction	<input type="text" value="\$10,100"/> k		
Total Capital Cost at C.O.D. Date	<input type="text" value="\$136,197"/> k or <input type="text" value="\$228,803"/> per TPD		
Annual Operating Costs	<input type="text" value="100%"/> Sensitivity Index		
Fixed:			
Labor	<input type="text" value="100%"/> Sensitivity Index <input type="text" value="\$0.203"/> /gal Ethanol	<input type="text" value="\$3,010"/> k/yr	
Fixed Maintenance Materials	<input type="text" value="\$0.071"/> k	<input type="text" value="\$1,050"/> k/yr	
Insurance	<input type="text" value="1.0%"/> of Capital Cost <input type="text" value="\$0.092"/> k	<input type="text" value="\$1,360"/> k/yr	
Total Fixed O&M Cost	<input type="text" value="\$0.365"/> /gal Ethanol	<input type="text" value="\$5,420"/> k/yr	
Variable:			
Variable Maintenance	<input type="text" value="\$0.000"/> /gal Ethanol	<input type="text" value="\$0"/> k/yr	
Waste Disposal - Pretreatment	<input type="text" value="\$0.000"/> k	<input type="text" value="\$0"/> k	
• - Fermentation	<input type="text" value="\$0.000"/> k	<input type="text" value="\$0"/> k	
• - Solids Separation	<input type="text" value="\$0.054"/> k	<input type="text" value="\$803"/> k	
Chemicals	<input type="text" value="\$0.160"/> k	<input type="text" value="\$2,375"/> k	
Utilities			
Power	<input type="text" value="\$0.000"/> k	<input type="text" value="\$0"/> k	
Water	<input type="text" value="\$0.002"/> k	<input type="text" value="\$24"/> k	
Natural Gas	<input type="text" value="\$0.000"/> k	<input type="text" value="\$0"/> k	
Steam	<input type="text" value="\$0.000"/> k	<input type="text" value="\$0"/> k	
Waste Water	<input type="text" value="\$0.001"/> k	<input type="text" value="\$17"/> k	
Total Variable O&M Cost	<input type="text" value="\$0.217"/> /gal Ethanol	<input type="text" value="\$3,220"/> k/yr	
Total Fixed & Variable O&M	<input type="text" value="\$0.582"/> /gal Ethanol	<input type="text" value="\$8,640"/> k/yr	
Feedstock:			
Blend			
Waste Paper	<input type="text" value="0.0%"/> 0.0 lb/gal Ethanol	<input type="text" value="\$0.00"/> /wet ton	
Wood Waste	<input type="text" value="0.0%"/> 0.0 lb/gal Ethanol	<input type="text" value="\$0.00"/> /wet ton	
Mixed Stock	<input type="text" value="100.0%"/> 24.3 lb/gal Ethanol	<input type="text" value="\$39.59"/> /wet ton	
	<input type="text" value="100.0%"/> 24.3 lb/gal Average	<input type="text" value="\$39.59"/> /wet ton Average	
Output:			
Ethanol	<input type="text" value="82.35"/> gal/wet ton	<input type="text" value="\$1.20"/> /gal	<input type="text" value="14,844,550"/> gallons Ethanol / year
CO ₂	<input type="text" value="0.00"/> CF/wet ton	<input type="text" value="\$0.00"/> /CF	<input type="text" value="0"/> CF CO ₂ / year
Lignin	<input type="text" value="0.00"/> tons/wet ton	<input type="text" value="\$0.00"/> /ton	<input type="text" value="0"/> tons lignin / year
Power	<input type="text" value="221.85"/> kwh/wet ton	<input type="text" value="\$0.03"/> /kwh	<input type="text" value="39,989,400"/> kwh / year
ECONOMIC:			
Inflation Rate (PP)	<input type="text" value="4.0%"/>		
Escalation Rates (Nominal)			
Capital Cost	<input type="text" value="4.0%"/>		
O&M Costs:			
Labor	<input type="text" value="4.0%"/>		
Maintenance Materials	<input type="text" value="4.0%"/>		
Insurance	<input type="text" value="4.0%"/>		
Waste Disposal - Pretreatment	<input type="text" value="4.5%"/>		
• - Fermentation	<input type="text" value="4.5%"/>		
• - Solids Separation	<input type="text" value="4.5%"/>		
Chemicals	<input type="text" value="4.0%"/>		
Utilities			
Power	<input type="text" value="4.0%"/>		
Water	<input type="text" value="4.0%"/>		
Natural Gas	<input type="text" value="5.5%"/>		
Steam	<input type="text" value="4.0%"/>		
Waste Water	<input type="text" value="4.0%"/>		
Feedstock:			
Output:			
Ethanol	<input type="text" value="4.0%"/>		
CO ₂	<input type="text" value="4.0%"/>		
Lignin	<input type="text" value="4.0%"/>		
Tax Data:			
Federal income tax rate	<input type="text" value="35.0%"/>		
State income tax rate	<input type="text" value="8.0%"/>		
Effective rate	<input type="text" value="40.0%"/>		
Local tax rate (Gross Receipts Tax)	<input type="text" value="8.25%"/>		
Property Tax Rate	<input type="text" value="0.0%"/> /\$100		
Estimated Annual Expense	<input type="text" value="\$0"/> k/yr		
Ethanol Production Tax Credit	<input type="text" value="\$0.00"/> /gal for max. <input type="text" value="15,000,000"/> gal/yr		
Last year credit applies	<input type="text" value="2000"/>		
Power from Certain Renew. Tax Credit	<input type="text" value="0"/> kwh		
Economic Development Incentives Apply?	<input type="text" value="0"/> (0 = No, 1 = Yes; See Table 2)		
Tax Depreciation			
Buildings	<input type="text" value="31.5"/> Life <input type="text" value="100%"/> Rate		
Development Costs	<input type="text" value="---"/> include in Biomass Conv.		
Plant:			
Biomass Conversion	<input type="text" value="5"/> 200% decl. bal.		
Balance of Plant	<input type="text" value="20"/> 150% decl. bal.		
Book Depreciation	<input type="text" value="20"/> years		
FINANCIAL:			
Debt Structure:			
Debt Fraction	<input type="text" value="80%"/>		
Financing Term	<input type="text" value="10"/> (Note: Must be <= Economic Life)		
Interest Rate	<input type="text" value="10.0%"/>		
Amortization of Loan	<input type="text" value="Level pm"/>		
Short Term Construction Interest	<input type="text" value="8.0%"/>		
Target Return on Equity	<input type="text" value="20%"/>		
Annual Quantities			
	<input type="text" value="0"/> wet tons / year		
	<input type="text" value="0"/> wet tons / year		
	<input type="text" value="180,255"/> wet tons / year		
	<input type="text" value="180,255"/> wet tons / year		

Note: The average tipping fee is calculated so that the project yields the Target Return on Equity. If value is positive, tipping fee is treated as revenue. If negative, tipping fee becomes feedstock charge and is an expense.

BIOMASS-TO-ETHANOL PRODUCTION FACILITY
 PROFORMA FINANCIAL STATEMENT
 THIRD PARTY CONTRACTOR / DEVELOPER
 SITE LOCATION - ALBANY, NY

TABLE 8 -3a: REQUIRED ETHANOL PRICE
 OPTION NO.: 1

Stone & Webster Development Corporation

595 TPD (wet) of 100.0% MIXED STOCK (50% WASTE WOOD & 50% WASTE PAPER), WITH GASIFICATION;
 WOOD @ \$20/TON

Page 1 of 2

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
End of Year	4	5	6	7	8	9	10	11	12	13	14
Years from P. D.	4	5	6	7	8	9	10	11	12	13	14
Operating Year	0	1	2	3	4	5	6	7	8	9	10
ANNUAL CAPACITY FACTOR		83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%
ANNUAL FEEDSTOCK QUANTITY (Tons per Year)		180,255	180,255	180,255	180,255	180,255	180,255	180,255	180,255	180,255	180,255
ANNUAL ETHANOL PRODUCTION (Gallons per Year)		14,844,550	14,844,550	14,844,550	14,844,550	14,844,550	14,844,550	14,844,550	14,844,550	14,844,550	14,844,550
CASH FLOW STATEMENT (\$1000's)											
REVENUE											
Ethanol \$1.96 /gallon		\$35,322	\$36,735	\$38,204	\$39,733	\$41,322	\$42,975	\$44,694	\$46,481	\$48,341	\$50,274
CO2		0	0	0	0	0	0	0	0	0	0
Lignin		0	0	0	0	0	0	0	0	0	0
Power		1,460	1,518	1,579	1,642	1,708	1,776	1,847	1,921	1,998	2,077
Tipping Fee -- Waste Paper \$0.00		0	0	0	0	0	0	0	0	0	0
-- Waste Wood \$0.00		0	0	0	0	0	0	0	0	0	0
-- Mixed stock \$0.00		0	0	0	0	0	0	0	0	0	0
Total Revenue		\$36,782	\$38,253	\$39,783	\$41,374	\$43,029	\$44,750	\$46,541	\$48,402	\$50,338	\$52,352
LESS O&M EXPENSES											
Labor -- Supervisory		\$3,662	\$3,809	\$3,961	\$4,119	\$4,284	\$4,456	\$4,634	\$4,819	\$5,012	\$5,212
Fixed Maintenance Materials		1,290	1,341	1,395	1,451	1,509	1,569	1,632	1,697	1,765	1,836
Insurance		1,667	1,733	1,803	1,875	1,950	2,028	2,109	2,193	2,281	2,372
Property Taxes		0	0	0	0	0	0	0	0	0	0
Variable Maintenance		0	0	0	0	0	0	0	0	0	0
Waste Disposal -- Pretreatment		0	0	0	0	0	0	0	0	0	0
-- Fermentation		0	0	0	0	0	0	0	0	0	0
-- Solids Separation (Ash or Lignin)		898	939	981	1,025	1,071	1,119	1,170	1,222	1,277	1,335
Chemicals		2,890	3,005	3,126	3,251	3,381	3,516	3,656	3,803	3,955	4,113
Power		0	0	0	0	0	0	0	0	0	0
Water		71	74	77	80	83	86	90	93	97	101
Waste Water		104	108	113	117	122	127	132	137	142	148
Steam		0	0	0	0	0	0	0	0	0	0
Natural Gas		0	0	0	0	0	0	0	0	0	0
Feedstock -- Waste Paper *****		0	0	0	0	0	0	0	0	0	0
-- Waste Wood *****		0	0	0	0	0	0	0	0	0	0
-- Mixed Stock (\$20.00)		4,386	4,562	4,744	4,934	5,131	5,336	5,550	5,772	6,003	6,243
Gross Receipts Tax (Income Tax Deductible)		3,034	3,156	3,282	3,413	3,550	3,692	3,840	3,993	4,153	4,319
Total O&M Expenses		\$18,002	\$18,726	\$19,480	\$20,264	\$21,080	\$21,929	\$22,811	\$23,730	\$24,685	\$25,679
GROSS MARGIN		\$18,780	\$19,526	\$20,303	\$21,110	\$21,949	\$22,822	\$23,729	\$24,673	\$25,653	\$26,673
INTEREST		(10,975)	(10,286)	(9,529)	(8,695)	(7,779)	(6,771)	(5,662)	(4,442)	(3,100)	(1,624)
TAX DEPRECIATION		(15,090)	(24,851)	(16,277)	(11,041)	(10,799)	(6,844)	(2,906)	(2,714)	(2,683)	(2,683)
TAXABLE INCOME		(\$7,285)	(\$15,611)	(\$5,503)	\$1,374	\$3,372	\$9,207	\$15,162	\$17,517	\$19,871	\$22,367
TAXES: Income		2,976	6,377	2,248	(561)	(1,377)	(3,761)	(6,194)	(7,156)	(8,117)	(9,137)
Production Tax Credit		0	0	0	0	0	0	0	0	0	0
INCOME AFTER TAX		(\$4,309)	(\$9,234)	(\$3,255)	\$813	\$1,994	\$5,446	\$8,968	\$10,361	\$11,754	\$13,230
TAX DEPRECIATION		15,090	24,851	16,277	11,041	10,799	6,844	2,906	2,714	2,683	2,683
PLANT COST (\$137,183)											
LOAN \$109,746											
PRINCIPAL PAYMENTS		(6,886)	(7,575)	(8,332)	(9,165)	(10,082)	(11,090)	(12,199)	(13,419)	(14,761)	(16,237)
NET CASH FLOW		(\$27,437)	\$3,895	\$8,043	\$4,690	\$2,688	\$2,711	\$1,200	(\$325)	(\$344)	(\$324)
CUMULATIVE CASH FLOW		(\$27,437)	(\$23,542)	(\$15,499)	(\$10,809)	(\$8,121)	(\$5,409)	(\$4,209)	(\$4,535)	(\$4,878)	(\$5,527)
CUMULATIVE IRR		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DEBT COVERAGE RATIO		1.051	1.093	1.137	1.182	1.229	1.278	1.329	1.381	1.436	1.493
CUM NPV 20.0%		(\$27,437)	(\$24,191)	(\$18,605)	(\$15,891)	(\$14,595)	(\$13,505)	(\$13,103)	(\$13,194)	(\$13,274)	(\$13,389)

BIOMASS-TO-ETHANOL PRODUCTION FACILITY
PROFORMA FINANCIAL STATEMENT
THIRD PARTY CONTRACTOR / DEVELOPER
SITE LOCATION - ALBANY, NY

TABLE 8-3a: REQUIRED ETHANOL PRICE

OPTION NO.: 1

Stone & Webster Development Corporation

595 TPD (wet) of 100.0% MIXED STOCK (50% WASTE WOOD & 50% WASTE PAPER), WITH GASIFICATION;
WOOD @ \$20/TON

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	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
End of Year	15	16	17	18	19	20	21	22	23	24
Years from P.D.	11	12	13	14	15	16	17	18	19	20
Operating Year										
ANNUAL CAPACITY FACTOR	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%
ANNUAL FEEDSTOCK QUANTITY (Tons per Year)	180,255	180,255	180,255	180,255	180,255	180,255	180,255	180,255	180,255	180,255
ANNUAL ETHANOL PRODUCTION (Gallons per Year)	14,844,550	14,844,550	14,844,550	14,844,550	14,844,550	14,844,550	14,844,550	14,844,550	14,844,550	14,844,550
CASH FLOW STATEMENT										
REVENUE										
Ethanol	\$1.96 /gallon	\$52,285	\$54,377	\$56,552	\$58,814	\$61,166	\$63,613	\$66,158	\$68,804	\$71,556
CO2		0	0	0	0	0	0	0	0	0
Lignin		0	0	0	0	0	0	0	0	0
Power		2,161	2,247	2,337	2,430	2,528	2,629	2,734	2,843	2,957
Tipping Fee- Waste Paper	\$0.00	0	0	0	0	0	0	0	0	0
- Waste Wood	\$0.00	0	0	0	0	0	0	0	0	0
- Mixed stock	\$0.00	0	0	0	0	0	0	0	0	0
Total Revenue		\$54,446	\$56,624	\$58,889	\$61,244	\$63,694	\$66,242	\$68,891	\$71,647	\$74,513
LESS O&M EXPENSES										
Labor - Supervisory		\$5,421	\$5,638	\$5,863	\$6,098	\$6,342	\$6,595	\$6,859	\$7,133	\$7,419
Fixed Maintenance Materials		1,909	1,985	2,065	2,147	2,233	2,323	2,415	2,512	2,613
Insurance		2,467	2,566	2,669	2,775	2,886	3,002	3,122	3,247	3,377
Property Taxes		0	0	0	0	0	0	0	0	0
Variable Maintenance		0	0	0	0	0	0	0	0	0
Waste Disposal - Pretreatment		0	0	0	0	0	0	0	0	0
- Fermentation		0	0	0	0	0	0	0	0	0
- Solids Separation (Ash or Lignin)		1,395	1,458	1,523	1,592	1,663	1,738	1,816	1,898	1,984
Chemicals		4,277	4,449	4,627	4,812	5,004	5,204	5,412	5,629	5,854
Power		0	0	0	0	0	0	0	0	0
Water		105	109	113	118	122	127	132	138	143
Waste Water		154	160	167	173	180	187	195	203	211
Steam		0	0	0	0	0	0	0	0	0
Natural Gas		0	0	0	0	0	0	0	0	0
Feedstock - Waste Paper	*****	0	0	0	0	0	0	0	0	0
- Waste Wood	*****	0	0	0	0	0	0	0	0	0
- Mixed Stock	(\$20.00)	6,493	6,752	7,022	7,303	7,595	7,899	8,215	8,544	8,886
Gross Receipts Tax (Income Tax Deductible)		4,492	4,671	4,858	5,053	5,255	5,465	5,684	5,911	6,147
Total O&M Expenses		\$26,712	\$27,788	\$28,907	\$30,071	\$31,281	\$32,541	\$33,851	\$35,214	\$36,633
GROSS MARGIN		\$27,733	\$28,836	\$29,982	\$31,174	\$32,412	\$33,701	\$35,040	\$36,433	\$37,880
INTEREST		(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
TAX DEPRECIATION		(2,683)	(2,683)	(2,683)	(2,683)	(2,683)	(2,683)	(2,683)	(2,683)	(2,683)
TAXABLE INCOME		\$25,051	\$26,153	\$27,299	\$28,491	\$29,730	\$31,018	\$32,357	\$33,750	\$35,198
TAXES: Income		(10,233)	(10,683)	(11,152)	(11,638)	(12,145)	(12,671)	(13,218)	(13,787)	(14,378)
Production Tax Credit		0	0	0	0	0	0	0	0	0
INCOME AFTER TAX		\$14,817	\$15,469	\$16,147	\$16,852	\$17,585	\$18,347	\$19,139	\$19,963	\$20,819
TAX DEPRECIATION		2,683	2,683	2,683	2,683	2,683	2,683	2,683	2,683	2,683
PLANT COST										
LOAN										
PRINCIPAL PAYMENTS		0	0	0	0	0	0	0	0	0
NET CASH FLOW		\$17,500	\$18,152	\$18,830	\$19,535	\$20,268	\$21,030	\$21,822	\$22,646	\$23,502
CUMULATIVE CASH FLOW		\$11,973	\$30,125	\$48,956	\$68,491	\$88,759	\$109,788	\$131,611	\$154,256	\$177,759
CUMULATIVE IRR		6.55%	11.17%	13.86%	15.65%	16.93%	17.88%	18.61%	19.17%	19.62%
DEBT COVERAGE RATIO		NA	NA	NA	NA	NA	NA	NA	NA	20.00%
CUM NPV	20.0%	(\$11,034)	(\$8,998)	(\$7,238)	(\$5,717)	(\$4,401)	(\$3,264)	(\$2,280)	(\$1,430)	(\$694)

BIOMASS-TO-ETHANOL PRODUCTION FACILITY
PROFORMA FINANCIAL STATEMENT
THIRD PARTY CONTRACTOR/ DEVELOPER
SITE LOCATION - BUFFALO, NY

TABLE 8-3b: REQUIRED ETHANOL PRICE
OPTION NO.: 7
595 TPD (wet) of 100.0% MIXED STOCK (50% WASTE WOOD & 50% WASTE PAPER) @ \$20/TON;
WITH GASIFICATION

Stone & Webster Development Corporation

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End of Year	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Years from P. D.	4	5	6	7	8	9	10	11	12	13	14
Operating Year	0	1	2	3	4	5	6	7	8	9	10
ANNUAL CAPACITY FACTOR		83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%
ANNUAL FEEDSTOCK QUANTITY (Tons per Year)		180,255	180,255	180,255	180,255	180,255	180,255	180,255	180,255	180,255	180,255
ANNUAL ETHANOL PRODUCTION (Gallons per Year)		14,844,550	14,844,550	14,844,550	14,844,550	14,844,550	14,844,550	14,844,550	14,844,550	14,844,550	14,844,550
CASH FLOW STATEMENT (\$1000's)											
REVENUE											
Ethanol	\$1.99 /gallon	\$35,881	\$37,316	\$38,809	\$40,361	\$41,976	\$43,655	\$45,401	\$47,217	\$49,106	\$51,070
CO2		0	0	0	0	0	0	0	0	0	0
Lignin		0	0	0	0	0	0	0	0	0	0
Power		1,460	1,518	1,579	1,642	1,708	1,776	1,847	1,921	1,998	2,077
Tipping Fee - Waste Paper	\$0.00	0	0	0	0	0	0	0	0	0	0
- Waste Wood	\$0.00	0	0	0	0	0	0	0	0	0	0
- Mixed Stock	\$0.00	0	0	0	0	0	0	0	0	0	0
Total Revenue		\$37,341	\$38,834	\$40,388	\$42,003	\$43,683	\$45,431	\$47,248	\$49,138	\$51,103	\$53,148
LESS O&M EXPENSES											
Labor - Supervisory		\$3,662	\$3,809	\$3,961	\$4,119	\$4,284	\$4,456	\$4,634	\$4,819	\$5,012	\$5,212
Fixed Maintenance Materials		1,338	1,392	1,448	1,505	1,566	1,628	1,693	1,761	1,832	1,905
Insurance		1,715	1,784	1,855	1,930	2,007	2,087	2,171	2,257	2,348	2,442
Property Taxes		0	0	0	0	0	0	0	0	0	0
Variable Maintenance		0	0	0	0	0	0	0	0	0	0
Waste Disposal - Pretreatment		0	0	0	0	0	0	0	0	0	0
- Fermentation		0	0	0	0	0	0	0	0	0	0
- Solids Separation (Ash or Lignin)		898	939	981	1,025	1,071	1,119	1,170	1,222	1,277	1,335
Chemicals		2,890	3,005	3,126	3,251	3,381	3,516	3,656	3,803	3,955	4,113
Power		0	0	0	0	0	0	0	0	0	0
Water		19	20	21	22	23	24	25	26	27	28
Waste Water		39	40	42	44	45	47	49	51	53	55
Steam		0	0	0	0	0	0	0	0	0	0
Natural Gas		0	0	0	0	0	0	0	0	0	0
Feedstock - Waste Paper	*****	0	0	0	0	0	0	0	0	0	0
- Waste Wood	*****	0	0	0	0	0	0	0	0	0	0
- Mixed Stock	(\$20.00)	0	0	0	0	0	0	0	0	0	0
Gross Receipts Tax (Income Tax Deductible)		4,386	4,562	4,744	4,934	5,131	5,336	5,550	5,772	6,003	6,243
		3,081	3,204	3,332	3,465	3,604	3,748	3,898	4,054	4,216	4,385
Total O&M Expenses		\$18,029	\$18,754	\$19,509	\$20,295	\$21,111	\$21,961	\$22,845	\$23,765	\$24,722	\$25,717
GROSS MARGIN		\$19,312	\$20,080	\$20,878	\$21,709	\$22,572	\$23,469	\$24,403	\$25,373	\$26,382	\$27,431
INTEREST		(11,310)	(10,600)	(9,820)	(8,961)	(8,016)	(6,977)	(5,834)	(4,577)	(3,194)	(1,673)
TAX DEPRECIATION		(15,683)	(25,816)	(16,888)	(11,437)	(11,189)	(7,073)	(2,973)	(2,778)	(2,745)	(2,745)
TAXABLE INCOME		(\$7,681)	(\$16,336)	(\$5,829)	\$1,311	\$3,366	\$9,419	\$15,595	\$18,018	\$20,442	\$23,012
TAXES: Income		3,138	6,673	2,381	(536)	(1,375)	(3,848)	(8,370)	(7,360)	(8,350)	(9,400)
Production Tax Credit		0	0	0	0	0	0	0	0	0	0
INCOME AFTER TAX		(\$4,543)	(\$9,663)	(\$3,448)	\$776	\$1,991	\$5,572	\$9,224	\$10,658	\$12,091	\$13,612
TAX DEPRECIATION		15,683	25,816	16,888	11,437	11,189	7,073	2,973	2,778	2,745	2,745
PLANT COST	(\$141,372)										
LOAN	\$113,098										
PRINCIPAL PAYMENTS		(7,096)	(7,806)	(8,587)	(9,445)	(10,390)	(11,429)	(12,572)	(13,829)	(15,212)	(16,733)
NET CASH FLOW		(\$28,274)	\$4,043	\$8,347	\$4,853	\$2,767	\$2,791	\$1,216	(\$374)	(\$394)	(\$376)
CUMULATIVE CASH FLOW		(\$28,274)	(\$24,231)	(\$15,884)	(\$11,031)	(\$8,264)	(\$5,473)	(\$4,257)	(\$4,631)	(\$5,025)	(\$5,400)
CUMULATIVE IRR		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DEBT COVERAGE RATIO		1.049	1.091	1.134	1.179	1.226	1.275	1.326	1.379	1.433	1.490
CUM NPV	20.0%	(\$28,274)	(\$24,905)	(\$19,108)	(\$16,300)	(\$14,965)	(\$13,844)	(\$13,437)	(\$13,541)	(\$13,633)	(\$13,766)

BIOMASS-TO-ETHANOL PRODUCTION FACILITY
PROFORMA FINANCIAL STATEMENT
THIRD PARTY CONTRACTOR / DEVELOPER
SITE LOCATION - BUFFALO, NY

TABLE 8-3b: REQUIRED ETHANOL PRICE
OPTION NO.: 7

Stone & Webster Development Corporation

595 TPD (wet) of 100.0% MIXED STOCK (50% WASTE WOOD & 50% WASTE PAPER) @ \$20/TON;
WITH GASIFICATION

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	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
End of Year	15	16	17	18	19	20	21	22	23	24
Years from P.D.	11	12	13	14	15	16	17	18	19	20
Operating Year										
ANNUAL CAPACITY FACTOR	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%
ANNUAL FEEDSTOCK QUANTITY (Tons per Year)	180,255	180,255	180,255	180,255	180,255	180,255	180,255	180,255	180,255	180,255
ANNUAL ETHANOL PRODUCTION (Gallons per Year)	14,844,550	14,844,550	14,844,550	14,844,550	14,844,550	14,844,550	14,844,550	14,844,550	14,844,550	14,844,550
CASH FLOW STATEMENT (\$1000's)										
REVENUE										
Ethanol \$1.99 /gallon	\$53,113	\$55,237	\$57,447	\$59,745	\$62,135	\$64,620	\$67,205	\$69,893	\$72,689	\$75,596
CO2	0	0	0	0	0	0	0	0	0	0
Lignin	0	0	0	0	0	0	0	0	0	0
Power	2,161	2,247	2,337	2,430	2,528	2,629	2,734	2,843	2,957	3,075
Tipping Fee- Waste Paper \$0.00	0	0	0	0	0	0	0	0	0	0
- Waste Wood \$0.00	0	0	0	0	0	0	0	0	0	0
- Mixed Stock \$0.00	0	0	0	0	0	0	0	0	0	0
Total Revenue	\$55,273	\$57,484	\$59,784	\$62,175	\$64,662	\$67,249	\$69,939	\$72,736	\$75,646	\$78,671
LESS O&M EXPENSES										
Labor - Supervisory	\$5,421	\$5,638	\$5,863	\$6,098	\$6,342	\$6,595	\$6,859	\$7,133	\$7,419	\$7,716
Fixed Maintenance Materials	1,981	2,060	2,143	2,228	2,318	2,410	2,507	2,607	2,711	2,820
Insurance	2,539	2,641	2,747	2,856	2,971	3,089	3,213	3,342	3,475	3,614
Property Taxes	0	0	0	0	0	0	0	0	0	0
Variable Maintenance	0	0	0	0	0	0	0	0	0	0
Waste Disposal - Pretreatment	0	0	0	0	0	0	0	0	0	0
- Fermentation	0	0	0	0	0	0	0	0	0	0
- Solids Separation (Ash or Lignin)	1,395	1,458	1,523	1,592	1,663	1,738	1,816	1,898	1,984	2,073
Chemicals	4,277	4,449	4,627	4,812	5,004	5,204	5,412	5,629	5,854	6,088
Power	0	0	0	0	0	0	0	0	0	0
Water	29	30	31	32	34	35	37	38	39	41
Waste Water	57	60	62	65	67	70	73	75	78	82
Steam	0	0	0	0	0	0	0	0	0	0
Natural Gas	0	0	0	0	0	0	0	0	0	0
Feedstock - Waste Paper *****	0	0	0	0	0	0	0	0	0	0
- Waste Wood *****	0	0	0	0	0	0	0	0	0	0
- Mixed Stock (\$20.00)	6,493	6,752	7,022	7,303	7,595	7,899	8,215	8,544	8,886	9,241
Gross Receipts Tax (Income Tax Deductible)	4,560	4,742	4,932	5,129	5,335	5,548	5,770	6,001	6,241	6,490
Total O&M Expenses	\$26,752	\$27,829	\$28,950	\$30,115	\$31,328	\$32,589	\$33,902	\$35,267	\$36,687	\$38,164
GROSS MARGIN	\$28,521	\$29,655	\$30,834	\$32,060	\$33,334	\$34,659	\$36,037	\$37,469	\$38,958	\$40,507
INTEREST	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
TAX DEPRECIATION	(2,745)	(2,745)	(2,745)	(2,745)	(2,745)	(2,745)	(2,745)	(2,745)	(2,745)	(2,745)
TAXABLE INCOME	\$25,776	\$26,910	\$28,089	\$29,314	\$30,589	\$31,914	\$33,291	\$34,724	\$36,213	\$37,762
TAXES: Income	(10,529)	(10,993)	(11,474)	(11,975)	(12,495)	(13,037)	(13,600)	(14,185)	(14,793)	(15,426)
Production Tax Credit	0	0	0	0	0	0	0	0	0	0
INCOME AFTER TAX	\$15,246	\$15,917	\$16,614	\$17,339	\$18,093	\$18,877	\$19,692	\$20,539	\$21,420	\$22,336
TAX DEPRECIATION	2,745	2,745	2,745	2,745	2,745	2,745	2,745	2,745	2,745	2,745
PLANT COST										
LOAN										
PRINCIPAL PAYMENTS	0	0	0	0	0	0	0	0	0	0
NET CASH FLOW	\$17,992	\$18,662	\$19,360	\$20,085	\$20,839	\$21,622	\$22,437	\$23,285	\$24,165	\$25,071
CUMULATIVE CASH FLOW	\$12,216	\$30,878	\$50,238	\$70,323	\$91,161	\$112,784	\$135,221	\$158,506	\$182,671	\$207,742
CUMULATIVE IRR	6.52%	11.15%	13.85%	15.65%	16.93%	17.88%	18.61%	19.17%	19.62%	20.00%
DEBT COVERAGE RATIO	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CUM NPV 20.0%	(\$11,345)	(\$9,251)	(\$7,442)	(\$5,878)	(\$4,525)	(\$3,356)	(\$2,344)	(\$1,470)	(\$713)	\$0

BIOMASS--TO--ETHANOL PRODUCTION FACILITY
PROFORMA FINANCIAL STATEMENT
THIRD PARTY CONTRACTOR/ DEVELOPER
SITE LOCATION -- ROCHESTER, NY

TABLE 8-3c: REQUIRED ETHANOL PRICE
OPTION NO.: 13
595 TPD (wet) of 100.0% MIXED STOCK (50% WASTE WOOD & 50% WASTE PAPER) @ \$20/TON;
WITH GASIFICATION

Stone & Webster Development Corporation

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	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
End of Year	4	5	6	7	8	9	10	11	12	13	14
Years from P.D.	4	5	6	7	8	9	10	11	12	13	14
Operating Year	0	1	2	3	4	5	6	7	8	9	10
ANNUAL CAPACITY FACTOR		83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%
ANNUAL FEEDSTOCK QUANTITY (Tons per Year)		180,255	180,255	180,255	180,255	180,255	180,255	180,255	180,255	180,255	180,255
ANNUAL ETHANOL PRODUCTION (Gallons per Year)		14,844,550	14,844,550	14,844,550	14,844,550	14,844,550	14,844,550	14,844,550	14,844,550	14,844,550	14,844,550
CASH FLOW STATEMENT (\$1000's)											
REVENUE											
Ethanol \$1.97 /gallon		\$35,602	\$37,026	\$38,507	\$40,047	\$41,649	\$43,315	\$45,048	\$46,849	\$48,723	\$50,672
CO2		0	0	0	0	0	0	0	0	0	0
Lignin		0	0	0	0	0	0	0	0	0	0
Power		1,460	1,518	1,579	1,642	1,708	1,776	1,847	1,921	1,998	2,077
Tipping Fee-- Waste Paper \$0.00		0	0	0	0	0	0	0	0	0	0
- Waste Wood \$0.00		0	0	0	0	0	0	0	0	0	0
- Mixed Stock \$0.00		0	0	0	0	0	0	0	0	0	0
Total Revenue		\$37,061	\$38,544	\$40,086	\$41,689	\$43,357	\$45,091	\$46,894	\$48,770	\$50,721	\$52,750
LESS O&M EXPENSES											
Labor -- Supervisory		\$3,662	\$3,809	\$3,961	\$4,119	\$4,284	\$4,456	\$4,634	\$4,819	\$5,012	\$5,212
Fixed Maintenance Materials		1,314	1,367	1,421	1,478	1,537	1,599	1,663	1,729	1,798	1,870
Insurance		1,691	1,759	1,829	1,902	1,978	2,058	2,140	2,225	2,314	2,407
Property Taxes		0	0	0	0	0	0	0	0	0	0
Variable Maintenance		0	0	0	0	0	0	0	0	0	0
Waste Disposal -- Pretreatment		0	0	0	0	0	0	0	0	0	0
- Fermentation		0	0	0	0	0	0	0	0	0	0
- Solids Separation (Ash or Lignin)		898	939	981	1,025	1,071	1,119	1,170	1,222	1,277	1,335
Chemicals		2,890	3,005	3,126	3,251	3,381	3,516	3,656	3,803	3,955	4,113
Power		0	0	0	0	0	0	0	0	0	0
Water		37	39	40	42	43	45	47	49	51	53
Waste Water		55	57	59	61	64	67	69	72	75	78
Steam		0	0	0	0	0	0	0	0	0	0
Natural Gas		0	0	0	0	0	0	0	0	0	0
Feedstock -- Waste Paper *****		0	0	0	0	0	0	0	0	0	0
- Waste Wood *****		0	0	0	0	0	0	0	0	0	0
- Mixed Stock (\$20.00)		4,386	4,562	4,744	4,934	5,131	5,336	5,550	5,772	6,003	6,243
Gross Receipts Tax (Income Tax Deductible)		3,058	3,180	3,307	3,439	3,577	3,720	3,869	4,024	4,184	4,352
Total O&M Expenses		\$17,991	\$18,715	\$19,468	\$20,252	\$21,067	\$21,915	\$22,797	\$23,715	\$24,670	\$25,663
GROSS MARGIN		\$19,071	\$19,829	\$20,617	\$21,437	\$22,290	\$23,176	\$24,097	\$25,055	\$26,051	\$27,087
INTEREST		(11,158)	(10,458)	(9,688)	(8,841)	(7,909)	(6,884)	(5,756)	(4,516)	(3,152)	(1,651)
TAX DEPRECIATION		(15,418)	(25,384)	(16,614)	(11,259)	(11,014)	(8,970)	(2,942)	(2,749)	(2,717)	(2,717)
TAXABLE INCOME		(\$7,505)	(\$16,013)	(\$5,685)	\$1,338	\$3,367	\$9,322	\$15,399	\$17,791	\$20,183	\$22,719
TAXES: Income		3,066	6,541	2,322	(546)	(1,375)	(3,808)	(6,290)	(7,267)	(8,245)	(9,281)
Production Tax Credit		0	0	0	0	0	0	0	0	0	0
INCOME AFTER TAX		(\$4,439)	(\$9,472)	(\$3,362)	\$791	\$1,991	\$5,514	\$9,108	\$10,523	\$11,938	\$13,439
TAX DEPRECIATION		15,418	25,384	16,614	11,259	11,014	6,970	2,942	2,749	2,717	2,717
PLANT COST (\$139,479)											
LOAN \$111,583											
PRINCIPAL PAYMENTS		(7,001)	(7,701)	(8,472)	(9,319)	(10,251)	(11,276)	(12,403)	(13,644)	(15,008)	(16,509)
NET CASH FLOW		(\$27,896)	\$3,977	\$8,211	\$4,780	\$2,731	\$1,208	(\$353)	(\$372)	(\$353)	(\$353)
CUMULATIVE CASH FLOW		(\$27,896)	(\$23,919)	(\$15,708)	(\$10,928)	(\$8,197)	(\$4,234)	(\$4,587)	(\$4,959)	(\$5,312)	(\$5,665)
CUMULATIVE IRR		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DEBT COVERAGE RATIO		1.050	1.092	1.135	1.180	1.227	1.276	1.327	1.380	1.435	1.492
CUM NPV 20.0%		(\$27,896)	(\$24,582)	(\$18,880)	(\$16,114)	(\$14,796)	(\$13,689)	(\$13,285)	(\$13,470)	(\$13,538)	(\$13,595)

BIOMASS- TO-ETHANOL PRODUCTION FACILITY
PROFORMA FINANCIAL STATEMENT
THIRD PARTY CONTRACTOR / DEVELOPER
SITE LOCATION - ROCHESTER, NY

TABLE 8-3c: REQUIRED ETHANOL PRICE

OPTION NO.: 13

595 TPD (wet) of 100.0% MIXED STOCK (50% WASTE WOOD & 50% WASTE PAPER) @ \$20/TON;
WITH GASIFICATION

Stone & Webster Development Corporation

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	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
End of Year	15	16	17	18	19	20	21	22	23	24
Years from P. D.	11	12	13	14	15	16	17	18	19	20
Operating Year										
ANNUAL CAPACITY FACTOR	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%
ANNUAL FEEDSTOCK QUANTITY (Tons per Year)	180,255	180,255	180,255	180,255	180,255	180,255	180,255	180,255	180,255	180,255
ANNUAL ETHANOL PRODUCTION (Gallons per Year)	14,844,550	14,844,550	14,844,550	14,844,550	14,844,550	14,844,550	14,844,550	14,844,550	14,844,550	14,844,550
CASH FLOW STATEMENT (\$1000's)										
REVENUE										
Ethanol \$1.97 /gallon	\$52,699	\$54,807	\$57,000	\$59,279	\$61,651	\$64,117	\$66,681	\$69,349	\$72,123	\$75,007
CO2	0	0	0	0	0	0	0	0	0	0
Lignin	0	0	0	0	0	0	0	0	0	0
Power	2,161	2,247	2,337	2,430	2,528	2,629	2,734	2,843	2,957	3,075
Tipping Fee- Waste Paper \$0.00	0	0	0	0	0	0	0	0	0	0
- Waste Wood \$0.00	0	0	0	0	0	0	0	0	0	0
- Mixed Stock \$0.00	0	0	0	0	0	0	0	0	0	0
Total Revenue	\$54,860	\$57,054	\$59,336	\$61,710	\$64,178	\$66,145	\$69,415	\$72,192	\$75,079	\$78,083
LESS O&M EXPENSES										
Labor - Supervisory	\$5,421	\$5,638	\$5,863	\$6,098	\$6,342	\$6,595	\$6,859	\$7,133	\$7,419	\$7,716
Fixed Maintenance Materials	1,945	2,023	2,104	2,188	2,275	2,366	2,461	2,560	2,662	2,768
Insurance	2,503	2,603	2,708	2,816	2,929	3,046	3,167	3,294	3,426	3,563
Property Taxes	0	0	0	0	0	0	0	0	0	0
Variable Maintenance	0	0	0	0	0	0	0	0	0	0
Waste Disposal - Pretreatment	0	0	0	0	0	0	0	0	0	0
- Fermentation	0	0	0	0	0	0	0	0	0	0
- Solids Separation (Ash or Lignin)	1,395	1,458	1,523	1,592	1,663	1,738	1,816	1,898	1,984	2,073
Chemicals	4,277	4,449	4,627	4,812	5,004	5,204	5,412	5,629	5,854	6,088
Power	0	0	0	0	0	0	0	0	0	0
Water	55	57	60	62	64	67	70	72	75	78
Waste Water	81	84	88	91	95	98	102	106	111	115
Steam	0	0	0	0	0	0	0	0	0	0
Natural Gas	0	0	0	0	0	0	0	0	0	0
Feedstock - Waste Paper *****	0	0	0	0	0	0	0	0	0	0
- Waste Wood *****	0	0	0	0	0	0	0	0	0	0
- Mixed Stock (\$20.00)	6,493	6,752	7,022	7,303	7,595	7,899	8,215	8,544	8,886	9,241
Gross Receipts Tax (Income Tax Deductible)	4,526	4,707	4,895	5,091	5,295	5,506	5,727	5,956	6,194	6,442
Total O&M Expenses	\$26,696	\$27,771	\$28,889	\$30,052	\$31,262	\$32,521	\$33,830	\$35,193	\$36,610	\$38,084
GROSS MARGIN	\$28,164	\$29,283	\$30,448	\$31,658	\$32,916	\$34,225	\$35,585	\$36,999	\$38,470	\$39,998
INTEREST (0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
TAX DEPRECIATION (2,717)	(2,717)	(2,717)	(2,717)	(2,717)	(2,717)	(2,717)	(2,717)	(2,717)	(2,717)	(2,717)
TAXABLE INCOME	\$25,447	\$26,567	\$27,731	\$28,941	\$30,199	\$31,508	\$32,868	\$34,282	\$35,753	\$37,281
TAXES: Income (10,395)	(10,395)	(10,853)	(11,328)	(11,822)	(12,336)	(12,871)	(13,427)	(14,004)	(14,605)	(15,239)
Production Tax Credit 0	0	0	0	0	0	0	0	0	0	0
INCOME AFTER TAX	\$15,052	\$15,714	\$16,403	\$17,119	\$17,863	\$18,637	\$19,441	\$20,278	\$21,148	\$22,042
TAX DEPRECIATION 2,717	2,717	2,717	2,717	2,717	2,717	2,717	2,717	2,717	2,717	2,717
PLANT COST										
LOAN										
PRINCIPAL PAYMENTS 0	0	0	0	0	0	0	0	0	0	0
NET CASH FLOW	\$17,769	\$18,431	\$19,120	\$19,835	\$20,580	\$21,354	\$22,158	\$22,995	\$23,865	\$24,759
CUMULATIVE CASH FLOW	\$12,104	\$30,535	\$49,654	\$69,490	\$90,069	\$111,423	\$133,581	\$156,576	\$180,440	\$207,450
CUMULATIVE IRR 6.53%	6.53%	11.16%	13.85%	15.65%	16.93%	17.88%	18.61%	19.17%	19.62%	20.00%
DEBT COVERAGE RATIO NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CUM NPV 20.0% (\$11,204)	(\$11,204)	(\$9,137)	(\$7,350)	(\$5,805)	(\$4,469)	(\$3,314)	(\$2,315)	(\$1,452)	(\$705)	\$0

BIOMASS-TO-ETHANOL PRODUCTION FACILITY
PROFORMA FINANCIAL STATEMENT
THIRD PARTY CONTRACTOR / DEVELOPER
SITE LOCATION - SYRACUSE, NY

TABLE 8-3d: REQUIRED ETHANOL PRICE
OPTION NO.: 19
595 TPD (wet) of 100.0% MIXED STOCK (50% WASTE WOOD & 50% WASTE PAPER) @ \$20/TON;
WITH GASIFICATION

Stone & Webster Development Corporation

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	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
End of Year	4	5	6	7	8	9	10	11	12	13	14
Years from P.D.	0	1	2	3	4	5	6	7	8	9	10
Operating Year											
ANNUAL CAPACITY FACTOR		83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%
ANNUAL FEEDSTOCK QUANTITY (Tons per Year)		180,255	180,255	180,255	180,255	180,255	180,255	180,255	180,255	180,255	180,255
ANNUAL ETHANOL PRODUCTION (Gallons per Year)		14,844,550	14,844,550	14,844,550	14,844,550	14,844,550	14,844,550	14,844,550	14,844,550	14,844,550	14,844,550
CASH FLOW STATEMENT (\$1000's)											
REVENUE											
Ethanol	\$1.94 /gallon	\$35,021	\$36,422	\$37,879	\$39,394	\$40,970	\$42,609	\$44,313	\$46,085	\$47,929	\$49,846
CO2		0	0	0	0	0	0	0	0	0	0
Lignin		0	0	0	0	0	0	0	0	0	0
Power		1,460	1,518	1,579	1,642	1,708	1,776	1,847	1,921	1,998	2,077
Tipping Fee - Waste Paper	\$0.00	0	0	0	0	0	0	0	0	0	0
- Waste Wood	\$0.00	0	0	0	0	0	0	0	0	0	0
- Mixed Stock	\$0.00	0	0	0	0	0	0	0	0	0	0
Total Revenue		\$36,481	\$37,940	\$39,458	\$41,036	\$42,677	\$44,384	\$46,160	\$48,006	\$49,926	\$51,923
LESS O&M EXPENSES											
Labor - Supervisory		\$3,662	\$3,809	\$3,961	\$4,119	\$4,284	\$4,456	\$4,634	\$4,819	\$5,012	\$5,212
Fixed Maintenance Materials		1,277	1,329	1,382	1,437	1,494	1,554	1,616	1,681	1,748	1,818
Insurance		1,655	1,721	1,790	1,861	1,936	2,013	2,094	2,177	2,264	2,355
Property Taxes		0	0	0	0	0	0	0	0	0	0
Variable Maintenance		0	0	0	0	0	0	0	0	0	0
Waste Disposal - Pretreatment		0	0	0	0	0	0	0	0	0	0
- Fermentation		0	0	0	0	0	0	0	0	0	0
- Solids Separation (Ash or Lignin)		898	939	981	1,025	1,071	1,119	1,170	1,222	1,277	1,335
Chemicals		2,890	3,005	3,126	3,251	3,381	3,516	3,656	3,803	3,955	4,113
Power	Economic Incentives Reduction: 0%	0	0	0	0	0	0	0	0	0	0
Water		29	30	32	33	34	36	37	38	40	42
Waste Water		21	22	22	23	24	25	26	27	28	29
Steam		0	0	0	0	0	0	0	0	0	0
Natural Gas	Economic Incentives Reduction: 0%	0	0	0	0	0	0	0	0	0	0
Feedstock		0	0	0	0	0	0	0	0	0	0
- Waste Paper	*****	0	0	0	0	0	0	0	0	0	0
- Waste Wood	*****	0	0	0	0	0	0	0	0	0	0
- Mixed Stock	(\$20.00)	4,386	4,562	4,744	4,934	5,131	5,336	5,550	5,772	6,003	6,243
Gross Receipts Tax (Income Tax Deductible)		3,010	3,130	3,255	3,385	3,521	3,662	3,808	3,961	4,119	4,284
Total O&M Expenses		\$17,828	\$18,545	\$19,292	\$20,069	\$20,876	\$21,717	\$22,591	\$23,501	\$24,447	\$25,431
GROSS MARGIN		\$18,653	\$19,394	\$20,166	\$20,967	\$21,801	\$22,667	\$23,569	\$24,505	\$25,480	\$26,492
INTEREST		(10,896)	(10,212)	(9,460)	(8,633)	(7,723)	(6,722)	(5,621)	(4,410)	(3,078)	(1,612)
TAX DEPRECIATION		(14,957)	(24,634)	(16,138)	(10,950)	(10,709)	(6,790)	(2,888)	(2,698)	(2,667)	(2,667)
TAXABLE INCOME		(\$7,200)	(\$15,452)	(\$5,433)	\$1,385	\$3,369	\$9,155	\$15,060	\$17,398	\$19,735	\$22,214
TAXES: Income		2,941	6,312	2,219	(566)	(1,376)	(3,740)	(6,152)	(7,107)	(8,062)	(9,074)
Tax Credits	\$0 Investment \$0 Wages	0	0	0	0	0	0	0	0	0	0
INCOME AFTER TAX		(\$4,259)	(\$9,140)	(\$3,214)	\$819	\$1,992	\$5,415	\$8,908	\$10,291	\$11,674	\$13,139
TAX DEPRECIATION		14,957	24,634	16,138	10,950	10,709	6,790	2,888	2,698	2,667	2,667
PLANT COST	(\$136,197)										
LOAN	\$108,958										
PRINCIPAL PAYMENTS		(\$6,837)	(7,520)	(\$2,272)	(\$9,099)	(10,009)	(11,010)	(12,111)	(13,323)	(14,655)	(16,120)
NET CASH FLOW		(\$27,239)	\$3,862	\$7,974	\$4,653	\$2,669	\$2,692	\$1,195	(\$316)	(\$334)	(\$314)
CUMULATIVE CASH FLOW		(\$27,239)	(\$23,378)	(\$15,404)	(\$10,751)	(\$8,082)	(\$5,389)	(\$4,194)	(\$4,510)	(\$5,158)	(\$5,473)
CUMULATIVE IRR		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DEBT COVERAGE RATIO		1.052	1.094	1.137	1.182	1.229	1.278	1.329	1.382	1.437	1.494
CUM NPV	20.0%	(\$27,239)	(\$24,021)	(\$18,484)	(\$15,791)	(\$14,504)	(\$13,422)	(\$13,022)	(\$13,110)	(\$13,187)	(\$13,299)

BIOMASS-TO-ETHANOL PRODUCTION FACILITY
PROFORMA FINANCIAL STATEMENT
THIRD PARTY CONTRACTOR / DEVELOPER
SITE LOCATION - SYRACUSE, NY

TABLE 8-3d: REQUIRED ETHANOL PRICE

OPTION NO.: 19

595 TPD (wet) of 100.0% MIXED STOCK (50% WASTE WOOD & 50% WASTE PAPER) @ \$20/TON;
WITH GASIFICATION

Stone & Webster Development Corporation

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End of Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Years from P.D.	15	16	17	18	19	20	21	22	23	24
Operating Year	11	12	13	14	15	16	17	18	19	20
ANNUAL CAPACITY FACTOR	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%
ANNUAL FEEDSTOCK QUANTITY (Tons per Year)	180,255	180,255	180,255	180,255	180,255	180,255	180,255	180,255	180,255	180,255
ANNUAL ETHANOL PRODUCTION (Gallons per Year)	14,844,550	14,844,550	14,844,550	14,844,550	14,844,550	14,844,550	14,844,550	14,844,550	14,844,550	14,844,550
CASH FLOW STATEMENT (\$1000's)										
REVENUE										
Ethanol \$1.94 /gallon	\$51,840	\$53,913	\$56,070	\$58,313	\$60,645	\$63,071	\$65,594	\$68,218	\$70,946	\$73,784
CO2	0	0	0	0	0	0	0	0	0	0
Lignin	0	0	0	0	0	0	0	0	0	0
Power	2,161	2,247	2,337	2,430	2,528	2,629	2,734	2,843	2,957	3,075
Tipping Fee - Waste Paper \$0.00	0	0	0	0	0	0	0	0	0	0
- Waste Wood \$0.00	0	0	0	0	0	0	0	0	0	0
- Mixed Stock \$0.00	0	0	0	0	0	0	0	0	0	0
Total Revenue	\$54,000	\$56,160	\$58,407	\$60,743	\$63,173	\$65,700	\$68,328	\$71,061	\$73,903	\$76,859
LESS O&M EXPENSES										
Labor - Supervisory	\$5,421	\$5,638	\$5,863	\$6,098	\$6,342	\$6,595	\$6,859	\$7,133	\$7,419	\$7,716
Fixed Maintenance Materials	1,891	1,967	2,045	2,127	2,212	2,301	2,393	2,488	2,588	2,691
Insurance	2,449	2,547	2,649	2,755	2,865	2,980	3,099	3,223	3,352	3,486
Property Taxes	0	0	0	0	0	0	0	0	0	0
Variable Maintenance	0	0	0	0	0	0	0	0	0	0
Waste Disposal - Pretreatment	0	0	0	0	0	0	0	0	0	0
- Fermentation	0	0	0	0	0	0	0	0	0	0
- Solids Separation (Ash or Lignin)	1,395	1,458	1,523	1,592	1,663	1,738	1,816	1,898	1,984	2,073
Chemicals	4,277	4,449	4,627	4,812	5,004	5,204	5,412	5,629	5,854	6,088
Power Economic Incentives Reduction:	0	0	0	0	0	0	0	0	0	0
Water	43	45	47	49	51	53	55	57	59	62
Waste Water	31	32	33	34	36	37	39	40	42	44
Steam	0	0	0	0	0	0	0	0	0	0
Natural Gas Economic Incentives Reduction:	0	0	0	0	0	0	0	0	0	0
Feedstock - Waste Paper *****	0	0	0	0	0	0	0	0	0	0
- Waste Wood *****	0	0	0	0	0	0	0	0	0	0
- Mixed Stock (\$20.00)	6,493	6,752	7,022	7,303	7,595	7,899	8,215	8,544	8,886	9,241
Gross Receipts Tax (Income Tax Deductible)	4,455	4,633	4,819	5,011	5,212	5,420	5,637	5,863	6,097	6,341
Total O&M Expenses	\$26,455	\$27,520	\$28,628	\$29,781	\$30,980	\$32,228	\$33,525	\$34,876	\$36,280	\$37,741
GROSS MARGIN	\$27,545	\$28,640	\$29,779	\$30,962	\$32,193	\$33,472	\$34,802	\$36,185	\$37,623	\$39,118
INTEREST	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
TAX DEPRECIATION	(2,667)	(2,667)	(2,667)	(2,667)	(2,667)	(2,667)	(2,667)	(2,667)	(2,667)	(8,051)
TAXABLE INCOME	\$24,879	\$25,974	\$27,112	\$28,295	\$29,526	\$30,805	\$32,136	\$33,519	\$34,956	\$31,067
TAXES: Income	(10,163)	(10,610)	(11,075)	(11,559)	(12,061)	(12,584)	(13,127)	(13,692)	(14,280)	(12,691)
Tax Credits	0	0	0	0	0	0	0	0	0	0
INCOME AFTER TAX	\$14,716	\$15,363	\$16,037	\$16,737	\$17,465	\$18,221	\$19,008	\$19,826	\$20,677	\$18,376
TAX DEPRECIATION	2,667	2,667	2,667	2,667	2,667	2,667	2,667	2,667	2,667	8,051
PLANT COST										
LOAN										
PRINCIPAL PAYMENTS	0	0	0	0	0	0	0	0	0	0
NET CASH FLOW	\$17,382	\$18,030	\$18,703	\$19,403	\$20,131	\$20,888	\$21,675	\$22,493	\$23,343	\$26,427
CUMULATIVE CASH FLOW	\$11,910	\$29,940	\$48,643	\$68,047	\$88,178	\$109,066	\$130,741	\$153,234	\$178,577	\$203,004
CUMULATIVE IRR	6.55%	11.17%	13.86%	15.65%	16.93%	17.89%	18.61%	19.17%	19.62%	20.00%
DEBT COVERAGE RATIO	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CUM NPV 20.0%	(\$10,960)	(\$8,938)	(\$7,189)	(\$5,678)	(\$4,372)	(\$3,242)	(\$2,265)	(\$1,420)	(\$689)	\$0

BIOMASS-TO-ETHANOL PRODUCTION FACILITY			TABLE 8-3a: REQUIRED TIPPING FEE		Stone & Webster Development Corporation										
PROFORMA FINANCIAL STATEMENT			OPTION NO.: 25												
THIRD PARTY CONTRACTOR / DEVELOPER			500 TPD (Dry) of 100.0% MIXED STOCK (50% WASTE WOOD & 50% WASTE PAPER), WITH GASIFICATION;		Page 1 of 2										
SITE LOCATION - SYRACUSE, N.Y.			ETHANOL @ \$1.20/GAL												
End of Year			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007		
Years from P.D.			4	5	6	7	8	9	10	11	12	13	14		
Operating Year			0	1	2	3	4	5	6	7	8	9	10		
ANNUAL CAPACITY FACTOR				83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%		
ANNUAL FEEDSTOCK QUANTITY				180,255	180,255	180,255	180,255	180,255	180,255	180,255	180,255	180,255	180,255		
CASH FLOW STATEMENT															
REVENUE															
Ethanol				\$21,673	\$22,540	\$23,441	\$24,379	\$25,354	\$26,368	\$27,423	\$28,520	\$29,661	\$30,847		
CO2				0	0	0	0	0	0	0	0	0	0		
Lignin				0	0	0	0	0	0	0	0	0	0		
Power				1,460	1,518	1,579	1,642	1,708	1,776	1,847	1,921	1,998	2,077		
Tipping Fee- Waste Paper		\$0.00		0	0	0	0	0	0	0	0	0	0		
- Waste Wood		\$0.00		0	0	0	0	0	0	0	0	0	0		
- Mixed Stock		\$39.59		8,683	9,030	9,392	9,767	10,158	10,564	10,987	11,426	11,883	12,359		
Total Revenue				\$31,815	\$33,088	\$34,412	\$35,788	\$37,219	\$38,708	\$40,257	\$41,867	\$43,542	\$45,283		
LESS O&M EXPENSES															
Labor - Supervisory				\$3,662	\$3,809	\$3,961	\$4,119	\$4,284	\$4,456	\$4,634	\$4,819	\$5,012	\$5,212		
Fixed Maintenance Materials				1,277	1,329	1,382	1,437	1,494	1,554	1,616	1,681	1,748	1,818		
Insurance				1,655	1,721	1,790	1,861	1,936	2,013	2,094	2,177	2,264	2,355		
Property Taxes				0	0	0	0	0	0	0	0	0	0		
Variable Maintenance				0	0	0	0	0	0	0	0	0	0		
Waste Disposal - Pretreatment				0	0	0	0	0	0	0	0	0	0		
- Fermentation				0	0	0	0	0	0	0	0	0	0		
- Solids Separation (Ash or Lignin)				1,001	1,046	1,093	1,143	1,194	1,248	1,304	1,363	1,424	1,488		
Chemicals				2,890	3,005	3,126	3,251	3,381	3,516	3,656	3,803	3,955	4,113		
Power	Economic Incentive Reduction:	0%		0	0	0	0	0	0	0	0	0	0		
Water				29	30	32	33	34	36	37	38	40	42		
Waste Water				21	22	22	23	24	25	26	27	28	29		
Steam				0	0	0	0	0	0	0	0	0	0		
Natural Gas	Economic Incentive Reduction:	0%		0	0	0	0	0	0	0	0	0	0		
Feedstock - Waste Paper		\$0.00		0	0	0	0	0	0	0	0	0	0		
- Waste Wood		\$0.00		0	0	0	0	0	0	0	0	0	0		
- Mixed Stock		\$0.00		0	0	0	0	0	0	0	0	0	0		
Gross Receipts Tax (Income Tax Deductible)				2,625	2,730	2,839	2,953	3,071	3,193	3,321	3,454	3,592	3,736		
Total O&M Expenses				\$13,160	\$13,691	\$14,244	\$14,819	\$15,418	\$16,041	\$16,688	\$17,362	\$18,064	\$18,793		
GROSS MARGIN				\$18,655	\$19,397	\$20,167	\$20,969	\$21,802	\$22,668	\$23,568	\$24,504	\$25,478	\$26,490		
INTEREST				(10,896)	(10,212)	(9,460)	(8,633)	(7,723)	(6,722)	(5,621)	(4,410)	(3,078)	(1,612)		
TAX DEPRECIATION				(14,957)	(24,634)	(16,138)	(10,950)	(10,709)	(6,790)	(2,888)	(2,698)	(2,667)	(2,667)		
TAXABLE INCOME				(\$7,197)	(\$15,449)	(\$5,431)	\$1,386	\$3,369	\$9,155	\$15,059	\$17,397	\$19,734	\$22,211		
TAXES: Income				2,940	6,311	2,219	(566)	(1,376)	(3,740)	(6,152)	(7,107)	(8,061)	(9,073)		
Tax Credits				0	0	0	0	0	0	0	0	0	0		
INCOME AFTER TAX				(\$4,257)	(\$9,138)	(\$3,212)	\$820	\$1,993	\$5,415	\$8,907	\$10,290	\$11,672	\$13,138		
TAX DEPRECIATION				14,957	24,634	16,138	10,950	10,709	6,790	2,888	2,698	2,667	2,667		
PLANT COST				(\$136,197)											
LOAN				\$108,958											
PRINCIPAL PAYMENTS				(6,837)	(7,520)	(8,272)	(9,099)	(10,009)	(11,010)	(12,111)	(13,323)	(14,655)	(16,120)		
NET CASH FLOW				(\$27,239)	\$3,863	\$7,975	\$4,654	\$2,670	\$2,693	\$1,195	(\$316)	(\$335)	(\$316)		
CUMULATIVE CASH FLOW				(\$27,239)	(\$23,376)	(\$15,401)	(\$10,747)	(\$8,077)	(\$5,384)	(\$4,189)	(\$4,505)	(\$4,839)	(\$5,155)		
CUMULATIVE IRR				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		
DEBT COVERAGE RATIO				1.052	1.094	1.137	1.183	1.229	1.278	1.329	1.382	1.437	1.494		
CUM NPV 20.0%				(\$27,239)	(\$24,020)	(\$18,482)	(\$15,788)	(\$14,501)	(\$13,419)	(\$13,018)	(\$13,106)	(\$13,184)	(\$13,296)		

BIOMASS-TO-ETHANOL PRODUCTION FACILITY		TABLE 8-3a:		REQUIRED TIPPING FEE		WITH ECONOMIC INCENTIVES		Stone & Webster Development Corporation					
PROFORMA FINANCIAL STATEMENT		OPTION NO.:		25									
THIRD PARTY CONTRACTOR / DEVELOPER		500 TPD (Dry) of 100.0% MIXED STOCK (50% WASTE WOOD & 50% WASTE PAPER), WITH GASIFICATION;											
SITE LOCATION - SYRACUSE, N.Y.		ETHANOL @ \$1.20/GAL											
End of Year		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017		
Years from P. D.		15	16	17	18	19	20	21	22	23	24		
Operating Year		11	12	13	14	15	16	17	18	19	20		
ANNUAL CAPACITY FACTOR		83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%	83.0%		
ANNUAL FEEDSTOCK QUANTITY		180,255	180,255	180,255	180,255	180,255	180,255	180,255	180,255	180,255	180,255		
CASH FLOW STATEMENT		(\$1000's)											
REVENUE													
Ethanol		\$32,081	\$33,364	\$34,699	\$36,087	\$37,530	\$39,031	\$40,593	\$42,216	\$43,905	\$45,661		
CO2		0	0	0	0	0	0	0	0	0	0		
Lignin		0	0	0	0	0	0	0	0	0	0		
Power		2,161	2,247	2,337	2,430	2,528	2,629	2,734	2,843	2,957	3,075		
Tipping Fee- Waste Paper	\$0.00	0	0	0	0	0	0	0	0	0	0		
- Waste Wood	\$0.00	0	0	0	0	0	0	0	0	0	0		
- Mixed Stock	\$39.59	12,853	13,367	13,902	14,458	15,036	15,638	16,263	16,914	17,590	18,294		
Total Revenue		\$47,095	\$48,978	\$50,937	\$52,975	\$55,094	\$57,298	\$59,590	\$61,973	\$64,452	\$67,030		
LESS O&M EXPENSES													
Labor - Supervisory		\$5,421	\$5,638	\$5,863	\$6,098	\$6,342	\$6,595	\$6,859	\$7,133	\$7,419	\$7,716		
Fixed Maintenance Materials		1,891	1,967	2,045	2,127	2,212	2,301	2,393	2,488	2,588	2,691		
Insurance		2,449	2,547	2,649	2,755	2,865	2,980	3,099	3,223	3,352	3,486		
Property Taxes		0	0	0	0	0	0	0	0	0	0		
Variable Maintenance		0	0	0	0	0	0	0	0	0	0		
Waste Disposal - Pretreatment		0	0	0	0	0	0	0	0	0	0		
- Fermentation		0	0	0	0	0	0	0	0	0	0		
- Solids Separation (Ash or Lignin)		1,555	1,625	1,698	1,774	1,854	1,938	2,025	2,116	2,211	2,311		
Chemicals		4,277	4,449	4,627	4,812	5,004	5,204	5,412	5,629	5,854	6,088		
Power Economic Incentive Reduction:		0	0	0	0	0	0	0	0	0	0		
Water		43	45	47	49	51	53	55	57	59	62		
Waste Water		31	32	33	34	36	37	39	40	42	44		
Steam		0	0	0	0	0	0	0	0	0	0		
Natural Gas Economic Incentive Reduction:		0	0	0	0	0	0	0	0	0	0		
Feedstock - Waste Paper	\$0.00	0	0	0	0	0	0	0	0	0	0		
- Waste Wood	\$0.00	0	0	0	0	0	0	0	0	0	0		
- Mixed Stock	\$0.00	0	0	0	0	0	0	0	0	0	0		
Gross Receipts Tax (Income Tax Deductible)		3,885	4,041	4,202	4,370	4,545	4,727	4,916	5,113	5,317	5,530		
Total O&M Expenses		\$19,553	\$20,343	\$21,164	\$22,019	\$22,909	\$23,835	\$24,798	\$25,800	\$26,842	\$27,927		
GROSS MARGIN		\$27,542	\$28,636	\$29,773	\$30,956	\$32,185	\$33,463	\$34,792	\$36,173	\$37,610	\$39,103		
INTEREST		(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)		
TAX DEPRECIATION		(2,667)	(2,667)	(2,667)	(2,667)	(2,667)	(2,667)	(2,667)	(2,667)	(2,667)	(8,051)		
TAXABLE INCOME		\$24,875	\$25,969	\$27,106	\$28,289	\$29,518	\$30,796	\$32,125	\$33,507	\$34,943	\$31,052		
TAXES: Income		(10,162)	(10,608)	(11,073)	(11,556)	(12,058)	(12,580)	(13,123)	(13,687)	(14,274)	(12,685)		
Tax Credits	\$0 Investment \$0 Wages	0	0	0	0	0	0	0	0	0	0		
INCOME AFTER TAX		\$14,714	\$15,361	\$16,033	\$16,733	\$17,460	\$18,216	\$19,002	\$19,819	\$20,669	\$18,367		
TAX DEPRECIATION		2,667	2,667	2,667	2,667	2,667	2,667	2,667	2,667	2,667	8,051		
PLANT COST													
LOAN													
PRINCIPAL PAYMENTS		0	0	0	0	0	0	0	0	0	0		
NET CASH FLOW		\$17,380	\$18,027	\$18,700	\$19,400	\$20,127	\$20,883	\$21,669	\$22,486	\$23,335	\$26,418		
CUMULATIVE CASH FLOW		\$11,910	\$29,937	\$48,637	\$68,037	\$88,163	\$109,046	\$130,715	\$153,200	\$176,536	\$202,954		
CUMULATIVE IRR		6.56%	11.17%	13.86%	15.65%	16.94%	17.89%	18.61%	19.17%	19.62%	20.00%		
DEBT COVERAGE RATIO		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		
CUM NPV	20.0%	(\$10,957)	(\$8,935)	(\$7,188)	(\$5,677)	(\$4,370)	(\$3,241)	(\$2,264)	(\$1,420)	(\$689)	\$0		

**Biomass-to-Ethanol Production Facility
to be Located in New York State (Phase II)**

**Table 8-4
Results of Financial Evaluation**

03/30/95

Capacity, TPD
Gasification ?
Lignin Disposal Cost, \$/ton

500	0	----->				500	500	----->				500
Y	N	Y	N	N	N	Y	N	Y	N	N	N	N
N/A	\$50	N/A	\$50	\$0	\$0	N/A	\$50	N/A	\$50	\$0	\$0	\$0

Site Location
Option Number
Feedstock
Cost of Feedstock, \$/ton (Input)
Required Ethanol Price, \$/gal (Result)

Albany, NY						Buffalo, NY					
1	2	3	4	5	6	7	8	9	10	11	12
Mixed Stock (50% waste wood & 50% waste paper)						Mixed Stock (50% waste wood & 50% waste paper)					
\$20	\$20	\$40	\$40	\$20	\$40	\$20	\$20	\$40	\$40	\$20	\$40
\$1.96	\$2.22	\$2.22	\$2.48	\$1.84	\$2.10	\$1.99	\$2.24	\$2.25	\$2.50	\$1.86	\$2.12

Site Location
Option Number
Feedstock
Cost of Feedstock, \$/ton (Input)
Required Ethanol Price, \$/gal (Result)

Rochester, NY						Syracuse, NY					
13	14	15	16	17	18	19	20	21	22	23	24
Mixed Stock (50% waste wood & 50% waste paper)						Mixed Stock (50% waste wood & 50% waste paper)					
\$20	\$20	\$40	\$40	\$20	\$40	\$20	\$20	\$40	\$40	\$20	\$40
\$1.97	\$2.23	\$2.24	\$2.49	\$1.85	\$2.11	\$1.94	\$2.20	\$2.20	\$2.47	\$1.82	\$2.09

Site Location
Option Number
Feedstock
Ethanol Sales Price \$/gal
Required Tipping Fee, \$/ton (Result)

Syracuse, NY					
25	26	27	28	29	30
Mixed Stock (50% waste wood & 50% waste paper)					
\$1.20	\$1.20	\$1.50	\$1.50	\$1.20	\$1.50
\$39.59	\$60.83	\$14.89	\$36.13	\$29.55	\$4.85

Economic Incentives Applied

Site Location
Option Number
Required Tipping Fee, (\$/ton)
Required Ethanol Price, (\$/ton)

Syracuse, N.Y.		Syracuse, N.Y.	
19	20	25	26
		\$5.76	\$34.37
\$1.61	\$1.95		

Ten-Year Economic Life (instead of Twenty)

Site Location
Option Number
Required Ethanol Price, \$/gal
Required Tipping Fee, \$/ton

Albany, NY		Buffalo, NY		Rochester, NY		Syracuse, NY		Syracuse, NY	
1	2	7	8	13	14	19	20	25	26
\$2.20	\$2.39	\$2.24	\$2.41	\$2.22	\$2.40	\$2.18	\$2.37		
								\$59.35	\$74.80

BUSINESS INTERESTS

This section identifies potential business interests for the Amoco waste biomass-to-ethanol production facility from land owners, feedstock suppliers, end product users, solid waste by-product consumers, and the financial community.

The Coalition of Northeastern Governors (CONEG) recently convened a forum to discuss "Siting an Ethanol Plant in the Northeast". The goal of the forum was to identify barriers and prospective strategies for siting biomass-to-ethanol facilities in the region in the near future. A letter from CONEG, with an attached forum agenda, is shown as Attachment 8-2 in the Appendix.

Land Owners

New York State Electrical & Gas Corporation (NYSEG) has expressed an interest in the biomass-to-ethanol facility by offering sites at power plant locations. The NYSEG letter of interest is shown as Attachment 8-3 in the Appendix. More detailed information about NYSEG sites can be seen in Attachment 8-4 in the Appendix.

Operation Oswego County Inc. and the County of Oswego Industrial Development Agency have expressed strong interest in financing an engineering feasibility study for retrofitting the Miller Brewery site to an Amoco ethanol facility. The Operation Oswego County Inc. letter is shown as Attachment 8-5 in the Appendix.

Feedstock Suppliers

Interest from feedstock suppliers includes lumber mills, paper mills and municipalities. Lumber by-products would be the main source of feedstock because of their plentiful supply and ease of accessibility. The lumber would be supplemented by paper sludge (especially in the Albany region) and three different types of municipal solid waste, consisting of paper products, yard

waste, and construction and demolition wood.

End Product Users

NYNEX Corporation has indicated a strong interest in considering the use of ethanol end product as an additive in its vehicle fleet as a response to the mandated use of oxygenated gasoline required by the Federal Clean Air Act by January 1995. As part of this study NYNEX is presently evaluating a number of alternative fuels for its vehicle fleet, including ethanol.

Solid Waste By-Product Consumers

Various waste-to-energy plants and other solid fuel burning plants, such as those owned by NYSEG, would be very interested in consuming the solid by-product from the Amoco process. Waste-to-energy plants would consider the by-product as municipal waste and would charge a fee on the order of \$50/ton. Interest from companies such as NYSEG provides flexibility for negotiating a price for the by-product.

Financial Community

Based on the financial pro forma runs in this section and Attachment 8-1, it was decided to delay contacting the financial community for equity interests at this time. An improved capital cost structure for building a facility in New York State is required to ensure attractive returns on investments commensurate with operating requirements, including stable feedstock costs/tipping fees for recycle paper.

**SCREENING STUDY FOR WASTE BIOMASS TO ETHANOL
PRODUCTION FACILITY USING THE AMOCO
PROCESS IN NEW YORK STATE**

PART III.

BUSINESS ASSESSMENTS

SECTION 9

BUSINESS ASSESSMENTS

This section contains the business assessments of the Amoco process made by Champion International and NYNEX, respectively a feedstock provider and a supplier/potential user of ethanol.

BUSINESS ASSESSMENT BY A FEEDSTOCK SUPPLIER

CHAMPION INTERNATIONAL

Background

Champion International performed a business assessment of the Amoco process as an alternative means for recycling paper. Its assessment is based on the past development of paper recycling practices, the success of which is significant in making feedstock material potentially available to the Amoco process.

Four years ago, the paper industry made a public commitment to increase the recovery, recycle, and reuse of paper products. This effort took the form of a national paper recovery goal to recover 40 percent of all paper used in the year 1995.

When this commitment was announced, there was uncertainty about the country's political motivation and ability to recover that amount of paper in usable condition, uncertainty about the sufficiency of markets among manufacturers both at home and abroad, uncertainty about the technology to increase recycled content in certain paper grades, and even uncertainty about consumer acceptance of various types of recycled and recycled-content paper and paperboard products.

Despite these uncertainties, the paper industry took the initiative, recognizing that, given the percentage of paper products in the municipal solid waste stream, there was a collective responsibility to help solve the national landfill crisis. Today, the paper industry takes pride

in achieving of 40 percent paper recovery goal a full 2 years ahead of schedule.

Thanks to the help of environmentally conscious citizens, the US paper industry today recovers:

- More than one of every two newspapers published
- Nearly 60 percent of all corrugated paper used
- A third of all paper and paperboard packaging, nearly three times the recovery rate of all other packaging materials combined.

The paper industry has invested billions of dollars to retrofit or build new capacity allowing it to substantially increase its dependence on recovered paper as a raw material. US mills use of recovered paper continues to grow at three times the rate of growth of total production capacity, and today a third of the industry raw material fiber comes from recovered paper.

For 6 consecutive years, there has been a reduction in the amount of paper and paperboard products being sent to landfills. From 1987 to 1993, the amount of paper and paperboard products going to landfills was cut by 11 million tons. In 1994, for the first time, more paper was recovered in the US for recycling and reuse than was buried in landfills.

More is still expected of this industry in paper recovery, recycling, and reuse. Most recently, the American Forest and Paper Association has embarked on a new initiative with the goal of recovering for recycling and reuse 50 percent of all the paper used in the US in the year 2000.

This goal will be very challenging because the industry faces the same uncertainties 4 years ago when the 40 percent recovery target was established. When achieved, the US paper recovery rate will far exceed the world average and will rival the recovery rates of far more densely populated and wood-fiber deficient countries such as Japan. At that point, twice as much paper and paperboard will be recovered in the US as will end up in landfills.

The following lessons were learned in reaching the current 40 percent recovery rate and will play a role in reaching the 50 percent recovered paper products:

- Increased levels of mixed paper recycling will be key to reaching these new goals.
- Paper recycling from office buildings will continue to increase. The office pack will become the norm for waste hauling from office buildings. Markets are already in place, and most haulers already know how to collect, process, and market office waste paper. Multi-tenant and small office buildings will continue to pose problems.
- Corrugated boxes will be collected from small generators and households.
- Residential mixed paper recycling will increase, but slowly and haphazardly. The greater diversity of residential mixed paper combined with less experience collecting, processing, and selling it create greater obstacles to success in this area.

Forces Driving Increased Office and Residential Paper Recycling

Intense Public Support of Recycling. For the last 6 years, public support for recycling has held steady in spite of the barrage of news stories about inadequate markets for recyclables and the reality that recycling is costly. This public support ensures that the supplies of wastepaper will continue to increase.

Increased State Recycling Goals. These will create more supplies of recyclables and put more pressure on end markets, particularly the paper industry to use more recycled/recovered material.

Volume-Based Fees. Volume-based fees are a method to have people pay for solid waste services based on the amount of trash they throw away. These fees will also create

additional pressure to recycle. After all, recycling is an alternative to trash. The amount of material collected for recycling increases dramatically when volume-based fees are instituted, thus increasing the pressure to collect residential mixed paper.

However, last year saw the defeat of a number of attempts to impose volume-based fees in the East Coast States. This defeat was largely because property taxes for trash collection and disposal were left in place and a per-bag fee was added.

Recycled Content Requirement. For newsprint, recycled content requirements exist nationwide, although they vary with locality.

For printing and writing papers, the President's Executive Order will clearly stimulate markets for office paper. The only way to get the fiber to meet these requirements is to increase the number of office collection programs and to increase the convenience of participation in these programs. Most states are currently aligning their procurement requirements with the Federal requirements, thereby strengthening the impact of the Executive Order.

In addition to state minimum content laws and Federal and state procurement requirements, the private business sector has clearly increased its desire to use recycled paper. For example, the National Recycling Coalition's Buy Recycled Business Alliance announced that its 500 members spent more than \$10.5 billion on recycled products in 1993. Minimum content requirements and buy recycled campaigns will push the demand side for the private sector.

Fiber Substitution. As recycled newspapers are increasingly used for newsprint and as corrugated paper increasingly goes to medium and linerboard, mixed paper will be in more demand as a substitute grade for mills that previously used newspaper and corrugated cardboard.

Forces That Could Delay or Prevent Increased Recycling

Backlash Against Recycling. Recycling costs money and is not a totally benign process. However, the political reality is that curbside collection programs and state recycling laws are not being canceled.

Source Reduction. If source reduction can be taken seriously, it will crowd out recycling with a higher priority.

Specifications. The definitions, forms, and specifications for recycled material remain unclear; e.g., What is an office pack? What is residential mixed paper? What do individual mills want and need?

Multi--tenant buildings will be good sources of a more mixed paper. It might be possible to keep newspaper separate, but expect a mixed office paper grade from these building.

Office paper recycling raises some interesting design-for-recycling issues. Will offices start demanding that overnight packages and mail services stop using (or take back) Tyvex packages? What about neon and goldemod colored paper?

Forces In Residential Mixed Paper Collection

Residential mixed paper recycling will increase but not as fast or easily as office paper recycling. A residential recycling program is, in effect, the ultimate multi-tenant program. Depending on what the local government requires collected, residences could produce anything from a low-grade mixed office stock to a completely mixed grade.

Currently, residential mixed paper efforts involve adding boxes or magazines to collection routes, although perhaps one or two hundred communities might collect box board, junk mail, or mixed paper. Residential mixed paper recycling must overcome a number of significant hurdles.

First, all collection programs are pioneering efforts. Little reliable data exist concerning the actual composition of individual community residential wastepaper or the effectiveness of existing programs in collecting and processing mixed paper. Some programs collect for tissue mills, some for boxboard mills, some for export markets.

Second, mixed paper poses unique and important collection problems. Should its collection be kept separate from newspaper? Should collection be kept separate for bottles and cans? What kind of collection equipment will be used? Will it be automatically collected using split costs? Will it be in wet-dry systems? Absolutely no consistency exists now in terms of how residential mixed paper is collected.

Many recycling collectors are using equipment purchased in the last 3 years. It is reasonable to expect them to want to fully depreciate the value of their equipment before they have to invest in new equipment of a different design.

Third, how will mixed paper be processed? Are materials recovery facilities, which are mostly bottle and can separation operations with some newsprint processing capacity, capable of processing mixed paper into a saleable grade?

Fourth, ironically, the cost of recycling and the need to meet state-imposed recycling goals could work against each other. Communities with access to tissue mills may only want to collect paper that can be used by these mills. After all, these mills have been able to pay more for biber than boxboard mills. Yet this means they will not collect all of the available grades of mixed paper and will achieve a lower recovery rate of paper.

One thing is certain, the need to meet the increased recycling goals and increased demand for mixed paper caused by increased markets and the realities of fiber substitution make residential mixed paper recycling inevitable. However, exactly how it will be collected and processed is still uncertain. There will be a great deal of experimentation over the next few years as haulers and processors learn the most efficient and cost-effective methods.

As for the market price of residential mixed paper, the most economical wastepaper sources have already been exploited and tapping additional sources for paper recycling will be more expensive.

The cost of wastepaper has risen to very high levels (\$100/ton) in just a few months. Historically, the cost of wastepaper has fluctuated with other paper market prices and, as the paper industry crawls out of one of its longest downturns, wastepaper prices are expected to be high for the next 3 to 5 years.

Effect on Amoco Process

In contracting a biomass-to-ethanol conversion facility based on the Amoco process, it would be prudent to find a cellulose raw material source with stable prices and a steady, readily available supply. The Amoco process is more economical when receiving a tipping fee for the feedstock than when required to pay for the raw material.

As a result, Champion recommends that the use of paper mill sludge be investigated. Based on a 1990 report for New York reference, there are 13 paper mills that have dedicated waste water treatment plants; the total generation rate is 410 dry tpd of mostly cellulose-containing sludge. If it were possible to quantify the sewer losses of those mills that use municipal sewage facilities, this cellulose source would increase significantly.

Currently, the New York State Department of Economic Development - Office of Recycling Market Development is conducting a study to expedite the development and application of paper mill sludge reuse technologies. Twenty five mills are currently involved. The objectives are of the studies: 1) to maximize the recovery and reuse of some or all components of paper mill sludge generated by mills using post-consumer fiber sources in New York State; 2) to minimize mill reliance on solid waste disposal capacity for mill sludges; and 3) to improve the cost effective management of mill sludge.

Consequently, there is the potential for a synergistic relationship between the Amoco project

and the recycling goals of New York State. (See Attachment 9-1 in the Appendix, letter from New York State Department of Economic Development).

For these reasons, the use of paper mill sludge as the cellulose source should be thoroughly considered as the feedstock for the biomass-to-ethanol conversion project.

Conclusion

Champion International believes that the Amoco process competes with current practices of the paper industry. The paper industry has already achieved national paper recovery rates of approximately 40 percent. Using existing recycling processes, the economics of achieving this recovery rate are demonstrated by the industry's ability to absorb recent rapid price increases for recycled paper to over \$100/ton in New York State. Such instability in price makes it currently unfavorable to recycle paper via the Amoco process. Instead of using (recycled) paper as a feedstock, Champion recommends that paper mill sludge would provide a more suitable source. This is particularly true in New York State, where approximately 400 dry tpd of paper sludge are generated and landfilled.

BUSINESS ASSESSMENT BY A FEEDSTOCK SUPPLIER/POTENTIAL ETHANOL USER - NYNEX

Background

NYNEX Corporation has joined with Amoco, Stone & Webster, Champion International, New York State Energy Research and Development Authority, and the National Renewable Energy Laboratory in a site evaluation study for a proposed Amoco biomass-to-ethanol facility to be located in New York State. NYNEX is involved in the project both as a facilitator of potential suppliers of feedstock and a potential user of the ethanol end-product in its vehicle fleet.

The project is divided into two parts: Part I focuses on New York City, and Part II focuses on the upstate New York urban regions of Buffalo, Syracuse, Albany, and Rochester.

NYNEX Deliverables. NYNEX had four primary deliverables as part of this site evaluation study:

- 1) Analyze the process involved in moving NYNEX toward the use of alternative fuels in its vehicle fleet (same for Part I and Part II)
- 2) Compare ethanol to other alternative fuels for fleet use (same for Part I and Part II)
- 3) Evaluate of the proposed Amoco processing facility for its potential to supply ethanol fuel at specific sites (in NYC for Part I; elsewhere in the State for Part II)
- 4) Evaluate of the Amoco process as an alternative end-use for recycled old telephone directories (OTD) (in NYC for Part I; elsewhere in the State for Part II).

Revised Approach. Since the project began in April 1994, NYNEX's approach to fulfilling its deliverable obligation has been modified. It was originally anticipated that NYNEX would have to do original research and testing of ethanol in its vehicles in order to compare alternative fuels.

It became evident that original research and testing were actually unnecessary in view of the availability of ethanol vehicle test results from the US EPA. During a meeting with officials from the New York City Department of Environmental Protection (DEP), NYNEX was informed that any valid testing of ethanol in fleet vehicles would probably involve a minimum 2-year study with multiple vehicles involved, all having undergone expensive conversion to accommodate alternative fuels.

DEP officials suggested that testing ethanol as a fuel additive was unnecessary since the Federal Clean Air Act mandates that oxygenated gasoline (using ethanol) must be used in New York City fleets by January 1995. Regarding use of ethanol as an alternative fuel, NYNEX's preliminary research indicated that a number of studies and comparisons have already been done.

Thus, NYNEX deliverables now include two new deliverables: 1) an analysis of the internal corporate process involved in making an alternative fuel decision; and 2) a comparison of alternative fuels using existing rather than original research.

Eventually, NYNEX plans to make use of the work involved in this project related to alternative fuel comparisons; however, a final decision on which alternative fuel is most appropriate for the vehicle fleet is not likely to be made prior to the conclusion of the site evaluation study.

Another change in the NYNEX portion of this project resulted from the unexpected death in early October of Mr. John Balaguer, Director of Environmental Issues for NYNEX Information Resources, and the driving force behind NYNEX's involvement in this project. Mr. Balaguer's work involved the comparison of ethanol to other alternative fuels. Much of his work is included in the report as background attachments and citations.

Moving the NYNEX Fleet Toward Alternative Fuels

Fleet Characteristics. The NYNEX fleet in New York State and New England totals more than 18,000 vehicles, including sedans, bucket trucks, vans, distribution trucks, and a variety of equipment used by these vehicles. Vehicles are housed at approximately 450 locations throughout the NYNEX territory. Of the more than 18,000 vehicles, some 3,000 are diesel-powered rather than gasoline-powered.

Approximately 12 million gallons of fuel (gasoline and diesel fuel) are consumed annually. Fueling facilities are widely dispersed throughout the territory. Not all facilities that are used to house vehicles have fueling capability.

New York City figures include: 4,000 vehicles (approximately 800 of which are diesel-powered) at 35 locations throughout the five boroughs.

New York State (outside of New York City) figures include: 8,000 vehicles housed at 160 different locations.

Alternative Fuel Decision-Making Process. In terms of corporate organizational structure, operation of the NYNEX fleet falls under the direction of the Vice President for Corporate Services. The reporting hierarchy includes a General Manager of Logistics and Fleet Services, a Director of Fleet Services, and approximately 650 lower level employees reporting to the Director and providing maintenance, service, dispatch, and other functions related to the vehicle fleet.

The NYNEX Corporate Environmental Organization reports to the same Vice President as the Fleet Services organization. The decision on moving to an alternative fuel for the vehicles would be centered in these two functional areas, with input from other business units that are in fact internal customers of the Corporate Services group.

Factors to be Considered. A number of factors would have to be considered before a decision on alternative fuels could be made, both in terms of the general concept of using alternative fuels as well as the specific choice from among the many fuels available, such as ethanol, methanol, compressed natural gas, propane, hydrogen, and even electricity.

These factors include but are not limited to: fuel cost; fuel economy; local availability (which may be different for NYC as opposed to upstate regions); safety; vehicle conversion cost; maintenance cost; operational effectiveness; emission benefits; potential tax incentives; and legislative and regulatory requirements, e.g., Clean Air Act Amendments of 1990, Energy Policy Act of 1992.

Another consideration involves the existing fleet fueling facilities. As a result of recent underground storage tank regulations, all NYNEX fueling facilities are currently being modernized, with completion expected by 1998. Because of the high cost of this effort, it is likely that the corporation would choose a liquid alternative fuel that the renovated fueling facilities could accommodate.

Comparison Of Ethanol To Other Alternative Fuels

NYNEX has already begun an extensive research analysis of existing testing efforts aimed at addressing the issues and questions raised in the preceding section.

As noted previously, an alternative fuel decision will not be made by the corporation in the time-frame of this site evaluation study. Such a decision will also not be made by the NYNEX Information Resources Environmental Issues Organization, the primary participant in this site evaluation study. NYNEX's role will be to provide the decision-makers within the Fleet Services organization with any research and information resulting from this study, and to continue to serve as a conduit for any further research data resulting from Amoco's operation of the potential ethanol-from-biomass facility.

No original comparative research will be done in conjunction with NYNEX participation in the site evaluation study. NYNEX is, however, participating in several other projects that will result in research data that will facilitate a decision on alternative fuels. One such project is the Vermont Electric Vehicle Demonstration Project. The NYNEX-New England telephone company is one of six utilities, seven government agencies, four corporations, two academic institutions, and two non-profit organizations participating in the project, which began in October 1993 and is scheduled to conclude in October 1995. The purpose of the project is to promote the testing and demonstration of near-term electric hybrid vehicle technology, assess the feasibility of electric vehicle use in a northern rural environment, disseminate results to the general public and to potential Vermont manufacturers of electric vehicle technologies, and make recommendations for promoting the technology in Vermont.

NYNEX is also involved in testing a number of compressed natural gas vehicles. Data from these and other efforts will be added to the wealth of information that will eventually be used to make an alternative fuel decision.

Existing Research. Key pieces of existing comparative research on alternative fuels include a series of reports from the US EPA detailing the positive and negative aspects of alternative fuels, including compressed natural gas (CNG), ethanol, liquefied petroleum gas, electricity and gasoline.

NYNEX has obtained and reviewed the following EPA reports:

- EPA Analysis of the Economic and Environmental Effects of Methanol as an Automotive Fuel, September 1989
- EPA Analysis of the Economic and Environmental Effects of Compressed Natural Gas as a Vehicle Fuel, April 1990
- EPA Analysis of the Economic and Environmental Effects of Ethanol as an Automotive Fuel, April 1990.

Information contained in these reports should prove helpful as NYNEX considers fleet fuel alternatives. Interestingly, however, most of the reports raise as many questions as they answer and indicate that more research is needed to resolve issues such as optimum engine configuration, fuel metering systems, fuel storage technology.

Initially, methanol looked promising as an alternative fuel since it clearly results in improved ozone levels and reduces the quantity of toxins released. But the fact that studies have uncovered problems with cold starting and formaldehyde emissions is troublesome.

Regarding CNG, the apparent cost benefits are attractive, but vehicle conversion costs of \$2,000-3,000 could present an obstacle. In addition, the recent NYNEX investment in upgrading underground storage facilities probably precludes non-liquid alternative fuels. Of course, ethanol has already been proven as a fuel additive as a result of its substantial air toxins benefits. Higher percentage mixes or neat ethanol, however, would require vehicle conversions. The higher octane in ethanol could result in improved engine efficiency by as much as 30 percent, but lower vapor pressure could cause cold-starting problems. And according to the EPA, "currently, projected fuel production costs...prohibit near-term consideration of neat ethanol as a major transportation fuel."

In summary, the NYNEX Fleet Operations staff has many issues to consider and questions to answer before deciding on an alternative fuel for the NYNEX fleet.

Other background material that will be turned over to Fleet Operations at the conclusion of this project include:

- "Clean Fuels Report", published by J.E. Sinor Consultants. This periodic report looks at CNG, LNG, propane, methanol, ethanol and biofuels, hydrogen, electric vehicles, and reformulated gasoline, and provides comprehensive coverage of current developments.
- "Exhaust Emission Testing of Two Ethanol Variable Fueled 1992 Chevrolet Lumina--Test Results 1993", published by Mike Samulski of the EPA's Engine and Vehicle Regulations

Branch. This report presents exhaust emission test results for two 1992 low-mileage Chevrolet Lumina ethanol variable fuel vehicles that were tested on both Indolene and E85 fuel using the Federal Test Procedure for exhaust emissions. This study showed that when operating on 85 percent ethanol, the Lumina's experienced reductions in NMHC, CO, CO₂, and NO_x, with penalties in alcohol and aldehyde emissions and fuel economy (per volume of fuel) when compared to operation on Indolene. Both vehicles saw a volumetric fuel economy penalty of 30 percent but saw a slight increase in energy based fuel economy when operated on 85 percent ethanol as compared to Indolene.

NYNEX has reviewed a number of Arthur D. Little studies including "Motor Fuels in a Clean Fuels Environment", "Fuel Cell Technology", "Electric Vehicle Use in Hong Kong", "CNG Transit Buses", and "Implementation of Alcohol Fuels".

NYNEX will also review additional related material from NREL's Alternative Fuels Utilization Program and from work by Southwest Research Institute, San Antonio, Texas, associated with ethanol variable fueled vehicles and economic and environmental effects of ethanol as an automotive fuel.

A report released by the Northeast Regional Biomass Program, entitled "A Resource Assessment for Ethanol in the Northeast" should also provide good background information.

Potential Of Amoco Facility To Supply Fuel To NYNEX Sites

With approximately 4,000 of NYNEX's 12,000 New York State vehicles located at 35 sites throughout the five boroughs of New York City, an Amoco ethanol facility located in the City would appear to offer efficiencies for providing fuel to at least one-third of the NYNEX New York fleet.

At the start of this project, it was thought that this question pertained to ethanol both as an additive and as a neat fuel. However, it now appears that the question is only relevant if NYNEX were to adopt ethanol as an alternative to its current fuel needs since, if Federal Clean Air Act standards require ethanol as an oxygenate additive, it must be assumed that such blends would be readily available through normal distribution channels.

Questions related to transportation costs, storage requirements and restrictions, and the Amoco intermediate distribution process itself remain to be answered before it can be determined if a New York City ethanol facility could efficiently serve the entire NYNEX region or if additional Amoco facilities would be required in other parts of the territory in order to get the fuel to the rest of 14,000 NYNEX vehicles located outside of New York City at more than 400 widely scattered locations.

Based on the issues raised above, it would appear likely that a more centrally located ethanol facility (either in the Capital District or the Syracuse area) would be needed to cost-effectively serve the rest of the NYNEX fleet.

Amoco Process As An Alternative Method Of Recycling NYC (OTD) Old Telephone Directories

NYNEX Background. NYNEX Information Resources Company (NIRC) publishes telephone directories for the NYNEX telephone companies in New York and New England, as well as selected markets overseas. NYNEX publishes more than 250 directory titles annually, with more than 35 million copies printed. Approximately 150 of those titles and 19 million copies are in New York State. Between 40,000 and 50,000 tons of directories are distributed annually, the majority in New York State.

Telephone directories comprise less than 1/2 of 1 percent of the total paper waste stream (paper is 41 percent of the total waste stream). But because of the seasonal nature of directory delivery, the books are a highly visible fraction of the waste stream. NYNEX's recycling activities are designed to minimize the impact of its products on the environment.

The NYNEX approach has been to work with local recycling officials and government officials to get directories included in existing recycling programs, rather than setting up separate collection programs just for phone books. NYNEX has also expended a great deal of effort on identifying and developing end-use markets for old telephone directories (OTD) so that once a collection is complete, an outlet for recycling the collected material will be available.

Currently, more than 40 counties in the New York State have some form of telephone directory recycling. Regarding recovery rates, NYNEX has experienced rates from 10 percent to 50 percent of books distributed compared to a national rate of slightly more than 17 percent.

Markets that are currently accepting OTD include boxboard, wallboard, animal bedding, cellulose insulation, packaging material, tissue products, padded envelopes, coreboard, compost, roll cores, disposable hospital utensils, hydro-seeding mulch, and new directory paper. The wastepaper markets are extremely positive at the present time and OTD is benefiting from the general improvement in these markets. Many markets are allowing OTD to remain in the newsprint mix, which is selling for \$70 to \$100/ton.

Even straight loads of phone books are finally commanding positive prices; for example a market in Dutchess County, NY, is paying \$35/ton for separated phone books. Among markets that are not paying positive dollars, many will at least backhaul truckload quantities of OTD at no expense to the community doing the collecting.

Biomass Conversion As Recycling in New York State

During the research for this site evaluation study, the question arose as to whether the biomass conversion technology as used in the Amoco ethanol process is considered recycling under New York State Department of Environmental Conservation (NYSDEC) definitions. This issue relates to New York City as well as the upstate New York areas.

Both Amoco and NYNEX wrote letters to the NYSDEC seeking an interpretation. Thus far,

NYNEX has received a verbal response and Amoco has received a written response, both of which indicated that "the proposed conversion facility would not be viewed as a recycling facility, but would be considered either a refuse-derived fuel processing facility regulated under Subpart 360.3 or a non-specific facility regulated under Section 350-1.9(b)" (see Attachments 9-2, 9-3, and 9-4 in the Appendix).

This preliminary determination may imply a possible reluctance on the part of some recycling programs to send material to the Amoco facility if they are unable to claim the tonnage against their state-mandated recycling goals. Some recycling coordinators interviewed in the upstate area were adamant that unless they could claim the material headed for the ethanol plant as recycled, they would rather divert that material to a local waste-to-energy facility.

DEC officials held out the possibility that county or municipal solid waste management plan recycling goals could be revised downward as a result of sending material to a refuse-derived fuel facility, and there is still a possibility that the DEC will revise its definitions of recycling to include biomass conversion. Thus, the eventual impact of this issue on the project remains to be determined.

New York City DOS officials said that while they would like to be able to use the residential mixed paper fraction to boost their recycling rates, even if they could not, there would still be a benefit to the City in diverting this fraction from the landfill to a biomass conversion facility.

New York City Analysis

The New York City DOS residential curbside recycling program, administered under Local Law 19 since 1989, covers approximately 3 million residences in the five boroughs of the City.

Since September 1993, New York City has also had mandatory commercial recycling. Businesses and institutions within the City must contract with a private hauler or recycler to recycle corrugated cardboard; high-grade office paper; newspaper; textiles; and magazines,

catalogs and phone books. Food or beverage service establishments must recycle corrugated cardboard, metal cans, glass bottles and jars, plastic bottles and jugs, and aluminum foil products.

The curbside residential program currently includes corrugated cardboard, newspaper, magazines, catalogs, and telephone directories.

The DOS is recovering approximately 1,200 tons of recyclables per day from the residential curbside/containerized program. About two thirds of that material is paper.

Starting in July 1995, under the City's solid waste management plan, the DOS plans to add residential mixed paper (RMP) to the recycling program. The RMP mix includes kraft paper, high-grade paper, non-corrugated cardboard, direct mail, and other mixed paper. The DOS anticipates recovering 423 to 705 tons per day of the RMP mix, or 128,000 to 213,000 tons per year.

Specific materials expected to be designated as RMP by the DOS include direct mail, paper bags, greeting cards, envelopes, printing and writing paper, computer printout, tissue product tubes, and telephone directories.

Telephone Directory Recycling. The RMP mix is the most likely feedstock for the proposed Amoco biomass conversion process since other markets are not readily available for most of the material included in the mix. Whether telephone directories are actually included in the mix is an open issue and is dependent on prevailing market conditions.

Currently, phone books are included in the residential curbside program and are a mandatory item in the City's commercial recycling program. New York City residents place their out-dated directories out with the rest of their paper recyclables on their normal recycling day.

New York City uses six to nine different recyclers in their residential program. Most of these firms are leaving the directories in with their newsprint mix, most of which is being

sold overseas. Newsprint markets are currently very strong, with prices in the \$70/ton range. At least one of the City's recyclers is separating the phone books out of the curbside mix.

NYNEX distributes well over 10,000 tons of Yellow Pages and White Pages directories in New York City annually. Different directory titles distribute at different times of the year. NYNEX estimates that New York City is collecting approximately 15 percent of the directories distributed, or 1500 to 1800 tons of directories per year.

In order for any of this tonnage to end up in the material being diverted to the Amoco ethanol facility, the DOS would have to move OTD from the current residential curbside mix to the new RMP fraction. While possible, DOS officials say it is unlikely because of the current strength of the newsprint markets. An incentive of some kind would be necessary for recyclers to separate phone books from the current mixed paper stream. For example, if the Amoco process were to provide a positive market, or if the recyclers could increase the quality and value of the newsprint fraction, then it might make sense to separate the OTD from the rest of the curbside mix. DOS officials have been cautious regarding the availability of the RMP stream in general since the City has a new mayor and new DOS commissioner and is in the midst of reviewing all of its recycling programs as well as attempting to renegotiate the provisions of Local Law 19.

The DOS has 5-year processing contracts in place with all of its recyclers. These firms enjoy a significant amount of autonomy in determining markets for collected material. Amoco will likely have to deal directly with the recyclers to determine what type and quantity of materials would be available for the Amoco biomass conversion process. As noted by DOS officials, this is a market-based decision to be made by the recyclers, not by the City or the DOS.

New York City Recyclers. Following are the recycling companies that New York City currently deals with on a primary and backup basis:

Rutigliano Paper Stock
854 Shepherd Avenue
Brooklyn, NY 11208
Contact: Jack Rutigliano
718-257-0244

Waste Management
72 Scott Avenue
Brooklyn, NY 11237
Contact: Glenn Lostritto
718-497-4000

Crystal Waste Paper
321 Canal Place
Bronx, NY 10451
Contact: Anthony V. LaCavalla
718-665-0770

A & R Lobosco Inc.
31-33 Farrington Street
Flushing, NY 11354
Contact: Michael Lobosco
718-358-2098

Recycling Systems
627 Eagle Rock Avenue, Suite 132
West Orange, NJ 07052
Contact: Manny Luongo
201-344-2222

D. Benedetto
420 Lexington Avenue
New York, NY 10017
Contact: Charles Rotante
212-867-8484

BQE
75 Thomas Street
Brooklyn, NY 11222
Contact: Richard Chestock
718-387-2794

Nekboh Recycling
2 North 5th Street
Brooklyn, NY 11211
Contact: Philip Barretti (Sr. or Jr.)
718-384-1001 or 718-384-5151

NMS Paper Removal
58-35 47th Street
Maspeth, NY 11378
Contact: Michael Sinisi
718-381-1319

Conclusions for New York City

While potential feedstock for the Amoco process appears to be abundant in New York City, both from the residential mixed paper stream and other sources, it appears unlikely that old telephone directories would be included in that feedstock as long as strong, positive markets exist for the City's current curbside and containerized waste paper mix, of which old phone books are already a part.

Another consideration is the DEC recycling definition. Even if the Amoco facility were to pay for the material, some recycling programs are not going to be interested in sending material there if they are not going to get credit for that material under their recycling mandate. As noted in the sections above, this feeling is not consistent throughout New York State, and other considerations, such as jobs and economic development, might be more important.

Regarding the NYNEX decision on alternative fuels for its vehicle fleet, review of EPA reports confirmed the benefits/costs associated with alternative fuels. However, more research is needed to determine such issues as optimum engine configuration, fuel metering systems, and fuel storage technology. NYNEX will be turning all of its information and research data over to the appropriate Fleet Services personnel for further study and evaluation. NYNEX will be happy to continue serving as the point of contact within NYNEX for any of the other site evaluation study participants.

Upstate New York Analysis

As part of the NYNEX deliverable in Part II, NYNEX interviewed recycling officials in Onondaga County (Syracuse), Erie County (Buffalo), and the Capital District (which includes Albany, Schenectady and Rensselaer counties). NYNEX does not publish directories in Rochester (Rochester Telephone territory).

NYNEX conclusions in Part I, regarding NYC, showed that, while potential feedstock for the Amoco process appears abundant in NYC, it is unlikely that old telephone directories would be included in that feedstock as long as strong, positive markets exist for the material, which is already part of the City's curbside recycling program.

NYNEX was interested in finding out if the conclusions would be the same in other parts of New York State.

Onondaga County. The first county contacted was Onondaga County, specifically Suzanne LaLonde, head of the recycling department for the Onondaga County Resource Recovery

Authority (OCRRA). Some years ago, 33 of 35 communities in the County gave OCRRA "contractual control" over disposal of garbage and recyclables.

In the summer of 1994, Onondaga completed its fourth annual telephone directory collection. The program started in 1991, when about 180 tons of directories were collected curbside and at drop-off centers. The bulk of the collected directories went to animal bedding, except for 50 tons that went to Anheuser-Busch as part of a test of shredded phone books as a bulking agent in the composting of brewery food waste.

The tonnage of directories collected has continued to increase over the years. In 1994, almost 300 tons of directories were recycled, most going to the cellulose insulation manufacturer American Intercel (Atlanta, Ga.), which paid the County a nominal amount for the material. Regarding other types of waste paper that might be available for the Amoco plant, Ms. LaLonde provided NYNEX with a chart showing the breakdown of available fibre (see Attachments 9-5 and Table 9-6 in the Appendix).

In general, while the County is currently recycling about 91,000 tons of paper waste a year, it is estimated that another 103,000 tons are still in the waste stream. This is partly because the County does not take certain grades of paper, but it is also due in part to the fact that people are not recycling all that they could.

All of the phone books are now being collected curbside. Ms. LaLonde said that the two material recovery facilities MRFs that the County uses are mixing some phone books in with their news mix (up to 5 percent per load). At present, the County does not recycle what has been referred to as residential mixed paper (RMP) (see Part I, NYC section).

Burn Plant Under Construction. Ogden Martin is currently building an 850-ton/day waste-to-energy facility in Onondaga County. Test burns were scheduled for this fall.

The question in Onondaga centers around the burn plant and the County's 40 percent recycling mandate. If the County will not get recycling credit for the

corrugated mill.

NYNEX Directory Distribution. NYNEX publishes four separate directory titles in Onondaga County and distributes approximately 600 to 700 tons of directories annually. Because of the central location of the County, however, the Amoco plant could conceivably draw significant tonnage from surrounding areas. The Onondaga collection program has recovered more than 300 tons of directories each of the past 2 years. Thus, the recovery rate is almost 50 percent--one of the highest in the Northeast.

See Attachments 9-5 and 9-6 in the Appendix for feedstock availability numbers for Onondaga County.

Erie County. The general feedstock (and specific telephone directory) situation is quite different in Erie County (Buffalo Area). According to Thomas Dearing, Community Planning Coordinator for the Erie County Planning Division, the County has no Solid Waste Management Plan, and, thus, no mandated recycling percentage. The County has no publicly-owned waste management facilities whatsoever. They rely completely on the private sector for waste management. Therefore, the concern about recycling credit for material diverted to a facility utilizing the Amoco process to convert biomass to ethanol would not be a factor in Erie County.

On the other hand, the mix that is referred to as RMP is not being recycled to any great extent in the 36 communities in the County (not counting Buffalo), according to Mr. Dearing. Recycling officials are just beginning to push communities to add this material to their programs.

NYNEX Directory Distribution. NYNEX publishes a county-wide Erie directory, as well as several smaller community directories. Total tonnage distributed is approximately 1,500 tons. Western New York, however, is one of the weakest areas for directory recycling. Three years ago, when NYNEX first began organizing a collection program, the City of Buffalo was the only

material that might go to the Amoco plant, then recycling officials there would just as soon send the material to the burn plant to help meet their quota.

This reaction was not consistent throughout the upstate area. Onondaga's 40 percent mandate is not controlled simply by its Solid Waste Management Plan. OCRRA's waste-to-energy plant permit states that the County must recycle 40 percent of its processables, which is an even higher standard.

Interestingly, the presence of a burn plant in a county results in numerous differences in how the state deals with those counties. For example, Onondaga County does not get credit toward its recycling mandate for any of the yard waste it composts, despite the state's inclusion of composting in the recycling definitions. That's because the mandate for Onondaga is "40% of all material that otherwise would have been burned." Since no yard waste is allowed to be burned in New York State, no credit for what the County composts is given.

Neighboring Madison County, on the other hand, which does not have a waste-to-energy facility, gets recycling credit for all the yard waste composted in the County.

Onondaga's proposed waste-to-energy (WTE) facility has a maximum capacity of 295,000 tons per year, and Ms. LaLonde feels they are going to be right on target with their current non-recyclable paper stream. The only way an ethanol facility would become an attractive alternative would be if the local economy continues to improve and the amount of burnable waste exceeds the 295,000 tons.

Solvay Site. The following is really outside of the NYNEX areas of concern for this report, but Ms. LaLonde said that the Solvay Site (originally an Allied Chemical location and currently site of a Stone Container corrugated mill) would make an ideal location for the Amoco plant because there is an adjacent power plant for co-generation and the potential for feedstock from the

municipality actively collecting directories. Most of the material collected in Buffalo's program went to U.S. Gypsum in Oakfield, which uses the material to make the backsheet of its wallboard products. Another strong market in the area is Buffalo Paperboard in Lockport, New York.

Over the years, other municipalities and private haulers added directories to their programs -- primarily because residents began pressuring them when they read about the City of Buffalo program in the Recycling Pages that run in the front of most NYNEX directories. Dealing with multiple private haulers and recyclers can be a frustrating experience; it is much easier to deal with a county-wide, single point-of-contact program as in Onondaga County.

See Attachments 9-7 and 9-8 in the Appendix for feedstock availability numbers for Erie County.

Capital District. The Capital District of New York comprises Albany, Schenectady, and Rensselaer counties, but, like Syracuse, the central location means an ethanol facility would be able to draw feedstock from a much wider area. Recycling programs are extensive and quite well-developed in the Capital District. The ANSWERS Program is the primary recycling operation in the area.

Jeff Edwards, Recycling Coordinator for Schenectady County, presented yet another response to a possible alternative end-use market for RMP. Mr. Edwards said he would not be a "purist" regarding the issue of getting recycling credit for material diverted to an biomass-to-ethanol facility. More important to Mr. Edwards was the willingness of such a facility to locate in Schenectady County for the economic development benefits. If the facility were to locate elsewhere in the vicinity, Mr. Edwards would also expect the market to be positive; i.e., willing to pay for the feedstock material. If the facility were located in Schenectady County, then he would be more willing to accept a flat market. With GE having recently laid off 1,000 employees, economic development and jobs take precedence over recycling mandates and other issues in this area.

Right now, most of the RMP fraction in Schenectady County goes to a local landfill. The County only collects junk mail and office paper among materials that might be part of the RMP mix. Next year, the RMP material will be going to a landfill out of the area. In 5 years, Schenectady County expects to have a burn plant in operation.

NYNEX Directory Distribution. NYNEX publishes a primary directory in all three Capital District counties, as well as numerous community directories. Other publishers also publish directories in this area. As noted, many more directories are published in surrounding counties. Because of the availability of transport via the Hudson River, it is conceivable that an biomass-to-ethanol facility located in this area could even draw phone books and other feedstock material from as far away as the New York Metropolitan Area.

In the three primary Capital District counties, NYNEX distributes approximately 1,000 tons of directories annually. Last year, more than 300 tons of directories were recovered in the three counties. Most of the collected material went to the nearby Bonded Insulation Company, a manufacturer of cellulose insulation. Another strong market in the area is Columbia Corporation, a manufacturer of boxboard. A strong emphasis on regionalization exists in the area, making the organization of collection programs simpler than in more segmented areas.

See Attachments 9-9 and 9-10 in the Appendix for feedstock availability numbers for Schenectady County and Attachment 9-11 for feedstock availability numbers for other parts of the Capital District as well as the rest of the state.

Conclusions for New York State

The conclusions for the upstate regions seem to be quite similar to the one in New York City: The viability of a biomass-to-ethanol facility as an alternative end-use market for phone books -- or any type of waste paper -- is completely dependent on current market

conditions.

In Onondaga County, for example, since the County is currently getting paid for its recycled directories there would be no incentive to send directories to Amoco at a zero-dollar rate. In fact, because of the current strength of the waste paper markets, it is unlikely that old telephone directories would be part of Amoco feedstock anywhere in New York State or the rest of the Northeast Region.

The residential mixed paper stream is probably a more likely feedstock since there appears to be no current positive market for most of this material. The Amoco process is particularly attractive for such things as soiled pizza boxes and other contaminated and otherwise unrecyclable materials.

The other consideration, however, is the DEC recycling definition. Even if the Amoco facility were to pay for the material, some recycling programs are not going to be interested in sending material there if they are not going to get credit for that material under their recycling mandate. However, this feeling is not consistent throughout the region and other considerations, such as jobs and economic development, might be more important in certain parts of the state.

Regarding the NYNEX decision on alternative fuels for its vehicle fleet, review of EPA reports confirmed the benefits/costs associated with alternative fuels. However, more research is needed to determine such issues as optimum engine configuration, fuel metering systems, and fuel storage technology. NYNEX will be turning all of its information and research data over to the appropriate Fleet Services personnel for further study and evaluation. NYNEX will be happy to continue serving as the point of contact within NYNEX for any of the other site evaluation study participants.