



**EVALUATING INVESTMENT OPPORTUNITIES
FOR REGIONAL BIOMASS ENERGY PROJECTS
FINAL REPORT**

Prepared for

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Table of Contents

1.0 Introduction/Summary..... 1-1

2.0 The Survey of Biomass Developers..... 2-1

3.0 State Programs Supporting the Financing Needs of
Biomass Development Projects 3-1

4.0 The Financing of Biomass Projects 4-1

List of Appendices:

- Appendix 1: Evaluating Investment Opportunities for Biomass Energy Projects –
Phase I: Current Status of Financing Biomass Technologies
- Appendix 2: State Programs Supporting the Financing Needs of Biomass
Development Projects

1.0 INTRODUCTION/SUMMARY

The CONEG Policy Research Center, Inc. (the Center), an active participant in the Northeast Regional Biomass Program (NRBP), has contracted with Alternative Resources, Inc. (ARI), Concord, Massachusetts, to address the issues associated with financing large-scale biomass-to-energy projects in the northeastern United States.

In particular, ARI was to address why apparently feasible and technically viable projects were not moving forward to full implementation, and whether the impediment was the lack of capital financing. Prior to the study proceeding, it was hypothesized:

- that technically sound projects were proceeding through initial feasibility assessments and through pilot plant development, but were not being developed into full scale commercially viable projects;
- that projects are not gaining access to available and affordable capital; and the lack of such capital was precluding the development of commercially viable biomass projects;
- that there is a market bias against these projects due to a lack of understanding of the technologies involved and the potential benefits of implementing such projects;
- that state funding programs are not providing or are unable to provide effective support for these types of projects, and
- that, with appropriate information and education, conventional sources of financing would become available to fund these projects.

The objective of the study was to assess the hypothesis and, assuming it was confirmed, to identify and/or develop means to support these projects, including the provision of direct financial support from appropriate state agencies.

In addition, the objectives of the study also included the following:

- to present an overview of the potential projects and the technologies involved to the investment community;
- to present and promote the benefits of biomass projects to the conventional lending community;
- to foster interest among the conventional lenders to fund large scale biomass projects;
- to identify state programs that have been or are able to effectively support the financing needs of proposed projects; and
- to suggest ways in which state programs could provide additional support for such projects.

Summary of the Services Performed

The services provided by ARI for the study included the following activities:

- We performed a survey of developers of biomass projects, to learn about their proposed projects, their organizations, their financing needs and strategies, and their experience to date in acquiring funding for projects. Twenty-two firms were contacted and interviewed; the results of such are presented in Appendix 1, entitled "Evaluating Investment Opportunities for Biomass Energy Projects - Phase I: Current Status of Financing Biomass Technologies".
- We performed a survey of state agencies responsible for programs that presumably are available to support biomass projects, as well as a broad range of other types of projects. Twelve agencies were contacted in five states, including New York, Massachusetts, Connecticut, Maine, and California. The programs were reviewed to determine the extent to which they offered meaningful opportunities in support of proposed biomass projects. Tables presenting the programs are presented in Appendix 2, entitled "Survey of State Financial Support Programs for Biomass Projects".
- We performed a survey of conventional lenders to assess their interest, or lack thereof, in lending to or investing in proposed biomass projects. Twenty organizations were contacted; the types of organizations include commercial banks, investment bankers, bond funds, and financing companies with specific project finance and/or cash flow lending groups.

As the study progressed, effort was focused on the financing needs of larger projects and on the financing interests and criteria of the conventional lender. There were several reasons for this:

- Undoubtedly, the interest of the Center and NRBP is to foster the development of all scales of economically and technically viable biomass projects. However, the immediate objective was to focus on the larger project, with capital costs ranging from \$10 to \$100 million, that could make a meaningful and obvious contribution to the development of the biomass to energy market, and that would also produce tangible economic development benefits, particularly in the form of capital investment and job creation. In addition, the immediate objective is to also do whatever is possible to foster the development of these larger projects in the eleven northeastern states.
- The conventional lender is seen as the most important source of large amounts of funds, at economically attractive rates. In order for the biomass to energy market to be successfully developed in the northeast, a substantial amount of the capital financing must come from the conventional sources in the capital markets, particularly those sources actively participating in the project finance needs of stand-alone energy projects.

- Venture capital as a source of funds was de-emphasized. Venture capital is a relatively expensive source of funds, both in terms of effective borrowing rate and in the demands imposed upon the project developer by the provider of the capital. In addition, venture capital is only expected to be available in relatively small amounts and, thus, is not expected to meet the financing needs of major projects, e.g., projects with capital costs of \$50 million or more (although a portion of the funds for that size project may be raised with venture capital). In order for large-scale projects to be developed in the northeast, the ultimate prime source of funds will come from the conventional lender, as opposed to the venture capitalist.
- Similarly, there was not a focus on the capital forums that are a popular and well-publicized means to match developers and entrepreneurs with investors, particularly venture capitalists. The capital forums play an effective role in coupling attractive development opportunities with some sources of funds. However, capital forums are perceived to be more suited to the interests of the investor, rather than the developer. In addition, capital forums are not an effective means of attracting the interest of the conventional lender; and the capital forums are not able to provide the volume of funds needed to develop large-scale biomass projects at affordable rates of interest.

The Range of Biomass Projects Addressed

For the purpose of this study, biomass projects initially included virtually all types and sizes of projects employing biomass as a feedstock to produce a useful and economically attractive and/or marketable product.

By way of example, the feedstocks included agricultural wastes, wood or wood waste, municipal solid waste (in particular, the non-manufactured portion of such waste), municipal landfill gas, paper mill sludge, wastewater treatment plant sludge, and discarded fatty vegetable oils and waste oils.

The potential projects range from small, modular combustion units and fuel cells, to large field erected processing or combustion facilities. The applications included efficient and productive on-site use of an agricultural waste, such as the combustion of chicken litter to dispose of the waste and generate heat for hen houses, to small combustion units to combust pellets made from wood wastes to heat public buildings, to large, commercially viable facilities to convert biomass to a usable product, such as ethanol. Thus, the end product ranged from energy to be used on-site, to a fuel or a useable source of energy to be sold to an off-site user.

The potential benefits of these biomass projects have been well documented in the literature. These projects support regional economic development, typically in the less urbanized areas of a state where such projects tend to be sited. The projects can result in significant amounts of capital investment, and can result in the creation of jobs - jobs directly related to the project, and jobs indirectly related to local or regional supporting activities and services.

In addition, the projects can produce appreciable environmental benefit. Depending on the type of project, project development can result in further development of renewable energy sources, particularly in the case of wood or agricultural waste to energy projects, or other forms of biomass to liquid fuels. Biomass projects can assist in reducing reliance on less desirable energy sources, less desirable means of energy generation, and on less desirable means of disposal of, for example, an agricultural waste or municipal solid waste. In general, they can result in the efficient and productive use of something that would likely otherwise be considered a waste product.

With particular reference to liquid fuel biomass projects, the emphasis of the study changed to focus on these projects during the course of the work - in particular, on the large scale biomass to ethanol projects. Notwithstanding the broad range of issues that affect the financing and implementation of the many types of potential biomass projects, there was particular interest on the part of the Center to focus on the financing and development of commercially and economically viable biomass to ethanol projects in the northeastern United States.

2.0 THE SURVEY OF BIOMASS DEVELOPERS

As presented in Appendix 1, twenty-two firms were interviewed. The purpose of the interviews was to determine the type of project developed or intended to be developed, the size and type of organization, the progress to date in arranging financing, and the general experience relating to access to the capital markets. The full report prepared by ARI presenting the survey of businesses is included herein as Appendix 1, entitled "Evaluating Investment Opportunities for Biomass Energy Projects - Phase I: Current Status of Financing Biomass Technologies". Reference should be made to the Appendix; this Section is intended to be a summary of the survey.

The twenty-two firms interviewed varied significantly in type and size. Some were wholly owned subsidiaries of major corporations; others were very small, start-up firms, or individual entrepreneurs. The firms' financing experiences also varied considerably, although none represented that funds were easily raised.

With particular reference to financing issues, the following statements summarize the comments made:

- The range of financing needs varied from "the tens of thousands" to in excess of \$100,000,000.
- Many firms referenced the support of grants funds, particularly from the Department of Energy Small Business Innovation Research (SBIR) program and from the National Renewable Energy Laboratory (NREL). In some cases, the grants support received was substantial, exceeding \$100 million over a fifteen-year period in one case. Many references were made to grants as matching funds.
- The larger projects were typically looking to a project finance type structure to effect their financing. In the cases where they were successful, a parent company guarantee or partial recourse to the parent company appeared to be a prerequisite to the financing.
- Several firms provided equipment to users, where the user (and, presumably, the purchaser of the equipment) was expected to raise the necessary capital. The financing of the projects occurred more readily with public sector purchasers (for example, a school district purchasing a wood pellet fired heating unit); more financing difficulties were experienced with private sector purchasers.
- Almost all firms cited the financial and "sweat" equity contribution made to their respective projects. Many referenced contributions by families and friends, as well as other 'investors', presumably in the form of limited partners to venture capital investors. (Many were not explicit about their sources of funds.) Often, the

comments of those interviewed reflected an expectation of a certain return on that equity and the investment of personal effort (and both factors are believed to have likely affected the objectivity of the developer when negotiating with a potential source of financing).

- On a limited basis, development funds were provided by parent companies (where such existed), utilities and utility associations. Support also was provided in the form of equipment and "in kind" expertise in support of project development.
- Relatively few firms cited use of venture capital, although a number had raised funds through private investors. The general perception of venture capital was that it is very expensive, and it requires an undesirable, if not unacceptable, shift of project control from the developer to the investor. Relatively few developers cited the belief that capital forums provide a practical source of funds for them.
- Relatively few firms cited the use of commercial lending services of local or regional banks as a source of funds. Banks were seen as too conservative and generally unwilling to divert from established lending criteria. Banks were typically associated with unacceptably short terms of lending, relative to the lending terms sought by project developers.
- Some developers have hired financial advisors and underwriters to assist in acquiring capital funds. At least two projects had successfully completed large financings through publicly offered debt.
- Most projects were described as being in developmental stages, looking to or currently trying to finance a commercially scaled project. Only a few had completed sizable financings. Most indicated difficulty in accessing the capital markets, and many reflected a lack of experience with or appreciation of such lenders and their respective lending criteria. None indicated that it was a relatively simple process to raise capital funds.

The results of the survey of biomass developers are not unexpected. The results reflect what would be expected in any new or developing technology, where the developers are more comfortable in and knowledgeable of the technology issues than the practice of developing and financing new business ventures. Many developer comments reflected the commitment to and belief in their development idea, the level of which might readily affect that developer's objectivity when addressing the credit criteria and lending procedures of an investor or lender. There was no general theme, however, that potential lenders or investors were purposefully avoiding biomass projects. There is no basis to conclude that the problems associated with financing these projects are exclusively present in and particular to biomass project development.

However, this is not to suggest that financing these projects will be straightforward. With particular reference to the financing of large-scale biomass projects on which the Center

wishes to focus, the characteristics of these projects and the requirements posed by the expected means to finance these projects will always pose very serious challenges. Furthermore, in the current market environment for these projects, it is very unlikely that many of these projects will have access to the lending sources they require. These issues are addressed in Section 4.

3.0 STATE PROGRAMS SUPPORTING THE FINANCING NEEDS OF BIOMASS DEVELOPMENT PROJECTS

As part of the study, a survey was performed of twelve state agencies in Connecticut, Massachusetts, New York, Maine, and California to review the types of programs that are available to provide financial assistance or support for biomass projects. Appendix 2 presents in tabular form the overview of these programs.

In general, each state appears to have programs that offer one or more of the following types of assistance or support:

Loan programs - With these programs, funds are lent by the program administrator to an intended project developer, either as senior or subordinate debt. These programs are typically limited as to the amount of financing that can be provided to any one borrower, either by maximum dollar amount or by percentage of total financing need.

Loan guarantees (and loan insurance) - These programs provide a guarantee to the lender, such as a commercial bank, which assures the repayment of the funds loaned either by the borrower or by the state in accordance with its loan guarantee or insurance. Again, these programs are limited as to the amount of credit support that can be provided to any one borrower.

Below market interest rates or interest rate subsidies - With the former, loans made are at below market rates. In the case of the latter, lending institutions lend at market rates, and the program sponsor makes direct payments to the lenders to partially defray the interest cost associated with the loans.

Grant programs - There are some grant programs to support project development. However, these programs are typically available on a very limited basis, if at all.

Access to the tax-exempt capital markets - Capital market access is allowed through the issuance of tax exempt, fixed rate (or variable rate) debt or lease-purchase or installment purchase financings. In these programs, a state entity acts as a conduit borrower, where the state entity issues the debt and passes the proceeds and all responsibility for repayment through to the business ultimately needing and borrowing the funds. The issuing conduit assumes virtually no liability for repayment the debt; it is simply facilitating access to tax-exempt financing. For credit worthy, qualifying projects, this is likely the program that results in the greatest reduction in borrowing cost to potential project developers.

Issuance of taxable bonds - These programs are similar to the preceding programs allowing access to tax-exempt debt except, in this case, the interest payable is not exempt from federal and state income taxes. Thus, the economic advantage associated with tax-exempt debt is not present. However, these programs do allow access to fixed rate, long term debt as an alternative to borrowing through a commercial bank.

Venture capital - Some limited programs exist where quasi-public entities assume equity positions in proposed projects. These programs are very limited in scope, amount and term of participation.

Technical support - Technical support may be available in the form of technical, legal or financial assistance, particularly in assisting in project development. For credit worthy proposed biomass projects, particularly for the smaller proposed projects, technical support in the form of legal assistance can appreciably contribute to reduce the issuance costs associated with tax-exempt financings.

Access to pooled loan programs - This type of program provides the opportunity for borrowers of small amounts to be combined with other small borrowers in one financing and, thus, gain efficient access to the capital markets.

Direct production subsidies - One program (through the State of California Energy Commission) provides a production subsidy, in the form of an amount paid per kilowatt-hour produced, for some small power producers. This is the only program of its type identified.

Tax deductions and credits - Some programs allow tax deductions and tax credits to defray a portion of the cost of certain types of capital investment.

Tax increment financing - Many states provide legislated authorization to use tax increment financings to support the cost of infrastructure improvements to a proposed project site. These are financings done to fund infrastructure improvements, where debt service is paid from a pledge of the incremental tax increase resulting from the increase in property assessed valuation.

The rationale for these programs is seen to be commonly shared among the different state agencies. The programs are designed to support economic development within each state, with the particular objective of promoting capital investment and/or job creation. Often, as applicable, the programs are designed to support a particular type of activity - for example, the re-investment in new manufacturing equipment by firms located in economically depressed areas of the state or of a particular urban area. Generally, to the extent possible, the programs are intended to provide access to funds for businesses that do not have access to traditional lending sources, such as commercial banks. These programs are seen as a support to small businesses and disadvantaged businesses that would not likely have ready access to the conventional capital markets.

None of the programs reviewed were specifically administered for the purpose of assisting in the development of biomass projects. Biomass development projects would likely qualify as eligible projects under many of these programs; however, with the exception of the availability of tax-exempt financing, the extent of assistance would be limited.

None of the program administrators to whom we spoke suggested that there was a conscious effort to promote and develop biomass projects, or to exclude such projects. Similarly, in our review, we did not identify any participation criteria that would specifically encourage or exclude the development of biomass projects.

Very few of the administrators with whom we spoke stated a specific case for the economic benefit of developing additional biomass projects (relative to the case they would state with any typical eligible project). In fact, with the exception of wood-fired, electric generating stations, few of the program administrators could identify biomass projects within their State, other than relatively small biomass projects.

Access to Tax-Exempt Financing

The financing programs that provide the most meaningful potential benefit to proposed biomass projects are those that allow access to long-term, fixed rate tax-exempt financing, or financings where the interest paid is partially exempt from federal and/or state income taxation. Each state provides a program to allow qualifying borrowers access to tax-exempt financing. Prior to the reform of the federal tax code in 1986, the state sponsored industrial revenue bond programs (also know as industrial development bond programs) were actively used to great advantage by those qualifying creditworthy firms. However, with the curtailing or elimination in the late 1980's of most uses of tax-exempt industrial revenue bonds, the state agencies responsible for such financings experienced dramatic reductions in the number of borrowers through such programs.

Generally, many of the biomass projects contemplated by the Center are likely to qualify for tax-exempt financing; and the state programs allowing such financings will be of appreciable benefit to the project developer. For the credit worthy, eligible proposed project, this type of program provides the most meaningful opportunity to reduce the interest cost of the borrowing and to extend the term of debt repayment to a manageably long period.

However, these programs do not provide any form of credit support or assistance to enhance the credit worthiness of the proposed financing. These state programs are not intended to strengthen the credit worthiness of a financially weak project; they are simply intended to provide access to a less costly form of borrowing. The ability to repay the debt must still be established through the financial and economic viability of the contemplated project; otherwise, the financing will not be consummated. As will be discussed in the next Section, the lack of access to the necessary financing required is due to structural and contractual characteristics of the projects themselves.

The Application of Other State Programs to Biomass Development Projects

None of the other state programs were seen as successful facilitators of biomass development projects. None offered adequately extensive support to meaningfully contribute to project development. In particular, the loan and loan guarantee programs are too limited to facilitate the financing of a large-scale biomass project - too limited by the dollar amount of funds available, the percentage of the total financing requirement available, and the required term of repayment.

The Center is particularly interested in identifiably effective programs supporting large-scale biomass development projects. Other than the California Energy Commission's direct subsidy to the cost of electric power produced, none were identified as models after which programs in other states might be fashioned.

The state programs surveyed simply do not provide sufficient assistance to increase the likelihood of biomass project development. Although any one particular program may provide legitimate assistance to a developing project, none offer any appreciable means to enhance the credit strength of such projects. As will be presented in Section 4, it is the credit strength and structure of proposed biomass projects that is precluding successful financing.

Possible Models for Enhanced State Assistance

The existing loan and loan guarantee programs, if funded and administered with the intent of supporting the financing needs of large-scale projects, could assist in biomass project development. However, the existing programs currently are not funded adequately, nor are expected to be funded to a level that could, for example, meaningfully enhance the ability to finance a \$50 million proposed biomass project over a twenty year term of debt amortization. In addition, these programs are not perceived to have the expertise in-house, or currently available to them, to evaluate these projects to the extent of determining whether the state program should support the project and assume a significant credit risk.

There are two potential models that might provide assistance to biomass development projects:

State revolving fund programs - these programs are being successfully administered for water pollution control projects, and are being expanded to assist in the funding of water system improvement programs. A similar application could be made applicable to biomass project development (in addition to the development of other desired renewable energy projects), where a program is funded and loans are made to eligible projects. The funding for such could be generated, for example, through direct appropriation and/or surcharges assessed to landfill tipping fees, or to any

similar activity where the surcharge would have the intended impact of discouraging that activity.

Renewable Energy Trust Fund - under utility deregulation, a surcharge could be assessed on energy consumption that is specifically intended to fund a Trust Fund to be available for desirable technology development, such as renewable energy sources. This type of Trust is being implemented in Massachusetts under the management of the Massachusetts Technology Collaborative, a quasi-public entity established to promote technology development of all types in the Commonwealth. The intended public interests to be advanced are broad: (1) the development and increased use of renewable energy resources, (2) the protection of the environment, (3) an increased fuel and supply diversity, (4) creation of employment opportunities, (5) increased public and private sector investment, and (6) the stimulation of entrepreneurial activity. The Trust could explicitly direct funds towards the types of development it would like to promote, and it could manage such funds on a revolving loan basis. In particular, funds could be used to make grants, contracts, loans, equity investments, and energy production credits; to provide bill credits and rebates; and to support financing obligations.

A third model of interest is the California Energy Commission's Renewables Program, which provides financial assistance through a number of subsidies directed at energy producers, generators and energy marketers. Over a four year period, the value of the available subsidies is expected to exceed \$500 million, funded through a "systems benefit charge" on the purchase of electric power, as stipulated in the State's energy deregulation legislation. Unfortunately, with particular reference to large-scale biomass to ethanol projects, the four-year time frame obviates the opportunity to facilitate project financings, because the existing subsidies will not be available for an adequate portion of the debt amortization period for a large-scale biomass project. With these projects, the term of availability of a subsidy or support is at least as important as the amount of the subsidy.

Any of these approaches could effect the Center's objective of enhancing biomass development projects, provided they were adequately funded, were able to assume credit risk, and were available for a meaningful amount of, if not all of, the term of financing.

However, from a practical perspective, for any model to be implemented successfully, basic issues would need addressing:

Is there a generally shared perception that the development of these types of projects should be encouraged and supported with sizable financial resources?

Should a state or state agency be assuming credit risk for these types of projects?

Are the administering agencies able to assess and absorb the credit risk that would likely be present?

Is sufficient state funding likely to be available for such, and are expanded state programs likely to be authorized?

Should all such projects be expected to establish their financial and economic viability without state credit enhancement? If they were able to do so, would there be the need for state support, or would conventional financing be available?

Notwithstanding the perceived benefit of biomass project development, these are all seen as formidable issues to address.

4.0 THE FINANCING OF BIOMASS PROJECTS

As previously stated, this study primarily addressed the financing of large-scale biomass to ethanol projects, ranging in capital costs from \$10 to \$100 million. In addition to requiring a major capital investment, these are projects that, if built, are expected to facilitate the development of a broader based biomass to ethanol industry in the northeast, as well as support job creation, local infrastructure investment, and local agricultural activities.

To the best of our knowledge, no large-scale biomass to ethanol facilities have been constructed in the eleven northeastern states. Furthermore, it is unlikely that any will be constructed in the immediate future, due to the financing requirements and constraints associated with these projects.

This Section will review (1) the relevant characteristics of large scale biomass to ethanol projects; (2) the likely sources of funds required to develop such projects; (3) the method of financing likely to be used, if possible, to fund the construction of a facility; and (4) the types of lenders available. The Section will conclude with observations specific to financing biomass to ethanol projects, and observations generally applicable to large project financings.

Characteristics of Large Scale Biomass Projects

The following characteristics are likely to be present and relevant to the financing of biomass to ethanol projects:

- The required capital investment is significant, likely ranging from \$10 million to over \$100 million.
- Given the expected revenue structure of a proposed facility, it will be necessary for the amortization term for any financing to be as long as feasible. The repayment period will be determined by the projected term of economic and technical viability of the facility.
- Given the very attractive interest rate environment of the past five years (where interest rates have been at, or near to, historic low levels), the economic viability of a proposed project will be appreciably enhanced through the maximum use of long term, fixed rate tax-exempt debt. The use of variable rate financing, or a financing with a periodic interest rate reset (as is typically the case with a commercial loan), will pose an appreciable risk to a project. A proposed project will most likely be structured with long term contractual commitments for feedstock purchase and output sale, unless the economic viability of the facility can be established on a spot market or merchant plant basis (which is not likely). The contractual structure will be precisely documented to assure the flow of adequate revenue to the facility and the appropriate use of that revenue, at least from the perspective of the lenders, to pay debt service.

- A proposed project is likely to be perceived as a technologically challenging undertaking, although one that is presumably able to be judged as sound and economically viable in an engineering feasibility study. An acceptable technology would not likely be untested; however, its general application may not be widespread. Investors will approach the project with apprehension about its technical viability.
- The project, as an asset, will need to be perceived as one of value, providing security to the lenders, with an expectation that the project, if repossessed, could operate as expected and produce the revenue streams originally anticipated.
- The general business and regulatory environment will influence any contemplated project. In the case where municipal solid waste is the feedstock, current regional solid waste disposal fees are extremely competitive. For most communities, there is little incentive to enter into long term commitments to deliver solid waste to an existing or proposed project. In addition, there is considerable uncertainty in the market concerning the legal validity of municipal contractual commitments to deliver waste. With utility deregulation, it will be difficult to acquire a long-term contractual commitment for the purchase of its output, particularly if that output is electric energy.
- With large scale biomass to ethanol projects, both the feedstock and the ethanol produced can be characterized as a commodity; commodity purchases and sales are not generally characterized by long term contractual commitments in highly competitive and volatile markets.

The Sources of Funds

A large-scale biomass to ethanol project will likely be financed with the maximum amount of debt and the minimum amount of equity possible. The use of debt will be maximized because of (1) the large dollar amount of the funds required; (2) the benefit of relatively less costly debt (relative to the cost of equity) to support the financial viability of the project, especially if tax-exempt debt is available; and (3) the long period of amortization required for the financing.

The source of debt is likely to be through a commercial lender, such as a bank, or the direct access to the capital markets through the issuance of bonds, or some comparable form of debt.

The amount of equity will be minimized because of its cost; equity is invariably an expensive source of capital. Equity is typically required, however, in order to assure the lenders of the debt that the project developer has at least a minimum, and meaningful, investment and commitment in the project.

The source of equity is likely to be the developer's own funds, funds raised from investors, and internal corporate funds, if any are available.

Excluded from consideration is any expectation that large amounts of venture capital might be available for such projects. Generally, venture capital is not likely to fund more than a relatively small portion of a major project with a lengthy term of debt amortization. Venture capital is expected to have a very high cost of capital and is expected to require a much too brief term of amortization. It is contemplated, however, that venture capital could satisfy all or a portion of the equity contribution required for the project to be financed.

Likely Financing Structures

Four means of financing a large-scale biomass project can be envisioned and are described in the following paragraphs. Of the four, it is most likely that the biomass to ethanol facilities that the Center would like to see developed in the northeastern states would be financed on a project finance basis, the first of the four means described.

- 1. A Project Financing** - Under a project financing, the financing is structured on a stand-alone basis, where the contractual structure and revenue generating ability associated with the project and the value of the asset provide the necessary security to the lender.

Generally, the feedstock required, and the output produced, would be (or, in order to finance the project, would be expected to be) under long term contractual commitments that support the economic viability of the project - the feedstock being purchased at an affordable and predictable cost, and the output being sold at a level to meet the revenue requirements of the project. The term of these contracts would be expected to be at least equal to the term of the financing, and likely should exceed the term of the financing by some minimal period. It is possible that both the feedstock and the output could be acquired and sold, respectively, on an open or spot market basis; however, in the current market environment, that would be highly risky and unlikely for a biomass project.

Prior to completing the financing, the economic viability of the project will need to be established. This will be accomplished through the preparation of extensive, and presumably conservative, financial projections that present annual revenues comfortably in excess of projected expenses for the term of the project. Revenue projections will also be required under sensitivity scenarios where assumptions are changed to reflect different market characteristics.

There would also be the requirement that the facility be judged as technically and economically able to operate and perform as expected over the term of the financing and the term of the supporting contracts for feedstock and output purchase.

Typically, the assessment of a recognized, credible and expert third party - a consulting engineering firm - would satisfy that need.

The asset - the facility - and the associated contractual arrangements would generally be pledged as security for the financing.

There may or may not be recourse back to a parent organization. Undoubtedly, the intent of the developer financing a project on a project finance basis is to have virtually no recourse back to the parent organization. The intent is to establish a project structure that is, for all practical purposes, a stand-alone structure.

A typical project financing would be consummated at a closing where all parts of the transaction are executed essentially simultaneously (or at least in a predetermined order, with documents held in escrow if such documents only become effective after the execution of other documents). The large amount of documentation involved would establish the contractual structure of a project financing over the term of the financing.

2. **A Cash Flow Financing** - A cash flow financing is one where the financing requirements associated with the project can be seen to be adequately supported by the cash flow of the project developer. Cash flow financings, consequently, are typically associated with well established and financially successful organizations that are undertaking a project which is in addition to its general revenue producing business activities, and where that project is a relatively minor portion of its overall revenue structure. Thus, a cash flow financing is one that can be used by an established firm with an available total revenue base that is able to support all project cost requirements, regardless of whether the project is generating revenue. Obviously, a cash flow financing cannot be effected by a start-up entity. In addition, typically, a cash flow financing cannot be accomplished with an intended project structure that restricts the liability of the parent and the recourse to the parent.

As an example, with reference to a biomass to ethanol facility, a cash flow financing could be successfully employed by a large profitable petrochemical firm that wishes to develop a small project to assess the firm's interest in entering that business line. However, it could not be employed by a project intended to have a stand-alone, limited liability type of financing structure.

3. **A Financing Supported by the Pledge of a Secure Revenue Stream** - It is possible that a project could be financed if the lending party is able to isolate a secure revenue stream and have that revenue stream dedicated to the retirement of debt. Presumably, the revenue stream would need to be present, secure and available for debt retirement regardless of whether the project is operating and producing revenue (or value in the form of its output).

For example, energy conservation projects in public buildings have been funded through this mechanism, where the expected savings from the installation of energy

conserving equipment can be secured and dedicated to the retirement of the debt associated with building the project.

It is possible, for example, that a biomass to energy project (for the purpose of heating a public building) could be effected in this manner, particularly if the public entity requiring the project pledged its full faith and credit to the retirement of the debt.

For a biomass to ethanol project, however, this is not a likely approach. There is not likely to be any secure revenue stream that could be used to assure debt service is paid.

4. **A Guaranteed Financing** - A biomass to ethanol facility, or any facility, could be financed if a creditworthy entity provided a guarantee for the financing. That guarantee could be provided by a third party, such as a parent corporation or a public entity willing to support biomass projects, or it could be accomplished through the pledge to repay the debt issued regardless of the functioning of the project. For example, a municipal landfill gas to energy project could readily be financed, if the municipal entity pledged its unlimited taxing powers and full faith and credit to the repayment of the debt. (The financing, on the other hand, would have to be structured as a project financing if the municipality was only willing to pledge project revenues.)

Although many types of financings are supported by guarantees, there cannot be any expectation that this will become a preferred and frequent means to support biomass to ethanol projects.

The Survey of Lenders

ARI surveyed a group of conventional lenders to assess their interest in funding biomass projects and, as applicable, their prime concerns, lending criteria, etc., relating to such. In total, officers in twenty separate lending organizations were interviewed:

- Project finance lenders or credit officers at three major New England regional banks, and one major international bank with an active project finance lending group;
- Project finance lenders at major financing companies, such as G.E. Capital, as well as a group of specialty financing firms actively participating in the project financing and lease financing of public sector projects;
- Investment banking firms that have been involved in such financings; and
- Insurance companies, investment funds associated with such and other institutional lenders that have participated in project financings for energy projects.

Their comments conveyed a general unwillingness to be active participants in financing biomass to ethanol projects. Their concerns related to (1) the ability, or lack thereof, of structuring a credible project finance transaction, (2) a general discomfort for the technologies associated with biomass projects, and specifically biomass to ethanol projects, and (3) the general market and economic environment in which these projects would be implemented. In particular:

- The potential lenders stated that they are unable to structure credible project financings for proposed projects. There was general concern for all aspects of the proposed projects, including the quality of the contractual commitments, the supposed long-term economic and technical viability of the projects, and the uncertainty generally in the current business environment in which these projects would be implemented.
- The potential lenders stated that, in many cases, projects with financing needs of less than \$20 to \$25 million are too small to finance. In the generally competitive lending market, the fees associated with a project of this amount are not sufficient for the time and effort required to evaluate and, if appropriate, approve the project. There are other financing opportunities available to the potential lenders that warrant the commitment of their time.
- The potential lenders are not comfortable with the technology associated with these projects. All else being equal, there are other types of energy project financings with which they are thoroughly familiar and comfortable and, thus, able to evaluate without absorbing the apparent technology risk associated with a biomass to ethanol project.
- The general market environment is perceived as risky or, at best, uncertain. There is considerable concern for the impact utility deregulation will have on any energy related project.
- There is a heightened awareness for credit issues. Two bagasse to energy projects in Florida have experienced events of default, supposedly for technical problems associated with bringing the units online. The local utility has renounced its contractual commitment to purchase the power produced, and currently the failed projects and the utility are litigating their respective contractual commitments.
- No potential lenders stated that they include any sort of "green criteria" into their evaluation processes, particularly criteria that would skew how a project is assessed because of the apparent environmental benefits, etc., associated with the project. They will focus on particular types of projects with apparent environmental advantages; however, the evaluation of and expectations associated with the project are comparable to those associated with any other type of project financing.

However, as a result of the conversations with potential lenders, one should not conclude

that the potential lenders would never be willing to fund a viable project. No one specifically stated that they would not finance biomass projects (relative to any other projects); no one articulated an explicit prohibition for these types of projects. Instead, they stated their unwillingness to finance these projects for specific valid reasons, particularly associated with the structuring of an acceptable financing. If a proposed project was, in

fact, able to be presented with a viable project finance structure, it should be assumed that the project could be financed. The current market for project financings is very competitive; once biomass to ethanol can be shown to be, first, financially viable and, second, technically viable, it can be assumed that cost effective lending sources will be available. Unfortunately, the first prerequisite to completing a financing is establishing the financial viability of a proposed project; this may not be attainable in the current business environment in which biomass to ethanol development is being considered.

The second prerequisite, technical viability, can be considered the less problematic of the two prerequisites. When financial viability for technically viable projects can be established, it can be assumed that the lending institutions will do what is required to find comfort with the technology.

Overall Conclusions Relating to Large Scale Biomass Projects

The conclusions of the study are the following:

1. With particular reference to large-scale biomass projects, proposed projects are not gaining access to the capital markets to fund project development. In the course of the study, a number of projects were identified that are currently attempting to arrange financing; however, none of these projects have moved ahead. There are no current examples of successful access to the capital markets for financing needs. Based on our conversations with both project developers and potential lenders, it is not likely that any large-scale biomass to ethanol projects will be developed in the near future.
2. For most large-scale biomass projects, it is expected that a project finance approach would be used to fund the capital needs of the project. If a number of large-scale projects were to be developed, this would be the logical and practical approach to structure the required financings. Other financing approaches are not practical approaches for funding large-scale biomass projects.

In the current and foreseeable business environment, the economic characteristics of biomass projects are not sufficiently strong to meet the structuring requirements of a project financing. It will be difficult to procure an assured feedstock over, at minimum, the term of the financing; and, as a result of utility deregulation, it is becoming increasingly unlikely that an economically attractive output purchase agreement could be obtained. Simply stated, any reasonable projected financial analysis of a proposed project is not likely to establish to the expectations of a

lending institution the financial viability of the project.

It should not be assumed that any projects will be developed on a merchant plant basis.

3. Some biomass projects could be financed on a "cash flow" basis, where the credit strength of the project is provided through a financially sound and well-established project developer.

However, in general, the characteristics of biomass project developers typically do not satisfy the requirements of a cash flow lender. The project developers are typically entrepreneurs, start-up organizations, or firms that wish to limit the amount of recourse to their other financial resources. With particular reference to the entrepreneur or start-up organization, they generally will not have an adequately established record of financial performance to meet the credit requirements of the cash flow lender.

4. There does not appear to be a generally shared market bias against biomass projects, and lenders should not be perceived as purposefully shunning biomass to ethanol projects. Instead, the concerns cited by the potential lenders are applicable to virtually any type of technically based project where the long-term viability of that project cannot be established.

There is a general discomfort with the technology involved; however, technology risk is more likely to be mitigated than the finance issues. If financially viable project financings could be structured for biomass projects, it is believed that there would be potential lenders that would commit the resources to evaluate and become comfortable with the proposed technology.

Unless and until economically and financially viable projects are presented to potential lenders, a concerted effort to inform the investment community of the types and benefits of biomass projects will not likely result in more facilities being financed.

5. In conversations with representatives of state agencies with programs supporting biomass projects, various spokespersons did cite reasons why it might be to the economic advantage of a state to support these projects. However, no one made a compelling case. Simply stated, there is not a strong level of commitment for these types of projects evident among the representatives of those state agencies.
6. There is a broad range of state programs that can provide some limited assistance relating to project development. In general, the most important assistance is each state's program that allows access to long term, fixed rate, tax-exempt financing, assuming a proposed project qualifies for such (and has a viable project finance structure). However, based on the survey completed, there are no identified programs that offer adequate credit support to enhance the financial structure of

large-scale biomass projects.

There appear to be state programs that could be structured to provide some assistance to these projects in the future. In particular, through state-legislated utility deregulation, there may be opportunities to provide limited sources of funding to proposed projects, or to require the purchase of the energy produced. However, that support will not be meaningful if that support is not committed to the project for the entire term of the financing.

7. Encouraging the development of smaller biomass to energy projects may be the logical alternative to large-scale biomass to ethanol project development. The financing requirements of the smaller projects will be appreciably different from those projects that can only be funded on a project finance basis. The development of a biomass to energy industry may be facilitated by the initial development of the smaller projects where the output is to be used on site and the source of financing is a creditworthy third party.

APPENDIX 1

Evaluating Investment Opportunities for Biomass Energy Projects - Phase I: Current Status of Financing Biomass Technologies

**EVALUATING INVESTMENT OPPORTUNITIES
FOR BIOMASS ENERGY PROJECTS**

**PHASE I: CURRENT STATUS
OF FINANCING BIOMASS TECHNOLOGIES**

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Table of Contents

1.0	Preface	1
2.0	Executive Summary	2
3.0	Introduction to Phase I	4
4.0	Developers Interviewed	5
5.0	Strategies Used to Obtain Financing	6
6.0	Financing Received to Date	15
7.0	Future Financing Plans	19
8.0	Financing Obstacles	22
9.0	Investor Requirements	24
10.0	Independent Third Party Reviews for Financing	25
11.0	Networking Activities	28
12.0	Federal and State Funding Sources	29
13.0	Other Government Services	30
14.0	Familiarity of Developers with Tax-free Financing	31
15.0	Advice to Other Developers	32
16.0	Conclusions	34

LIST OF APPENDICES:

- Appendix A: Questionnaire for Biomass Technology Developers
- Appendix B: Individuals/Organizations Valuable in Search for Financing

List of Tables

Table 4.1	Developers by Type of System, Technology and Feedstock	7
Table 4.2	Past, Current and Future Development Plans for Technologies	9

List of Figures

Figure 4.1	Current Developmental Stage of Technologies	11
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1.0 PREFACE

An objective of the Northeast Regional Biomass Program (NRBP) is to increase the role of biomass fuels in the region's energy mix through education, market development, coordination of public sector efforts and encouragement of private investments. The NRBP is one of five regional biomass programs funded throughout the nation by the United States Department of Energy. The NRBP is administered by the Coalition of Northeastern Governors (CONEG) Policy Research Center, Inc. in Washington, D.C. Several biomass technologies have developed to a point where outside financing is needed for demonstration or commercialization. The NRBP wants to ensure that these projects will not fail due to a lack of funding.

Alternative Resources, Inc. (ARI) and Oppenheimer and Co., Inc. have been retained by the NRBP through the CONEG Policy Research Center, Inc. to evaluate investment opportunities for biomass energy technologies. The purpose of this project is threefold:

first, to determine if, in fact, biomass projects are being impacted by a lack of available, affordable capital;

secondly, to explore the State-sponsored investment funds – which cushion some of their investors' risks, to determine their appropriateness for focusing on the emerging biomass technologies; and

thirdly, to educate investors and potential investors about the specific economic costs and benefits these new technologies offer.

ARI and Oppenheimer are pursuing these study objectives through activities conducted in three phases of study. Phase I involves interviewing biomass energy technology developers to arrive at a set of case studies focusing on how developers have been able to attract investment capital from various sources. Phase II is identification of some State-sponsored funds that would consider investing in emerging biomass technologies. Finally, the private financial market will be surveyed for interest in biomass technologies in Phase III and provided with written information, contacts and an opportunity to attend a forum on the biomass energy market. The forum will be organized by ARI, Oppenheimer and the CONEG Policy Research Center. Participants in the forum will be technology developers and consultants, investors, researchers and economic and energy development government officials. The forum and a final report will complete Phase III of this study.

2.0 EXECUTIVE SUMMARY

In Phase I of this study, ARI has interviewed developers of biomass-to-energy facilities regarding their financing experiences. This Phase I report summarizes both the successes and barriers encountered by these companies in pursuit of financing. Interviewed by ARI for this study were 22 companies that are developing new, biomass technologies, such as biodiesel, acid hydrolysis of cellulose to produce ethanol, carbonate fuel cells, and gasification.

Developers of biomass technologies can be classified into three groups based on the stages of development of their technologies. The first group comprises those in the feasibility and planning stages who rely on personal funds and government sponsors to finance their research and development work. Developers in the first group appear to compete successfully for government funds and other financing sources, as witnessed by the fact that all but one of the developers interviewed have progressed into the implementation phase.

The second group contains developers in the initial stages of implementation attempting to demonstrate their technology on a pilot or commercial scale for the first time. It is the second group of developers in the initial stages of implementation who experience difficulty in obtaining financing because they do not have a track record. Lack of financing can lead to delays, which translate into additional costs.

Developers in this phase continue to apply for government funding, but also approach private investors and explore relationships with investment banks and strategic partners. Developers in the third group have moved beyond their first commercial facility and are seeking to expand their markets. These developers have the ability to raise private capital through project financing. The third type of developer appears to be successful at raising private capital. Based on information learned in the interviews, once a commercial facility is operating successfully, technology developers become successful project developers with the addition of business and financial expertise to their project management team.

No developers interviewed admitted failure in obtaining financing, but some are clearly more successful at finding financing and progressing towards commercialization than others. All but one of the companies interviewed are seeking financing at this time.

The challenge for the DOE NRBP and CONEG, and for other such government organizations and affiliations that want to promote the use of biomass-to-energy technologies, is to find ways to channel financing to those developers in the second group who are in the initial stages of implementation.

This might be done, for example, through encouraging the arms of Federal agencies with funding mandates to:

provide loan guarantees which make the risk of first-time commercialization acceptable to traditional bank financing sources;

continue to provide matching funds and seed money to make pilot and commercial projects attractive to private investors; and

enter into public/private partnerships with developers where the agencies make long-term commitments to the success of the technologies.

The NRBP and CONEG could also assist developers to identify potential state government fund managers and private investors, and educate these financing sources on promising biomass-to-energy technologies.

3.0 INTRODUCTION TO PHASE I

Phase I explores the premise that developers are not being successful in developing biomass energy facilities because they do not have the necessary financing. The first task consisted of interviewing biomass technology developers about their projects and implementation success to date. ARI prepared a questionnaire that was answered by developers during 19 telephone interviews and three personal interviews. See Appendix A for a copy of the questionnaire. The completed questionnaires are available for review but are under separate cover because of their length.

This report summarizes the information conveyed by the developers during their interviews. First, each biomass energy developer is described in terms of its type of system and past, current and future stages of development. Next, the strategies that developers have used to obtain financing, the financing they have received to date, and their future financing plans are presented. Any obstacles encountered when securing financing are identified, as well as investors' closing requirements. The report also discusses independent third-party reviews that have been conducted on the technologies. Developers' opinions on networking activities are presented. Individuals and organizations considered helpful in the developers' search for financing are mentioned, as well as Federal and state funding sources and other government services provided to the developers. Also discussed is the familiarity of developers with preferential tax-free financing for solid-waste fueled projects. Lastly, any advice that the developers had for other developers attempting to commercialize technologies is presented here.

4.0 DEVELOPERS INTERVIEWED

ARI contacted companies that are developing new biomass technologies, such as biodiesel, acid hydrolysis of cellulose to produce ethanol, carbonate fuel cells and gasification. ARI identified an initial list of developers through contacts provided by CONEG, as well as through its own contacts in the biomass industry. These initial developer contacts led to other developers or industry consultants being suggested during the course of interviews until ARI felt a representative and large enough sample was reached to be able to draw conclusions about the state of the industry. The following developers were interviewed for this study:

Acrion Technologies	International Fuel Cells (IFC)
Arkenol	Masada Resource Group
Biofine	Neutralysis
Cratech	New England Wood Pellets
Chiptec	Pinnacle Biotechnologies International
Energy Research Corporation (ERC)	Polsky Energy Corporation
Energy Transitions Technology	Stirling Motors Corporation
Future Energy Resources Corp. (FERCO)	Thermal Technologies
Fiber Fuel International	Twin Rivers Technologies
GeneSyst	U.S. Generating Company
Ingram Howell	Vayda Energy Associates

Table 1 lists the individuals at those companies who participated in the survey, their types of biomass-to-energy system, and the process or technology and feedstock used in the system.

Each company's development history, current stage of development and future plans, as described by the interviewee, are summarized in Table 2. To better understand where each company is currently, in terms of developing its technology and hence its financing needs, ARI translated the previous information into Figure 1, which shows the current stage of development for each technology.

5.0 STRATEGIES USED TO OBTAIN FINANCING

Business Planning

Developers were queried about their formal business plans. A business plan describes the service or products, developmental history, future plans for growth, key management, market information including competitiveness, and provides historical and projected financial information. The plan states the amount of financing that is required, the purpose of the loan, the intended use of the funds, and the plan to repay the financing (the "exit strategy").

All the developers interviewed have business plans. More than half wrote their own business plan. Others had financial consultants or retired business executives write the plans for them. A few developers paid for this service with some company stock. In this way, the companies were able to enlist people with business skills to help the companies in their drive for success without significant cash expense.

Several developers thought that a financial professional should only advise on format but that the business plan itself should be written by the company. In this way, the employees of the company take ownership in the plan, its goals, objectives and strategies for obtaining them.

Developers said that business plans are crucial when making presentations to potential investors. However one developer warned that a business plan can be dangerous when it is a vehicle for raising funds because the plan can take on a life of its own – serving to tell a good story instead of being a management tool used to guide the company's direction.

About one quarter of the companies said that their business plans are always changing.

Investor Forums

Several developers have made presentations at investor forums with mixed success. Neutralysis, Pinnacle, Biofine, FERCO and Stirling Motors have all participated in several forums but did not receive any money as a result. Based on their experience, they believe that a developer needs to be commercially demonstrating its technology in order to be seriously considered for financing. However, some felt that there was value in getting comfortable making presentations through practice at forums.

Acrion had a consulting firm organize some forums for the company at which company employees met three utilities with whom they are discussing potential applications. GeneSyst found some shareholders at investor forums but no major capital investors. Masada presents its business plan to private investors and venture capitalists but tends not to present its technological ideas at investor forums where competitors are present.

Instead of investor forums, New England Wood Pellets buys booths at recycling/biomass

energy fairs to promote its pelletizing technology, in this manner several good contacts have been made.

Loan/Grant Writing

Loan/grant writing is a strategy that has been very successfully used for funding research and demonstration efforts by many developers. Biofine stressed the need to write good proposals to State and Federal grant managers because one needs to use this government money to develop something of interest to private investors.

Loan/grant writing is an ongoing process for technological research and development and demonstration activities at Biofine, Cratech, ERC, FERCO, Fiber Fuel International and IFC.

Developers arrange to get on mailing lists for solicitations from government agencies and other non-profit or quasi-government organizations whose funding they want to attract.

Financial Expertise

Many developers have in-house personnel with financial backgrounds. For example, some Polsky employees have gained financial expertise at other development firms or financial houses. Some developers, especially smaller ones, have hired outside consultants. Fiber Fuel International retained a capital advisor who specializes in environmental technologies and leveraged buyouts and acquisitions. He is currently trying to help Fiber Fuel International buy an unrelated business and use these revenues as leverage.

Outside Income

The strategy of using unrelated revenues as leverage for technology development has been successfully used by some of the developers. The owners of Vayda Energy, Biofine and Twin Rivers all have businesses that provide income that is either invested in developing the biomass technology or, at a minimum, pays the salaries of employees so the company can continue to develop the biomass technology. Pinnacle scientists have found another source of outside income: they generate company revenues by subcontracting to Federal agencies on projects.

Strategic Partners and Affiliations

Several developers have formed strategic partnerships with companies that would benefit from the successful development of their technologies. Examples of such strategic liaisons between technology developers and other companies are described here.

Arkenol has relationships with companies in the transportation fuels industry and biobase chemicals that have deep pockets. For example, Arkenol and the Pure Energy

Table 1

BIOMASS TECHNOLOGY DEVELOPER	CONTACT	TYPE OF SYSTEM	PROCESS OR TECHNOLOGY	FEEDSTOCK
Acron Technologies, Inc.	William Brown	Landfill Gas-to-Methane and Carbon Dioxide	Contaminants Removal through Adsorption and Purification	Municipal Solid Waste
Arkenol	Mark Carver	Biomass-to-Ethanol and Bio-Based Chemicals	Concentrated Acid Hydrolysis	Waste Wood and Paper, Grasses, Agricultural Residues
Biofine, Inc.	Steve Fitzpatrick	Cellulose-to-Levulinic Acid	Acid Hydrolysis	Anything > 40% Cellulose
Cratech, Inc.	Joe Craig	Wood-to-Energy	Gasifier coupled with Gas Turbine	Wood
Chiptec Wood Energy Systems*	Louis Bravakis	Wood-to-Energy	Wood Gasification	Wood Chips
Energy Research Corporation (ERC)	Eric Simpkins	Biomass-to-Energy	Carbonate Fuel Cell	Biomass Derived Fuels, Landfill Gas
Energy Transitions Technology, Inc.	Horvey Scudder, Windrush	Landfill Gas-to-Energy	Turbo Charger Gas Turbine	Municipal Solid Waste
Future Energy Resources Corporation (FERCO)	Sim Weeks	Biomass-to-Energy	Gasification, Combustion, Gas Turbine	Pulp and Paper Industry Waste, Chicken Litter, Switchgrass, Refuse-Derived Fuel
Fiber Fuel International, Inc.	Larry Staab	Wood-to-Energy	Co-Fired Power Plants at Refineries	Wood, Cotton Waste, Coconut Shells, Bamboo, Waste from Carpet Mills
GeneSyst	James Timas	MSW-to-Energy	Mild Acid Hydrolysis and Fermentation	Municipal Solid Waste
Ingram Howell, L.L.C.	Arlon Van Draanen	Biomass-to-Ethanol	Acid Hydrolysis using Arkenol Technology	Waste Wood and Paper, Agricultural Residues
International Fuel Cells (IFC) (ONSI)	Doug Wheat	Methane from Landfill Gas or Digester Gas-to-Energy and Heat	Fuel Cell	Landfill or Digester Gas
Masada Resource Group, L.L.C.	Ted Bergland	MSW and Sewage Sludge-to-Construction Aggregate	CES OxyNol Process (Acid Hydrolysis)	Municipal Solid Waste, Sewage Sludge
Neutralysis	Jack Robison	Sludge, Waste and Clay-to-Construction Aggregate	Remediation of Short Paper Fibers and Polywaste with Clay from Landfills	Papermill Sludge and Other Wastes
New England Wood Pellets	Steve Walker	Sawdust-to-Pellets for Fuel	Pelletization	Sawdust
Pinnacle Biotechnologies International	Brian Duff	Biomass-to-Biogas for Electricity, Steam and Compost	Hi-Solids Anaerobic Digestion	Organic Waste
Delco Energy Connection*	Mark Ierman	Biomass-to-Energy	Bubbling Bed Pin Hole Grate	Wood, Sawmill Waste

Table 1

BIO MASS TECHNOLOGY DEVELOPER	CONTACT	TYPE OF SYSTEM	PROCESS OR TECHNOLOGY	FEEDSTOCK
Stirling Motors Corporation	William McKeough	Biomass-to-Energy	Commercial Gasifier (Chiptec) Coupled with Stirling Engine	Wood, Rice Husks, Sugar, Bagasse, Coconut Shells
Thermal Technologies, Inc.	John Cleland, Research Triangle Institute	Wood-to-Low BTU Gas for Electricity	Down-Draft Wood Gasifier linked to Spark Ignition Engine	Demolition Waste Pallets, Tree Trimmings, Forestry Waste
Twin Rivers Technologies, Inc.	Gene Gebobys	Excess Soybean Oil and Used Cooking Oil Grease-to-Biodiesel		Excess Oil from Soybean Plants, Used Cooking Grease
U.S. Generating Company	Guy Marchmont	Bagasse-to-Steam and Electricity	Incineration	Sugar Cane Waste
Visyda Energy Associates, Inc.	Steve Vayda	Chicken Litter-to-Heat	Fluidized Bed Combustion Technology	Chicken Litter

* These companies are project developers (Ingram Howell, Polisky) or equipment manufacturers (Chiptec) rather than developers of the biomass energy technology.

Table 2

BIOMASS TECHNOLOGY DEVELOPER	CURRENT STATUS	EARLIER STAGES OF DEVELOPMENT	FUTURE DEVELOPMENT PLANS
Acron Technologies, Inc.	Preparing to demonstrate technology in a New York landfill; applied for patent.	Worked in landfill gas area since 1990, technology was developed in mid-70's, won SBIR Phase I and II awards	Selling technology to landfill gas project developers.
Arkenol	Commercialization in US and overseas; operating plant in Pennsylvania.	R&D plant in Orange, CA operating since 1991.	Site in Sacramento, CA; permitted and licensed; sites in Italy and Brazil; considering sites in Indonesia, Malaysia, and South Africa.
Biolfine, Inc.	Demonstration plant to operate 7/97, six projects under design - NYC, CA, Italy, Ireland, Taiwan and Brazil.	Developing technology since 1984 using testing plant at Dartmouth College.	To build six projects currently under design.
Cratsch, Inc.	Commercially demonstrating within one year.	Developing technology since 1984.	To complete Phase 3 when more funding is received.
Chiptec Wood Energy Systems	Sells wood gasifiers to schools and state buildings for heating.		
Energy Research Corporation (ERC)	Advanced development stage - almost ready for pre-commercialization.	ERC began developing carbonate fuel cell technology in 1976.	ERC has licenses to develop technology in Germany, Denmark, and Japan. In North America, will develop power plants with A&E firms.
Energy Transitions Technology	First commercial application will be in operation in Fall of 1997.		Hopes to replace internal combustion engines with turbines in landfills across the country.
Future Energy Resources Corporation (FERCO)	Demonstration on a commercial scale in Burlington, Vermont.	Process under development for 17 years, began in the late 70's; pilot plant was built in 1980.	Plans to get an established base of plants operating. Next one to be at a Weyerhaeuser mill.
Fiber Fuel International	Successfully tested commercial-size utility boilers and patented the process.	Began as a consulting firm; became R&D firm.	Designing industrial refineries to use this fuel in Europe.
GeneSyst	Trying to build small commercial plant to prove viability.	Formed in 1994, components off-the-shelf, but not in this configuration	Ten facilities of same size. Potential sites have been identified.
Ingram Howell, L.L.C.	Planning and implementation; developing site in Alexandria, NH.	Company formed in 1995	To have first plant opening in 1998, then to develop more sites.
International Fuel Cells (ONSI Corporation)	Demonstration phase for biomass applications at sewage treatment plants and landfill sites; learning to operate fuel cell using biogas.	fuel cell power plant has operated for one year on digester and landfill gas. Technology has been developing for 30 years using natural gas.	Several more demonstration units for digester plants and landfills. Possibly overseas too.
Masada Research Group, L.L.C.	Design and permitting stage of first commercial facility, Middletown, NY.	Pilot plant demonstration facility is at TVA.	To build 15-20 plants over the next 10 to 15 years.
Neutralsys	Planning to build plant at paper company in Green Bay, WI.	Bought technology in 1989 from Australian company. R&D lab is being built in PA.	Plans to commercialize technology in Europe & U.S.
New England Wood Pellets	Pilot plant went on-line 11/95 in Concord and Acton, MA.	Technology being used in 1970's for wood stove fuel. Company started in 1992.	Wants to build another plant, which can accept green wood waste.
Pinnacle Biotechnologies International	Technology verification and validation. Applied for some patents, building a pilot reactor in Stanton, CA to prove technology is viable.	An NREL spin-off a year ago after ten years of research	To market their technology and seek buyers for their units.
Poleky Energy Commercial	Developer of projects using natural gas and some	Company formed in 1991, biomass projects:	WTE facility in Illinois to be on-line in 1997.

Table 2

BIOMASS TECHNOLOGY DEVELOPER	CURRENT STATUS	EARLIER STAGES OF DEVELOPMENT	FUTURE DEVELOPMENT PLANS
	biomass.	Brooklyn, NY; energy center in Nova Scotia; a power plant in Quebec.	Future plants will be fueled with natural gas; biomass only if there is a set aside component or regulatory incentive.
Stirling Motors Corporation	Pre-commercialization. Within two years of commercialization.	Company started in 1979.	To commercialize this engine technology using renewable and non-renewable sources of fuel.
Thermal Technologies	Operating facility at Camp LeJeune, N. C.		
Twin Rivers Technologies	Commercialization in US and overseas; 3-year contract with Massport; 3-year contract with MBTA.	Bought P&G business, use manufacturing of fatty acid consumer products to pay for biodiesel side of business.	Overseas markets for biodiesel – Mexico City, Greece, Brazil. Other contracts with bus fleets in NY, NJ and CA.
US Generating Company	Recently announced two merchant plant projects. Developing natural gas projects in Charleton, MA and NY. Bagasse plants in FL declared bankruptcy.	Began as partnership in 1989 between PG&E and Bechtel. 17 IPPs are in operation.	To develop more IPP projects using all fuels but nuclear.
Vayda Energy Associates, Inc.	Working with new second farmer to demonstrate viability; now have support of Purdue.	Project three years in development. Attempted to build a demonstration unit at a chicken farm in VA.	To build small low-cost system. If successful, to build larger systems and expand to overseas.

Figure 1

CURRENT DEVELOPMENTAL STAGE OF TECHNOLOGIES

BIOMASS TECHNOLOGY DEVELOPER	FEASIBILITY	PLANNING	IMPLEMENTATION		
			PILOT	COMMERCIALIZATION	EXPANSION
Acno Technologies	████████████████████				
Arkercol	████████████████████				
Biofine, Inc	████████████████████				
Ciatech, Inc	████████████████████				
Chiptec Wood Energy Systems (1)	████████████████████				
Energy Research Corporation (ERC)	████████████████████				
Energy Transition Technology, Inc	████████████████████				
Future Energy Resources Corporation (FERCO)	████████████████████				
Fiber Fuel International, Inc	████████████████████				
GeneSyst	████████████████████				
Ingram Howell, L.L.C. (2)	████████████████████				
International Fuel Cells (FC)	████████████████████				
Masada Resource Group, L.L.C.	████████████████████				
NeutraSys	████████████████████				
New England Wood Pellets	████████████████████				
Pinnacle Biotechnologies International	████████████████████				
Polsky Energy Corporation	████████████████████				
Silting Motors Corporation	████████████████████				
Thermal Technologies, Inc.	████████████████████				
Twin Rivers Technologies	████████████████████				
U.S. Generating Company	████████████████████				
Vayda Energy Associates, Inc	████████████████████				

Key: ██████████ Completed pilot stage if small scale demonstration plant is in operation
 ██████████ Completed commercialization stage if first commercial size plant is in operation.

1) Chiptec manufactures and sells gasifiers to schools and state office buildings; the company purchased the technology.
 2) Ingram Howell plans to develop projects using the Arkercol technology.

Corporation have formally agreed to research and develop production pathways and better economics for certain bio-based chemicals used by Pure Energy in its fuel. The agreement specifies a research phase followed by the design, construction, and operation of a pilot plant for Pure Energy by Arkenol.

Champion International and the Great Lakes Chemical Corporation - one a supplier of the feedstock and the other a user of the product - have both invested in the Biofine technology. Stone and Webster has also been publicly supportive of the Biofine technology because of the possibility of becoming the engineering/construction firm on future projects.

Fluor Daniel was the A&E partner for an ERC fuel cell demonstration facility in California. Fluor Daniel prepared the site and designed the power plant. A California utility provided the site for the project.

The Polsky Energy Corporation has developed three biomass-fueled projects. When project financing is needed, Polsky employees will call investment-banking firms where they have contacts. They will assemble a package of information on the project. The bond underwriter will arrange for the financing and set up the meetings and presentations to potential bond buyers. For example, the U.S. Generating Company retained Smith Barney to be the bond underwriter for its two bagasse-to-energy projects in Florida.

Most developers believe that if a developer has a project with solid underlying economics, then he will find financing. However, if a technology has been demonstrated on a pilot scale only, then making the leap to a commercially-sized facility has been difficult for many of the developers interviewed.

Public/Private Partnerships

Public/private partnerships do exist, however there is little grant money available for many projects. ERC and Arhenol are two examples where the government has provided large sums of money to make public/private partnerships work.

The direct carbonate fuel cell technology has been jointly developed and financed by DOE, the Electric Power Research Institute (EPRI), and ERC over many years under a DOE-sponsored product improvement cooperative agreement. This technology has been recently demonstrated at a power plant built in Santa Clara, California.

Under a cost sharing agreement and partnership with DOE, Arkenol is combining its concentrated acid hydrolysis process with NREL's genetically engineered bacteria, "zymonas mobilis," to test the commercial viability of the combined process to produce ethanol from sugar cane wastes, softwoods and napier grass.

Bank Financing

Developers of technologies that have advanced to the point where several projects have been built use more traditional means of financing. For example, the New England Wood Pellets Company received a commercial bank loan for its second facility. Polsky Energy and the U.S. Generating Company have both used tax-exempt bonds to finance projects.

In-Kind Contributions

Several developers have reported nonmonetary services provided to them by other companies or government agencies. These contributions can equate to money when applying for cost-sharing grants or loans. For example, a California utility provided the site for a demonstration facility built for ERC. The Burlington Electric Department, Vermont, donated a site and labor for a FERCO project. Champion International was interested in having paper mill sludge be a feedstock for the Biofine technology and provided monies and promised \$80,000 of in-kind work including some analytical testing, which led the State of New York to provide matching funds to Biofine.

Other ways that developers report having used to locate financing are as follows:

- Asking for cash and expertise from business associates and friends.
- Maintaining personal contacts and relationships over time.
- Tracking relevant government solicitations.
- Reviewing Commerce Business Daily announcements.
- Getting on mailing lists for government solicitations.
- Attracting local investors in the community.
- Meeting people at conferences.
- Reviewing Internet information.
- Subscribing to news article clipping services.
- Having business lunches with potential investors.
- Keeping up with government clients.
- Contacting state and federal agencies by telephone.
- Learning about financial experts through published directories.
- Writing articles in trade publications.
- Publicity in newspapers; magazines, trade journals.

6.0 FINANCING RECEIVED TO DATE

The financing received by the developers as of the interviews in Spring 1997 is summarized here. Sweat equity is also given if unpaid labor hours have been tracked and translated into money. Some developers were more specific than others during the interviews about the amount of money they received and from whom. Only those developers that shared this information are mentioned in this section. The amounts presented here were noted from recollections during telephone conversations and not documented in writing, so that some may not be accurate.

Acricion Technologies received DOE Small Business Innovative Research (SBIR) Phase I and Phase II awards. The Phase I award was for \$60,000. However, sweat equity for Acricion Technologies has been in the hundreds of thousands of dollars over the last six years.

DOE awarded Arkenol a 50% matching grant of \$2.3 million through its Commercial Ventures program. Arkenol has a \$670,000 cost-share agreement with DOE NREL through the DOE Golden Field Office, Colorado.

Biofine has received \$6 million in financing. Biofine first received some funds in 1986 by NREL for testing feedstocks. The State of New York State provided \$300,000 after the initial test results. Champion Paper added another \$300,000 and promised \$80,000 of in-kind work. Friends and relatives of the three Biofine partners contributed \$150,000 for patents. Then, the DOE Office of Industrial Technology and Environmental Waste Programs awarded \$3 million to build the Biofine demonstration plant in Glen Falls, New York. Matching funds were provided by the Great Lakes Chemical Corporation, the State of New York, Biofine and BioMetics.

By the end of 1996, Cratech had spent \$1.5 million developing its wood-to-energy technology. Third-party funds came from the DOE Western Regional Biomass program, private funding, the states of Vermont, New York and Texas, as well as from EPA and DOD. This includes money for sweat equity but not for equipment. An independent auditor calculated that Cratech invested \$1.20 of private funds (friends, family and the developer) for every \$1.00 of state and federal funding.

ERC has recently completed a \$45 million demonstration plant using natural gas in a fuel cell in California. Project financiers were six California utilities, EPRI, NRCA, and DOE with some money from private investors and stock sales. ERC has found that large potential applications for their fuel cell technology are more interested in using natural gas than biomass for the fuel. Over a fifteen-year period, ERC has received over \$180 million from DOE, utilities and utility associations. For its biomass power program, ERC has earned three DOE contracts through the DOE Biomass Power for Rural Development Program. ERC has received funding from the DOE Great Lakes Regional Biomass Program and the

Western Regional Biomass Program. ERC has received \$140,000 in DOE grant monies which required matching funds.

Energy Transitions has spent hundreds of thousands of dollars in sweat equity to develop its turbo charger gas turbine that uses landfill gas. The American Gas Institute paid for tests they conducted on a lab version of the gas turbine.

The FERCO process has been under development for 17 years using only DOE funding. In the late 1970's, research on biomass-to-energy began at the Batelle Memorial Institute. A pilot plant was built there to test this as well as other technologies. Development costs paid by DOE have been approximately \$15 million. FERCO was founded in 1992 when the patents for the technology were purchased from Batelle. A private investor has provided approximately \$2 million to develop the technology to the point where a facility could be sited in Vermont in 1995. The investor was a friend of the founder. Since then, Weyerhaeuser received a \$600,000 DOE matching grant to do a feasibility study of using the FERCO technology at one of its mills. Weyerhaeuser has spent several million dollars of its own money studying gasification.

Fiber Fuel International has been privately funded since 1991. The company has raised \$2 million by selling equity through private offerings to a dozen investors. Fiber Fuel International had been offered a grant from DOE through the Tennessee Valley Authority (TVA). The company did not accept the grant because the grant language stated that TVA would have the first right to patents and licenses for any technology being developed under the grant. TVA had planned to fund only 5% of the project with the rest being privately financed. On another occasion, Fiber Fuel had to refuse a \$70,000 DOE grant because, according to the Securities Exchange Commission (SEC), its prospectus could only be distributed to qualified private investors.

GeneSyst has raised equity from about 100 private investors through selling privately-held stock. GeneSyst has received no loans, grants or subsidies. The owner has personally invested \$750,000 of cash. Some full-time employees are having their labor hours converted into stock. Some 15 to 20% of holdings in GeneSyst have been obtained in exchange for individual labor hours.

Ingram Howell received a \$200,000 loan from the Newfound Economic Development Corporation for project development activities for a proposed biomass-to-ethanol plant in Alexandria, New Hampshire.

IFC has been developing its fuel cell technology for 30 years. IFC has received millions of dollars from DOE, EPRI, the Gas Research Institute, several industrial partners (including gas and electric utilities) and from its parent corporation, United Technologies.

The Masada Resource Group has to date been internally financed. Partners have invested in excess of \$6 million.

Three employees of Neutralysis have invested a considerable amount of personal money into their corporation. Neutralysis received \$100,000 in grant monies from the State of

Wisconsin for site-specific research. Neutralysis could also have had a matching loan of \$500,000 from the State of Indiana but the economics of siting a plant in Indiana was not favorable because of low tipping fees for disposal of municipal solid waste. Neutralysis is currently developing a \$750,000 pilot plant that will be financed through EPA by a tax program. The pilot plant will take dredging spoils from the New York/New Jersey harbor and produce lightweight construction aggregate.

Several investors – family and friends – contributed \$200,000 to the New England Wood Pellets Company. The developer personally invested another \$200,000 in cash. The company received a loan commitment through the Small Business Administration for \$400,000 for its New Hampshire facility; however, five months later, the bank that is to provide the SBA loan still has not been able to close the loan. New England Wood Pellets has one major private investor, an "angel" who runs the books and is very involved with project operations. The investor loaned money at the prime rate of interest and has an equity share.

Pinnacle employees were on the staff of DOE NREL for 5 to 10 years. Last year, Pinnacle's technology was at a point where it could be successfully commercialized, so the technology proponents left NREL to start Pinnacle in order to reduce overhead and construction costs. Their initial DOE subcontract is for the construction of a process demonstration plant. Pinnacle owners have put a limited amount of their own funds into the company.

The Polsky Energy Corporation has two biomass-fueled projects in Canada that have been financed by Mutual Life of Canada. The Wood River plant in Illinois is being financed by Goldman Sachs & Co. and ABN AMRO, Inc.

Thermal Technologies' Camp LeJeune biomass-to-energy facility in North Carolina cost about \$3 million. Most of the funding was from the Strategic Environmental R&D Program of DOD and administered by EPA. Approximately \$100,000 has come from the North Carolina Energy Division.

Stirling Motors' private investors have contributed millions of dollars. Stirling Motors also received a \$160,000 cost-sharing grant from DOE.

Twin Rivers Technologies has received about \$7 million from limited partners, who are individual investors. Principals in the firm have also added some money.

The U.S. Generating Company has two bagasse-to-energy facilities in Florida that were financed mainly through \$288.5 million of industrial development bonds, that were floated by Palm Beach County through an allocation under the State of Florida's volume cap.

Vayda Energy spent \$100,000 of the owner's personal funds to build a prototype to prove viability, which made the project more saleable. Vayda wants to get a challenge grant from DOE. Vayda's experience with venture capitalists has not been positive. Venture capitalists wanted seats on Vayda's board and half of the equity; these terms would have led to the Venture capitalists' receiving \$1.5 million after five years from an initial

contribution of the \$25,000.

7.0 FUTURE FINANCING PLANS

The developers interviewed plan on financing the commercialization of their technologies using the various strategies listed below. A brief discussion of their specific plans follows the list.

- Licensing fees

- State and Federal grants, loans, and matching funds

- Bond financing

- Strategic partnerships with design, and construction firms or with product users or energy users

- Sales of equity to private investors, including venture capitalists

- In-kind contributions of site, labor, engineering costs, capital

- Sales of equity to funds that manage money from insurance companies and pension plans

- Sales of tax benefits to private companies

- Loan guarantees

Acrion plans to receive money from project developers who pay an up-front license fee to use its technology. The company is currently approaching landfill gas project developers who may be interested in using its technology.

Arkenol plans to continue to use federal grants and loans, investment banking sources, and strategic partnerships. Arkenol is developing these strategic partnerships with project developers and/or manufacturing companies that could use the chemical products that are made in the process.

Biofine has a partnership with Pencor to attract financing to its projects. Biofine is on the brink of receiving financing for a project in New York. Investment banks like Merrill Lynch are providing the funding.

Cratech plans to receive money from private investors, and EPA and DOE matching funds.

Energy Transitions plans to attract investors with tax credits (Section 29 of the Internal Revenue Code), who will buy equity interests in exchange for a capital investment. Energy Transitions also plans to obtain additional project financing from traditional sources, such as banks in connection with developing its landfill gas-to-energy projects. Because of difficulties in attracting bank loans, Energy Transitions plans to seek loan guarantees from Federal agencies such as the Small Business Administration (SBA) and the United States Department of Agriculture (USDA) Rural Development Program.

ERC plans to continue to seek financing from government sources like the DOE Carbonate Fuel Cell Program. ERC has entered into agreements with the Electric Power Research Institute and the National Rural Electrical Cooperative Association.

Half of the cost of FERCO's first commercial project will be paid by matching DOE funds

(\$15 million). FERCO is providing approximately \$3 million in cash and \$10 million in an in-kind contribution of site and labor by the Burlington Electric Department in Vermont. A gas turbine also will be provided by the Burlington Electric Department acquired with \$5 million in funds from DOE and FERCO. At the end of the project, Burlington Electric will have the ability to buy the facility for what FERCO invested in cash. This price will be less than half the cost of the plant.

Fiber Fuel International plans to continue to finance its business by having private offerings of equity.

GeneSyst plans to finance its first commercial facility with Federal tax-exempt bonds. This strategy was recommended by Oppenheimer, although it took 18 months to secure Federal tax-exempt status for the bonds. Oppenheimer of Boston will sell the tax-exempt bonds if GeneSyst will contribute \$2.5 million of its own equity and \$1 million in a cash reserve account.

GeneSyst is also researching a DOE Request for Proposals for small businesses. DOE has promised a list of eligible uses of DOE funding, none of which matches GeneSyst's needs. For example, DOE wants research to be done on wastewater disposal methods at the plant, but GeneSyst would rather identify the cost effectiveness of the mechanics of some aspect of the technology. GeneSyst believes a solution in the future is to talk to those at DOE who manage the list of fundable activities before it is published.

For its New Hampshire project, Ingram Howell plans to have traditional project financing using tax-exempt bonds with an equity partner that would construct and operate the facility. Ingram Howell is beginning to attempt to convince communities that will benefit from the facility to buy equity in the project.

IFC relies on the customer or project developer to provide financing, with the ownership of the equipment to be negotiable.

Masada is currently self-funded. The company is comprised of a number of people with financing experience who invested equity when they joined the group. Merrill Lynch will underwrite tax-exempt bonds when Masada goes to the market. Masada's Middletown, New York project will cost \$80 million in bonds and \$20 million in project equity from additional investors.

Neutralsys released an RFP for financing companies to underwrite the James River project. Robert Baird was selected to raise the capital. About nine months ago, Neutralsys hired William Blair, a financial advisory firm in Chicago, to model a private placement. Advantage, a subsidiary of Virginia Power, wants to own and develop a project in Chicago and will give Neutralsys an interest in exchange for the rights to use Neutralsys's technology. Neutralsys is talking to ENRON about providing capital and engineering to commercialize its technology.

New England Wood Pellets plans to build a \$2 million plant for conversion of green wood waste. After selecting the site, the company will be seeking investors to finance the

project. The access to raw materials will determine the facility's location. The developer is first looking in the State of New Hampshire for a potential site. New England Wood Pellets is applying for a DOE grant for energy conservation devices. Waste heat from a wood chip power plant could be used to dry the incoming wood waste to be more energy efficient. New England Wood Pellets is contacting power-marketing companies that plan to sell inexpensive power after deregulation. These companies appear interested in the company's energy efficient systems.

Pinnacle is seeking an equity investor, venture capitalist or strategic partner. The company would prefer to find a design & construction firm to be an exclusive partner. Pinnacle plans to use contacts in the field of chemical engineering to find suitable investors.

Polsky is seeking project financing for projects that have already signed a power or steam sales agreement. Polsky will seek to borrow money from a financing organization like a bank, or from other sources; such as, insurance companies, pension funds, or private investors.

Investors in Stirling Motors are businessmen who have been given seats on the company's Board of Directors. Two directors are in the automotive components business and thus familiar with engines.

Twin Rivers Technologies is a limited partnership. Its fatty acid division does not have a large margin, but is a good volume, stable business that finances the biodeisel division. Twin Rivers plans to continue to finance internally. CONEG may grant the State of Rhode Island \$45,000 to encourage marina businesses to use biodeisel from Twin Rivers to fuel their boats. Twin Rivers recently won a Massachusetts Bay Transit Authority (MBTA) contract that involves four buses operating on biodiesel for two years. This could lead to a \$15 million commitment to use alternative fuels as the means to comply with the Clean Air Act (CAA) Amendments of 1990. CAA compliance by MBTA is mandated by January 1998.

U.S. Generating is currently developing two natural gas power plant projects in the Northeast that will need to be financed. However, the bonds for the bagasse-to-energy projects developed by U.S. Generating are in default. The limited partnerships that own the plants filed for bankruptcy protection after Florida Power and Light filed a lawsuit claiming that the plants missed deadlines and were unreliable.

Vayda Energy manufactures fire logs from sawdust and waste and plans to invest the cash flow from this business in a chicken-litter-to-energy facility. Once the first unit is operational, Vayda will approach venture capitalists for financing.

8.0 FINANCING OBSTACLES

Developers described several obstacles to obtaining financing for their projects. The most frequently mentioned obstacle was the lack of available financing to develop the first commercial facility. Developers find that banks want to finance the third or fourth plant, not the first two plants. The first project to demonstrate a technology is thought to be risky with no guaranteed income. These projects have capital assets with 20-year lives but have not been demonstrated to work for 20 years. One developer found that making a presentation on his first project at an enterprise growth forum was premature because venture capitalists were more interested in participants that had operating power plants.

Public support is available for the early stages of development (research and pilot scale) but not for the later stages (commercial demonstration). However, approximately \$5 to \$10 million in development costs will be spent during the time between when a technology is patented to when bonds to finance a facility are sold. Developers have to first arrange for waste supply contracts, performance guarantees, siting and permitting before receiving financing.

Competition for tax-exempt debt through annual bond cap allocations is intense, especially if the money will be used for a privately-owned projects. Not paying attention to the timing of financing commitments can lead to problems. GeneSyst had to delay its application for tax-exempt bond financing to the State of Ohio until its underwriter was ready to sell the bonds within 60 days, because State approval is valid for only two months. Moreover, GeneSyst had to allow time for getting Federal (18 months) and State tax-exempt status.

The majority of financial companies need a minimum of \$25 million before they will underwrite bonds. Only five or six investment firms will finance projects in the \$10 to \$15 million range. GeneSyst made a presentation to a New York investment bank, but was rejected because the deal was less than \$20 million.

Developers have found that venture capitalists will provide financing but not on acceptable terms. For a relatively small investment, venture capitalists want to own the company. Biofine struggled to retain control when Champion wanted exclusive rights to the Biofine technology in exchange for providing \$1 million on a \$6 million project. The money was part of a finance package that DOE was going to match. This request was made after Champion had already provided several hundred thousand dollars; however, DOE and other companies had also invested over the years in the technology. The obstacle was surmounted when DOE asked Biofine to make an unsolicited proposal to replace the Champion funds, which was done by including Bio Metics, an affiliate of Biofine, as the designer and project sponsor.

The amount of time necessary to develop a biomass-to-energy project can be a barrier to financing. Permitting and development of biomass projects can take a long time, however five years is the longest that many venture capitalists will accept.

Some developers considered their ignorance of the business of raising money to be an obstacle. To compensate, one technology developer joined a project developer with a general partner who is a group of investors.

Another developer cited the frustration of not being able to communicate properly with foreign banks as an obstacle, although he reported that European community markets are more likely to pay for all aspects of developing a project as opposed to American banks.

Competition from natural gas and coal to be the fuel choice for new power plants is intense at this time of low fossil fuel prices. One developer believes that there is a lack of public interest in biomass technologies, therefore little value is placed on the industry. This lack of commitment to use biomass as an energy source becomes even more critical when fossil fuel costs are low.

Another obstacle is the limited amount of Federal financial assistance available and the resulting need to compete for these resources. For example, Energy Transitions has been advised to seek political support in the form of letters of support for its applications for loan guarantees from Federal agencies.

One developer cited the frustration of approaching commercial banks who will not finance capital-intensive projects. He also believes that banks consider pilot plants to be "failures" if some tests conducted at them fail. Developers believe many banks' lending criteria to be too rigid, inflexible and conservative to finance a biomass project.

Some developers think that the restructuring of electric utilities has made the utilities hesitant to sign power purchase agreements with new technologies, while others see restructuring as an opportunity that frees up money for investments in new but related energy technologies.

A few developers that manufacture products from biomass, rather than producing electricity, heat or steam, report that they have difficulty signing long-term market contracts. Potential users want to test the product before they will sign a contract. For example, Neutralysis makes a construction aggregate that companies want to first observe before they sign a sales agreement.

Being located within the City limits can preclude County financing as was learned by GeneSyst after applying to the Stark County Improvement Corporation in Ohio.

Siting power plants can be an obstacle to financing if they are regarded as noxious facilities, or the site may have characteristics that become problems when considered for development. Both Ingram Howell and Masada are experiencing delays due to their choice of sites for facilities.

9.0 INVESTOR REQUIREMENTS

In general, investors have certain criteria that must be met in order to make them feel comfortable with a project. All investors want a business plan and some require an equity portion in the project. Technology guarantees and a cash sinking fund of 10% of the operations may be required by investors to minimize project risk. Some investors want the partnership to be the exclusive licensing entity in the United States. Good patent protection is also important. Others want to know about your competition.

DOE SBIR grants require extensive Phases I, II, and III applications which include an economic analysis to show project viability.

A pro forma reveals your debt strategy; the further you take the pro forma, the more attractive to the investment community. Developers have found that investors want to see pro formas that extend past paying off project debt - a five-year pro forma is not long enough. A \$2 million project needs to have a 7 to 12 year pro forma and a \$10 million project needs to go 15 to 20 years.

A developer has to contribute at least 5% equity before investors will be interested in a project. The interest rate for financing is lowered as the equity in a project increases. For example, one developer reported that (in 1997) investors require a 9% interest rate for a tax-free note for 10 years with no equity, but if 40% to 50% equity is added, the interest rate will be approximately 7% per year. Besides equity, the proven ability of developers to actively participate in cost sharing is important, especially for public investors.

One developer found that both a technology feasibility study had to have been done and most of the waste supply contracts had to have been developed before financing was given. Also necessary are a construction contract and performance guarantees from an engineering construction firm that is liable for substantial liquidated damages. A power sales agreement or steam sales agreement is also important. An independent feasibility study is needed to verify a market forecast. Fiber Fuel International hired a top six accounting firm to do such a study to give them credibility.

Investors also like to see what a developer's "dream team" would be if the project is financed. Having someone in top management with an MBA is important.

A gas rights contract is necessary for landfill gas technologies. Also, evidence of the amount of gas in the landfill must be provided.

Some investors need an exit vehicle before they commit to providing funds.

10.0 INDEPENDENT THIRD PARTY REVIEWS

Eighteen out of the 22 developers interviewed had independent reviews conducted on their technologies. The independent reviews were often conducted internally by an engineering firm before it decided to become involved in a project. For example, Rust Engineering, Davey International and Process System International conducted engineering studies at landfills in conjunction with potential Acirion projects. Champion, Stone and Webster, R.W. Beck and Badger Engineering (now Raytheon) all reviewed the Biofine technology.

More formal third-party reviews for project financing are very comprehensive. Reviews involve evaluating a project's economics, its pro forma and end-product markets; biomass feedstock quantity, availability and pricing; environmental regulatory compliance and performance of any pollution control equipment; system performance, reliability and availability; and any contracts or agreements in place.

This level of detail is demanded by bond investors and is published in the official statements when the bonds are offered by the underwriter. Polsky Energy and the U.S. Generating Company are two developers in this study that have undergone such reviews.

The following are other types of reviews that have been conducted for the developers interviewed in this study:

The American Gas Institute conducted third-party tests on a lab version of Energy Transition's gas turbine.

EPRI has done a third party review of the ERC fuel cell technology. DOE hired a consultant to review the ERC technology as well as to protect its investment.

In the early stages of technology development, ICF Resources conducted a market study for FERCO.

Fiber Fuel International has had reviews of its technology done by Arthur D. Little, Raytheon, and R.W. Beck.

Alternative Resources Inc. conducted an independent third-party review for GeneSyst.

Ingram Howell internally evaluated several technologies before choosing Arkenol for its projects.

IFC has had multiple feasibility studies done of its technology. The literature contains many studies that have been done on fuel cells.

Masada has had third-party reviews preformed by R.W. Beck, DOE and DOE NREL.

The feasibility study being done by Alternative Resources, Inc. for Wisconsin Public Service on the Neutralysis technology is the third such study being done on the technology.

The Research Triangle Institute (RTI) reviewed the energy technologies submitted by seven companies, who made personal presentations and submitted written proposals to RTI before choosing Thermal Technologies for the Camp LeJeune facility.

Government auditors reviewed Stirling's work on previous government contracts.

Through the Massachusetts Strategic Environmental Partnership (STEP) program, the University of Massachusetts, Boston assembled a blue ribbon panel that performed environmental and economic assessments of Twin Rivers. Booz Allen also conducted an independent study of the Twin Rivers' technology.

R.W. Beck conducted a technology review of U.S. Generating's bagasse-to-energy projects for its underwriter.

Vayda Energy stated that an independent review has not been needed on its technology, but that the DOE Regional Biomass Program reviewed the technology before awarding any grants.

Cratech has not yet had a review done, however a booklet and published papers on its technology have been peer reviewed by other scientists.

Most developers stated that the independent reviews of their technologies were favorable. Often there is a list of issues that the engineer has as a result of the technology review. The developer has to satisfy the engineer that it mitigated any potential problems. The engineer will work with the developer to alleviate any concerns.

Developers mentioned the following issues that have been identified as a result of technical reviews:

- whether the amount of financing requested was sufficient to develop the project
- the impact of utilities deregulation on the project
- whether markets were adequate in size and variation
- if Federal subsidies (e.g., for ethanol) or a Federal tax exemption was included in the pro forma, and if so, the likelihood of receiving these advantages for this project
- the ability to guarantee the project
- the degree of complexity of the technology
- the presence of contingencies adequate to address future problems

the potential effects of feedstock impurities; e.g., concern over the non-homogeneity of municipal solid waste on ethanol production led to additional pilot testing, with varying amounts of plastic in the feedstock

if the ability to demonstrate continuous performance was in question, then the payments were linked to certain deliverables; i.e., equipment purchase or demonstration of continuous operation.

11.0 NETWORKING ACTIVITIES

Networking has been important to these technology developers. Many have reported meeting state and Federal government contacts at conferences, that has led to applying for matching funds or grants, or identification of sites for their facilities. A conference is where Twin Rivers was introduced to CONEG.

Some developers thought conferences are only worthwhile if you are on the program for presenting a paper or being a panel participant. Newspaper articles on your company or project have also been helpful in finding financing. Many articles on the Biofine technology were published in trade magazines. Pencor contacted Biofine after reading one of these articles. ENRON read an article about Neutralysis' association with the James River Company and when ENRON Capital was contacted by Neutralysis, ENRON was enthusiastic about the project.

Presenting your technology at conferences is good practice for making presentations to an audience of investors.

One developer thought that people in the bioenergy business should share more information, possibly working together on projects overseas, or passing on leads about potential sites and contacts in other states. Understandably, developers keep information about potential funding sources close to the vest.

Several developers belong to professionals associations. Pinnacle staff network with other chemical engineers at professional meetings. A few developers do not participate in conferences due to a lack of funding.

The following are networking events attended by developers and organizations that they belong to:

- DOE Regional Biomass Meetings
- Annual SWANA Conference
- International Biomass Conference of the Americas
- Annual BioEnergy Conference
- TAPPI (The Association of Pulp and Paper Industries)
- Power Gen
- National BioEnergy Industries Association, Washington, D.C. (202-383-2540)
- Pellet Fuels Institute
- Northeastern Pelletizer Association (716-492-2990)
- EPA Landfill Outreach Program
- National Biofuels Association, Washington, D.C. (202/530-5717)

12.0 FEDERAL AND STATE FUNDING SOURCES

The following is a list of government entities that have provided funding to the developers interviewed:

- DOE, EPA, DOD Small Business Innovative Research (SBIR) Program
- DOE Commercial Ventures Program has opportunities for emerging technologies for up to half the cost of a project
- DOE Office of Industrial Technology and Environmental Waste Programs
- DOE Biomass Power for Rural Development Program
- DOE Renewable Energy Office
- DOE Regional Biomass Programs
- DOE Alternative Fuels Group
- DOE Research Laboratories, including the Environmental Sciences Research Lab (ENRL)
- DOE Energy Conservation Grants
- DOE Renewable Energy Production Incentive
- Environmental Protection Agency, Research Triangle Park
- Department of Defense
- U.S. AID
- Electric Power Research Institute (EPRI)
- Local and State Finance Agencies
- States of New York, Wisconsin, Maryland, Massachusetts
- EPA Technology Development Assistance Grants
- MA Strategic Environmental Partnership Program
- State Emerging Technology Funds

13.0 OTHER GOVERNMENT SERVICES

New York State Energy Research and Development Authority (NYS ERDA) led the environmental permitting effort for the Biofine facility at Glen Falls, New York, and also disseminated information about the project to the public.

The State of California provided assistance to ERC when applying for siting permits for its California demonstration project.

The DOE Western Regional Biomass Program did a market study for Cratech.

Government agencies have provided permitting and guidance, siting assistance and job training to Fiber Fuel. The DOE Regional Biomass Programs (CONEG and SERBP) were helpful providing industry analyses, information on the general competition, and advice on marketing and sales strategies. The Georgia Department of Industry and Commerce was helpful in introducing Fiber Fuel International to the international community through participation in a trade mission. The agency promoted the company's literature at trade shows and when marketing in Asia and Europe. The U.S. Department of Commerce introduced Fiber Fuel International to the World Bank, various ambassadors and the Import/Export Bank. The Georgia State Capitol Library has international trade publications and provides guidance on how to do business internationally. Literature is also available on tax laws and structuring business ventures.

The State of New Hampshire has helped Ingram Howell with permitting guidance and siting assistance. The company has not yet filed for permits because the project is still conceptual and the company needs to first identify project financing.

Environmental permitting for the New England Wood Pellet facility was uncomplicated in New Hampshire, costing about \$500 in permit fees. In contrast, the company estimates that to permit the same plant in Massachusetts would have cost about \$50,000 because many more permits are needed.

The State of North Carolina provided cost sharing for promoting Thermal Technologies' technology, and the Research Triangle Institute provided permitting assistance for Thermal Technologies' Camp LeJeune facility.

Pinnacle received a \$5,000 grant from the Rocky Flats Local Initiative to aid displaced workers.

Twin Rivers Technologies has received significant assistance from the Commonwealth of Massachusetts: technology assessment, business planning (including political assistance in selling to the public sector), expedited permitting and guidance, siting assistance (including lobbying of officials by the Governor), technology demonstration and purchasing, technology transfer (including international contacts).

14.0 FAMILIARITY WITH PREFERENTIAL TAX-FREE FINANCING

Approximately 75% of the developers said that they were familiar with tax-free financing but not necessarily for waste processing facilities. Some said that although they were not personally familiar with the tax laws, their investment bankers are knowledgeable about this type of financing.

The tax incentives mentioned were:

- State tax subsidies for co-fired boilers

- Federal rebates for fuel cell purchases

- Federal tax advantages for gasifier installations (versus combustion installations)

- Tax advantages for biodeisel

- BTU tax credit (1%) for fuel crop biomass gasification

- Federal tax credit for landfill gas-to-energy equipment

15.0 ADVICE TO OTHER DEVELOPERS

Below is a summary of advice offered to other biomass technology developers by the developers interviewed for this study.

First of all, developers should all enjoy what they are doing but not depend on it for a livelihood.

Developers should maintain a sense of independence from the idea. Ideas take a long time to develop and it is a mistake to become wed to an idea too early. For instance, Acrion's technology has always fascinated the company's employees, but the process has evolved from coal gasification to low-quality natural gas to landfill gas.

Developers need to have patience, to be knowledgeable, and to persevere. The best developers are scientists and engineers with business skills. Skills that may be acquired through business courses are: how to write financial statements, how to keep the books, how to write grants. Learning the skills allows developers to avoid costly dependence on others for these services. One can also learn from stories written by others, such as anecdotes of those who have raised capital.

New developers should realize that the development process is long and complex requiring many resources and talents. Developers without all the necessary ingredients should focus on strategic partners to round out the team.

Developers should accumulate a portfolio of both financial and human resources. A successful firm needs a broad base of stakeholders motivated to make the firm succeed. Also, financing can be assembled from a number of sources for a single venture. One developer (ERC) raised funds through cooperative agreements, strategies, strategic partnerships and stock sales after many years of DOE funding.

Developers should investigate resources within their states, as well as within the Federal government, that can provide assistance. A developer needs to be able to write proposals and seek out all potential opportunities.

Developers should seek professional help, from paid consultants if necessary, in preparing business plans.

Developers should be aware that it is expensive to get a loan; at least 5% of project costs go toward obtaining financing. For example, the owner of the New England Wood Pellets spent about \$40,000 to obtain a \$350,000 loan. The smaller the loan, the larger percentage is spent on obtaining a loan.

Most developers need to establish more credibility in their markets before looking for financing. Even for a small enterprise, a developer needs more than one client to be credible. Developers should visit industry sites and develop a clear understanding of what

services or products the industries that they hope to serve really need. Developers must avoid becoming so infatuated with their technologies that they fail to focus on meeting the needs of their customers.

Developers in need of cash flow during the development phase of a venture should team with companies that already receive stable revenues but do not have exciting long-term prospects.

If overseas markets are being sought, a developer should consider a joint venture with a large oil company or project financier or company that will license the technology. However, assistance from inside the host country is also important. For example, Twin Rivers sells its biodeisel in countries where there is a favorable public policy climate, and where the company receives support from government insiders.

Developing biomass-to-energy plants is extremely competitive at this time of utility deregulation. Any builder of power plants is a direct competitor. Prices for natural gas and coal are so low at this time that biomass has a difficult time being competitive as an electricity producer. Renewable energy technologies need to have a captured waste stream or need to be sold as green power to justify the additional costs.

The commercialization process can be very long, especially if a developer lacks a steady financing source. Marketing and production along with development of the technology are very important.

16.0 CONCLUSIONS

In this final section, ARI evaluates, based on the information gathered in the survey, the premise that developers are not being successful because they lack access to financing. The current financing needs expressed by developers in the interviews are also reviewed.

Developers of biomass technologies can be classified into three groups based on the stages of development of their technologies. The first group comprises those in the feasibility and planning stages who rely on personal funds and government sponsors to finance their research and development work. The second group contains developers in the initial stages of implementation attempting to demonstrate their technology on a pilot or commercial scale for the first time. Developers in this phase continue to apply for government funding, but also approach private investors and explore relationships with investment banks and strategic partners. Developers in the third group have moved beyond their first commercial facility and are seeking to expand their markets. These developers have the ability to raise private capital through project financing.

Developers in the first group appear to compete successfully for government funds and other financing sources, as witnessed by the fact that all but one of the developers interviewed have progressed into the implementation phase. It is the second group of developers in the initial stages of implementation who experience difficulty in obtaining financing because they do not have a track record. Lack of financing can lead to delays, which translate into additional costs. The third type of developer appears to be successful at raising private capital. Based on information learned in the interviews, once a commercial facility is operating successfully, technology developers become successful project developers with the addition of business and financial expertise to their project management team.

No developers interviewed admitted failure in obtaining financing, but some are clearly more successful than others at finding financing and progressing towards commercialization. Except for Stirling Motors, who is internally financed, all the companies interviewed are seeking money at this time.

Companies interviewed that have received government funding and are not yet ready to seek private project financing are Pinnacle Biotechnologies, IFC, Cratech, ERC and Acron Technologies. As shown in Figure 1, these developers are still in the precommercialization or pilot stage of development and continue to rely on government funding to sponsor their research and development.

Developers who are attempting to build their first commercially-sized plant are in the most need of outside financing assistance. Biofine recognized this and responded by forming a partnership with Pencor. Companies at this stage that seem to be most hindered by a lack of money are Vayda Energy, GeneSyst, Neutralysis, New England Wood Pellets and Energy Transitions. Ingram Howell and Masada are experiencing delays in

commercializing their first projects but the delays are attributed to site suitability and acceptability issues rather than to financing difficulties.

A number of developers interviewed have built at least one commercial facility and express a fair degree of confidence in their ability to raise financing for additional projects. Arkenol and FERCO have developed their first plants but now need money to finance their subsequent projects. Fiber Fuel International has been successful in privately financing its business. Twin Rivers Technologies is successful at obtaining private financing but continues to seek public funding support because the sale of its product is linked to environmental and public policy goals. Polsky Energy and U.S. Generating appear to be capable of obtaining project financing as they have received financing before.

The challenge for the DOE NRBP and CONEG, and for other such government organizations and affiliations that want to promote the use of biomass-to-energy technologies, is to find ways to channel financing to those developers in the second group who are in the initial stages of implementation.

This might be done, for example, through encouraging the arms of Federal agencies with funding mandates to:

- provide loan guarantees which make the risk of first-time commercialization acceptable to traditional bank financing sources;
- enter into public/private partnerships with developers where the agencies make long-term commitments to the success of the technologies; and
- continue to provide matching funds and seed money to make pilot and commercial projects attractive to private investors.

The NRBP and CONEG could also assist developers to identify potential state government fund managers and private investors, and educate these financing sources on promising biomass-to-energy technologies.

APPENDIX A

**NRBP STUDY ON EVALUATING INVESTMENT OPPORTUNITIES
FOR BIOMASS ENERGY PROJECTS**

QUESTIONNAIRE FOR BIOMASS TECHNOLOGY DEVELOPERS

Company:_____

Location:_____

Date:_____

Phone:_____

Interviewer:_____

Contact:_____

NRBP STUDY ON EVALUATING INVESTMENT OPPORTUNITIES FOR BIOMASS ENERGY PROJECTS

QUESTIONNAIRE FOR BIOMASS TECHNOLOGY DEVELOPERS

Introduction:

Explain purpose of call and **briefly** describe NRBP study.

Explain where we got their name from.

Are you in fact a developer of biomass energy technology?

Explain why it is to their benefit to participate in this survey.

This conversation will take about 15 minutes of their time.

Describe confidentiality policy – let them review draft beforehand if we specifically refer to them in case study.

Will provide them with a copy of the NRBP study and an invitation to the fall forum.

Are you willing to participate in our study?

Begin Interview:

Time: _____

1. Briefly describe your technology.

2. At what stage of development are you at this time?
 feasibility
 planning
 implementation – pilot, commercialization, expansion

3. Describe any earlier stages of development (with a time line).

4. Do you have a formalized business plan?
5. What are your future development plans?
6. What are your project financing plans?
7. Have you received financing thus far? Can you tell me from whom and in what amounts?
8. What obstacles, if any, have you encountered thus far in finding financing?
9. What strategies have you used to obtain financing?
e.g. business planning
investor forms
loan/grant writing
public/private partnerships
partner affiliations
other
10. How did you locate financing source(s)?

11. What individuals/organizations have proved most valuable to you in your search for financing?
12. If you have received outside financing, what did the investor(s) require before they gave you funding?

e.g. a business plan
an equity portion
management structure
pro forma
feasibility study
cash contingency fund
confirmation of the viability of the technology
13. Can you tell me how much money did you need to put into the project yourself thus far?
14. Have you looked into federal and/or state funding sources? Which ones?
15. Do you network attend conferences, belong to trade associations? Which ones? Are they helpful in finding financing sources?
16. What kind of financing and credit enhancements have you received? And from whom?

e.g. debt
equity
loan guarantees
tax advantages
matching funds

17. Are you familiar with preferential (tax-free) financing for certain waste processing projects?
18. Have you received any services from federal/state economic development agencies? If yes, from whom?
 - e.g. technology assessment
 - business planning
 - expedited permitting and guidance
 - siting assistance
 - technology demonstration and purchasing
 - technology transfer
 - market assistance
19. Have you undergone an independent, third-party technology review (or feasibility study/due diligence)? If yes, from whom?
20. If so, what issues (if any) were identified that could affect financing?
21. Are you interested in learning about what conferences are held by trade associations for renewable energy industries?
22. Are you interested in receiving additional information on financing opportunities? e.g., names of potential investors, financing networks, forms, and databases.
23. Are you interested in possibly attending the CONEG forum in Fall 1997 described at the beginning of our conversation?

24. Can you send me any literature available on your technology and project?
e.g., a flyer, project description, published article, business plan, feasibility study

25. What advice would you give other developers starting out or to those entrepreneurs who cannot find financing?

26. Is there anything else, or anyone else, that I should be talking about or to, related to these issues?

Thank you for your time.

Time: _____

APPENDIX B

**NRBP STUDY ON EVALUATING INVESTMENT OPPORTUNITIES
FOR BIOMASS ENERGY PROJECTS**

INDIVIDUALS / ORGANIZATIONS VALUABLE IN SEARCH FOR FINANCING

APPENDIX B

INDIVIDUALS / ORGANIZATIONS VALUABLE IN SEARCH FOR FINANCING

The following is a list of personal contacts and organizations that have provided assistance to the developers in obtaining financing:

Business associates and friends with deep pockets
Government contacts and customers
Bond underwriters
Financial management consultants
Hugh Guthrie and Charles Beyer, DOE, Natural Gas Group, Morgantown, West Virginia
Judy Jarnefelt, Jeff Peterson, Larry Hudson, New York State ERDA
Pencor and its development arm, Environmental Ventures, L.P.
Hervey Scudder, Windrush
DOE NREL Investor Forums
DOE Regional Biomass Programs
Local industry leaders can help find investors
Local Chambers of Commerce
Bear Stearns
Merrill Lynch
Oppenheimer and Co., (Elizabeth Jick, Susan Winshall in Boston)
Smith Barney (Walter Kulakowski in New York)
Robert Baird
Goldman Sachs
New York Power Authority
Developers themselves if they have investment banking experience
Public Service of New Hampshire
Jack Dugan, Keene Industrial Development Corporation
William Pillsbury, State of New Hampshire
Mutual Life of Canada
Coalition of Northeastern Governors
NESCOM
Maryland Business and Economic Development Agency
DawnBreaker, Rochester, New York
William Blair, Chicago, Illinois
Newfound Economic Development Commission, New Hampshire
Advantage, subsidiary of Virginia Power
Rui Alfonso, New England Power Company
Northeastern Utilities
Southern California Gas Company
Center for International Business

Champion International
Great Lakes Chemical Corporation
United Technologies
Gas Research Institute
Winrock International
John Cleland, Research Triangle Institute
U.S. Aid
World Bank
Export Import Foundation
Linda Hurwitz, American Equipment Leasing, Boston, MA
Burlington Electric Department, Vermont
ENRON Capital
Bank of Boston (Bank Boston)
Massachusetts Development Finance Agency
David Lutes, Envirotechnology Industry Specialist, State of MA
Gordon Carr, Greater Boston Regional Office Director for Economic Affairs
Environmental Facilities Corporation (EFC), New York
Empire State Development Corporation, New York
Ed Von Stein, Technology for Connecticut (Tech Conn) – 860/437-4645

Other contacts that were recommended as being knowledgeable about the biomass-to-energy field:

Lee Lynd, Dartmouth Thayer School, Research Center for Biomass – 603/646-2231
National Biomass Energy Association
Ed Neuhauser, Niagara Mohawk Power Corporation – 315/428-3355
UBECA (Utility BioEnergy Commercialization Association, a trade association of utilities interested in biomass, Paula Edison – 202/296-8663
Minnesota Valley of Alfalfa Producers, Chris Hanson, Project Manager–612/625-5747
Iowa Cheraton Valley Resources Conservation and Development
Jim Cooper, 515-437-4376
Barbara Shine, Dry Creek Pellets – 716/492-2990
Averill Cook, Catamount Pellet Fuel – 413/743-8212
Ed Poitras, The McBurney Corporation – 770/925-7100
James Ford, Tondu Energy – 713/961-4222
Dan Robison, Hardwood Research Cooperative
Tim Maher, Energy Efficiency Associates – 802/223-6918
Evan Hughes, EPRI – 415/855-2179

APPENDIX 2

State Programs Supporting the Financing Needs of Biomass Development Projects

1.0 CALIFORNIA

Financial assistance is available to qualified businesses in California through the California Energy Commission and the California Pollution Control Financing Authority, as described below.

CALIFORNIA ENERGY COMMISSION

1516 9th Street
Sacramento, CA 95814
916/654-4531
916/653-8251 fax

www.energy.ca.gov/energy/renewables

PROGRAM	TYPE	AMOUNT	CRITERIA	NOTES
Renewables Program to support existing, new, and emerging renewable technologies from 1998 through 2001.	Production incentive.	Cap of 2.5 cents per kilowatt-hour.	Existing technology.	Generators must apply for and receive certification from the Energy Commission to be eligible to receive monthly payments for their renewable generation. Funds for existing technologies may decrease annually to encourage the development of increasingly competitive technologies.
See above.	Production incentive based on a competitive solicitation process.	Cap of 1.5 cents per kilowatt-hour. No single project can receive more than 25 percent of these funds.	New technology.	Funds will be paid over a four-year period after a project begins generating electricity. The amount of funds may increase annually.
See above.	Rebates, buy-downs or equivalent incentives to purchasers, lessees, lessors, or sellers of eligible electricity generating systems.	None.	Emerging technology.	Eligible technologies include fuel cell technologies that use renewable fuels.

CALIFORNIA POLLUTION CONTROL FINANCING AUTHORITY (CPCFA)

915 Capitol Mall, Room 466

Sacramento, CA 95814

916/654-5610

916/ fax

<http://www.treasurer.ca.gov/cpcfah.htm>

PROGRAM	TYPE	AMOUNT	CRITERIA	NOTES
California Capital Access Program (CalCAP)	Loan portfolio insurance for lenders to qualified small businesses.	Maximum loan amount is \$2.5 million. Maximum premium CPCFA will pay is \$100,000 per loan.	Must be an industry listed in "qualified" SIC codes list. Primary business and 50% of its employees or business income, sales or payroll must be in California. Business activity must be created and retained in California. Must be classified as a small business by USSBA or have fewer than 500 employees.	For acquisition of land, construction or renovation of buildings, the purchase of equipment, other capital projects and working capital.
Small Business Pollution Control Tax-Exempt Bond Financing Program	Tax-exempt bonds.	Minimum of \$1 million, maximum of \$20 million.	Must be classified as a small business by USSBA or have less than 500 employees. Projects must abate, eliminate, prevent, or control pollution or solid waste disposal.	For acquisition of land, buildings, fixtures, furnishings, machinery or equipment, as well as architectural, engineering, surveying, permitting, and other costs.

2.0 CONNECTICUT

A search for economic development programs should begin at the Connecticut Economic Resource Center (CERC). CERC is a nonprofit corporation, which functions as a clearinghouse for information and services, and directs inquiries to the appropriate public or private source.

Connecticut Economic Resource Center
805 Brook Street, Bldg. 4
Rocky Hill, CT 06067-3403
Tel: 800/392-2122
Fax: 203/571-7150

CONNECTICUT DEVELOPMENT AUTHORITY (CDA)

999 West Street

Rocky Hill, CT 06067

Tel: 860/258-7800

Fax: 860/257-7582

www.state.ct.us/cda/cdaprogs.htm

PROGRAM	TYPE	AMOUNT	CRITERIA	NOTES
Direct Loan Program	Junior participation or subordinated loan participation with partnership leaders.	Up to \$5 million; or no more than \$20,000 per job created or retained.	Strong economic development potential, and/or loan cannot be made without CDA. Proceeds must improve business; personal guarantee required; debt service capability is evident; collateral appropriate to transaction.	Terms vary from 1 to 3 years for revolving lines of credit; up to 25 years for real estate mortgages.
Inducement Rate Loan	Direct loan with below market rates.	Up to \$10 million; or no more than \$20,000 per job created or retained.	See above.	For manufacturing, industrial research or product development or distribution. Targeted to companies expanding in or relocating to Connecticut.
Loan Guarantee Program		Up to 40% of principal balance; over 40% for extraordinary opportunities.	See above, except no collateral requirement.	For working capital, equipment, real estate, guarantee performance, etc.
Self-Sustaining Revenue Bonds	Tax-exempt bonds. (Also offers taxable bonds and tax increment bonds for major economic development projects).	Up to \$10 million.	Must be manufacturer or eligible non-manufacturing projects, including water, waste disposal, sewage for government, 501(c)(3) corporations, redevelopment projects. A company's total bonds outstanding nationwide are limited to \$40 million.	For land acquisition, construction or addition, new equipment, or purchase of real property.
504 Program	Loans through the Connecticut Business	No limit. CBDC portion up to	Must be a for-profit entity generating active income, established for at least	For equipment, machinery, owner-occupied buildings, land,

PROGRAM	TYPE	AMOUNT	CRITERIA	NOTES
	Development Corporation (CBDC), a certified development company under the Small Business Administration.	\$1 million. Repayment period is 20 years for real estate and 10 years for equipment.	3 years; net worth less than \$6 million; after-tax profit of less than \$2 million; fewer than 500 employees. Must occupy 51% of existing building to be financed or 66% of new building to be financed.	renovation, leasehold improvements. Ineligible for working capital, venture capital, debt consolidation, refinancing.
URBANK	Loan insurance.	Up to \$500,000.	Demonstrated ability to repay through historical operations and reasonable cash flow projections.	For businesses in New London or Windham Counties or in 25 targeted municipalities.
Entrepreneurial Loan Program	Loans from People's Bank insured by CDA.	Up to \$50,000.	Must successfully complete Entrepreneurial Center business training program. Must be starting or expanding a for-profit business that is ineligible for any other financial assistance. Must have strong character record. Not necessary to own collateral or have a positive credit history. Adverse personal credit history acceptable, if caused by external factors such as job layoff, divorce, or illness. Public assistance recipients will be considered.	For business start-up or expansion of an existing business and supported by the business plan.
Environmental Assistance Fund	Direct CDA loan or guarantee of bank loans	Up to \$250,000	Project must be approved by the Connecticut Hazardous Waste Management Service as reducing the use of hazardous and toxic substances in the manufacturing process.	For manufacturers with less than 150 employees or revenues less than \$25 million.

3.0 MAINE

The Maine Department of Economic and Community Development has prepared a manual that includes all the financial resources, training, programs and incentives that the State of Maine has available for private business, including programs offered by the Finance Authority of Maine (FAME) and the Maine Science and Technology Foundation.

FINANCE AUTHORITY OF MAINE (FAME)

83 Western Avenue
 P.O. Box 949
 Augusta, ME 04332-0949
 207/623-3263
 207/623-0095 fax
 www.famemaine.com

PROGRAM	TYPE	AMOUNT	CRITERIA	NOTES
SMART-E Bond Program	Secondary market tax-exempt bonds	Up to \$7,000,000	Manufacturing; Must demonstrate strong likelihood to repay debt	For land or depreciable assets. Provides a low, fixed or variable interest rate on 90% of a loan for up to 15 years.
SMART Bond Program	Secondary market taxable bonds	Up to \$7,000,000	Must demonstrate strong likelihood to repay debt.	For real estate, equipment or other fixed assets. Provides issuance for up to 90% of the loan.
Major Business Expansion Program	Similar to SMART Bond Program	Up to \$25,000,000	For larger Maine businesses to significantly expand operations in Maine. Must demonstrate strong likelihood to repay debt.	
Revenue Obligation Securities Program	Tax-exempt industrial revenue bonds (IRB's)	No specified limit.	Must be allowed under US Internal Revenue Code, including manufacturing facilities, solid waste projects and loans for non-profit corps.	For land, buildings, machinery and equipment, financing and interest charges, engineering, legal services, surveys, cost estimates and studies.
Commercial Loan Insurance Program	Loan insurance	Up to \$7,000,000 (\$2,500,000 on recreational projects)	Must demonstrate loan repayment ability; be located in Maine; have sufficient collateral to meet statutory loan to value standards; demonstrate public benefits such as job creation and retention, increase in municipal tax base.	Provides insurance for up to 90% of the loan. For purchase of, and improvements to, real estate, fishing vessels, machinery and equipment, and working capital.

PROGRAM	TYPE	AMOUNT	CRITERIA	NOTES
Regional Economic Development Revolving Loan Program	Loans	Up to \$200,000 but prefer \$100,000 or less	Must have fewer than 50 employees; create or retain quality jobs.	Loans may not exceed 1/3 of new funds being provided to any borrower.
Small Business and Veterans' Small Business Loan Insurance	Loan insurance	Up to \$1,000,000 (or 90% of a Small Business loan). For wartime veterans, up to 100% of \$75,000 or less, and up to 90% of a loan of up to a maximum of \$1,100,000.	Must employ 50 or fewer employees or have gross annual sales of \$5 million or less. Must demonstrate loan repayment ability.	For small businesses that cannot obtain conventional commercial financing. Considerations include public benefit of project and adequacy of collateral.
Small Enterprise Growth Fund	Venture capital	Up to \$150,000 on a matching basis	Industries with high rate of growth and job creation, including marine science, biotechnology, manufacturing, exporting, software development, environmental sciences, value-added natural resources.	Allows investments to be repaid according the cash needs of the company. Payment deferrals may be allowed. Will accept royalty structures or warrants.

MAINE DEPARTMENT OF ECONOMIC AND COMMUNITY DEVELOPMENT (DECD)

59 State House Station
Augusta, ME 04333-0059
207/287-2656
207/287-5701 fax

PROGRAM	TYPE	AMOUNT	CRITERIA	NOTES
Tax Increment Financing	Local tax increment	Varies	Any business making significant capital investments within a municipality such that the municipality is willing to provide financial support through use of the revenue stream of new property taxes resulting from these investments.	The municipality can issue bonds (which are retired using the tax increment) or pay the tax increment directly to the investing business to cover project costs.
Business Assistance Program	Local loan or grant	Up to \$300,000	Has a significant impact on local or regional economy and requires financing to carry out an economic development project leading to creation or retention of jobs principally for low and moderate income persons. Not eligible if located in Auburn, Bangor, Lewiston, or Portland. Must demonstrate that all other financing opportunities have been exhausted.	Program provides grant to local government to loan or grant to finance fixed assets including capital equipment, commercial or industrial buildings, fixtures or property improvements.
Development Fund Loan Program	Loan	Up to \$100,000 of "gap" financing for up to 40% of development activities	Must create or retain jobs for low and moderate income persons and must require "gap" financing that cannot be obtained from other public sources.	For either fixed asset investments or working capital.

MAINE SCIENCE AND TECHNOLOGY FOUNDATION (MSTF)

87 Winthrop Street
Augusta, ME 04333
207/287-6350
207/287-6369 fax

PROGRAM	TYPE	AMOUNT	CRITERIA	NOTES
Maine Technology Investment Fund	Direct investment or loan.	Not specified.	A business located in Maine in a target industry such as biotechnology, composite materials, or environmental sciences and technology.	For a business with a technology that can lead to product or process innovation. Investments target funding for the next step required to bring a promising idea from "the bench" to commercialization.

4.0 MASSACHUSETTS

The Massachusetts Office of Business Development (MOBD) serves as the central clearinghouse for companies seeking State assistance. MOBD is a state agency that coordinates the services of the multiple quasi-public and private entities which provide financial (and technical) assistance in Massachusetts, including the Massachusetts Development Finance Agency (MDFA). The programs listed for MOBD are offered by other entities with which MOBD coordinates.

MASSACHUSETTS DEVELOPMENT FINANCE AGENCY (MDFA)

75 Federal Street
 Boston, MA 02110
 617/451-2477
 617/451-3429 fax
 www.magnet.state.ma.us/mdfa

PROGRAM	TYPE	AMOUNT	CRITERIA	NOTES
Tax-Exempt IDBs*	Industrial Development Bonds	\$1.2 million recommended minimum; federally imposed maximum of \$10 million	Must be located in Massachusetts and create or retain jobs. Total capital expenditures may not exceed \$10 million within the same municipality, three years prior to and three years after issuance of the IDB.	For purchase of land, buildings or equipment; construction or renovation of buildings. Possibly for refinance of existing debt. Must expend bond proceeds within three years of date of issuance.
Taxable Bonds	Taxable Bonds	No limit	Must be located in Massachusetts and must create or retain jobs.	Well-suited to major industrial and commercial real estate projects for purchase of land, buildings or equipment; construction or renovation of buildings. Possibly for refinance of existing debt. May be exempt from state income taxes.
Tax-exempt and taxable bonds for 501(c)(3) non-profits	Tax-Exempt Bonds	No limit	Must qualify as a 501(c)(3) not-for-profit located in Massachusetts. For-profit assisted living facilities may qualify if certain Federal tax code requirements are met.	Exempt from state and federal income tax. For purchase of land, buildings or equipment; construction or renovation of buildings. Possibly for refinance of existing debt.
Tax-exempt and taxable bonds for environmental projects	Taxable and Tax-Exempt Bonds	\$1.2 million recommended minimum; no maximum	Qualified solid waste, hazardous waste, wastewater treatment, and energy generation projects. Must be located in Massachusetts and create or retain jobs.	For purchase of land, buildings or equipment; construction or renovation of buildings.

PROGRAM	TYPE	AMOUNT	CRITERIA	NOTES
Predevelopment Assistance	Grants, one-to-one match	\$5,000 - \$25,000	Must offer potential economic benefit and location in Economic Target Area	For pre-construction including engineering, environmental testing, appraisals
Direct Loan/ Guarantee Program	Loan	Loans up to \$3 million for a maximum term of 18 years.	Must demonstrate: need for financing due to insufficient available funds; commitment to job retention/ creation and community revitalization	Can be used to acquire, renovate or construct property. Industrial park land acquisition and infrastructure improvements can be financed with a construction loan to be repaid from parcel sales.
Tax-exempt Lease/Purchase Financing Program	Installment purchase	\$300,000 or more	Must meet eligibility requirements of industrial development bonds or must qualify as a 501(c)(3).	MDFA leases the equipment and subleases it to the borrower; at the end of the lease term, the borrower owns the equipment.
Emerging Technology Fund	Loan guarantees	\$1.5 million or one-half of total borrowing need, whichever is less	Strong management team, technical feasibility, market demand.	Tenant build-out; to construct or expand facilities; to purchase new equipment.
Emerging Technology Fund	Loans	\$2.5 million or one-third of total borrowing need, whichever is less	Strong management team, technical feasibility, market demand.	To construct or expand facilities, or to purchase new equipment.

*Generally, all available tax-exempt funds are subject to eligibility requirements of the Federal Tax Code, and require uniform cap allocation (with some limited exceptions) from the Commonwealth.

MASSACHUSETTS OFFICE OF BUSINESS DEVELOPMENT (MOBD)

One Ashburton Place, 21st Floor

Boston, MA 02108

617/727-3206

617/727-8797 fax

www.state.ma.us/mobd/finance2.htm

PROGRAM	TYPE	AMOUNT	CRITERIA	NOTES
Capital Access Program	Loans.	Up to \$500,000.	Company's annual sales must not exceed \$5 million. Must be authorized to do business in Massachusetts.	For small business unable to obtain financing through conventional means.
Venture Capital Fund	Debt and, occasionally, equity financing.	\$100,000 – \$300,000 with CDFC providing up to one-third of total financing.	For working capital, expansion or acquisition costs.	
Commonwealth Enterprise Fund (CEF)	Equity or subordinated debt financing.	\$100,000 – \$300,000.	For minority and disadvantaged firms.	CEF is a Specialized Small Business Investment Company (SSBIC) that is licensed by US Small Business Administration. CEF was developed by the Community Development Finance Corp. and the Massachusetts Minority Enterprise Investment Corp., a multi-bank community development corporation.

NOTE: CDFC = Community Development Finance Corp., a quasi-public organization providing flexible financing for small business and real estate development projects. Its primary interest is to create jobs, commercial revitalization and business ownership in low-income communities.

MASSACHUSETTS EXECUTIVE OFFICE OF COMMUNITIES AND DEVELOPMENT (EOCD)

100 Cambridge Street
 Boston, MA 02202
 617/ 727-7001
 617/ 727-4259 fax

PROGRAM	TYPE	AMOUNT	CRITERIA	NOTES
Community Development Fund	Community grants - single town and regional planning agency.	\$100,000 to \$800,000.	Must meet HUD national objectives: low income, blight, critical area.	Planning, acquisition, technical and capital assistance to non-profit and small businesses, infrastructure, streetscape and downtown revitalization.
Ready Resource Fund	Community grants - single town, and regional planning agency.	Maximum \$500,000.	Must meet HUD national objectives: low income, blight, critical area.	Planning, acquisition, business loan fund programs, infrastructure.
Massachusetts Community Capital Fund	Grants to communities who then make loans to local private businesses.	\$100,000 to \$500,000 per year. Maximum is one-third of total project cost.	Job creation/retention for low-moderate income persons. Demonstrated need. Creditworthiness.	May be used for working capital, refinancing, real estate acquisition, new construction or rehab, and capital equipment.
Loan Guarantee Program	Loan guarantees for a variety of economic development activities.	\$500,000 to \$5 million.	Guarantee up to 40% of project costs.	Acquisition, rehab, construction, interest and relocation payments.
Municipal Incentive Grant Program	Community grants for primarily planning studies.	Maximum \$50,000.	Up to 10% cash matching requirement	Capacity building, service and innovation, strategic planning.

NOTE: These programs provide grants and loan guarantees to non-entitlement communities (less than 50,000 population) for economic development.

5.0 NEW YORK

The search for economic development programs in New York State should commence at the Empire State Development Corporation. Information should be obtained at the appropriate regional office for information.

EMPIRE STATE DEVELOPMENT CORPORATION

One Commerce Plaza
Albany, New York 12245
518/486-6291
www.empire.state.ny.us

PROGRAM/TYPE	AMOUNT	CRITERIA	NOTES
Direct loans for a portion of the cost of a project.	Not Available	Companies that plan to locate, expand or modernize their facilities in New York State.	Generally for acquisition of land and buildings or machinery and equipment. Also fund construction or renovation of buildings or the infrastructure and working capital required for the establishment or expansion of an eligible company.
Interest rate subsidies to reduce the cost of borrowing from private- or public-sector financial institutions, in the form of a grant or linked deposit with the lending institution.	See above	See above	See above
Loan guarantees for working capital assistance.	See above	See above	See above
Loan and grant combination for a portion of the cost of an infrastructure project.	See above	See above	See above
Investment and wage tax credits to encourage the creation of jobs in Economic Development Zones.	See above	See above	See above

NEW YORK STATE ENVIRONMENTAL FACILITIES CORP. (EFC)

50 Wolf Road

Albany, New York 12205

800/882-9721 or 518/457-4222

518/485-8773 fax

www.nysefc.org

PROGRAM	TYPE	AMOUNT	CRITERIA	NOTES
Industrial Finance Program	Loans through sale of special obligation revenue bonds (tax-exempt or taxable).	Case specific, no limit.	Only for solid waste management, sewage treatment, resource recovery, inactive hazardous waste site remediation, hazardous waste disposal, and water supply and management.	For construction, land purchase, engineering, equipment purchase, etc.

NEW YORK STATE ENERGY RESEARCH AND DEVELOPMENT AUTHORITY (NYSERDA)

Corporate Plaza West
286 Washington Avenue Extension
Albany, New York 12203-6399
518/862-1090
518/862-1091 fax
www.nyserdera.org

PROGRAM	TYPE	AMOUNT	CRITERIA	NOTES
Research and Development Program	Grant	Up to 50% of project cost up to maximum \$200,000	Available to commercial, industrial, residential and utilities for eligible technologies including biomass.	
Linked Deposit Program	Loan Subsidies through Empire State Development Corp.	2 to 3% lower than prevailing rates, up to maximum of \$500,000 for up to 2 years	Manufacturing business with 500 or fewer employees. Existing businesses only.	Must be for an energy improvement or business expansion. Not for refinancing.