An Ethanol Production Guidebook for Northeast States

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Table of Contents

EXECUTIVE SUMMARY **1**
1.0 INTRODUCTION **4**
PURPOSE OF THIS GUIDEBOOK 4
GUIDEBOOK COMPONENTS 5
2.0 ETHANOL POTENTIAL IN THE NORTHEAST UNITED STATES **7**
ETHANOL INDUSTRY OVERVIEW 7
AVAILABILITY OF FEEDSTOCK IN THE NORTHEAST 8
Starch and Sugar-Based Feedstock *9*
Cellulosic Feedstock *9*
NEAR-TERM AND MID-TERM ETHANOL PRODUCTION OPPORTUNITIES IN THE NORTHEAST 11
Regional Opportunity *11*
3.0 ETHANOL MARKETS IN THE NORTHEAST **13**
4.0 ECONOMIC AND ENVIRONMENTAL IMPACTS OF USING ETHANOL **16**
ECONOMIC IMPACTS 16
Job Creation *16*
Increased Tax Revenue and Tax Base Diversity *17*
ENVIRONMENTAL IMPACTS 17
Air Quality *17*
Greenhouse Gas Emissions *18*
Water Quality *18*
FOREIGN OIL DEPENDENCE 19
Energy Independence *19*
Net Energy Balance *19*
5.0 ETHANOL PRODUCTION PROCESSES **21**
STARCH AND SUGAR-BASED ETHANOL 21
Dry Mill Process *22*
Wet Mill Process *22*
CELLULOSIC ETHANOL 23
PREPARING A STARCH-BASED ETHANOL PLANT FOR CELLULOSIC ETHANOL PRODUCTION 24
6.0 IMPORTANT ISSUES FOR NORTHEAST STATES **26**
PLANT SIZE, TYPE, AND FEEDSTOCK REQUIREMENTS 26
Opportunistic Starch and Sugar-Based Ethanol Facilities *26*
Cellulosic-Based Ethanol Facilities *27*
Grain-Based Ethanol Facilities *29*
FACILITY SITING / ENVIRONMENTAL PERMITTING ISSUES 29
General Siting Issues *29*
Environmental Siting and Permitting Issues *30*
ETHANOL PROJECT CO-LOCATION AND OTHER INFRASTRUCTURE ISSUES 31
ETHANOL CO-PRODUCTS 32
Cellulosic Ethanol Plants *33*
Grain Ethanol Plants *33*
ETHANOL PROJECT FINANCING OPTIONS AND COSTS 34
FUNDING SOURCES FOR ETHANOL PROJECTS 36
POLICY CONSIDERATIONS 37
PUBLIC RELATIONS CHALLENGES 38
7.0 CONCLUSIONS AND RECOMMENDATIONS **40**
8.0 APPENDICES

EXECUTIVE SUMMARY

The Northeast United States is the only region of the country without any ethanol production capacity. As a result of the impending phase-out of MTBE in California and elsewhere, national demand for ethanol may soon outpace national supply. On a regional basis, Northeast demand for ethanol can be expected to grow in parallel.

At present, Northeast states import ethanol from Midwest production centers, resulting in an additional cost of up to 15 cents per gallon. This added cost creates an economic incentive for the development of ethanol production capacity in the Northeast. However, the Northeast is resource poor when it comes to grains and other traditional ethanol feedstock. But cellulosic feedstock, such as wood waste, agricultural waste, and municipal solid waste, is abundant in the Northeast.

As demand for ethanol grows in the Northeast, a transition to cellulosic ethanol production seems inevitable. However, the timing of this transition is uncertain. Emerging technologies for producing ethanol from cellulose are promising, but have yet to move beyond the demonstration phase. Building a cellulosic ethanol industry in the Northeast at the present time therefore presents challenges. This difficulty is largely attributable to the unproven economics of commercial cellulosic ethanol production, and subsequent difficulties in financing new facilities.

Given the challenges associated with developing cellulosic ethanol production capacity in the Northeast, the most feasible short-term option appears to involve the use of proven, traditional technologies. Experience in the Midwest and elsewhere has shown that even small-scale production using traditional technologies can be cost-effective. The limited availability of conventional, grain-based feedstock in the Northeast therefore does not need to be a deterrent to the growth of regional production capacity. In fact, it may be a part of a solution.

In the short term, it appears to make sense for the Northeast to develop early ethanol production facilities based on conventional models, utilizing traditional corn and sugar-based feedstock. Meanwhile, over time the Northeast region could both evaluate and gain experience with ethanol production. As emerging cellulosic technologies become more viable economically, the region could transition toward greater reliance upon cellulosic feedstock.

This approach is founded in both caution and opportunism. While Northeast states begin to develop small-scale production facilities, they could concurrently resolve any remaining questions they may have about the environmental impacts of ethanol use (e.g., fate and transport in groundwater). At the same time, they would be positioning themselves to take advantage of the economic opportunity offered by ethanol production should demand continue to grow and ethanol cellulosic technologies continue to emerge.

As Northeast states consider embarking on this course, a number of important lessons can be learned from Midwest states that have successfully developed significant ethanol production capacity over the past two decades. Some of the key lessons offered by Midwest states include the following:

Plant Size, Type, and Feedstock Requirements

- Availability, cost, and diversity of feedstock are critical economic variables for ethanol developers.
- Ethanol facilities that convert "opportunity" feedstock or waste streams using existing technologies make economic sense, and offer an immediate opportunity for ethanol production in the Northeast.
- With an abundance of large population centers, Northeast states have a ready inventory of waste streams that are likely to provide opportunities for ethanol production.
- The near-term development of starch and sugar-based ethanol production in the Northeast would facilitate the mid-term development of cellulosic-based ethanol production. The use of cellulosic feedstock would give rise to additional considerations. Cost of feedstock is a critical variable.
- Research suggests that plants do not have to be developed on a large scale in order to be viable.
- In Northeast states that produce or import grain products, traditional dry mill ethanol facilities are a viable option. Project economics and constraints for these facilities are well understood.
- Initial ethanol developers in the Northeast may find that it makes sense to utilize grain-based feedstock initially, before transitioning to increased ethanol production from cellulosic feedstock.

Facility Siting / Environmental Permitting Issues

- Ethanol facilities that "piggyback" on other manufacturing operations may be easier to site.
- State involvement in feasibility and site assessment can be helpful, but is not essential to project success.
- The siting and permitting process varies by state and locality. Developers should begin the process as early as possible to avoid delays.
- Water availability and wastewater requirements are some of the most important siting considerations for developers.

Ethanol Project Co-Location and Other Infrastructure Issues

- The co-location of ethanol projects with mature infrastructure and certain types of industries can help reduce facility operational costs and will pay off over the lifetime of a facility.
- Co-location with a biomass power plant can positively impact the economics of ethanol production in a variety of different applications. The synergies associated with co-location can lead to a reduction in capital costs for the ethanol facility, decreased operating costs for both facilities, and the creation of new revenue streams. In the Northeast, there is great opportunity to co-locate cellulosic ethanol facilities with biomass power plants.

Ethanol Co-Products

- The consideration of co-products and their markets is important to project economics. Different feedstock and production technologies yield different co-products.
- It will be advantageous for early grain-based ethanol plants to have access to markets for livestock feed.
- The sale of feed by-products from ethanol production is an important source of revenue.
- As manufacturing technologies evolve, ethanol co-products are likely to have an even greater positive impact on project economics.

Ethanol Project Financing Options and Costs

- Project financing is one of the greatest challenges associated with ethanol facility development, particularly when new technologies and new regions are involved. Project financing becomes more feasible when a number of key variables are in place.
- State funding is helpful for ethanol developers, but is not critical to the successful siting of ethanol facilities. Creative approaches to project financing can be important to project success. In fact, creative approaches to project financing increase the likelihood of project success – perhaps because those projects can clearly stand on their own merits.
- The likelihood of success for an ethanol project increases significantly in the presence of broad community support and dedicated local champions. States should strive to build community interest and to cultivate champions for local ethanol development.

Funding Sources for Ethanol Projects

- Federal funding for economic development has been and will continue to be important to ethanol developers.

Policy Options

- Supply-side assistance, rather than demand-side incentives, has been the most effective means of stimulating in-state ethanol production.
- Ethanol policymakers need to consider regional economics of supply as they debate potential requirements for ethanol use.

Public Relations Challenges

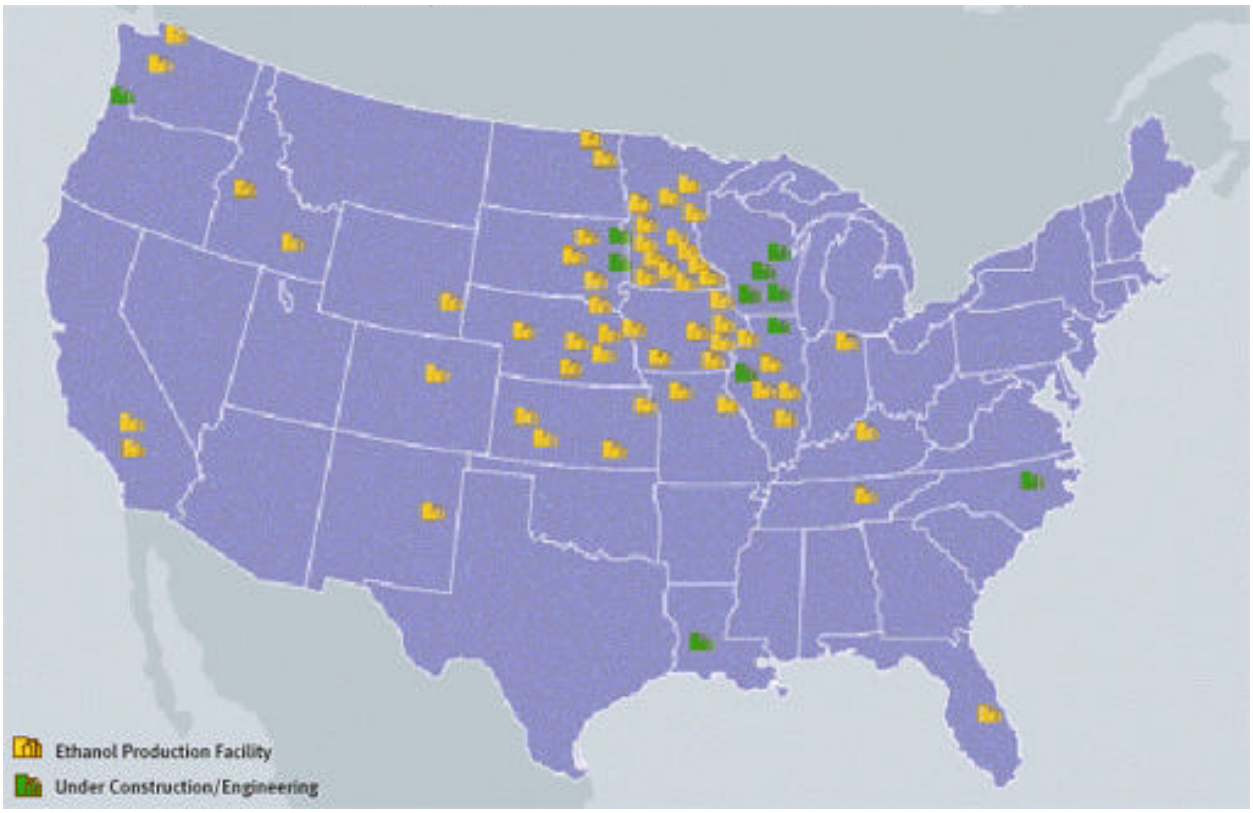
- Ethanol facilities may emit a strong odor. Potential problems associated with this odor can be mitigated through appropriate planning and community outreach.
- Labeling of ethanol at the gas pump creates more harm than benefit.

1.0 INTRODUCTION

Purpose of this Guidebook

This Guidebook is intended to serve as a resource for state officials as they consider opportunities to develop ethanol production capacity in the Northeast. The Guidebook was written with guidance provided by officials from Midwest states, many of whom have been instrumental in successfully developing significant ethanol production capacity over the past two decades.

As evidenced in the graphic below, some level of ethanol production capacity currently exists or is under development in virtually all regions of the U.S. except for the Northeast**.**



U.S. Ethanol Production Facilities
Source: Renewable Fuels Association

However, with ethanol demand expected to grow significantly in coming years, the Northeast need not be left behind. Opportunity does exist for Northeast states to begin to develop regional ethanol production capacity. This opportunity is manifest in the near-term through the use of traditional starch and sugar-based feedstock, and in the long-term through the use of cellulosic feedstock, such as wood and paper waste, agricultural waste, and certain types of municipal solid waste. In recognition of this opportunity, this Guidebook:

- provides information about ethanol production potential in the Northeast;

- highlights associated economic and environmental impacts;
- describes traditional and emerging ethanol production technologies; and
- identifies key issues that state officials will need to consider if they wish to stimulate ethanol industry growth in their states.

Importantly, the Guidebook also suggests that irrespective of whether an individual state chooses to endorse ethanol *use* as a fuel or fuel additive, there is still a significant economic development opportunity for ethanol *production* in the Northeast.

Guidebook Components

Following the **Introduction**, the Guidebook continues with a discussion of **Ethanol Potential in the Northeast United States**. This section provides a general assessment of the opportunity for developing regional ethanol production capacity. It begins with an overview of the ethanol industry, and then provides a discussion of ethanol feedstock availability and options. The section concludes with a description of reasonable **Near-Term and Mid-Term Ethanol Opportunities**.

The next section provides an overview of potential **Ethanol Markets in the Northeast**. Key potential markets are discussed, including markets for MTBE alternatives, octane, carbon monoxide abatement, oxygenated diesel, E85, and next generation technologies.

In the third section, the **Impacts of Using Ethanol Fuel**, as well as some of the advantages and risks of using ethanol, are discussed. Topics of discussion include economic development, environmental advantages, unresolved environmental questions, and energy independence.

The next section of the Guidebook provides an overview of **Ethanol Production Processes**, with discussion about both starch and sugar-based, as well as cellulosic-based, ethanol production. The section also includes information about ethanol plants that are capable of producing both starch-based feedstock and cellulosic biomass feedstock.

The final section of the Guidebook highlights **Important Issues for Northeast States**. Key issues that are discussed include: plant size and feedstock type; facility siting and permitting; facility co-location and infrastructure requirements; ethanol co-products; project financing options and costs; funding sources for ethanol projects; policy considerations; and public relations challenges. Much of this information was drawn from the experiences of Midwest states that have successfully developed ethanol production capacity.

The **Conclusions and Recommendations** section summarizes important findings from the Guidebook, and provides a number of recommendations for next steps.

The **Conclusion** is followed by a number of **Appendices**:

A) Abstracts and bibliographies detailing the cost of using ethanol in the Northeast, the air quality impacts of the use of ethanol-blended gasoline, and the fate and transport of ethanol-blended gasoline in the environment;

B) A state by state matrix detailing Midwest states' efforts, challenges, and successes in developing ethanol production capacity;
C) A directory of key ethanol industry contacts for Northeast states; and
D) Copies of key ethanol legislation enacted by Midwest states.

2.0 ETHANOL POTENTIAL IN THE NORTHEAST UNITED STATES

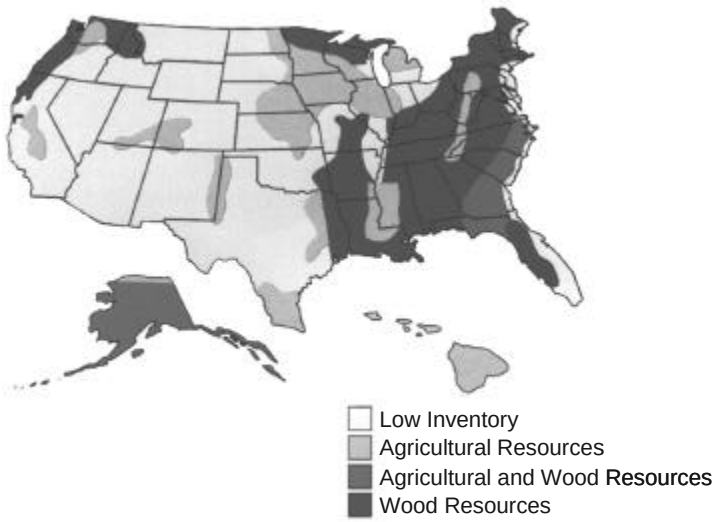
Ethanol Industry Overview

Ethanol is a renewable alcohol-based fuel that can be produced from starches, sugars, and cellulosic biomass. Traditional feedstock, which is used for ethanol production throughout the Midwest, includes crops such as corn, wheat, and sorghum. With recent advances in cellulosic technology, ethanol can also be produced from agricultural waste products like sugar cane bagasse, rice hulls, potato waste, and brewery waste; from forestry and paper wastes; and from municipal solid waste. Presently, corn constitutes about 90 percent of the feedstock used for ethanol production in the United States. The other 10 percent comes largely from grain sorghum, along with some barley, wheat, cheese whey, and potatoes.

Fuel ethanol has been used in the United States since 1908. Henry Ford, a proponent of domestically produced renewable fuels, designed the Model T so that it could run on either gasoline or pure ethanol. However, as oil products became inexpensive and readily available, ethanol use declined. During the oil crisis of the 1970s, ethanol had a resurgence as an alternative to foreign petroleum. In 1978, the National Energy Act was approved, giving a federal tax exemption to 10 percent ethanol blends. This credit is currently active through 2007. In part encouraged by the ethanol tax credit, ethanol production capacity in the United States grew from just 175 million gallons annually in 1980 to a present annual capacity of more than 1.6 billion gallons per year. Most of this growth has occurred in the Midwest, where supplies of corn are abundant.[1]

Most of the nation's ethanol production capacity currently exists in the Midwest, in close proximity to corn production. Corn has long been considered a choice feedstock for ethanol because it is a relatively low cost source of starch that can efficiently be converted to simple sugars, fermented, and distilled into ethanol fuel. However, experts widely believe that in the mid to long-term, the most cost-effective ethanol production will utilize emerging cellulosic ethanol conversion technologies. The Northeast has especially abundant reserves of cellulosic biomass, such as wood and paper waste (see below). This creates an opportunity for the Northeast to become a significant producer of ethanol.

[1] Ethanol is produced largely in the corn belt of the Midwest, with more than 88 percent of production occurring in five states: Illinois, Iowa, Nebraska, Minnesota and Indiana. Because it is generally less expensive to produce ethanol close to the feedstock source, it is not surprising that the top five corn-producing states in the U.S. are also the top five ethanol-producers.



U.S. Biomass Resources
Source: U.S. DOE Office of Fuels Development

Although a handful of cellulosic ethanol pilot projects are in various stages of development in locales throughout the United States, there are presently no full-scale operational facilities. Likewise, although laboratory testing has demonstrated the technical feasibility of cellulosic ethanol production, the economic viability of these projects has yet to be demonstrated with certainty. *Northeast states therefore find themselves in a challenging situation – they have modest and geographically limited feedstock resources when it comes to traditional, proven ethanol technologies, but they are feedstock rich when it comes to promising, but economically uncertain cellulosic technologies.* One option is to investigate ethanol production in the short-term using traditional starch and sugar-based processes, with the expectation of transitioning to emerging cellulosic technologies over time.

As Northeast states consider the pros and cons of regional ethanol production, there are lessons to be learned from the Midwest ethanol industry. The growth of the ethanol industry in the Midwest has not been accidental. Rather, this growth has been supported by the concerted efforts of Midwest states to willfully expand the ethanol industry and to increase the value of ethanol feedstock resources. Citing the need to boost economic development in rural areas, to gain control over corn markets, and to add value to their agricultural products, Midwest states have undertaken a variety of measures to encourage ethanol production and use.

Advice from Midwest states forms the basis of the recommendations outlined in this Guidebook.

Availability of Feedstock in the Northeast

In order to take advantage of ethanol production opportunities, the Northeast must have demonstrable feedstock resources in the region that are capable of supporting ethanol production. These resources fall into two general categories:

- **Starch and sugar-based feedstock** that relies on traditional ethanol production technologies; and
- **Cellulosic feedstock** that relies on emerging ethanol conversion technologies.

In addition to considerations about type of feedstock, other issues that affect or may affect feedstock costs are critical for ethanol developers:

- Proximity to feedstock has direct bearing on a facility's fixed operational costs.
- Diversity of feedstock is also an important consideration; access to more than one feedstock increases the stability of a plant's operational model by insulating the facility from market or seasonal fluctuations that impact feedstock price.

These considerations underscore the importance of aligning ethanol production with ethanol feedstock resources early in the ethanol facility siting process.

Starch and Sugar-Based Feedstock

Starch and sugar-based feedstock includes grains (e.g., corn and barley) and food processing waste streams, such as potato and brewery waste. To date, a region-wide assessment of available starch and sugar-based feedstock for ethanol production has not been conducted in the Northeast.

It is possible, through the use of U.S. Department of Agriculture statistics, to calculate potential regional ethanol production capacity from corn. Approximately 125 million bushels of corn were produced in the Northeast United States in 1999. If this corn could be diverted entirely to ethanol production, regional ethanol production potential would be upwards of 300 million gallons per year.[2] However, this production would be confined to New Jersey, New York, and Pennsylvania – the three Northeast states that presently grow corn. Reliance on corn-based ethanol alone therefore does not constitute a viable-long term ethanol production strategy for the entire Northeast region.

Moving forward, additional research into starch and sugar-based feedstock availability and cost is necessary before the feasibility of ethanol from these traditional feedstocks can be fully evaluated. However, experience from the Midwest does show that small-scale ethanol production can be viable, so modest supplies of traditional feedstocks should not necessarily be a deterrent, assuming they feedstocks can be made available at low cost. Barley, for example, is sometimes used as a rotation crop for potatoes, and could conceivably be used as a feedstock for ethanol production. Other starch and sugar-based feedstocks may also hold promise, but further research is necessary.

Cellulosic Feedstock

Types of cellulosic feedstock potentially suitable for ethanol production include agricultural crop residues, forestry wood wastes, mill residues, urban wood wastes, paper manufacturing wastes, waste paper, and energy crops. A 1994 report by the Coalition of Northeastern Governors Policy

[2] Assumes a standard industry conversion factor of 2.5 gallons of ethanol per bushel of corn.

Research Center, Inc. (CONEG) evaluated cellulosic feedstock availability in the Northeast.[3] The following table summarizes the results of the CONEG study.

State by State Available Biomass Feedstock in the Northeast		
State	**Feedstock (Thousands of Bone Dry Tons/ Year)**	**Maximum Ethanol Production (Million Gallons/ Year)**
Connecticut	587	60
Delaware	518	52
Maine	2,325	240
Maryland	1,813	185
Massachusetts	981	99
New Hampshire	417	42
New Jersey	1,335	135
New York	11,161	1,140
Pennsylvania	6,374	650
Rhode Island	177	17
Vermont	1,046	107
Total	**26,734**	**2,727**

The above data show that the Northeast could produce 2.73 billion gallons of ethanol per year using available cellulosic feedstock alone. This figure does not include the potential production from food processing wastes or dedicated energy crops in the Northeast. Additionally, regarding agricultural crop residue, the above table includes potential production from corn stover only. Corn stover refers to the stalks, leaves, and cobs that remain aboveground after the corn itself is harvested. Notably, corn stover represents a significant potential feedstock for cellulosic ethanol; approximately one pound of stover is produced per each pound of grain harvested.

Some of the potential cellulosic feedstock options in the Northeast are waste products, and as such may be available at minimal cost. Use of waste products as feedstock can also offer quantifiable financial and environmental benefit when the avoided cost of alternative disposal options is considered. It is important to note, however, that once a waste has value, it becomes a commodity. Therefore, the feasibility of ethanol production from cellulosic feedstock will depend in part on the long-term price and availability of that commodity. Biomass power plants, for example, may compete with ethanol production facilities for feedstock. Ethanol production viability from cellulosic feedstock, then, may depend in part on control of the feedstock (perhaps vertical integration that includes feedstock production, or a partnership with a feedstock producer).

[3] Donovan, CT, Lee Rybeck. The Potential for Producing Ethanol From Biomass In the Northeast: A Resource Survey. Northeast Regional Biomass Program. CONEG Policy Research Center, Inc., Washington, D.C., September 1994.

Near-Term and Mid-Term Ethanol Production Opportunities in the Northeast

For the purposes of this Guidebook, we use the phrase "near-term" to designate the present period up to 2004, while "mid-term" represents the period from 2005-2010. Note, the Guidebook presumes that the Northeast will experience significant and growing ethanol demand during this time period. This is substantiated by a discussion of **Ethanol Markets in the Northeast** in Section 3.

Regional Opportunity

Utilizing a strategy that combines both traditional and cellulosic ethanol technologies is perhaps the best way to ensure a smooth and timely transition to a sustainable and economical cellulosic-based ethanol industry in the Northeast.

- Near-term Opportunity – In the near-term, development of ethanol production capacity is possible using demonstrated, economically viable technologies – i.e., traditional ethanol feedstock like starches, sugars, and grain. Midwest experience has shown that even small-scale starch and sugar-based ethanol production facilities can be successful if they take advantage of existing waste streams, such as brewery waste or potato processing waste. In such cases, the avoided cost of disposal is the key economic variable. Avoiding disposal costs by utilizing waste streams for ethanol production allows for reduced economies of scale and increased project efficiency. These are important considerations for early Northeast ethanol manufacturers that will have to compete with ethanol shipped from the Midwest.

  Therefore, despite the longer term promise of cellulosic technologies, early Northeast production facilities would likely need to be located in close proximity to waste starch and sugar, grains, and/or rotational crops. Since the number of suitable locations for traditional corn-based ethanol facilities in the Northeast will be severely limited, most early manufacturers should seek to identify niche feedstock opportunities, characterized by an abundance of food or process waste or other feedstocks.

  In addition to niche opportunities, some Northeast states, particularly those with existing corn production, may seek to develop traditional dry mill ethanol facilities. In one scenario, project developers may be able to "intercept" Midwest grain shipments that are en route to livestock feed markets in Northeast states. This intercepted grain could be utilized for ethanol production. At the other end of the production process, distillers grains – a high protein livestock feed that is one of the chief by-products of ethanol production – could then be sold as livestock feed. A near-term strategy of this nature will help to ensure the success of early ethanol projects while minimizing risks to early developers and financiers.

  It is important to note that even with the wide scale development of these near-term strategies for ethanol production, the use of starch and sugar-based feedstock alone will not enable the Northeast to realize its full ethanol production potential. In this regard, developers of near-term facilities should consider the possibility of designing early facilities so that they can be

modified (in part or in whole) to produce ethanol from cellulosic feedstock when that technology becomes economically feasible.

Mid-term Opportunity – By 2005, according to forecasts by the U.S. Department of Energy's Office of Fuels Development, cellulosic ethanol technology will be more efficient, production costs will be lower, and initial barriers generally associated with increased ethanol use in the Northeast will be less formidable than in the near-term scenario. In the mid-term, it may therefore be economical to pursue production from cellulosic-based plants. If traditional ethanol facilities are developed in the Northeast in the near-term, there will be an opportunity to build investor confidence and consumer familiarity with ethanol development. This may enable a mid-term transition to cellulosic technologies that will be driven by technology improvements, cellulosic feedstock availability, and anticipated markets for ethanol in the Northeast.

3.0 ETHANOL MARKETS IN THE NORTHEAST

In the wake of the impending phase out of MTBE in California and elsewhere, US markets for ethanol are expanding. Demand for ethanol in the U.S. surged to an all-time high in 2000, achieving monthly and annual production records. The U.S. fuel ethanol industry today supports more than 2 billion gallons of annual production capacity, and will continue to grow throughout 2001. The growth of markets for ethanol creates opportunities for the development of ethanol production in the Northeast.

The largest potential ethanol market in the near-term is the gasoline oxygenate market. The replacement of MTBE with ethanol could increase the demand for ethanol to nearly 3.2 billion gallons by 2004, up from 1.3 billion gallons in 2000.[4] Based on these numbers, ethanol demand appears likely to increase from current levels due to the phase out of MTBE. Demand projections grow even further when other ethanol markets, such as the octane and carbon monoxide attainment markets, are considered. For instance, demand for ethanol as an octane enhancer for premium-grade gasoline will increase regardless of any federal action that may occur regarding the oxygenate requirement that may occur.

Moving forward, Northeast ethanol developers seeking equity to finance their projects need to be able to demonstrate the existence of regional ethanol demand to potential investors. To some degree, ethanol demand already exists in the Northeast. For instance, major gasoline distributors, such as Getty Petroleum, are already blending ethanol in Northeast gasoline . *Northeast demand for ethanol, however, has been limited in part by a lack of ethanol availability*. At present, Northeast ethanol is imported from Midwest production centers, where 90 percent of U.S. ethanol is produced. Shipping ethanol to the Northeast from the Midwest can add as much as 15 cents per gallon to the price of ethanol for Northeast users. This incremental cost provides an economic incentive for developing regional production capacity.

The following potential markets for Northeast ethanol could show significant growth in the near and mid-term:

- <u>Replacement for MTBE</u> – The Clean Air Act Amendments of 1990 require the use of oxygenated gasoline in ozone non-attainment areas. In the Northeast, a majority of this need has been met by MTBE. According to the Northeast States for Coordinated Air Use Management, 1.3 billion gallons per year of MTBE are presently used in gasoline in the Northeast. Ethanol, also an oxygenate, is one potential alternative to MTBE. Assuming a 5.7 percent ethanol blend in gasoline, replacement of a 10 percent MTBE blend with ethanol in the Northeast would require 749 million gallons per year of ethanol.[5] To meet this demand, approximately fifty ethanol plants, each supplying 15 million gallons per year of ethanol, would be required. The future role of ethanol as a replacement for MTBE will be largely determined by the outcome of the ongoing federal policy debate about the federal

[4] AUS Consultants. Ability of the U.S. Ethanol Industry to Replace MTBE. Prepared for the Governor's Ethanol Coalition. March 20, 2000.
[5] Northeast States for Coordinated Air Use Management. "An Assessment of Option for Reducing MTBE in Reformulated Gasoline." NESCAUM: Boston, MA. February 1998.

reformulated gasoline program. In the near-term, the use of ethanol as an alternative to MTBE represents the largest potential market in the Northeast.

- Octane – Ethanol provides an octane boost, both for conventional and reformulated gasoline. In the absence of ethanol, gasoline suppliers use alkylates and other petroleum-based compounds to increase the octane of gasoline. Ethanol is particularly desirable as an octane enhancer since it can substitute for benzene and other aromatic hydrocarbons, such as toluene, xylene, and other 'benzene-ring'-based compounds in gasoline. This substitution reduces emissions of benzene and butadiene, both of which are carcinogenic. To date, the use of ethanol as an octane enhancer in the Northeast has been limited by its regional lack of availability.

- Wintertime Blend for Carbon Monoxide – The federal oxygenate program specifies a minimum oxygenate content of 2.7 percent by weight. The presence of oxygenate was mandated in past federal fuel regulations as a means of reducing carbon monoxide (CO) emissions. Ambient CO levels are usually more pronounced in winter months. While mandating the use of oxygenates in gasoline is a practical CO reduction strategy, the CO benefits of oxygenated fuels have declined since the introduction of vehicles with electronic air/fuel ratio controls in the early 1990s. The EPA estimates that CO emissions resulting from the use of oxygenates will decline as older vehicles are replaced with newer vehicles. Although important in the near and mid-term, the CO reduction market is not likely to support ethanol demand in the long-term.

The following potential markets for Northeast ethanol could support significant growth in the mid-term and long-term:

- E85 – E85 refers to a fuel mixture that is 85 percent ethanol and 15 percent gasoline. E85 qualifies as an “alternative fuel” under the Energy Policy Act (EPACT), which requires fleet owners to own a certain percentage of alternative fuel vehicles. In addition, existing Corporate Average Fuel Economy (CAFE) standards encourage automobile manufactures to produce alternative energy vehicles. At present, Daimler/Chrysler, Ford, and GMC all produce flexible fuel vehicles capable of running on E85, gasoline, or combinations thereof. More than 750,000 flexible fuel vehicles made their way to United States automobile showrooms in 2000, and each year the percentage of the United States vehicle fleet that is capable of operating on alternative fuels is increasing. However, none of the policies to encourage alternative fuel vehicles require the sale of E85, and the major impediment to E85 growth has been availability of the fuel itself. Even the Midwest lacks the supporting distribution infrastructure necessary to support the use of E85 fuel. In the long-term, as infrastructure continues to develop, the use of E85 may provide a significant market for ethanol fuel.

- Oxygenated Diesel Fuel – Oxygenated diesel is a blend of diesel fuel, ethanol, and a blending agent that is designed to run in unmodified diesel engines. Oxygenated diesel is expected to be cleaner burning than conventional diesel fuel, requires no engine modifications, and is stable to very low temperatures. With the introduction of tough new standards for diesel aimed at reducing pollution, the blending of ethanol with diesel presents a significant

opportunity to reduce exhaust emissions from diesel-fueled vehicles and equipment. Thus far, oxygenated diesel has primarily been targeted toward urban bus and truck fleets that make use of central refueling, and has been used only in selected demonstration projects. In these projects, researchers have seen little to no change in the performance of vehicles run on oxygenated diesel versus conventional diesel fuels. In fact, the addition of ethanol and a blending agent turns conventional number two diesel fuel into a premium diesel fuel. As ethanol becomes increasingly available in the Northeast, oxygenated diesel may find its way into a growing number of on-road diesel fuel vehicles. It is worth noting that ethanol-blended oxygenated diesel has not yet received USEPA Fuel Certification because a Health Impact Study has not been done. Such a study is under consideration as part of a demonstration program now underway in Illinois.

- Next Generation Technologies - Ethanol will be a key energy source for emerging clean air technologies, such as fuel cells in alternative fuel vehicles. According to the U.S. Department of Energy, ethanol has many advantages as a fuel for fuel cells in alternative fuel vehicles. Among its advantages, ethanol is simple and efficient, is a liquid fuel, and is characterized by surmountable infrastructure and supply issues.[6]

[6] Presentation by Patrick Davis, United States Department of Energy. "Ethanol for Transportation Fuel Cells: Opportunities and Challenges." National Conference on Ethanol Policy and Marketing. February 22 -24, 1999.

4.0 ECONOMIC AND ENVIRONMENTAL IMPACTS OF USING ETHANOL

The following section provides a summary of some of the expected impacts from increased ethanol use in the Northeast. In general, compared with alternatives, the use of ethanol in the Northeast is expected to result in significant economic development, environmental benefits, and greater energy independence. Unanswered questions about the fate and transport of ethanol in groundwater will soon be addressed in a study at Lawrence Livermore National Laboratory. For a more detailed assessment of these impacts and associated issues, see Appendix A.

Economic Impacts

Development of ethanol represents a long-term economic development strategy for Northeast states. Expanded production capacity will foster job growth and boost state and local tax revenues.

Job Creation

At present, an estimated 200,000 Americans are directly and indirectly employed by the ethanol industry. Development of an ethanol industry in the Northeast could potentially bring thousands of additional jobs into the region. A feasibility analysis of a proposed cellulosic biomass ethanol plant in Northern California found that operating a 15 million gallon per year biomass ethanol plant co-located with a biomass power plant would create at least 28 permanent operational jobs, and an additional 63 to 100 feedstock-related jobs. These jobs would be augmented by an additional 93 to 122 indirect jobs. The payroll for direct jobs related to plant operations and feedstock supply would be more than $2.6 million annually for each new plant. Payroll for combined direct and indirect jobs would be more than $4.8 million annually. Facility construction would create an estimated additional 88 jobs, with an estimated payroll of $2 million for each new facility.[7]

The replacement of MTBE with ethanol in Northeast gasoline would require 749 million gallons per year of ethanol. To meet this demand, approximately fifty ethanol plants, each supplying 15 million gallons per year of ethanol, would be required. Applying job data from the above California feasibility study suggests that operation of these plants would result in an estimated 1400 permanent operational jobs, 3150 to 5000 feedstock supply jobs, and 4650 to 6100 indirect jobs in the Northeast. Importantly, there is more than enough biomass presently available in the Northeast to meet this demand. If this ethanol production potential were fully realized, the Northeast region could also supply local markets for E85, oxygenated diesel, and emerging next generation technologies, as well as become a net exporter of ethanol.

[7] Quincy Library Group, California Energy Commission, California Institute of Food and Agricultural Research, Plumas Corporation, TSS Consultants and National Renewable Energy Laboratory. Northeast California Ethanol Manufacturing Feasibility Study. November 1997.

Increased Tax Revenue and Tax Base Diversity

In addition to job creation, ethanol development in the Northeast would provide benefits to rural economies, help diversify the tax base, and result in increased tax revenues. The state of Minnesota reports that its ethanol industry contributes more than $350 million in net annual benefit to the state. The state of Nebraska reports that its state and local tax revenues have increased by $450 million as a result of its ethanol industry. In 1999, Minnesota and Nebraska together produced 490 million gallons of ethanol. Although this sort of analysis has not been conducted for the Northeast region as a whole, if ethanol production in the Northeast reached 750 million gallons per year, the amount of ethanol that would be needed to replace MTBE in Northeast states, it is reasonable to assume that similar positive economic impacts would be observed. Importantly, many of the benefits of a new ethanol industry would provide a welcome boost to ailing resource-based industries in Northeast states, such as the Northeast's pulp and paper industries.

Environmental Impacts

Studies suggest that increased use of ethanol in the Northeast would result in important environmental benefits related to air quality and greenhouse gas emissions.

Air Quality

In general, predictive and actual measured research shows that the use of gasoline formulated to meet the Clean Air Act's reformulated gasoline (RFG) specifications provides a range of air quality benefits. Ethanol is one potential oxygenate that can be blended with gasoline to achieve these benefits. Research by the California Air Resources Board has shown that the use of ethanol as a gasoline additive in reformulated gasoline helps contribute to reduced carbon monoxide (CO), nitrogen oxide (NO_x), and volatile organic compound (VOC) emissions.[8] In addition, the use of ethanol (as well as other oxygenates) dilutes toxic components such as the aromatic hydrocarbons benzene and toluene, enabling ethanol-blended gasoline to potentially "over comply" with toxic content regulations for gasoline. Used as an additive in diesel fuel, ethanol has been shown to exhibit similar positive air quality impacts.

It is important to note that the use of ethanol-blended gasoline may result in increased acetaldehyde emissions. Acetaldehyde is a precursor to another air pollutant called peroxyacetylnitrate (PAN). Increased ethanol use may result in increased ambient PAN levels. However, it is also important to point out that increasing the use of ethanol in gasoline, relative to MTBE, will result in a decrease in emissions for butadiene and poly-cyclic organic matter (POM) -- the two most toxic gasoline constituents from a cancer potency perspective. When these impacts are considered, the net effect of blending ethanol with gasoline instead of MTBE is a one percent increase in toxic emissions on a mass basis, but a two percent decrease in the cancer potency of these toxic emissions.[9]

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[8] California Air Resource Board. "Air Quality Impacts of the Use of Ethanol in Gasoline." December 1999.
[9] Northeast States for Coordinated Air Use Management. "An Assessment of Options for Reducing MTBE in Reformulated Gasoline." NESCAUM. Boston, MA. February 1998.

Greenhouse Gas Emissions

The use of ethanol, a renewable fuel, is also capable of reducing greenhouse gas emissions relative to the use of fossil fuels. It is important to note, however, that fossil fuel inputs are generally required to process the plants and plant wastes into ethanol (and in the case of corn, to grow the plant material in the first place). Additionally, the magnitude of the emissions reduction depends on the type of ethanol feedstock utilized.

A life cycle analysis conducted by the Argonne National Laboratory found that use of a gallon of corn-based ethanol reduces full fuel cycle greenhouse gas emissions by 12 to 19 percent, assuming that the ethanol is blended in gasoline at 10 percent. Meanwhile, for a gallon of cellulosic-based ethanol, greenhouse gas emissions can be reduced by up to 100 percent (or more[10]) when compared to conventional fuel.[11]

Water Quality

Reviews of the fate and transport of ethanol in water and groundwater generally show that ethanol, unlike MTBE, is not likely to accumulate or persist for long in the environment. Regarding surface water environments, it is commonly accepted by the scientific community that ethanol evaporates quickly in surface water, and poses little threat to environmental or human health. Ethanol is also expected to be rapidly degraded in groundwater, and is not expected to move beyond source areas.

However, the behavior of ethanol-blended gasoline in subsurface environments is a subject of ongoing study.[12] Of particular concern are the BTEX[13] compounds – all six of which are powerful depressants to the central nervous system and potentially serious threats to public health. For instance, some laboratory evidence has suggested that in some cases BTEX biodegradation may be inhibited in the presence of ethanol, since ethanol will preferentially degrade relative to BTEX compounds. Due to limited laboratory testing and a paucity of field evidence, overarching conclusions cannot yet be made.

Scientific studies currently underway at the Lawrence Livermore National Laboratory are now evaluating BTEX biodegradation in the presence of ethanol. Studies are being conducted with aquifer solids from sites with different histories of fuel contamination to address two issues:

- Effects on Microbial Ecology - assessment of changes in the relative abundance of BTEX-degrading bacteria resulting from exposure to gasoline with and without ethanol under various conditions; and

[10] Benefits of over 100 percent could be achieved because of the possibility of energy cogeneration in the production process.
[11] Wang, *et al.* "Effects of Fuel Ethanol Use on Fuel-Cycle Energy and Greenhouse Gas Emissions." Argonne National Laboratory. January 1999.
[12] Ulrich, G. "The Fate and Transport of Ethanol-Blended Gasoline in the Environment"
[13] BTEX collectively refers to the aromatic hydrocarbons benzene, toluene, ethyl benzene, and xylene.

- Degradation Kinetics - generation of computer simulations for BTEX compounds (primarily toluene) and ethanol under various conditions in aquifer materials with different histories of gasoline and oxygenate exposure.

These studies have the potential to answer remaining questions by Northeast states about ethanol fate and transport in the environment.

Foreign Oil Dependence

Because ethanol is a domestically produced renewable fuel, its use has important implications for long-term sustainable energy use.

Energy Independence

The development of a domestic ethanol industry in the Northeast would increase the nation's fuel supply, reduce the severity of gasoline price spikes from world oil price fluctuations, and significantly reduce demand for imported petroleum over the long term. For illustrative purposes, New York state alone spends $25 billion per year on energy, most of which leaves the state. Development of a renewable ethanol industry in New York would help to keep this money both in the state and the region.

Declining domestic oil resources and increased reliance on imports are primary reasons for the nation's lack of control over the price of gasoline. The replacement of oil with ethanol would help reverse this unsustainable trend over the long term. According to the National Renewable Energy Laboratory, researchers estimate that an average of 2.45 billion metric tons of cellulosic biomass could be available in the United States each year for ethanol production. This is enough biomass to produce over 270 billion gallons of ethanol – approximately twice the current level of United States gasoline consumption.

Net Energy Balance

Cellulosic biomass ethanol provides about four units of energy for every unit of fossil fuel energy used to produce it – a significantly higher ratio than for other renewable fuels, such as corn ethanol.[14] The large positive net energy balance for cellulosic biomass ethanol compared to corn ethanol is due to the fact that relatively little fossil energy is used in the creation of cellulosic biomass and in the biomass to ethanol conversion process. It is worth noting that energy is used to grow and harvest some types of biomass wastes, such as rice hulls, and bagasse. However, unlike starch based crops, such as corn, this biomass waste is often burned (ethanol production solves this problem), and does not have market value other than as feedstock for energy production. In addition, biomass resources such as wood waste, and certain dedicated biomass ethanol crops (such as switch grass) are not nearly as energy intensive to produce as starch crops.

[14] Net energy balance is calculated by taking the energy (Btu) contained in one gallon of ethanol (76,000 Btu) minus the fossil fuel energy (petroleum, natural gas, and coal) required to produce that gallon.

The net energy balance for both corn ethanol and cellulosic biomass ethanol translates into reduced reliance on fossil fuels (including imported petroleum) and reductions in greenhouse gas emissions.

5.0 ETHANOL PRODUCTION PROCESSES

Ethanol production technology can generally be divided into two main categories:

- Technologies that convert **starch or sugar-based feedstock** into ethanol; and
- Technologies that convert **cellulosic feedstock** into ethanol.

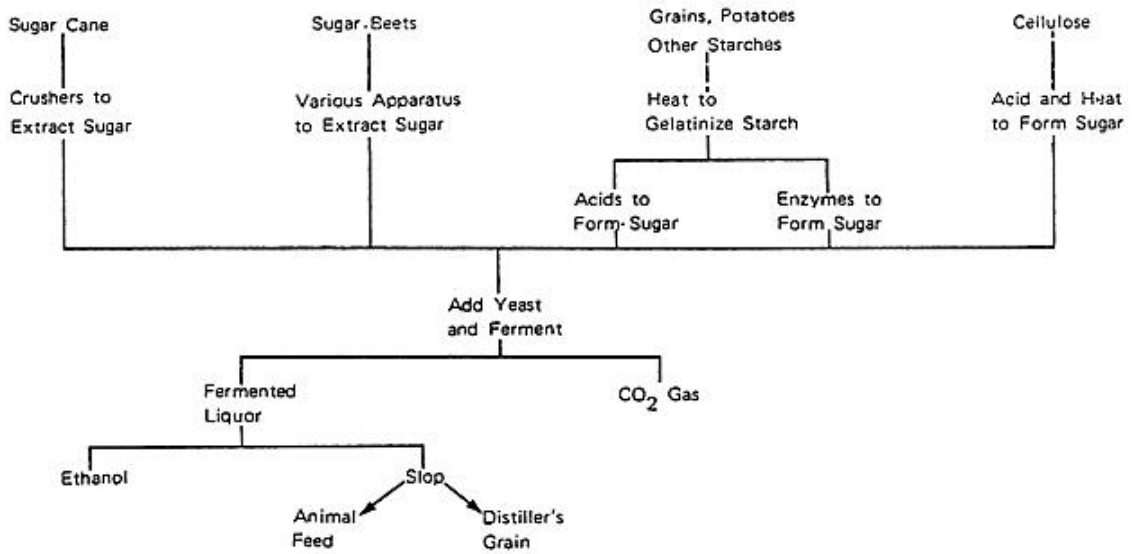
The majority of ethanol produced today falls into the first category, and utilizes corn and other grains as feedstock to produce ethanol using either a dry or wet mill process. These processes are discussed in greater detail below. Also discussed below is the process of converting cellulosic waste into ethanol. This discussion is followed by an explanation of how a traditional ethanol production facility could be prepared, or retrofitted, to enable it to also handle cellulosic feedstock.

Starch and Sugar-Based Ethanol

There are three basic steps that need to occur in the production of ethanol from starch and sugar products:

1) the formation of a solution of fermentable sugars;
2) the fermentation of sugars to ethanol; and
3) the separation of ethanol by distillation.

The graphic shown below illustrates the ethanol production process using various types of feedstock:



Source: University of Florida Cooperative Extension Service, Institute of Food and Agricultural Service.

Dry Mill Process

In the dry-milling process for ethanol production, the feedstock is first ground into flour and water is added to create a mash. The mash is then cooked and made to undergo a chemical reaction to create fermentable sugars. The entire product then goes through the next step, fermentation, to create ethanol. The by-products of the dry-milling process are dried distillers grains and carbon dioxide.

After the grain products have been processed through wet or dry milling to create six-carbon sugars, fermentation occurs. In this step, yeast cells are added to the sugar solution to form ethanol and carbon dioxide. As the yeast cells convert the sugars into ethanol, carbon dioxide is produced and must be vented off continuously. Fermentation is complete when carbon dioxide is no longer produced. The resulting mixture is called "beer."

Distillation is the process by which ethanol is separated from the beer mixture. Ethanol vaporizes at a lower temperature than water. Therefore, when the mixture is heated, the ethanol vapors are released from the mixture. The collected ethanol is about 95 percent pure. However, in order for ethanol to be sold as fuel, it must be anhydrous, or 100 percent pure ethanol. A dehydration processes further isolates the ethanol in order to create pure ethanol.

In both the wet and dry mill processes, a bushel of corn will produce between 2.4 and 2.6 gallons of ethanol.[15]

Wet Mill Process

The objective of the wet mill process is to obtain as many usable by-products as possible from the different components of the corn feedstock. Usable by-products of wet milling typically include dozens of different materials, including oil, fructose, sweeteners, and various feed products. Although wet mill facilities tend to be capital intensive during the development process, their operational costs are lower relative to dry mill facilities. Wet mill facilities also tend to be fewer in number than dry mill facilities, but have a higher production capacity. The siting requirements for wet mill facilities are also more demanding, necessitating large navigable waterways, nearby population centers, and significant amounts of nearby livestock and feedstock.

In the wet mill process, corn is first steeped in water to begin the separation of the corn kernel into its component parts (starch, germ, oil, and hull). Following this step, the corn is ground and washed to further separate the kernel. When corn is processed, the germ is removed to form corn oil and the starch is converted to the simple sugars used in the ethanol production process. The remaining solids, gluten meal and gluten feeds, are sold as high protein livestock feed.[16]

It is worth noting that it will likely be very difficult to site wet mill facilities in the Northeast. Aside from their high initial capital costs and demanding siting requirements, their need to be

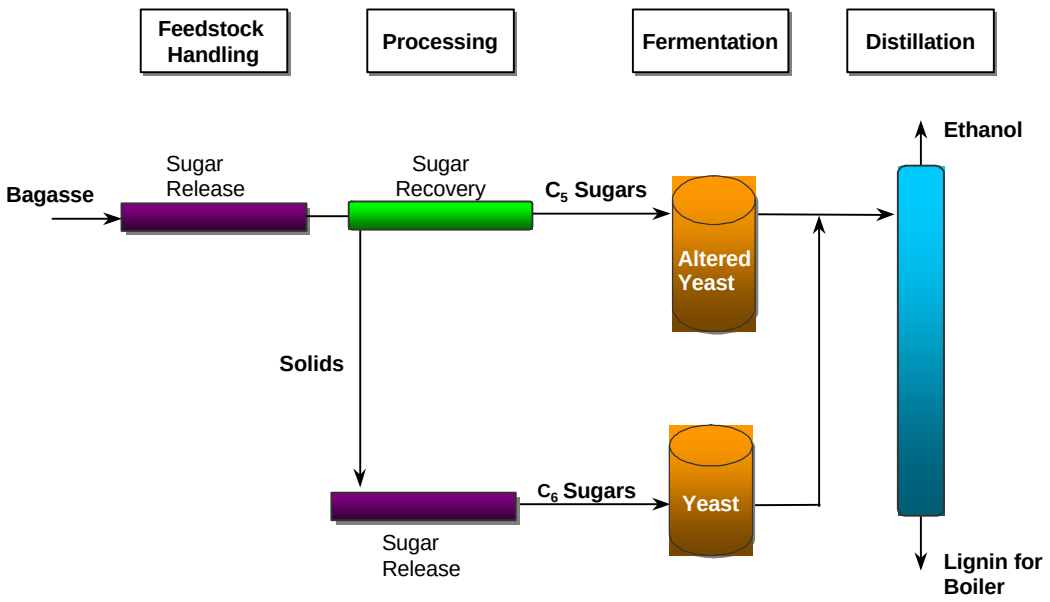
[15] Sneller, Todd. "Producing Ethanol from Corn."
[16] University of Wisconsin-Stevens Point, Solid Waste Management Center, " An Assessment of Biomass Resources for Ethanol Production in Wisconsin."

built on navigable waterways and in close proximity to agricultural markets for co-products will make them unlikely prospects.

Cellulosic Ethanol

Cellulosic biomass ethanol technology converts agricultural waste, wood waste, and even some types of municipal solid waste into ethanol. In general, cellulosic feedstock is converted to ethanol through processes that are very similar to those used in traditional ethanol production. But, unlike traditional ethanol conversion, sugars must be formed from the cellulosic material as a first step. Once formed, these sugars can be fermented and distilled into ethanol. The basic production process for cellulosic ethanol is illustrated in the following figure:

Cellulosic Ethanol Production



Source: BC International Corporation

Like starch-based feedstock, biomass feedstock must be prepared before it can be converted into fermentable sugars. The waste is reduced in size and then pretreated using physical, chemical, or biological methods. Research to date has focused primarily on chemical pretreatments like dilute acids, alkalines, organic solvents, ammonia, sulfur dioxide, and carbon dioxide.

After the material is pretreated, it is converted to fermentable sugars using a hydrolysis procedure. There are two common hydrolysis processes. The oldest and best-understood hydrolysis technology utilizes dilute sulfuric acid to create fermentable sugars. However, dilute acid hydrolysis also produces a large amount of undesirable by-products. In concentrated acid hydrolysis, concentrated sulfuric acid and diluted water convert cellulosic materials to sugars. While the concentrated acid hydrolysis produces fewer by-products, the acid must be recycled in order to make the plant economically efficient. Recycling adds complexity to the already complicated process of handling the highly corrosive sulfuric acid.

There are also several approaches to hydrolysis now being developed. The most promising of these is enzymatic hydrolysis. The process uses the enzyme cellulase, instead of sulfuric acid, to convert the feedstock to sugars. By combining cellulase and yeast, the sugars are produced and fermented in the same step.[17] NREL estimates that the future cost reductions of producing ethanol using enzymatic hydrolysis could be four times greater than cost reductions using concentrated acid hydrolysis and three times greater than cost reductions for dilute acid hydrolysis.[18]

After the hydrolysis process is complete, like in the starch-based ethanol production process, the sugars are fermented into ethanol. However, two different sugars are produced – six-carbon and five-carbon sugars. The five-carbon sugars cannot be converted to ethanol using natural organisms like yeast. Instead, researchers have developed genetically engineered yeasts that are capable of fermenting the five-carbon sugars into ethanol. Recent technology has made these specialized yeasts available for the commercial production of cellulosic ethanol.[19] Six carbon sugars can be converted to alcohol using traditional processes.

Preparing a Starch-Based Ethanol Plant for Cellulosic Ethanol Production

As cellulosic ethanol technology improves, it makes sense for initial starch-based ethanol production facilities sited in the Northeast to be capable of also accepting cellulosic feedstock. According to an industry expert, building a production facility that is capable of converting starch and cellulosic biomass into ethanol will involve altering the front-end equipment of the process. This additional equipment will be necessary for preparation and hydrolysis of the cellulosic feedstock. A separate fermentation tank might also be necessary because of the different sugars produced in the hydrolysis of cellulosic material. Additionally, six–carbon sugar can be fermented in the same tanks used in the starch-based ethanol production, although another tank might be necessary to ferment the five-carbon sugars.

In order to maintain the same ethanol output, a plant converting from starch-based ethanol to cellulosic biomass ethanol would also have to increase its number of fermentation tanks. The initial fermentation of cellulosic biomass produces a lower percentage of ethanol than the fermentation of starch products. Therefore, fermentation tanks must be added to maintain facility capacity.

In total, these modifications to an existing ethanol production plant could cost as much as $30 million for a 20 million gallon ethanol plant. However, conversions can be simplified if the ethanol production facility is built initially with additional fermentation tanks and space for the extra biomass preparation and hydrolysis. While the cost of building the plant will initially increase, the existing infrastructure will facilitate the shift from starch or sugar-based ethanol to biomass ethanol production. As cellulosic ethanol conversion efficiencies increase, this will be a preferred technology, due to the low cost and widespread availability of cellulosic feedstock.

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[17] DiPardo, Joseph. "Outlook for Biomass Ethanol Production and Demand." Energy Information Association, U.S. Department of Energy, April 2000.
[18] National Renewable Energy Laboratory. *Bioethanol Multi-Year Technical Plan*, Preliminary Draft. July 1999.
[19] DiPardo, Joseph. "Outlook for Biomass Ethanol Production and Demand." Energy Information Association, U.S. Department of Energy, April 2000.

Early Northeast ethanol plants that plan ahead for this transition will have a competitive advantage over their counterparts. Larger facilities will tend to absorb the extra capital costs more easily relative to smaller production facilities. In addition, the conversions will be more inexpensive as the cellulosic ethanol technology advances.[20]

[20] Personal conversation with Mike Gaylor, Gaylor Engineering, September 21, 2000.

6.0 IMPORTANT ISSUES FOR NORTHEAST STATES

A close look at Midwest states that have successfully developed ethanol production capacity provides valuable lessons for Northeast states that may be trying to build their own ethanol industries. The following section presents detailed information for ethanol decision makers in the Northeast. Information is drawn from the specific experiences of Midwest states, as well as from ethanol research literature. For more detailed information about each Midwest state's ethanol industry, see the matrix in Appendix B.

Plant Size, Type, and Feedstock Requirements

Ethanol can be produced from a variety of starch and sugar-based feedstock, as well as cellulosic-based feedstock. Initially, viable near and mid-term ethanol facilities in the Northeast are likely to be of small to medium capacity, designed to take advantage of "opportunity" feedstock, for instance food waste or co-processing applications. Early facilities should be designed so they are capable of expanding to meet increased regional ethanol demand. Since feedstock costs are a key driver of overall ethanol fuel economics, cellulosic-based ethanol facilities should become even more desirable over the long-term, as cellulosic waste facilities can often utilize low-cost or no-cost feedstock.

<u>Opportunistic Starch and Sugar-Based Ethanol Facilities</u>

Lesson – Availability, cost, and diversity of feedstock are critical economic variables for ethanol developers.

- Proximity to feedstock, which has direct bearing on a facility's fixed operational costs, is one of the most important variables for ethanol developers. Diversity of feedstock is also an important consideration. Access to more than one feedstock increases the stability of a plant's operational model by insulating the facility from market or seasonal fluctuations that may impact feedstock price.

Lesson – Ethanol facilities that convert "opportunity" feedstock or waste streams using existing technologies make economic sense, and offer an immediate opportunity for ethanol production in the Northeast.

- The first ethanol plants sited in the Northeast should aim to take advantage of local opportunity feedstock, such as brewery waste, cheese whey, wheat gluten, potato waste or other food processing wastes or low cost rotational crops that may be readily available at no or low cost. Such plants will tend to be small, low-risk, and easy to finance relative to stand alone starch-based or cellulosic ethanol facilities.

- Facility size will vary by feedstock availability; facilities can be sized to match the existing waste stream. Unlike traditional grain facilities, ethanol facilities that employ opportunity feedstock can successfully operate at reduced economies scale – a result of having a reliable, nearby, and low or no-cost supply of feedstock. Ethanol production can also typically occur right on site, reducing project capital costs.

Lesson – With an abundance of large population centers, Northeast states have a ready inventory of waste streams that are likely to provide promising opportunities for ethanol production.

- Niche feedstock applications may offer the best opportunities for early plants. Potential resources for locating niche opportunities include the following:

  – State Manufacturing Directory – Developers may benefit from going through the state manufacturing directory and identifying, by SIC code, manufacturers that may have a convertible waste stream.
  – Food Associations – Local food associations may be able to help identify convertible waste streams.
  – State Agencies – A short survey of state agencies that may be alert developers to niche opportunities. For instance, state water permitting specialists may be aware of convertible wastewater streams.

Making Ethanol from Opportunistic Waste Streams: Two Examples

- Two 3 million gallon per year facilities were constructed by J.R. Simplot in Idaho in the mid-1980s. The two facilities, both of which are still operational, are co-located with J.R. Simplot's French Fry processing plants, and utilize potato waste for feedstock. The ethanol facility generates income from ethanol production and reduces waste disposal costs for the facility. Ethanol produced at the facilities is sold primarily in Idaho, and produces positive cash flow for the company.
- A 15 million gallon per year facility began production of ethanol from brewery waste in St. Paul, Minnesota earlier this year. The facility, developed by Gopher State Ethanol for $20 million, operates in a section of the facility that was formerly unused. The ethanol facility helps lower operational costs for the brewery, since expenses are now shared by the ethanol venture. Both facilities also benefit from the sale of carbon dioxide by-product from the ethanol production process.

Cellulosic-Based Ethanol Facilities

Lesson – The near-term development of starch and sugar-based ethanol production in the Northeast would facilitate the mid-term development of cellulosic-based ethanol production. The use of cellulosic feedstock would give rise to additional considerations. Cost of feedstock remains a critical variable.

- Mid-term facilities in the Northeast are likely to be capable of producing ethanol from cellulosic feedstock. Plant size can be expected to vary according to the type of facility and by project. Initially, cellulosic plants will likely produce around 20 million gallons of

ethanol per year; some mid-term plants may be larger, perhaps 40 to 50 million gallons per year.[21]

- Some additional rules of thumb for cellulosic ethanol plants include the following:

  – Assume a yield of about 70 gallons per dry ton.
  – Feedstock must be obtained economically from potential suppliers. Additionally, suppliers must be willing to sign long-term agreements, or financiers will be hesitant to back projects.

Lesson – Research suggests that plants do not have to be developed on a large scale in order to be viable.

- With regard to plant size, an analysis by the National Renewable Energy Laboratory (NREL) has shown that ethanol plant equipment costs do not increase linearly with plant size, and that generally, equipment costs scale with an exponent of about 0.7 (1.0 would translate to linear scaling).[22] However, savings that may result from increased economies of scale may be offset by increased costs for feedstock collection, as the more feedstock a plant demands, the greater distance it must be transported.

- The minimum plant size for which capital and operating costs begin to level out is about 10 million gallons per year; 20 million gallons per year is preferable. This means that a minimum of approximately 300,000 bone dry tons of feedstock per year is necessary for a 20 million gallon per year facility.

Cellulosic Ethanol Facilities Under Development

- A cellulosic ethanol facility now being developed in Middletown, New York by Masada Resource Group will provide 10 millions gallon of ethanol annually from municipal solid waste and sewage sludge. The facility will require 230,000 tons per year of garbage, and 70,000 bone dry tons (BDT) per year of sewage sludge. The total estimated cost of the project, which is being built at a greenfield (i.e., new) site, is $250 million. The cost also includes a recycling facility.
- A cellulosic ethanol facility under development in Jennings, Louisiana by BC International will produce 23 million gallons of ethanol annually from sugarcane bagasse, with potential to increase capacity to over 60 million gallons. The facility initially will require approximately 320,000 bone dry tons of bagasse. The cellulosic ethanol facility is being converted from a formerly operating petroleum refinery and grain-to-ethanol facility. Total project costs are estimated to be around $90 million.

[21] California Energy Commission. " Evaluation of Biomass-to-Ethanol Fuel Potential in California." December 1999.
[22] Wooley, R., Ruth, M. Sheehan, J., Ibsen, K., Majdeski, H., and Galvez, A. *Lignocellulosic Biomass to Ethanol Process Design and Economics Utilizing Co-Current Dilute Acid Prehudrolysis and Enzymatic Hydrolysis Current and Futuristic Scenarios*. National Renewable Energy Laboratory. Contract No. DE-AC36-98-GO10337. July 1999.

Grain-Based Ethanol Facilities

Lesson – In Northeast states that produce or import grain products, traditional dry mill ethanol facilities are a viable option. Project economics and constraints for these facilities are well understood.

- Experiences from the Midwest indicate that plants should be no smaller than about 10 million gallons per year capacity. Evidence from the Midwest indicates that facilities smaller than this size may fail to realize operational economies of scale. Likewise, initial facilities should not be more than 40 million gallons of annual capacity. Plants that are any larger at the outset will be higher risk, will face difficulties finding capital, and will require more feedstock. Smaller plants should be designed so capacity can be increased as demand increases.

- Developers will have a choice of siting dry mill versus wet mill facilities. For a variety of reasons, dry mill facilities are likely to be preferred. Reasons include the smaller size and economy of scale associated with dry mill plants, the greater ease of siting smaller plants, lower initial capital costs, and reduced feedstock requirements.

Lesson – Initial ethanol production facilities in the Northeast may find that it makes sense to utilize grain-based feedstock initially, before transitioning to increased ethanol production from cellulosic feedstock.

- Assuming a conversion efficiency of 2.5 gallons of ethanol per bushel of corn, six million bushels of corn will be required for a 15 million gallon production facility. Over time, such a facility could increase output by accepting cellulosic feedstock for ethanol production. For perspective, New Jersey, New York, and Pennsylvania produced 123 million combined bushels of corn in 1999.

Producing Ethanol from Grain:
A Dry Mill Approach in New Jersey

Plans are currently underway to develop a farmer-owned dry mill plant that could make about 10 million gallons of fuel ethanol annually in New Jersey. That plant would consume some 3.8 million bushels of corn each year, and net return per member is estimated to average $1,954 annually over the period 2001-2010. This would represent a 15.6 percent return on investments and a $0.39 per bushel return.

Facility Siting / Environmental Permitting Issues

Siting and permitting issues will be subject to state and local siting and environmental regulations, and will vary according to project scope and location. Siting issues are not likely to vary significantly for traditional and cellulosic ethanol plants. The following section highlights some key considerations related to ethanol facility siting and permitting.

General Siting Issues

Lesson – Ethanol facilities that "piggyback" on other manufacturing operations may be easier to site.

- Early ethanol facilities that utilize opportunistic feedstock from existing manufacturing or processing facilities will have fewer permitting requirements than stand alone facilities being built from the ground up since they are integrated into existing operations. Additional permits related to ethanol production, storage, and VOC monitoring will likely be necessary.

Lesson – State involvement in feasibility and site assessment can be helpful, but is not essential to project success.

- In case studies of Midwest states' ethanol facilities, it is apparent that the states themselves typically play a minimal role in the facility siting process. When states have been involved, they have usually taken on an advisory or administrative role. For instance, in Minnesota, the state left the siting process up to the developers, but assisted by setting up meetings between developers and regulatory authorities. Along these lines, experience shows that developers enjoy greater success when they communicate early and often with local community members.

- With regard to conducting a site assessment or feasibility study, the role of the state varies by project. This has been true in the Midwest. In some cases, the state assisted with feasibility studies, particularly early on in the development process. In other cases, feasibility studies were paid for privately by the developer and investors.

<u>Environmental Siting and Permitting Issues</u>

Lesson – The siting process varies by state and locality. Developers should begin the process as early as possible to avoid delays.

- Ethanol facility developers in most states have not run into significant environmental permitting problems, although the nature of the process has varied by state. For instance, Iowa ethanol plants have noted difficulty meeting wastewater treatment permit requirements due to higher than average standards in that state.

- Developers and other parties interested in obtaining environmental permits should be encouraged to begin the permitting process as soon as possible, for several reasons:

  - Generally speaking, regulators may be totally unfamiliar with ethanol facilities, and may need to learn about ethanol plants from square one.
  - With regard to air permitting, in cases where no inventory of ambient air quality exists, plant developers may be required to build a baseline. This process alone could take as long as a year.
  - The permitting process is generally complex. For instance, in Nebraska more than 50 permits need to be obtained when siting an ethanol facility. Many Midwest plants also have difficulty expanding due to permit caps on emissions.

Lesson – Water availability and wastewater requirements are some of the most important siting considerations for developers.

- Water is required for ethanol facilities both for process water and for the production of steam that is typically used in pretreatment and ethanol distillation processes. Specific water requirements will vary by facility, and can be reduced by co-locating with an existing power plant and by recycling water. NREL estimates that for a 10 million gallon per year ethanol facility co-located with a power plant, between 80 to 320 gallons per minute will be required. This translates into annual water requirements of 60 to 488 acre feet.[23]

- The quality of the source water for the ethanol facility should be sufficient to protect fermenting bacteria from toxic water contaminants and to avoid the fouling of heat exchangers by dissolved solids. Water treatment will likely be necessary to ensure this quality is attained.

- Wastewater generated by a ten million gallon per year ethanol facility will be approximately 260 gallons per minute. Actual quantities of wastewater will be determined during the design phase of the project. Factors that influence wastewater volume include the quality of the water supply, the treatment process, and the amount of water recycling. Complete recycling of all wastewater from the facility is possible, but increases initial capital costs. Treatment consists of anaerobic and aerobic treatment that converts organic wastes to biogas that can be burned in the boiler. Solids are separated out and disposed of. Wastewater disposal can take place through discharge to surface water, land, or an evaporation pond. Of these three options, evaporation ponds are the most costly.

Ethanol Project Co-Location and Other Infrastructure Issues

Lesson – The co-location of ethanol projects with mature infrastructure and certain types of industries can help reduce facility operational costs and will pay off over the lifetime of a facility.

- A study by the California Energy Commission has found that co-location can result in an overall capital cost reduction of 30 percent for the cellulosic ethanol facility and reduce labor costs by 20 percent. In addition, co-location increases the value of lignin, a high Btu, low sulfur byproduct that can be used to generate process heat and electricity. The value of lignin at a co-located facility would be about $20 per ton more than for a standalone facility because of reduced transportation and marketing costs.

- For all types of ethanol projects, facilities should be located in close proximity to rail lines, water sources, highways, and a reliable power source. Some facilities will require significant wastewater treatment capacity, depending on project design. Developers should also try to locate as close as possible to feedstock sources, as this reduces costs associated with feedstock transport. It also makes sense for developers to locate near markets for ethanol co-products, such as livestock and poultry operations, although experience shows that proximity to feedstock is a more critical economic driver.

[23] Yancey, M. and Kadam, K. *Biomass to Ethanol Facility Design, Cost Estimate, and Financial Evaluation, Volume 1*. NREL. November 1997.

- Co-location reduces initial capital costs associated with facility development. Much of the required infrastructure for the ethanol facility may already be in place, such as waste treatment facilities.

Lesson – Co-location with a biomass power plant can positively impact the economics of ethanol production in a variety of different applications. The synergies associated with co-location can lead to a reduction in capital costs for the ethanol facility, decreased operating costs for both facilities, and the creation of new revenue streams. In the Northeast, there is great opportunity to co-locate cellulosic ethanol facilities with biomass power plants.

- According to a report by the California Energy Commission, co-locating a cellulosic ethanol facility with an existing biomass power plant to create a biorefinery can create synergies that provide significant economic benefits to each facility.[24] Some of the synergies associated with co-locating biomass ethanol plants and existing biomass power plants include:

  - The biomass power plant's biomass feedstock can be diverted to the ethanol facility for ethanol production, with subsequent return of high Btu, low sulfur lignin as a replacement fuel for the biomass power plant. In addition, new feedstock, such as agricultural waste, can be used to produce ethanol and lignin fuel for biomass power plants (thus, limiting competition for biomass resources). This allows the facilities to share the cost of collecting, transporting, and processing feedstock, thereby reducing feedstock and operating costs.
  - The ethanol facility can purchase steam and electricity from the biomass power plant, creating new revenue for the biomass power plant and reducing the cost of electricity and steam to the ethanol facility. This will also eliminate the need to invest in steam and electricity production infrastructure for the ethanol facility, further reducing capital costs.
  - Co-location with an existing biomass power plant can reduce fixed costs for both facilities and capital costs for the ethanol facility. Co-locating the ethanol facility at an existing biomass industrial site can reduce development costs associated with environmental, construction, and operating permit issues. This can help reduce risks and associated cost of development capital.

Ethanol Co-Products

Ethanol project economics are impacted by the ability to sell co-products created by the ethanol production process. The number and type of co-products produced vary by the type of production facility. Since wet mill plants are unlikely to be sited in the Northeast, they are not considered here.

[24] California Energy Commission. " Evaluation of Biomass-to-Ethanol Fuel Potential in California." December 1999.

Cellulosic Ethanol Plants

Lesson – The consideration of co-products and their markets is important to project economics. Different feedstock and production technologies yield different co-products.

- Important potential co-products from cellulosic ethanol production include the following:

  - Protein – Some sources of lignocellulosic biomass can contain up to 15 percent protein based on dry weight, making it marketable as an animal feed supplement.
  - Carbon Dioxide – For every pound of ethanol produced, approximately one pound of carbon dioxide is produced from the fermentation process. Carbon dioxide may be sold as a beverage carbonating agent, as a compression agent to make dry ice, and may be directed to the production of algae or methane.
  - Lignin – Lignin is a component of lignocellulosic biomass that generally passes through the ethanol conversion process unchanged. Extraction of lignin offers a high Btu, low sulfur compound that can be used to generate process heat and electricity.
  - Furfural – Xylose, the primary sugar in hemicellulose, can be processed into furfural, a selective solvent for refining high quality lubricating oils. Furfural can be used to produce commercial resins, adhesives, and wood coatings, and also has an application in the production of nylon.
  - Stillage – Fermentation is carried out by a variety of microorganisms that on a dry weight basis may contain up to 70 percent protein. Processing this stillage produces a protein rich powder that can be used as a substitute for soy protein or fish meal in feeds for animals and aquatic species. Stillage may also be processed to produce methane.
  - Methane – Methane can be produced from anaerobic digestion of stillage and/or conversion of carbon dioxide. Methane may be used for electricity generation or as a chemical feedstock for production of other materials.

- It should be pointed out that although ethanol is the likely product to be produced from the conversion of cellulose to sugars, it is not the only potential product. Other products that might be produced from converted sugars may include higher value products, like plastic. A number of manufacturing companies are beginning to explore this possibility. Although the growth of these industries may compete with ethanol at some level, it may also lead to the further development of technologies necessary for cellulose conversion. Importantly, it may also provide an avenue for potential alliances and partnerships for ethanol developers.

Grain Ethanol Plants

Lesson – It will be advantageous for early grain-based ethanol plants to have access to markets for livestock feed.

- Grain ethanol plants typically produce distillers grains – a valuable by-product that serves as a high protein livestock feed. The starch in grain products is converted into ethanol and carbon dioxide. The remaining nutrients, such as protein, fat, minerals, and vitamins, are concentrated into distillers grains.

- Distillers grains from ethanol production may be sold as livestock feed in wet or dry form. Wet distillers grains are more costly to ship, due to the extra weight associated with their higher moisture content, and typically can be shipped economically only for distances less than 100 miles. Dry distillers grains (DDGs), which have gone through a drying process, are more readily transportable over long distances. Both wet and dry distillers grains can be used as feed for beef and dairy cattle, poultry, and swine. Distillers grains provide an excellent protein source for aquaculture operations.

Lesson – The sale of feed by-products from ethanol production is an important source of revenue.

- A Midwest-based case study of a 15 million gallon per year dry mill facility found that the sale of DDGs brings in more than $6 million in annual revenue. This is based on a DDG price of just over $100 per ton and annual DDG production of approximately 60,000 tons.[25]

Lesson – As manufacturing technologies evolve, ethanol co-products are likely to have an even greater positive impact on project economics.

- In the past, carbon dioxide has been overlooked in many starch and sugar-based ethanol operations. Increasingly, there is more and more investment in carbon dioxide recovery and sale. In many cases, ethanol manufacturers enter into direct agreements with independent companies that collect and market the carbon dioxide themselves, providing a valuable source of revenue.

- Examples of other innovative and creative co-product applications include the potential extraction of corn syrup from dry corn mash by exposing it to propane gas, and the potential use of certain feed by-products as an alternative to salt and sand on icy roads.

Ethanol Project Financing Options and Costs

Developers of ethanol facilities have numerous options when it comes to project financing. This section highlights some of the approaches taken by Midwest developers to finance projects. Also noted are approximate costs associated with project financing and development.

Lesson – Project financing is one of the greatest challenges associated with ethanol facility development, particularly when new technologies and regions are involved. Project financing becomes more feasible when a number of key variables are in place.

- Average capital requirements for constructing an ethanol plant in the Midwest using traditional technology are less than $2.00 per gallon of annual production.[26]

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[25] Crooks, A. *Rounding the Corner? Co-op Involvement in Ethanol Industry Grows Despite Uncertainty.* Rural Cooperatives. July/August, 1997.
[26] Van Dyne, D., Braschler, C., and Blase, M. *Estimated Benefits of two Corn Processing Plants in North Missouri*, an interim report to the Missouri Corn Growers Association and The Missouri Corn Merchandising Council. 1996.

- Capital requirements for cellulosic ethanol facilities are in the range of $2.00 to $3.50 per annual gallon, depending on existing infrastructure.[27] (Over time, the higher capital costs associated with cellulosic facilities will be offset by the lower cost of cellulosic feedstock compared with traditional feedstock).

- Utilizing tried and true ethanol production technology will make project financing easier for developers. In addition, prior to seeking project financing, developers should be able to:

  - demonstrate adequate levels of technology development;
  - provide process guarantees;
  - demonstrate markets for ethanol, chemicals, and co-products;
  - obtain contracts with feedstock suppliers; and
  - obtain site agreements.

Lesson – State funding is helpful for ethanol developers, but is not critical to the successful siting of ethanol facilities. Creative approaches to project financing can be important to project success. In fact, creative approaches to project financing increase the likelihood of project success – perhaps because those projects can clearly stand on their own merits.

- The approaches undertaken in the Midwest vary by state, and often depend on the availability of public funds in those states. Below are some examples of approaches to obtaining financing employed by developers in various states:

  - Ethanol plants have been sited within some states through the use of private developers' funds only. Examples include facilities in Indiana, Kansas, and South Dakota, as well as two small potato waste processing plants in Idaho.
  - A number of states have relied on a combination of private and public funds for facility development. Illinois plants were given economic development grants for site assessment, monitoring, and construction. Iowa project developers were mentored by the state in early stages of project development, and were granted loans and forgivable loans up to $900,000. Minnesota plants received loans from the state of up to $500,000 per plant, as well as grants for construction and start-up costs. Nebraska designated an Ethanol Authority and Development Board to administer an equity investment program that partnered private and public funds for the construction and expansion of ethanol plants.

- In the Midwest, various types of cooperative approaches have been instrumental in building the industry.

  - The farmer cooperative is one successful model of project development. Farmer-owned cooperatives account for a sizeable portion of the recent expansion in the domestic ethanol industry. Today, one-third of all United States ethanol production is accounted for by farmer-owned ethanol production facilities. The cooperative approach enables farmers to purchase ownership in an ethanol facility. In return, farmers agree to sell a

[27] Personal communication, BC International Corporation. August 2000.

certain amount of grain to the ethanol facility each year. They typically are guaranteed to receive average annual market price for their corn, enabling them to not have to worry about product marketing. Additionally, as shareholders, the farmer owners share in facility profits.

- The rural electric cooperative provides another example of synergies realized and applied for the purpose of siting an ethanol facility. In Minnesota, the state's rural electric cooperatives have worked to site and build ethanol plants. For the rural electric cooperative, the ethanol facility provides a significant base electricity load, as well as an economic boost for the community, both of which are instrumental to the long term success of the electric cooperative. For the ethanol facility, the electric cooperative provides a source of initial financing, project guidance, and a reliable source of low cost electricity. Although rural electric cooperatives are uncommon in the Northeast, this example provides insight into the types of niche opportunities that could be fostered in Northeast states.

Lesson –The likelihood of success for an ethanol project increases significantly in the presence of broad community support and dedicated local champions. States should strive to build community interest and to cultivate champions for local ethanol development.

- The success of early ethanol projects in the Midwest can frequently be attributed to strong local leadership and community support. Dedicated leadership is essential for guiding projects from conception all the way through to implementation. Additionally, dedicated local leadership is necessary to generate trust within the community and to build ties with community members, stakeholders, and financiers.

- To help generate leadership and support, states should be prepared to do a lot of handholding and grassroots work. Some successful strategies from the Midwest include:

  - Designate a local ethanol commission to examine key issues, disseminate information, and provide a forum for discussion for community members and ethanol stakeholders.
  - Avoid partisanship. Give credit for successes to all participants.
  - Reach out to groups that have an economic interest in ethanol development.

Funding Sources for Ethanol Projects

Lesson – Federal funding for economic development has been and will continue to be important to ethanol developers.

In addition to federal and state grants, loans, and other programs that may become available on certain occasions, there are a number of existing federal programs that may provide assistance to ethanol developers in various ways. A brief description of some of these programs is provided below.

- **Biomass Research and Development Act of 2000** – In June 2000, the Biomass Research and Development Act of 2000 (P.L. 106-224) was passed by Congress. The Act provides structure and funding for President Clinton's Executive Order 13134, issued in August 1999,

which established a national goal of tripling United States use of biobased products and bioenergy by 2010. The Act authorizes $49 million in research and development funds for biomass research and development. The Act also establishes a Biomass Research and Development Board, which is responsible for coordinating Federal activities for the purpose of promoting the use of biobased industrial products. The Board is a federal, cabinet level group that meets quarterly.

- **Commodity Credit Corporation (CCC)** – On October 30, 2000, the Department of Agriculture announced a $300 million program designed to encourage increased ethanol production, particularly from smaller plants and farmer owned cooperatives. The two-year program is part of the CCC and will provide funds to ethanol and other bioenergy producers to expand production of biobased fuels. Payments are to be made on a portion of the increase in agricultural commodities purchased for expanded bioenergy production, with smaller and cooperatively-owned facilities able to receive higher payment rates.

- **Job Training Partnership Act (JTPA)** – A number of ethanol facilities in Midwest states have taken advantage of funding available under the JTPA. The JTPA provides grants to states for local training and employment programs. State and local governments, together with the private sector, have responsibility for developing, managing, and administering training programs. Job training grants may be applied to disadvantaged adults and youth, dislocated workers, and others who face significant employment barriers.

- **Tax Increment Financing (TIF)** – Ethanol facilities in the Midwest have also taken advantage of TIF to assist with development. TIF provides a means for municipalities, in conjunction with the private sector, to undertake local economic development projects to stimulate beneficial development or redevelopment that might not otherwise occur. Under the TIF program, incentives are provided to municipalities within a specific area known as a Tax Incremental District (TID). Once the TID has been established, the tax revenue from the higher value resulting from the project, which would otherwise go to the taxing jurisdictions in the municipality (i.e., school district, etc.), is allocated instead to a separate municipal fund for the TID. The fund is used each year to pay the principal and interest on the money borrowed. Funds for local economic development and the provision of direct incentives to business qualify for TIF.

Policy Considerations

Lesson – Supply side assistance, rather than demand-side incentives, has been the most effective means of stimulating in-state ethanol production.

- Numerous types of state level policies have proven instrumental in stimulating ethanol industry growth in Midwest states. In the Midwest, a handful of states initially tried to build an ethanol industry through policies that created demand for ethanol in their states. But, those states later discovered that demand-side incentives, while important to the development of local ethanol markets, did not work as well to attract developers as did production incentives. More often, it was supply-side assistance, such as grants, low interest loans, and

various other state-based producer incentives that were most successful in attracting ethanol production.

- An example is provided by the state of Nebraska. In the 1980's, Nebraska was largely unsuccessful in stimulating the growth of in-state ethanol production after it instituted incentives designed to stimulate ethanol use/demand. In the 1990's, however, following the enactment of production incentives, along with passage of the Clean Air Act at the federal level, the state witnessed robust development of ethanol production facilities. Nebraska is now a net exporter of ethanol, producing approximately 285 million gallons and using only 80 million gallons of ethanol each year.

- For additional information about state policies to encourage ethanol development, please see the State by State Matrix in Appendix B.

Lesson – Ethanol policymakers need to consider regional economics of supply as they debate potential requirements for ethanol use.

- In the summer of 2000, gasoline prices spiked to unprecedented levels in reformulated gasoline (RFG) markets in the Midwest U.S. Although industry stakeholders attributed the price spikes to varying causes, including pipeline disruptions, low gasoline inventories, and new RFG requirements, the exact reasons are a subject of ongoing debate. Regardless of the exact reasons behind it, the price spike does demonstrate that regional fuel prices are highly susceptible to supply-side constraints.

  - If Northeast states ultimately choose to increase ethanol use, they should consider policies and strategies that apply to Northeast markets as a whole, rather than individual states or smaller markets.
  - Requirements that call for niche, or boutique, fuels for small market segments, will increase supplier costs and decrease fungibility of supply.
  - Reliance on niche fuels increase the risk of supply disruptions and contribute to greater price volatility.

Public Relations Challenges

The introduction of ethanol production facilities and the increased use of ethanol in the Northeast can be expected to create public relations challenges.

Lesson – Ethanol facilities may emit a strong odor. Potential problems associated with this odor can be mitigated through appropriate planning and community outreach.

- For some types of ethanol facilities, odors associated with the fermentation process can be a nuisance for the surrounding area. These problems are more pronounced when the community in which the ethanol plant is to be sited has been uninformed about the potential for odors to be produced. In addition, odor problems can be avoided by ensuring that facilities are not sited close to population centers. For the most part, however, Midwest

states report that communities have welcomed the prospect of having an ethanol facility sited nearby, a result of the jobs created and associated economic development.

Lesson – Labeling of ethanol at the gas pump creates more harm than benefit.

- Several states enacted mandatory pump labeling of ethanol-blended gasoline in the 1980s. In those states, mandatory pump labeling actually created a significant public relations hurdle for ethanol. As a result of labeling, it was found that retail consumers were very quick to blame ethanol for problems with vehicle or engine performance that occurred after filling up with ethanol-blended gas. In actuality, vehicle performance problems were unrelated to the use of ethanol blends. This problem was solved by the repeal of mandatory pump labeling laws in states with labeling laws.

7.0 CONCLUSIONS AND RECOMMENDATIONS

Now is the time to consider building an ethanol industry in the Northeast United States. Over the past two decades, Midwest states have enjoyed myriad economic, environmental, and other benefits from the growth of a regional ethanol industry. In the Northeast, there is ample opportunity for similar growth to occur. The utilization of traditional ethanol conversion technology applied to niche feedstock offers promise for ethanol production opportunities in the Northeast. Development of a nascent Northeast ethanol industry based on this approach could help facilitate a smooth and timely transition to cellulosic ethanol production as that technology matures in the next five to ten years. Steps taken in this direction would help ensure that the Northeast benefits from a rapidly growing national biofuels industry.

As Northeast states consider whether and how to stimulate ethanol production in their states, there are a number of immediate steps that can be taken. The following is a short list of potential actions:

- Education – It all begins with information. Work with government agencies and ethanol advocacy groups to educate stakeholders and the public about the opportunities and benefits of ethanol.
- Policy Exploration – Work with state and local government officials to explore and coordinate potential policies to support in-state ethanol production. Inform policy-makers of the economic growth that ethanol project development can foster, both directly, through job creation and increased tax revenue, and indirectly, through development of complementary industries. Consider policies that have aided ethanol development in other regions, including production incentives, tax credits, and low interest loans.
- Feasibility Analysis – Locate problematic/opportunistic waste streams. Assist potential developers with site assessments and feasibility analysis.
- Outreach – Cultivate community leadership. Reach out to community members and stakeholders and help them come together. Find people with an economic interest in ethanol development. Work with them to put together an ethanol commission. Involve potential ethanol developers, community members, farmers, energy experts, environmental advocates, and other interested parties.
- Identify and Address Unresolved Concerns – Collaborate with federal and state agencies and researchers to identify and evaluate unresolved environmental and economic issues associated with ethanol use. Learn from the MTBE crisis, and take steps to ensure that it is not repeated. Discover as much as possible about options and alternatives before advocating their widespread public use.

While an examination of ethanol in the Midwest illustrates the many benefits to be enjoyed from the successful development of a regional ethanol industry, it also shows that success does not come easily. It is the hope of the Northeast Regional Biomass Program that this Guidebook will provide Northeast states with the information they need to more thoroughly consider the development of regional ethanol production, and ultimately, to realize the economic benefits and long-term energy sustainability that development of this industry may foster.

Appendix A – Ethanol Issue Abstracts and Bibliographies

Air Quality Impact of the Use of Ethanol-Blended Gasoline
Abstract

With the potential phase-out of MTBE, ethanol will increasingly be used as an additive in federal reformulated gasoline (RFG) and conventional gasoline (non-RFG). There are a number of air quality benefits and concerns associated with increasing the use of ethanol-blended gasoline.

Gasoline Background

Driven by the Clean Air Act Amendments of 1990, the federal RFG program began in 1995. RFG is a gasoline blend developed to provide additional reductions in emissions of ozone-forming and toxic pollutants compared to conventional gasoline. RFG is used in about 17 states, including most of the Northeast states. RFG is required to contain 2.0 percent oxygenate by weight. Both ethanol and MTBE are used to satisfy the oxygenate requirement. Ethanol and MTBE are also commonly used in conventional gasoline to increase octane (which prevents engine knocking). Northeast fuel suppliers predominately use MTBE; however, Getty Petroleum Marketing Company is using 40 million plus gallons of ethanol each year.

Air Quality Impacts

In general, predictive and actual measured research studies show that the use of ethanol-blended gasoline is consistent with the air quality goals of RFG. For example, a recent California Air Resources Board report on the air quality impacts of ethanol found that the use of ethanol-blended gasoline would provide for significant reductions in every emission of concern relative to 1997 baseline levels involving the use of MTBE. As illustrated in the following chart, ethanol would provide similar air quality benefits as alkylates. Note, these results are based on the Southern California Air Basin; similar studies have not been conducted in the Northeast.

Emission Changes from 1997 MTBE Baseline										
	Ozone (8 hour)	CO	NOx	VOC	Benzene	Butadiene	Acetald -ehyde	Formal-dehyde	Ethanol	MTBE
2003 5.7% Ethanol	-23%	-21%	-21%	-14%	-35%	-27%	-6%	-15%	37%	-100%
2003 10% Ethanol	-21%	-26%	-21%	-14%	-33%	-26%	15%	-15%	59%	-100%
2003 Non-Oxygenate (Alkylates)	-23%	-18%	-21%	-14%	-38%	-27%	-13%	-16%	-5%	-100%

Ethanol is also beneficial due to its ability to reduce toxics in gasoline. The use of ethanol in place of MTBE dilutes toxic components, such as BTEX[1] --- potentially allowing for ethanol-blended gasoline to "over comply" with toxic content regulations. In addition, ethanol has a low sulfur content and can be used to help comply with stricter regulations for sulfur content.

Global Warming Impacts

[1] BTEX collectively refers to the aromatic hydrocarbons benzene, toluene, ethyl benzene, and xylene.

The use of ethanol, a renewable fuel, is also capable of reducing greenhouse gas emissions relative to the use of fossil fuels. It is important to note, however, that fossil fuel inputs are generally required to process the plants and plant wastes into ethanol (and in the case of corn, to grow the plant material in the first place). Additionally, the magnitude of the emissions reduction depends on the type of ethanol feedstock utilized.

A life-cycle analysis conducted by the Argonne National Laboratory found that use of a gallon of corn-based ethanol reduces full fuel cycle greenhouse gas emissions by 12 to 19 percent, assuming that ethanol is blended in gasoline at 10 percent. Meanwhile, for a gallon of cellulosic-based ethanol, greenhouse gas emissions can be reduced by up to 100 percent (or more[2]) when compared to conventional fuel.[3]

There are, however, outstanding issues concerning the impact on air quality of increasing the use of ethanol-blended gasoline. For example:

- **Reid Vapor Pressure ---** The Reid Vapor Pressure (Rvp) of gasoline is related to evaporative emissions. The higher the Rvp of gasoline, the higher the evaporative emissions of volatile organic compounds (precursors to ozone formation). There is a 1 Rvp waiver for ethanol-blended gasoline in conventional gasoline areas. Increasing the use of ethanol in conventional gasoline may increase ozone formation.

- **Commingling ---** Even if ethanol-blended gasoline is compliant with Rvp standards, when an ethanol-blended gasoline is mixed with non-ethanol blended gasoline (for example, during refueling), the Rvp of the resultant blend is increased. For instance, California's new RFG regulations require a 0.1 psi Rvp decrease to account for commingling, and CARB is performing additional research on commingling impacts.

- **Acetaldehyde and PAN Emissions ---** The use of ethanol-blended gasoline may result in increased acetaldehyde emissions. Acetaldehyde is a precursor to another air pollutant called peroxyacetylnitrate (PAN). Increased ethanol use may result in increased ambient PAN levels.

- **Transportation of Ethanol ---** Transporting large quantities of corn ethanol from the Midwest to the Northeast by diesel truck, rail, and barge may impact air quality across the region.

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[2] Benefits of over 100 percent could be achieved because of the possibility of energy cogeneration in the production process.

[3] Wang, *et al.* "Effects of Fuel Ethanol Use on Fuel-Cycle Energy and Greenhouse Gas Emissions." Argonne National Laboratory. January 1999.

Air Quality Impact of the Use of Ethanol-Blended Gasoline
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The Cost of Using Ethanol in the Northeast
Abstract

A number of key economic issues arise when increased ethanol use in the Northeast is considered. Among them are the added costs associated with developing adequate transportation and distribution infrastructure and concerns about the ethanol industry's ability to expand to meet demand in the Northeast. Of primary concern are the impacts that these issues will have on both gasoline supply and the price of gasoline for consumers in the Northeast.

Overall Costs to Consumers
The anticipated costs to consumers associated with the overall cost of replacing MTBE with ethanol vary by study. Two of the primary studies on this topic have analyzed costs for California; no study has monetized equivalent costs for the Northeast. The studies show that the costs for ethanol are generally comparable to MTBE and other alternatives. The California Energy Commission reports that it would cost 1.9 to 2.5 cents per gallon to replace MTBE with ethanol over a six-year period; not using an oxygenate would cost 0.9 to 3.7 cents per gallon. A May 2000 study by Downstream Alternatives prepared for the Renewable Fuels Association calculates that a switch to ethanol blends would result in a blend price of 3 plus cents per blended gallon less than MTBE blends. This switch is more than sufficient to cover the cost of complying with stricter Reid Vapor Pressure requirements. The results of both studies indicate that consumers would not be seriously impacted by increased costs from ethanol blending, relative to alternatives like alkylates.

Transportation and Distribution Costs
Because of ethanol's affinity for water, ethanol as of yet is not transported via pipeline; transporting ethanol by pipeline will require the use of dedicated pipelines. As a result, a transition to the widespread use of ethanol in the Northeast will, at least initially, require the shipping of ethanol via barge, rail, or truck. Unlike MTBE, ethanol also needs to be blended with gasoline on-site, necessitating the creation of new storage tank capacities and blending facilities. A study by the California Energy Commission (CEC) estimated that these modifications in California would cost $60 million and require 18 to 24 months to complete.

Production Capability
According to NESCAUM, 1.3 billion gallons per year of MTBE are presently used in the Northeast U.S. Replacement of a 10% MTBE blend with a 5.7% ethanol blend in the Northeast would require 749 million gallons per year of ethanol. In the short-term, as ethanol use is phased in to replace MTBE, demand could be met by ethanol produced in the Midwest. Getty Petroleum is already blending 40 million gallons of ethanol each year in the Northeast using ethanol imported from the Midwest.

The U.S. Department of Agriculture recently completed an analysis of the effects of replacing MTBE with ethanol. Its analysis shows that "a 4-year adjustment period is sufficient to enable ethanol production and distribution capacity to expand to meet the projected increase in demand." Its analysis is based on an increase of approximately 50%

to 3 billion gallons by 2004. Although its analysis assumes that new capacity will be met from dry milling corn-ethanol production, development of new biomass ethanol facilities would augment this capacity.

Regionally, biomass ethanol companies are already exploring projects in the Northeast. For instance, Masada is developing a 10 million-gallon per year waste-to-ethanol plant in New York. Based on total biomass resources, including wood waste, agricultural waste, and municipal waste, potential biomass ethanol production in the Northeast is estimated by CONEG to be up to 1.3 billion gallons per year.

Impact of Ethanol on the Federal Highway Trust Fund

Ethanol-blended fuels are taxed differently from petroleum fuels. Currently, ethanol receives a 54 cent per gallon subsidy in the form of a partial exemption from the federal fuel excise tax and an income tax credit. Based on a 10% blend of ethanol in gasoline, this translates into a 5.4 cent per gallon federal tax break on each gallon of ethanol-blended gasoline sold. Currently, this subsidy reduces the nation's Highway Trust Fund by $870 million annually. A significant increase in ethanol use may therefore impact the amount of revenue credited to Northeast states in the Federal Highway Trust Fund.

Long-term Outlook

Through the development of a local ethanol industry, the Northeast could realize further reductions in the cost of producing and transporting ethanol. In addition, due to technology advancements, the National Renewable Energy Laboratory (NREL) projects cost reductions for ethanol of about 50 cents per gallon by 2005, and about 60 cents per gallon by 2010. This would make the cost of ethanol about 80 cents per gallon of ethanol in 2010.

Cost of Using Biomass Ethanol in the Northeast
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The Fate and Transport of Ethanol-Blended Gasoline in the Environment
Abstract

The detection and persistence of MTBE in subsurface waters throughout the U.S. and potential limitations on its continued use in gasoline have prompted inquiries into the fate and transport of oxygenated gasoline containing ethanol. It is commonly accepted by the scientific community that ethanol evaporates quickly in surface waters, posing little, if any, threat to environmental or human health. However, the behavior of ethanol-blended gasoline in subsurface environments has been a subject of debate and recent study.

Characteristics of Ethanol
Ethanol is infinitely soluble in water. Unlike MTBE, ethanol is structurally simple and able to biodegrade rapidly. Ethanol is also a naturally occurring compound that is produced during the fermentation of organic matter in anoxic (completely lacking in oxygen) environments. It can be expected to rapidly biodegrade in virtually all environments with conditions that support microbial activity. The fate and transport of ethanol in groundwater aquifers will be primarily a function of this microbial activity.

Impact of Ethanol on BTEX Compounds
An important issue is the potential impact that the presence of ethanol will have on the fate and transport of toxic gasoline components in contaminated subsurface environments. Of particular concern are the BTEX[4] compounds – all six of which are powerful depressants to the central nervous system and potentially serious threats to public health. Some laboratory evidence has suggested that in some cases BTEX biodegradation may be inhibited in the presence of ethanol, since ethanol will preferentially degrade relative to BTEX compounds. Due to limited laboratory testing and a paucity of field evidence, overarching conclusions cannot yet be made.

A recent literature review on the topic conducted for the Governors' Ethanol Coalition found that transport models that incorporated both biological and abiotic factors showed that ethanol will not migrate substantial distances beyond the source of a spill of gasoline containing ethanol. Based on the length of ethanol plumes predicted in models and the assumption that benzene will not biodegrade in the presence of ethanol, the presence of ethanol in a gasoline spill is predicted to increase the migration of benzene by not greater than 25 percent. Yet, not considered in the model is the fact that ethanol-blended fuels contain less BTEX relative to baseline gasoline. Moreover, due to the relatively short time necessary for ethanol to fully leach from non-aqueous gasoline relative to hydrocarbons, and due to the relatively rapid rates of ethanol biodegradation, it is unlikely that ethanol will persist for a long time in gasoline-contaminated groundwater relative to BTEX.

A December 1999 report on the subject conducted for the State of California similarly concluded, "Although the dissolved equilibrium concentrations of gasoline components… increase in the presence of high concentrations of ethanol, the 10% ethanol expected to be added to gasoline in California should have only a minor effect on

[4] BTEX collectively refers to the aromatic hydrocarbons benzene, toluene, ethyl benzene, and xylene.

the dissolution of these gasoline components." The report went on to conclude that although the presence of ethanol in groundwater could contribute to increased benzene plume lengths, "for gasoline containing 10% ethanol, these processes will likely be insignificant."

Further field study is needed to better understand and document the fate of ethanol-blended gasoline in subsurface and surface water environments. Scientific studies currently underway at the Lawrence Livermore National Laboratory are evaluating BTEX biodegradation in the presence of ethanol. Studies are being conducted with aquifer solids from sites with different histories of fuel contamination to address two issues:

- Effects on Microbial Ecology - assessment of changes in the relative abundance of BTEX-degrading bacteria resulting from exposure to gasoline with and without ethanol under various electron-accepting conditions; and

- Degradation Kinetics - generation of computer simulations for BTEX compounds (primarily toluene) and ethanol under various conditions in aquifer materials with different histories of gasoline and oxygenate exposure.

These studies have the potential to answer any remaining questions by Northeast states about ethanol fate and transport in the environment.

Other topics that warrant further consideration are outlined in the aforementioned reports for the Governors' Ethanol Coalition and State of California.

The Fate and Transport of Ethanol-Blended Gasoline in the Environment
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Appendix B - State by State Matrix of Midwest Ethanol Industry

	How Many In-State Ethanol Facilities? Size? Type?	When Did Existing Facilities Begin Operations?	What Was the Key State Assistance Provided for Developers?
Idaho	2 Plants @ 3 mil.gal./yr each - Feedstock is potato processing waste - Facilities are enzyme-coding, with fermentation, distillation, and pressure swing absorption drying	Caldwell (JR Simplot) = 1986 Heyburn (JR Simplot) = 1985	State Fuels Tax: The excise tax on gasoline is reduced by the same percent as the amount of ethanol in the gasoline
Illinois	4 plants - All corn-fed - 3 wet mill, 1 dry mill - 1@ 275 mil.gal./yr. - 1@ 125 mil.gal./yr. - 1@ 100 mil.gal./yr. - 1@ 90 mil.gal./yr. - New plant to produce 35 mil. gal./yr. - 700+ mil gal/yr total capacity	ADM (Peoria)= 1980 (purchased from Hiram Walker) ADM (Decatur) = 1977 (converted from an exisiting corn processing plant) Williams= 1981 (converted from an exisitng corn processing plant) Midwest Grain Products= 1980 (purchased from an existing ethanol plant)	Alternative Energy Research, Development, and Demonstration Program - Financial and technical assistance for ethanol projects that provide an economic or environmental benefit to IL - State grants to plants and Illinois FIRST funds - IL gives grants for plants as technological assistance including site assessment and monitoring - Economic development funds for construction
Indiana	1 plant - Corn-fed - Dry mill - 85 mil. gal./yr.	New Energy= 1984	State Production Incentive (Not currently available) - lasted 1.5 yrs. Property tax abatement - local, lasted 5 yrs.
Iowa	7 plants - 6 corn-fed, 1 sugars/starch fed - 2 wet mill, 1 dry mill - 2 >200 mil.gal./yr - 4 ≤ 10 mil. gal./yr - 1 @ 35 mil.gal./yr - 435 gallons of total capacity	ADM (Cedar Rapids)= 1981 ADM (Clinton)= 1962 Cargill= 1992 Permeate Refining= 1993 Sunrise Energy= 1999 Grain Processing Corp.= approx. 1946 (took over a gov't ethanol plant after WWII) Manildra Ethanol= 1988 (tookover an ethanol plant started in 1982)	Rural Economic Value-Added Mentoring Program - Initial mentoring to companies to develop business plans - Additional funding (up to $24,000) available for mentor to complete business plan - Value-Added Agricultural Products and Processes Financial Assistance Program - Loans and forgivable loans up to $900,000
Kansas	4 plants - Feedstocks are corn, milo, wheat starch - All dry mill - 1 @ approx. 25 mil.gal./yr. - 1@ 18 mil.gal./yr - 1 @10 mil.gal./yr. - 1 @ 1.5 mil.gal./yr. - 50+ mil.gal./yr. total capacity	Reeve= 1981 ESE= 1980 Midwest= 1941 High Plains= 1984	Producer Incentive Payment - $2.5 mil. divided quarterly among the operational ethanol facilities based on production, direct cash payment
Minnesota	15 plants - 13 corn-fed, one cheese whey (Kraft-owned) - 1 wet mill - 1 @ 2.6 mil.gal./yr. - 1 @ 12 mil.gal./yr. - 8 @ approx.15 million gal/yr - 3 @ approx. 20 million gal/yr - 1 @ 32 million gal/yr - 225 mil.gal./yr. total capacity	Marshall (MCP)= 1988 Morris (DENCO)= 1991 Winnebago (Corn Plus)= 1994 Winthrop (Heartland)= 1995 Benson (CVEC)= 1996 Claremont (Al-Corn)= 1996 Bingham Lake (Ethanol2000)= 1997 Buffalo Lake (MN.Energy)= 1997 Melrose (Kraft)= 1986 Preston (Pro-Corn)= 1998 Luverne (Corn-er Stone)= 1998 Little Falls (CMEC)= 1999 Albert Lea (Exol-Agri Resources)= 1999 St. Paul (Gopher State Ethanol)= 1999	Loans to Producers for up to $500K per plant - 5 cent per gallon tax credit to distributors - 20 cents per gallon ethanol production credit (up to $3 million per plant; statewide limit of $30 million) - Statewide oxygenated fuel requirement (effective '97); prior to that for Twin Cities only (effective '95) - $550 million in total corn/etoh project spending for construction and start-up - $240 million worth of corn is committed for processing annually by farmers
Nebraska	7 plants - All corn and milo-fed - 2 wet mill, 5 dry mill - 1 @ 15 mil.gal./yr. - 1 @ 35 mil.gal./yr. - 1 @ 40 mil.gal./yr. - 1 @ 45 mil.gal./yr - 1 @ 60 mil.gal./yr. - 1 @ 75 mil.gal./yr. - 1 @ 80 mil.gal./yr. - 339 mil.gal./yr. total capacity	Chief Ethanol Fuels= 1986 Ag Processing= 1995 Minnesota Corn Processors= 1992 High Plains Corp.= 1994 Cargill= 1995 Nebraska Energy= 1995 Sutherland Assoc.= 1999	Current Incentives - 20 cent per gallon production tax credit through 2002 (used since 1993) - 50 cent per gallon production tax credit for ETBE (not used) (Revised Statutes of Nebraska Ch. 66, 1338-1345) - Local county government has authority over property taxes Inactive Incentives - 1980's incentives to encourage blending
South Dakota	3 plants - All corn-fed - All dry mill - 2 @ 12 mil.gal./yr. - 1 @ 8 mil.gal./yr. - 32 mil.gal./yr. total capacity - New Plant in development- 40 mil.gal./yr.	Broin Enterprises= 1988 Heartland Grain Fuels (Aberdeen)= 1992 Heartland Grain Fuels (Huron)= 1999	Producer Incentive - $.20 per gal. up to 5 mil. gal. Or $1 mil.

Appendix B - State by State Matrix of Midwest Ethanol Industry

	From Where Did Funding Typically Originate? Public vs. Private Sources?	Who Initiated Facility Development Efforts? Public or Private Groups?	What Was the Policy Rationale for State Involvement?
Idaho	Developer (JR Simplot) provided the funding.	Private	Very little state involvement (if any)
Illinois	Previous plants were all privately funded. - New plant under construction was given $3 mil. in legislative pass through grants. - No federal funds	Current plants were all initiated by private developers; the new plant was initiated by farmers.	Economic Development
Indiana	100% Private Funding - Through the issuance of limited partnership shares	Private	Economic Development
Iowa	Multiple Funding Sources - Private financing for projects - State funding for wastewater treatment	Primarily private business (Big corporations like ADM and Cargill)	Economic Development - Ethanol and its co-products account for about 400 bushels of corn annually (20% of the state's crop) - The industry provides 2500 jobs - Boosts state and local tax revenue by $111 million
Kansas	Mostly Private Funding - Basic economic development funding available from the Department of Commerce and Housing - No federal funding	Private Several public groups are currently analyzing opportunities for new co-operative ethanol plants	Economic Development - Utilization of agricultural products
Minnesota	Mostly Private Funding. - 12 of Minnesota's plants are co-operatives. Early plants were required by banks to raise 50% equity; subsequent plants were only required to raise 40% equity. - No federal funds were used, though recent plants have FHA loan guarantees.	Development efforts were initiated by local leadership, typically a community leader, a farmer that was also buying stock, in some cases a rural electric cooperative.	Primarily Economic Development - Creation of a stable market for corn -- MN exported 2/3 of corn and had lowest corn prices in nation - General economic development -- the program brings $350 to 500 million annual benefit - Environmental concerns, including global warming, CO reduction, toxics reduction
Nebraska	Prior to 1993 - NE only had one plant (Chief Ethanol Fuels, 1985) - CA S&L financed w/ Federal 10% investment tax credit and 10% energy investment tax credit Post 1993 - Several greenfield projects (independently financed, or raise capital, some local banks) - Some farmers cooperatives, one cooperative/ corporation partnership - Lenders can receive the 20 cent credit from the state directly (the law allows the producers to assign the proceeds to a third party, and many local lenders require this)	Private/ Public support - Combination of private corporations, investors and farmer cooperatives - Nebraska has an ethanol board to encourage the development of ethanol in the state	Economic Development. - Value-added market for corn - 3% of total tax revenue is from ethanol industry - 20% of corn and 70% of sorghum is used to make ethanol - 4000 jobs due to existing industry
South Dakota	Multiple sources - Public groups, primarily the South Dakota Corn Utilization Council (funded by corn producers) - One private company - Federal funding for biomass ethanol research	Primarily public - SD Corn Utilization Council - All of the plants except the one private plant are co-operatives	Support the agricultural industry

Appendix B - State by State Matrix of Midwest Ethanol Industry

	Which Came First, Production or Demand?	What was the Role of the State in the Siting Process; Were Feasibility Studies Done?	To What Degree Were Facilities Co-located Around Existing Infrastructure?
Idaho	Production (efforts initiated by JR Simplot)	State government did not have a role.	Both ethanol plants are located next to french fry processing plants and they use the waste potato from the plant as feedstock.
Illinois	Production - Demand has slowly and continually grown	Grants for site assessment in new plant - Feasibility studies privately done	Facilities were located near - Rail - Highways - Feedstock - River
Indiana	Production	Feasibility study done by partnership No state input in siting	Facilities were located near - Transportation (Rail and highway) - Utilities (reliable, inexpensive electricity) - Wastewater treatment capacity
Iowa	Demand - The projects would not have received bank financing if they couldn't demonstrate a market for their product - About 40% of gasoline sold in Iowa is an ethanol blend	Siting is done on an individual basis by each facility - Each group of investors works with an engineering firm to conduct an engineering study - In addition, most investors work with plant designers in selecting a location - City Council and Econ. Dev. Board assisted in location and siting	Facilities were located near feedstock sources
Kansas	Production (Kansas is primarily an exporter of ethanol)	Minimal role of the state in the siting process. 2 of the 4 plant sites have been in use for at least 30 years. Private feasibility studies.	Facilities utilized: - Complementary operations (feedstock, grain processing) - Copious water resources - By-product markets
Minnesota	Demand came first, the result of a 1979 etoh tax incentive that started at 4 cents per blended gallon.	Minimal. The state preferred to help set up meetings, etc. Siting was left to developers, though developers were encouraged to work with regulatory agencies.	Facilities were located near - Roads - Sewer lines - Rail lines
Nebraska	Demand came first, but demand side incentives did not work as well to attract developers as production incentives	Some feasibility support and minimal siting oversight	Facilities were located near internal and external infrastructure - Most internal infrastructure from the ground up, some have expanded operations over time - Developers try to locate near grain handling facilities, feed lots, rail, sewer, water, etc.
South Dakota	Demand	Very little state involvement - Feasibility studies taken by the SD Corn Utilization Council	Facilities were located near - Roads - Rail - Feedstock, - Reliable energy source - High quality water. Dairy farms moved to the plant's location for feed.

Appendix B - State by State Matrix of Midwest Ethanol Industry

	Were Local and Regional Stakeholders Particularly Active During the Development Process?	What Are the Key Markets Supplied by the Facilities?	What Were the Key Barriers Overcome During the Siting and Development Process?
Idaho	No. Plants developed privately by JR Simplot	Southern Idaho	None (Part of a large corporate program)
Illinois	Yes. Farmers and elevator owners brought new plants to the community.	Fuel grade ethanol to Chicago and Milwaukee	Determining the market and finding financing
Indiana	Yes. Local development groups were influential in the siting process.	Fuel grade ethanol to Chicago, Indianapolis, Cleveland, Toledo	Convincing stakeholders of: - Ability of infrastructure to support ethanol plants - Safety of the process
Iowa	Somewhat. City Council brought in an economic development group to bring valued added industry to the area.	Fuel, beverage, and industrial grade - Out of 425 mil. gal. produced annually, 66 mil. stay in Iowa. The rest is shipped nationally and internatoinally.	Wastewater concerns with the City.
Kansas	All the plants were developed privately. Currently, there are several groups looking at the potential for co-operative plants.	Beverage Industry - National and international Fuel Grade - Colorado, Wichita	Uncertainty over the federal tax incentive The competing price of crude oil
Minnesota	Yes. In almost all cases there was a local champion that led efforts to put together a steering committee, sell stock, and move the project forward.	Minnesota oxygenated gasoline market is *the* market.	Barriers in several categories - Financing -- selling stock; getting co-op Board members to take their role seriously - Regulatory agencies had to learn about ethanol plants from square one - Local siting issues, such as smells. Response varied by town.
Nebraska	Yes. Nebraska is an agriculture state. - There was widespread support for ethanol development - There was competition among towns to attract ethanol developments	Nebraska is a net exporter of ethanol. - NE is one of the more western ethanol producing states, so production tends to work its way west - 80% goes to OR, WA, AZ, NM, and CO, some goes to MN.	It's a Developers market and finding the best site is the issue - Developers can go to the Nebraska Dept. of Econ. Development, ask for proposals from towns, etc. - Desire good water supply, labor, rail access, close to grain and grain handling facilities, and a market nearby market for distillers grains (as applicable) - The local governments ability to provide local property tax breaks and build infrastructure (roads, rails, sewers, etc.) is also important
South Dakota	Yes. The corn producers' boards from the community were highly influential and leaders within the community.	Most of the ethanol (mostly fuel grade) is exported out of the state to the Pacific Northwest and California.	Two key barriers - Raising equity - Finding high quality water with low mineral content to lessen impact of wastewater treatment

Appendix B - State by State Matrix of Midwest Ethanol Industry

	What, if any, Types of Environmental Issues Were Encountered?	Were There Noteworthy PR Challenges Related to Facility Development and/or Ethanol Use?	What By-products Are Utilized?
Idaho	There wasn't enough wastewater treatment for both the French Fry plant and the ethanol plant, so Simplot built an evaporator to take care of water waste.	None	Stillage cake for feedlots and evaporator syrup.
Illinois	Typical manufacturing plant issues (e.g. air and water permitting)	None. Outside of Chicago the state is primarily agricultural and encouraged development of ethanol plants.	Traditionally dry distillers grains, but now the state is looking into other by-products like corn oil. These ideas are only in the research phase.
Indiana	Air and Water permitting	Traffic issues in the community of South Bend	Dried distillers grains for cattle feed and liquid compressed CO2.
Iowa	Wastewater Treatment - Plants don't feel they have time to meet permit requirements and that Iowa standards are higher than avg.	None.	Dried distillers grains for cattle feed and other wet milling by-products.
Kansas	Air and Water permitting, EPA standards	None, except for the challenges related to people opposed to the consumption of alcohol that comes from the beverage ethanol.	By-products include dried distillers grains, CO2 recovery, and glycerin.
Minnesota	Depended on the type of plant - Some were designed so they produced no effluent, so sewage and water weren't a concern. In other cases they were. - Air permitting was typically not excessively difficult. Plus, plants under 20 million gallons do not require an environmental impact statement.	Getting rid of mandatory pump labeling in 1989 was of critical importance. - Huge political battle waged by refineries against the mandatory oxygenate requirement.	Other products include corn syrup, industrial starch, CO2, livestock feed.
Nebraska	No major problems - NE has a lot of Ag processing - Ethanol is not really a big deal - Overall the state does not have many environmental problems	None - In Nebraska agriculture is king	Dry mill plants only produce ethanol and distiller's grain. Wet mill plants separate corn into 6 or 7 components and can produce 15 to 20 different products,such as corn oil, sweetener, gluten, etc., depending on market conditions.
South Dakota	Several environmental issues - Emissions scrubbers - Wetlands - Wastewater	Odor - Communities must deal with odors from the plant and therefore, location of the plant within the community is important. - PR challenges associated with co-located dairy farms.	Cattle and dairy feed

Appendix B - State by State Matrix of Midwest Ethanol Industry

	What Lessons Have Been Learned? What Should Have Been Done Differently?	Are There Facilities in Your State that use Cellulosic Feedstock?
Idaho	None	No. Potato waste only.
Illinois	Everything was done through large companies, so many problems were internalized.	No
Indiana	Need to consider the logistics of the plant - Transportation - Energy sources - Water treatment	No
Iowa	Developers need to work with city and state on flexibility with wastewater treatment permits so that plants can work within the requirements.	No, only grains and starches.
Kansas	None.	No, only grains and starches.
Minnesota	Need Ensure strong lines of communications between regulators and developers - Without strong local leadership, don't even try to site a plant - Provide developers with a directory of goods and service providers - The Boards need to maintain control over the life of the project, and to make sure that money comes back to farmers.	Not yet, although MN would love to have the first operational cellulosic facility.
Nebraska	Ethanol is driven by incentives - In 1990's the industry took off due to 1990 CAA - NE had right incentives, etc. so industry came to them - 2000 CAA could further increase ethanol demand and developers will go to the states with the best incentives Access to Rails - Rail costs are an important operational cost (Export product, import chemicals, etc.) - Some earlier plants only have access to one railroad company, now plants try to find access to two, so that they are not subject to monopoly rates	Not yet - Understand that corn ethanol might face stiff competition from biomass ethanol - Long-term transition to make higher values products from corn and milo and make ethanol from significant amounts of ag wastes
South Dakota	Need to consider the energy source of the plant. - Researching now whether is it more efficient to build plant near the inputs and export ethanol or to build plant near the demand and import feedstock.	No. But there is ongoing research on a plant to convert logging wastes from western SD into ethanol.

Appendix C -- Key Ethanol Industry Contacts for Northeast States

Contact Person	Title	Organization	Email Address	Phone Number
John Ferrell	Director	Office of Fuels Development, Department of Energy	john.ferrell@hq.doe.gov	(202) 586-6745
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Appendix D: Key Midwest Ethanol Legislation

Table of Contents

IDAHO **2**
SUMMARY: 2
DETAIL: 2
ILLINOIS **3**
SUMMARY: 3
DETAIL: 3
INDIANA **5**
SUMMARY: 5
IOWA **5**
SUMMARY: 5
KANSAS **5**
SUMMARY: 5
MINNESOTA **6**
SUMMARY: 6
DETAIL: 6
Definition: *6*
Tax Credits/State Payments: *6*
Oxygenated Fuel Requirements: *7*
NEBRASKA **10**
SUMMARY: 10
DETAIL: 10
SOUTH DAKOTA **16**
SUMMARY: 16

Idaho

Summary:

There is currently one important piece of legislation, the State Fuels Tax. The legislation states that the excise tax on gasoline is reduced by the same percent as the amount of ethanol in the gasoline.

Detail:

TITLE 63 REVENUE AND TAXATION CHAPTER 24 FUELS TAX 63-2405.

IMPOSITION OF TAX. (1) An excise tax is hereby imposed on all gasoline received. The tax is to be paid by the licensed distributor, and measured by the total number of gallons of gasoline received by him, at the rate of twenty-five cents (25) per gallon. That tax, together with any penalty and/or interest due, shall be remitted with the monthly distributor's report required in section 63-2406, Idaho Code. (2) The excise tax rate set forth in this section shall, when applied to gasohol or to special fuels designed for use in diesel engines, be reduced by the same percentage that the quantity of denatured anhydrous ethanol contained in the gasoline or, in the case of special fuels the quantity of such special fuel which is derived from agricultural products or the wastes of such products, bears to the total fuel subject to tax. Provided however, in no event shall the rate set forth in this section be reduced more than ten percent (10%).

Illinois

Summary:

Illinois, through its Department of Commerce and Community Affairs' (DCCA) Bureau of Energy and Recycling, has put together a program called "The Alternative Energy Research, Development and Demonstration Program." The purpose of the program is to; "promote and expand the use of ethanol and alternative fuels." The DCCA provides grant funding as well as technical assistance to qualified projects.

Detail:

The DCCA provides financial and technical assistance for projects that:

- Accelerate the commercialization of new alternative energy technologies and products to improve rural economics;
- Develop and expand business and industry opportunities in Illinois;
- Reduce the outflow of energy dollars from the region; and/or
- Improve the environment through economically sound measures.

Use of Funds

Eligible expenditures for grant funding are determined upon the type of project, but may include:

- Costs incurred in conducting research, testing and/or demonstrating new alternative energy technologies;
- Preparing reports;
- Purchase of equipment;
- Development of educational and informational materials; and/or
- Dissemination of information relative to the development, demonstration and promotion of alternative energy technologies.

Scope

The Alternative Energy Research, Development and Demonstration Program provides grants through three project categories:

- *Demonstration Projects* -- These projects involve the development and expansion of new alternative energy business and industry opportunities in Illinois, by increasing the utilization of alternative energy technologies and reducing related production costs. DCCA provides grant funding up to $250,000 and requires a grantee investment of at least 50 percent of the total project cost. No applicant investment is required for governmental or not-for-profit entities.
- *Research/Development Projects* -- These projects involve feasibility studies, planning efforts and pilot research and development projects concerning the utilization of alternative energy technologies and reducing related production costs. DCCA provides grant funding up to $200,000. No applicant investment is required.

- *Education/Promotion Projects* -- These projects involve the dissemination of information regarding alternative energy technologies and products at conferences, workshops, fairs and expositions and education efforts involving the development and distribution of information to organizations. DCCA provides grant funding up to $60,000. No applicant investment is required.

Grant funds are allocated for a 12-month performance period, however, a longer performance period may be required depending upon the nature of the proposed project.

Eligibility

Eligible entities include governmental organizations, for-profit and not-for-profit businesses and organizations, educational institutions and individuals. All projects must clearly demonstrate the potential to provide an economic or environmental benefit to Illinois residents and/or the Illinois business community.

Indiana

Summary:

Currently there are no programs/legislation in place regarding ethanol use or production. Recently, there was a state production incentive in place, but it has since been repealed.

Iowa

Summary:

Currently, there is no pertinent state ethanol legislation.

Kansas

Summary:

Currently, there is no pertinent state ethanol legislation.

Minnesota

Summary:

Currently, there are two pieces of state legislation that directly impact ethanol. The first is a series of tax credits and state payments made to producers and distributors of ethanol. The second is a state wide oxygenated fuel requirement, which requires the use of ethanol in gasoline..

Detail:

Definition:

"Ethanol" means agriculturally derived fermentation ethyl alcohol derived from agricultural products, including potatoes, cereal, grains, cheese whey, and sugar beets, forest products, or other renewable resources, including residue and waste generated from the production, processing, and marketing of agricultural products, forest products, and other renewable resources.
Notwithstanding Minnesota Statutes, section 41A.09, subdivision 3, and Laws 1993, chapter 172, section 7, subdivision 3, the total payments from the ethanol development account to all producers may not exceed $14,800,000 for the biennium ending June 30, 1995. $75,000 is appropriated for fiscal year 1995 for use in the enforcement and management of the recombinant bovine growth hormone labeling program under Minnesota Statutes, section 32.75.

Tax Credits/State Payments:

The amount of the payment for each producer's annual production shall be as follows: (1) for each gallon of ethanol produced on or before June 30,1995, 20 cents per gallon.; (2) for each gallon of ethanol produced on or before June 30, 2010, 25 cents per gallon;

The commissioner shall make payments to producers of ethanol in the amount of 1.5 cents for each kilowatt hour of electricity generated using closed-loop biomass in a cogeneration facility at an ethanol plant located in the state. Payments under this paragraph shall be made only for electricity generated at cogeneration facilities that begin operation by June 30, 2000. The payments apply to electricity generated on or before the date ten years after the producer first qualifies for payment under this paragraph. Total payments under this paragraph in any fiscal year may not exceed $750,000. For the purposes of this paragraph: (1) "closed-loop biomass" means any organic material from a plant that is planted exclusively for purposes of being used to generate electricity; and (2) "cogeneration" means the combined generation of: (i) electrical or mechanical power; and (ii) steam or forms of useful energy, such as heat, that are used for industrial, commercial, heating, or cooling purposes.

The total payments from the account to **all** producers may not exceed $20,000,000 in any fiscal year during the period beginning July 1,1994, and ending June 30, 2010.

The total payments to **any** producer may not exceed $3,750,000 in fiscal year 1996 or subsequent fiscal years.

Oxygenated Fuel Requirements:

Subd. 10a. Oxygenate. "Oxygenate" means agriculturally derived, denatured ethanol, ETBE, MTBE, or other alcohol or ether, approved as an oxygenate by the United States Environmental Protection Agency.

Subd. 10b. Oxygenate blender. "Oxygenate blender" means a person who has registered with the division to blend and distribute, transport, sell, or offer to sell gasoline containing a minimum of 2.0 percent, and an average of 2.7 percent oxygen by weight.

Subd. 10c. Oxygenated gasoline. "Oxygenated gasoline"means gasoline that has been blended with agriculturally derived denatured ethanol or with another oxygenate approved by the United States Environmental Protection Agency.

(i) agriculturally derived, denatured ethanol that complies with the specifications in this chapter;

Subd. 5. Product identification; alcohol, alcohol-based motor fuel. An identification tag placed on a storage tank containing unblended alcohol or a predominantly alcohol-based motor fuel must be marked with the word "ALCOHOL" and with the appropriate product name of the fuel stored in the tank. The product name must be selected from the following:

(1) "ETHANOL" for denatured ethanol, as defined in section 296A.01;

(2) "METHANOL" for methanol;

(3) "E-85" for an ethanol-gasoline blend, as defined in section 296A.01; or

(4) "M-85" for a methanol-gasoline blend, as defined in section 296A.01.

Subd. 3. Gasoline. Gasoline that is not blended with ethanol must not be contaminated with water or other impurities and must comply with ASTM specification D 4814-96. Gasoline that is not blended with ethanol must also comply with the volatility requirements in Code of Federal Regulations, title 40, part 80. After gasoline is sold, transferred, or otherwise removed from a refinery or terminal, a person responsible for the product:

(2) shall not blend the gasoline with any oxygenate other than denatured, agriculturally derived ethanol;

(3) shall not blend the gasoline with other petroleum products that are not gasoline or denatured, agriculturally derived ethanol;

Subd. 5. Denatured ethanol. Denatured ethanol that is to be blended with gasoline must be agriculturally derived and must comply with ASTM specification D 4806-95b. This includes the requirement that ethanol may be denatured only as specified in Code of Federal Regulations, title 27, parts 20 and 21.

Subd. 6. Gasoline blended with oxygenate. Gasoline that is blended with an oxygenate, other than denatured ethanol, must comply with ASTM specification D 4814-96. Oxygenates, other than denatured ethanol, must not be blended into gasoline after the gasoline has been sold, transferred, or otherwise removed from a refinery or terminal.

Subd. 13. E85. A blend of ethanol and gasoline, containing at least 60 percent ethanol and not more than 85
percent ethanol, produced for use as a motor fuel in alternative fuel vehicles as defined in section 296A.01, subdivision 5, must comply with ASTM specification D 5798-96.

239.791 Oxygenated gasoline.

Subdivision 1. Minimum oxygen content required. Except as provided in subdivisions 10 to 14, a person responsible for the product shall comply with the following requirements:

(a) After October 1, 1995, gasoline sold or offered for sale at any time in a carbon monoxide control area must contain at least 2.7 percent oxygen by weight.

(b) After October 1, 1997, all gasoline sold or offered for sale in Minnesota must contain at least 2.7 percent oxygen by weight.

Subd. 2. Repealed, 1993 c 250 s 3

Subd. 3. Blending restriction. When gasoline contains an oxygenate, a person responsible for the product shall not blend the product with ethanol or with any other oxygenate after it is transferred or otherwise removed from a refinery or terminal.

Subd. 4. Repealed, 1995 c 220 s 141

Subd. 5. Repealed, 1995 c 220 s 141

Subd. 6. Repealed, 1995 c 220 s 141

Subd. 7. Oxygenate records; state audit. The director shall audit the records of registered oxygenate blenders to ensure that each blender has met all requirements in this chapter. Specific information or data relating to sales figures or to processes or methods of production unique to the blender or that would tend to adversely affect the competitive position of the blender must be only for the confidential use of the director, unless otherwise specifically authorized by the registered blender.

Subd. 8. Disclosure. A refinery or terminal, shall provide, at the time gasoline is sold or transferred from the refinery or terminal, a bill of lading or shipping manifest to the person who receives the gasoline. For oxygenated gasoline, the bill of lading or shipping manifest must include the identity and the volume percentage or gallons of oxygenate included in the gasoline, and it must state: "This fuel contains an oxygenate. Do not blend this fuel with ethanol or with any other oxygenate." For nonoxygenated gasoline sold or transferred before October 1, 1997, the bill or manifest must state: "This fuel must not be sold at retail in a carbon monoxide control area." For nonoxygenated gasoline sold or transferred after September 30, 1997, the bill or manifest must state: "This fuel is not oxygenated. It must not be sold at retail in Minnesota."

This subdivision does not apply to sales or transfers of gasoline between refineries, between terminals, or between a refinery and a terminal.

Nebraska

Summary:

There are a number of tax credits currently in place that benefit ethanol producers. The credits include 20 cents per gallon for ethanol production, with limitations and 50 cents per gallon for ETBE. The state also set up the "Ethanol Production Incentive Cash Fund" to support producers. Excise taxes were put in place to support the fund. See details below.

Detail:

66-1334: Agricultural Alcohol Fuel Tax Fund; created; use; investment.

(1) The Agricultural Alcohol Fuel Tax Fund is hereby created. No part of the funds collected under section 66-4,134 or of federal funds or other funds solicited in conjunction with research or demonstration programs shall lapse to the General Fund. In addition to such unexpended balance appropriation, there is hereby appropriated such amounts as are deposited in the Agricultural Alcohol Fuel Tax Fund pursuant to such section in each year. The fund shall be administered by the board. Any money in the fund available for investment shall be invested by the state investment officer pursuant to the Nebraska Capital Expansion Act and the Nebraska State Funds Investment Act.

(2) The fund shall be used for the following purposes: (a) Establishment, with cooperation of private industry, of procedures and processes necessary to the manufacture and marketing of fuel containing agricultural ethyl alcohol; (b) Establishment of procedures for entering blended fuel into the marketplace by private enterprise; (c) Analysis of the marketing process and testing of marketing procedures to assure acceptance in the private marketplace of blended fuel and byproducts resulting from the manufacturing process; (d) Cooperation with private industry to establish privately owned agricultural ethyl alcohol manufacturing plants in Nebraska to supply demand for blended fuel; (e) Sponsoring research and development of industrial and commercial uses for agricultural ethyl alcohol and for byproducts resulting from the manufacturing process; (f) Promotion of state and national air quality improvement programs and influencing federal legislation that requires or encourages the use of fuels oxygenated by the inclusion of agricultural ethyl alcohol or its derivatives; (g) Promotion of the use of renewable agricultural ethyl alcohol as a partial replacement for imported oil and for the energy and economic security of the nation; (h) Participation in development and passage of national legislation dealing with research, development, and promotion of United States production of fuels oxygenated by the inclusion of agricultural ethyl alcohol or its derivatives, access to potential markets, tax incentives, imports of foreign-produced fuel, and related concerns that may develop in the future; and (i) As the board may otherwise direct to fulfill the goals set forth under the Ethanol Development Act, including monitoring contracts for existing ethanol program commitments consummated pursuant to the law in existence prior to September 1, 1993, and solicitation of federal funds.

66-1344: Ethanol tax credits; conditions; limitations; Department of Revenue; powers and duties.

(1) Each producer of ethanol shall receive a credit pursuant to this section of twenty cents per gallon of ethanol produced in Nebraska, which credit shall be in the form of a

nonrefundable transferable motor vehicle fuel tax credit certificate. After July 1, 1994, no such credit shall be given for ethanol produced at an ethanol facility which was in production on or before January 1, 1992, unless on or before July 1, 1994, the name plate design capacity for the production of ethanol, before denaturing, at the facility has been expanded to equal at least two times the name plate design capacity for production of ethanol, before denaturing, existing at the facility as of January 1, 1992.

(2) Any ethanol facility which is in production at the rate of at least twenty-five percent of its name plate design capacity for the production of ethanol, before denaturing, on or before December 31, 1992, shall receive a credit of twenty cents per gallon of ethanol produced beginning with the first month for which it is eligible to receive such credit and ending not later than December 31, 1997.

(3) Any ethanol facility which is not in production on or before December 31, 1992, but which is in production at the rate of at least twenty-five percent of its name plate design capacity for the production of ethanol, before denaturing, on or before December 31, 1995, shall receive a credit of twenty cents per gallon of ethanol produced for sixty months beginning with the first month for which it is eligible to receive such credit and ending not later than December 31, 2000, if the ethanol facility maintains an average production rate of at least twenty-five percent of its name plate design capacity for at least six months after the first month for which it is eligible to receive such credit.

(4) Any ethanol facility eligible for a credit under subsection

(1),

(2), or

(3) of this section shall also receive a credit of twenty cents per gallon of ethanol produced in excess of the original name plate design capacity which results from expansion of the facility completed on or before December 31, 1995. Such credit shall be for sixty months beginning with the first month for which production from the expanded facility is eligible to receive such credit and ending not later than December 31, 2000.

(5) The credit shall be given only for ethanol produced at a plant in Nebraska at which all fermentation, distillation, and dehydration takes place. No credit shall be given on ethanol produced for or sold for use in the production of distilled spirits. Not less than two million gallons and not more than twenty-five million gallons of ethanol produced annually at an ethanol facility shall be eligible for the credit, and the credit may only be claimed by a producer for the period specified in subsection

(2),

(3), or

(4) of this section. Not more than one hundred twenty-five million gallons of ethanol produced at an ethanol facility by the end of the sixty-month period set forth in subsection

(3) or

(4) of this section shall be eligible for the credit under such subsection, in addition to the ethanol entitled to credit under subsection

(1) or

(2) of this section.

(6) The Department of Revenue shall prescribe an application form and procedures for claiming the credit and shall adopt and promulgate rules and regulations to carry out this section.

(7) For purposes of ascertaining the correctness of any application for claiming the credit provided in this section, the Tax Commissioner (a) may examine or cause to have examined, by any agent or representative designated by him or her for that purpose, any books, papers, records, or memoranda bearing upon such matters, (b) may by summons require the attendance of the person responsible for rendering the application or other document or any officer or employee of such person or the attendance of any other person having knowledge in the premises, and (c) may take testimony and require proof material for his or her information, with power to administer oaths or affirmations to such person or persons. The time and place of examination pursuant to this subsection shall be such time and place as may be fixed by the Tax Commissioner and as are reasonable under the circumstances. In the case of a summons, the date fixed for appearance before the Tax Commissioner shall not be less than twenty days from the time of service of the summons. No taxpayer shall be subjected to unreasonable or unnecessary examinations or investigations. All records obtained pursuant to this subsection shall be subject to the confidentiality requirements and exceptions thereto as provided in section 77-27,119.

66-1345: Ethanol Production Incentive Cash Fund; created; use; investment; transfers; Department of Revenue; duties.

(1) There is hereby created the Ethanol Production Incentive Cash Fund which shall be used by the board to pay the credits created in section 66-1344 to the extent provided in this section. Any money in the fund available for investment shall be invested by the state investment officer pursuant to the Nebraska Capital Expansion Act and the Nebraska State Funds Investment Act. The State Treasurer shall transfer to the Ethanol Production Incentive Cash Fund such money as shall be (a) appropriated to the Ethanol Production Incentive Cash Fund by the Legislature, (b) given as gifts, bequests, grants, or other contributions to the Ethanol Production Incentive Cash Fund from public or private sources, (c) made available due to failure to fulfill conditional requirements pursuant to investment agreements entered into prior to April 30, 1992, (d) received as return on investment of the Ethanol Authority and Development Cash Fund, (e) credited to the Ethanol Production Incentive Cash Fund from the fertilizer fee pursuant to section 77-4401, (f) credited to the Ethanol Production Incentive Cash Fund from the excise taxes imposed by section 66-1345.01, and (g) credited to the Ethanol Production Incentive Cash Fund pursuant to section 66-1345.04.

(2) The Department of Revenue shall, at the end of each calendar quarter, notify the State Treasurer of the amount of motor fuel tax that was not collected in the preceding calendar quarter due to the credits provided in section 66-1344. The State Treasurer shall transfer from the Ethanol Production Incentive Cash Fund to the Highway Trust Fund an amount

equal to such credits less the following amounts: (a) For 1993, 1994, and 1995, the amount generated during the calendar quarter by a one-cent tax on motor fuel pursuant to sections 66-489, 66-668, and 66-6,107; (b) For 1996, the amount generated during the calendar quarter by a three-quarters-cent tax on motor fuel pursuant to such sections; (c) For 1997, the amount generated during the calendar quarter by a one-half-cent tax on motor fuel pursuant to such sections; and (d) For 1998, 1999, and 2000, no reduction. The amounts shall be transferred through December 31, 2000. For 1993 through 1997, if the amount generated pursuant to subdivisions (a), (b), and (c) of this subsection and the amount transferred pursuant to subsection

(1) of this section are not sufficient to fund the credits provided in section 66-1344, then the credits shall be funded through the Ethanol Production Incentive Cash Fund but shall not be funded through either the Highway Cash Fund or the Highway Trust Fund. For 1998, 1999, and 2000, the credits provided in such section shall be funded through the Ethanol Production Incentive Cash Fund but shall not be funded through either the Highway Cash Fund or the Highway Trust Fund.

(3) The State Treasurer shall transfer from the Ethanol Production Incentive Cash Fund to the Management Services Expense Revolving Fund the amount reported under subsection

(4) of section 66-1345.02 for each calendar quarter of the fiscal year as provided in such subsection.

(4) On February 15, 2001, the State Treasurer shall transfer any unexpended and unobligated funds from the Ethanol Production Incentive Cash Fund to the Nebraska Corn Development, Utilization, and Marketing Fund and Grain Sorghum Development, Utilization, and Marketing Fund in the same proportion as funds were collected pursuant to section 66-1345.01 from corn and grain sorghum.

66-1345.01: Corn and grain sorghum; excise tax; procedure.

An excise tax is levied upon all corn and grain sorghum sold through commercial channels in Nebraska or delivered in Nebraska. The tax is three-fourths cent per bushel for corn and three-fourths cent per hundredweight for grain sorghum. The tax shall be in addition to any fee imposed pursuant to sections 2-3623 and 2-4012. The excise tax shall be imposed on any sale or delivery occurring on or after July 1, 1995, and before January 1, 2001. The Legislature finds and declares that those in production agriculture have contributed sufficiently to support the Ethanol Production Incentive Cash Fund by the imposition of the excise tax. If additional funds are needed in the future to meet the Legislature's obligation to fully fund the Ethanol Production Incentive Cash Fund, those funds should come from sources other than production agriculture. The excise tax shall be imposed at the time of sale or delivery and shall be collected by the first purchaser. The tax shall be collected, administered, and enforced in conjunction with the fees imposed pursuant to sections 2-3623 and 2-4012. The tax shall be collected, administered, and enforced by the Department of Agriculture. No corn or grain sorghum shall be subject to the tax imposed by this section more than once. In the case of a pledge or mortgage of corn or grain sorghum as security for a loan under the federal price support program, the excise tax shall be deducted from the proceeds of such loan at the time the loan is made. If, within the life of the loan plus thirty days after the collection of the excise tax for corn or grain sorghum that is mortgaged as security for a loan under the

federal price support program, the grower of the corn or grain sorghum so mortgaged decides to purchase the corn or grain sorghum and use it as feed, the grower shall be entitled to a refund of the excise tax previously paid. The refund shall be payable by the department upon the grower's written application for a refund. The application shall have attached proof of the tax deducted. The excise tax shall be deducted whether the corn or grain sorghum is stored in this or any other state. The excise tax shall not apply to the sale of corn or grain sorghum to the federal government for ultimate use or consumption by the people of the United States when the State of Nebraska is prohibited from imposing such tax by the Constitution of the United States and laws enacted pursuant thereto.

66-1345.02: Excise tax; records required; remittance of tax; Department of Revenue; duties.

(1) The first purchaser, at the time of sale or delivery, shall retain the excise tax as provided in section 66-1345.01 and shall maintain the necessary records of the excise tax for each sale or delivery of corn or grain sorghum. Records maintained by the first purchaser shall provide (a) the name and address of the seller or deliverer, (b) the date of the sale or delivery, (c) the number of bushels of corn or hundredweight of grain sorghum sold or delivered, and (d) the amount of excise tax retained on each sale or delivery. The records shall be open for inspection and audit by authorized representatives of the Department of Agriculture during normal business hours observed by the first purchaser.

(2) The first purchaser shall render and have on file with the department by the last day of each January, April, July, and October on forms prescribed by the department a statement of the number of bushels of corn and hundredweight of grain sorghum sold or delivered in Nebraska. At the time the statement is filed, the first purchaser shall pay and remit to the department the excise tax.

(3) The department shall remit the excise tax collected to the State Treasurer for credit to the Ethanol Production Incentive Cash Fund within thirty days after the end of each quarter.

(4) For each fiscal year beginning with fiscal year 1995-96 through fiscal year 2000-01, the department shall calculate its costs in collecting and enforcing the excise tax imposed by section 66-1345.01 and shall report such costs to the Department of Administrative Services within thirty days after the end of the fiscal year. Sufficient funds to cover such costs shall be transferred from the Ethanol Production Incentive Cash Fund to the Management Services Expense Revolving Fund at the end of each calendar quarter. Funds shall be transferred upon the receipt of a report of costs incurred by the Department of Agriculture for the previous calendar quarter by the Department of Administrative Services.

66-1346: Producer of ethyl tertiary butyl ether; tax credit; limitations; procedure; Department of Revenue; duties.

Through December 31, 2000, each producer of Nebraska-produced ethyl tertiary butyl ether shall receive a nonrefundable credit of fifty cents per gallon of each gallon of Nebraska-produced ethyl tertiary butyl ether sold for delivery outside the State of Nebraska, which credit shall be in the form of a transferable income tax credit certificate

which may be applied only to the income tax liability of the producer, its parent, or a subsidiary thereof. A credit certificate may not be applied to income tax liability incurred prior to the year the credit certificate was earned. Not more than two and one-half million gallons of ethyl tertiary butyl ether produced annually at a plant shall be eligible for such credit. The credit shall be given only for ethyl tertiary butyl ether produced at a plant in Nebraska at which all fermentation, distillation, and dehydration takes place. The credit shall be reduced by the amount of any producer's credit earned pursuant to section 66-1344 by the producer of the ethyl tertiary butyl ether on ethanol used to produce ethyl tertiary butyl ether and shall be claimed no later than the due date, including extensions, of the tax return filed for the taxable year of the claimant ending not more than thirty-six months after the taxable year of the claimant in which the certificate is issued. The Department of Revenue shall prescribe an application form and procedures for claiming the credit and shall adopt and promulgate rules and regulations to carry out this section.

66-1347: Written agreement required; contents; board and department; duties.

(1) The Tax Commissioner, the administrator of the board, and the producer eligible to receive credit under section 66-1344 shall enter into a written agreement. The producer shall agree to produce ethanol at the designated facility and any expansion thereof. The Tax Commissioner and administrator, on behalf of the State of Nebraska, shall agree to furnish the producer the tax credits as provided by and limited in such section in effect on the date of the agreement. The agreement to produce ethanol in return for the credit shall be sufficient consideration, and the agreement shall be binding upon the state. No credit shall be given to any producer of ethanol which fails to produce ethanol in Nebraska in compliance with the agreement. The agreement shall include: (a) The name of the producer; (b) The address of the ethanol facility; (c) The date of the initial eligibility of the ethanol facility to receive such credits; (d) The name plate design capacity of the ethanol facility as of the date of its initial eligibility to receive such credits; and (e) The name plate design capacity which the facility is intended to have after the completion of any proposed expansion. If no expansion is contemplated at the time of the initial agreement, the agreement may be amended to include any proposed expansion.

(2) The board and the Department of Revenue shall prepare quarterly projections on the use of the Ethanol Production Incentive Cash Fund. The projections shall include the number of gallons for which each eligible producer has claimed credit, the amount of credit furnished to each eligible producer by the Tax Commissioner, and the amount of future credits each eligible producer may receive under section 66-1344. In addition to the report required by section 66-1336, the board shall submit a report to the Legislature by December 1 of each year summarizing the use of the fund and detailing the forecasted use of the fund. The report shall also include all the information provided in agreements entered into pursuant to this section and the projections which are to be prepared. The department shall furnish all the pertinent facts and data to the board for purposes of fulfilling its obligations pursuant to this section.

South Dakota

Summary:

Currently, there is no pertinent state ethanol legislation.