FEASIBILITY STUDY

ALH Corporation
485 Clyde Avenue
Mountain View, CA 94042

FEASIBILITY STUDY

A project to design and build an alcohol plant usually begins with a feasibility study (sometimes called a project development study). The feasibility study defines the probable costs and profitability of the project, identifies important problems, outlines answers or approaches to these problems, and shows what additional information is required to make a final evaluation. In addition, many feasibility studies assemble all this information into a financial prospectus or proposal for funding, so that after the study the client has the financing package ready, has applied for or actually received funding, and is ready for engineering and construction.

Planning a Feasibility Study

A feasibility study usually combines conceptual engineering activities with market and financial analysis. The study emphasizes the market analysis for feedstock and products, since the costs of feedstock and the income from products and by-products dominate the profitability of most alcohol projects. However, it is also necessary to identify at least roughly what technologies the plant will use and what the plant will look like, as well as what it will cost, how it will operate, and where it will be located. Such information defines capital and operating costs as well as the mix of products, including both alcohol and the many by-products. Often the feasibility study is iterative, examining various sites, feedstocks, market situations, plant sizes, and plant technologies until the most profitable combination is discovered. For a large plant, the feasibility study often iterates on the level of detail, beginning with a brief overview study, and then adding detail for those options which appear attractive.

ALH engineers have performed feasibility studies for energy facilities ranging from small boiler conversions to three major coal gasification facilities to more than ten large solar installations. For fuel alcohol facilities we have done feasibility studies for:

- a 1 million gallon per year corn-to-ethanol facility associated with a poultry feed mill
- a 5 million gallon per year corn-to-ethanol plant adjacent to a grain elevator
- a 132 million gallon per year corn-to-ethanol facility

We combine a complete background of feedstock and product market information with engineering and process technology to cover every aspect needed in a feasibility study. We will be glad to explain to you how our earlier studies were planned and carried out, and how the plan was shaped by the objectives and circumstances of each case. Then we will work with you to plan your study, and to tailor the plan to your specific requirements.

Making a Conceptual Design, a Costing, and a Schedule

The engineering portion of the feasibility study begins by selecting a tentative size and process, and then develops a process flow diagram defining flows of materials, conditions and equipment. Engineers then prepare plot plans and general arrangements. Costings are done to within 10% or 15% accuracy, usually based on guidelines and prior experience, accounting for:

- equipment requirements (considering any already on hand)
- materials
- operating costs
- working capital
- site factors
- safety and environmental considerations
- water supply
- energy supply

For a sizeable alcohol facility, these last three aspects usually dominate the engineering considerations. Providing water supply and water pollution control is extremely important, and sometimes is difficult and costly. Providing energy to the plant in the best way often has a decisive effect on plant profitability and, when waste fuels are used, sometimes poses difficult engineering problems. Choice of the right fuel can help in obtaining government support, if it is desired. Similarly, electing to build a cogeneration facility which also produces electric power can, in some locations, greatly increase the amount of support available.

Other important design considerations which must be evaluated in at least a preliminary way during the feasibility study are:

- plant size, and whether or not the plant should be built as a series of modules or "streets".
- plant technology, especially yeast concentrations, temperatures, and reaction times, and whether the process is batch, as is usual, or continuous, which is uncommon in fermentation due to the risks of contamination
- materials selection
- energy recovery and "cascading", to minimize energy requirements
- for starch feedstocks, the amount of pre-processing and protein separation before cooking, hydrolysis, and fermentation; and the amounts and techniques of solids separation at various steps in the process
- the amount of instrumentation and automatic control

- yeast recovery
- separation technology: number of distillation stages and amount and type of final water extraction
- by-product drying

To evaluate these, the study team seeks the right balance between capital cost, yield or output rate, energy efficiency, reliability, and risk. Sometimes it it necessary to do the feasibility study in some detail for several approaches, particularly for unusual feedstocks or situations where capital costs are relatively large. For plants using corn and sugar cane and sugar beet, well-tried technology usually proves best.

After the conceptual design is complete, the engineering team makes a preliminary list of key equipment, a rough costing, and a preliminary schedule for design and construction. The costing and the construction schedule will be needed in subsequent analyses of cash flow and profitability.

ALH brings to a feasibility study a total capability in process engineering. We can help in any aspect of technology evaluation and costing. ALH has no proprietary or patent position in hydrolysis, fermentation, or separation technologies. Our clients rely on us for a completely unbiased and objective evaluation of all technologies which can contribute to a project.

Selecting and Characterizing the Feedstock

At the start of some feasibility studies, the feedstock has not been selected. The study must determine the best feedstock. Site data and agricultural information must be pulled together to evaluate possible crops. Climate and soil data, environmental aspects, crop yield information, fermentation and harvesting needs, and handling, storage and processing practices must all be characterized and evaluated. ALH has done several such studies in close teamwork with specialists experienced in local agriculture and agricultural economics, including representatives of the U. S. Department of Agriculture, state and local agriculture departments, the technical committees of growers' and processors' organizations, and agricultural schools and universities.

The outcome of these studies is a detailed specification of the optimum feedstock, its properties, and how it should be grown, harvested, and processed. If you need help with this part of a feasibility analysis, we would be glad to assist.

Assessing Environmental Impacts and Problems

Environmental assessments are in a sense a part of the conceptual design task. However, under current regulations the environmental portion of the feasibility study can be so important that it deserves separate consideration and discussion. Environmental impacts may require costly engineering solutions, and environmental problems may imply lengthy delays in the permitting process.

Sometimes an alcohol project will even have to solve the environmental problems of other local projects or facilities in order to offset any new discharges from the alcohol plant.

The conceptual design process must take care to identify discharges (especially water discharges) and to outline engineering solutions. Sometimes entire pollution control systems or projects must be included with the alcohol plant study, especially for feedstocks rich in sugar, for which residue disposal can be a serious problem.

The various agencies involved in permitting must be identified and the permitting process defined. Information requirements must be identified and plans formulated for developing the information. A schedule must be made for the future permitting process; for a large plant this schedule can sometimes control all other activities. Lastly, the permitting activities must be costed; for large plants these costs can be significant.

The ALH staff has a complete background in environmental impact assessment. We regularly prepare such studies and assessments for a wide range of clients from utilities to small chemical plants. To support this activity we maintain a staff dedicated to sampling and measuring emissions and discharges and interpreting the results. We also have our own chemical analysis laboratory specializing in environmental problems.

Because of our combined experience in alcohol plants and environmental assessment, we were selected by the U.S. Environmental Protection Agency to survey the environmental problems of small alcohol plants throughout the U.S. Under this program we will be helping E.P.A. and plant operators to identify and solve discharge problems.

Many feasibility studies need this kind of background. If yours does, we would be glad to help.

Making a Market Study

The market study portion of a feasibility study determines how feedstocks are best acquired and how products and by-products are best sold. For small plants, this part of the feasibility study often is short and simple: the feedstock may be captive, the by-product uses may be on-site as well, and the alcohol sales might be a simple contract with a local gasoline distributor. For large plants the market study can grow to become the largest single portion of the feasibility study.

A large plant using corn as a feedstock, for example, may need a number of sources of supply, some from hundreds of miles away. Cropping patterns need to be considered, as well as transportation practices and costs by rail, truck, and barge or ship. The study must evaluate risks of supply interruption by crop shortages and transport disruptions. Purchasing mechanisms need to be evaluated and some conclusions formulated about the possible methods of guaranteeing future prices, including forward contracting and futures contract purchases. Finally, prices need to be projected over several years.

Similarly, for many plants the feasibility study must make a careful assessment of markets for by-products such as corn gluten meal, corn gluten feed, corn germ meal, distillers dry grains, citrus pulp, and carbon dioxide. The cash flows from sales of these by-products can be critical to overall plant profitability, and for larger plants the sales prices of large quantities of by-products must be projected. Sometimes to find a buyer and to define a price the study must conduct allied studies such as experiments to determine the nutritional properties and value of protein-rich by-products.

For the alcohol product, the feasibility study usually tries to identify the specific purchasers, the likely prices, the probable form of the delivery contract, and possible penalties for non-delivery. Prices are usually first projected by taking current prices and allowing for increases at the rate of projected gasoline price increases (usually taken as the assumed inflation percentage rate plus 2% or 3%, but other more sophisticated projections are available from government and industry sources). Allowances are then made for expected changes in government price support and subsidy programs (including entitlements), expected changes in the willingness of the public to pay a gasohol premium, expected prices for synthetic (i.e., from ethylene) alcohol, import prices (chiefly Brazilian--also affected by subsidy policies, and expected changes in local production and import). If the market radius is large, transport prices must be included in the projections.

ALH can help you with every aspect of a market study. We have an especially deep background in corn and wheat purchasing and handling, and we are also specialists in marketing feedstuffs derived from grains, soybeans, and citrus. We have several decades of experience in forward contracting and in futures markets operations. We can bring to a market study this complete range of experience.

Computing Cash Flows

This portion of the feasibility study integrates the results of the conceptual engineering study - with its associated schedule of capital requirements for engineering and construction - with the cash flows suggested by the market study, producing a year-by-year (or quarter-by-quarter or month-by-month) cash flow for the proposed project. This would be a simple mechanical task except for the complication of taxes and the financing structure.

Computing cash flows requires that the financial structure of the venture be specified (See our Information Sheet on "Financing an Alcohol Venture".) This in turn specifies the debt burden and the rate of interest payments and debt retirement, and any cash flows due to entitlements provisions. With this information cash flows and profit before depreciation and taxes can be calculated. A depreciation schedule and an assumed tax rate then produce an after tax profit result. To this are applied the various investment tax credits and business energy investment tax credits, and the alcohol production tax credit. (Use of some of these credits is restricted by the method of financing.) If not all the tax credits can be taken, even after carryforward and carryback provisions, the venture will usually have to be restructured, as the credits can have a decisive effect on the attractiveness of the project.

The calculations therefore may take several iterations before the final ourcome of project cash flow over time can be developed. This cash flow can then be used for the key step in the feasibility study: the assessment of profitability and return on investment.

The financial staff of ALH is prepared to help you with tax advice, including all aspects of the complex and continually changing tax program stimulating synthetic fuels production. We would be happy to work closely with you and your tax advisors to help you make full use of the tax provisions.

Assessing Profitability

Assessing profitability of the proposed project is the central purpose of the feasibility study. After market and technical portions of the study have identified costs and cash flows, the profitability assessment

- decides on the methods of computing profitability and the methods of assessing profitability or comparing alternatives
- computes profitability and compares alternatives
- evaluates the meaning of the results in terms of the market and technical inputs to the analysis

Of these, the second involves mere calculation. The first and third require careful thinking and deciding.

In the first aspect, we can work with you to select the method best for your circumstance, if you have not already selected the method. If you haven't, we can help you understand the advantages and disadvantages of all the many methods, from simple payback methods to the most elaborate discount-cash-flow/internal-rate-of-return methods. All alcohol projects of any size would probably be evaluated with one of the more elaborate methods which include the time-value-of-money in a continuous-compounding fashion: either a net present value method or an internal-rate-of-return method.

Once the results have been computed by whatever method is selected, the third aspect of evaluation must provide an interpretation, especially in terms of risks. Any given case, or scenario, involves hundreds of individual cost estimates or assumptions and technical performance estimates and assumptions. Profitability results mean nothing if detached from some idea of the risks in these assumptions. For example, if the alcohol plant availability has been taken at 330 days per year but there is a 50 percent chance that centrifuge performance will be insufficient to maintain column performance without 70 days of cleaning instead of 35, clearly the more pessimistic case should be given equal attention. Similarly, it is usually necessary to examine a range of market price scenarios. And lastly, because alcohol project profitability depends critically on government subsidies and support, it is prudent to examine several projected courses of government actions for subsidy levels and tax policies.

We can help you account for the risks in several ways. Often all the uncertainties in a project are lumped into a general feel for overall level of risk, and the required rate of return specified accordingly: high for high risk projects (uncertain feedstock prices, no established technology for this feedstock, new and relatively unproven processes, potential permitting delays). For other situations it seems worthwhile to do a full statistical analysis of all the scenarios and compute expected returns and variations. Sometimes it is sufficient to examine a fey key sensitivities (high-impact assumptions) and then restructure the project accordingly. This is the key part of a complex feasibility study. We must work hand-in-hand with you at this point to make certain that all factors are properly included and evaluated, and that you fully understand the design, the assumptions, the profits, and the risks.

Preparing for Financing

An important part of most feasibility studies is some amount of preparation for financing. Hence, the study may include sections which are presentations to obtain financing. Such sections typically summarize the technical and economic results of the study, show site maps, present supporting legal documents (permits, leases), and describe the proposed financial structure and approach to obtaining capital. Our information Sheet on "Financing an Aclohol Venture" describes some of these issues in detail.)

We would be glad to help you construct such presentation materials. We have complete art and publications departments, with word processors, composers, a photo lab, and a printing shop.

Preparing for Engineering

Most feasibility studies include a task which uses the information developed during the study to make at least a brief plan for subsequent engineering:

- what are the major problems to be solved?
- how will the plant be designed and built?
- what major equipment needs to be designed and specified?
- who should have responsibility for:
  - engineering
  - environmental documentation
  - permitting
  - procurement
  - construction
- who will manage the project? What will be the relationships between the contributing parties?

- what will the client's role be?
- what is the projected schedule and cost for engineering and construction? What are the milestones and review points?

Planning for engineering during the feasibility study can improve the chances of getting financing and can make possible a quick start once financing is obtained. The ALH engineering staff can help you prepare plans for engineering. As an engineering company, we know what needs to be done.

Keeping First Things First

Feasibility studies can range from a two-page quick look to 2,000 pages of exhaustive analysis, but even the largest feasibility study should provide the client with simple, clear, brief, and unequivocable answers to some key questions:

- How profitable is this project?
- What is the best way to obtain feedstock? to sell products?
- What will the project cost and how long will it take to build it?
- What are the key assumptions, risks, and sensitivities in these conclusions?
- What is the best financial structure for the project?
- What additional information is needed?
- What needs to be done next to get the project designed and built?

If the feasibility study is a large one, for a major plant, it is usually best to begin with a brief study which comes to preliminary answers to these questions quickly. If the conclusions seem to warrant further work, the study can be expanded and deepened. Sometimes it is best to work through several expansions, but the discipline of starting small helps keep even a big study focussed on the important topics.

We want to work with you to do the job you need--specific to your project and your budget. If you can do most of the study yourself, we will help you with those pieces you can't do. If you prefer, we will do the entire study. But in either case, we want to do your study efficiently. Our experience shows that starting with a quick look, and then building up the level of detail in later phases, usually saves you money and effort. We can help you at each step and at each step we will tie the results to the key questions you want answered.