BUSINESS MODELS FOR ETHANOL AND BIODIESEL

Prepared for:

UNITED STATES DEPARTMENT OF AGRICULTURE

Prepared by:

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The positions expressed in this study do not necessarily reflect the official positions of USDA or the Administration.

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I. EXECUTIVE SUMMARY

The U.S. Department of Agriculture ("USDA") commissioned Informa Economics, Inc. ("Informa") to study the business models in use in the renewable transportation fuels industry. The objectives of the study were to:

- Provide a full description of the basic renewable energy production business models;
- Articulate the advantages and disadvantages of each model and the conditions of the marketplace products and raw materials, sources of capital, and regulatory and tax environment that most favor use of each particular model; and
- Assess public policy and program steps that should be taken to optimize the alignment of particular models to the conditions each best suits.

There are four main business models in use in the ethanol industry, which is by far the largest component of the renewable transportation fuels sector:

- The "Corporate" Business Model. The renewable fuels producer is a corporation or a subsidiary of a corporation. Internal staff manages the plant(s) and the functions of grain procurement, renewable fuels marketing and co-product marketing.
- The "Farmer-Owned" Business Model. Farmers have a majority ownership in the facility and have grain delivery obligations to the facility. Often, farmer-owned plants utilize third-party service providers to market their ethanol and distillers grains.
- The "Engineer/Builder-Owned" Business Model. The design/build firms either own facilities outright or maintain a significant ownership interest along with investors in individual plants, based upon which they maintain a degree of control over management. Given their ownership in multiple facilities, they have the scale to have internal staff conduct key functions, including grain procurement and renewable fuels and co-product marketing.
- The "Franchise" Business Model. The organization is not vertically integrated but rather is characterized by its dependence on service providers to link to other levels of the supply chain. The producer depends on third-party service providers for grain procurement and the marketing of renewable fuels and co-products.

These business models are relatively efficient, and there are relatively low barriers to entry into the industry, including entry by organizations with substantive investment from farmers and other rural investors. While the business models per se are not faulty, there are three issues that are constraining current and future investment by farmers and other rural investors:

- The large scale of a typical new facility (mainly for ethanol);
- Cumbersome legal structures; and
- Underdeveloped management systems.

The scale of plants being built as of the writing of this report requires a level of equity that can be difficult to raise from farmers and other rural investors, and there is little that the government can do to affect the cost and scale of the facilities now being built. There are, however, initiatives that the USDA and the government in general can take to address the other two challenges.

Regarding legal structures, it is clear that the cooperative structure is too restrictive to lend itself to widespread use in the renewable fuels industry, particularly given the levels of investment that are now required. It is recommended in this report that the USDA investigate whether the co-op structure can be adapted to modern, large-scale renewable fuel production operations and, if so, what key of changes need to be made to statutes and regulations. Once such changes are made, the USDA should launch an outreach program to let farmer/rural groups know the specific details of how co-ops can be utilized for renewable fuel production operations.

Regarding management systems, while there are materials available to guide new groups through the process of establishing a renewable fuels production operation, they typically describe general steps rather than providing specific details, and an informal network of individuals and service providers assists the groups in accomplishing each task required to get an operation up and running. It is suggested in this report that the USDA can have an important role in providing detailed information to renewable fuels operations as they are organizing and in facilitating the use of "best practices" management systems once the operations are running.

In conclusion, there are concrete steps that the USDA can take to facilitate the establishment and operation of renewable fuels facilities owned by farmers and other rural investors, although no large-scale intervention in the business models being used by the industry appears necessary.

II. INTRODUCTION

A. BACKGROUND ON RENEWABLE FUELS INDUSTRY VOLUMES & STRUCTURE

The ethanol industry is by far the largest component of the renewable transportation fuels sector, with 3.9 billion gallons produced in 2005, worth nearly $7 billion. It is expected that ethanol production in 2006 will grow by another billion gallons. This represents dramatic growth from 1990, when production was 900 million gallons, and even from 2000, when production was 1.6 billion gallons.

In 1990, Archer Daniels Midland ("ADM") held 55% of industry capacity, and other corporations such as Pekin Energy (now owned by Aventine Renewable Energy), A.E. Staley (Tate & Lyle) and High Plains Corp. (Abengoa Bioenergy) accounted for most of the other significant-sized facilities, then defined as having a capacity of at least 10 million gallons per year. That same year, two pieces of legislation that have been key to the growth and structure of the ethanol industry were passed by Congress. Amendments to the Clean Air Act established programs that required the use of oxygenates (i.e., oxygen-rich fuel additives, such as ethanol) to make fuel burn cleaner and thereby combat carbon monoxide and ground-level ozone (i.e., smog) in many metropolitan areas. The second key legislative development was the inclusion of the Small Ethanol Producer Tax Credit (SEPTC) in the Omnibus Budget Reconciliation Act of 1990.

The programs established under the Clean Air Act Amendments took effect in the first half of the 1990s and resulted in an increase in ethanol demand, and farmer-owned operations participated in this growth. By 2000, 18 of 44 operating ethanol plants were farmer owned, with capacity of over 400 million gallons per year (mmgy), accounting for 22% of total industry capacity, according to statistics from the Renewable Fuels Association.

At the time, the SEPTC was limited to producers with capacity of less than 30 mmgy, and many state governments that offered producer incentives also capped the number of gallons on which payments were made. As a result, all but three farmer-owned facilities (two Minnesota Corn Processors plants, which have since been acquired by Archer Daniels Midland, and an AGP plant) had capacity of 30 mmgy or less.

The biodiesel industry is only a fraction of the size of the ethanol industry, with 2005 production estimated at 75 million gallons. Additionally, whereas the ethanol industry has established its position in the motor fuels market and has expanded considerably over almost 30 years, the biodiesel industry was quite small until the Federal Bioenergy Program (CCC-850) was established in 1999, and substantive growth did not begin until an excise tax credit for biodiesel was included in the JOBS Act of 2004.

B. CURRENT STATUS & EMERGING STRUCTURE OF THE ETHANOL & BIODIESEL INDUSTRIES

During the current decade, ethanol industry growth has accelerated as a result of a rise in petroleum prices and the banning of the competing oxygenate methyl tertiary butyl

ether (MTBE). Farmer-owned facilities have participated in this growth to an even greater extent than in the 1990s. Plants owned by farmers and other rural investors represented 50 out of the 107 operating ethanol facilities and 37% of capacity as of November 17, 2006, according to the Renewable Fuels Association. The capacity of this segment of the industry has more than quadrupled since 2000, to a total of 1.9 billion gallons per year (bgy). With relatively high profit margins during this time period, farmers and other rural investors have participated greatly in the success of the industry.

Approximately 46% of industry capacity is in the hands of firms structured as limited liability companies (LLCs). Including other limited-liability business structures, such as limited liability partnerships, the share of capacity increases to 50%. Considering that Archer Daniels Midland still has 20% of industry capacity and that there are other major corporations such as Cargill and Abengoa Bioenergy in the industry, it is clear that the LLC has become the business structure of choice among producers that are not major corporations. Notably, 29% of industry capacity is accounted for by operations that the Renewable Fuels Association designates as being owned by farmers and other local investors and that are organized as LLCs or similar structures, out of the total 37% of capacity having farmer/rural ownership (i.e., nearly 80% of the capacity owned by farmers and other rural investors is organized as LLCs or similar structures).

Only five of the 49 new ethanol facilities under construction as of November 17, 2006, are owned by farmers and other rural investors, although six of eight plants being expanded fall into this segment. Such plants account for only 15% of the capacity being added. This diminution of participation by farmers and other rural investors is likely a result of the increase in the minimum size of a new plant to 40-50 mmgy, with the costs of engineering, procurement and construction (EPC) often exceeding $75 million, not including site preparation and business start-up costs. Although the definition of a small producer was increased to 60 mmgy in the Energy Policy Act of 2005, minimum equity-to-capitalization ratios are 35-40% for new plants – and traditional lenders to the industry can have even higher requirements – and farmers and other rural investors can struggle to raise $30 million in equity.

Moreover, many plants under construction have a planned capacity of 100 mmgy, involving EPC costs of $165 million and equity of $60 million or more. This investment size and profit margins in recent years have been attracting equity from mainline U.S. investors, including private equity funds. Given the size of the investment and the efficiencies of larger facilities, the loss of the SEPTC payment of $1.5 million per year (i.e., 10 cents/gallon on the first 15 million gallons of production) is not a prohibitive opportunity cost.

C. PURPOSE OF THE STUDY

Given this background, the U.S. Department of Agriculture ("USDA") commissioned Informa Economics, Inc. ("Informa") to study the business models in use in the renewable transportation fuels industry, with the following objectives:

- Provide a full description of the basic renewable energy production business models. Basic types of models presented should include, but not be limited to:
  - The franchise model system
  - New generation cooperatives
  - Producer owned LLCs
  - Wholly and partially owned subsidiaries
  - Mixed ownership businesses
  - Traditional cooperative organizations
- Articulate the advantages and disadvantages of each model and the conditions of the marketplace products and raw materials, sources of capital, and regulatory and tax environment that most favor use of each particular model.
- Assess public policy and program steps that should be taken to optimize the alignment of particular models to the conditions each best suits.

III. LEGAL STRUCTURES OF RENEWABLE FUEL PRODUCERS

Given the fragmentation of the ethanol and biodiesel industries and the diversity of investors in those operations, renewable fuel production operations have been established utilizing most of the legal structures available in the U.S., with the choice of structure often influenced by the specific laws governing such entities in the states where they are incorporated or formed. Most states have around six categories of legal structures for businesses, with numerous sub-categories. These categories include:

- Sole proprietorship (a basic legal structure, but one which is rarely used among modern renewable fuel producers, except perhaps small biodiesel companies)
- Partnership
  - General partnership
  - Limited partnership (LP)
- Corporation
  - Non-profit
  - For profit
    - C corporation
    - S corporation
- Traditional cooperative
  - Marketing
  - Supply
  - Service
  - Education
- New generation cooperative
- Limited liability company (LLC)

There are several criteria that are typically considered when structuring a business, in order to maximize earnings and capital flexibility while minimizing taxes. The primary criteria are:

- Who controls the business?
- How are profits and losses allocated and distributed?
- Where is the capital sourced?
- Who is liable?
- How are taxes paid or incurred?
- How long is the business lifespan?
- What restrictions are there on transferring interests?

A. PARTNERSHIP

A general partnership is an association of two or more parties operating a business with the purpose of earning a profit and is viewed as being one and the same as its owners. If it can be established that two people are in businesses with each other, then there is a general partnership due to the relatively lack of formality.

Without an agreement to the contrary, the Uniform Partnership Act (UPA) gives equal voting rights regardless of the owners' respective capital contributions. Owners of a partnership have unlimited personal liability and in general, each partner in a partnership is jointly and severally liable for the partnership's obligations. Joint liability means the partners can be sued as a group and several liability means that the partners are individually liable (for the entire liability of the partnership). Whether a partnership is jointly or severally liable varies by state. Because of such considerations, only seven of the more than 100 operational ethanol production facilities were structured as limited partnerships (LP); six of these were farmer-owned facilities. One facility under construction is an LP.

A partnership has only one level of taxation and is a tax-reporting entity, not a tax-paying entity. Profits pass through to the owners and are allocated as originally specified in the partnership agreement.

B. CORPORATION

The corporation is a sophisticated form of business entity and the most prevalent among large companies. Unlike formation as a cooperative or LLC, corporate profits can be taxed twice, as corporate profits are taxed and the dividends they pay to shareholders are taxable as personal income. A corporation organized under subchapter C of the 1986 IRS code (known as a C-corp) is subject to a marginal tax rate between 15%-35% depending on its level of taxable income. Profits that are paid out as dividends are taxed a second time at the personal level. As such, a company may reduce its tax burden by including more debt in its capital structure, since interest payments are tax deductible.

From a liability perspective, a C corporation has its advantages because its shareholders generally are not personally liable for the debts incurred by the corporation.

Owners of common stock in a corporation have the right to vote on issues affecting the company, while preferred stock owners get paid dividends before common stockholders.

An S Corporation begins its existence as a "C-Corporation". However, after the corporation has been formed, it may elect "S Corporation Status" by submitting IRS form 2553 to the Internal Revenue Service (in some cases a state filing is required as well). Once this filing is complete, the corporation is taxed like a partnership or sole proprietorship rather than as a separate entity. Thus, the income is "passed-through" to the shareholders for purposes of computing tax liability. Therefore, a shareholder's individual tax returns will report the income or loss generated by an S corporation. An S corp is operated in the same way as a traditional C corp. An S corp must follow the same formalities and record keeping procedures. The directors or officers of an S corp manage the company. An S corp does, however, have some significant restrictions, such as it can have no more than 75 shareholders, none of the shareholders can be

nonresident aliens, shareholders cannot be other corporations or LLCs and it may only have one class of stock.

C. LIMITED LIABILITY COMPANY

Investors in limited liability companies generally are protected from liabilities, unlike general partnerships and sole proprietorships. An LLC is similar to an S corp in that it is a "pass-through" entity for tax purposes; the income is passed through to the owners and reported on the owners' personal income tax returns, thereby eliminating the double taxation incurred by owners of a standard corporation, or C corporation (although not often done, an LLC may elect to be taxed as a C corporation). The reason that LLCs are often attractive is that this form offers flexibility in ownership and ease of operation. In general, there are no restrictions on the ownership of an LLC, and profits and losses may be allocated and distributed at the discretion of management and the board, subject to the LLC's operating agreement, rather than having to be distributed in a manner dictated by laws governing a specific business structure. Depending on the specific statute in the state in which an LLC is formed, an LLC may be managed by its members, its managers or a board. Ordinarily, voting interest directly corresponds to interest in profits, which in turn directly corresponds to share of ownership, unless the articles of organization or operating agreement provide otherwise.

As with all "pass through" entities, it is important to note that although profits may not be distributed to the members, the members will be allocated their pro rata share of such profits and will be required to pay tax at the personal level on such profits. For this reason, the operating agreements of LLCs often provide that profits, to the extent of the taxes owed by its members, shall be distributed to them, before the LLC retains the balance of the profits. Owners of an LLC that are also employed by the LLC must pay a self-employment tax.

D. COOPERATIVE

Cooperatives are state-chartered businesses, organized and operated under applicable state laws. Co-ops are businesses owned and controlled by the people who use them. Co-ops differ from other forms of businesses because they are member owned and operate for the benefit of members, rather than to earn profits for investors.

Traditional cooperatives are controlled by a Board of Directors, which is elected by the members of the cooperative. One unique feature of a cooperative is that each member usually has only one vote in selecting directors, regardless of the amount of equity that the member has. Another feature is that all or most of the directors must be members of the cooperative; thus, the leaders are regular suppliers to the co-op or users of its products and services.

Equity comes from the members of the co-op, rather than outside investors. The three primary ways members provide equity to the cooperative are direct investment, retained margins and per-unit capital returns. Direct investment refers to cash purchases of membership certificates, common and preferred stock, or other forms of equity. Most

cooperatives involved in renewable fuels production require a member to make a direct payment when joining the cooperative. In return, the member receives a membership certificate in a non-stock cooperative or a share of common stock in a stock cooperative. Closed co-ops raise a specific amount of equity at start-up and close membership once the desired level of equity is raised.

Earnings (or losses) on business conducted on a cooperative basis are allocated to the members on the basis of their transactions with the cooperative during the course of the year (e.g., corn deliveries), which in the case of an open co-op can differ significantly from the share of the equity they hold. The allocations may be distributed in cash or retained as additional equity, or members may receive a combination of cash and an allocation of equity. If additional equity is needed (e.g., for expansion), by agreement with members a portion of proceeds from each unit of product sold can be withheld. Earnings from business with members are taxed once, either as income of the corporation when earned or as income of the members when allocated to them.

A cooperative typically has perpetual existence, and memberships can be bought and sold without disrupting ongoing operations, though this is more difficult in the case of a closed co-op. If a co-op fails, the liability of each member is limited to the amount he or she has invested.

E. NEW GENERATION COOPERATIVE

A new-generation cooperative (NGC) is a relatively new type of cooperative that is used primarily in the value-added processing of agricultural commodities, such as corn used for ethanol production. The value-added NGC approach is thought to have originated in the upper Midwest in the early 1970's by American sugar beet growers. Developed from that model, NGCs are today processing diverse commodities such as bison, durum wheat, soybeans, eggs and poultry.

NGCs share many of the same characteristics of traditional cooperatives, including:

- Democratic control, based on one-member one-vote;
- Distribution of earnings as a function of use of service or sales to the cooperative; and
- A Board of Directors elected by members.

There are some general attributes that differentiate NGCs from traditional cooperatives. These include:

- Delivery rights are contracted and tied to the initial level of investment;
- Membership is limited to those who purchase delivery rights;
- Higher levels of equity investment by individual members are required; and
- Shares that provide delivery rights are transferable and can appreciate or depreciate in value.

Table 1 compares the principles of an NGC to a traditional cooperative.

Table 1: Comparison of Traditional Cooperative to NGC

Co-operative Principles	Traditional Co-operative	New Generation Co-operative
Voluntary and Open Membership — voluntary organizations, open to all persons able to use their services and willing to accept the responsibilities of membership.	Yes	Membership restricted to only those who purchase delivery rights shares
Democratic Member Control — co-operatives are democratic organizations controlled by their members, who actively participate in setting their policies and making decisions.	Yes	Yes
Member Economic Participation — members contribute equitably to and democratically control, the capital of their co-operative.	Yes	Members share in earnings according to their delivery rights. Higher equity contributions are required.
Autonomy and Independence — co-operatives are autonomous organizations controlled by their members. In agreements with other organizations, or raising capital from external sources, negotiated terms ensure democratic control and autonomy is maintained.	Yes	Yes

Source: OMAF

Deanne Hackman of the Missouri Department of Agriculture has outlined the six primary characteristics of a NGC. They are as follows:

1. Defined membership. Frequently, NGCs are referred to as "closed" cooperatives. However, "defined" might be a more accurate term. The number of members in an NGC depends upon the proposed capacity of the cooperative's operations. One of the key features of the NGC is its ability to control supply or access to the cooperative's operations. In other types of cooperatives, members can enter and exit as they please, and cooperatives operating without marketing contracts with their members have no way to guarantee a specific operating capacity at any one time. By limiting membership to those members who purchase the right to supply the cooperative, the NGC is able to ensure a steady supply of the agricultural inputs required for running operations at the most efficient level possible. In an NGC, the membership is generally not permanently closed. If the cooperative decides to expand production, for example, it could seek equity from producers outside the initial membership.

2. Delivery rights: a right and an obligation to deliver. Once members contribute equity toward the NGC, they receive the right, and the obligation, to deliver a specific quantity of the commodity each year. … If they cannot deliver that amount or if the commodity does not meet the quality standards set forth in the

marketing agreement, the cooperative may have the right to buy the commodity on the producers' behalf and charge for the difference in price.

3. Upfront equity required from producers. Adding value to agricultural commodities can be capital-intensive. Before lending money to a project, banks and other lending institutions will require producers to raise part of the project cost. Often, this means producers must raise 40 percent or more of the total project cost. Although it may be possible to find private investors to reach the required equity level, producers are often the sole source of equity. As a way to tie members' use to the total project equity required, the total amount to be raised is broken into smaller units. These units are tied to the amount of product required to be delivered.

4. Delivery rights are transferable and may fluctuate in value. The delivery right is similar to a share of corporate stock because it represents a firm's permanent equity. As with a share of corporate stock, the value of the delivery right will depend on the firm's profitability. If an NGC is successful and provides value for its members, the delivery right may appreciate in value. If the NGC does not provide sufficient returns to its members, the value of the delivery right may decrease. Unlike stock in a public corporation, however, the delivery right has a very limited resale or trading market. To comply with antitrust, securities, tax, and incorporation statutes, NGC bylaws limit transfer to other producers and usually require the Board of Directors to approve any transfer.

5. Marketing agreement entered into between member and cooperative. Upon purchasing delivery rights, members are required to sign a marketing contract outlining the duties of both the members and the cooperative toward each other with respect to the delivery, quality, and quantity of producers' commodities. These contracts are usually evergreen contracts, meaning they are for specified periods of time (from one to five years) but are renewed automatically unless either party gives notice to the other within a window of time specified in the marketing agreement. The marketing agreement often specifies the quality standards required of members' commodities, especially in cooperatives producing consumer-level goods. The marketing agreement outlines the specific quality required to be delivered, how quality will be measured, and the producer's rights and obligations if the quality standard is not met.

6. Members and their NGC share three primary legal relationships.

- Members must purchase a share of common stock or other membership interest to enable them to vote in all decisions set forth in the bylaws.
- Members also purchase delivery rights, which are both a right and an obligation to deliver. The delivery rights are evidenced by legal documentation and are usually transferable upon approval from the Board of Directors.
- Finally, members must sign a marketing agreement when purchasing delivery rights and voting stock. The marketing agreement defines the rights and

obligations of both the member and cooperative toward each other with respect to the delivery of commodities from the member to the cooperative.

Members must pay money to the cooperative for both the voting stock (usually minimal) and delivery rights (amount varies on project size, minimum and maximum purchase requirements, and the specific amount of commodity to be delivered by the member). Members also are required to deliver the specified quality and quantity of commodities at pre-specified intervals for the length of the marketing agreement. Some marketing agreements, in turn, require the co-op to pay members a price for the commodities delivered that is a formula price based on a specified exchange or commonly reported cash market price, with additions or subtractions based on quality. The cooperative also is required to return any profits to members on a pre-specified schedule determined by the Board of Directors. Due to securities law issues, cooperatives are not actively involved in the transfer of delivery rights. The cooperative usually requires approval from the Board before any transfer is complete, and sometimes an outside broker handles the actual transfer of delivery rights.

All co-operatives that incorporate with share capital can issue membership and preference shares. Preference shares can have different rights and privileges attached to them. This is the case with NGCs that issue preference shares with delivery rights. These are sometimes called equity shares; however they are simply a specific class of preference share. The NGC share structure typically includes membership shares and several classes of preferred shares. One of the classes of preferred shares has delivery rights attached to it. The preferred share without delivery rights allows the co-op to invite investment from non-producers. Preferred shareholders cannot vote except in certain circumstances as described in legislation.

IV. BUSINESS MODELS IN THE RENEWABLE FUELS SECTOR

A. BUSINESS MODEL DEFINITION

A business model is a concept that can be defined as "a description of the value a company offers to one or several segments of customers and of the architecture of the firm and its network of partners for creating, marketing and delivering this value and relationship capital, to generate profitable and sustainable revenue streams."[1] Thus, a business model focuses on the role and linkages of actors in a product supply chain (in this case, renewable fuels) and is related to but distinct from the legal structure of the firm and the strategies it develops and implements.

B. PROFILE OF BUSINESS MODELS IN THE ETHANOL INDUSTRY

As a result of the entry of a number of diverse organizations into the ethanol industry over the last 15 years, a myriad of business structures are now in place. However, most of the producers and the capacity can be categorized as falling into four main business models:

- The "Corporate" Business Model;
- The "Farmer-Owned" Business Model;
- The "Engineer/Builder-Owned" Business Model; and
- The "Franchise" Business Model.

Each of the models can be briefly described as follows:

- The "Corporate" Business Model. The renewable fuels producer is a corporation (typically a C corporation) or a subsidiary of a corporation. Internal staff manages the plant(s) and the functions of grain procurement, renewable fuels marketing and co-product marketing. The producer does not own or manage farmland. If the corporation produces biodiesel, it might have integrated oilseed crushing operations. Some corporations might provide third-party grain supply and renewable fuel and co-product marketing services to other producers. (See Figure 1.)
- The "Farmer-Owned" Business Model. The legal structure can be as a cooperative or an LLC or similar organization. Farmers have a majority ownership in the facility. In a co-op or a co-op within an LLC, they have grain (defined here as including

[1] Osterwalder, A., Y. Pigneur and C.L. Tucci, "Clarifying Business Models: Origins, Present and Future of the Concept." Communications for the Association for Information Systems, Volume 15, May 2005.

oilseeds) delivery obligations to the facility. They have access to storage, including on-farm bins and limited storage at the facility, and especially if the ownership is through a cooperative, they might also have separate grain elevator operations. (See Figure 2.)

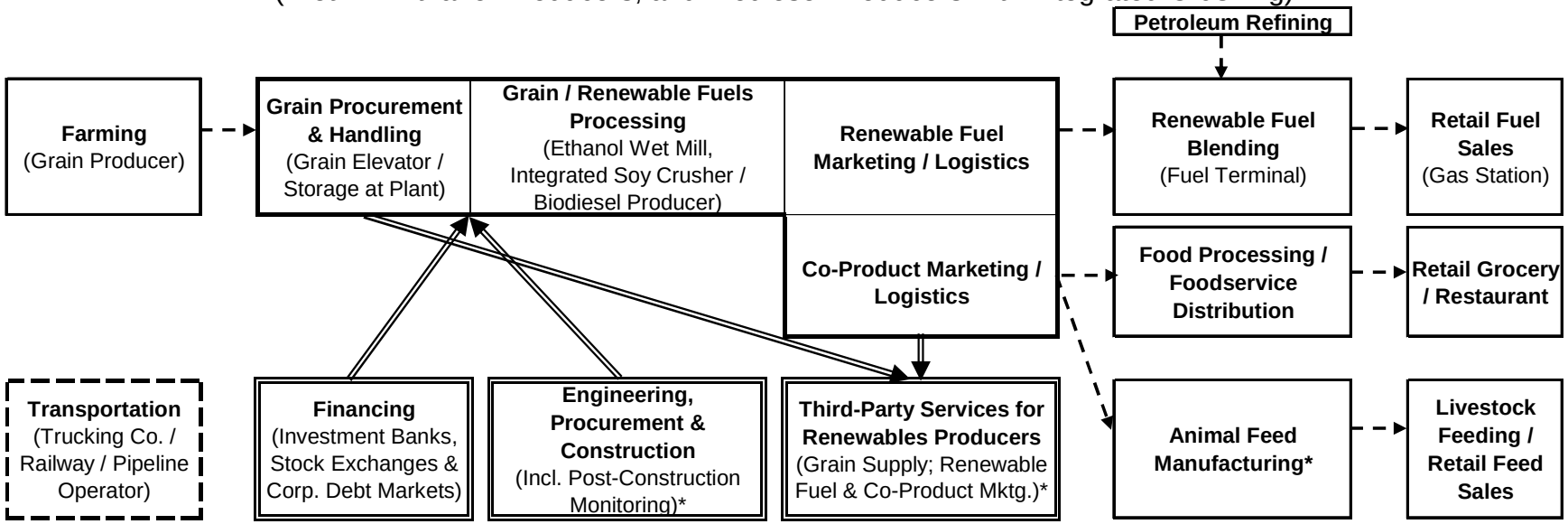
- The "Engineer/Builder-Owned" Business Model. The design/build firms either own facilities outright or maintain a significant ownership interest along with investors in individual plants. In either case, the design/build firms maintain a controlling interest in management. Given their ownership in multiple facilities, they have the scale to have internal staff conduct key functions, including grain procurement and renewable fuels and co-product marketing, which they might also provide as services to unaffiliated plants. (See Figure 3.)
- The "Franchise" Business Model. The organization is not vertically integrated but rather is characterized by its dependence on service providers to link to other levels of the supply chain. The plant is a cookie-cutter facility designed and built by one of the major firms/consortiums, and its production process is monitored remotely by the engineering company. The producer depends on third-party service providers for grain (or vegetable oil) procurement and the marketing of renewable fuels and co-products. For new operations under this model, given a lack of operating history, the financial institution(s) providing loans/debt might require the producer to enter into long-term agreements with these service providers. In turn, the service providers might invest a moderate amount of capital in the facility. (See Figure 4.)

Further elaboration on the "franchise" business model was provided in *Rural Cooperatives*, a publication of USDA's Rural Business-Cooperative Service: "The business model of choice in the U.S. ethanol industry has been the 'franchise' model. A few specialized engineering firms have standardized ethanol plant design and the project development process. These engineering firms guide farmer-investors through every aspect of plant development – from feasibility to plant opening and beyond, including financing, contracting, marketing, procurement and management."[2]

[2] Alan Borst, USDA Rural Development, "Bring It on Home:: Local Ownership of Renewable Energy Helps 'Keep It on the Farm,'" Rural Cooperatives, September/October 2006, p. 37.

Figure 1: The "Corporate" Business Model

(Wet-Mill Ethanol Producers, and Biodiesel Producers with Integrated Crushing)



Key:

Renewable Fuel Producer

Transportation/Physical Commodity Flow

Third Party

Services Provided

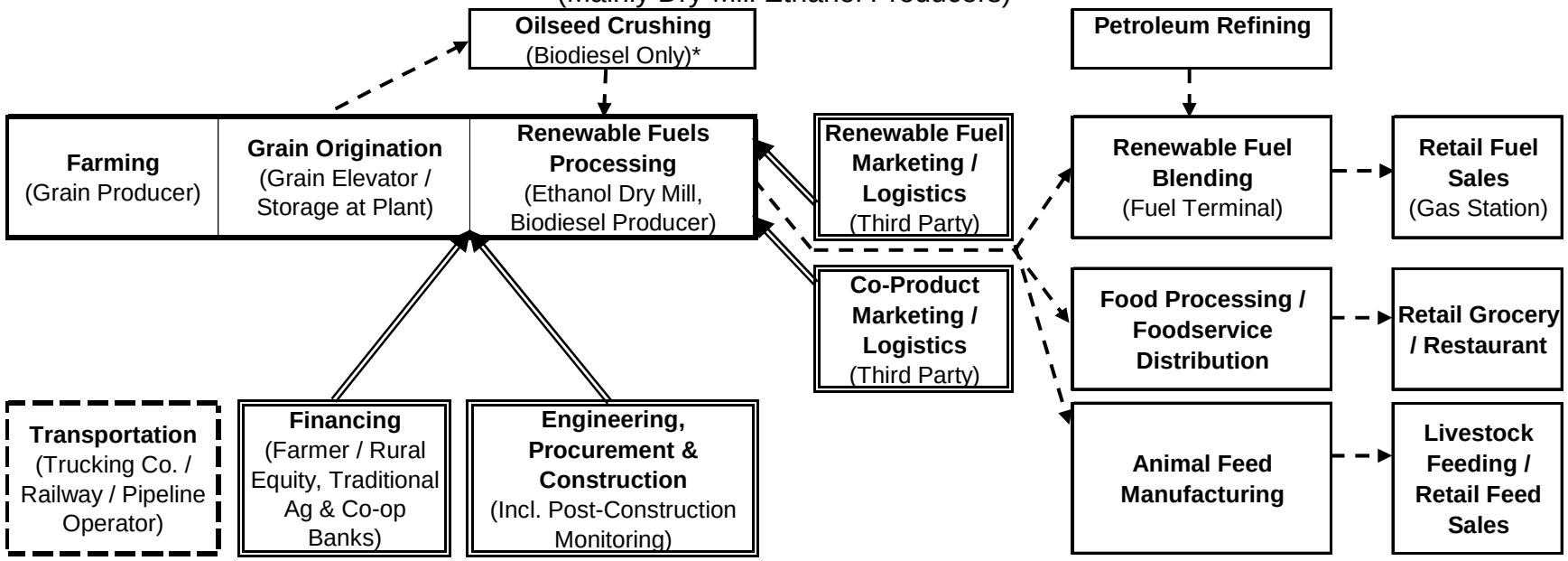
Notes:

* Internal function at limited number of renewable fuel producers.

Glycerin not depicted since raw glycerin is a small part of the revenue stream for biodiesel producers.

Figure 2: The "Farmer-Owned" Business Model

(Mainly Dry-Mill Ethanol Producers)



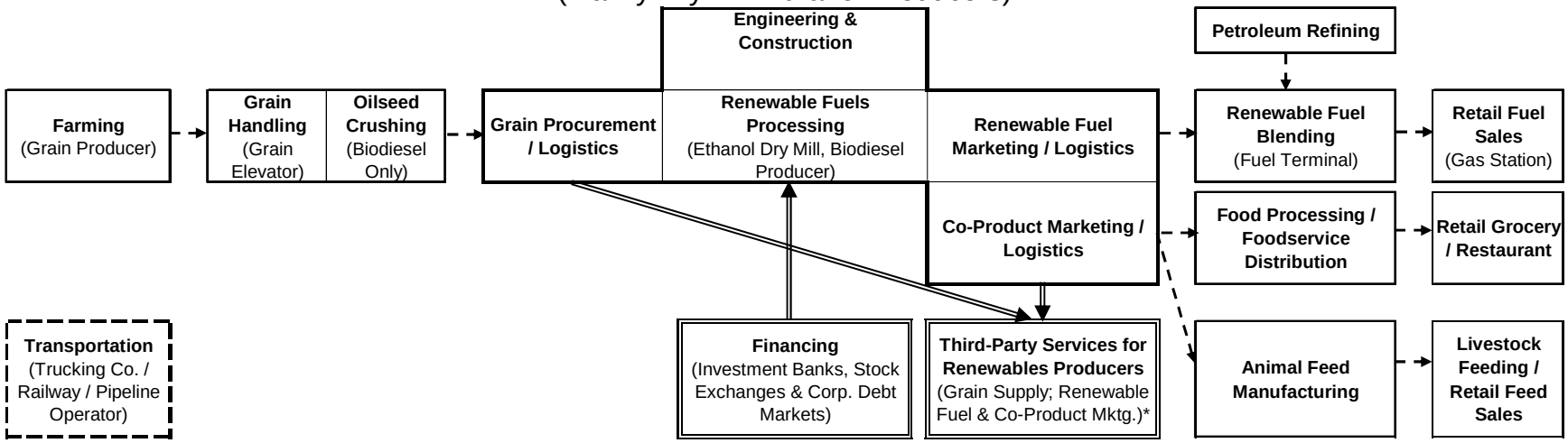
Key:

- Renewable Fuel Producer
- Transportation/Physical Commodity Flow
- Third Party
- Services Provided

Notes:
* Internal function at limited number of renewable fuel producers.
Glycerin not depicted since raw glycerin is a small part of the revenue stream for biodiesel producers.

Figure 3: The "Engineer/Builder-Owned" Business Model

(Mainly Dry-Mill Ethanol Producers)



Key:

- Renewable Fuel Producer
- Transportation/Physical Commodity Flow
- Third Party
- Services Provided

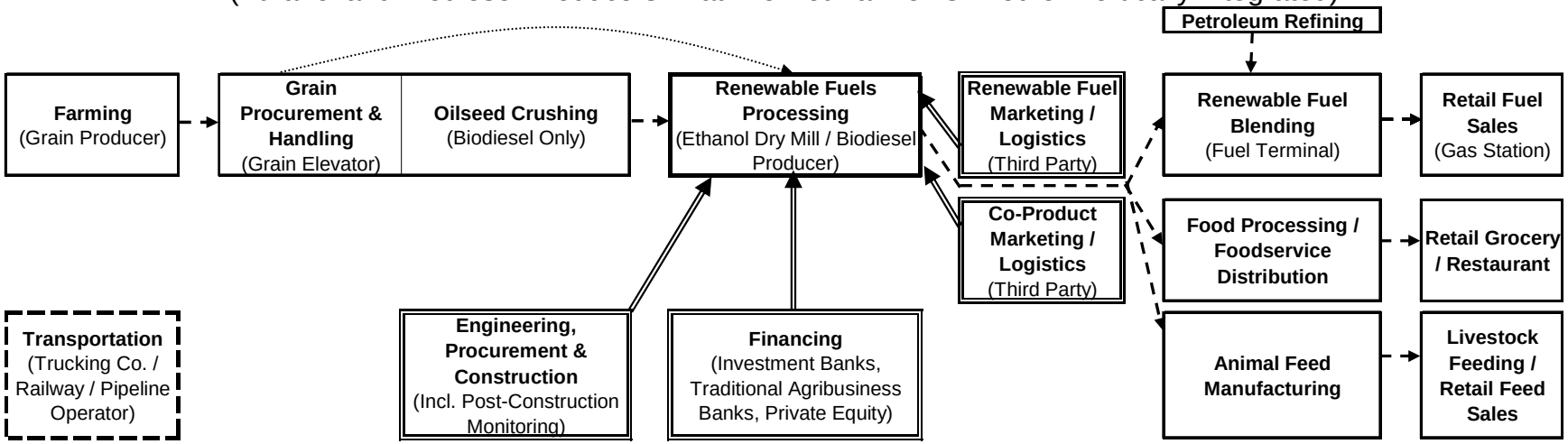
Notes:

* Internal function at limited number of renewable fuel producers.

Glycerin not depicted since raw glycerin is a small part of the revenue stream for biodiesel producers.

Figure 4: The "Franchise" Business Model

(Ethanol and Biodiesel Producers That Are Not Farmer-Owned or Vertically Integrated)



Key:

- Renewable Fuel Producer
- Transportation/Physical Commodity Flow
- Third Party
- Services Provided

Notes:

Glycerin not depicted since raw glycerin is a small part of the revenue stream for biodiesel producers.

In a sense, the "farmer-owned" and "engineer/builder-owned" business models can be viewed as variations of the "franchise" model; however, they have elements of vertical integration that differentiate them from the pure "franchise" model. Farmer-owned operations, by definition, are linked to the farmer segment of the supply chain, and in some cases there is integration with a grain elevator as well. Thus, the need for a feedstock supply agreement is eliminated, at least for ethanol operations. Similarly, operations that are owned wholly or partially by engineers/builders, by definition, are linked to the design/build firm(s) involved in the construction of the plant. In the case of Broin, it often has a role in the management of the ethanol plants in its network, and they use the Broin-affiliated service providers Ethanol Products and Dakota Gold to market their output of ethanol and distillers grains, respectively.

C. THE ROLE OF THIRD-PARTY SERVICE PROVIDERS

The advent of third-party marketing organizations has been an important development in the industry and a key component of certain business models, especially the "franchise" model. As of November 2006, there were 98 companies that owned ethanol facilities, ignoring ownership by certain investors across several ethanol companies. It would be costly for each of these facilities to have internal sales staff for ethanol and distillers grains, the main co-product of dry-mill ethanol production, and it would be inefficient for fuel blenders to have to purchase ethanol from 98 different entities. (The wet-mill segment of the industry is concentrated and composed mostly of large-scale operations and, therefore, wet-mill companies are more able to justify internal sales staffs.) Moreover, with the opening of large new markets for ethanol on the East and West Coasts due to state bans and industry withdrawals of MTBE, as well as the necessity of selling distillers grains outside of the Midwest as the industry has grown, it would be inefficient to transport ethanol and distillers dried grains (DDGS) in shipments of one or a few railcars at a time (rail is the predominant mode of transportation for both commodities to destinations outside the Midwest), as rail carriers tend to favor shipments that involve a limited number of origins and destinations (preferably one of each) and reflect this in their rate structure.

As of September 2006, eight organizations marketed 4.4 billion gallons of ethanol annually, equivalent to 90% of annualized ethanol production in the U.S. at that time (see Table 2). They marketed the output for 75 plants. ADM and Cargill, which are among the largest producers of ethanol, primarily market the ethanol they produce, but Cargill has become considerably more aggressive over the last couple of years in offering ethanol marketing services to other producers, and ADM has begun to take

steps in this direction as well. Cargill has ethanol-marketing agreements in place with a number of plants that are now under construction. Aventine, which is also a large-scale producer, had already developed third-party ethanol marketing as a significant business, providing marketing services to 12 plants in addition to those the company owned. While ADM was the largest marketer at the time, Ethanol Products, which primarily markets ethanol for plants in the Broin system, was the second largest, and Renewable Products Marketing Group, which is owned by a consortium of independent plants, was the third largest.

Table 2: Top Eight Ethanol-Marketing Companies as of September 2006

Marketer	Marketing Volume (mmgy)	Number of Plants Served
Archer Daniels Midland	1,172	9
Ethanol Products*	906	20
Renewable Products Marketing Group	850	14
Aventine Renewable Energy, LLC**	648	14
Eco-Energy, Inc.	325	5
United Bio Energy***	287	8
Cargill, Inc.	120	2
Abengoa	110	3
Total	4,417	75

* Primarily markets ethanol for plants affiliated with the Broin Companies

** Includes 207 mmgy of Aventine-owned capacity operating and under construction, and 230 mmgy existing capacity of VeraSun Energy Corp., which is transitioning to market its own ethanol

*** Merged with US BioEnergy, which then joined its ethanol marketing service with that of CHS in a venture named Provista. A news release issued Nov. 22, 2006, indicates that Provista will be marketing 800 mmgy by the end of 2007.

In addition to the rise of ethanol-marketing firms, five organizations provide distillers grains marketing services for four or more producers. Dakota Gold Marketing sells the distillers grains for the plants in the Broin system. Commodity Specialists Company claims to be the largest independent marketer of distillers grains. Land O'Lakes Purina Feeds and United Bio Energy, which merged with US BioEnergy, also are significant marketers of distillers grains. Due to the increase in the number of ethanol plants under construction or proposed that do not have substantial farmer ownership, there has also been increasing activity by third-party providers of grain origination services.

Along with these service providers for physical commodities, a centralized network to provide technical support also has developed. This is largely due to the concentration among the firms that design and build ethanol plants. As of November 2006, four firms/consortiums – ICM and Fagen, Delta-T and its construction partners, Lurgi PSI

and Broin – accounted for over 85% of the ethanol capacity then under construction. Similarly, most of the capacity built in recent years has been designed and built by ICM/Fagen and Broin. The engineering companies typically provide distributed monitoring services for recent vintage and new plants, facilitating the rapid resolution of any technical issues and a reduction in plant downtime and on-site visits by engineers.

In the two years since the excise tax credit was enacted for biodiesel usage, the biodiesel industry has to a great extent drawn upon the ethanol industry for the business models that it has adopted. Given the critical role of oilseed crushing in the biodiesel supply chain, the companies that own a large share of crushing industry capacity (ADM, Bunge, Cargill and AGP) provide raw materials supply agreements that are key for independent biodiesel producers. Somewhat similar to Broin and US BioEnergy in the ethanol industry, West Central Cooperative and Crown Iron Works jointly formed the Renewable Energy Group to provide engineering and management services to biodiesel producers. A notable exception has been corporations that already had significant oleochemical operations or other processing capacity that was available to be brought into biodiesel production with relatively modest equipment conversion and time requirements; such operations tend to follow the corporate ethanol model rather than the franchise model.

D. THE CHOICE OF BUSINESS MODEL BY A NEW OPERATION

The issue of which business model a new entrant into the renewable fuels industry should choose – and even which models are available to the operation – is a function of the ownership/legal structure, financing and size of the operation, as well as the characteristics of the market in which the entity will operate. If a group of farmers and other rural investors organizes a cooperative to own a single 50-mmgy ethanol plant, they likely could not choose the corporate model, in which ethanol and co-product marketing would be done internally but there would not be a built-in feedstock supply linkage.

In the past, it was necessary for a company to have a minimum of 100 mmgy of capacity to justify an internal sales staff. However, in the future, the minimum size is likely to increase, given the proliferation of individual plants with 100 mmgy of capacity. For example, with two plants totaling 230 mmgy in capacity and another 110-mmgy plant under construction, VeraSun Energy Corp. is transitioning to market its own ethanol, whereas in the past Aventine Renewable Energy performed this function.

Although there is no set rule, it appears that operations need to produce an aggregate 300 mmgy or more to be able to justify having an internal sales staff.

Yet, even producers of this size that are new entrants to the ethanol industry are often pushed by lenders and debt holders to use third-party marketing companies, at least until the producers have gained sufficient experience in the industry. Lenders and debt holders are solely interested in maximizing the likelihood that the debt will be repaid, and they will favor the use of marketing companies with far-reaching operations, experienced staff and a sizable balance sheet even if these attributes come at a cost to the renewable fuels producer. For example, even though the ASAlliances Biofuels facilities that are under construction will have an aggregate capacity of 300 mmgy, "Cargill, Inc. will provide corn and natural gas procurement services for each facility, as well as ethanol and distillers grains marketing and transportation services."[3]

As a generalization, it is probably advisable for a new ethanol operation without experienced managers to utilize an ethanol-marketing company, at least until the operation is of sufficient scale and has been running long enough to be able to manage the internalization of a sales staff. For a cooperative or other producer-linked operation, the grain buying function can be handled by internal staff. For an operation without such a linkage, if it is located in the Corn Belt, it may be possible to hire experienced grain buyers and conduct this function internally, whereas a facility near an ethanol "destination" area without significant corn production might want to use a third-party grain supplier. The situation is similar for distillers grains: if the facility is near sizable operations but is in an area without much competition from other ethanol plants, it might be able to have one or more employees sell the distillers grains; otherwise, especially if the area around the plant is already saturated with distillers grains and the facility's output will mostly have to be sold outside the local market area, it would probably be advisable to utilize a third-party distillers grains marketer.

Thus, which business model is right for a renewable fuels producer is dependent upon the nature of the entity and the markets in which it will operate.

[3] http://www.asabiofuels.com/about.html

E. CASE STUDIES OF THE UTILIZATION OF DIFFERENT BUSINESS MODELS

"Corporate" Business Model Example: Archer Daniels Midland

Archer Daniels Midland is a vertically integrated agribusiness conglomerate and is the largest renewable fuel producer in the world, including being the largest ethanol producer in the U.S. with over 1 billion gallons of annual production capacity. ADM has an extensive network of grain elevators, and it "is one of the world's largest agricultural processors of soybeans, corn, wheat and cocoa."[4] It is a Delaware corporation, and its stock is listed on the New York Stock Exchange. As such, ADM is the largest example of the corporate business model for renewable fuels.

ADM had net sales and other operating income of $36.6 billion in fiscal 2006. The company divides its operations into three reportable business segments: Oilseeds Processing, Corn Processing, and Agricultural Services. All of the remaining operations are grouped together as an "Other" business segment. Its ethanol operations fall into the Corn Processing business segment.

ADM operates seven ethanol production facilities: Decatur and Peoria, Illinois; Cedar Rapids and Clinton, Iowa; Columbus, Nebraska; Marshall, Minnesota; and Wallhalla, North Dakota. ADM is currently in the process of building new 275-mmgy plants at its Cedar Rapids and Columbus sites.

ADM has an experienced internal sales force to market its ethanol; only within the last year has it begun offering ethanol-marketing services to independent ethanol producers in a significant manner. Additionally, ADM has substantial transportation assets, including 20,000 railcars, 2,000 barges and 1,500 tractor trailers. Finally, ADM has the capability to merchandise its co-products, and in particular the feed co-products can be sold via its ADM Alliance Nutrition subsidiary.

According to Patricia Woertz, the company's Chief Executive Officer and President, "ADM is uniquely positioned at the intersection of the world's increasing demands for both food and fuel. As one of the largest agricultural processors in the world and the largest biofuels producer in the world, ADM is in a category of one to capitalize on the exceptional opportunity ahead."[5]

[4] http://www.admworld.com

[5] http://www.admworld.com/naen/mainstory.asp

"Farmer-Owned" Business Model Example: Chippewa Valley Ethanol Co.

The Chippewa Valley Agrafuels Cooperative (CVAC) formed in the early 1990s with the intent of establishing an ethanol facility in Benson, Minnesota, and based on the tenacity, vision and innovation of its management and board, it has continued to grow and succeed in the decade since the plant began operations in 1996. CVAC "was formed with over 650 shareholders made up of producers, elevators and local investors. Planning for the ethanol plant began in 1993. CVAC teamed up (with) the design-builder Delta-T Corporation to form Chippewa Valley Ethanol Company, LLC (CVEC). Delta-T were original equity investors, in part to meet a shortfall in equity that the local producers faced with their original equity drive. This brought together a local interest with a supply of corn and an engineering firm who had the experience and expertise in the ethanol business."[6] The co-op subsequently bought out Delta-T's minority stake.

CVEC originally had a capacity of 15 mmgy but over the following few years expanded to 20 mmgy. Over time, as the size of new ethanol plants increased, CVEC expanded again to stay competitive. A major expansion was completed in 2003, bringing total capacity to 45 mmgy. In late 2006, CVEC was on the move again, signing a letter of intent with Fagen, Inc, to build a new 40-mmgy facility alongside the existing facility.

However, CVEC not only has been willing to invest additional capital when necessary, but also has been adept at new initiatives to improve its market position and diversify its revenue stream. In the late 1990s, CVEC was one of the founding members of the Renewable Products Marketing Group, which was established by producers to aggregate sales of ethanol in volumes demanded by buyers, and to market the ethanol in a cost-effective manner. Members also have used their buying power to reduce costs on certain raw materials, such as enzymes, by purchasing them collectively through RPMG. Additionally, in 2003, CVEC teamed up with some former technical and marketing executives from Pete's Wicked Ale, and after a period of investigation began to produce Shakers Original American Vodka, a premium brand. CVEC has proven that the farmer-owned business model can be adaptive and progressive, offering business strengths that go beyond an assured supply of grain.

[6] $(S\&T)^2$ Consultants, Inc., and Meyers Norris Penny, LLP, "Economic, Financial, Social Analysis and Public Policies for Fuel Ethanol: Phase 1," 2004. http://www.greenfuels.org/ethanol/pdf/OConnor-Report-Ethanol-2004.pdf

"Engineer/Builder-Owned" Business Model Example: Broin Companies

From the small scale of the Broin family's entry into the ethanol industry in the 1980s, it would have been difficult to predict the extensive role that the Broin Companies have across the ethanol supply chain today. The family built a small plant on its farm in Kenyon, Minnesota in 1983 and then purchased and refurbished a foreclosed ethanol plant in Scotland, South Dakota, in 1987. In the early 1990s, Broin & Associates began providing ethanol facility engineering and construction services for other organizations, and by the end of the decade the Broin Companies provided a range of services to ethanol producers that made them the prototype of the engineer-owned business model.

The Broin Companies now provide a comprehensive set of services for ethanol producers. "In 1991, Broin & Associates began operations as a center for plant design, engineering, construction, and research. Broin Management was formed in 1994 to provide management services for Broin–designed plants. Dakota Gold Marketing™ was established in 1995 to market Dakota Gold Enhanced Nutrition Distillers Products™. In 1999, Ethanol Products was formed to market ethanol and [carbon dioxide]."[7]

Twenty-three operating ethanol plants have been designed and built by Broin, and an additional nine were under construction or development as of late 2006. It markets more than 800 mmgy of ethanol and has indicated that this will exceed 1 bgy by mid-2007.

Broin also has retained an equity interest in many, if not all, of the plants it has designed and built. Although the Broin Companies are privately held and do not publicly report their financial status, informal reports indicate that Broin typically retains a roughly 20-25% equity stake in its partner facilities.

With its engineering and construction capabilities, ownership in and management of partner plants, and its ethanol and distillers grains marketing services, Broin has pioneered the "engineer/builder-owned" business model.

[7] http://www.broin.com/UserFiles/File/History%20of%20the%20Broin%20Companies.pdf

Franchise Business Model Example: ASAlliances Biofuels, LLC

ASAlliances Biofuels, LLC ("ASA") was formed in 2004 by Americas Strategic Alliances, LLC, a firm specializing in merchant banking and investments. ASA is building ethanol facilities with a capacity of 100 mmgy each in Albion, Nebraska; Bloomingburg, Ohio; and Linden, Indiana. According to the company, "The basic premise of the company was to combine top-tier service providers with sophisticated financial partners…To that end, each facility will be located adjacent to an existing Cargill grain elevator and will be designed and built by Fagen, Inc. Cargill, Incorporated will provide corn and natural gas procurement services for each facility, as well as ethanol and distillers grains marketing and transportation services. United Bio Energy Management, LLC will be responsible for operational and maintenance support services to each facility."[8]

While these partner companies are being relied upon to supply grain to the facilities, market the output and mange the facilities, Americas Strategic Alliances plans to "continue to provide project development, finance, capital markets, and corporate development expertise." In addition to negotiating contracts with the construction, grain supply, product offtake and facilities management firms, Americas Strategic Alliances put together the group of equity backers for the project and obtained the debt financing. "A group of private equity firms comprised of American Capital Strategies, Ltd., Laminar Direct Capital, L.P. (a member of the D.E. Shaw group), US Renewables Group, LLC, and Midwest First Financial, Inc., provided a significant portion of the equity and all of the subordinated debt to ASAlliances Biofuels….Challenger Capital Group, Ltd., a Dallas based full-service investment bank, secured $148 million in equity and subordinate debt." The company indicates that, at the time, this was the largest financing transaction completed to date in the U.S. ethanol industry.

Americas Strategic Alliances touted its use of the franchise model in its press release announcing the ethanol venture: Americas Strategic Alliances "has assembled a group of world-class companies that collectively possess best-in-class expertise in each of the strategically necessary areas, including production plant design and construction, grain origination, ethanol and DDG marketing, risk management, product plant management, executive management, and corporate development."[9]

[8]http://www.asabiofuels.com/about.html.

[9]http://www.asalliances.com/ethanol.htm

V. ADVANTAGES & DISADVANTAGES OF BUSINESS STRUCTURES & MODELS IN RENEWABLE FUELS

The legal structures and business models discussed in the two preceding sections of this report have evolved over time, and each has its advantages and disadvantages and is suitable for some types of renewable fuel production operations but not others. The advantages and disadvantages of the legal structures and business models were identified and elaborated on through telephone interviews and a focus group conducted in connection with this project for the USDA and can be summarized as follows:

A. COOPERATIVE

Advantages

- The legal structure is relatively simple
- There is a natural link to grain supplies, which can be important during times of tight availability
- Earnings are passed through to members and taxed only once, at the member level
- Open co-ops can be sustainable over time due to their size, the diversity of the membership and the ease of entry and exit
- Regional co-ops, which are owned by a series of local co-ops, have better access to funds due to their size and can often fund investments internally

Disadvantages

- Limits the ability of the operation to raise equity from non-farmers
- Farmers tend to have limited equity and are conservative investors, so it can be necessary to have well over 100 farmers as investors, which causes an equity drive to involve substantial time and money
- There are commodity delivery obligations that must be met (in a closed co-op), which can be problematic in case of drought and, again, can keep out potential investors who might have capital but insufficient farming operations
- The one-member/one-vote system can discourage a investor with substantial capital from making a large investment in an ethanol facility, since the large investor will have the same vote as a small investor
- There can be conflicting motives among the Board of Directors and management: should processing margins or the corn price paid to members be maximized?
- The Board of Directors can be large and unwieldy, given conflicting motives and the possibility that some farmers might be unfamiliar with managing a business that sells its output into the transportation fuel supply chain
- Requirements on how earnings must be distributed as patronage dividends can be inflexible
- In the case of a closed co-op, there is a lack of liquidity of the investment, and it is difficult to value the shares; as the membership ages and a number of members want to sell their interests, it might be necessary to sell the entire operation if it is difficult for members to sell their individual shares

B. LIMITED LIABILITY COMPANY

Advantages

- Flexible business structure; there is considerable latitude on how profits and losses are distributed among different classes of investors
- Allows equity to be raised from a wide range of investors, not only farmers
- The Board of Directors can be streamlined, and professional management can be retained and included on the Board
- Earnings are passed through to investors and taxed only once, at the personal level
- Limited legal liability

Disadvantages

- Without product delivery obligations, it is harder to link investment in an LLC to an assured grain supply; however, it is possible to offset this to some extent by having a cooperative be an investor in an LLC (or by having co-op members own a separate class of stock), though the degree of farmer control is subject to negotiation
- If there are 500 or more investors, public registration and reporting of financials can be required, which can be costly and, due to Sarbanes-Oxley legislation, can be cumbersome; the desire to keep the number of investors below 500 can be negative for the inclusion of farmers since individual farmers they tend to have limited equity to invest

C. LIMITED PARTNERSHIP

Advantages

- Allows equity to be raised from a wide range of investors, not only farmers
- The management through the general partner (whether an entity or individual) may be streamlined
- Earnings are passed through to investors and taxed only once, at the personal level
- Limited legal liability

Disadvantages

- Without product delivery obligations, it is harder to link investment in a limited partnership
- Participation may be restricted to accredited investors, who have a high net worth

D. C CORPORATION

Advantages

- The primary advantage of a C corporation is that its equity can be traded in public markets; that is, an initial public offering of the stock can be held, allowing the investment to be highly liquid
- Allows equity to be raised from a wide range of investors, not only farmers
- The Board of Directors can be streamlined, and professional management can be retained and included on the Board

- C corporations tend to be large organizations with substantial balance sheets, which banks prefer and, therefore, can result in easier access to credit and more favorable debt terms
- Equity can be used alongside or instead of cash to acquire other operations
- Limited legal liability

Disadvantages

- The primary disadvantage of the C corporation is the double taxation of earnings, as income is taxed at the corporate level and dividends are taxable as part of the personal incomes of the individual investors; this is an important issue for individual investors, but venture capitalists tend to be more comfortable with the tax structure as liquidity is a key issue
- Public reporting of financials is costly, and compliance with Sarbanes-Oxley legislation is cumbersome

VI. IMPLICATIONS FOR THE FUTURE: CELLULOSIC ETHANOL AND NEW GOVERNMENT BIOFUELS TARGETS

In his 2007 State of the Union Address, President George W. Bush emphasized the need for expanding the Renewable Fuel Standard (RFS) that was originally established in the Energy Policy Act of 2005 into an Alternative Fuel Standard (AFS) that would reach 35 billion gallons by 2017 – nearly five times the original 2012 RFS target of 7.5 billion gallons. In order to meet this target, advances in alternative fuels will need to come from sources such as corn ethanol, ethanol from cellulosic feedstocks, advanced biofuels including biobutanol, biodiesel, renewable diesel and other transportation energy options.

To meet this goal, the commercial-scale conversion of biomass feedstocks into ethanol, in particular cellulose to ethanol, will need to play a prominent role. Simply put, biomass can be considered as a form of stored solar energy where the energy of the sun is "captured" through the process of photosynthesis in growing plants. The fact that the U.S. agricultural economy grows the most cultivated/harvested biomass crops in the world, places it in the lead role for the further development of a U.S. corn-based and cellulosic-based renewable ethanol industry.

The risks and uncertainties are still great, however, since to date, there are no commercial-scale cellulose-to-ethanol facilities in operation as of late 2006.[10] Significant breakthroughs in new technologies will need to continue on multiple fronts in order to reach commercialization. In order to bridge these gaps and spread the startup risks, joint ventures and partnerships that aggregate technical expertise from both the private and public sectors will dictate the evolution of the cellulose-to-ethanol industry.

For this section of the report, it is useful to define some of the foundational terms that are used in the cellulosic/renewable energy industry. The U.S. Department of Energy (DOE), Biomass Program, Feedstock Composition Glossary and Professor Lee Lynd, define a number of the key terms as follows:[11]

> **Cellulosic biomass:** Biomass composed primarily of inedible plant fibers having cellulose as a prominent component. These fibers may be hydrolyzed to yield a variety of sugars that can subsequently be fermented by microorganisms. Examples of cellulosic biomass include grass, wood, and cellulose-rich residues resulting from agriculture of the forest products industry.[12]
>
> **Hemicellulose:** Hemicellulose consists of short, highly branched chains of sugars. In contrast to cellulose, which is a polymer of only glucose, a hemicellulose is a polymer of five different sugars. It contains five-carbon sugars

10 The private Canadian company Iogen has demonstrated pilot scale successes regarding the use of wheat straw to make ethanol. Their partners include such firms as Goldman Sachs, Royal Dutch/Shell Group, Petro Canada and the Government of Canada.

11 (http://www1.eere.energy.gov/biomass/feedstock_glossary.html).

12 Dr. Lee Lynd, Dartmouth University.

(usually D-xylose and L-arabinose) and six-carbon sugars (D-galactose, D-glucose, and D-mannose) and uronic acid. The sugars are highly substituted with acetic acid. The branched nature of hemicellulose renders it amorphous and relatively easy to hydrolyze to its constituent sugars compared to cellulose. When hydrolyzed, the hemicellulose from hardwoods releases products high in xylose (a five-carbon sugar). The hemicellulose contained in softwoods, by contrast, yields more six-carbon sugars.

Hydrolysis: The conversion, by reaction with water, of a complex substance into two or more smaller units, such as the conversion of cellulose into glucose sugar units.

Lignin: The major noncarbohydrate, polypenolic structural constituent of wood and other native plant material that encrusts the cell walls and cements the cells together.

Lignocellulose — Refers to plant materials made up primarily of lignin, cellulose, and hemicellulose.

Starch: A molecule composed of long chains of a-glucose molecules linked together (repeating unit $C_{12}H_{16}O_5$). These linkages occur in chains of a-1,4 linkages with branches formed as a result of a-1,6 linkages (see below). This polysaccharide is widely distributed in the vegetable kingdom and is stored in all grains and tubers. A not-so-obvious consequence of the a linkages in starch is that this polymer is highly amorphous, making it more readily attacked by human and animal enzyme systems and broken down into glucose.

Structural Chemical Analysis: The composition of biomass reported by the proportions of the major structural components; cellulose, hemicellulose, and lignin. Typical ranges are shown in the table below.

Component	Percent Dry Weight
Cellulose	40-60%
Hemicellulose	20-40%
Lignin	10-25%

Ethanol can be made from cellulosic biomass (plant matter composed primarily of inedible cellulose fibers that form the stems and branches of most plants). Agricultural crop residues (such as corn stalks, wheat straw and rice straw) wood waste, and

municipal sold waste are potential sources of cellulosic biomass. Dedicated energy crops, such as switch grass, are also potential cellulose sources that can be produced in a sustainable manner in certain regions of the country.

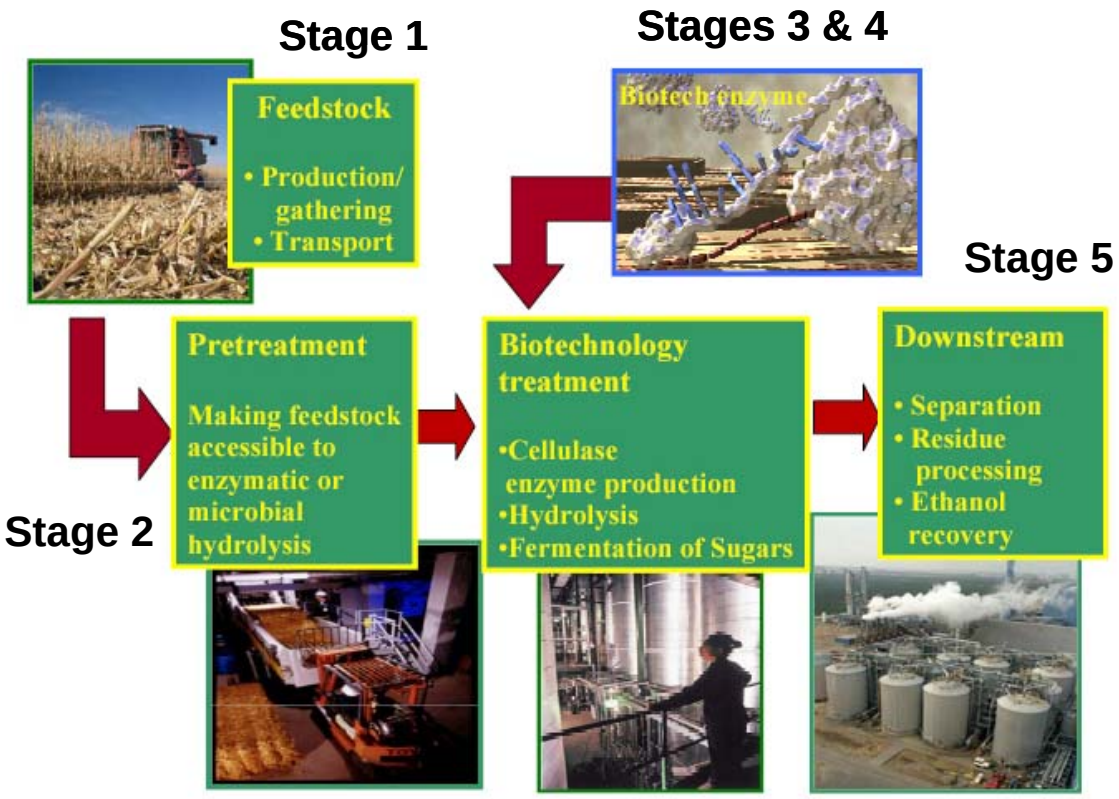
The path to ethanol from cellulosic plant matter is described in a simplified diagram in Figure 5. Five stages are identified to highlight the process as the cellulose is transformed into ethanol.

- **Stage 1: Feedstock** – This is the production, gathering and transportation of the cellulosic feedstock. The process may sound quite simple; however, the logistical aspects of the pathway to cellulosic ethanol are still in the seminal stage of development and are actually quite complex. Some of the issues regarding this stage are as follows:
    - The volume of renewable cellulosic biomass material that is available is, of course, one of the attractive aspects of the cellulose-to-ethanol model. The ability to harvest/collect the biomass in an efficient/economical manner, however, is a challenge that is being discussed by such companies as Deere. The first large-scale cellulose-to-ethanol operations will likely be based on corn stover; which raises such questions as to how and how much of the corn stover should be extracted from fields. New equipment and cultivating practices are being explored and could radically reshape traditional cropping practices, such as the concept of "one pass" harvesting, where a combine would extract both the corn and corn stover simultaneously.
    - There will need to be a critical mass of renewable cellulosic feedstock within a geographic region to justify the cost of transporting the feedstock to the processing facility.
    - DuPont (Pioneer Hi-Bred), for example, is actually trying to expand the amount of available feedstock as identified in the company's three-part strategy concerning biofuels, where it states that the goal is to improve existing ethanol production through differentiated agricultural seed products and crop protection chemicals.[13]

- **Stage 2: Pretreatment** – The pretreatment process is the mechanical and chemical preparation of the bulk mass of cellulosic material for hydrolysis. The complex structure of lignocellulosic biomass, the crystalline structure of cellulose, and the physical protection provided by hemicellulose and lignin prevent efficient hydrolysis and subsequent release of fermentable sugars by hydrolytic enzymes. Therefore, pretreatment is required to alter the structure of cellulosic biomass. In general, an effective pretreatment enhances the susceptibility of biomass to enzymatic hydrolysis by disrupting/removing barriers such as lignin and hemicellulose so that more surface area is available for the enzyme, and/or by decreasing the crystallinity of the cellulose structure.

13 The other two strategies are (1) develop and supply new technologies to allow conversion of cellulose to biofuels and (2) develop and supply next generation biofuels with improved performance. Source: www2.dupont.com.

Figure 5: The Path to Ethanol from Cellulose



Source: Biotechnology Industry Organization (BIO), Informa Economics.

- **Stage 3: Biotech Enzymes** – This is a relatively new field of industrial biotechnology using techniques in genomics, proteomics, and bioinformatics. The advancements of biotech enzymes are making it possible to convert the fermentable cellulosic sugar stream into ethanol. The use of biotechnology is allowing scientists to maximize the effectiveness and efficiency of enzymes and to custom-tailor the specificity of enzymes, improve catalytic properties or broaden the conditions under which enzymes can function so that they are more compatible with existing industrial processes. This field is often based on the science of serendipity. For example, scientist Mark Emalfarb was looking for a better enzyme to soften blue jeans. His search led him to a naturally growing fungus in eastern Russia. The result of his find was an organism that when turned into a biofactory (the world's most prolific fungus) is capable of producing vast amounts of enzymes that convert cellulosic material into ethanol. Emalfarb's company, Dyadic International Inc. has signed a deal with the Spanish energy firm Abengoa to use the fungus to make fuel in a forthcoming cellulosic (feedstock will be agricultural waste) pilot plant in Nebraska.[14]

14 Business Week, "Put Termite in Your Tank," December 18, 2006.

- **Stage 4: Biotechnology Treatment** – This stage involves the application of the biotech enzymes created in Stage 3 to the pretreated cellulosic feedstock in order to convert/ferment the sugars into ethanol.

- **Stage 5: Downstream** – The downstream stage will vary significantly based on the goals of the firm(s) involved. The ethanol industry is working hard to adapt the petroleum refinery model where numerous "downstream" value-added products are manufactured in tandem with the ethanol stream at a "biorefinery."

The modern ethanol industry has advanced significantly over the last thirty years. Initially, one bushel of corn yielded approximately 2.0 gallons of ethanol; today, the yield is above 2.8 gallons per bushel of corn, and some industry experts expect the yield to rise to 3.0 gallons per bushel of corn over the next five years. The platform for producing ethanol, however, has changed little: ground corn, water and enzymes convert starch into sugar, and then the sugars are fermented into alcohol by adding yeast. Initially the corn-to-ethanol industry was faced with noteworthy hurdles, both in terms of capital investments/requirements as well as technological barriers. The role of federal and state governments along with private sector investments has helped to make the corn-to-ethanol industry commercially viable.

In terms of industry development (not necessarily science), the status of the cellulose-to-ethanol industry is similar to where the corn-to-ethanol industry was thirty years ago. Expectations are very high regarding the potential contribution toward meeting transportation fuel needs, but technological breakthroughs and increased capital investments are necessary to move from the lab/pilot plant status to the commercially viable (profitable) stage of production.

The primary barrier with cellulose to ethanol has been the resistance of the cellulose, hemicellulose and lignin to conversion into sugar molecules than can be converted (fermented) into ethanol. Dr. John Ashworth of the National Renewable Energy Laboratory (NREL) identifies three principal efficiency gains that must occur for cellulose-based fuels to be cost-effective operations:

- Find lower cost feedstocks, in the range of $25 to $30 per ton delivered to the plant;
- Get the cost of enzymes down to the level routinely found for enzymes in corn ethanol plants; and
- Develop a robust industrial ethanol producing micro-organism (yeast or bacteria) that can use all the biomass sugars, is highly ethanol tolerant, and can produce high levels of ethanol in a short time period.[15]

Dr. Kevin Gary, the director of alternative fuels for Diversa Corp, believes that "there still has to be a lot of technology developed to start up a purely cellulosic ethanol plant." He adds that seizing the appropriate technology for decoding biomass decomposition will

15 Ethanol Today, "Cellulosic Ethanol: Harvesting Potential," p. 11, October 2006.

require expertise from a variety of industry leaders and scientists, stating, "it is an aggregation of technical expertise." [16]

The NREL is pursuing this vision of acting as a catalyst to aggregate technical expertise in order to convert biomass into a range of valuable fuels, chemicals, and other materials, and products, much like oil refineries and petrochemical plants do. The platform being developed is the concept of a biorefinery: a facility that integrates biomass conversion processes and equipment to produce fuels, power, and chemicals from biomass. The biorefinery concept is analogous to today's petroleum refineries, which produce multiple fuels and products from petroleum.

Industrial biorefineries have been identified as the most promising route to the creation of a new domestic biobased industry. By producing multiple products, a biorefinery can take advantage of the differences in biomass components and intermediates and maximize the value derived from the biomass feedstock. A biorefinery might, for example, produce one or several low-volume, but high-value, chemical products and a low-value, but high-volume liquid transportation fuel, while generating electricity and process heat for its own use and perhaps enough for sale of electricity. The high-value products enhance profitability, the high-volume fuel helps meet national energy needs, and the power production reduces costs and avoids greenhouse-gas emissions.

Because there is such uncertainty regarding the rate at which new technologies will be adopted in the cellulose-to-ethanol industry, there is significant disparity in the forecasted growth trajectory of the industry. As previously mentioned, the rate of build-out is heavily dependent on technologies and processes that are currently available yet are not commercially (financially) viable. A number of noteworthy forecasts for the U.S. production cellulosic ethanol are as follows:

- The U.S. DOE, Energy Information Administration (EIA) in its Annual Energy Outlook 2007, forecasts U.S. total ethanol production will reach 14.6 billion gallons by 2030, with corn as the primary source. Ethanol from cellulosic feedstocks will account for only 1.0 billion gallons of the total production.
- The Biotechnology Industry Organization (BIO) is more optimistic, with forecasts of cellulosic ethanol production reaching levels of approximately 6.0 billion gallons by 2020 and 9.0 billion gallons by 2025.[17]

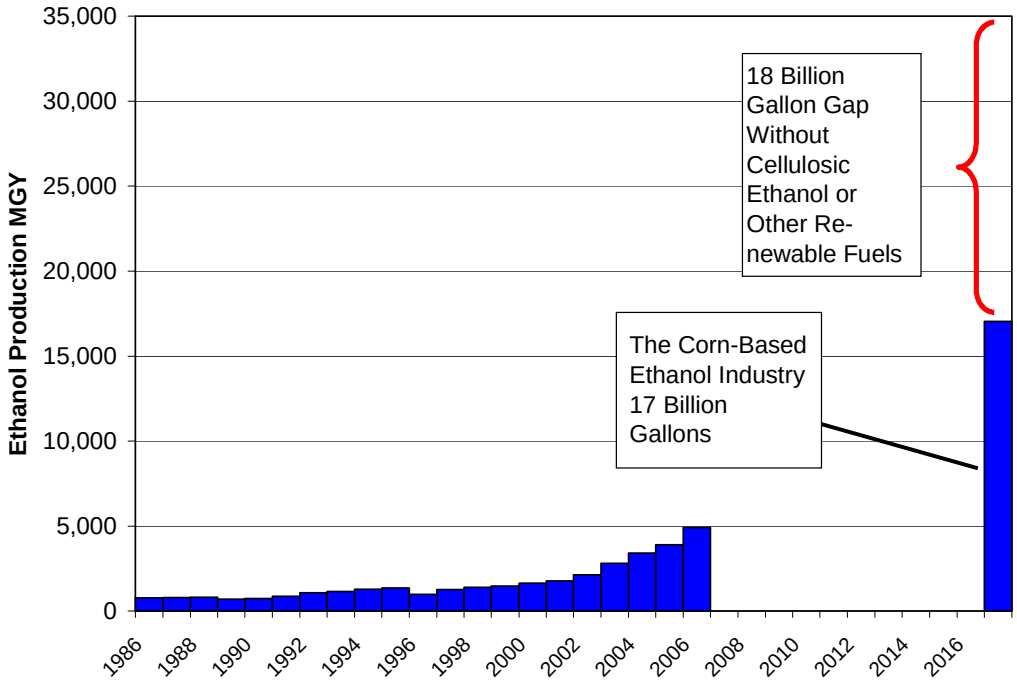
Informa estimates that U.S. corn-based ethanol production will reach approximately 17 billion gallons of production by 2017, well shy of the President's 35 billion gallon goal (see Figure 6). In order to bridge the remaining 18-billion-gallon gap, significant gains in

16 Ibid.

17 BIO represents more than 1,100 biotechnology companies, academic institutions, state biotechnology centers and related organizations across the United States and 31 other nations. BIO members are involved in the research and development of healthcare, agricultural, industrial and environmental biotechnology products. (www.bio.org)

cellulosic ethanol and other renewable energies such as biodiesel will be required to make up the difference.

Figure 6: Reaching 35 Billion Gallons of Renewable Fuels by 2017 by Corn to Ethanol



Sources: Renewable Fuels Assn. (History), Informa Economics (Forecast)

If cellulosic conversion becomes commercially viable by 2017, the platform for conversion would likely be based on the concept of a biorefinery, where cellulosic ethanol would be one of numerous co-products that are produced. The biorefineries will have large capital requirements in order to capture economies of size. The primary cellulosic feedstock used would likely be corn stover, since it is a complementary co-product in the production of corn.

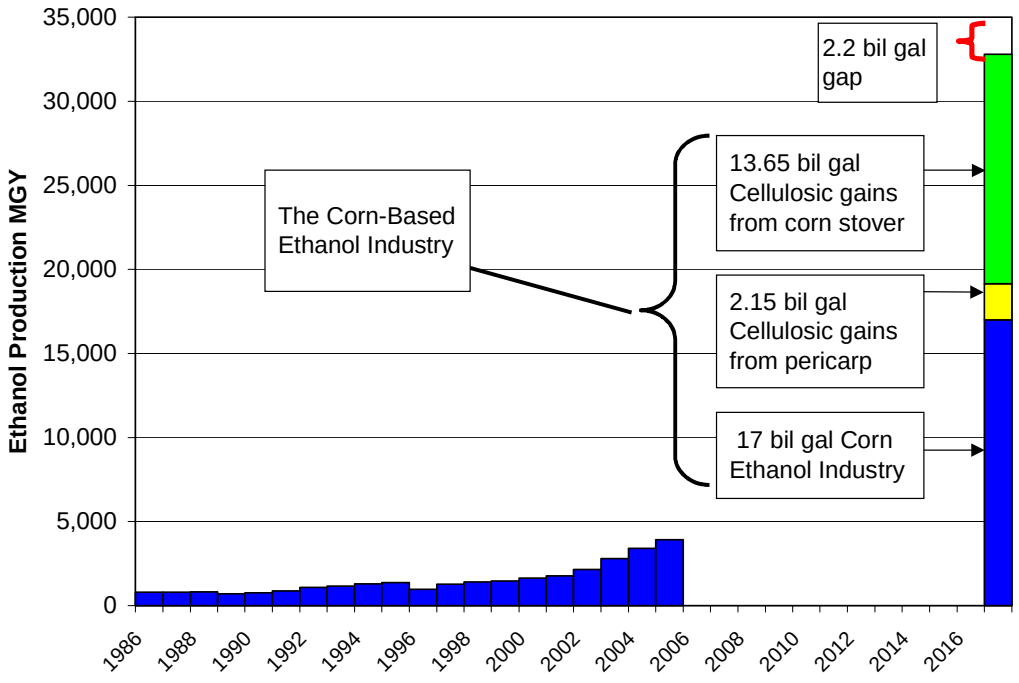
It is generally assumed that corn stover-to-grain ratios remain at 1:1 on a dry-weight basis.[18] With 87.0 million corn acres (187 bushels/acre) projected by Informa for 2017, about 456 million dry tons of corn stover could be produced in the U.S. However, not all the corn stover produced can and should be harvested. The share of stover that can be removed depends on machinery efficiency, erosion control, moisture retention, and the carbon sequestration impact on soils. Assuming tolerable soil erosion and partial collection of harvested stover, no more than 40% of the stover could be removed, (even

[18] Perlack, Robert D., Lynn L. Wright, Anthony F. Turhollow, Robin L. Graham, Bryce J. Stokes, Donald C. Erbach. Biomass as Feedstock for a Bioenergy and Bioproducts Industry: The Technical Feasibility of a Billion-Ton Annual Supply. U.S. Department of Energy and Department of Agriculture, Washington DC, April 2005.

though it is possible, under the right conditions, to collect 60-70% of the stover). At this removal rate, as much as 182 million dry tons of corn stover, or about 2.1 dry tons/ harvested acre, could be collected in the U.S. in 2017.

According to the U.S. Department of Energy, the theoretical ethanol yield that can be obtained with corn stover is 113 gallons/dry ton of feedstock (source: DOE ethanol calculator). Actual figures can be much smaller, and a more conservative figure is 70-80 gallons/dry ton of feedstock, which would represent as much as 13.65 billion gallons of ethanol in 2017 (157 gallon/acre of corn stover) (see Figure 7). An additional 2.15 billion gallons of cellulosic ethanol might also come from the corn pericarp. Thus, total output of ethanol from corn grain, stover and pericarp could, in theory, nearly reach 35 billion gallons. Assuming that cellulosic ethanol becomes viable by that time, other sources of feedstock such as wood chips and, eventually, energy crops could fill any remaining gap.

Figure 7: Reaching 35 Billion Gallons of Renewable Fuels by 2017, by Corn to Ethanol and Cellulosic Corn Stover



Sources: Renewable Fuels Assn. (History), Informa Economics (Forecast)

This assessment shows that there is significant potential for cellulosic ethanol to contribute to the renewable energy equation, although it should be emphasized that the timing of the technology breakthroughs are very uncertain and could greatly impact the speed and magnitude of cellulosic ethanol significantly complementing corn-based ethanol in meeting U.S. transportation fuels needs.

VII. SYNTHESIS OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

A. FINDINGS REGARDING BUSINESS MODELS CURRENTLY USED IN THE RENEWABLE FUELS INDUSTRY

The business models that have evolved in the renewable transportation fuels sector are relatively efficient, and there are relatively low barriers to entry into the industry, including entry by organizations with substantive investment from farmers and other rural investors. However, while the business models per se are not faulty, there are three issues that are constraining current and future investment by farmers and other rural investors:

- The large scale of a typical new facility (mainly for ethanol);
- Cumbersome legal structures; and
- Underdeveloped management systems.

New ethanol facilities that are being built as of late 2006 tend to fall in two general size categories: 40-60 mmgy and 100 mmgy. A 50-mmgy facility can involve plant and equipment costs of $80 million and total project costs of $90 million or more; this would require that $35 million or more in equity be raised. For a 100-mmgy plant, the total project cost and equity requirement are nearly twice as large, though there are some plant an equipment items that do not have to be doubled in scale and cost. It can be difficult to raise such levels of equity from farmers and other rural investors; for example, if the average investment were $100,000 there would need to be 350 investors for a 50-mmgy plant, and many more than 350 people would need to be solicited for the investment. The biodiesel industry involves somewhat smaller plants, though the industry appears to have begun to gravitate toward plants that have capacities of 30 mmgy or more, which involve investments nearly as substantial as a 50-mmgy ethanol plant.

Additionally, as the investor group moves toward forming a legal entity, the choice of legal structure can be complicated. If the group consists mainly of farmers but also needs to include other outside investors in order to reach the required equity, it might not be able to utilize a cooperative structure. Cooperative and LLC statutes can vary by state, with some allowing flexibility and others being more constraining.

Finally, while funding and legal structure are crucial issues as a renewable fuel production facility is formed and starts up operations, management remains a key issue even after the plant begins to produce. This issue encompasses both management systems and the quality of the personnel running the operation. This is likely to continue to be an area where plants owned by farmers and other rural investors will need to focus efforts in order to stay competitive with corporations (i.e., operations utilizing the corporate model) as well as new entrants that do not want to be involved in day-to-day management but are well-capitalized and able to hire high-quality managers and choose among third-party service providers (i.e., the franchise model).

For groups organized by farmers and other rural investors, the issue of management arises early on in the formation of the organization. An individual leader or, more often, a steering committee must commission a consultant to conduct a feasibility study, engage an attorney to assist in the legal formation of the organization (and determine the most appropriate legal structure), lead the equity drive and negotiate with commercial or investment banks to raise the debt, purchase or take out an option on a piece of property, select an engineering and construction company/consortium (and get a slot in their construction pipeline) and apply for the necessary permits from government agencies. As this is time consuming – particularly for an operation started by a group of farmers and other rural investors, since a large number of people (sometimes hundreds) have to be approached in order to convince a sufficient number of people to invest – there needs to be either a steering committee composed of people willing to volunteer their time or a project manager who is compensated.

Assuming the plant has substantive farmer ownership, management eventually would still have to enter into an agreement with an ethanol/biodiesel marketer and, for an ethanol producer, perhaps a distillers grains marketer. While there is an informal network of people and companies that provide individual components of these services, there is no single entity that provides these services comprehensively from the conception/discussion stage through to when the plant is operating, except perhaps in the case of engineering/construction companies that retain an equity stake in the operation. As a result, newly formed groups often must have to make their way up the same learning curve that previous entrants into the industry have, sometimes “reinventing the wheel” in the process.

Once the plant is operating, leadership and the use of effective management systems continue to be important. Depending upon how the ethanol or biodiesel is marketed,

decisions have to be made about whether to accept forward contract bids, which typically have a term of three to 12 months. Margin risk management for renewable fuel producers can be complicated; even though liquid futures markets exist for corn and soybean oil, the treatment of co-product credits and especially the pricing of the renewable fuels (e.g., fixed forward contracts vs. gasoline-plus contracts vs. spot pricing) have considerable bearing on the management of margins. On a more mundane basis, the renewable fuel production process has to be maintained at a high level of efficiency, accounting systems have to be selected and adapted to the operation, people have to be managed, and other day-to-day management responsibilities have to be performed. Additionally, the board of directors has to make decisions about whether to retain profits in order to expand or to weather any future periods of negative margins, or else to distribute the profits as dividends to investors. For plants that have been in operation for several years, decisions have to be made about adopting new processes and technologies.

B. CELLULOSIC ETHANOL IMPLICATIONS FOR BUSINESS MODELS

With the advent of cellulosic ethanol in the coming years, the issues of cost, legal structures and management are going to become even more acute. Capital expenditures per gallon of capacity for cellulosic plants are estimated to be at least three times those for a traditional corn-based plant, and between the total cost of a facility and obtaining the rights to use cellulosic ethanol technology, it might be the case that only large corporations and private equity funds have the financial resources to provide the equity for such ventures, especially given the associated risk. Given the importance of intellectual property in cellulosic ethanol, and the fact that some of the main engineering companies serving the corn-based ethanol industry are also devoting resources to cellulosic ethanol, it is possible that the engineer/builder-owned business model will also rise in prominence.

Collection and storage systems have generally not been established for crop-based feedstocks, although central milling locations exist for some forest and paper products. Given the scale of the investments and the role of intellectual property in cellulosic ethanol, it is possible that the farmer-owned business model will struggle to be relevant in the new industry; however, farmers will be the main source of cellulosic feedstock, without which the ethanol cannot be produced, so it is possible that a hybrid model will need to be developed in which farmers are brought into the ownership structure. The Broin system of partnering with farmers and other rural investors might be adaptable for this purpose of tying together capital, intellectual property and feedstock; however, the

feedstock supply linkage would probably need to be enhanced. Given the legal and management issues discussed above, it will be important to ensure that any necessary modifications to legal structures and management systems be put in place during the next few years if farmers and other rural investors are to participate fully in the cellulosic ethanol industry of the future.

Business models will likely become even more complex with the advent of cellulosic ethanol. Whereas corn is the predominant feedstock for the ethanol industry of today, a variety of feedstocks – corn, agricultural wastes, dedicated energy crops, forestry products and others – may well be utilized by the cellulosic ethanol industry of tomorrow. The producers of the feedstocks of tomorrow might not only be row crop farmers, so the "farmer-owned" business model might have to expand to encompass more types of producers. Moreover, with the advent of biorefineries, the number and specialization of co-products could multiply, possibly requiring a diverse mix of third-party co-product marketing firms. In the case of some products with highly technical applications, the use of specialized marketing firms or long-term offtake agreements might be necessitated by the difficulty of having a plant employee perform the sales function. In all likelihood, there will be more business models created by the advent of cellulosic ethanol, and they will be even more complex than today's business models.

C. RECOMMENDATIONS

As discussed above, the business models used in the renewable fuels industry are relatively efficient, but there are three issues that are constraining current and future investment by farmers and other rural investors. There is little that the government can do to affect the cost and scale of the facilities now being built, and the overall question of access to and investment in the renewable fuels industry by farmers and other rural investors is the subject of a separate study that was commissioned by USDA Rural Development simultaneously with the study on Business Models for Ethanol and Renewable Energy addressed in this report. There are, however, initiatives that the USDA and the government in general can take to address the other two challenges: cumbersome legal structures and underdeveloped management systems.

- Legal structures. It is clear that the cooperative structure is too restrictive to lend itself to widespread use in the renewable fuels industry, particularly given the levels of investment that are now required. The USDA should convene a panel of existing and newly forming renewable fuels companies that are primarily owned by farmers and other rural investors, as well as attorneys who have experience setting up

cooperatives and using other legal structures, especially LLCs. The panel discussion should focus on whether the co-op structure can be adapted to modern, large-scale renewable fuel production operations and, if so, what key of changes need to be made to statutes and regulations (i.e., not items that need to be changed in statutes specific to individual states, but rather the kinds of provisions that are generally found in co-op laws and need to be changed). If it is determined that the co-op structure can be molded to the needs of renewable fuels producers, then USDA attorneys (either on staff or retained by the agency) should conduct a review of state and federal laws and regulations governing cooperatives and formulate a comprehensive set of recommended changes to "correct" the situation (the ability of co-ops to include members from multiple states also reportedly can be problematic). On the other hand, if it is determined that the changes that would be necessary would alter the fundamental nature of the cooperative structure, then USDA attorneys should investigate any changes to state and federal laws and regulations that would streamline and facilitate the utilization of cooperatives within other legal structures, such as the co-op being an investor in and grain supplier to a renewable fuels operation structured as an LLC. Once such changes are made, the USDA should launch an outreach program to let farmer/rural groups know the specific details of how co-ops can be utilized for renewable fuel production operations. Finally, although the USDA cannot directly change legislation, it could inform lawmakers of the unintended consequences of certain legislation. Specifically, the public registration and financial reporting required of organizations with more than 500 investors, and the Sarbanes-Oxley provisions that apply to such organizations, can be burdensome and costly to operations that cross such thresholds simply due to the limited resources available from farmers and other rural investors.

- Management systems. While there are materials available to guide new groups through the process of establishing a renewable fuels production operation, they typically describe general steps rather than providing specific details, and an informal network of individuals and service providers assists the groups in accomplishing each task required to get an operation up and running. Some states that want to attract renewable fuels facilities have designated government agencies (or quasi-governmental organizations) or established Web sites to guide prospective operations through such processes as applying for air permits, but the level of information differs from state to state. The USDA can have an important role in providing detailed information to renewable fuels operations as they are organizing and in facilitating the use of "best practices" management systems once the operations are running. USDA Rural Development should consider creating a

centralized Web site (along with support staff available by telephone) that would provide not only a generalized guide to the major steps in establishing a renewable fuel operation but also the following:

- Guidance on the legal structure(s) most appropriate for prospective operations based on the types of investors involved and other circumstances specific to the individual operation; based on the results of the legal review suggested above, detailed information could be provided on how to structure as a co-op – or as a co-op within another structure such as an LLC – on a state-by-state basis, in order to encourage the formation of co-ops wherever appropriate;
- Lists of attorneys and law firms that have worked in the past with co-ops and other renewable fuels operations during their formation, though any USDA certification of attorneys or recognition of specializations could be problematic;
- Specific information on the procedures for applying for air quality permits and complying with other regulatory requirements (e.g., taxation) in all 50 states;
- Templates for third-party grain supply and product offtake contracts, with standardized terminology and contents (e.g., arbitration provisions) such as those provided to homeowners due to "truth in lending" requirements, though such items as service fees and the pooling of supplies versus plant-by-plant sales would be subject to negotiation between the renewable fuel operation and the third-party service provider;
- Lists of third-party service providers that work with the renewable fuels industry, along with contact information;
- Guidance on how to run an equity drive, potentially with assistance from USDA field offices in the states where groups of farmers and other rural investors are attempting to establish operations;
- Information on the types of debt financing that are available to renewable fuels producers and the circumstances in which the individual types of debt are appropriate to use; and
- For plants that are operating, information on such issues as enterprise/accounting software available to the industry and "best practices" regarding a range of issues faced by renewable fuels producers, such as risk management (e.g., a risk management handbook could be jointly developed with the Chicago Board of Trade, where corn and soybean oil futures contracts are traded, and the New York Mercantile Exchange, where gasoline and heating oil contracts are traded) and procedures that a board of directors should follow to be effective.

Additionally, given that the tremendous expansion in the renewable fuels industry in recent years has stretched thin the ranks of experienced managers, the USDA might be able to develop associates degree and continuing education programs through community colleges in areas where renewable fuels operations are concentrated. These programs would be designed to train managers and directors in a range of issues that face renewable fuel producers, such as the basics of process science, accounting and risk management. Product quality is a particular concern in the biodiesel industry, and it might be possible for this to be addressed through training programs that are integrated into the industry's ongoing quality control program (though the USDA might consider its own quality certification program if the industry is unable to achieve the necessary results in a timely manner).

In conclusion, there are concrete steps that the USDA can take to facilitate the establishment and operation of renewable fuels facilities owned by farmers and other rural investors, although no large-scale intervention in the business models being used by the industry appears necessary.