A METHOD FOR THE ASSESSMENT OF SITE-SPECIFIC ECONOMIC IMPACTS OF COMMERCIAL AND INDUSTRIAL BIOMASS ENERGY FACILITIES

A HANDBOOK AND COMPUTER MODEL

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PREFACE

This handbook has been prepared by Resource Systems Group Inc. under contract to the Southeastern Regional Biomass Energy Program (SERBEP). The first four case studies were prepared primarily by Fichtner USA Inc. of Atlanta Georgia from engineering specifications of actual plants in operation in the southern states. The handbook was originally intended for use in the southeastern states and was therefore focused primarily on industrial and commercial wood energy systems, which predominate in that region. At the request of other regions, the handbook was extended for use in all the states, and the computer program and handbook have been modified for nationwide use.

The methodology described here is appropriate for all biomass energy projects providing that the user has access to the appropriate data inputs required. It should be noted however, that this methodology has been more extensively tested in relation to wood energy plants and that there have been relatively few applications of this approach to alcohol plants and other biomass derived fuel facilities. In applying these techniques to ethanol plants it is important to recognize that the methodology cannot automatically deal with the secondary economic impacts associated with the tax subsidies given to alcohol fuels, or with any effects on crop prices, crop price support programs or gasoline additive businesses. These effects can be estimated but the user must take the responsibility of modifying the model depending on what assumptions are made about these complex issues. This methodology is not appropriate for use in assessing the economic impacts of the combustion of municipal solid waste or hazardous industrial wastes, without substantial modification.

SUMMARY

A handbook on "A Method for the Assessment of Site-specific Economic Impacts of Industrial and Commercial Biomass Energy Facilities" has been prepared by Resource Systems Group Inc. under contract to the Southeastern Regional Biomass Energy Program (SERBEP). The handbook includes a user-friendly Lotus 123 spreadsheet which calculates the economic impacts of biomass energy facilities. The analysis uses a hybrid approach, combining direct site-specific data provided by the user, with indirect impact multipliers from the U.S. Forest Service IMPLAN input/output model for each state. Direct economic impacts are determined primarily from site-specific data and indirect impacts are determined from the IMPLAN multipliers.

The economic impacts are given in terms of income, employment, and state and federal taxes generated directly by the specific facility and by the indirect economic activity associated with each project. A worksheet is provided which guides the user in identifying and entering the appropriate financial data on the plant to be evaluated. The IMPLAN multipliers for each state are included in a database within the program. The multipliers are applied automatically after the user has entered the site-specific data and the state in which the facility is located. Output from the analysis includes a summary of direct and indirect income, employment and taxes. Case studies of large and small wood energy facilities and an ethanol plant are provided as examples to demonstrate the method.

Although the handbook and program are intended for use by those with no previous experience in economic impact analysis, suggestions are given for the more experienced user who may wish to modify the analysis techniques. This includes advice on how to assess the "hard to quantify" economic impacts, such as forest-stand improvements, and how to deal with energy and waste disposal cost savings. The economic impact methodology described in the handbook and used in the computer model, is primarily oriented toward wood fired energy systems, but it can also be used for any other type of biomass energy facility and, with modification, for certain other energy facilities. Advice is also given on how to compare the economic impact of biomass energy facilities with alternative systems.

1.0 PURPOSE OF THE HANDBOOK

1.1 BACKGROUND SCOPE AND OBJECTIVES

Almost every new or expanded biomass energy facility constructed in the United States is subject to some form of public permitting process which can range from a simple minor source air quality permit to a multi-level environmental impact analysis, public utility review and local planning and zoning board review. In most cases project developers point to jobs, increased tax revenues and other economic benefits to the local area, and opponents often cite hidden costs as well as environmental problems as reasons for challenging a project. The purpose of this handbook, accompanied by a computer-based spreadsheet model, is to provide a simple and relatively inexpensive method for evaluating the direct and indirect economic impacts of specific biomass energy projects that should permit developers, citizens and public officials to evaluate the economic effects of projects in an objective manner. This should facilitate the process of biomass energy facility permitting and where a project is to be publicly owned or supported, assist in the evaluation of the project's net benefit to the

community. The method of analysis is applicable to all feasible biomass energy facilities and biomass fuel processing facilities in the United States.

1.2 APPROACH

The economic impacts of biomass energy facilities are quite site-specific therefore each facility must be assessed individually and on its own merits. The approach taken in this handbook is to provide a method by which any plant can be evaluated in terms of employment and income generated and taxes paid. In addition guidance will be provided on the assessment of other economic impacts which are more difficult to quantify, such as community costs, forest-stand improvements, wood residue disposal cost avoidance, displaced fuel effects and savings benefits.

The method which is described and set out both in the handbook and computer-based spreadsheet model is a hybrid approach. It combines direct input of plant specific data on costs, salaries and labor requirements with input/output model-derived multipliers, that are used to assess the indirect and induced employment and income. Similarly, in the tax revenue analysis, local property taxes which are quite site-specific, are input by the user. State and federal tax revenues are calculated automatically, using statewide formulae. In all cases, the analytical method covers all parts of the system, including plant design, construction, operation, maintenance, and fuel procurement and transportation. Economic impacts are summarized for both the construction and operation phases.

In order to make the assessment methodology useful to the non-specialist, examples of typical biomass energy facilities are provided. There are two reasons for this approach. First, the examples make it clear exactly how the assessment method works. Second, the examples provide cases against which the user may compare the results of his/her own analysis. Example cases are based on actual facilities, although specific companies are not identified.

1.3 WHAT ECONOMIC IMPACT ANALYSIS CAN DO

Economic impact analysis is a collection of quantitative techniques used to determine how a specific economic activity or class of economic activities will affect the economy of a community, state, region or nation in which the activity takes place. The usual measures which are used for this analysis are income, employment, taxes paid and community costs. Because all economic activities involve the expenditure of money which in turn becomes the income of other community members, there is a multiplier effect which creates additional jobs and income and further tax payments. These indirect or multiplier effects are very important and are a key part of a complete economic impact analysis. Not all the expenditures of a specific project will remain in the community however, as purchases of equipment, fuel and even specialized services may transfer expenditures out of the state or even abroad. Therefore, determining which expenditures directly benefit the community, the magnitude of the multiplier effect, and the income and taxes generated by jobs is a principle task of a quantitative economic impact analysis. An economic impact analysis has two essential components. First, it should provide a clear objective method for tabulating the direct expenditures and employment of a specific activity and second, it should provide an objective method for determining the indirect effects of these expenditures on the community. The method described in this handbook and in the accompanying computer model is designed to allow the user to complete both parts of the analysis without any previous training in economic impact modeling techniques.

1.4 WHAT ECONOMIC IMPACT ANALYSIS CANNOT DO

Economic impact analysis can be helpful in project planning, but it is not a complete project feasibility or community decision-making tool. Some of the more important limitations of economic impact analysis are as follows:

- Economic impact analysis cannot determine if a project is economically feasible or profitable because corporate revenue estimates are generally not part of the analysis. It is possible that projects with very large favorable economic impacts may be quite unprofitable.
- Economic impact analysis can only deal with impacts which are easily quantifiable in dollars or employment. Environmental, health or social impacts are not normally assessed, even though they may have economic implications.
- Economic impact analysis does not assess all the long-term side effects of projects, such as the magnet effect that an industry may have in attracting other industries to locate in the same area. Similarly the analysis will not itself estimate impacts on local prices of goods or services purchased for the facility.
- Economic impact analysis assumes linear relationships between changes in demand for products and services and the resulting changes in income and employment. It therefore does not take into account how specific businesses may increase their productivity over time, or with changing local circumstances. The analysis also assumes that the response to any incremental change in demand for goods or services is at the average rather than the marginal rate. This may slightly overestimate the impacts of personal consumption expenditures on basic sectors, such as food, and underestimate the impacts on discretionary purchase sectors, such as recreation.
- Economic impact analysis cannot identify the specific individuals or the location of individuals or businesses impacted. For example, the analysis may show that a specific number of jobs may be generated in trucking, but it cannot determine if those jobs will be filled from a specific town or what will be the effect on unemployment rolls or welfare payments in specific towns.

The limitations of the analysis described in this handbook are greater with smaller projects and smaller impacted areas. This is because the multipliers provided are based on statewide data for each state, whereas individual communities may differ from those averages. Furthermore, small projects, especially those closely integrated with other industries, may also differ markedly from statewide averages. It is therefore very important that the inputs to the analysis, especially those on direct plant expenditures and employment, be as precise as possible rather than relying on regional, or industry-wide averages. Ultimately, the quality of an economic impact analysis is only as good as the data used and the model user must therefore rely on the project sponsor for detailed financial information. Unfortunately, some of the information which is essential to a good economic impact analysis, such as the prices paid for fuel or the wages paid to workers, is precisely the type of information a company may wish to keep confidential.

1.5 THE TYPES OF BIOMASS ENERGY SYSTEMS COVERED

The method described in this handbook is applicable to all industrial and commercial biomass energy facilities for which financial data is available on the construction cost, operation costs and direct employment. Where the biomass energy plant is part of an integrated industrial operation (e.g.

a pulp mill) it must be possible to separate the costs of the biomass energy component. The handbook is primarily oriented to wood combustion systems, but it can be used for wood fuel processing facilities, alcohol production plants, or for other biomass energy facilities, including waste burning, providing the user is quite familiar with the technology and fuel supply. It is not, however, suitable for the analysis of municipal solid waste systems. The method described can also be adapted to evaluate the economic impact of some types of conventional fossil-fueled plants.

2.0 THEORY BEHIND ECONOMIC IMPACT ANALYSIS

2.1 THE MEASURES OF ECONOMIC IMPACT

Every economic activity, including biomass energy conversion, involves expenditure, income, employment and the payment of taxes. The expenditure of any business becomes the income of other businesses and individuals, which in turn is re-spent in the economy to provide more income for others. Thus any initial economic activity has a multiplier effect that ripples through the economy. Economic impact analysis is a set of techniques that provide measures of these economic effects in the area where activity takes place. The primary parameters measured and estimated are income, employment and taxes.

The assessment of economic impact must be made for a specific geographic area which is defined in advance. The method described here calculates the economic impact based on the state in which the facility is located, because the method is dependent upon statewide multipliers derived from IMPLAN, a national economic input/output model used in this method¹. Not all the impacts of a facility are confined to the home state. Purchases of equipment, services, fuel and biomass feedstock may occur out of the state. Some purchases, such as fuel oil, may be imported, which means that there would be an economic impact abroad. These out of state and foreign impacts are not assessed in this method, and therefore the economic impact assessment is always an underestimate of the total economic impact of the activity. Even within the state, the economic impact is not evenly distributed and certain activities, such as plant operations and woodfuel harvesting, will mainly impact the local area. Major equipment purchases and specialized engineering services will often mean expenditures and economic impacts further away even if they occur within the state. Making an assessment of the area impacted is discussed in greater detail in Section 4.0 of this handbook.

The method described here provides nine specific measures of economic impact which can be summarized in three categories (jobs, income and taxes) and, where relevant, cost savings and community costs.

2.1.1 DIRECT INCOME

The direct income generated by a project is the sum of all the direct expenditures which are made by the facility in the impact area. This includes salaries and wages paid to direct employees of the plant, profits or compensation to owners and managers, purchases of fuelwood, and other supplies. These data come from the plant owners.

2.1.2 DIRECT EMPLOYMENT

The direct employment is the number of persons employed directly by the plant including owners and managers. This information is usually provided by the plant owners.

2.1.3 INDIRECT INCOME

The term indirect income, as used in this analysis, is actually the sum of the indirect and induced income. It is composed of the sum of the expenditures made by the companies that act as suppliers to

¹Palmer, C and E. Siverts, IMPLAN Analysis Guide, US Forest Service, Fort Collins Colorado, 1985

the energy facility (indirect income), plus the expenditures made by the employees of the facility and the expenditures made by the employees of suppliers (induced income). These expenditures include such items as spare parts, supplies, fuel, utilities, trucking, financial services and the retail and other personal expenditures of employees. The estimates of indirect income are obtained by taking the plant's expenditure on supplies, equipment and services and applying IMPLAN multipliers to determine the amount of indirect and induced income from each class of expenditure. For example, in the case of the indirect effects of spending by employees, IMPLAN provides the multiplier, or average fraction of personal income spent in each sector (retail, automotive, food, etc.), from which the indirect income can be calculated.

2.1.4 INDIRECT EMPLOYMENT

Indirect employment is the number of persons employed as a result of the indirect income generated by the facility. The number is derived by using the IMPLAN indirect employment multiplier expressed as the number of full-time-equivalent (FTE) jobs per \$1 million of indirect income. The jobs estimates are provided for the same categories as indirect employment. Some employment categories will only have fractional FTEs, so in reporting results it may be better to aggregate categories.

2.1.5 LOCAL PROPERTY TAXES

Most biomass energy plants will be required to pay local property or other local taxes dependent on the value of the plant, land and/or inventory. These vary with municipality, and publicly owned or non-profit organizations may be exempted. The calculation must be made for each facility on a case-by-case basis using the financial data provided by the plant owner. Property tax assessments and rates are normally a matter of public record. Local taxes are often considered to be a very important factor in evaluating the economic effects of a facility, and the extent to which they cover or exceed anticipated community costs, may have an important effect on public reception of the project.

2.1.6 STATE TAXES

The actual amount of state (or federal) taxes paid by any facility and by its suppliers and employees is very hard to estimate and is usually considered to be confidential information. The amount of corporate tax will depend not only on the profitability of the plant but also on its parent company. Because it is usually impossible to estimate the plant-specific state tax payments, the method used here assumes the taxes paid as a percentage of income by the facility, and all directly and indirectly related activities, are the same as the state average.¹ In the case of certain biomass energy facilities, such as alcohol fuel plants, a specific tax subsidy may be granted. In this case the value of the tax subsidy should be calculated and entered in the model.

2.1.7 FEDERAL TAXES

The federal tax payments from a project are estimated by a procedure similar to that used for state taxes.²

¹The tax rate is the total state tax revenues of each state in 1990 (excluding property and other local taxes) divided by the gross state product. Source: U.S. Dept. of Commerce, Statistical Abstract of the United States 1992, U.S. Govt. Printing Office Washington D.C. 1992

²The federal tax rate is the federal tax revenue collection for each state divided by the gross state product. The federal tax revenue is based on the tax burden estimates for each state in 1990 made by the Tax Foundation Washington D.C.

2.1.8 COST SAVINGS

Under some circumstances a company may be able to save money by operating a biomass energy plant. Such savings are usually realized through savings on the disposal cost of wood waste or other biomass waste and/or by reducing energy costs. Where such savings occur they can be evaluated separately and considered as part of the economic impact of the plant. The theory about how to include these savings in the cost is somewhat complicated by our imperfect knowledge of what happens to the savings. There are four possibilities. First, savings may contribute to higher profits, in which case they can be included as company or proprietors' income. Second, they may be passed on to workers in the form of higher wages, in which case they will be accounted for in the analysis as employee income. Third, they may be passed to customers in the form of lower prices for the product, in which case the impact may be very hard to track. Fourth, the savings may result in making the plant economically feasible whereas it would not have been without the savings, in which case the economic impact analysis fully captures the impacts of the plant. The exception to this would be in a situation where without the savings the company would have built another type of energy facility (for example an oil fired plant) in which case a comparative analysis with the alternative plant would be in order. This is discussed in section 6.

2.1.9 COMMUNITY COSTS

Almost every industrial or commercial development produces an increase in community costs to some degree. These costs include road maintenance, police and fire protection, water, sewers, social services and education. State and local taxes are normally expected to pay the project's share of these expenses, and, in theory, the tax payments should balance these costs. Therefore, in most circumstances, community cost need not be evaluated. Unfortunately, there are no easy methods for quantifying this. As a general rule, industrial and commercial energy developments, especially those which are capital intensive, generate more local tax revenues than they increase community costs, which is why they are often welcomed as additions to the tax rolls. The additional employment may be expected to reduce some social services costs, but again, it is difficult to estimate this effect directly. The analysis recommended in this handbook only includes unusual and clearly identifiable community costs which must be estimated on a case-by-case basis.

2.2 THE DIFFERENCE BETWEEN ECONOMIC IMPACT ANALYSIS AND COST BENEFIT ANALYSIS

The economic impact analysis method described here provides a basis for estimating the more important economic consequences for a community, which can be a useful tool in planning and decision making. Economic impact analysis has some similarities with another planning tool known as cost benefit analysis, but it also differs from it in several important respects.

The first major difference between economic impact analysis and cost benefit analysis is that cost benefit analysis attempts to quantify all the benefits and costs associated with the project, including social and environmental parameters which are not usually quantified in terms of dollars. Consequently, there is more controversy associated with the values that are given to the parameters in a cost benefit analysis.

A second important difference is that an economic impact analysis makes no judgments about whether economic effects are beneficial or not. Jobs and income are simply quantified and the users of the analysis can decide if they consider such changes to be beneficial.

Finally, cost benefit analysis is frequently used as a decision making tool where typically a benefit cost ratio over one (or some number greater than one) becomes the basis for deciding in favor of

the project. There are no such thresholds in economic impact analysis. The employment, income and tax estimates of economic impact analysis should be used along with many other factors in making decisions about biomass energy projects.

2.3 DIRECT IMPACTS: COLLECTION OF DATA

Economic impact analysis is only as good as the basic data that forms the input to the analysis. The data on direct expenditures (income) and direct employment are normally obtained from the facilities owner or operator. The direct impacts should be divided into two parts corresponding to the construction phase and the operations phase. This distinction is important because the construction phase activity, although it involves large expenditures, lasts for a relatively short period of time ranging from a few months to two years. The impacts for the construction phase are best considered as occurring during a discrete period, while the operations phase, which will normally last many years, is best characterized by expressing the impacts on an annual basis. Making this distinction is also important because the impacts are usually very different in character as well as magnitude. Construction usually brings temporary workers who commute to the site, or take up temporary residence near the site, and therefore have a different type of impact than the permanent workers and contractors of the operations phase.

Accurate estimates of the direct impacts require careful identification of the direct expenditures. In general, the principle for including direct impacts is that every expenditure in both the construction and operation phase that is made directly by the plant owners should be entered into the analysis. That includes payments which must be made for local taxes and fees, such as water or sewer fees, and the state or federal income and sales tax expenditures included in invoices and salaries. When a biomass energy operation is part of a larger business, that proportion of the costs which are attributable to the biomass plant must be separated. The analysis method then uses IMPLAN multipliers to calculate how much remains in the state, and in the case of personal income, how that income is spent among the different sectors of the economy. The same principle applies to determining direct employment and a consistent set of assumptions must be used with respect to employment and income. If a job position is part of the direct employment then the salary of that position must be included in the direct expenditure under payroll.

The estimates of direct expenditure must be made for a specific year (the input reference year) and this year must be used consistently throughout the analysis. The IMPLAN base year from which the multipliers are derived is 1990. The computer model provided with this handbook requires that all input data be in 1990 dollars. If the data from the plant to be analyzed are for a different year then they should be adjusted to 1990 dollars using the appropriate producer or consumer price index¹.

2.4 INDIRECT IMPACTS: USE OF INPUT/OUTPUT MODELS

The indirect impact (including induced impacts) of biomass energy facilities could in theory be obtained by conducting surveys and field investigations of how the expenditures of the plant actually flow through the economy. Such surveys would be very time consuming and costly and would involve intruding into the financial affairs of numerous individuals and companies that have business relationships with the plant. Because this approach is impractical, most economic impact analyses make use of input/output models of the economy, which trace the linkages between various business

¹U.S. Bureau of Labor Statistics, Producer Price Indexes (Monthly and Annual), Monthly Labor Review and CPI Detailed Report, (January issue each year).

sectors and can estimate the indirect income and employment associated with specific direct expenditures.

This handbook uses the results of the IMPLAN input/output model in the form of a set of multipliers and expenditure fractions which have been calculated for each state. The IMPLAN model uses basic data on business which have been collected by the Department of Commerce for businesses categorized by SIC codes. IMPLAN is an input/output model developed by the U.S. Forest Service for economic impact analysis of forest and natural resource based activities although it has been used for many applications throughout the country. This handbook uses the IMPLAN 1990 data set for each state and runs of the 91-F version of the Micro IMPLAN model¹. These IMPLAN results are incorporated into the computer spreadsheet model which calculates the economic impacts.

Several of the limitations of economic impact analysis, discussed in section 1 of this handbook, stem from the characteristics of input/output models. Nevertheless input/output models are the only practical way of assessing the indirect effects of a project. In this methodology, the input/output approach is combined with direct income and employment in a hybrid assessment. This is necessary because biomass energy is not classified as a separate industry by the Department of Commerce and has no SIC code of its own. For larger industries, such as utilities or the oil industry, the impacts can be estimated by direct reference to IMPLAN. The appropriate IMPLAN multipliers may also be used for assessing the impacts of alternative projects such as oil-fired facilities against which the biomass plant may be compared.

¹US Forest Service and the Minnesota IMPLAN Group, Micro IMPLAN Users Guide, Version 91-F, Minnesota IMPLAN Group St. PAUL Minnesota. 1993.

3. COMPONENTS OF TYPICAL BIOMASS ENERGY SYSTEMS

For those not familiar with the structure of biomass energy systems, this section provides a brief description of the parts of the systems that are relevant to an economic impact assessment. The main parts of the system consist of the biomass energy facility, the fuel procurement system, the fuel transportation system, and the waste disposal system. In the case of biomass derived fuels such as pellets or alcohol the final product must also be transported to market, usually by truck.

3.1 BIOMASS ENERGY FACILITIES

There is a wide variety of types and sizes of biomass energy systems. These may be classified into three categories as follows:

1 Direct or indirect combustion systems

- Wood chip, bark, hogged-fuel or sawdust boilers—grate type
- Wood chip, bark, hogged-fuel or sawdust boilers—suspension fired
- Wood chip, bark, hogged-fuel or sawdust boilers—fluidized bed
- Black liquor recovery boilers (energy and pulping chemicals are recovered from pulp liquor)
- Crop waste boilers (bagasse, nut shells or other crop waste)
- Close-coupled wood gasifiers with direct combustion of gas
- Wood pellet furnaces or boilers
- Log or stick-wood furnaces or boilers (small sizes only)
- Multifuel boilers (some combination of wood, coal, oil and natural gas)

2 Internal combustion or gas turbines

- Close coupled wood gasifiers with internal combustion engines
- Close coupled wood gasifiers with gas turbines

3 Biomass derived fuel systems

- Pellet plants (using sawdust, wood chips or crop residue or paper waste)
- Artificial log plants (similar to pellets but log size)
- Wood to methanol plants (gasification plus methanol synthesis)
- Crop to ethanol plants (fermentation and distillation)
- Wood to ethanol plants (acid or enzymatic hydrolysis, fermentation and distillation)
- Manure to methane digesters (anaerobic manure digesters)

The great majority of industrial and commercial-sized biomass energy plants are direct-fired wood chip or wood waste boilers. Most of these boilers also have the ability to burn some quantity of oil or natural gas to maintain control of the combustion conditions. There are also many multifuel boilers which have the capability of burning wood with other fuels. The greatest number of wood

boilers in the U.S. are associated with the paper and wood products industries. In addition, many pulp mills have black liquor recovery boilers which burn the lignin and other waste liquids from the pulping process and recover valuable chemicals for reuse in the pulp digesters. There are a number of gasifiers in use, but nearly all of them are close-coupled devices in which the gas is fed to a boiler or furnace similar in design to an oil or gas boiler. The primary application of close-coupled gasifiers is to retrofit oil or gas boilers to wood fuel. Wood pellet furnaces or boilers tend to be very small but are, in most respects, similar to wood chip boilers. Wood pellet fuels can be used in boilers designed for chips with few modifications. Industrial log furnaces or boilers are also small, but the designs are quite different from chip or pellet systems.

Crop ethanol plants have been constructed to produce fuel ethanol for gasohol mixes. In some respects, they are similar to beverage alcohol plants. The most common feed stock is corn. Wood ethanol and methanol plants are now only in the experimental or demonstration stages and are unlikely to be encountered in commercial applications. This is also true of biomass derived gas-fired, internal combustion engines and turbines.

Wood densification plants producing pellets or artificial logs are in commercial production, although they are not common. In most respects, they are more similar to a product factory than an energy plant. Manure-to-methane digesters, although very common in developing countries, are relatively unusual in the United States. They are primarily farm-size units with few off-farm impacts.

Most of the systems which produce steam, (wood, wood waste, pellets, crop residue and black liquor boilers, and close-coupled gasifiers) can also be used to produce electric power. There are some stand-alone biomass-fueled electric power plants, but cogeneration of process steam and power is more common. Electric power systems have turbines and generators attached to the boiler and appropriate switch gear and transformers for connection to the grid. Biomass-gas fueled internal combustion engines or turbines can also be connected directly to generators.

3.2 TYPICAL PARTS OF A BIOMASS ENERGY PLANT

This description applies primarily to the most common types of plants, such as those which burn or gasify wood fuel or crop residue in the form of chips, hogged fuel, sawdust or similar sized waste or pellets. A typical biomass energy facility consists of the following parts:

- fuel storage and handling including truck unloaders
- combustion or conversion and heat recovery
- emissions control and venting
- ash collection
- cooling system

In addition, where electric power is generated, the following are present:

- turbines
- electric generators
- switch gear, transformers and power lines

Black liquor recovery plants also have equipment for the recovery of chemicals from the boiler. Multifuel boilers may have storage for oil or coal and/or natural gas lines.

Crop ethanol plants usually include the following components:

- feedstock handling equipment
- fermentation facility
- distillation plant, including combustion system
- byproduct processing facility (distillers dry grains, corn meal and corn syrup)

3.3 FUEL /FEEDSTOCK PROCUREMENT SYSTEM

There are two general types of fuel procurement systems for most biomass energy facilities. These are fuel harvest systems and waste fuel collection systems.

The most common type of fuel harvest system is a whole tree chipping operation which consists of the following :

- feller buncher or feller forwarder
- grapple skidder(s)
- whole tree chipper
- chip van semi-trailers

In some instances, chainsaw felling may be substituted for the feller buncher and a chain skidder for the grapple skidder. Occasionally, wood chips may be provided by traditional logging operations with chain saws, skidders and log trucks. In this case, chipping will be carried out at the plant or at an intermediate location. Frequently, harvesting of wood chips takes place on third party land for which the logging company pays a stumpage fee charged on the basis of the volume cut. Sometimes harvesting may take place on land owned by the company owning the biomass plant. A few examples exist of harvesting from company-owned biomass fuel plantations.

Waste fuel collection systems are extremely variable. In the simplest systems, the biomass plant is fed with wood or other waste generated on site by a processing facility such as a saw mill, and the wastes are conveyed directly to the boiler with automated equipment or loaders. The most complex waste fuel procurement systems would involve open-market purchases of wastes from a large area and from diverse suppliers. Typical suppliers may be sawmills, pulpmills, crop processing plants, furniture factories or demolition contractors. Logging residue (tops) and bark from debarking machines may be included under the definition of waste. Waste fuels are sometimes less expensive than harvested wood, but they may require processing (hogging) and they may be much more variable in quality. Systems which burn municipal solid waste and special wastes such as tires or hazardous wastes, are not considered in the analysis described here.

Crop feedstock procurement systems for alcohol production plants are essentially the same as other crop production systems. Cultivation and harvesting for ethanol feedstocks such as corn are highly mechanized and are not distinguishable from feed or food grain production systems. Feedstock procurement systems are typically not disaggregated in the impact model so detailed analysis of the components is not necessary.

3.4 FUEL /FEEDSTOCK TRANSPORTATION SYSTEM

In most cases the fuel transportation system is quite simple, consisting of semi-trailer vans designed specifically to carry wood chips, sawdust or similar materials, which haul the fuel directly from the harvest site for wood chips or from the source of waste fuel. These trucks, which have payloads of approximately 20 tons, are typically operated by independent truckers, by the supplier of fuel, or occasionally by the plant owners. Unloading at large plants is commonly done with large hydraulic tippers which tip the whole truck, or by trucks with moving floors. Hauling distances are usually less than 50 miles but hauls of a 100 miles or more may occur. Occasionally, rail or barge may be used to transport wood fuels or feedstocks. Crop wastes and grain crops used as feedstocks for alcohol fuel plants are also typically transported by road.

3.5 WASTE DISPOSAL SYSTEM

Waste from most biomass combustion plants consists of ash, which is rich in calcium and potassium and of low toxicity so it that may be used as a soil supplement or fertilizer. Disposal practices vary, ranging from distribution as a fertilizer to landfilling. As wood ash is not normally classified as a hazardous substance it can be disposed of in standard landfills. Ash is normally transported either to farms or landfills in dump trucks. Allowance should be made for other waste disposal from sources such as air pollution control equipment, crop feedstock processing, combustion of supplementary fuels in multifuel boilers or combustion of fossil fuels in ethanol distillation plants.

4. STEPS IN THE PROCESS OF ECONOMIC IMPACT ASSESSMENT

This section takes the user through each step in the analysis procedure indicating where data should be entered in the program.

4.1 DEFINING THE SCOPE OF THE ANALYSIS

To begin an economic impact analysis, the user should carefully define the scope of the facility and the analysis, preferably with input from the ultimate client for the analysis. In some cases, such as a stand-alone plant buying fuel in the open market, the scope is quite easy to define, but where an energy plant is part of an integrated industrial facility, such as a pulp mill, using waste from the mill and recovering heat and chemicals to be reused in the same mill, it becomes more difficult to define the boundaries of the facility. Define in advance what is to be analyzed. Is it just a wood boiler or a boiler plus black liquor recovery? The decision on what to include depends upon what is to be done with the analysis. One possible definition of the scope may be provided by a regulatory or permit proceeding that the economic analysis will accompany. Remember also to decide if the scope will include other activities that are taking place at the same time as the energy plant construction but which are not directly related. (e.g., upgrading the energy efficiency of an adjoining factory, improving vehicle access or bringing adjoining facilities up to building or safety codes) Decide how to break down costs and employment where there are shared personnel or facilities. (e.g., one manager supervises more than one facility or service crews work in several locations.) However the scope is defined, it is important to be consistent so that the same definitions are used for all inputs to the analysis. For example, if a person works half time for the plant then he/she is considered 0.5 of an FTE and earns 50% of the salary for their job category.

It is also necessary to decide in advance if the analysis is for a new plant which is to be considered as an entirely new economic activity, if it is a replacement for an older plant perhaps burning a different fuel, or if it is partly replacement and partly expansion. If a plant replaces, in whole or in part, an existing plant, then both the old and the new plants should be analyzed and the net economic benefits should be determined (see section 6). Unless otherwise stated, it is assumed that an analysis is to be made for a new plant.

4.2 DEFINING THE AREA OF IMPACT

In some cases, the area of impact of a plant may be quite clear, but in many cases the economic impacts of the plant will cross state lines. The default method described here includes all the impacts within a state and ignores impacts outside the state. Determine if there are significant direct expenditures and employment outside the state where the plant is located, such as major purchases of fuelwood/feedstock or a satellite wood fuel processing facility. If this is the case, and the out-of-state impacts are important to the client, then that part of the operation that is out of state can be analyzed separately and the multipliers for the appropriate state should be used. (See section 4.8.)

Although the indirect impact multipliers used in this method do not permit us to determine how the impacts are distributed within the state, it should be possible to obtain an approximate break down of where most of the direct expenditures are made. This will enable the author of the impact report to indicate where in the state economic effects may be concentrated.

4.3 DATA ON DIRECT IMPACTS: CONSTRUCTION PHASE

Construction costs provided by the owners or engineers should be subdivided into three categories as shown in Table 1: engineering design and permitting cost, materials and equipment purchased, and on site construction work. All costs should be in 1990 dollars.

Table 1 Construction Phase Data Entry Worksheet (The example is Case One: see Section 7)¹

	A	B	C	D
17	INPUT DATA			
18	Project Information			
19	Facility name	Alpha Newsprint		
20	Facility type	Wood waste fired boiler		
21	Facility location (Use two letter state code in caps)	MS		
22	Energy capacity (Specify PPH, HP, Btu, MW)	135000		PPH
23	Ethanol production per year (gallons)	0		
24	Wood waste fuel use per year (tons)	35000		
25	Wood chip fuel use (harvested only) per year (tons)	0		
26	Grain feedstock use per year (bushels)	0		
27	Construction Phase			
28	Construction (incl contract labor) costs	\$ Cost		
29	Engineering design & permitting costs	\$700,000		
30	Materials and equipment (purchased)	\$5,319,650		
31	Construction (on site work)	\$3,241,350		
32	Total construction cost	\$9,261,000		
33	Employment	Direct Jobs		
34	Construction workers (direct hire only)	Person/		
35	Total direct construction payroll (direct hire only)	days		
36		12/05		
37		\$1,524,600		

Project Information identifies the project and provides information on fuel/feedstock use. The two letter state mail code must be entered in capitals. This code selects the multipliers from the state multiplier database.

Engineering, design and permitting should include all engineering fees, surveys, design and drafting costs, and state and local permit application costs including consultant fees and legal fees. These costs may amount to 10% of total construction costs.

Materials and equipment purchased should include the cost of the primary equipment such as fuel/feedstock handling, boilers, turbines, generators, pollution control equipment, electrical equipment, fermentation and distillation equipment and all other materials purchased.

Construction costs should include the cost of construction work, installation, and assembly done on site by the owners or contractors. This would include labor and specialized services such as crane hire, welding, etc. Site purchase and preparation cost such as grading, roads, parking, and water supply are also included in this category. The ratio between purchased equipment and on site construction work depends on the type and size of the plant. Larger plants often include field-erected boilers and therefore usually have greater on-site construction costs in proportion to purchased equipment. Small plants are usually sold as package units with much smaller on-site costs. In consequence, the distribution of impacts is also different.

¹ Tables 1 through 6 show parts of the model spreadsheet. These table numbers are used for reference in the text only and do not appear in the computer spreadsheet. The numbers shown in the examples in the text may differ slightly from the cases worked through in the spreadsheet as the spreadsheet may have been revised after the text was finalized.

Compiling the data on direct construction phase employment may be difficult because the design engineers usually do not specify the number of workers, but rely on contractors to bring workers to the site as needed. Sometimes the best estimate that can be made is the peak and average number of site workers and the approximate construction period. It is important to distinguish between peak and average numbers and to convert employment numbers into person days. It is not uncommon for construction companies wishing to stress the job potential of a project to quote the maximum number of workers as the number of jobs provided. This should not be confused with a job defined as a full time equivalent job (FTE). One FTE is approximately 250 person days. Employment data should be entered as person days. The program will convert it to FTEs. Costs should be in 1990 dollars even if the plant was constructed earlier.

4.4 DATA ON DIRECT FACILITY IMPACTS: OPERATION PHASE

The operation phase inputs are all the direct expenditures and employment from the normal operation of the plant. This subsection deals with the operation of the actual plant. Fuel procurement and transportation are considered in the next subsection. Expenditures and employment should be given on an annual basis for the first typical year, in 1990 dollars. Because economic impacts are usually expressed on an annual basis it is important to select a typical year for analysis. The first year of operation for most plants is atypical with production and fuel consumption below normal. Also some construction or modification activity may continue in the first year. Estimating in advance the normal operation levels may require some judgment and consultation with the plant design engineers. It is important to distinguish between the design capacity or maximum level of operations which are used as the basis for air and water quality permits and the normal or average level. Economic impacts are best evaluated by using average operation levels and therefore average levels of expenditure and employment.

Table 2, which is part of the data entry worksheet for the program, shows the categories of direct expenditures and employment used in the analysis. All costs and salaries should be in 1991 dollars throughout. If the original data are for a different year they should be converted using the appropriate inflation rate.

Table 2: Plant Operation Data Entry Worksheet

	A	B	C	D
3.9	Operations Phase			
4.0	Plant Operation and Maintenance	Annual \$ cost		
4.1	Wood waste fuel purchase	\$280,000		
4.2	Wood chip fuel purchase (harvested wood)	\$0		
4.3	Other waste material fuel purchase (MSW, sludge)	\$0		
4.4	Grain feedstock purchase	\$0		
4.5	Natural gas purchase	\$605,000		
4.6	Fuel oil purchase	\$0		
4.7	Coal purchase	\$0		
4.8	Electric power purchase	\$5,000		
4.9	Waste disposal costs	\$0		
5.0	Repairs & maintenance	\$55,000		
5.1	Other supplies purchased	\$10,000		
5.2	Other operating costs	\$2,000		
5.3	Interest payments on debt (not equity)	\$62,000		
5.4	Property taxes & other local taxes or fees	\$76,300		
5.5	Insurance payments	\$14,250		
5.6	Total operating costs (excluding direct labor)	\$1,109,550		
5.7			Direct	Average
5.8			Jobs	Annual
5.9	Employment (direct hires & contracts)		FTEs	Salary
6.0	Managers and engineers (FTEs)		1	\$39,000
6.1	Clerical workers (FTEs)		0	\$0
6.2	Skilled plant operators (FTEs)		9	\$29,500
6.3	Other workers (low skill) (FTEs)		4	\$20,000
6.4	Plant payroll	\$364,500		
6.5				
6.6	Proprietors income, dividend or profit	\$133,000		

Wood/biomass waste fuel/feedstock purchase is the category for all wood/biomass purchases other than that harvested specifically for the plant. It includes mill residues, sawdust, shavings, bark hogged fuel, residue wood chips from other operations, and other biomass wastes such as crop residues or manure. This includes purchases made in the open market or from a connected facility. Judgment is required in defining this expenditure especially when the wood or other biomass waste is obtained internally by the company from an existing facility. The general rule for this should be as follows:

Enter the expenditure on the waste if :

- It was purchased in the open market
- It was purchased internally with an actual cash transaction and the waste was not previously being used or new waste was generated as a result of a simultaneous increase in production at the waste source

Do not enter the expenditure on the waste if:

- It was obtained internally without any cash transaction
- It was obtained internally but it was previously being purchased by a cash transaction

In all cases value added to the waste should be counted as an expenditure if the waste is sorted, loaded, dried, transported, etc. The cost of transfer from a related facility on the same site will probably be included under other categories in this section and should not be double counted. Savings from avoided disposal costs should not be included here. They are included in another section of the worksheet. (See Table 4)

Wood chip fuel purchase is the category for all purchases of wood chips (or logs) purchased from harvesting operations operating specifically for this purpose, or from multipurpose harvesting operations, as long as the cost given is market value or fairly reflects the fraction of the procurement

cost associated with the wood fuel. From this figure it is possible to determine the employment and income from the woodfuel harvesting operation. It is assumed that the cost entered in this section accurately represents the total cost, including labor, of procuring the wood fuel. This will be true if the woodfuel is purchased on the open market. If the company employees play a part as supervisors, foresters, or in harvesting or trucking the wood, they should be added as plant employees in the appropriate section of the worksheet below.

Other waste material fuel purchases include any supplementary waste material used as fuel. It is unlikely that any expenditure would be made in this section as in most cases wastes are available free of charge. There may be revenue from waste disposal in which case it should not be included here. (See discussion under proprietors' income or profit below.)

Grain feedstock purchases is the category for all purchases of grains to be used as feedstock for ethanol production plants. Crop wastes used as feedstock should be included in the waste material category discussed above. An entry in this section will result in a calculation based on the assumption, that the purchase of grain as a feedstock will result in additional grain being grown by the farm sector, that the grain is not displacing another crop and that the additional grain demand will not have any significant affect on grain prices or price support payments. These may be reasonable assumptions, but the user should be satisfied that they apply. If additional grain purchases primarily displace similar grain purchases by others, or if they displace the production of crops of similar value, then no entry should be made in this section because there is no significant economic impact. The model, as it is presently configured, cannot deal with the impact of changes in price in local or regional grain markets or the impact of grain purchases on the price support system. The model can be used to estimate the economic effect if the user knows from other sources the total dollar value of the price increase within the state. The value of that increase (but only the increase) can be added to the project specific value of the feedstock purchase for the plant.

Natural gas, oil, and coal purchases are three sections in which data is entered on the direct purchases of these three fuels. These expenditures are assumed to be at prevailing market prices from local suppliers. Oil and natural gas are straightforward to deal with and plant owners can usually estimate the amount to be used. In the unlikely event that coal is to be used in the plant in large quantities, as in the case of a large multifuel boiler, and the fuel is to be obtained by direct contract with an out of state mine, then a separate analysis should be conducted for the coal supply.

Electric power purchase includes all electric power purchased from the utility but not cogenerated power produced internally. This should include the demand or capacity charge.

Waste disposal costs (including ash disposal) are those payments made to a landfill or other waste facility including payments for trucking if not conducted in company vehicles.

Repairs and maintenance is the category for the cost of spare parts replacement and repairs to the plant. It should not include the cost of plant labor used to undertake the repairs but it would include the cost of contracted labor.

Other supplies includes all routine supplies purchased.

Other operating costs include any other operating expenditure not specifically identified.

Interest payment includes payments on debt to financial institutions and others, but not payments of dividends, profits, etc. on equity holdings.

Property taxes and other local taxes is the category for property and other local taxation paid by the plant, but it should not include state or federal income, sales or excise taxes. Local sewer or water taxes should be included. One time community impact fees should be included in the construction phase input under construction. Property taxes are usually a matter of public record and can be obtained from the local tax collection office or from the plant owners. If the energy plant is part of a larger industrial complex, the energy plant fraction can normally be assigned by value. Allowance should be made for

any special exceptions or rebates for pollution control or other circumstances. If land is owned by the plant that is used for harvesting biomass fuel, the property taxes on that land should be included. These taxes should be prorated by the fraction of the total harvest made up of fuel wood harvest. Some judgment may be required to avoid over counting these taxes if the land is being held for investment value or other purposes and fuelwood harvesting is only a secondary use of the land.

Insurance is the category for all plant insurance costs which are not related to employees.

Employment is listed in four categories with space for the entry of average salaries. The computer model will calculate the plant payroll from the input of the number of employees and salary data. The user may adjust these job categories if needed. Salary information may be considered confidential but the user could estimate it. As an alternative the user can enter the total payroll directly and the total number of employees if this data is available from the owners. The salaries and total payroll should include benefits, social security and other payroll taxes paid by the employer.

Proprietors' income or dividends is the category for entering the income dividend or profit of the plant. With respect to the economic impact calculation, it is normally treated the same as payroll. It is separated from payroll because it must usually be estimated by different methods. For a public company, the dividend is published and the user may assume that the plant is making the same return on investment. However, if the company is a national or multinational corporation, only a fraction of the profit would remain in the state. If the company is a small, locally owned business, it may be assumed that the owners' income or profit will be spent locally and can be treated the same as payroll. Most small businesses will not reveal their profit or return on investment so the analyst is left either to ignore the item or make an estimate. In some cases, for example, where a public utility sales contract is involved, the financial details may be available. The following guidance may be useful in making an estimate of this item. For a national public corporation, assume the same company-wide dividend to book value of assets ratio applies to the plant. Calculate the value of the dividend for the plant based on the plant capital cost. Now assume that the shareholders in the national corporation are distributed by state in proportion to population and multiply the plant dividend by the fraction of the U.S. population resident in the state in question. Enter this amount as the proprietors' income that will be spent locally. If the plant is owned by a local individual or company and they will not disclose their profit, estimate typical returns on investment in the industry in question and enter that data. Businesses schools or university extension services may be able to advise on the rates of return in similar local businesses. If this estimate is based on the investment in the plant, only count the equity investment. The debt payments (bank loans or bonds) have already been entered under principal and interest payments. This distinction between debt and equity repayments is important as it affects where this expenditure is distributed and therefore there is a different multiplier effect.

4.5 DATA ON DIRECT IMPACTS OF FUEL / FEEDSTOCK PROCUREMENT AND TRANSPORTATION

Expenditure on wood or other biomass fuel or feedstock procurement and transportation, may be considered as a direct or indirect impact of the plant, depending whether these activities are undertaken directly by the plant owners, or whether the plant purchases the fuel/feedstock from independent contractors. The total economic impacts estimated should not differ substantially, but the way the data are entered and computed is different. If the biomass fuel/feedstock is purchased from independent contractors, the cost is entered in the section on direct impacts of plant operation shown in Table 2 above. Grain or other ethanol feedstocks will also fall into this category and should be entered in table 2 above. If the wood fuel is harvested and/or transported by the company, with company employees and equipment, then the appropriate data are entered in the section of the worksheet

shown in Table 3. Sometimes the harvested wood fuel is procured through a combination of several procedures, perhaps involving different divisions of the parent company. In that case it may be difficult to obtain the data required for this section. An alternative procedure would be simply to determine the number of tons of harvested wood fuel used, then estimate its market value and enter the cost as if it were purchased wood chip fuel (not wood waste fuel) in the section above (Table 2). This part of the worksheet shown on Table 3 below should generally not be used for waste wood fuel, except where the cost previously entered (Table 2) does not include transportation. In that case only the plant-provided transportation should be included here.

Table 3: Wood Fuel Procurement and Transportation Data Entry Worksheet.

	B	C	D
6.8	Woodfuel/Feedstock Procurement & Transport		
6.9	(If not included in plant O+M costs)	Annual \$ Cost	
7.0	Harvesting equipment annualized cost	\$0	
7.1	Stumpage or other harvesting fees	\$0	
7.2	Woodfuel/feedstock transportation costs	\$0	
7.3	Fuel and other operating costs	\$0	
7.4	Finance, Interest and Insurance Costs	\$0	
7.5			
7.6	Procurement & transportation employment	Direct Jobs FTEs	Average Annual Salary
7.7	Foresters and supervisors (FTEs)	0	\$0
7.8	Loggers and equipment operators (FTEs)	0	\$0
7.9	Truck drivers(FTEs)	0	\$0
8.0	Mechanics(FTEs)	0	\$0
8.1	Total procurement & transportation payroll	\$0	
8.2			
8.3	Total plant direct payroll & profit (Include benefits)	\$517,500	

Harvesting equipment annualized cost is the category in which the annual cost of the equipment for harvesting and transportation is included. This would include feller bunchers, skidders loaders, chippers, forwarders and trucks. The annualized cost includes the repayment of principal and interest or lease fees, repairs, insurance, etc. Because there are so many configurations of equipment and methods of financing there is no standard method for calculation.

Stumpage is the fee paid by the logger to the land owner for the wood harvested. The stumpage is usually charged on a per ton or per cord basis. The estimate entered should be for the annual harvest.

Fuel and supplies includes those for the harvesting equipment and trucks if operated by the company.

Wood or other fuel transportation cost should be included here only if it is contracted separately and not included in the equipment cost and labor costs in this section.

Ash or other waste transportation costs should be included here if contracted separately and not included under equipment and labor costs either in this section or in the section under direct facility operations (Table 2).

Procurement and transportation employment under specific job categories is entered here with the number of employees (FTEs) and the average salaries under each category. The user can change the definitions of these categories if required. Average salaries for each category should include benefits

paid by the employer. As in the case of plant employees discussed above, total payroll and total employees can be substituted for the data by job category if the data are available in that form.

4.6 DATA ON SAVINGS FROM PLANT OPERATION

Under some circumstances a biomass energy facility may produce significant savings, either through saving energy costs, or by saving the disposal cost of waste wood or other biomass material. These savings have economic impacts and are therefore entered into the worksheet as direct impacts. The data on these savings are entered in the section of the worksheet shown on Table 4 below. For these savings to have economic impact value, they must involve actual savings over some pre-existing situation and the savings must be respent in the community. From the perspective of economic impact, they are treated in the same way as proprietors' income, with similar assumptions made about how they are spent. If the user believes that any savings are reflected in the entry for profit or proprietors' income, then no entry should be made in this section. Use of this section will probably be most applicable for assessing the impacts of changes in existing facilities rather than for completely new plants.

Table 4 Savings Data Entry Worksheet.

	A	B	C	D
8.6	Savings	Annual \$ Savings		
8.6	Waste wood disposal cost savings		\$0	
8.7	Net energy cost saving compared to existing fuel		\$0	

Waste wood disposal cost savings include those costs such as landfill, incineration, and transportation costs that would have been actually paid to remove and dispose of the material that is being used as fuel. No allowance should be made for environmental benefits (this is not a cost benefit analysis). Even if the wastes were formerly disposed of by a method such as open burning, which is now illegal, no benefit can be counted except for actual cash savings. It is important not to double count, for example, transportation costs saved in this category if the same transportation cost were incurred to transport the waste to the plant. In general, savings in this section should only be counted if the specific waste used as fuel previously incurred a specific waste disposal charge that has been saved. If the waste is purchased in the open market or through brokers, it is probably the case that the waste has simply been diverted from one use to another. In most areas of the country there are existing markets for waste wood, especially sawdust and shavings, so that no real disposal cost would have occurred. It is also important not to count these savings if they cannot be distinguished from the overall profit of the enterprise. If these savings are included in the proprietors' income or profit category (Table 2 above), they should not be included here. Savings of disposal costs will usually occur where a wood waste generating industry switches to wood waste fuel from another fuel. Therefore, if an entry is made here an additional analysis should be undertaken of the displaced impacts of the waste disposal in a fuel switching case. The fuel switching case is discussed in greater detail in section 6. If the disposal cost savings occur in another state, please refer to the discussion in section 4.2 above.

Net energy cost savings compared to existing fuel is the section for entry of energy costs savings, with similar constraints to those that apply to waste disposal cost savings. Savings must be real savings, when compared to some pre-existing situation, and they must not be counted in the proprietors' income or profit entry. Generally this entry should not be used for entirely new plants because any cost advantages of biomass fuel are assumed to be part of the overall income of the facility. This entry may

be used, for example, where an existing oil or coal boiler is switched to wood or other biomass waste and an energy cost saving occurs. It should be remembered, however, that when an analysis is being made of a fuel switching situation, the new fuel's economic impacts displace the jobs, income, and taxes associated with the previous fuel. Therefore if an entry is being made here for a fuel switching case, an additional analysis should be undertaken of the displaced impacts of the old fuel. This is discussed in greater detail in section 6.

4.7 DATA ON COMMUNITY COSTS AND SUBSIDIES

Community costs are those direct costs of the facility that must be borne by local or state government. The theory of which community costs should be included in the analysis has been discussed in Section 2 of the handbook. In keeping with the general principles of economic impact analysis, environmental, social, aesthetic or other intangible costs should not be included. In general, we recommend that community costs should not be included here, unless they are special and unusual. A good working definition of what should be included would be services provided to the facility by state or local government which are beyond those normally provided to other businesses, and which therefore constitute an incentive payment or subsidy. An example might be where a local government obtains land and leases to an industry at a below market price, constructs a road, bridge or dock specifically for the industry, or provides water or sewer services at subsidized prices. Road improvements for increased truck traffic, additional police or fire protection, education, or social service costs for plant staff dependents should not be included because they are normally paid for with taxes paid by the facility or its employees. Financial incentives should only be included as community costs if they are specific to the plant and not normally available to other businesses in similar circumstances. In general, the use of low interest industrial development bonds should not be considered a plant specific subsidy, unless the bonds are not available for competing energy plants. Community costs, if any, should be entered in the appropriate heading in the section of the worksheet shown in Table 5.

A special class of community costs is represented by tax subsidies given to certain biomass energy projects, especially ethanol production. If taxes are reduced the value of these tax subsidies should be calculated and entered in the appropriate section as shown in Table 5. The federal excise tax on gasoline is remitted on gasohol mixtures. Several states also reduce the state gasoline tax or give a producer subsidy. These tax subsidies go to the ethanol producers and are essential to the commercial production of ethanol. They are however, a reduction in state and federal tax revenues and result in a reduction in economic impacts in those sectors where the taxes would have been spent. The tax subsidies should be entered under the specific headings given, as each subsidy category has a different impact. The total of all tax subsidies are subtracted from taxes paid to produce net tax revenue estimates in the output tables, but the impacts are calculated separately with the following assumptions:

- State revenue reductions in gasoline taxes result in a direct reduction of expenditure in highway construction and maintenance in the state.
- Federal revenue reductions in gasoline taxes result in no reduction of expenditure in the state.
- State revenue reductions in other taxes result in reduction in the state general fund expenditures.
- Federal revenue reductions on other taxes result in no reduction in the state general fund expenditures.

- Direct financial incentives (grants or cost sharing) from state funds is the equivalent of a state general fund expenditure reduction as discussed above.
- Direct financial incentives (grants or cost sharing) from federal funds is the equivalent of a federal tax revenue reduction as discussed above.

Table 5 Community Costs Data Entry Worksheet

		Annual \$ Cost	
8.9	Community Costs		
8.9.1	Education costs	\$0	
8.9.2	Social services costs	\$0	
8.9.3	Transportation costs	\$0	
8.9.4	Safety and security costs	\$0	
8.9.5	Land or property costs	\$0	
8.9.6	Total community costs	\$0	
8.9.7	State tax revenue reduction	\$0	
8.9.8	Federal tax revenue reduction	\$0	
8.9.9			

The value of total community costs is reported in the economic impacts summary tables. Interpretation of these results is discussed in section 4.10.

4.8 SELECTION OF INDIRECT IMPACT MULTIPLIERS

The computer model automatically selects the appropriate multipliers from a set of tables included within the program. These multipliers are derived from the IMPLAN input/output model for each state. Impacts are calculated and reported separately for the construction and operation phases. The selection of the multipliers has been made as follows:

- Direct expenditures by the plant, including payments of salaries, are partitioned into appropriate sectors based on statewide averages of personal consumption expenditures in different sectors and data specific to the wood energy industry.¹
- Expenditures by sector are then multiplied by the statewide total income multiplier which calculates the total indirect income effect within the state of that expenditure.
- Expenditures by sector in turn multiplied by the total employment multiplier, which is expressed in full-time equivalent jobs per \$1,000,000 of expenditure, to calculate the indirect and induced jobs by sector.
- All expenditures, direct and indirect, are summed and multiplied by the state and federal tax multipliers to obtain the estimated federal and state taxes paid by the economic activity resulting from the facility.

The user typically will have no need to change this assignment of multipliers. The multipliers are, of course, different for each state. The user specifies the state in which the facility is located in the Project Information section of the worksheet. A macro selects the appropriate multiplier set from the tables based on the entry (coded by the two letter postal service state code, e.g. AL). If the analysis of the project is being partitioned because impacts occur in more than one state, the user should change the state code as appropriate for each run of the program.

¹Southeast Regional Biomass Energy Program, Economic Impact of Wood Energy Use in the Southeast Region of the U.S. Tennessee Valley Authority, Muscle Shoals AL.

4.9 RUNNING THE COMPUTER MODEL

Running the computer model is straightforward for anyone familiar with computer spreadsheets. The file named ELACALC.WK3 is opened with Lotus 123. It can be started with an example case, which provides a model for the user to enter the data for the project to be assessed. The data for a new project should be entered in the input section following the instructions given in section 4, starting at the top with Project Information and continuing down to Community Costs. The section open for data entry is shaded, and all other sections are unshaded and initially locked. The user should be sure to replace all the data from the example case with data from the project to be evaluated, or use 0 where no entry is needed. Except for the first three lines of the project information section, all data entries must be numerical only. The program recalculates the results as it proceeds and produces the output summary in the section immediately below the input data section. Further information on running the model is given in the appendix.

4.10 INTERPRETING THE OUTPUT OF RESULTS

The results of the analysis using the computer model are shown as a summary table. There are three primary measures of economic impact, which although related, should be considered separately. These are income, employment and taxes. Income and employment are both divided into direct and indirect components. Taxes are separated into federal, state and local. Community costs should also be considered if they significant. A output summary table is shown in Table 6 below.

Table 6 Output Summary

	A	B	C	D
89	OUTPUT SUMMARY			
100	Economic Impact Output Summary	Alpha Newspaper		
101	Construction Phase Impacts	1990 Dollars	Jobs	
102	Total Construction expenditure	\$9,261,000		
103				
104	Direct Income	\$1,200,750		
105	Indirect Income	\$8,314,742		
106	Total Income	\$7,515,492		
107	Direct Jobs (FTEs)		51	
108	Indirect Jobs (FTEs)		217	
109	Total Jobs (FTEs)		268	
110	Local Taxes Paid	\$76,300		
111	State Taxes Paid	\$450,877		
112	Federal Taxes Paid	\$1,218,647		
113	Total Taxes Paid	\$1,745,824		
114	Community Costs	\$0		
115				
116	Operations Phase (Annual Impacts)			
117	Total Operation expenditure	\$1,627,060		
118				
119	Direct Income	\$506,046		
120	Indirect Income	\$943,362		
121	Total Income	\$1,549,408		
122	Direct Jobs (FTEs)		14	
123	Indirect Jobs (FTEs)		31	
124	Total Jobs (FTEs)		45	
125	Local Taxes Paid	\$76,300		
126	State Taxes Paid	\$92,964		
127	Federal Taxes Paid	\$251,239		
128	Total Taxes Paid	\$420,492		
129	Community Costs	\$0		
130	State Tax Revenue Reductions	\$0		
131	Federal Tax Revenue Reductions	\$0		
132				

Total construction and operation expenditures are gross expenditures and include payments made outside the state. Construction phase and operations phase impacts should be considered separately and not added together. Although the impacts are expressed in the same categories they are not directly comparable. Construction period impacts typically last for a few months up to two years, whereas operations impacts will last the life of the plant which may be 30 years or more. Construction usually has few lasting impacts on the local community, as construction workers commute or temporarily relocate.

The impact summary is self-explanatory but we recommend that more emphasis be placed on the total jobs and total income in each phase rather than on the distinction between direct and indirect impacts. Both direct and indirect jobs and income have the same effect in the state, although direct jobs are probably going to be located in a more restricted geographic area. To some extent, the distinction between direct and indirect jobs and income may be arbitrary, depending, for example, on whether wood fuel is harvested by company employees or independent contractors, or whether plant repairs are made by plant employees or outside contractors. The estimates of local taxes are likely to be more accurate than the estimates of state and federal taxes. Community cost estimates, if any are made, are likely to be very approximate. In general reports, the analyst should not subtract any estimate of community cost from the tax estimate to provide a net tax benefit, unless the client is using this for a specific and clearly understood purpose. All figures are in 1990 dollars. They can be adjusted to any other year using the consumer price index¹. Jobs should not be adjusted.

In some applications where two plants are being compared or where an existing plant is being compared with a modified plant, the analysis will be run twice and two output summary tables are generated. If a net impact is to be calculated, the output tables can be copied to a new worksheet and the results compared.

¹U.S. Bureau of Labor Statistics, CPI Detailed Report,

5.0 HARD-TO-QUANTIFY ECONOMIC IMPACTS

Although the primary focus of the economic impact assessment is to quantify income, jobs, and taxes, there are other aspects of economic impact which should be given attention even if they cannot be fully quantified. These include forestry and agricultural impacts, community costs, and community benefits. In each case there are impacts which in theory can be quantified, but in practice are either so difficult to quantify, or they are so subject to conflicting assumptions, that it is nearly impossible to incorporate them into a standard form of analysis. The purpose of this section is to suggest some possible approaches to assessing these impacts while leaving the analyst to decide how, if at all, they should be included in the overall assessment.

5.1 FORESTRY AND AGRICULTURAL IMPACTS

Harvesting wood for fuel provides a market for wood that, in many cases, was formerly of no commercial value and in some cases was preventing the upgrading of forest stands or their conversion to more marketable species.¹ It has been argued that the availability of a market for this low quality wood makes it possible to improve forest stands, which will in time yield high value material and stimulate a productive forest industry. Therefore there may be additional value associated with wood fuel harvesting which will be realized in the future. Unfortunately, there is no agreement among foresters as to the exact value of this benefit. There are actually two different impacts that can be assessed. First, if the wood fuel harvesting operation carries out a thinning or clearing operation that would have in fact occurred independently, then the cost of that operation is saved and the harvesting provides an actual saving. This can be counted as savings with the same restrictions as other savings, i.e., the saving must be a real and it must not be reflected in a lower price for the wood or otherwise included as profit for the plant owners. However, the economic impact of that thinning or clearing operation displaced should be taken out. A second impact is the value of the additional growth of marketable timber which can be directly attributed to the stand improvement from harvesting. To estimate this, a forester must estimate the future growth and calculate the stumpage value of that timber at maturity and subtract all the other carrying costs of producing that timber (including taxes, thinning, pesticides etc.). The net value of that timber at maturity must then be discounted back to the present from its maturity date, which may be 20 to 50 years hence. In practice such discounted net values are extremely small and make very little difference to the overall economic impact analysis. Even if a discounted value approach is taken, it is doubtful if it should be directly added to the annual impacts summary because the economic impacts will not occur for many years. It is possible, although unlikely, that there may be agricultural benefits associated with the cultivation of other biomass crops and a similar approach can be taken to assessing their value. The potential for reduced long term yields from land being used for intensive production of biomass energy crops through soil erosion and nutrient depletion is of concern to some agriculture and silviculture experts. If this occurs there would be net economic costs to society, but these costs are typically not included in an economic impact analysis because, like timber stand improvements they do not result in transactions in the present. This must be accepted as a limitation of economic impact analysis.

¹For a general discussion of the environmental, sociological and silvicultural impacts of fuelwood harvesting see for example: U.S. Congress, Office of Technology Assessment, "Energy from Biological Processes" Volume I and II, U.S. Government Printing Office, Washington DC, 1980.

5.2 COMMUNITY COSTS

Community costs have been discussed in the section describing the inputs to an economic impact analysis above, with the recommendation that only unusual community cost that constitute a direct subsidy of the plant should normally be included in the analysis. It can be argued that a complete economic impact analysis would include all community costs and community benefits, which should then be compared with tax revenues to obtain a community impacts balance sheet. Community costs would include education, social services, police, and fire protection, etc. These community costs are normally covered by taxes, therefore the assumption made in the approach recommended here is that there is a balance. Determining the specific community impact can be undertaken but it requires a very painstaking approach and is quite site-specific. An outline of the steps to be taken in such an approach is as follows.

- 1) Refine the area to be evaluated. The impact analysis is statewide, but the community impact analysis should probably be restricted to the town, city or county in which the plant is located.
- 2) Make a list of plant specific impacts: roads (traffic volumes), water and sewers (gallons per hour), police and fire protection (plant specific), and obtain from the appropriate local government agency estimates of the incremental cost of the additional services.
- 3) Make a list of all additional workers who may be expected to move into the area. This list can be compiled from the plant estimates of direct labor, plus the estimated indirect employment by category given in the output section of the worksheets. Plant owners and the local labor department office can then be requested to help estimate how many of the workers will be recruited in the defined local area and how many will come from outside. Only those who move to the area from outside will increase the community education and social service costs. Using the list of workers who will migrate into the area, estimate the number of school age and other dependents based on census or other local data to estimate the additional school enrollment and additional social services demands. Obtain from the appropriate local schools and social service agencies the incremental cost of providing education and social service to these dependents.
- 4) Partition these costs into state and local shares using standard state cost sharing accounting methods.

When all these estimates have been made they can be entered into the community costs section of the worksheet with the clear understanding which criteria have been used. If this approach is used and all community costs have been carefully estimated, the total local community costs can be subtracted from the estimated local taxes to determine the net tax impact. A similar calculation can be made for net state tax revenues, but the basic method for calculating the state tax revenues is less reliable at the site specific level and therefore this type of calculation should be interpreted with caution.

5.3 IMPACTS ASSOCIATED WITH TAX SUBSIDIES

Ethanol and sometimes other biomass energy projects receive special tax treatment which may require specific analysis. The tax subsidy must be calculated for the specific plant and partitioned into federal, state and local shares. In the case of ethanol the model calculates the loss of income and jobs assuming that the state tax subsidy is a loss of revenue that would have been spent on state and local government. (See section 4.7.) Other tax subsidies are simply treated as a reduction in general revenue.

Treatment of other special tax subsidies depends on the origin of the subsidy. Generally subsidies that originate from the federal treasury can be ignored in this analysis because the impact assessment is restricted to the state level. Ethanol tax subsidies may result in complex cross border transactions which must be untangled on a case by case basis. If necessary, two or three analyses may be required: one for the state in which the plant is located, another for the state in which the gasohol is sold and perhaps a third for a state supplying a significant part of the corn requirement.

5.4 COMMUNITY BENEFITS

A community experiencing additional employment and income receives benefits in addition to the income, employment, and taxes which are estimated in this method. Additional employment and income usually result in a reduction in the number of people receiving unemployment benefits, welfare, and other social services. Making an estimate of the value of these reductions in social service costs is difficult because it depends upon the nature of the unemployment in the area. In a simple case, each FTE job will remove, on average, approximately one person from the unemployment rolls, but the amount of money saved by the community is extremely variable depending upon the level of payments made to the unemployed. This varies by state and city and the database available for the computer model does not permit us to estimate this. However, it is possible to conduct this analysis for a specific county or metropolitan area, although the data collection process is quite time consuming. In order to conduct such an analysis, the local area must be defined and a breakdown of which jobs (direct and indirect) will be filled by local workers and which will be filled by workers moving into the area is required. Only those being filled by local workers will be considered for this purpose. For the local area (county or SMSA) the costs of all unemployment and welfare benefits must be obtained for the most recent year, the origin of the payments (federal, state or local) must be determined, and the annual average number of recipients obtained in order to compute the average payment derived from state and local sources. This figure would then be multiplied by the number of locally employed workers, assuming that one locally hired worker reduces the welfare rolls by one. This will provide an approximation of the savings of unemployment and welfare benefits from the plant. It is, however, only an approximation for several reasons. In rural areas, wood harvesting, or agricultural jobs may be filled by people engaged in part-time work, such as farming, who may not be receiving unemployment or welfare benefits. Some of the indirect jobs in the retail and service sectors may be filled by an expansion in the working hours of part-time workers who may not have previously been receiving benefits. In addition, there may be some reduction in other social service payments, such as Medicaid, school lunch programs, etc. However, it is probably not worth trying to estimate these.

Before embarking upon what will probably be a time consuming analysis of unemployment and social service cost savings, it should be clear what the purpose is for undertaking the analysis, and what additional assistance it may provide to the final client for the work. Normally the purpose of an economic impact analysis is to evaluate the relative merits of a biomass facility compared with some other alternative. In this case income, employment and taxes provide a good measure of the impacts. Even if the precise dollar value of social service savings is not calculated, it may be considered to be directly proportional to jobs; therefore FTE jobs provides an adequate measure of the relative impact.

In general, if an estimate of the these avoided unemployment and welfare payments is made, it should be made in conjunction with a refined estimate of community costs as discussed above. In such a case these community benefits should be used to offset community costs.

6.0 COMPARATIVE AND NET ECONOMIC IMPACT ANALYSIS

There are a number of purposes for which a site-specific economic impact analysis may be conducted. These include providing economic impact information as part of an overall environmental impact assessment, which may be related to a regulatory or planning process or providing justification for a project that requires a zoning variance, subsidy or other special treatment. One of the questions that often arises is how the economic impacts of a specific biomass energy plant compare with other alternatives. These other alternatives may include a no action or no build scenario, continuing to use a plant burning conventional fuels, switching fuels, building a new energy facility with a different fuel, or building an alternative biomass fueled facility. All of these involve some type of comparative economic impact analysis or a net economic impact analysis allowing for displacement of other impacts. The method which is described in this handbook is quite suitable for undertaking some types of comparative and net economic impact analysis, although there are certain guidelines which should be followed and some restrictions on the scope of the analysis which can be undertaken.

In some sense, all economic impact analysis is comparative and therefore, in theory at least, there is a vast range of alternatives with which the facility in question may be compared. The method described in this handbook is designed for biomass energy facilities, and, although it has some flexibility, it cannot be used for the analysis of non-energy facilities. The method is not suitable for comparison between the use of a specific site for a biomass energy system and its use, for example, as a retail outlet or an Air Force base. Similar techniques can be used for retail outlets or Air Force bases but the worksheets and computer model given here cannot be used for this purpose. If the economic impacts calculated with this method are to be compared with those for a different type of facility using a different computer model, great care should be taken to ensure that there are consistent assumptions and consistent definitions being used.

Some of the more frequent comparative applications for the method are described below.

6.1 BUILD VERSUS NO-BUILD

The simplest application of the method is to assess the economic impacts of building a facility when compared with not building the facility. With the assumption that it is a new stand-alone facility, all that needs to be done is to follow the method described in this handbook. The no build scenario has zero impact. A variant on this scenario is where the new facility consists of additional capacity at an existing facility but involves no replacement. Again the analysis follows the method described, but some staff or facilities will be shared with the existing capacity and allowance must be made for this in the inputs to the analysis.

6.2 MODIFYING AN EXISTING BIOMASS FACILITY

An existing biomass energy plant is modified to burn a different biomass fuel (e.g. switching from waste wood to harvested wood chips). In this case the same method is followed, but two runs of the program are needed. In the first, only changes such as new wood handling equipment and different wood prices and transportation costs are substituted. In the second run, only the displaced activities in the operation phase, such as the purchase of wood waste and the transportation of wood waste, are entered. The net impact is the difference between the output of the two runs.

6.3 REPLACING AN EXISTING FOSSIL FUELED BOILER WITH A BIOMASS FACILITY

An existing energy plant such as an oil fired boiler is replaced with a new biomass fueled boiler. The standard method is followed for entering the data on the new facility and the model is run to determine the full impacts of the new facility. The only modification would be to add to the construction cost estimate for the new plant the cost of demolition or mothballing the old facility. Demolition cost would be entered in the on-site construction cost category. A second run of the model is then undertaken for assessing the displaced impacts of the old fossil fueled facility. In this analysis the construction phase impacts will be zero. The operations phase impacts of the displaced plant can be assessed by using the same worksheet set up for a biomass facility, but with entries that reflect that it is a fossil fueled plant. Input data should be given for the last complete or typical year of operation before replacement, adjusted to 1990 dollars. An example entry for the operation phase impacts for a displaced oil fired boiler is given in table 7 below.

Table 7 Plant Operation Data Entry Worksheet For A Displaced Oil Fired Boiler.¹

Operations Phase	
Plant Operation and Maintenance	
	Annual \$ cost
Wood waste fuel purchase	\$0
Wood chip fuel purchase (harvested wood)	\$0
Other waste material fuel purchase (MSW, sludge)	\$0
Grain feedstock purchase	
Natural gas purchase	
Fuel oil purchase	\$1,750,000
Coal purchase	\$0
Electric power purchase	\$230,000
Waste disposal costs	\$4,500
Repairs & maintenance	\$300,000
Other supplies purchased	\$120,000
Other operating costs	\$110,000
Interest payments on debt (not equity)	\$1,230,000
Property taxes & other local taxes or fees	\$245,000
Insurance payments	\$85,000
Total operating costs (excluding direct labor)	\$4,074,500
Employment (direct hires & contracts)	
Managers and engineers (FTEs)	1 \$45,000
Clerical workers (FTEs)	1 \$25,000
Skilled plant operators (FTEs)	3 \$33,000
Other workers (low skill) (FTEs)	1 \$25,000
Plant payroll	\$194,000
Proprietors income, dividend or profit	\$185,000

¹Table 7 is numbered here for reference purposes only. It is a part of the input section of the spreadsheet previously shown as table 2 and discussed in section 4.4

The main differences between the entries for a displaced oil boiler and the standard use of this worksheet are as follows:

- Entries for wood fuel and wood waste purchases are zero.
- Oil purchases are entered in the appropriate cell.
- Ash disposal costs are much lower.
- Interest payments on a plant that is about to be closed are probably zero, on the assumption that the debt has been fully paid, or that it will be fully repaid at the time the new plant is constructed. If for any reason the debt has not been repaid, the mortgage would probably be transferred to the new plant, so that interest payments in the new plant analysis should reflect that.
- Plant employment should be entered exactly as it is, or was, in the old plant even if the employees will be retained by the company. If the same workers are to be kept on to run the new plant, they will be accounted for in the new plant analysis. Employment at a biomass plant will typically be higher than for an oil fired plant of the same capacity.
- A best estimate of the proprietors' income or profit for the old plant should be made, following the guidelines that have been suggested in section 4.4 of this handbook. It is assumed this profit will be lost and will be replaced by profit from the new plant. If the user cannot estimate what the profit is, but believes it to be essentially the same for the new and old plants, then the same estimate, e.g. zero, can be entered for this category in both runs of the model.

The wood procurement and transportation input section of the worksheet does not apply and therefore zero should be entered for all cells. The savings section does not apply and zero should be entered. Savings, if any, from the new plant are in the new plant analysis. On the assumption that only unusual community costs will be entered in the community cost section, it is probably safe to assume that community costs displaced at the old facility are also zero. There might be rare exceptions to this: for example, when the town or city is subsidizing a dock used exclusively for bringing oil barges to the displaced facility. If this is the case, then it is a community cost saving to be set against any community costs for the new facility. It is important to be consistent in the treatment of community cost estimates for the old and new plants.

6.4 COMPARING A NEW BIOMASS PLANT WITH A NEW FOSSIL FUELED PLANT

This is a case in which there is an option to build either a biomass fueled facility or a fossil fueled facility and the purpose of the analysis is to compare the economic impacts of the two options. In this case, the biomass fueled facility analysis follows the standard pattern described in the handbook, and then a second run of the model is undertaken to assess the fossil fueled plant. For this case, new construction is assumed, and therefore both the construction and operation phases will need to be assessed.

The construction phase input data entries for the fossil fueled plant follow the same categories used for the biomass fueled plant. If natural gas is to be obtained from a pipeline, construction of the pipeline extension must be included. If coal is to be obtained by rail, then some rail construction may need to be included. The most important distinction is to separate construction costs in to the three

categories of engineering and design, materials and equipment purchases, and on site construction work. This distinction will normally work as well for fossil fueled plants.

The operation phase inputs should follow the guidelines suggested above (section 6.3 and Table 7) for an existing oil plant. The purchase cost of the appropriate fossil fuel or fuels should be entered and zero entered for all the biomass and waste categories. The multipliers used for assessing the indirect effects of the oil, gas, and coal purchases assume typical statewide fuel economic linkages for these fuel purchases. If, for example, coal were being purchased from out-of-state suppliers by direct contract, this assumption may not be valid. The assumptions used to estimate proprietors' profit should be consistent with those used for the biomass plant, but this is the entry that should reflect any overall difference in profitability between the two fuel options. The sections of the worksheet that apply to wood fuel procurement and transportation should not be used, and therefore zero should be entered on those lines. The purchase price entered for fossil fuels should include transportation. Zero should be entered in the savings section. Community costs should be computed for the two options on a consistent basis.

The method described here for comparing biomass with a fossil fueled plant is probably quite satisfactory as long as similar facilities are being compared. However, this analysis should not be used to compare biomass plants with fossil fueled plants in different locations, or those that are very different in scope. For example it should not be used to compare a 10 MW biomass steam/electric cogeneration plant with the pro-rated impacts of a 500 MW coal fired electric plant, even if the impacts are pro-rated. Nor should it be used to compare biomass cogenerated electric power with the purchase of electric power from a utility. Furthermore, comparisons with nuclear generated electricity, hydro-electric power, solar systems and conservation programs are beyond the scope of the procedures described here.

7. CASE STUDIES

Five case studies have been provided in the spreadsheet model to give the user examples of biomass energy plants and their economic impacts. The first four of these case studies are of actual biomass plants which have been constructed recently in the southeastern states. These examples can be run for other states by changing the state identifier in the third line of the input section. In most cases the financial and employment data have been provided by the plant owners or their engineers. A few figures have been estimated based on experience or industry averages, when actual data were not available, and a few minor changes have been made for illustrative purposes. The four companies have been given pseudonyms to protect the confidentiality of some financial data. The economic impacts for each of these cases are calculated in the spreadsheet and shown in the output summary table for each case.

7.1 CASE ONE : ALPHA NEWSPRINT

Alpha Newsprint operates a 135,000 PPH steam boiler that provides process steam for its newsprint mill. The boiler burns wood waste, paper sludge and natural gas to provide 100% of the steam requirements of the mill. Wood waste and sludge are obtained from the Alpha Mill and this accounts for approximately 70% of the fuel requirements. The remaining 30% is wood waste purchased from other suppliers and delivered by truck. The biomass fired boiler uses a vibrating water cooled spreader stoker for the combustion of the wood waste and paper sludge. Natural gas burners are provided in the furnace sidewalls and are used during start-up and shutdown. A package natural gas fired boiler is also available on site. Pollution control for NO_x and CO is achieved through the use of staged combustion and particulates are controlled by mechanical collectors and a venturi scrubber.

Construction took place in 1988/89 over a period of eleven months with a peak construction work force of 80 persons. The construction labor figures have been converted to average person days in the data entry work sheet and costs have been converted to 1990 dollars. Approximately 30% of the workforce during construction resided within 50 miles of the site.

The operation of the biomass plant requires 14 FTE workers. Some positions are shared with the Alpha Mill operations. The plant is operated continuously. No special community costs have been identified. Some savings occur from burning paper sludge that would otherwise have been disposed of in landfills. These savings are incorporated in the proprietors profit. The full entry for this case is given in Table 8 below.

Table 8a: Data Entry Worksheet For Case One; Alpha Newsprint

INPUT DATA CASE ONE			
Project Information			
Facility name	Alpha Newsprint		
Facility type	Wood waste fired boiler		
Facility location (Use two letter state code in caps)	MS		
Energy capacity (Specify PPH, HP, Btu, MW)	135000	PPH	
Ethanol production per year (gallons)	0		
Wood waste fuel use per year (tons)	35000		
Wood chip fuel use (harvested only) per year (tons)	0		
Grain feedstock use per year (bushels)	0		
Construction Phase			
Construction (incl contract labor) costs	\$ Cost		
Engineering design & permitting costs	\$700,000		
Materials and equipment (purchased)	\$5,319,650		
Construction (on site work)	\$3,241,350		
Total construction cost	\$9,261,000	Direct Jobs	
		Person/	
		days	
Employment		12705	
Construction workers (direct hire only)			
Total direct construction payroll (direct hire only)	\$1,524,600		
Operations Phase			
Plant Operation and Maintenance			
Wood waste fuel purchase	Annual \$ cost		
Wood chip fuel purchase (harvested wood)	\$280,000		
Other waste material fuel purchase (MSW, sludge)	\$0		
Grain feedstock purchase	\$0		
Natural gas purchase	\$0		
Fuel oil purchase	\$605,000		
Coal purchase	\$0		
Electric power purchase	\$0		
Waste disposal costs	\$5,000		
Repairs & maintenance	\$0		
Other supplies purchased	\$55,000		
Other operating costs	\$10,000		
Interest payments on debt (not equity)	\$2,000		
Property taxes & other local taxes or fees	\$62,000		
Insurance payments	\$76,300		
Total operating costs (excluding direct labor)	\$14,260		
	\$1,109,560		
		Direct	Average
		Jobs	Annual
		FTEs	Salary
Employment (direct hires & contracts)		1	\$39,000
Managers and engineers (FTEs)		0	\$0
Clerical workers (FTEs)		9	\$29,500
Skilled plant operators (FTEs)		4	\$20,000
Other workers (low skill) (FTEs)			
Plant payroll	\$384,500		
Proprietors income, dividend or profit	\$133,000		

Table 8a: Data Entry Worksheet For Case One; Alpha Newsprint-Continued

Woodfuel/Feedstock Procurement & Transport

(If not included in plant O+M costs)

Harvesting equipment annualized cost

Stumpage or other harvesting fees

Woodfuel/feedstock transportation costs

Fuel and other operating costs

Finance, interest and insurance Costs

Annual \$ Cost

\$0

\$0

\$0

\$0

\$0

**Direct
Jobs
FTEs****Average
Annual
Salary**

Procurement & transportation employment

Foresters and supervisors (FTEs)

Loggers and equipment operators (FTEs)

Truck drivers (FTEs)

Mechanics (FTEs)

Total procurement & transportation payroll

0

\$0

0

\$0

0

\$0

0

\$0

\$0

Total plant direct payroll & profit (including benefits)

\$517,500

Savings

Waste wood disposal cost savings

Net energy cost saving compared to existing fuel

Annual \$ Savings

\$0

\$0

Community Costs

Education costs

Social services costs

Transportation costs

Safety and security costs

Land or property costs

Total community costs

State tax revenue reduction

Federal tax revenue reduction

Annual \$ Cost

\$0

\$0

\$0

\$0

\$0

\$0

\$0

\$0

Note: Blank Space is included to facilitate layout of the spreadsheet images in Tables 8 through 12.

Table 8b: Output Summary For Case One; Alpha Newsprint

OUTPUT SUMMARY		
Economic Impact Output Summary	Alpha Newsprint	
Construction Phase Impacts	1990 Dollars	Jobs
Total Construction expenditure	\$9,261,000	
Direct Income	\$1,168,563	
Indirect Income	\$11,460,580	
Total Income	\$12,629,144	
Direct Jobs (FTEs)		51
Indirect Jobs (FTEs)		251
Total Jobs (FTEs)		302
Local Taxes Paid	\$76,300	
State Taxes Paid	\$748,546	
Federal Taxes Paid	\$2,339,371	
Total Taxes Paid	\$3,164,216	
Community Costs	\$0	
Operations Phase (Annual Impacts)		
Total Operation expenditure	\$1,627,060	
Direct Income	\$589,800	
Indirect Income	\$1,350,773	
Total Income	\$1,940,573	
Direct Jobs (FTEs)		14
Indirect Jobs (FTEs)		30
Total Jobs (FTEs)		44
Local Taxes Paid	\$76,300	
State Taxes Paid	\$115,020	
Federal Taxes Paid	\$359,464	
Total Taxes Paid	\$550,784	
Community Costs	\$0	
State Tax Revenue Reductions	\$0	
Federal Tax Revenue Reductions	\$0	

For a discussion on the interpretation of the output see section 4.10 of this handbook.

7.2 CASE TWO: BETA PULP AND PAPER MILL

Beta Pulp and Paper Co. in 1989/1990 constructed a 455,000 PPH steam boiler fired with wood waste and natural gas. This boiler is one of six boilers providing steam for the mill complex. The boiler is a water cooled vibrating spreader stoker with staged combustion for NOx and CO control and mechanical collectors and venturi scrubbers for particulate control. Wood fuel consists of both wood waste for the mill and purchased wood chips. Natural gas is used for combustion control at start up and shut down and as a supplementary fuel.

Construction took place over 18 months. Approximately 40% of the workers resided within 50 miles of the site.

Operation requires eleven workers (FTEs) but some activities are shared with the mill complex. Proprietors' income is an estimate of the profit spent in the state. There are no special community costs or savings at this facility, except for those reflected in the plants overall profitability.

Table 9a: Data Entry Worksheet For Case Two: Beta Pulp and Paper Co.

INPUT DATA CASE TWO			
Project Information			
Facility name	Beta Pulp and Paper		
Facility type	Woodchip and Waste Fired Boiler		
Facility location (Use two letter state code in caps)	MS		
Energy capacity (Specify PPH, HP, Btu, MW)	450000	PPH	
Ethanol production per year (gallons)	0		
Wood waste fuel use per year (tons)	22000		
Wood chip fuel use (harvested only) per year (tons)	20000		
Grain feedstock use per year (bushels)	0		
Construction Phase			
Construction (incl contract labor) costs	\$ Cost		
Engineering design & permitting costs	\$1,200,000		
Materials and equipment (purchased)	\$15,350,000		
Construction (on site work)	\$8,950,000		
Total construction cost	\$25,500,000		
Employment		Direct Jobs	
Construction workers (direct hire only)		Person/days	2300
Total direct construction payroll (direct hire only)	\$184,000		
Operations Phase			
Plant Operation and Maintenance			
Wood waste fuel purchase	Annual \$ cost		
Wood chip fuel purchase (harvested wood)	\$320,000		
Other waste material fuel purchase (MSW, sludge)	\$0		
Grain feedstock purchase	\$0		
Natural gas purchase	\$0		
Fuel oil purchase	\$205,000		
Coal purchase	\$0		
Electric power purchase	\$7,500		
Waste disposal costs	\$12,000		
Repairs & maintenance	\$85,000		
Other supplies purchased	\$13,500		
Other operating costs	\$7,000		
Interest payments on debt (not equity)	\$0		
Property taxes & other local taxes or fees	\$209,100		
Insurance payments	\$38,500		
Total operating costs (excluding direct labor)	\$897,600		
Employment (direct hires & contracts)		Direct Jobs	Average
Managers and engineers (FTEs)		FTEs	Annual Salary
Clerical workers (FTEs)		1	\$45,000
Skilled plant operators (FTEs)		0	\$20,000
Other workers (low skill) (FTEs)		6	\$26,000
Plant payroll	\$281,000	4	\$20,000
Proprietors income, dividend or profit	\$750,000		

Table 9a: Data Entry Worksheet For Case Two: Beta Pulp and Paper Co. Continued

Woodfuel/Feedstock Procurement & Transport

(If not included in plant O+M costs)

Harvesting equipment annualized cost

Stumpage or other harvesting fees

Woodfuel/feedstock transportation costs

Fuel and other operating costs

Finance, interest and insurance Costs

Annual \$ Cost

\$0

\$0

\$0

\$0

\$0

**Direct Jobs
FTEs****Average
Annual
Salary**

Procurement & transportation employment

Foresters and supervisors (FTEs)

Loggers and equipment operators (FTEs)

Truck drivers (FTEs)

Mechanics (FTEs)

0

\$0

0

\$0

0

\$0

0

\$0

Total procurement & transportation payroll

\$0

Total plant direct payroll & profit (including benefits)

\$1,031,000

Savings**Annual \$ Savings**

Waste wood disposal cost savings

\$0

Net energy cost saving compared to existing fuel

\$0

Community Costs**Annual \$ Cost**

Education costs

\$0

Social services costs

\$0

Transportation costs

\$0

Safety and security costs

\$0

Land or property costs

\$0

Total community costs

\$0

State tax revenue reduction

\$0

Federal tax revenue reduction

\$0

Table 9b: Output Summary For Case Two: Beta Pulp and Paper Co.

OUTPUT SUMMARY		
Economic Impact Output Summary	Beta Pulp and Paper	
Construction Phase Impacts	1990 Dollars	Jobs
Total Construction expenditure	\$25,500,000	
Direct Income	\$144,915	
Indirect Income	\$14,900,815	
Total Income	\$15,045,730	
Direct Jobs (FTEs)		9
Indirect Jobs (FTEs)		518
Total Jobs (FTEs)		527
Local Taxes Paid	\$209,100	
State Taxes Paid	\$902,638	
Federal Taxes Paid	\$2,439,685	
Total Taxes Paid	\$3,551,424	
Community Costs	\$0	
Operations Phase (Annual Impacts)		
Total Operation expenditure	\$1,928,600	
Direct Income	\$1,038,823	
Indirect Income	\$1,412,323	
Total Income	\$2,451,146	
Direct Jobs (FTEs)		16
Indirect Jobs (FTEs)		47
Total Jobs (FTEs)		63
Local Taxes Paid	\$209,100	
State Taxes Paid	\$147,052	
Federal Taxes Paid	\$397,457	
Total Taxes Paid	\$753,608	
Community Costs	\$0	
State Tax Revenue Reductions	\$0	
Federal Tax Revenue Reductions	\$0	

For a discussion on the interpretation of the output see section 4.10 of this handbook.

7.3 CASE THREE: GAMMA SAWMILL

Gamma Sawmill is a smaller facility producing 60,000 PPH of steam at 200 PSIG; it cogenerates an average of 1.8 MW of electric power for use in the mill and produces steam for drying lumber. The boiler is fired with a mix of bark, saw dust and saw trim material. Some of the equipment was purchased used and the air pollution control does not meet today's standards which accounts for the relatively low capital cost of the facility. Construction costs have been adjusted to 1990 dollars, but no allowance has been made for increasing the cost of pollution control systems.

Construction took six months with an average work force of eight persons, primarily the companies own employees.

Operations requires a staff of ten. The fuel is provided entirely from the sawmill and no expenditure is made. Savings are included within the proprietors' profit estimate, which is assumed to be spent locally. No special community costs have been identified.

Table 10a: Data Entry Worksheet For Case Three: Gamma Sawmill Co.

INPUT DATA CASE THREE			
Project Information			
Facility name	Gamma Sawmill		
Facility type	Bark fired boiler		
Facility location (Use two letter state code in caps)	AL		
Energy capacity (Specify PPH, HP, Btu, MW)	60000	PPH	
Ethanol production per year (gallons)	0		
Wood waste fuel use per year (tons)	7000		
Wood chip fuel use (harvested only) per year (tons)	0		
Grain feedstock use per year (bushels)	0		
Construction Phase			
Construction (incl contract labor) costs	\$ Cost		
Engineering design & permitting costs	\$500,000		
Materials and equipment (purchased)	\$5,500,000		
Construction (on site work)	\$500,000		
Total construction cost	\$6,500,000		
Employment		Direct Jobs	
Construction workers (direct hire only)		Person/days	
Total direct construction payroll (direct hire only)	\$462,000	5250	
Operations Phase			
Plant Operation and Maintenance	Annual\$ cost		
Wood waste fuel purchase	\$0		
Wood chip fuel purchase (harvested wood)	\$0		
Other waste material fuel purchase (MSW, sludge)	\$0		
Grain feedstock purchase	\$0		
Natural gas purchase	\$0		
Fuel oil purchase	\$25,000		
Coal purchase	\$0		
Electric power purchase	\$0		
Waste disposal costs	\$4,500		
Repairs & maintenance	\$65,000		
Other supplies purchased	\$6,000		
Other operating costs	\$0		
Interest payments on debt (not equity)	\$0		
Property taxes & other local taxes or fees	\$52,000		
Insurance payments	\$10,100		
Total operating costs (excluding direct labor)	\$162,600		
Employment (direct hires & contracts)		Direct Jobs	Average
Managers and engineers (FTEs)		FTEs	Annual Salary
Clerical workers (FTEs)		1	\$32,000
Skilled plant operators (FTEs)		0	\$0
Other workers (low skill) (FTEs)		6	\$24,000
Plant payroll	\$236,000	3	\$20,000
Proprietors income, dividend or profit	\$205,000		

Table 10a: Data Entry Worksheet For Case Three: Gamma Sawmill Co.-Continued

Woodfuel/Feedstock Procurement & Transport

(If not included in plant O+M costs)

	Annual \$ Cost	
Harvesting equipment annualized cost	\$0	
Stumpage or other harvesting fees	\$0	
Woodfuel/feedstock transportation costs	\$0	
Fuel and other operating costs	\$0	
Finance, interest and insurance Costs	\$0	
Procurement & transportation employment		
Foresters and supervisors (FTEs)	0	\$0
Loggers and equipment operators (FTEs)	0	\$0
Truck drivers (FTEs)	0	\$0
Mechanics (FTEs)	0	\$0
Total procurement & transportation payroll	\$0	

Total plant direct payroll & profit (including benefits)	\$441,000
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Savings

	Annual \$ Savings
Waste wood disposal cost savings	\$0
Net energy cost saving compared to existing fuel	\$0

Community Costs

	Annual \$ Cost
Education costs	\$0
Social services costs	\$0
Transportation costs	\$0
Safety and security costs	\$0
Land or property costs	\$0
Total community costs	\$0
State tax revenue reduction	\$0
Federal tax revenue reduction	\$0

Table 10b: Output Summary For Case Three: Gamma Sawmill Co.

OUTPUT SUMMARY		
Economic Impact Output Summary	Gamma Sawmill	
Construction Phase Impacts	1990 Dollars	Jobs
Total Construction expenditure	\$6,500,000	
Direct Income	\$360,189	
Indirect Income	\$5,073,536	
Total Income	\$5,433,727	
Direct Jobs (FTEs)		21
Indirect Jobs (FTEs)		152
Total Jobs (FTEs)		173
Local Taxes Paid	\$52,000	
State Taxes Paid	\$290,435	
Federal Taxes Paid	\$958,209	
Total Taxes Paid	\$1,300,644	
Community Costs	\$0	
Operations Phase (Annual Impacts)		
Total Operation expenditure	\$603,600	
Direct Income	\$343,817	
Indirect Income	\$494,560	
Total Income	\$838,377	
Direct Jobs (FTEs)		10
Indirect Jobs (FTEs)		17
Total Jobs (FTEs)		27
Local Taxes Paid	\$52,000	
State Taxes Paid	\$44,812	
Federal Taxes Paid	\$147,843	
Total Taxes Paid	\$244,655	
Community Costs	\$0	
State Tax Revenue Reductions	\$0	
Federal Tax Revenue Reductions	\$0	

For a discussion on the interpretation of the output see section 4.10 of this handbook.

7.4 CASE FOUR: DELTA MOLDING CO.

Delta Molding Co. operates a small close coupled gasifier which has been used to retrofit a boiler previously fired by natural gas. The boiler provides heat for space heating in the factory and for the wood drying kilns. The gasifier is an updraft design producing 20 million BTU per hour of hot low BTU gas. The fuel is provided from the factory mostly in the form of saw dust which is collected by a vacuum system from the wood working machines. There is no cost for the fuel but there are no savings of disposal cost, as the wood was previously disposed of at no cost to the company. The owners are saving by avoiding natural gas purchases and these savings are part of the proprietors' profit estimate.

Construction took three months and was undertaken primarily by four of the company's employees. Plant operation does not require any additional plant employees. Maintenance costs are high due to expensive refractory repairs. No special community costs are identified.

Table 11a: Data Entry Worksheet For Case Four: Delta Molding Co.

INPUT DATA CASE FOUR			
Project Information			
Facility name	Delta Molding Co.		
Facility type	Wood waste gasifier		
Facility location (Use two letter state code in caps)	NC		
Energy capacity (Specify PPH, HP, Btu, MW)	20000000	BTU	
Ethanol production per year (gallons)	0		
Wood waste fuel use per year (tons)	17500		
Wood chip fuel use (harvested only) per year (tons)	0		
Grain feedstock use per year (bushels)	0		
Construction Phase			
Construction (incl contract labor) costs	\$ Cost		
Engineering design & permitting costs	\$50,000		
Materials and equipment (purchased)	\$400,000		
Construction (on site work)	\$100,000		
Total construction cost	\$550,000		
Employment	Direct Jobs		
Construction workers (direct hire only)	Person/days		
Total direct construction payroll (direct hire only)	\$32,000	315	
Operations Phase			
Plant Operation and Maintenance	Annual \$ cost		
Wood waste fuel purchase	\$0		
Wood chip fuel purchase (harvested wood)	\$0		
Other waste material fuel purchase (MSW, sludge)	\$0		
Grain feedstock purchase	\$0		
Natural gas purchase	\$0		
Fuel oil purchase	\$0		
Coal purchase	\$0		
Electric power purchase	\$1,000		
Waste disposal costs	\$0		
Repairs & maintenance	\$155,000		
Other supplies purchased	\$0		
Other operating costs	\$0		
Interest payments on debt (not equity)	\$0		
Property taxes & other local taxes or fees	\$7,590		
Insurance payments	\$1,200		
Total operating costs (excluding direct labor)	\$164,790		
Employment (direct hires & contracts)	Direct Jobs	Average Annual Salary	
Managers and engineers (FTEs)	0	\$0	
Clerical workers (FTEs)	0	\$0	
Skilled plant operators (FTEs)	0	\$0	
Other workers (low skill) (FTEs)	0	\$0	
Plant payroll	\$0		
Proprietors income, dividend or profit	\$44,000		

Table 11a: Data Entry Worksheet For Case Four: Delta Molding Co.-Continued

Woodfuel/Feedstock Procurement & Transport

(if not included in plant O+M costs)

	Annual \$ Cost		
Harvesting equipment annualized cost	\$0		
Stumpage or other harvesting fees	\$0		
Woodfuel/feedstock transportation costs	\$0		
Fuel and other operating costs	\$0		
Finance, interest and insurance Costs	\$0		
		Direct Jobs	Average
		FTEs	Annual
Procurement & transportation employment			Salary
Foresters and supervisors (FTEs)		0	\$0
Loggers and equipment operators (FTEs)		0	\$0
Truck drivers(FTEs)		0	\$0
Mechanics(FTEs)		0	\$0
Total procurement & transporation payroll	\$0		

Total plant direct payroll & profit (including benefits) **\$44,000****Savings**

	Annual \$ Savings
Waste wood disposal cost savings	\$0
Net energy cost saving compared to existing fuel	\$0

Community Costs

	Annual \$ Cost
Education costs	\$0
Social services costs	\$0
Transportation costs	\$0
Safety and security costs	\$0
Land or property costs	\$0
Total community costs	\$0
State tax revenue reduction	\$0
Federal tax revenue reduction	\$0

Table 11b: Output Summary For Case Four: Delta Molding Co.

OUTPUT SUMMARY		
Economic Impact Output Summary	Delta Molding Co.	
Construction Phase Impacts	1990 Dollars	Jobs
Total Construction expenditure	\$550,000	
Direct Income	\$25,078	
Indirect Income	\$397,887	
Total Income	\$422,965	
Direct Jobs (FTEs)		1
Indirect Jobs (FTEs)		11
Total Jobs (FTEs)		12
Local Taxes Paid	\$7,590	
State Taxes Paid	\$24,348	
Federal Taxes Paid	\$71,250	
Total Taxes Paid	\$103,188	
Community Costs	\$0	
Operations Phase (Annual Impacts)		
Total Operation expenditure	\$208,790	
Direct Income	\$34,482	
Indirect Income	\$197,935	
Total Income	\$232,416	
Direct Jobs (FTEs)		0
Indirect Jobs (FTEs)		7
Total Jobs (FTEs)		7
Local Taxes Paid	\$7,590	
State Taxes Paid	\$13,379	
Federal Taxes Paid	\$39,152	
Total Taxes Paid	\$60,121	
Community Costs	\$0	
State Tax Revenue Reductions	\$0	
Federal Tax Revenue Reductions	\$0	

For a discussion on the interpretation of the output see section 4.10 of this handbook.

7.5 CASE FIVE: EPSILON ETHANOL CO.

Epsilon Ethanol Co. is a generic example of a corn to ethanol plant based on several mid-western facilities. Epsilon Ethanol is a dry milling plant producing ethanol and distillers dry grains (DDGS) as a by-product. The plant was constructed in the late 1980s and the construction costs are adjusted to 1990 dollars. Other costs are also in 1990 dollars. In this example there is a 20 cents per gallon state producer subsidy and no state excise tax allowance. The producer tax subsidy is considered to be a reduction in state general revenues. Federal tax subsidies are based on 5.4 cents per gallon of gasohol. This is a federal revenue loss but the loss may not occur entirely within the state. The producer does not receive all of this subsidy. It is assumed that there are no in state effects of the federal revenue loss. It is also assumed that the corn production for the plant is additional and results in increased production by the corn producers. No allowance is made for any corn market or livestock feed grain market price or price support effects. Transportation costs are included in the corn price.

Table 12a: Data Entry Worksheet For Case Five: Epsilon Ethanol Co.

INPUT DATA CASE FIVE			
Project Information			
Facility name	Epsilon Ethanol		
Facility type	Corn to ethanol plant		
Facility location (Use two letter state code in caps)	KS		
Energy capacity (Specify PPH, HP, Btu, MW)	0	0	
Ethanol production per year (gallons)	37,000,000		
Wood waste fuel use per year (tons)	0		
Wood chip fuel use (harvested only) per year (tons)	0		
Grain feedstock use per year (bushels)	13,500,000		
Construction Phase			
Construction (incl contract labor) costs	\$ Cost		
Engineering design & permitting costs	\$11,500,000		
Materials and equipment (purchased)	\$42,000,000		
Construction (on site work)	\$41,500,000		
Total construction cost	\$95,000,000		
Employment	Direct Jobs		
Construction workers (direct hire only)	Person/days		
Total direct construction payroll (direct hire only)	\$0	0	
Operations Phase			
Plant Operation and Maintenance			
Wood waste fuel purchase	Annual \$ cost		
Wood chip fuel purchase (harvested wood)	\$0		
Other waste material fuel purchase (MSW, sludge)	\$0		
Grain feedstock purchase	\$33,750,000		
Natural gas purchase	\$9,100,000		
Fuel oil purchase	\$0		
Coal purchase	\$0		
Electric power purchase	\$1,000,000		
Waste disposal costs	\$55,000		
Repairs & maintenance	\$7,600,000		
Other supplies purchased	\$2,700,000		
Other operating costs	\$1,500,000		
Interest payments on debt (not equity)	\$8,000,000		
Property taxes & other local taxes or fees	\$1,900,000		
Insurance payments	\$475,000		
Total operating costs (excluding direct labor)	\$66,080,000		
Employment (direct hires & contracts)	Direct Jobs	Average	
Managers and engineers (FTEs)	FTEs	Annual Salary \$	
Clerical workers (FTEs)	20	\$45,000	
Skilled plant operators (FTEs)	10	\$25,000	
Other workers (low skill) (FTEs)	35	\$33,000	
Plant payroll	20	\$25,000	
	\$2,805,000		
Proprietors income, dividend or profit	\$2,200,000		

Table 12a: Data Entry Worksheet For Case Five: Epsilon Ethanol Co.-Continued

Woodfuel/Feedstock Procurement & Transport

(If not included in plant O+M costs)

	Annual \$ Cost		Average Annual Salary \$
Harvesting equipment annualized cost	\$0		
Stumpage or other harvesting fees	\$0		
Woodfuel/feedstock transportation costs	\$0		
Fuel and other operating costs	\$0		
Finance, interest and insurance Costs	\$0		
Procurement & transportation employment		FTEs	
Foresters and supervisors (FTEs)		0	\$0
Loggers and equipment operators (FTEs)		0	\$0
Truck drivers(FTEs)		0	\$0
Mechanics(FTEs)		0	\$0
Total procurement & transportation payroll	\$0		

Total plant direct payroll & profit (including benefits) **\$5,005,000****Savings**

	Annual \$ Savings
Waste wood disposal cost savings	\$0
Net energy cost saving compared to existing fuel	\$0

Community Costs

	Annual \$ Cost
Education costs	\$0
Social services costs	\$0
Transportation costs	\$0
Safety and security costs	\$0
Land or property costs	\$0
Total community costs	\$0
State tax revenue reduction	\$7,400,000
Federal tax revenue reduction	\$1,998,000

Table 12b: Output Summary For Case Five: Epsilon Ethanol Co.

OUTPUT SUMMARY		
Economic Impact Output Summary	Epsilon Ethanol	
Construction Phase Impacts	1990 Dollars	Jobs
Total Construction expenditure	\$95,000,000	
Direct Income	\$0	
Indirect Income	\$83,099,350	
Total Income	\$83,099,350	
Direct Jobs (FTEs)		0
Indirect Jobs (FTEs)		2610
Total Jobs (FTEs)		2610
Local Taxes Paid	\$1,900,000	
State Taxes Paid	\$4,306,728	
Federal Taxes Paid	\$15,887,613	
Total Taxes Paid	\$22,094,341	
Community Costs	\$0	
Operations Phase (Annual Impacts)		
Total Operation expenditure	\$71,085,000	
Direct Income	\$3,838,305	
Indirect Income	\$47,722,336	
Total Income	\$51,560,641	
Direct Jobs (FTEs)		85
Indirect Jobs (FTEs)		1483
Total Jobs (FTEs)		1568
Local Taxes Paid	\$1,900,000	
State Taxes Paid	\$2,672,195	
Federal Taxes Paid	\$9,857,785	
Total Taxes Paid	\$14,429,980	
Community Costs	\$0	
State Tax Revenue Reductions	\$7,400,000	
Federal Tax Revenue Reductions	\$1,998,000	

For a discussion on the interpretation of the output see section 4.10 of this handbook.

APPENDIX

INSTRUCTIONS FOR USING THE SITE SPECIFIC ECONOMIC IMPACT MODEL (EIACALC.WK3)

It is strongly recommended that the user makes a copy of the program for use and stores the original in a safe place. The model is contained in the file EIACALC.WK3. This file should be opened using Lotus 123. The model requires the application Lotus 123 for use on an IBM compatible (MSDOS or Windows) computer. The use of the WYSIWYG enhancement for Lotus 123 is highly recommended to obtain the full layout features of the spreadsheet. The file EIACALC.FM3 contains the formatting information and is used by EIACALC.WK3 for WYSIWYG display.

RUNNING THE EIA CALCULATOR (EIACALC)

- 1) Start Lotus 123 and WYSIWYG enhancement
- 2) Retrieve file EIACALC.WK3 from the disk or hard disk.
- 3) Enter data for your project in the shaded cells of the INPUT DATA section . You should copy over the example data entered in this section. Be sure to replace all example data. Use zero where there are no values used.
- 4) To change states enter the two letter state code, in capitals, in the space for facility location in the project information section. Any entry in that section other than a two letter state code in capitals will result in an error.
- 5) Data should be entered only in shaded cells. All other cells are locked initially.
- 6) All dollar values should be entered in 1990 dollars
- 7) The results are displayed in the OUTPUT SUMMARY section below the input section .
- 8) If you wish to run one of the case studies copy the data from the case study section of the spreadsheet into the DATA INPUT section. If you wish to copy the cases as a block it may be necessary to turn off the document protection feature.
- 9) Save results of model runs as files with names other than EIACALC
- 10) If you wish to make comparisons of different situations, as discussed in section 6 of this handbook, copy the output summary to another worksheet for calculation.

OTHER FEATURES

The default values for the component wood fuel costs (expressed as fractions) are given in rows 2-16 and columns R-Y. These values are only used when total wood fuel costs are used in cell B42. These values are based on national averages and can be changed by the user if local data is available. However, if local data is available it would be better to enter it in the woodfuel procurement section and breakdown the expenditure in that section.

The IMPLAN multipliers are given in the right part of the spreadsheet and generally should not be changed by the user. State tax rates are given at the bottom of each state column and are based on 1990 data. They can be changed by the user with the caution that the interpretation of the results, which are based on 1990 multipliers, will be problematic.

The spreadsheet is in Lotus 123 format. This format can be read by some other spreadsheet programs, including Quattro Pro and Microsoft Excel.