Road Map to the Commercialization of
Next-Generation Biofuels – Part II

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In Part I of this series, we examined the development pathway that will take next-generation biofuels technologies into commercial facilities. The steps in that pathway are the same for any large capital project, including a feasibility study, project scoping, detailed design, procurement, construction, start-up and performance testing. Such an approach is expected by traditional financial institutions and is time-tested to be the best approach for large capital projects. In execution of these steps, however, there is latitude in construction contracting and financing methods. The available options for both and their applicability to next-generation biofuels technologies are discussed in this paper.

Construction Contracting Methods

The source of project funding will typically impact the contracting style that is utilized for the project. The three main contracting formats are cost-reimbursable, fixed-price, and engineer-procure-construct (EPC) with a performance guarantee. Each of these is detailed as follows:

Cost-Reimbursable

Often referred to as time and materials, this cost is defined by hourly labor rates, a mark-up percentage on equipment and sub-contracts, and a contractor fee. This approach is usually best for projects that are not fully defined at the point of starting construction and when the schedule drives the project. This approach leaves most of the cost risk with the owner and can often provide the lowest project cost, if the contract is managed well. The downside of this contract style is a lack of cost cap, which can be a problem if not properly managed. If the owner lacks construction management experience, particular attention should be paid when hiring an outside engineering firm to assure that they will able to provide this service.

Fixed Price

When the engineering is complete and the project schedule allows, multiple contractors can bid on the project to be completed under a fixed price for the scope of project outlined. This is generally the favored approach for projects for which the technology is proven, the design is set, and major changes during construction are not anticipated. The fixed-price approach is less desirable when changes occur during construction, be they from unknown site conditions or process changes. Significant change orders can lead to major cost overruns. The contractors also will include a risk premium when determining a fixed price; typically this premium adds 10-15% to the cost of a properly managed cost reimbursable project.

<u>EPC with a Performance Guarantee</u>
This is a turnkey project in which the owner is purchasing a fully operable facility for a fixed price. The contractor will be responsible for all phases of the project process, from detailed design through performance testing, including guaranteeing that the project passes its performance test. This performance guarantee combined with the fixed price for engineering and construction is referred to as a project "wrap." This approach is often preferred by banks as the entire project has a fixed overall price with a guarantee of performance. The downside of the EPC with wrap approach is that it generally carries a 30% - 100% overall project cost premium for the contractor to assume all the risk.

The primary differences among these contracting mechanisms are the types of risk and the entity who accepts responsibility for those risks. In general, the performance guarantee is seen as a larger risk than the cost of construction guarantee and is not typically available for emerging technologies. While there are companies that provide the underlying production process for traditional industries such as corn-based ethanol (called the "process provider"), no similar entity for cellulosic ethanol and algal-based biofuels exists. This does not imply a lack of companies with second-generation technologies; they just have not demonstrated their technologies at a significant enough scale to provide a performance guarantee for financial institutions. This makes EPC a non-viable option for emerging technologies.

Financing Options
Financing mechanisms for major capital projects generally include a mix of equity and bank financing. The ratio of these is dependent upon the pro-forma of the project and the credit-worthiness of the owner(s). Historic ratios of debt versus equity have been in the 50 to 80% debt range. Thus, a minimum amount of project equity that needs to be put forward by the owners is 20 to 50% of the project cost. A compounding factor is that this assumes the project is a technology that is proven and will have a performance guarantee from a credible process provider. This has become a basic criterion for most project finance banks and is not available for emerging technologies. This is a core of the problem for emerging technologies moving into commercial scale.

Many renewable energy technologies are funded by venture capitalists and other equity holders. The necessity of raising large amounts of equity to build a project without traditional bank finance has a serious dilution impact on early investors' funds, thus limiting the efficacy of this option.

The U.S. Government guarantees loans for selected projects; these loan guarantees have become an emerging option to move renewable energy projects forward. The Department of Energy (DOE) has announced nearly $10 billion of proposed loan guarantees to work around the lack of process guarantor for these new technologies. Additional loan guarantees are being offered through the U.S. Department of Agriculture.

Summary

A significant number of promising second-generation biofuel technologies have not been commercialized, partly due to a lack of available financing. The core of the financing issue is the lack of a technology guarantor and a project financing system that has become accustomed to EPC-style project execution. EPC is not practical for emerging technologies, and backers of these projects will need to raise more equity and possibly utilize government loan guarantee programs to bring their technologies to full commercial operation. Cost-reimbursable construction management is better suited to the fast-paced scheduling and ongoing design of second-generation biofuels, but requires significant construction experience that many technology developers lack. Once a technology has multiple commercial-scale facilities operating, there will be a basis for allowing EPC-style projects. This will dramatically increase the emergence of facilities.

About Harris Group

Harris Group Inc. provides full-service engineering and consulting services in the production of fuels and chemicals from renewable feedstocks through sustainable technologies. Our experience encompasses conventional and emerging technologies for conversion of biomass into ethanol, biodiesel, biogas (methane), commodity chemicals, and other saleable products and byproducts. Harris Group Inc. provides both technical and program management services, with specific services to meet the needs of each customer.

Harris Group Inc.'s history in biorefining dates back to 1994 and the development of a process for conversion of municipal solid waste to ethanol. Since then, we have worked alongside entrepreneurs, researchers, and project developers on a variety of projects, from traditional corn ethanol and biodiesel to cellulosic ethanol and renewable diesel. Harris Group is a recognized leader in next generation biofuels technologies and was selected by the U.S. Department of Energy to provide independent oversight on some of America's first biorefineries, which are being partially funded by the DOE. Harris Group is familiar with established biofuels technologies and provides balance-of-plant engineering for providers of traditional biofuels processes. Harris Group Inc. provides strategic support from project definition and feasibility studies through construction management and start-up in both greenfield and retro-fit applications with core services of engineering and plant design. Specialty services include process conceptualization and development, research management and coordination, basic and detailed engineering, owner's engineering, due diligence and independent engineering, process improvement and control systems integration.

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