

A Guide for Evaluating the Requirements of Ethanol Plants



Developed by:

The Clean Fuels Development Coalition

and

The Nebraska Ethanol Board

In Cooperation with

The U.S. Department of Agriculture



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Information contained in this publication was initially developed under an agreement between the Clean Fuels Foundation and the Clean Fuels Development Coalition in cooperation with the Nebraska Ethanol Board. This ethanol plant guide was developed to assist communities, cooperatives and other agricultural organizations in making an initial determination regarding the economic feasibility of developing an ethanol project. Information contained in this document is considered to have applicability to biofuel processing ventures aside from ethanol projects. Readers of this document should consider the information to be for general application only. Communities with an interest in evaluating prospective ethanol projects in more detail may wish to contact local and state economic development agencies in their respective states.

Readers of this document may also want to review information contained in the Ethanol Fact Book. Copies of this publication are available via the Nebraska Ethanol Board web site www.ne-ethanol.org in cooperation with the Clean Fuels Development Coalition www.cleanfuelsdc.org and the Clean Fuels Foundation, sponsors of Ethanol Across America ethanolacrossamerica.net.

Additional information about the economic impacts and energy balance of ethanol production is also available at: ethanolacrossamerica.net.

To Readers:

During the past decade, interest in the production of biofuels from renewable resources has continued to grow throughout the United States. Major grain producing states have placed special emphasis on the production of ethanol. The production and use of ethanol generates a variety of essential economic activity at the local, state and national level. *(Readers wishing to learn more about specific economic benefits associated with the production of ethanol may wish to review the CFDC Issue Brief series available at www.ethanolacrossamerica.net.)*

As concerns about the economic downturn in the agricultural sector and rural communities continue to mount, many groups and individuals have been motivated to consider the potential for producing ethanol. Across the country, farmer cooperatives, rural development coalitions, bio-energy advocates and others have gathered to explore the process and prospects for developing ethanol production facilities. In many cases these efforts have resulted in the successful development of ethanol plants.

The current demand for ethanol and the projected increase in the use of these fuels under a national renewable fuels standard continues to stimulate interest in the prospects for the development of new ethanol plants. This publication is designed to assist interested parties during the initial stages of evaluating the potential for development of a processing facility. During this process, interested parties can consider the requirements and potential impact of an ethanol production facility in a community or region of the state. With this information, the parties can make a more informed decision about the viability of a proposed project and the level of commitment and cost required to proceed.

Entities interested in development of ethanol processing plants are often attracted by the variety of economic benefits generated by the plants. The value-added aspects of producing a high value product from lower cost raw materials has considerable appeal in agricultural states and areas where reliable supplies of biomass feedstocks exist. For example, high protein co-products made in the fuel ethanol production process, such as distillers dried grains and gluten feeds, have gained the full acceptance of feedlot operators and dairymen as premium feeds for their cattle. Used in wet form, these protein feed supplements induce significant economic benefits for the livestock and dairy industries while reducing the input of energy at ethanol plants. These high value co-products also represent billions of dollars in value-added exports.

In many states where virtually all liquid transportation fuels must be imported from sources outside the region, the use of ethanol can also help retain energy dollars in the state's economy when such fuels are produced locally. On a broader scale, the use of ethanol nationally will also help offset our dependence on imported oil. Under no circumstance should dependence on imported oil at the level we are now experiencing in the U.S. be acceptable. Domestic production of renewable biofuels from a host of feedstock materials can play an increasingly important role in meeting our transportation fuel needs while creating opportunities for rural economic development.

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Major advances in technology to convert cellulosic biomass into fuel ethanol have set the stage for a significant expansion of the ethanol industry during the next decade. Advances in genetics, farming practices, feed grain and oil bearing crop production will increase the efficiency of producing biofuels from conventional and new energy crops. More importantly, the use of cellulosic biomass (i.e., agricultural residues, wood wastes, yard and garden trimmings and the biomass fraction of municipal waste) essentially eliminates the upper boundaries to the production of ethanol.

The increasing demand for ethanol is evident today and the prospects for additional use of this renewable fuel look promising. Many states are ideally suited for the development of ethanol production facilities. Reliable supplies of raw materials, mature transportation systems, competitive energy costs and a strategic position relative to national markets provide excellent opportunities for development of ethanol plants in dozens of states.

The Clean Fuels Development Coalition and the Nebraska Ethanol Board are working with a variety of organizations and agencies throughout the United States to support development of ethanol plants. As communities, cooperatives, rural development organizations and others consider the prospects for ethanol development, a variety of resources are available to support this process. This publication was designed to provide initial guidance for evaluating the potential for local production facilities. Other resources are noted in the publication.

While this document provides useful information about various requirements for siting ethanol plants, readers should not rely on the information contained herein to provide advice on related investments.

This document is intended for use as an ethanol plant assessment guide produced for use by organizations with an interest in ethanol plant development. However, the process discussed is generally relevant for other biofuels projects as well. Many communities will find the site location criteria to be most useful in evaluating potential sites for proposed ethanol plants. While the requirements of each proposed facility will vary, the infrastructure requirements outlined in this document should provide useful information for local economic development organizations and community leaders. This publication is designed only to provide guidance during the initial stages of project evaluation and site assessment.

We appreciate the support of the U.S. Department of Agriculture on this project. We hope that readers find this publication useful in the process of considering ethanol production opportunities across the country.

Sincerely,



Douglas A. Durante, Executive Director
Clean Fuels Development Coalition



Todd C. Sneller, Administrator
Nebraska Ethanol Board

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United States Department of Agriculture
Rural Development
Office of the Under Secretary

Utilizing rural America's natural resources to create new and sustaining energy sources is a critical part of America's overall energy strategy. Since 2001, President Bush has sought to increase our independence from foreign energy by embracing new and innovative technologies. Technologies that allow us to develop American made energy, particularly ethanol. As noted by the President during his 2006 State of the Union, renewable energy, including ethanol and biodiesel, could greatly reduce our "oil addiction".



"A Guide for Evaluating the Requirements of Ethanol Plants" contains in depth information that can serve as a useful tool as you begin to assess the feasibility of developing an ethanol production facility in your community. Topics such as feasibility studies, incentives for building, and the final steps in the formation of the business entity must be fully understood and considered during the initial stages of determining if an ethanol venture is right for you. Moreover, you will also find information relating to community benefits, government and private sources of funding, tax incentives and structures, and a list of related organizations used as a model.

Rural America has the resources to create local economic opportunities and increase energy self sufficiency. Please do not hesitate to contact any of our USDA Rural Development offices, or visit our website at www.rurdev.usda.gov for information on ways in which USDA Rural Development financial and technical assistance programs may assist you in exploring ways in which you can join in creating an energy independent nation.

A handwritten signature in black ink, which appears to read "Thomas C. Dorr". The signature is fluid and cursive, with a large initial "T" and "D".

Thomas C. Dorr
Under Secretary
USDA Rural Development

Pre-Feasibility Evaluation: Initial Considerations



Beginning the Process

As noted, a variety of factors are stimulating interest in the production of ethanol. Regardless of the motivation, initial interest is often expressed by a small group of individuals or an organization. This entity often asks for advice about the factors that help determine project feasibility.

A key consideration in ethanol plant feasibility is the size and cost of the plant. Current capital cost per annual gallon of installed capacity for an ethanol plant ranges from \$1.25 to \$2.00. For example, a 40 million gallon per year plant may cost nearly \$80 million. Capital cost per annual gallon tends to decrease with plant size. A 100 million gallon per year ethanol plant may have a capital cost of approximately \$125 million.

Operating capital increases the financial requirements of the project. If not deterred by the capital cost requirements, an entity subsequently requests assistance with the process of making an initial evaluation of ethanol production feasibility.

This guide is designed to provide basic information and initial guidance. Additional details about plant siting and many details associated with development of ethanol plants are provided later in this publication. This guidance is generally applicable to biofuel projects as well.

Pre-Feasibility Evaluation (continued)

Organization

At the outset, it is important to focus on the organizational structure of the entity that will take an active role in this evaluation process. The process requires a commitment of time and resources. Formation of this entity can be informal but the initial information gathering and dissemination functions required in the process should be undertaken by individuals who are willing to accept fact finding assignments. A central repository for information should be determined and a key point of contact should be established. An ad hoc committee may need to determine whether a local business or other entity will volunteer office space and communication equipment to help coordinate the initial efforts of the project assessment team. One word of caution: several states have strict banking and securities laws that regulate the raising of money. Even “passing the hat” to collect start-up funding may be legally interpreted as a violation of securities laws. An initial step in this process of forming an evaluation committee should be to check with state banking and securities officials to determine the laws that govern the process.

Project Coordination

Once a steering committee of interested parties has been organized, the group may want to take steps to create public awareness of the proposed project. This step can be accomplished through a variety of means. Media announcements of public information meetings, news letters, newspaper articles and other low-cost or no-cost announcements can be utilized. The response to this informational solicitation can help gauge interest in the project, thereby expanding the pool of people who may be able to assist the effort. A public information meeting can often be enhanced by presentations about ethanol plant development opportunities. This information can be general in nature and can come entirely from an overview generated by the steering committee. The meeting can also be expanded to include a presentation by someone affiliated with ethanol production or parties experienced in this process. The steering committee will be well served to be certain of the applied experience

and credentials of parties represented as having experience with ethanol project development.

After a public meeting or a determination of interest in the process of evaluating ethanol production opportunities, the steering committee may wish to consider a variety of factors. Following are factors that represent many of the basic considerations during the initial assessment of ethanol plant viability.



Basic Considerations in the Pre-Feasibility Evaluation

Assessment Factors

An initial assessment of ethanol production economics and project viability in a specific area should be based on several factors. The assessment is not intended to be a feasibility study but rather an initial indicator of whether the proposed project is practical from an economic perspective. The project team should ask the question: Can a well designed, well built and well run ethanol plant located in this area make money and provide a competitive return to owners and operators? This question forces project developers to evaluate objectives and analyze available resources. This process also provides an opportunity to evaluate alternatives.

Undertaking this initial assessment will help provide justification to proceed with a more detailed and costly technical and engineering analysis, if warranted. The

later analysis will also help determine optimum sites and other factors that refine the economic outlook should the project proceed.

Initial Considerations

The initial pre-feasibility evaluation should include but is not necessarily limited to:

- An overview of the ethanol industry.
- A review of current and projected regional markets, including competing gasoline components and prices.
- A review and assessment of possible areas in a state or region that may be best suited for ethanol production, based on factors such as feedstock availability, demand and cost; utilities and related infrastructure including waste water treatment options, roads, process and drinking water quantity and quality; transportation options; pre-existing environmental conditions that may impact the area; land zoning and cost; weather and prevailing wind patterns; other key economic issues, including eligibility for public finance programs.
- An initial assessment of labor availability.
- An assessment of co-products and by-products from preferred feedstocks and production processes.
- A preliminary assessment of markets for co-products.
- An overview of production processes that are applicable to preferred feedstocks in the area.
- An estimate of the capital, operating costs and environmental impact of ethanol plants of a size considered practical when feedstocks and applicable production processes have been evaluated.
- An assessment of the approximate economic impact of the proposed plant on the local area.

- Review of a financial model that is applicable to the proposed process.
- Review of the business structure options that may be viable for the proposed project.
- A review of additional informational and potential financial resources that may be available to project developers.

Resources

While the initial assessment may at first appear to be a formidable project, the final item on the list is perhaps one of the most important. A host of business development assistance programs are currently available at the local, state and national level. Identifying these resources may be essential for many proposed projects at this juncture. Task allocation can be spread among steering committee members and one or a few members may be willing to serve as a coordinator of information. Educational and economic development organizations in the area are often excellent resources. Project assessment grant programs exist in many states. Several federal programs, including portions of the current USDA Farm Bill titles, authorize grant funds for this type of preliminary economic assessment. Several foundations provide monetary grants for this type of activity provided the proposals meet specified criteria. Additional information about potentially available grant programs can be obtained from the Grant Insider web site (<http://mail-factory.com/refer/mailform>).

Internship programs and graduate studies programs are often a resource for projects seeking personnel who can assist with the initial assessment. Utility companies and banks frequently serve as local resources.

Project Coordination Options

Implementation of the pre-feasibility study can be successful provided the resources above are marshaled and coordinated. This often requires a significant time commitment. If this “volunteer” approach is not

Pre-Feasibility Evaluation (continued)

deemed practical, the steering committee may try to identify financial resources that can be applied to various tasks or the study as a whole. However, direct participation in this process by steering committee members and others is helpful if the project advances beyond the initial stages. Local “ownership” of this process and the resulting work product, i.e., the pre-feasibility conclusion, tends to serve as motivation for the feasibility study process if initial results support a more detailed evaluation of the proposed project.

Pre-Feasibility Conclusions

Following completion of the pre-feasibility study, a conclusion must be reached regarding the practicality of ethanol production under the circumstances considered. The steering committee may conclude that the project is simply not feasible at that time in that area. This may be an accurate conclusion and the steering committee should be prepared to accept this result.

Project Variables

During the assessment, those who are working on the study may wish to identify specific factors that can change the conclusion. For example, if targeted ethanol production incentives become available, what impact will these and other incentives have on the proposed project? If infrastructure exists in a specific location, thereby substantially reducing the capital cost of the proposed project, will this factor substantially change the conclusion of the study? If feedstock materials have

little or no cost of acquisition, will this materially affect the conclusion? What is the impact of combining the proposed project with an existing asset like low-cost waste generation steam? These and other factors should be considered. An awareness of these potential resource assets will also be valuable during the next step if a feasibility study is conducted. Such a study should begin to focus on optimum sites and factors noted above that may play an important role in the economics of ethanol production in some situations.

Evaluating Options

If the pre-feasibility study conclusion supports a more detailed economic and site assessment, the steering committee may wish to work with state or local economic development organizations. Such organizations often have a data base of sites that meet specific infrastructure requirements. Utility companies often have business development divisions that can provide similar assistance. In addition, there are consulting groups that have experience in leading the feasibility study process while working closely with the project organizers. While there are a variety of approaches that can be employed during the feasibility study, the steering committee should clearly understand that this next step requires a commitment of time and money. Resources are available to support the project sponsors during this process. However, the experiences of the past decade clearly point to the higher success rate of projects in which the steering committee is active and able to attract financial support and expertise during the feasibility study phase.

The Feasibility Study: Initial Steps



As noted earlier, there are a variety of approaches used in organizing the feasibility study effort. The approach may be shaped by the skills of people associated with the proposed project, the availability of financial resources, and the resources available from other partners in the assessment, such as economic development organizations or energy companies. Based on these and other factors the steering committee should determine the means by which to undertake the feasibility study. There are many variations of this process but the preliminary economic assessment is generally followed by the more detailed feasibility study if the initial conclusion is favorable. The next phase generally includes several specific studies that must be integrated into the final economic assessment. Each of these studies requires a different discipline and approach.

Task Delineation

The full project evaluation typically includes:

- Detailed technical and engineering analysis; initial environmental analysis
- Development of a business plan, including risk management
- Marketing plan development
- Site selection process

Based on the specific skills and experience generally required for a credible ethanol plant assessment, many entities award a contract for these services. The approach can and should directly involve project organizers, even to the extent that some information collection tasks are conducted by members of the steering committee or their designees. However, coordination and data assessment are essential during development of the study. Therefore, a contractor with no emotional attachment to the project or to a specific site will generally produce the most credible analysis.

Primary Criteria

The sophistication of studies varies considerably but the goal remains the same: determine the most economically viable combination of site, technology and feedstock that, when combined with other key location criteria, results in optimum ethanol production economics. A general set of criteria has been developed over more than a decade. These project assessment criteria will vary somewhat by project and region but virtually all of the following information has been included in dozens of feasibility studies across the country. This information forms the basis for the economic assessment of proposed ethanol projects.



Plant Site Selection

Site criteria should be identified and ranked in terms of importance. These criteria provide guidance in the selection of a specific plant site and are helpful when evaluating competing locations. Feedstock and energy costs are typically among the highest input costs but other factors are important in determining production cost estimates, profitability and competitiveness of the plant. Proper siting of an ethanol plant, including the optimum location of the plant on the site itself, is among the most important aspects of project development. This process should be based on a broad range of parameters designed to optimize the economic viability of the plant and the opportunity for successful, sustained operation of the facility. The following criterion should be considered general site location factors. Process technology, feedstock options and other factors that may represent unique locational factors or opportunities should also be considered when present.

Site Selection Factors – Feedstock

Grain is the primary feedstock used in ethanol production in the United States. Other feedstocks will vary by region. Any type of grain containing starch can be used to produce ethanol. Biomass materials vary considerably in potential ethanol yield and should be carefully evaluated. Corn is the predominant grain processed in U.S. ethanol plants. In some areas of the country other grains including wheat, barley and grain sorghum are used as feedstocks for ethanol. Some process technologies allow multiple

grain feedstocks to be used in the same plant. Grain fractions, out of condition grain and off-spec grain can also be used for ethanol production in some cases. However, most process technologies are designed to use a single type of grain that meets specific grading parameters.

Careful attention should be given to the cost and availability of the primary feedstock. In many grain ethanol plants, the feedstock cost can account for 50-70 percent of the ethanol input cost depending on the price range. Feedstock price volatility should be examined and strategies should be employed for managing this cost.

In some instances, a plant may be sited to take advantage of other materials that can be used as feedstocks. Starch or sugar containing materials such as food processing waste have been used for ethanol production. The production of ethanol has historically been limited to using sources of soluble sugar or starch. However, new technologies are being developed to allow production from cellulosic biomass. Biomass materials demonstrating potential as ethanol feedstocks include wood, waste, paper, leafy crop materials, rice or wheat straw and other renewable matter. Several process technologies are currently available for conversion of biomass materials into ethanol. Extensive information about cellulose feedstocks, process technology and economics of ethanol production from cellulosic materials, and biofuels from other renewable resources is available from the National Renewable Energy Laboratory www.nrel.gov in Golden, Colorado. Additional information about the production of ethanol is available via a request to www.ne-ethanol.org.

When evaluating net feedstock costs, project developers should consider the following factors, regardless of feedstock:

- Price history, production patterns and trends in the area from which the ethanol plant is most likely to acquire the primary feedstock.
- The quantity of feedstock historically available in the area and other sources of competition for the feedstock.

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- Location of the ethanol plant in relation to proximity of the feedstock and methods of transporting feedstock to the plant on a year around basis.
 - On site and off site feedstock storage options and methods of moving required feedstock volumes through the receiving system. This is an increasingly important factor as plant size and throughput increase.

Energy Requirements

The energy requirements for ethanol production have improved markedly during the past decade due to a variety of technology and plant design improvements. The energy needed to produce a gallon of ethanol has decreased nearly 50 percent over the past fifteen years and that trend is likely to continue as process technology improves. In modern grain ethanol plants, the critical energy cost is the price of natural gas. It is used in the ethanol production process and in drying the related grain co-products. Due to the significant cost of drying wet distillers grains, some plants are designed to minimize this option provided they are located in an area where this product can be marketed in wet form. Due to the potential for energy price volatility, project developers should pay close attention to the selection of process energy sources. During the past year a few plants have integrated coal as a primary boiler fuel. A strategy to manage energy cost risks should be considered while evaluating energy options for the plant.

Natural gas may not be immediately available as a process fuel at each prospective plant site. However, the process energy cost must be carefully evaluated since it will likely represent the second largest input cost in an ethanol plant. The historic price of electricity has not varied in most states like the price of natural gas. The operating costs for electricity in a medium size grain ethanol plant may be nearly \$2 million annually but this cost can be managed via contract options. Increased demand for coal may also impact the long term price of energy at facilities that opt for coal as a boiler fuel.

Energy expenses are one of the key variables in site selection that can affect profitability. In some instances, ethanol plants are able to lower energy expenses by locating near existing industrial or power generating facilities that produce excess steam. Co-location of the proposed ethanol plant with such a facility should be explored if practical. Other types of co-generated energy are also emerging in some areas of the country. Power co-generation units and integrated methane production from ethanol plants co-located with livestock or dairy production are examples.

When evaluating potential ethanol plant sites, energy cost factors for consideration should include the following:

- Proximity to energy source (natural gas pipeline, coal, propane, co-generation, etc.)
- Historic price, availability and reliability of supply
- Emission control costs and permit issuance time for selected energy sources
- Electric utility rates
- Contract options for all energy sources

A variety of energy price information sources are available to ethanol project developers. State energy offices typically maintain an energy price and supply database that may be useful. The U.S. Energy Information Agency provides a variety of energy related information that may also be helpful (see www.eia.gov).

The U.S. Department of Energy publishes a fuel price report through the Clean Cities Program. This report provides price data for fuels including natural gas and propane. The Alternative Fuel Price Report can be obtained via the Department of Energy web site www.doe.gov/cleancities.

The Feasibility Study (continued)

Transportation

The cost of transportation is important to plant input costs and marketing costs. With regard to marketing costs, an initial market assessment conducted during a pre-feasibility or feasibility study phase should identify primary markets for the plant. Depending on proximity of the plant to population centers, marketing costs may be based on a variety of transportation modes. Ethanol has historically been shipped to markets via truck, rail and barge. The location of the plant should take into consideration the modes of transportation by which the bulk of finished products will move to market. Rail access is often viewed as an essential requirement for large scale ethanol plants.



The cost of transportation varies considerably depending on mode and shipment volume. The marketing assessment should help identify primary markets where netback to the plant is greatest, based on transportation cost and value of products in target markets. Access to reliable, cost competitive transportation is an important site factor. Project developers should evaluate the modes of transportation necessary to supply materials to the plant and determine the availability and cost of these modes at prospective sites. Ethanol marketing companies can assist with this analysis and with identification of target markets.

Transportation related factors for consideration should include:

- Major highway and interstate access to target markets

- Potential for disruption of travel on these routes based on projected construction and historic weather patterns
- Proximity of mainline rail to site and estimated cost of related rail siding and switching services
- Orientation of highway and rail access in relationship to the plant location on site
- Number of transportation providers in each sector
- Options for competitive transportation services
- Proximity and access to petroleum distribution terminals in the region

A variety of excellent sources are available for transportation information. State transportation agencies typically maintain detailed information about highway and rail service and infrastructure. Transportation providers will provide information about rates and service schedules. A recently published transportation logistics overview published by Oak Ridge National Laboratory also provides extensive information about modes of transportation considered relevant to ethanol producers (Ethanol Logistics Overview and Observations, June 15, 2001, ORNL Subcontract No. 4500010570).

Water Requirements

Water quality, quantity and infrastructure for handling water treatment are important factors in site selection. The water requirements factor into capital cost of the plant, operating costs and permit issues that will become important when the plant is constructed. During the past decade, new process technology has reduced the volume of process water required in ethanol plants and has minimized the water discharge volume. An understanding of specific water use and discharge requirements is useful during the site selection process. Local resource agencies can provide information about water use and potential discharge restrictions.

Water reuse has become a standard procedure in most plants today. Wastewater has been minimized and much of the process water is recycled in the plant. In most plants, the only loss of water is boiler blow-down and evaporative loss from cooling towers. Technology innovations are further reducing the total water use at modern plants and reducing the cost of waste stream treatment.

Depending on the site, there are typically several water-related options to be considered when evaluating sites:

- Potential availability and cost of water provided by a community water system
- The cost, volume, quality and accessibility of water from on-site wells
- Cooling water availability from river frontage sites
- Overall water quality (pH, mineral content, etc.)
- Existing infrastructure available for water supply and wastewater treatment
- Water supply issues affected by local law or regulation

Site Size and Location

Site size is often determined by geographic constraints, land cost and proximity to pre-existing infrastructure. The actual plant footprint for an intermediate size ethanol plant is approximately 10-15 acres depending on plant technology and configuration. However, factors such as air permit considerations, rail and on-site transportation patterns, in addition to future plant expansion needs, often dictate a site of 40 acres or more for an intermediate plant. As the scale of ethanol plants increased in size during the past several years and with the concurrent desire to expand rail shipment efficiency, plant site size increased considerably. Ethanol plants

producing at projected rates of 100 million gallons annually often require sites of more than 160 acres to accommodate rail track and switches located on site. Plant sites should be large enough to accommodate an expansion in plant size, rail track expansion and related infrastructure. Factors to consider when determining plant size and location include:

- Prevailing wind patterns and proximity to community or inhabited dwellings
- Desirable site buffer to accommodate aesthetic goals and air permit requirements
- Adequate room for future expansion or to accommodate an allied business partnership
- Adequate space for on-site road and rail configurations and expanded storage
- Additional space for waste water or other pollution mitigation options
- Sufficient space to accommodate plant re-configuration to meet future needs dictated by changes in production output or regulatory changes

Community Considerations

The project development team may include representatives of the community near which the ethanol plant site is located. In this case, the representatives may already be interacting with community officials. Interaction with community officials and representatives can play an important role in determining the extent to which the community will support the project. Project support may be in the form of tax incentives, site considerations, zoning changes or a variety of other concessions that vary in value.

The Feasibility Study (continued)

Also of importance is the general awareness of community residents who will typically be curious about the project and the manner in which an ethanol plant will impact the community. The project development team can play an important role in facilitating development of the project by keeping key community officials informed and by providing general information about the project to residents in the area. Community residents will be far more likely to support the project, and less likely to complicate permit and zoning processes, if they understand the positive, and potentially negative, impact of the proposed plant. Potential negative impacts can be minimized with proper planning and site selection.

Community Support

Ethanol plants are frequently located in sparsely populated areas. Jobs created by the plant generally have a significant economic impact on the community. Job related benefits, taxes generated by the plant, infrastructure improvement stimulated by the plant and goods and services required by the plant are all important factors that will have a positive impact on the community. This information should be provided to area residents as part of a series of project information seminars that are scheduled periodically in an effort to generate support for the project and address concerns that may arise.

Community Concerns

A properly located plant can minimize potential problems for the community and area residents. Factors that can have an impact on residents living in proximity to the plant may include:

- Prevailing wind direction. Plant odors can be controlled with a variety of pollution and odor control equipment but most ethanol plants emit an odor or odors. Odors moving away from area residents will reduce potential complaints.
- Dust. Increased traffic especially on gravel roads located near the plant may raise concerns about air quality and visibility during certain driving conditions. Dust control is an area covered by pollution control agencies. Dust from any plant source, including traffic, is considered particulate matter (PM). PM controls are included in plant permit applications and must be approved by the state air pollution control agency.
- Infrastructure. In many cases ethanol plants can be integrated into water and waste treatment systems operated by a community. These community services can generate fees for the community, thereby increasing revenue required to amortize the community system. In other cases, the plant may propose to provide revenue for an expanded system that can be shared with the community. Proper planning will allow project developers to work with community officials to design a system that is advantageous to both entities.
- Fire Safety. Plant safety coordinators deal with a wide range of safety and emergency preparedness issues. Good communication between the safety manager and local fire safety officials will help to ensure that plans are in place for dealing with potential fire and safety issues.



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- Plant emissions. Best available control technology, typically the “newest and best” emission control technology, is generally required by state and local regulatory officials. Emission control requirements for ethanol plants are discussed in the Permits section of this publication.
 - Noise pollution. Plant generated noise can be a source of complaints if a plant is located near residential areas. Site buffers can generally be included in the site design to minimize any potential problems.
 - Plant site lighting. Plant lighting should be carefully considered so light pollution complaints are minimized. This is an issue during construction and operation of a facility but potential problems can be minimized with proper planning of plant design.

Project developers who work closely with community officials can help facilitate the pace of project development as well as the degree to which a community will support an ethanol plant. Awareness of the need for good community relations and communications can help project developers maximize mutual benefits and minimize community concerns.

Corporate Citizenship and Community Relations

The location of a processing plant in or near a community presents a host of challenges. Project developers who conduct this process in an open, constructive manner are often able to overcome potential pitfalls that may otherwise slow project development and strain working relationships with local and state officials. As one of the partners in this process, the project developer has specific responsibilities for developing relationships with community members, regulatory officials, elected leaders and others who can assist in this process if so inclined. By contrast, mistakes made during this process may result in near and long term consequences that hamper the development of ethanol processing facilities.

Corporate Communications

Prior to selection of a specific site, project developers should initiate contact with several parties. These include officials who will play a role in the pace at which the project develops. These contacts should include state as well as local officials.

A positive working relationship with state and local contacts can help facilitate project development. Conversely, failure to communicate project needs and goals can impede project development and add costs to the plant. Ethanol plant developers should consider initiating the following contacts during early stages of the project:

- State economic development officials. These state agencies generally maintain a data-base of sites that may meet project criteria. These agencies often administer state and federal incentive programs, many of which include infrastructure development and job training funds for which the project may qualify.
- State regulatory officials. These officials typically issue permits required by ethanol plants. Early contact with regulatory officials will help clarify permit requirements and can help mitigate confusion that can delay permit issuance. Additional suggestions for dealing with regulatory officials are included in the Permits section.
- State tax or revenue officials. These agencies often administer tax credit programs that may have an impact on the project. They can also provide information about tax compliance matters that affect plant development and operation.
- Elected officials. Elected officials including state legislators are interested in economic development projects and can often be enlisted as project supporters if they are aware of the project at an early stage.

The Feasibility Study (continued)

- Energy and transportation service providers. Representatives of gas, transportation and utility companies provide useful information and can serve as project advocates.
- Local contacts. These include the local economic development directors, utilities managers and City Hall. These contacts can orient the project manager to the community, to community expectations, regulatory requirements and resources, local incentives, and they can facilitate community acceptance of the project. These contacts can also assist with public information meetings that help orient potentially vocal citizens or groups to the benefits of the proposed project. Project developers should be responsive to the non-proprietary informational needs of the community and local media.

Facilitating Buy-in via Effective Communication

To the extent the community perceives a partnership in the project, the process of acceptance and support will be enhanced. This is an important factor in permitting, zoning, incentive package negotiations, local investment, and public perceptions about the project. Laying the groundwork for supportive community involvement can pay dividends at the time of public hearings on permits, zoning variations, and the inevitable complaints about various plant impacts. Involvement of public officials, local development organizations and chambers of commerce, community organizations and other dignitaries during groundbreaking ceremonies and the eventual ribbon cutting ceremony can help facilitate community buy-in and a sense of partnership.

Compliance with regulations, codes of conduct and the expectations of communities and state officials is good business. The consequences of violating laws, regulations, ordinances or community expectations can be severe. Consequences can range from delays or fines to legislative repercussions that may have an adverse consequence on the financial stability of a project.

Ultimately, these responsibilities are up to the entity that owns or controls the plant. Project developers, construction companies, contractors and others typically move on to the next project by the time regulatory or compliance problems become evident. At that point, the consequences are the sole responsibility of the plant owners. Project owners should make it part of their business to know about regulatory compliance requirements and they should understand the consequences of failing to meet these standards.



Other Factors Related to Site Selection

In addition to factors discussed above, there are other aspects of the site selection process. Several of these were briefly covered in the pre-feasibility study discussion. During the feasibility study, these factors need additional attention.

Markets: Ethanol

Ethanol produced from grain via a dry-mill process yields three primary products: ethanol, distillers grains, and carbon dioxide. On a weight basis, approximately one-third of a bushel of grain is converted to each of these products. However, the value of each of these products is significantly different. Ethanol represents the greatest value of the products produced and for that reason current and potential ethanol markets must be considered during the site location process. An ethanol market assessment is typically part of the feasibility study. This assessment

helps identify markets and the relative value of current and potential markets based on a variety of factors. These factors may include:

- Regulatory, legislative or legal factors that impact target markets
- An assessment of demand for specific gasoline components
- Transportation costs and options, including a rail service evaluation, a determination of commercial trucking service and other applicable modes including barge capability and potential pipeline shipment in the region
- Infrastructure review, including the proximity of pipeline terminals
- Current ethanol utilization in target markets and an assessment of existing competition
- Ethanol price and volume utilization history in target markets

The market assessment generally provides a national overview of ethanol and gasoline markets, a regional overview, a discussion of ethanol demand factors and a description of potential target markets of highest potential value to the local ethanol producer. The market assessment will help provide guidance on site related issues that may potentially improve or impede ethanol marketing from specific locations.

Markets: Distillers Grains

Distillers grains represent the second most valuable product in conventional ethanol plants. Distillers grains can be dried for shipment to markets in the area as well as remote markets, depending on demand. Distillers grains can also be marketed in wet form, depending on local markets. Extensive information about the use of distillers grains in livestock rations is available from the NebGuide series of publications issued by the University

of Nebraska <http://ianrwww.unl.edu> and from the National Corn Growers Association www.ncga.com.



The Alcohol Times, published by the Alltech Institute of Brewing and Distilling www.alltech.com includes an excellent series of articles in issues beginning with the February 2002 edition. Additional information about distillers grain feeding values, results and economic impact can be obtained by an information request to www.ne-ethanol.org. Emerging interest in corn fractionation processes also requires attention to the technologies available and the specific products resulting from the process. An understanding of current and potential markets, product values and economic trade-offs associated with any new process should be considered.

The portion of the marketing study that evaluates potential markets for distillers grains or other grain fractions should cover factors including:

- Current and potential markets for protein feeds, including an assessment of current demand in local markets by livestock type (cattle, dairy, swine) and consideration of alternative outlets in new sectors including fish and pet foods
- A discussion of the potential for marketing wet distillers grains in local markets
- Proximity to cattle, dairy and poultry markets in the area and region
- An assessment of price potential based on the nutritional profile of distillers grains and syrup extract from the plant

The Feasibility Study (continued)

Markets: Carbon Dioxide

Carbon dioxide is the least valuable of the three products typically produced at a grain ethanol plant. However, many ethanol producers find local market outlets for this product. Carbon dioxide is transportation sensitive due to its relatively low value.

For that reason, local markets should be assessed.

Local markets for carbon dioxide may include:

- Food processing companies
- Beverage or bottling companies
- Industrial gas companies
- Oil and natural gas recovery operations
in nearby fields

Ethanol produced from grains other than corn or grain sorghum, such as barley or wheat, will require a somewhat different assessment based on ethanol co-products that may be produced in a proprietary process. Likewise, biomass feedstocks will yield different co-products. The marketing assessment should include a relevant evaluation for these products regardless of the ethanol process being considered. Potential marketing barriers should be considered during this assessment.

Regulatory Permits



During the site selection process, the project team should make an initial contact with state and local authorities who are responsible for environmental regulation and relevant zoning permits. The project team should confirm that no pre-existing conditions exist that may make the site difficult or impossible to permit in a timely fashion. The permit process varies from state-to-state and local jurisdictions may also require specific action steps that can affect the project development time-frame. This initial review of permit requirements will help familiarize the project team with state and local contacts in the various regulatory agencies. Discussions with regulatory officials will also help define the time-frame in which a project can reasonably be expected to receive permits.

Permit applications require technical data that is generally supplied by the engineering or development firm(s) selected to design and build the ethanol plant. Since the project team may not have contracted with such a firm early in the development process, the project team may not be able to provide detailed information to regulatory authorities. However, an initial review of this process is important to project developers and regulatory officials alike. As noted, this process can accomplish the following:

- Orient project developers to tasks the engineering firm or permit consultant will be performing
- Familiarize state and local regulatory officials with constituents who will be involved in development of the project, thereby providing a local contact
- Familiarize project developers with state and local contacts in the regulatory agencies that will have jurisdiction during the various permit processes
- Determine any pre-existing conditions that may make a site unsuitable for an ethanol plant
- Familiarize the project developers with the time-frame in which various permits can be issued



Ethanol Plant Emissions

Modern ethanol plants have been designed to incorporate a variety of emission control equipment to make the plants safe, efficient, and to control potential pollutants. It is important for project developers, and regulatory officials, to be familiar with the regulated pollutants. Plant emissions may vary slightly depending on process, design, plant type and feedstock. The typical ethanol production process includes feedstock delivery to the plant, feedstock handling and milling. During this process, tiny particles (particulate matter less than 10 microns in diameter, PM10) are released into the air. PM10 is also emitted during the drying process.

During fermentation, distillation and drying, volatile organic compounds (VOCs) are released. Some VOCs are known as hazardous air pollutants (HAPs). These include some or all of the following: acetaldehyde, acrolein, ethanol, formaldehyde, 2-furaldehyde, methanol, acetic acid and lactic acid. Potential emissions of these compounds must be measured and appropriate controls included in plant design regardless of the biofuel technology being considered.

Carbon monoxide, nitrogen oxides, and sulfur oxides are also generated from combustion in the boilers at the plant. Carbon monoxide may also be generated in the drying process if such a process is included in the plant design. Modern emissions control equipment is included in most plant designs. However, potential emissions must be calculated and appropriate control strategies included in permit applications.

Other emissions may result from activities not associated with the production process. These may include: hydrogen sulfide and VOCs released from the wastewater treatment process; PM10 from the cooling towers; fugitive PM10 and VOC emissions from haul road traffic and equipment leaks, respectively; PM10, NO_x, SO_x, CO and VOCs from emergency equipment; and potential VOC evaporative loss emissions from the wet distillers grains solids storage piles if dryers are not in use at the plant.

The diagram on page 28 illustrates the typical emission points at a dry mill ethanol plant and the air pollutants emitted from each emission point.

Air Quality Permits

Virtually every state has enacted air quality regulations that require facilities with the potential to emit air pollutants above specified levels to obtain construction and/or operating permits. State regulations may vary in terms of permit requirements and the time-frame for authorizing and issuing permits. The project development team should confirm that the engineering firm or permit consultant with whom they may contract for these services is properly licensed in the state. The project development team should also review applicable work of the prospective firm(s) to determine relevant experience in these important areas. The project team should maintain an awareness of permit conditions and requirements that may affect plant operations initially, and in the future if plant expansion is contemplated.

Several states have extensive experience with ethanol plant monitoring, permitting and compliance issues. In recent years environmental regulators from Nebraska and Minnesota collaborated on a publication that describes state and federal permit requirements. This publication can serve as a general guidance document for project development teams. The publication should be used only for general orientation purposes. For a copy of the publication, Air Quality and Ethanol Production, contact: melissa.woolf@ndeq.state.ne.us

Construction Permits

Before a new plant is built or an existing facility expands or modifies its plant, an air quality construction permit may be required. There are two types of construction permits: state and federal, known as Prevention of Significant Deterioration (PSD) permits. The type of construction permit needed will depend on the air pollutants that could be released from the new plant or expansion project.

Purpose

First and foremost, air quality construction permits are needed to protect the ambient air quality. Ambient air is the air outside of buildings that the general public has access to. The U.S. Environmental Protection Agency (EPA) has developed national ambient air quality standards (NAAQS) to protect the public health, welfare, and the environment.

Predictive computer modeling is conducted prior to issuing construction permits to evaluate the potential impact the plant will have on the ambient air quality. A construction permit cannot be issued if the plant will cause or significantly contribute to violations of the ambient air quality standards.

Construction permits also impose federally enforceable requirements that are recognized by the EPA. Construction permits include emission and/or production

limits that ensure air quality protection. The permits contain recordkeeping, reporting, monitoring, and testing requirements to ensure the plant is able to demonstrate that the permitted limits are met.

The public is given notice that a construction permit may be issued and is given an opportunity to comment on activities that affect their environment. The public notice also provides an opportunity for communities to be educated about the environmental impacts of plants locating in their area.

State Construction Permits

Many states have had air quality construction permits in place since 1972 or earlier. In recent years, state permit requirements have been modified to reflect changes in the Clean Air Act Amendments of 1990. Facilities are typically required to obtain a construction permit before they construct, reconstruct or modify any air contaminant source or emission unit where there is a net increase in the potential-to-emit above prescribed quantities. Potential-to-emit (PTE) means the maximum emissions that would result from operating the source at full capacity 24 hours a day, 7 days a week, 52 weeks a year taking into consideration federally enforceable requirements.

Federal Construction Permits

EPA developed the federal construction permit program, known as the New Source Review program, in 1977. Many states have incorporated the federal program into the state regulations and thereby maintain the authority to implement and enforce these rules. This program assures the following: economic growth will occur in harmony with the preservation of existing clean air resources; public health and welfare will be protected from adverse affects which might occur even at pollution levels below the ambient standards; and the air quality in areas of special natural recreation, scenic, or historic value, such as national parks and wildlife areas, will be preserved, protected and enhanced.

Regulatory Permits (continued)

Under the New Source Review program there are two types of preconstruction permits. In areas that have pollution levels below the NAAQS, referred to as attainment areas, sources that meet the appropriate criteria will obtain a Prevention of Significant Deterioration (PSD) permit. In areas that have pollution levels above the NAAQS, referred to as nonattainment areas, sources meeting the appropriate criteria will obtain a nonattainment New Source Review permit.

In order for a facility to trigger the emission levels that require a PSD or New Source Review construction permit, they must meet both of the following criteria:

1) The facility must have the PTE of:

- 100 tons per year (tpy) of any criteria pollutant if the source is one of 28 specific source categories listed in the PSD rules (40 Code of Federal Regulations (CFR) §52.21 (b))

OR

- 250 tpy of any criteria pollutant for sources not specifically listed in the PSD rules, and

2) Have net emissions increases of:

- 15 tons per year (tpy) of PM10
- 40 tpy of SO₂ or SO₃ or any combination thereof,
- 40 tpy of NO_x (calculated as NO₂),
- 40 tpy VOC,
- 100 tpy CO, or
- 0.6 tpy Pb (lead)
- Other pollutants with significant thresholds include total suspended particulate (TSP), fluorides, sulfuric acid mist, hydrogen sulfide (H₂S), total reduced sulfur (TRS), and reduced sulfur compounds.

- * Criteria pollutants are PM₁₀, NO_x, CO, VOCs (used as an alternative to ozone), and Pb.

Chemical process plants are considered a major stationary source. It has been determined that ethanol plants are chemical process plants, so they are subject to the major stationary source requirements and the 100 ton per year

threshold. A determination regarding production of other biofuels should be made during consultation with state permitting authorities.

If a plant must obtain a construction permit under the PSD program, it must conduct a control device review and install BACT based on that review. The plant must also conduct an air quality review using computer modeling to assure that they will not exceed the NAAQS or impact areas of special natural recreation, scenic, or historical significance. As part of the air quality review, an increment analysis must also be performed. Increment is the portion of the ambient air that a facility is allowed to impact. This ensures each facility doesn't excessively pollute the air and affect future growth in the area. PSD permits may be subject to review by EPA, federal land managers, bordering states, and tribal organizations.

Operating Permits

An ethanol plant or any other type of biofuels plant may also need to obtain an air quality operating permit. There are two types of operating permits: major source (federal program) and minor source (state program). Again, the potential emissions from the plant will determine whether a facility must obtain a major or minor operating permit.

Purpose

The federal operating permit program, known as the Title V program, was created by the Clean Air Act Amendments of 1990 and was designed to create a "one stop" permit. The Title V operating permit compiles all of the applicable state and federal regulatory requirements, existing construction permit provisions, and recordkeeping, reporting, testing, and monitoring requirements into one permit. The intention behind listing everything in one permit is to assist facilities with maintaining compliance. Often times, a facility will have several construction permits for several pieces

of equipment and it is difficult to keep track of all of the requirements in each permit. One permit with all of the facility's requirements is intended to make it easier to track the requirements.

Public notification is also an important aspect of the operating permit program. The public is notified when an operating permit is proposed and is given the opportunity to comment during the 30-day public notice period.

This gives the public the opportunity to become educated about the impacts that the facility may have on their environment.

Many states have implemented comprehensive operating permit programs for facilities emitting certain air pollutants. Several states have taken the operating permit program one step further than the federal Title V operating permit program. The federal program only regulates larger facilities (or major sources) of air pollution while some state operating permit programs regulate both larger and smaller facilities (or minor sources) of air pollution.

Unlike a construction permit that must typically be obtained prior to construction and is generally valid for the life of the emission unit, an operating permit must usually be applied for within some period, often 2 months, after the facility begins operation. The operating permit may be issued for a specific period of time rather than the life of the operating unit. Project developers should contact state regulatory officials to determine specific permit requirements for the proposed project.

Permit Process

Project developers should take steps to understand the time requirements of the various permits required by federal, state and local authorities. Permits dictate the pace of project development and permit conditions may

affect the operating parameters of the plant. Permits are typically filed on behalf of the ethanol project development group by an engineering firm or permit consultant. As noted previously, project developers should understand the time commitment for permit applications and the process that governs the review and content requirements of the applications. The best source of information is typically the regulatory agency staff. Staff members can provide details about specific information required for the proposed project. General information about which the project developers should be aware is listed below.

General Information

- Is it a new source or modification of an existing source?
- If it is a modification, has the applicant provided information regarding the existing source?
- Are all of the applicable forms complete with the appropriate information?
- Have emission points been identified, described, and consistently named?
- Does the plant diagram show heights and locations of all buildings, delineations of ambient air (e.g. property boundaries), and emission points?

Emissions Information

- Are fuel types, fuel use, raw production materials, consumption, production rates, and operating schedules provided?
- Have both actual and potential emissions of regulated air pollutants been provided?
- Have the assumptions and calculations of the actual and potential emissions been included?
- Are citations of emission factors included?
- Can a major or minor source determination be made?
- Is the project subject to Prevention of Significant Deterioration (PSD) review?

Control Equipment and Methodology

- Has emission control equipment been identified and described?
- Is supporting information on control equipment efficiencies included?
- Did the facility propose limits on plant operation or work practices that may affect emissions?
- If it is a PSD project, has a Best Available Control Technology (BACT) analysis been provided?

Monitoring, Recordkeeping, and Reporting

- Have compliance monitoring devices or activities been identified and described?
- Has the facility proposed testing of any emission units?
- Did the facility provide information on existing or proposed recordkeeping practices?

Modeling

- Is the project subject to modeling?
- If yes, has a modeling protocol been submitted and approved?
- Have the modeling inputs, assumptions, etc. been provided to the state regulatory agency on CD or diskette?
- Was the modeling conducted in accordance with the approved protocol?
- If it is a PSD project, have the ambient standards, PSD increment, and other impacts analyses been provided?

After a draft permit is filed, reviewed and approved, it is prepared for public notice. The public notice period generally includes an opportunity for public comments or public hearings. Project developers are advised to be attentive to potential sources of dissent and to take steps to mitigate concerns and questions about the project prior to the comment period. The permit process can be a lengthy period during which technical and community issues are discussed with project developers,

technical consultants, regulatory officials and community representatives. As a general resource, the Air Quality and Ethanol Production publication prepared by the Nebraska Department of Environmental Quality includes suggestions that may be helpful in expediting this process anywhere in the country.

Permit Application Tips

State regulatory officials understand there is a significant volume of information required in construction and operating permit applications. In addition, waste water treatment and drinking water permits will likely be required. Several tips that may make the process go more smoothly include:

- Start early. Recognize the permit requirements and the time frame for permit issuance by federal, state and local authorities.
- Talk with the regulatory agency staff. Communication is a key to a successful permitting process.
- Make sure the permit application is complete and accurate. If plans change after you have submitted permit applications, you have an obligation to submit updated information, or face the risk of delays.
- Address confidentiality issues appropriately, if such issues are important.
- Include calculations and citations with your permit application. This information will assist the regulatory staff during permit review.
- Research. Generally, ethanol plants are subject to various federal standards as well as state regulations. Federal requirements could influence your decisions regarding plant equipment. The issue of dryers at the plant is a recent example of permit issues influencing equipment choices.

-
- Be aware of current regulatory issues. As the ethanol industry continues to expand throughout the nation and more emissions data is gathered, state agencies face new and often times challenging issues. Many of these issues are best dealt with during the early planning stages of the project. Again, communication with state regulatory officials will help the project development group address these issues.
 - Get help. Although not required, state regulatory officials generally suggest that plant developers consult with people or companies that are familiar with the specific state requirements for permitting an ethanol plant. A qualified consultant that is familiar with the process and professional staff can help minimize the cost and time required for successful completion of the permit process. Familiarity and professional relationships can help move the permit process toward a successful completion in a timely fashion.

Permit Content

Construction permits and operating permits generally consist of the same basic elements. Each permit will contain general and specific conditions. Project developers should be generally familiar with the content and conditions of the permit. Working with and communicating with a qualified consultant is essential to this process. State regulatory officials can provide precise information about permit requirements.

Other Permitting and Compliance Issues

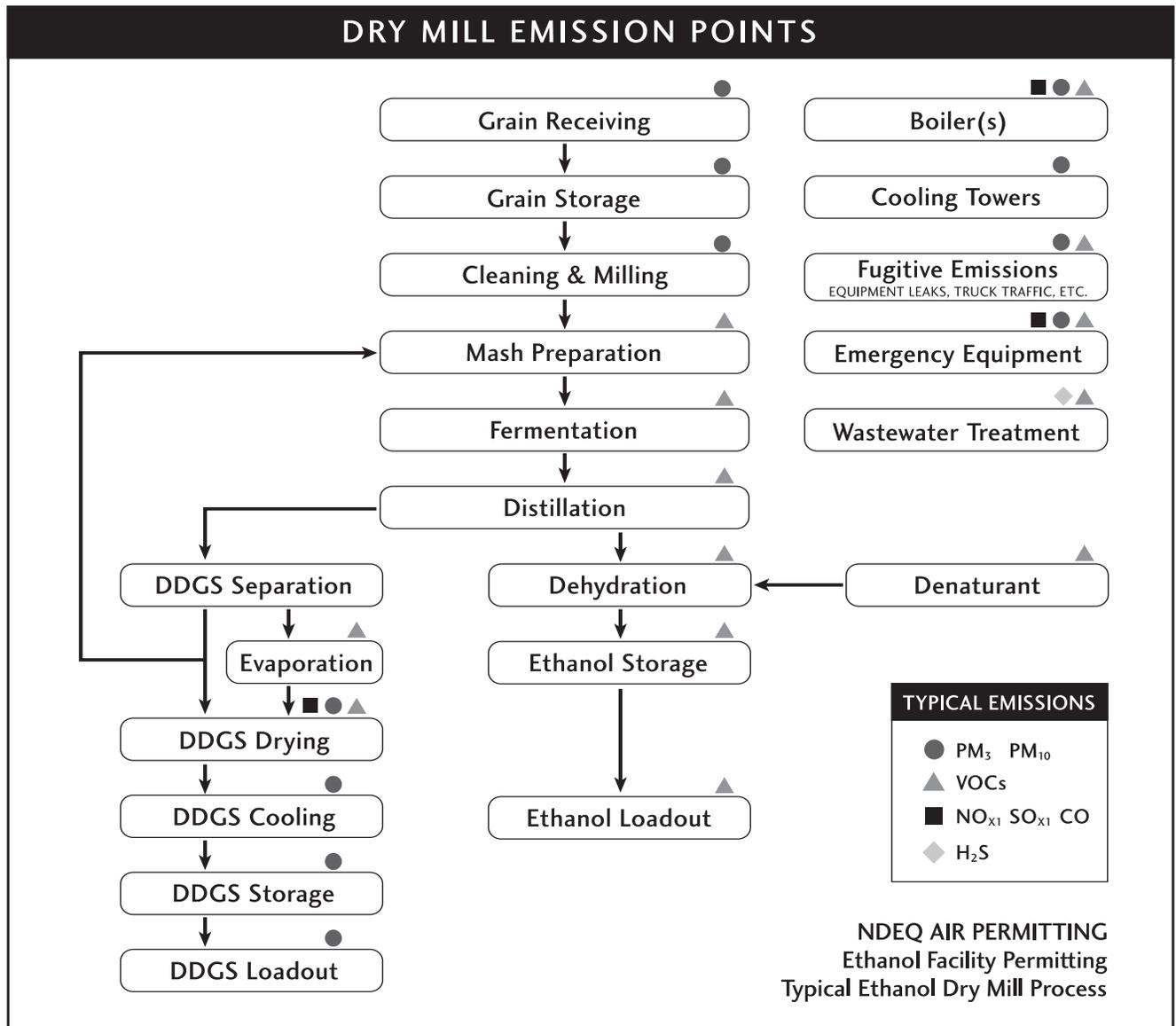
State regulatory officials monitor compliance of ethanol plants and other biofuel production facilities but compliance responsibilities ultimately rest with the plant owners and operators. Compliance issues can arise

when the plant is constructed or operated in a fashion that differs from the conditions in the construction permit or operating permit. Common violations include failure to perform emissions testing, testing late, exceeding emissions or production limits, failure to keep adequate records, failure to submit required reports on time, and failure to conduct and keep records of control equipment maintenance. Following are a few tips that can help a facility maintain compliance, and reduce the potential for adverse economic consequences that may impact the plant owners.

Compliance Tips

- Read and reread permit on a routine basis.
- Understand permit requirements.
- Keep records in one place and in a logical order.
- Properly operate and maintain control equipment.
- Designate an “environmental manager” and train a backup.
- Ask state regulatory officials questions in order to get necessary information and to avoid misunderstandings and mistakes.
- Plan ahead!

As noted, state and local regulatory agencies are the best source of information that is specifically applicable to an ethanol plant in the area. Information about federal permit requirements can be obtained from regional EPA offices and by visiting the EPA web site located at: www.epa.gov.



Business Incentives



Since the 1930's, many states and the federal government have provided various incentives designed to stimulate the production and use of fuel ethanol. Incentives have ranged from grant and finance programs for ethanol production facilities to at-the-pump incentives designed to encourage the sale of ethanol blended gasoline. As project developers evaluate the impact of incentives on the proposed project, it is important to understand the net value of incentives and the benchmarks that must be met to qualify for specific incentives.

Value of Incentives

Ethanol incentives have historically been of two types:

- Incentives designed to stimulate the use of ethanol.
- Incentives designed to stimulate the production of ethanol.

The most valuable ethanol incentives are generally production credits or payments. Such incentives have periodically been available from the federal government. Several states also provide some form of ethanol production incentive. Ethanol project developers should review applicable federal, state and local business incentives that may have an economic impact on the project. Such incentives may also be a consideration during the site selection process. Project developers can often obtain detailed information about general business incentives from state and local economic development authorities. These same sources should be aware of incentives that may be applicable to the production of ethanol specifically or to biomass derived products generally. Project developers should develop a value estimate of incentives that may be available to the facility.

An Overview of Incentive Programs

Tax incentives can play an important role in the profitability of ethanol plants and other biofuel projects. Project financiers will also expect an analysis of incentives for which a proposed facility may be eligible. Following is a general overview of incentives that may be available to an ethanol plant depending on eligibility requirements of the various programs.



Federal Incentive Programs

Various federal incentive programs have been designed to meet the primary objectives noted above: to encourage the production and utilization of ethanol and other bio-fuels. Additional factors including the implementation of a national Renewable Fuel Standard in 2006 serve as an effective catalyst for increased biofuel production and use. For the purposes of a project impact analysis, only those incentives applicable to the proposed project should be considered. Federal incentives that may be applicable to an ethanol project include the following:

Excise Tax Incentives

Since 1979, the federal government has provided various levels of exemption from federal motor fuel excise taxes for qualified alcohol fuels (specifically those not derived from petroleum, natural gas, coal, or peat). Most ethanol sold in the United States incorporates the federal excise tax incentive (VEETC) as opposed to another mechanism designed to encourage ethanol use, the income tax credit for alcohol fuels.

Income Tax Credit for Alcohol Fuels

Like the federal excise tax noted above, the federal income tax credit for blenders of gasoline and ethanol is currently in the law until 2010. The incentive is

presently fifty one cents per gallon. While the credit can be carried forward, it is non-refundable and non-transferable. Therefore, it is of little value to entities that have no federal income tax liability.

Ethanol Production Incentive

Incentives discussed above have focused on mechanisms intended to increase the use of ethanol fuels. These incentives may be of limited value to new ethanol projects. However, various incentives have been crafted to encourage development of production facilities. During the past fifteen years a variety of incentives have been available through federal government programs. These incentive programs are summarized below.

Income Tax Credit

The income tax credit discussed above has generally been considered as an incentive to increase ethanol use. This perception is based on the fact that the application of this incentive is tied to the blending of all components of the finished fuel, i.e., ethanol and gasoline. Although seldom applied as a production incentive, this credit may be narrowly viewed as an incentive for ethanol production.

Income Tax Credit for Small Ethanol Producers

Effective January 1, 1991, certain small fuel ethanol producers are eligible to receive an income tax credit of ten cents for each gallon of qualified (denatured) ethanol fuel produced. The provision limits the qualified ethanol fuel production of any producer for any taxable year to no more than 15 million gallons per year produced at a facility whose total production capacity does not exceed 60 million gallons per year. The tax credit is included in income and is therefore taxable, is nonrefundable and nontransferable, but can be carried forward into future taxable years.

Loans and Loan Guarantee Programs

Fifteen years ago Congress authorized a series of programs to encourage development of alternative energy enterprises in the U.S. Among the primary incentives available

through these programs were loans and loan guarantees. The Departments of Energy and Agriculture have administered loan and loan guarantee programs for which ethanol projects were eligible. Under the programs, qualified applicants were eligible for loans or loan guarantees that provided direct financing or guaranteed loans for capital construction. Funding and authorization for the ethanol related provisions of these programs are extremely limited under Department of Energy programs today but USDA programs authorized under the 2002 Farm Bill include several applicable programs.

Grant Programs

In past years the Departments of Energy and Agriculture have administered grant programs for which ethanol projects have been eligible. In most cases the grants have been for projects that met specific criteria. However, the availability of grants can often provide leverage for project financing. Because grants are, in effect, a gift, they do not dilute equity or encumber a project with additional debt. The DOE and USDA both administer programs for which plants meeting specific criteria may qualify.

Cooperative Financing

The federal Bank of Cooperatives has been an important source of financing for many ethanol projects built in the Midwest. Ethanol ventures that are structured as cooperatives are eligible for project financing. The Bank of Cooperatives has been active in direct loan and loan guarantee programs during the past decade. The Bank remains an active participant in ethanol ventures today. This source of debt financing is often more accessible to new ethanol ventures than conventional lenders.

Feedstock Incentives

On many occasions the federal government has provided commodities to meet specific needs or policy objectives. This mechanism has also been used as a production incentive for ethanol. The Commodity Credit Corporation has provided corn and other commodities to ethanol producers as a production inducement and an inventory

control measure. While this mechanism has been used only on a limited basis, it serves as an example of an incentive that can stimulate ethanol production. At present, a federal biofuels production incentive is available for new or expanded ethanol production. These provisions are included under the Energy Title of the 2002 Farm Bill but are likely to expire after 2006. Prospective ethanol producers wishing to enroll in the program should evaluate the Bioenergy Program Agreement. Details of the agreement and of the Bioenergy Program are available via the Internet at www.fsa.usda.gov/daco/bio_daco.htm.

Other Federal Incentives

The primary challenge of encouraging investment in new ethanol production facilities is to create an environment that mitigates risk. Many of the federal incentives are designed to reduce risk in different ways. The value of incentives is often dependent on specific projects. For example, some start-up projects may find incentives most useful if they help attract capital. Companies that are capable of financing projects internally may find market-based incentives like contract preferences to be more valuable.

Some incentives are designed to provide a supplement to costs that are typically applicable to all projects. Infrastructure grants and job training grants are examples of these incentives. While these grants may be administered by state agencies, the federal government provides the funding for these programs. Infrastructure incentives simply decrease total project cost to the developer if such costs are borne by other entities. Job training grants typically offset the cost of training new employees for operations at the ethanol facility. Since the skills required might not be generally available in a local labor pool, training costs can be expensive. Job training grants offset the direct cost to the project developer, thereby making funds otherwise spent on this activity available for other project needs.

State Incentive Programs

Like the federal government, many states have elected to encourage ethanol use through a variety of incentive mechanisms. Most incentives have been in the form of excise tax reductions in the state fuel tax rate. States have adopted this form of incentive to encourage ethanol use. These incentives are generally adopted to support existing ethanol production and are seldom effective in stimulating new production.

Many states have also adopted innovative mechanisms to stimulate the production of ethanol fuels. The specific components of incentive programs vary from state to state as a result of differing public policy objectives and state constitutional provisions. The following sections of this report examine different incentives used by various states to encourage ethanol development.

Oxygen Standard

Similar to the federal oxygenate program, a related state incentive program is the so-called “Minnesota Model”. This program established a statewide oxygen standard in Minnesota that is most economically met by using ethanol. The program is in effect year around and the market stability generated by the program has helped to significantly increase ethanol production in Minnesota since implementation of the program in 1998. A similar law designed to encourage the use of biodiesel has been effective in expanding the production and use of biodiesel statewide in Minnesota.

Fuel Tax Incentives

As noted above, fuel tax incentives are frequently adopted as a means of encouraging ethanol use. State legislatures have adopted a variety of “at-the-pump” incentives to stimulate ethanol use. Depending on the fuel tax structure of a specific state, the incentive may be in the form of an excise tax reduction or fuel tax credit. All such mechanisms are intended to provide an incentive that encourages ethanol use. As noted previously, these

incentives are seldom an effective means of stimulating ethanol production but may help to stimulate ethanol demand in local markets.

Targeted State Incentives

Several states have recognized the need to focus incentives to meet specific needs of ethanol project developers. During the past decade, the states have enacted a variety of laws that provide incentives designed to stimulate ethanol production. In several cases, the specific form of incentive is based on local considerations. Targeted incentives specifically designed to attract ethanol production facilities have been very successful in some states. Following is a summary of incentives specifically intended to attract ethanol production facilities to states.

Ethanol Production Payments and Credits

During the past decade several states have aggressively targeted development of ethanol plants through production payments or credits. These targeted recruitment efforts have generally been an effective means of attracting companies to a specific state. In some instances, the production incentive has been a deciding factor in the siting of plants. States have provided production incentives directly, through a payment from the state to the ethanol producer, or indirectly, through a credit mechanism that can be sold for cash. Production incentives are typically performance-based incentives requiring an ethanol producer to manufacture specified quantities of ethanol in order to earn the incentive.

Loan and Loan Guarantee Programs

Like the federal loan programs described earlier, several states have adopted loan and loan guarantee programs to provide a source of funding for ethanol and other alternative fuel projects. Often times these programs are designed to serve as a sort of “lender of last resort.” As a result, projects perceived to be high risk proposals are often the participants in these programs. The challenge of these programs is to balance sound lending practices with the fact that some projects may, in fact, be high-risk ventures. Risk may be attributable to uncertain feedstock

availability or price, untested technology, inexperienced management or other factors. Coupled with the risk assessment factors is the need by project developers for favorable loan terms. Conventional lenders tend to impose extremely difficult terms on high-risk ventures if they participate. Such terms are obviously contrary to the needs of the project. Loan and loan guarantee programs, to be effective, must recognize these challenges at the outset. One variation of these programs is the so-called “forgivable loan”, which is, in effect, a grant to the project in the event of project failure. This feature is attractive to project developers and can be designed with more stringent eligibility criteria to help improve the prospects of a successful venture.

Ethanol Tax Credits

Several states have used tax credits as a mechanism to attract ethanol production. State credit programs are designed in much the same manner as the federal credits described earlier. Tax credit programs can also be viewed as performance incentives since they require specific objectives to be met before incentives can be collected. This mechanism can be effective, especially as a means of inducing expanded production at existing facilities. However, the tax credits are useful only to the extent they offset tax liability that otherwise must be paid. Start-up ventures often have little tax liability in the early years of operation. Therefore the value of these incentives may be less than anticipated.

Other Tax Credit Incentives

Tax credits are a common incentive in state business recruitment programs. Tax credits can be targeted to specifically apply to activities related to ethanol production, or they can be designed to encourage specific aspects of ethanol production. For example, California officials are in the process of examining credits that may effectively stimulate ethanol production from biomass and waste materials. Credits can be designed to specifically encourage this type of investment. Plant size may be another factor. The federal Small Producer Tax Credit, discussed earlier, is an example of a prefer-

ential tax credit specifically designed to encourage investment in “small” ethanol plants. Other tax credits may be based on employment or capital investment criteria that are pertinent to ethanol production facilities.

Equity Investment Programs

Several states have offered targeted equity investment programs specifically designed to provide capital financing for ethanol projects. These programs provide the means for a state to take an active role in the development of targeted projects. Equity investment provides risk sharing by the state and reduces the debt load of start-up projects, thereby making them more attractive to potential lenders.

Bond Programs

Some states and political subdivisions have authority to issue bonds used to finance capital construction projects. This mechanism can be targeted to give preference to ethanol or other alternative fuel projects. This approach has been used for ethanol projects in the past and ventures meeting specified investment criteria may seek project development funds from such a source, especially if preferential provisions are extended to ethanol projects.

Tax Abatement and Tax Increment Financing

Tax abatement programs are a tool routinely used by states in business recruitment programs. While this is not an effective primary incentive, it can function as a useful supplement to encourage investment. This type of incentive may have applicability to plants in many states, especially where state tax law is designed to encourage the location of processing facilities in underdeveloped areas. Such incentives, including tax increment financing programs, typically help attract financing to a project by improving overall economics of the venture.

Other Production Incentives

States use a variety of incentive packages to attract processing facilities to their respective states. Many of these conventional incentives can be adapted to ethanol projects. These preferential incentives are typically tied to a specific public policy objective. For example, Iowa

Business Incentives (continued)

designed a program specifically intended to spur investment in value-added processing facilities located in rural areas of the state. Incentives tied to such criteria have been successful in stimulating investment in ethanol related projects. Feedstock cost rebates are another mechanism that can be used to encourage ethanol production. Feedstock costs are a significant portion of the operating cost of ethanol plants. Feedstock rebates may be used to offset the cost of specifically targeted materials. This approach provides more stability to projected economics of a project and may help mitigate risk for potential lenders or investors. Guaranteed purchase contracts are another form of incentive that can lend stability to the economics of a start-up venture.

Local Incentives

Local incentives are typically in the form of site concessions that may include cost underwriting or similar concessions to make a specific location more attractive. Other mechanisms are tax increment financing, assumption of infrastructure costs, tax abatement, financing via a local bond authority, or other mechanisms that make one site more attractive than a competing site. The competitive nature of industrial recruitment generally fosters an environment in which the developer of a project can negotiate a variety of concessions that make the project more economically attractive to lenders and investors. These factors should be recognized and quantified when specific sites are considered.

Project analysts should also review existing incentives for projects constructed in specified areas of the state. These incentives should be quantified to determine value within the context of the total project cost.

Final Steps in Assessing Project Feasibility



Economics of Ethanol Production

A wide variety of factors affect the economics of ethanol production. These factors include feedstock and energy costs, capital and debt financing costs, the value of products produced and plant design and efficiency. A host of other factors will also affect production costs and profitability. Many of these factors have been discussed and additional factors should be quantified during the site specific feasibility study. These value factors will be essential to the financial pro forma and sensitivity analyses conducted during a detailed project evaluation.

Value assumptions typically include input from the project development team as well as consultants and other advisors on the project. A sensitivity analysis will provide an indication of value ranges for input factors used in the financial pro forma. Many of the input factors represent potential risk. For example, a rapid increase in feedstock or energy costs that may occur concurrently with a strong downward trend in ethanol prices will considerably change the financial outlook for the project. Risk management practices can often mitigate risk and help to insulate the project's exposure to rapid swings in cost and price scenarios. Risk mitigation strategies are essential to the long term viability of most ethanol projects. Project developers should evaluate risk management strategies and consider the impact of these strategies during the financial analysis of the project.

Any person contemplating an investment in an ethanol plant should evaluate a variety of criteria to determine suitability of the investment under consideration. Agribusiness lenders with Farm Credit Services of America offer the following tips for evaluating investment in an ethanol plant:

- Equity-to-asset ratio of at least 40%. That means investors should own 40% of the total value of the plant and inventory, with no more than 60% financed by loans.
- Working capital for buying and hedging inputs of at least 10¢ for every gallon of plant capacity.
- Adequate corn supply. Ideally, a plant should use no more than 50% of the net exportable bushels of corn in a 35- to 50-mile radius.
- Find management with industry experience, something that's difficult to do during rapid expansion. Some plant builders/designers will train staff and manage start-ups.
- Have a risk management strategy. The goal is to lock in a margin by hedging inputs of corn and natural gas used in distilling. Plants hedge or contract outputs of ethanol and distillers' grains when possible.
- Use technology. With high natural gas prices, some new plants are looking to coal or methane from manure. Capital cost for these energy sources can be higher.
- Have a competitive break-even cost. Energy inputs are pushing that up. Typical breakevens currently run from \$1.10 to \$1.30 a gallon.
- Use marketers. Many plants sell ethanol through marketing companies.

Final Steps in Assessing Project Feasibility (continued)

Sensitivity Analysis

A sensitivity analysis conducted as part of the financial evaluation of project economics will help determine economic viability of the proposed plant. This process will also help identify variable costs that will have the most profound impact on project economics. The economic analysis should incorporate a variety of factors. These include:

- **Feedstock costs.** The source of raw materials including feedstock and other inputs like enzymes should be considered. Sources of the feedstock, price history, supply and access on a year around basis should be evaluated.
 - **Energy costs.** Energy costs are a major economic factor in ethanol plant economics. Pricing history and supply options should be considered. While risk management should extend to many areas of plant operations, energy and feedstock costs are key input factors where risk mitigation strategies should be developed and considered during the economic evaluation.
 - **Markets.** A range of projected values for the primary and secondary products produced at the plant should be developed. These values should be projected for target markets most advantageous to the plant. Elasticity of the products and the markets should be considered, as well as an analysis of competing producers.
 - **Technology.** A variety of process technologies are available for ethanol production. Appropriate technologies should be evaluated. Commercial applications of the technology should be confirmed and process guarantees should be considered.
 - **Construction.** Qualifications, experience and responsibilities of the design and build firm(s) should be thoroughly evaluated. Construction cost(s) and tasks should be fully identified and the total project cost should be clearly understood.
- Project time lines should be established and the cost of potential design, materials or construction changes should be identified.
- **Site and infrastructure.** The rationale for selecting a specific site should be understood and advantages relative to competing sites should be calculated. Costs for utilities, energy, process and sanitary water, waste treatment and permits should be confirmed. Detailed planning and diligent supply negotiations can help control capital costs and operating expenses.
 - **Transportation and storage.** Ethanol production requires transportation and storage of products into the plant (feedstock and other inputs) and out of the plant (finished and intermediate products). Cost competitive transportation modes should be evaluated and storage requirements should be calculated to determine the impact on capital and operating costs.
 - **Management and organization.** The cost of recruiting and training the management team should be assessed. The impact of personnel costs should be calculated by operating and management team positions and the projected number of employees required by the plant should be established. Organizational models will be discussed later in this document. However, this factor should be coordinated with design of the management team.
 - **Capital costs and debt financing.** A range of projected costs should be considered during the economic assessment. The business model and impact of various tax laws and incentives should be estimated in the financial pro forma.

A comprehensive sensitivity analysis will help evaluate the need for cost control measures and can provide an early indication of potential profitability. An excellent discussion of economic issues related to ethanol project development is contained in a paper

by David Coltrain of Kansas State University. Economic Issues with Ethanol may be obtained via e-mail at: coltrain@agecon.ksu.edu

Financial and economic analysts hired to assist the project may elect to use a variety of economic models to assess profitability. The U.S. Department of Agriculture's Agricultural Research Service has developed a prototype production/financial model for a mid-size dry mill ethanol plant. This model:

- includes capital and operating cost parameters;
- can be adapted for different capacities and feedstock combinations;
- allows operating cost differences to reflect regional variations, most notably the cost differences related to energy and labor inputs;
- provides a 10-year prototype income statement and projected investor ROI.

More information about the model may be available by contacting: dce@ars.usda.gov.

Formation of the Business Entity

As the project development team continues to assess the prospects for developing an ethanol production facility they should consider the type of business entity that is most practical. The team should consider a range of options and factors that include:

- Debt and equity sources. Some business structures may be qualified for targeted financing programs geared specifically toward cooperatives, for example. The target market for equities placement may also be a factor in determining the business structure. For example, state and federal securities laws generally dictate investment thresholds, securities licensing requirements for single and multiple state sales activities and other factors relevant to the business structure.

- Tax laws and tax incentives. Several tax provisions are based on the specific make-up of the owners of a business entity. For example, the small producers investment tax credit for which many smaller ethanol plants qualify may not be beneficial to an entity structured as a cooperative.
- Grant eligibility. Provisions of the current Farm Bill include grant programs specifically targeted to business entities comprised of at least 51 percent farmer owners.

As the project development team considers formation of the business entity, the group should evaluate these and other factors that may affect development of the project, eligibility for financing through various sources, or tax eligibility implications. The project development team may wish to engage financial advisors and legal counsel to assist in evaluating the most beneficial business entity for the specific venture. The planning committee may wish to consider forming an originating board of directors that is capable of designing and defining a comprehensive plan for forming the business entity. With assistance from legal counsel, the project development team or originating board of directors should also consider and understand the requirements of applicable governance concepts and legal documents including:

- Articles of Incorporation
- By-laws of the organization
- Disclosure statements
- Advantages of various organizational structures
- Responsibilities of the Board and management team
- Confidentiality issues
- Actions that constitute insider trading or conflicts of interest
- Concepts of fiduciary responsibility

As the project development team or organizing board considers the needs of the venture and evaluates business entity options with the aid of legal and financial counsel, the group should determine the best form of governance for the specific project. Regional differences may have an impact on this decision.

Final Steps in Assessing Project Feasibility (continued)

For example, many of the ethanol plants developed in Midwestern agricultural communities were formed as cooperatives. In other instances, different investment philosophies compelled project organizers to form Limited Liability Companies (LLC). The general form of business entity should be based on a variety of factors, including those listed above. Business entities formed for ethanol project development include:

- Cooperatives
- Limited Liability Companies
- Partnerships
- “C” Corporations

This document does not intend to recommend any one form of business entity over another. However, a variety of issues should be thoroughly evaluated before finalizing an agreement to form a business entity. The choice of business entity should be beneficial for investors and the community near which it is located. The preferred business entity should be designed to incorporate federal and state tax incentives and other advantages that accrue to the business entity formed by the organizing board.

Capitalization Options

As noted, this document makes no recommendations regarding the most appropriate business entity or capitalization alternative for a specific project. However, it may be instructive to note that many of the ethanol projects currently under development in the U.S. are either cooperatives or Limited Liability Companies. If the feasibility study suggests that capitalization options should be evaluated, the project development team should examine the options discussed above. In ethanol ventures initiated by farmers, the two capitalization alternatives most frequently adopted are:

- Cooperatives. Farmers have often been influenced by the fact that ethanol projects developed by a cooperative can generally qualify for financing through the Bank of Cooperatives. Cooperative banks have specific charter requirements and business detail requirements that are often suited to the cooperative structure.

Under this structure, the business is owned and controlled by members and profits are distributed according to a formula based on member participation in the cooperative. The project development team should evaluate potential benefits and disadvantages of this option. Farmer Owned Cooperatives typically are constituted and governed in a manner that is different from a Patronage Cooperative. The project development team should evaluate the impact of the different forms on the proposed venture.

- Limited Liability Company. The LLC is a legal business structure that combines the limited liability of a traditional corporation with the single tax treatment of a partnership. Generally, the LLC option allows broader participation for equity investors and greater flexibility in distribution of tax benefits than the cooperative option.

The growing involvement of capital management firms and national project development companies is not covered in this publication. However, this trend in ethanol plant development and ownership is unmistakable. Local leaders in areas where such projects are contemplated often negotiate an ownership structure that allows some level of local equity participation. This practice can benefit the majority owners in a variety of ways and should be considered as an option by project developers and local residents.

Financial Guidelines and Risk Assessment

As the project development team or originating board of directors evaluates the feasibility study and assesses the prospects for project financing options, a discussion about potential debt and equity sources will ensue. Ethanol projects have been financed in a variety of ways but most ventures face inherent risks that should be recognized early in the process. Many of the ethanol projects recently developed or currently under development include farmers among the owners. In some cases, farmers constitute the majority of project ownership. Of these projects,

many have sought and received financing from Cooperative Banks.

Potential Project Hazards

Based on extensive experience with farmer owned ethanol projects, the St. Paul Bank of Cooperatives has developed the following guidelines for consideration. These guidelines were initially developed for farmer-owned cooperatives but they may be generally applicable to many new ethanol projects. The St. Paul Bank of Cooperatives identified ten project related “hazards” and five “major risks” that can result in jeopardy for the project and investors. Following are the Project Hazards identified in the published guidelines prepared by the St. Paul Bank of Cooperatives:

- Plant specifications are not met.
- Construction contract problems, such as delays and overruns.
- Lack of serious commitment by the owner-members.
- Location that puts the business in a noncompetitive situation.
- Market projections are overly optimistic.
- Unrealistically low operating cost projections that cannot be met.
- Faulty marketing assumptions based on government data.
- Problems with management.
- Excessive debt-to-equity ratios.
- Led by an outside promoter rather than local people.

Financial Risk and Market Risk Factors

Many of the same risk factors identified by the project development team will likely be issues that require attention during the project finance phase. The St. Paul Bank of Cooperatives published a series of questions that can serve as guidelines during preparation for meetings with prospective project financiers. An assessment of these questions can help identify risks from a lenders perspective and resolution of these issues can help prospects for project financing. The importance of specific risk factors may vary from project to project

but both the project development team and the lender will likely encounter these issues as the prospectus and loan documents are developed.

- Is there a need for the product(s) to be produced?
- Who are your customers?
- What market barriers stand in your way?
- What advantages do you have over your competition?
- How large is your market?
- What is the projected market share?
- Is management capable of developing a solid marketing plan?

Financial Structure

As discussed above, the business entity selected as the vehicle for project development will have a bearing on debt to equity ratios, applicable tax incentives, equity sources, eligible financial institutions and a host of other factors noted. However, the St. Paul Bank of Cooperatives developed a basic financial structure that may be generally applicable to proposed ethanol projects. This general financial structure includes the following components:

Equity

- Cooperative permanent assets to be financed include land, plant, equipment, other assets, start-up losses, and a minimum level of permanent working capital.
- Owners should have as much invested in the permanent assets as the lenders. The rule of thumb for permanent-asset financing is 50% equity and 50% debt.
- Risk reducers, such as project feasibility, firm marketing contracts, grower-pooling concepts, turn-key construction costs and quality management can lower the equity requirement, but rarely to less than 35 to 40 percent.

Working Capital

- Minimum permanent working capital is (a) required to annually “zero-out” for 30 days, or (b) required to margin loan advances of approximately 65% of acceptable inventories and 80% of acceptable receivables.

Final Steps in Assessing Project Feasibility (continued)

- Operating capital is available through short-term seasonal loans to finance fluctuations in current assets. The maximum seasonal loan typically does not exceed three times permanent working capital.

Loan Duration

- The length of a loan depends on its purpose. Loans for new plants and equipment usually are repaid in 10 to 15 years, or less, in recent years.

Cash-flow Requirements

- Annual principal repayments should take no more than 50-65% of annual cash flow – after tax earnings less patronage refunds received plus depreciation.

Interest Rates

- Rates typically will be prime plus 2 to 2.5% for farmer-owned cooperatives projects. Some fixed-rate options and rate-reduction incentives are usually offered for successful construction management and start-up.

Lender Considerations

Ethanol projects vary in many ways despite apparent similarities. Every proposed project is unique. Financial lenders will therefore scrutinize all details of a project in much the same manner as the project development team analyzes the project. While the project development team may dismiss some aspects of the project as having minor relevance, the project lender will typically evaluate all aspects of the project in significant detail. Proper due diligence by the lender will increase the potential for a successful relationship between the lender and the prospective plant owners.

From the perspective of the project development team or organizing board, the lender may be evaluating information that appears routine. Yet the differing aspects of each ethanol project require due diligence on the part of the lender. In much the same manner as the project development team evaluated project variables of significant importance, the lender will also evaluate key points of consideration. These include:

- Economic and competitive environment in which the project will operate.
- The proposed management team and the character and experience of the management team and board of directors.
- Critical financial developments that may have an impact on the project and the financial and economic trends that will likely have a bearing on the plant.
- State and federal government policies that may fundamentally impact feedstocks, products produced at the plant, markets and incentives.
- Underwriting guidelines that are most applicable to the specific project.

Economic Assessment by Lender

The lender will review many of the economic and competitive assumptions made by the project development team. The lender may ask for extensive information and validation of information contained in the feasibility study. The lender will also review:

- The corporate structure of the business entity, the proposed ownership of the plant and the business plan developed by the management team and board.
- The projected cost of the project, contract guarantees and a source and use statement developed during financial deliberations of the board.
- An assessment of the project engineer and contractor to determine experience and past performance on related projects.
- The overall plant management, the licensed production process, transportation issues, risk management strategies and the marketing plan.

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- The proposed location of the plant, feedstock cost projections, transportation costs, community acceptance and participation, utility cost estimates and market information for all products.
 - Confirmation of feedstock supply and cost, delivery strategies and marketing agreements.

Management Team Assessment

Successful ethanol production companies typically have an astute management team that is stable and cohesive. Successful management will play an important role in the efficiency of plant operations and will in part determine the degree to which the venture is profitable. The rapid growth of the ethanol industry during the past several years requires that astute recruitment and hiring decisions are made by the operating board during development of the management team. The lender is interested in several aspects of the management team including:

- The applied or applicable experience of the plant management team and the ability of top management to train and motivate the employee group.
- The business experience of the board of directors and confirmation of the management team's experience.
- The structural relationship of the board of directors and the compatibility of the management team and board.
- Community relations and the board's plan for maintaining a beneficial working relationship with key decision makers in the community.

Financial Developments and Trends

Financial assumptions made in the feasibility study and financial pro forma will be evaluated and tested by lenders. Key factors reviewed by the lender will

be similar to the critical financial elements considered by the project development group, including:

- Supply, demand and pricing history of ethanol and co-products in target markets served by the plant.
- Experience of management team marketing personnel.
- The type and scope of marketing contracts and the marketing strategies developed by marketing personnel.
- Risk management strategies for acquiring feedstock and selling finished products.
- Knowledge and operating experience with the ethanol process technology used.
- The report should include a statement of opportunities and potential problems for project developers and other affected parties, including the community.
- The report should contain a recommendation to proceed or not, depending on findings of potential for profitability and suitability of the process and site. If a recommendation to proceed with the project is stated, the report should provide guidance on site selection factors discussed in this document. The report should also consider pertinent technology, engineering and feedstock modifications that may be applicable.
- The report should identify more than one entity for financial, marketing, engineering and legal tasks that may be recommended by the consultant(s).

Project Checklist

Ethanol Project Development Tasks

Action	Review Person	Responsible Party	Draft	Intermediate Date	Final Deadline	Status
Entity Formation/Agreements						
Selection of Legal Business Entity & Articles of Organization						
Retain Legal and Financial Advisors						
Raise Seed Capital						
Identify Project Development Team						
Identify Initial Board of Directors						
Conduct Preliminary Feasibility Study						
Develop Business Plan						
Negotiate Letter of Intent with Design/Build firm						
Investigate Public Funding Sources						
Conduct Initial Meetings with Energy Suppliers						
Evaluate Transportation Options						
Evaluate Primary Site Options						
Draft Operating Agreement						
Negotiate Contribution Agreement						
MOU						
Review Environmental Permit Process						
Confidentiality & Nondisclosure Agreement						
Review Plant Layout Options						
Site Evaluation and Selection						
Water and Soil Testing						
Survey						
Historical and Archaeological Assessment						
Property Identification & Acquisition						
Submit Air Permit Applications						
Refine Rail Service Agreement and Rail Plan Design						
Submit Construction Permit Applications						
Apply for Water Permits/Negotiate Allocation						
Title Commitment						
Deed						
Bill of Sale						
Closing						
Submit Local Applications for Permits/Zoning						
Prepare Public Announcement of Intent						

Ethanol Project Development Tasks

Action	Review Person	Responsible Party	Draft	Intermediate Date	Final Deadline	Status
Due Diligence						
Site Access						
Finalize Highway Plan and Funding Sources						
Development Details to Local and County Commissioners						
Final Site Plan to State Transportation Department						
Road Transfer to State						
Rail Plans Finalized						
Letter of Intent Finalized/Construction						
Contract Details Negotiated						
Agreement on Scope of Work						
Utilities Services Finalized						
Fire Prevention and Storage Plan Completed						
Use and Consumption Rates Agreements						
Water						
Sewer						
Electric						
Gas						
Annexation						
Easements						
Existing Domination Restrictive Easements						
Water Rights Contracts Completed						
Existing (source/purpose of use/ place of use/season of use)						
Transfer Application						
Owners' Project Manager Retained						
Environmental Permit Applications Monitored						
Soils, Drainage, Groundwater Levels						
Physical Inspection						
Zoning (Local Governments)						
Comprehensive Plan/Zoning Ordinances						
Special or Conditional Use Permit						
County Contracts						
City Contracts						
Lines Litigation						
Existing Leases, Agreements, Orders						
Title - Extended Coverage						
Flood Plain						

Project Checklist (continued)

Ethanol Project Development Tasks

Action	Review Person	Responsible Party	Draft	Intermediate Date	Final Deadline	Status
Transportation Plans and Costs Finalized/Bid						
Review of Permit Status and Public Hearings						
County						
State						
Federal						
Final Review of Water Permit and Use						
Wastewater						
Receiving Water						
Water Quality Designation						
POTW						
NPDES (EPA)						
401 Certification						
On Site Treatment/Evaporation						
Cooling Water						
Process Water						
Storm Water						
Discharge Temperature						
Air Emissions Control Plan Finalized						
Pre-Application Site Visit						
On-Site Permit Review						
Application for Permit						
Permit Negotiations						
Permit to Construct						
New Source						
Attainment/ Non-Attainment Area						
Special or Conditional Use						
BATF and Other Permits						
Zoning Resolutions Completed						
Community/Site Area Outreach Implemented						
Plant Tours						
Media Relations						

Ethanol Project Development Tasks

Action	Review Person	Responsible Party	Draft	Intermediate Date	Final Deadline	Status
Financing						
Debt/Equity						
Development of Prospectus						
Insurance/Risk Mitigation						
Tax Incentives						
Contracts						
Block Grant Agreements						
Finalize Terms of Financial Agreements						
Feedstock Contracts						
Supply Agreements						
Sales Agreements						
Ethanol Marketing Agreements						
Finalize Risk Management Plan						
Management and Operating Plans Finalized						
Co-products						
CO2						
Negotiate Final Project Capitalization						
Requirements with Senior Lenders						
Complete Final Business Plan and Financial Projections for Private Placement Memorandum or Public Offering Documents						
Finalize Sources of Project Equity						
Negotiation and Signing of Loan Documents						
Securities Registration						
SEC						
State Registration						
Maintain Investor Communications						
Local Contracts						
Finalize Construction Timeline and Responsible Parties						
Receive Required Permits for Construction						
Proceed to Construction Phase						

Biofuels for Sustainable Transportation – Glossary

Additives: Chemicals added to fuel in very small quantities to improve and maintain fuel quality. Detergents and corrosion inhibitors are examples of gasoline additives.

Acid Hydrolysis: A chemical process in which acid is used to convert cellulose and hemicellulose to sugars.

Alcohols: Organic compounds that are distinguished from hydrocarbons by the inclusion of a hydroxyl group. The two similar alcohols are methanol and ethanol.

Alternative Fuel: As defined pursuant to the Energy Policy Act '92 (EPACT), methanol, denatured ethanol, and other alcohols, separately or in mixtures of 10 percent by volume or more with gasoline or other fuels; compressed natural gas (CNG); liquefied natural gas (LNG); liquefied propane gas (LPG); hydrogen; coal derived liquid fuels; fuels other than alcohols derived from biological materials; electricity; biodiesel; or any other fuel determined to be substantially not petroleum and yielding potential energy security benefits and substantial environmental benefits.

Anaerobic Digestion: A biochemical process by which organic matter is decomposed by microorganisms in the absence of oxygen, producing methane and other by-products.

Biochemical Conversion: The use of living organisms or their products, such as enzymes, to convert organic material to fuels, chemicals or other products.

Biodiesel: A biodegradable transportation fuel produced from oils or fats for use in diesel engines.

Bioenergy: Renewable energy produced from organic matter. The conversion of the complex carbohydrates in organic matter the energy. Organic matter may be used either directly as a fuel or processed into liquids and gases.

Biofuels: Fuels made from cellulosic biomass resources. Biofuels include ethanol and biodiesel.

Biogas: A combustible gas derived from decomposing biological waste. Biogas normally consists of 50 to 60 percent methane (see Anaerobic Digestion).

Biomass: Renewable organic matter such as energy crops, crop-waste residues, wood, animal and municipal wastes, aquatic plants, etc., used for the production of energy.

Carbon Dioxide (CO₂): A product of combustion that has become an environmental concern in recent years. CO₂ does not directly impair human health but is a “greenhouse gas” that traps the earth’s heat and contributes to the potential for global warming.
(Carbon Monoxide (CO): A colorless, odorless gas produced by the incomplete combustion of fuels, as in automobile engines. CO is poisonous if inhaled, entering the bloodstream through the lungs and forming a compound that inhibits the blood’s capacity to carry oxygen to organs and tissues. CO can impair exercise capacity, visual perception, manual dexterity, learning functions, and may, in high concentrations, cause death.

Cellulase: Refers to a family of enzymes (enzyme complex) that acts to degrade (hydrolyze) cellulose. Cellulases are produced most commonly by fungal and microbial organisms. The fungi *Trichoderma reesei* and *Trichoderma viride* are often used for the production of cellulase. *Trichoderma reesei* has three distinct enzymes that convert crystalline, amorphous, and chemically derived cellulose to glucose.

Cellulose: A polymer of the simple sugar glucose. It is an insoluble complex carbohydrate that forms the skeletal structure of plant cells, and is the main carbohydrate in living plants. The general formula for cellulose is (C₆H₁₀O₅)_n, where n is the number of glucose units in the polymer molecule.

Cetane: Ignition performance rating of diesel fuel. Diesel unit of measure similar to gasoline octane.

Clean Diesel: An evolving definition of diesel fuel with lower emission specifications, which strictly limit sulfur content to 0.05 weight percent.

Compressed Natural Gas (CNG): Natural gas that has been compressed under high pressures, typically between 2,000 and 3,600 psi, held in a container. The gas expands when released for use as a fuel.

Corn Stover: Residue materials from the corn plant obtained after harvesting, consisting of the cob, leaves, and stalk.

E-Fuels: Ethanol/gasoline mixtures containing from 10 percent denatured ethanol and 90 percent gasoline (E10 or gasohol) to 95 percent denatured ethanol and 5 percent gasoline (E95).

Energy Crops: Crops grown specifically for their fuel value. These include food crops such as corn and sugarcane, and nonfood crops such as poplar trees and switchgrass. Currently, two energy crops are under development: short-rotation woody crops, which are fast-growing hardwood trees harvested in 5 to 8 years, and herbaceous energy crops, such as perennial grasses, which are harvested annually after taking 2 to 3 years to reach full productivity.

Enzymatic Hydrolysis: A process by which enzymes (biological catalysts) are used to break down starch or cellulose into sugar.

Ethanol (aka Ethyl Alcohol, Grain Alcohol, CH₃CH₂OH): Can be produced chemically from ethylene or biologically from the fermentation of various sugars from carbohydrates found in agricultural crops and cellulosic residues from crops or wood. Used in the United States as a gasoline octane enhancer and oxygenate, it increases octane 2.4 to 3.0 numbers at 10 percent concentration. Ethanol can be either hydrous (containing water) or anhydrous (without water).

Ethyl Tertiary Butyl Ether (ETBE): An aliphatic ether similar to MTBE. This fuel oxygenate is manufactured by reacting isobutylene with ethanol. Having high octane and low volatility characteristics, ETBE can be added to gasoline up to a level of approximately 17 percent by volume.

Feedstock: Any material converted to another form of fuel or energy product. For example, corn starch can be used as a feedstock for ethanol production.

Flexible-Fuel Vehicles (FFV): Vehicles with a single fuel tank designed to run on varying blends of unleaded gasoline with either ethanol or methanol.

Fuel Cell: An electrochemical engine (essentially a battery) that converts the chemical energy of a fuel, and an oxidant, hydrogen and oxygen, directly to electricity.

Gasification: Any chemical or heat process used to convert a solid feedstock to a gaseous fuel. This process is conducted in devices called gasifiers.

Lignin: An amorphous polymer that together with cellulose and hemicellulose forms the cell walls of woody plants and acts as the bonding agent between cells.

Low-Emission Vehicle (LEV): Describes vehicles meeting either EPA's Clean Fuel Vehicle LEV standards or the California Air Quality Board's Low Emission Vehicle Program standards.

Methyl Tertiary Butyl Ether (MTBE): An ether manufactured by reacting methanol and isobutylene that has high octane and low volatility. MTBE is a fuel oxygenate and is permitted in unleaded gasoline up to a level of 15 percent by volume.

Neat Fuel: Fuel that is free from a mixture or dilution with other fuels.

Octane Enhancer: Any substance, such as ethanol or ETBE, that is added to gasoline to increase octane.

Oxygenated Gasoline: Gasoline containing an oxygenate such as ethanol or MTBE. The increased oxygen content promotes more complete combustion, thereby reducing tailpipe emissions of CO and other pollutants.

Pyrolysis: The thermal decomposition of solid organic material, including biomass at temperatures higher than 400 F, or 200 C in the absence of air. Also called destructive distillation.

Reformulated Gasoline (RFG): Gasolines that have had their compositions and/or characteristics altered to reduce vehicular emissions of pollutants, particularly pursuant to EPA regulations under the Clean Air Act. Related Organizations

Related Organizations

Alternative Fuels Data Center	www.afdc.nrel.gov
American Coalition for Ethanol	www.ethanol.org
Argonne National Laboratory	www.anl.gov
Clean Cities	www.ccities.doe.gov
Clean Fuels Development Coalition	www.cleanfuelssdc.org
CONEG Policy Research Center, Inc.	www.coneg.org
Department of Commerce	www.commerce.gov
Department of Energy	www.energy.gov – www.eere.energy.gov
Department of Treasury	www.ustreas.gov
E-10 Unleaded Coalition	www.e10unleaded.com
Energy Information Administration (EIA)	www.eia.doe.gov
Energy-Related Web Servers	www.fe.doe.gov/moweb.html
Ethanol Facts	www.ethanolfacts.com
Ethanol Producers and Consumers	www.ethanolmt.org
Ethanol Promotion and Information Council (EPIC).....	www.drivingethanol.org
Fossil Energy Worldwide Web Network	www.fe.doe.gov
Global Climate Coalition	www.globalclimate.org
Governors' Ethanol Coalition	www.ethanol-gec.org
Institute for Local Self-Reliance	www.ilsr.org
Interstate Oil and Gas Compact Commission	www.iogcc.oklaosf.state.ok.us
Iowa State University Farm Economics	www.isufarmeconomyteam.org
Lawrence Berkley Laboratory	www.lbl.gov
Lawrence Livermore Laboratory	www.llnl.gov
Los Alamos National Laboratory	www.lanl.gov
Minnesota Department of Ag New Generation Cooperatives	www.mda.state.mn.us/ethanol/cooprulus.htm
Morgantown Energy Technology Center.....	www.em.doe.gov/bemr96/metc.htm
National Conference of State Legislatures	www.ncsl.org/index.htm
National Ethanol Vehicle Coalition	www.e85fuel.com
National Renewable Energy Laboratory	www.nrel.gov
National Technology Transfer Center	www.nttc.edu
Natural Resources Defense Council	www.nrdc.org
Nebraska Ethanol Board	www.ne-ethanol.org
New England Interstate Water Pollution Control Commission	www.neiwpcc.org
New York State Technology Enterprise Corporation	www.nystec.com
Northeast Regional Biomass Program	www.nrbp.org
Northeast States for Coordinated Air Use Management	www.nescaum.org
Office of Science and Technical Information	www.osti.gov
Press Release Center	www.ino.com
Renewable Fuels Association	www.ethanolrfa.org
Sandia National Laboratories	www.sandia.gov
Society of Automotive Engineers	www.sai.org
State and Local Government on the Net.....	www.piperinfo.com
USA CityLink.....	www.usacitylink.com/default.htm



The Clean Fuels Development Coalition is a non-profit organization dedicated to the development of alternative fuels and technologies to improve air quality and reduce U.S. dependence on imported oil. The broad CFDC membership includes ethanol producers, agricultural interests, automobile manufacturers, state government agencies, and engineering and new technology companies. Since its beginning in 1988, the Coalition has become a respected source of information for state, local and federal policy-makers as well as private industry on a range of transportation, energy, and environmental issues.



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