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Subcontractor Report

State-Level Workshops on Ethanol for Transportation

Final Report

Angela Graf
BBI International
Cotopaxi, Colorado

National Renewable Energy Laboratory

1617 Cole Boulevard
Golden, Colorado 80401-3393

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NREL Technical Monitor: H. Brown

Prepared under Subcontract No. ACO-2-32052-01

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Submitted by:
BBI International
Angela Graf, Project Manager
September 25, 2003

INTRODUCTION

In 2002/2003, under contract to the National Renewable Energy Laboratory, BBI International conducted state-level workshops ethanol in Hawaii, Nevada, Kentucky and California. These four workshops followed over 30 other workshops previous held under the Ethanol Workshop Series program sponsored by the U.S. Department of Energy. Two other workshops were conducted by BBI International during 2003, Oklahoma and Kansas, under contract to the Western Regional Biomass Energy Program.

The Ethanol Workshop Series (EWS) was intended to provide a forum for interest groups to gather and discuss what needs to be accomplished to facilitate ethanol production in-state using local biomass resources. In addition, the EWS was to provide a promotional and educational forum for policy makers, community leaders, media and potential stakeholders. It was recognized that to eventually achieve biomass-ethanol production, it was necessary to support grain-ethanol production as a bridge.

The long-term goal of the Workshops was to facilitate the development of biomass ethanol plants at a state-level. The near-term goal was to provide correct and positive information for education, promotion, production and use of fuel ethanol. The EWS drew from 65 to over 200 attendees and were deemed by the local organizers to have served the objectives set out by the U.S. Department of Energy.

BACKGROUND

The U.S. Department of Energy, Regional Biomass Energy Program, sponsored the first year of what became a five-year program to promote ethanol production from biomass feedstocks. The Ethanol Workshop Series (EWS) was a groundbreaking grassroots program that provided states with a forum to review and identify issues, resources and opportunities to develop a biomass-ethanol industry in their state.

As a subcontractor to the U.S. Department of Energy (U.S. DOE), BBI International coordinated and managed the EWS since its inception in 1999. Over 35 ethanol workshops in 27 states were held under this U.S. DOE sponsored program (including follow-up workshops in 8 states).

The EWS began in 1999 with workshops in Alabama, Alaska, Maine, Michigan, Mississippi, South Dakota and Wisconsin. Recognizing the success and effectiveness of this program, another nine states were added in 2000 including, Colorado, Indiana, New York, Ohio, Oregon/Washington (joint workshop), Pennsylvania, South Carolina, and Texas. This was followed by another three years of workshops, plus follow-on workshops held by EWS states who wanted to build on their initial workshop.

Participating States in the Ethanol Workshop Series:

1999	2000	2001	2002/2003
*Alabama+	*Colorado+	*Idaho	*California
Alaska+	*Indiana	*Iowa	Hawaii
*Maine	*New York	*Maryland	*Kansas
*Michigan+	*Ohio	*North Carolina^	*Kentucky
Mississippi	*Oregon+	Puerto Rico	*Nevada
*South Dakota	*Pennsylvania^	*Utah	Oklahoma
*Wisconsin+	South Carolina		
	*Texas+		
	*Washington+		

* denotes states that have new or expanding ethanol production or have projects seriously under consideration
+ denotes states that have had more than one EWS Workshop
^ denotes states that have had a related DOE agricultural ethanol workshop

Summary highlights from each state are included in Appendix D, "U.S. DOE Ethanol Workshop Series - State Summaries."

2002/2003 Ethanol Workshop Series

Four Ethanol Workshops were conducted under sub-contract to the National Renewable Energy Laboratory and sponsored by the U.S. Department of Energy, Office of Biomass Program and Office of Energy Efficiency and Renewable Energy. Workshops were held in Hawaii, Nevada, Kentucky and California.

Hawaii – Honolulu, November 14, 2002, "Ethanol Fuel: Coming to a Car Near You"
Nevada – Reno, January 9, 2003, "Developing a Pathway to Rural Economic Development Through Ethanol"
Kentucky – Frankfort, February 3, 2003, "Ethanol in Kentucky, A Growing Opportunity"
California – Sacramento, April 14-15, 2003, "Developing Ethanol's Role in California's Energy, Economic and Environmental Future"

Appendix A contains State Workshop Summaries and Highlights.
Appendix B contains State Workshop Electronic Announcements and Press Releases.
Appendix C contains Ethanol Workshop Media and Industry Coverage – Links to Articles on the Internet.
Appendix D contains U.S. DOE Ethanol Workshop Series – State Summaries.
Appendix E is included in the electronic version only (www.nrel.gov/docs/fy04osti/35212.pdf). It contains the actual presentations from the workshops.

The purpose of the EWS was to provide a forum for policy makers, community leaders, media, and potential stakeholders and a catalyst for long-term cooperative action within the states. The goal was to educate potential users, government officials, and stakeholders about ethanol fuels in order to:

- create awareness of the benefits of ethanol
- create a positive image for ethanol
- support the widespread use of ethanol
- establish facilities for ethanol production

Ultimately, the objective was to lay out the pathway for development of an ethanol industry in the state by bringing together a coalition of people to address pertinent issues and exchange information. The attendance at each of these workshops ranged from 75 to over 200. Participants typically included representation from:

- State and Federal Energy Offices
- State and Federal Departments of Agriculture
- Local and State Economic Development Agencies
- State and Federal Departments of Forestry
- State Department of Air, Land and Water Resources
- Commodity Organizations, e.g., Corn, Wheat and Vegetable Growers Associations
- Public Utility Commissions
- State Legislatures and Governor's Offices
- Motor Vehicle Manufacturers and Fleets
- Universities and Trade Schools
- Environmental Organizations
- Ethanol Technology and Service Providers
- Ethanol Plant Developers
- Ethanol Producers

Each participating state felt that the EWS has been a very effective means to reach the established goal. It enabled interested groups to gather, in many cases for the first time, to discuss issues and actions needed to facilitate ethanol production and use. The following are just a couple of the many positive comments about the Workshops.

"Thanks to the US DOE Ethanol Workshop, interest and support of fuel ethanol in Hawaii went from zero to sixty in one week." – Maria Tome, Energy, Resources and Technology

Division, Department of Business, Economic Development and Tourism, State of Hawaii (Workshop Planning Committee Chairperson)

"The Workshop gave Kentucky's agriculture leaders an opportunity to hear about how other states are benefiting from a growing market. [I] became even more convinced that ethanol production can help Kentucky farmers." – Senator Joey Pendleton, D-Hopkinsville, Kentucky (Workshop participant and speaker)

Not only did the EWS result in the opportunity to bring interest groups together, it encouraged participants to identify action steps and priorities to enable industry development. At the end of each workshop, a session *"Where Do We Go from Here"* was coordinated and lead by planning committee members. The outcome from this session included:

- Clearinghouse of Resources on Biomass and Ethanol – States provided resources to obtain more information on biomass and ethanol to interested individuals.

- Economic Impact Studies – Some states conducted an economic impact analysis to support the state and local benefits of ethanol production and use.

- Resource Assessments and Feasibility Studies on specific feedstocks or site-specific locations – Several states commissioned reports to gain more information about state resources and viability of ethanol production.

- State Ethanol Workgroups or Coalitions – Most states organized committees to continue discussions and action steps identified during the workshops, which now meet on a regular basis.

The EWS has also received national and international recognition at several industry events. Results and success stories from the EWS has been presented at the International Fuel Ethanol Workshop, National Ethanol Conference, World Summit on Ethanol for Transportation, Governors' Ethanol Coalition Meetings, and many other industry events.

STATE SELECTION & WORKSHOP COORDINATION

Mid-2002 BBI International received recommendations from the U.S. Department of Energy headquarters on states which they'd like to have participate in the Ethanol Workshop Series. Under NREL Subcontract #ACO-32052-01, workshops were conducted in four states: Hawaii, Kentucky, Nevada and California.

Hawaii – Honolulu, November 14, 2002 – Over 120 people attended the Hawaii Ethanol Workshop. The Workshop also included an add-on seminar for automotive mechanics to help educate them on the use of ethanol. The main Workshop addressed issues concerning ethanol production in the state. There are three proposed plants in the state that will use sugarcane as their primary feedstock. Legislation is pending requiring a 10% ethanol blend in gasoline, which will help to support ethanol. Since the Workshop, regular meetings are being held with key individuals to continue developing the support for ethanol state-wide.

Nevada – Reno, January 9, 2003 – Biofuels in Nevada is highly supported by the state, including the Governor's Office. The state hopes to become energy exports within 10 years. As of recent, they've become energy importers. They see ethanol as a means to help reach that goal with the neighboring California market being a major driver. A feasibility study was commissioned to review specific sites and feedstock considerations for building an ethanol plant.

Kentucky – Frankfort, February 3, 2003 – A groundbreaking ceremony was held in Kentucky around the time of the workshop so much interest in ethanol was developing in the state. It also attracted much needed political support, in fact, a state legislator emcee'd the workshop. An ethanol task force was organized as a result of the workshop consisting of the Kentucky Energy Division, Kentucky Corn Growers, Farm Bureau, and Clean Cities Program. The goal of the committee is to increase the use of ethanol in the state, becoming a marketplace for their current and future production.

California – Sacramento, April 14-15, 2003 – The California Ethanol Workshop attracted the largest gathering of the EWS, over 210 participants. Several challenges to ethanol industry development were address, but the consensus was that California had enormous opportunities for ethanol production. It is currently the largest ethanol market in the country with nearly every major gasoline marketer switching to ethanol.

A complete summary for each of the four workshops – Hawaii, Kentucky, Nevada and California – can be found in Appendix A.

Once a state had been selected, BBI International began coordination activities with the State Bioenergy Coordinator. Each state has a designated Bioenergy Coordinator usually through the State Energy Office. The Bioenergy Coordinator provided guidance, direction and planning assistance for the workshop. The Coordinator also recommended representatives to serve on the Workshop Planning Committee. Committee members included representatives from state agencies, stakeholders and other industry representatives who provided workshop planning, program development, promotion, and subsequent workshop follow-up activities.

The Planning Committees were essential for developing a program that addressed critical needs of the state and bringing together the right people to discuss these issues. Each state varies in their level of industry development and interests, therefore, state planning committees are required to produce a program that best suits the needs of their state and audience. BBI International worked with each planning committee to help develop a workshop program that presented the desired message for each workshop.

In addition to working on program development with the state planning committees, BBI International coordinated pre- and on-site registration, sponsorship program, promotional campaign, registration materials and handouts, local logistics, on-site technical production, all on-site management, and workshop follow-up activities.

As part of the EWS outreach activities, BBI International distributed all workshop and reports to state planning committee members and U.S. Department of Energy and National Renewable Energy Laboratory bioenergy staff members, published articles summarizing the highlights and developments from each workshop in their industry trade magazine, *Ethanol Producer Magazine*, produced a newsletter, the *EWS News*, and produced and maintained all workshop information on the EWS website, www.bbiethanol.com/doe.

WORSKHOP PROMOTIONS

Each workshop was promoted in coordination with the workshop planning committee. The planning committee helped to define a target audience, which helped to meet the goals of their workshop. From this, BBI International developed a mailing list for distribution of printed and electronic announcements. The mailing list was developed through a combination BBI International's in-house industry database and in-state industry contacts provided by the planning committee.

The promotional activities for each state workshop:

- Produced, printed and mailed a postcard announcement
- Produced, printed and mailed tri-fold program brochure
- Produced and issued workshop electronic announcements
- Provided details for state planning committees to produce press releases
- Posted detailed information on the EWS website
- Contacted industry representatives who may have special interest in attending and supporting the workshop
- Produced and published article in industry magazine, *Ethanol Producer Magazine*
- Produced and distributed workshop newsletter, *EWS News*

Sample copies of each of the state workshop electronic announcements and press releases issued by the planning committee can found in Appendix B.

Summary of 2002/2003 Workshop Outreach and Results (Attendance):

	Mailing List (# of people)		
State	**Print**	**Electronic**	**Attendance**
Hawaii	1,254	283	120
Kentucky	2,287	556	77
Nevada	1,645	385	75
California	2,600	1,472	210
Total Attendance			**482**

The EWS website explains the purpose and goals of the EWS and includes detailed information about each state that has participated in the EWS. Each state ethanol workshop web page includes complete information about the state's workshop including program

agendas, speaker papers, workshop summaries and committee contact information; EWS calendar; and editions of the *EWS News.* The Ethanol Workshop Series website can be viewed at www.bbiethanol.com/doe.

The website has been a significant tool in sharing interesting and important information about the EWS to interested individuals. It has helped promote the series as well as present the outcome of each Workshop. The EWS web pages have received over 1,200 hits monthly. The EWS web pages will be posted indefinitely.

Specific Internet Links to the Ethanol Workshops:

Hawaii (http://www.bbiethanol.com/doe/conference.cgi?doeid=41)
Kentucky (http://www.bbiethanol.com/doe/conference.cgi?doeid=42)
Nevada (http://www.bbiethanol.com/doe/conference.cgi?doeid=43)
California (http://www.bbiethanol.com/doe/conference.cgi?doeid=45)

The *EWS News* is an electronic newsletter that served as a tool to keep planning committee members and workshop supporters abreast of activities occurring in participating EWS states. Copies of the *EWS News* can be found on the EWS website, www.bbiethanol.com/doe.

Several articles were written about the EWS, primarily from local media (who received workshop press releases and announcements) and industry organizations promoting the EWS. Appendix C lists several web links to articles about the individual state ethanol workshops in Hawaii, Kentucky, Nevada and California.

The workshops were also promoted through BBI International's monthly industry publication, *Ethanol Producer Magazine*. *Ethanol Producer Magazine* is distributed nationwide to all ethanol producers, agricultural and other feedstock organizations, government and private organizations, stakeholders, and other related industries.

CONCLUSION & RECOMMENDATIONS

Due to the grassroots-level success of the EWS, BBI International highly recommends its continuation; not only in states that have not had the opportunity to host an Ethanol Workshop, but also follow-on Ethanol Workshops in states who are actively moving forward as a result of their first workshop.

The success was greatly due to the fact that the workshop agenda was not a template, but rather, it was focused on the specific needs of each state. The Workshops should continue focusing on educating state agencies, stakeholders, and other interested parties about the opportunities for cellulose-ethanol production and use but also further develop a path-forward for establishing and expanding an ethanol industry on a state level.

APPENDIX A

State Workshop Summaries and Highlights
NREL Subcontract # ACO-2-32052-01
2002/2003

Hawaii Ethanol Workshop

November 14, 2002
Ala Moana Hotel
Honolulu, Hawaii

The first of the ethanol workshops was held in Honolulu, Hawaii. Approximately 120 participants attended, most from the island of Oahu with a few from the neighboring islands. The majority of the attendees worked in private industry with a handful from either government or academia.

The planning committee chose the theme, "Ethanol Fuel: Coming to a Car Near You," in hopes gain interest from both the production and use side of the industry. The planning committee [comprised of representatives from Hawaii Department of Business, Economic Development and Tourism (committee chair); City and County of Honolulu; Hawaii Department of Agriculture; Hawaii Department of Health; Hawaii Natural Energy Institute; JN Automotive Group; and Honolulu Clean Cities] felt that educating the audience on the use of ethanol as well as the production was necessary to gain acceptance of ethanol in the state.

Many of the Hawaii attendees were surprised to learn that today's cars are designed to use ethanol. Hawaii currently does not have any fuel ethanol production or use, although there are several incentives and an ethanol content requirement in Hawaii State law (pending promulgation of rules).

The morning half of the workshop was designed to give a broad overview of policies and legislation, funding options, economic impacts, and historical perspectives of the ethanol industry. Eileen Yoshinaka, Pacific Liaison, U.S. Department of Energy, gave an overview of the Department of Energy Biomass Energy Program, its goals and mission. She provided a background on both petroleum and ethanol production and reviewed opportunities the Program offers to foster bioproducts use and develop partnerships with industry partners.

Maurice Kaya, Administrator for Hawaii's Energy, Resources and Technology Division, stated the workshop's purpose:

- Provide a context; update on the current national status of ethanol
- Discuss the potential for fuel ethanol production in Hawaii
- Provide an opportunity for community input
- Build a foundation for future discussion, work and collaboration

"Ethanol offers a tremendous opportunity for Hawaii," summarized Doug Durante from the Clean Fuels Development Coalition, based in Washington, DC. His overview was a comprehensive snapshot of federal and state programs supporting ethanol, ethanol production history and current usage, current oxygenate requirements, and discussion about the Renewable Fuels Standard and pricing.

Mark Yancey from BBI International presented a preliminary review of an economic impact analysis underway on the costs and benefits of ethanol production in Hawaii. The Hawaii Department of Business, Economic Development and Tourism is analyzing the possibility of satisfying a portion of the state's future transportation energy demand through alternative fuels. The report evaluated three possible ethanol production projects: two to produce ethanol from molasses and one would use biomass. Preliminary results look favorable, although this was just an economic impact analysis and not a feasibility study.

Warren Hall of EA Engineering, Science and Technology, Inc., based in Hawaii, discussed a historical perspective of ethanol in the state. Maurice Kaya covered the state energy policy, incentives and mandates.

After lunch (which included an outdoor exhibit of an alternative fueled vehicle), the subject matter turned to specifics of fuel ethanol production, distribution and uses. The first panel focused on different feedstocks, including cellulose, molasses, sugar cane and municipal solid wastes. Presenters included Rick Elander from the National Renewable Energy Laboratory (Golden, CO), Jayant Godbole from Praj Industries (a design/engineering firm with experience building molasses-to-ethanol plants), and Hawaii-based Bob Shleser from the Aina Institute who authored a 1994 report on the feasibility of ethanol production in Hawaii.

Under the topic of distribution, two petroleum representatives discussed ethanol blending options and issues. Barry Duffin of ConocoPhillips and Mike Allen of Allen Oil Company talked about their current experiences providing ethanol-blended gasoline.

Barry Duffin, Quality Control Specialist at ConocoPhillips, described the approach used to switch their California stations (over 1000 stations) to sell gasoline with ethanol rather than MTBE. The switch was completed in December of 2001. ConocoPhillips is the largest gasoline retailer in the U.S. Mike Allen, President of Allen Oil Company, said that the public wants fuel ethanol so offering fuel ethanol can build customer loyalty.

The final panel on fuel ethanol use focused on the practical applications of ethanol's use presently in cars, racing engines, fuel cells, and diesel engines. Maria Tome, organizer of the workshop, from the Energy, Resources, and Technology Division of the Hawaii Department of Business, Economic Development and Tourism applauded the audience's interest and participation and concluded that ethanol can contribute to the state (and national) economy… and Hawaii's energy future. She strongly encouraged people to see the workshop as just the beginning of continued emphasis toward ethanol in the state. She invited all to complete their surveys of the workshop and sign up to become part of an on-going working group.

As with previous workshops in the DOE Ethanol Workshop Series, a participant survey was included in the materials distributed. There was a significant amount of feedback with positive, hopeful impressions of ethanol. A majority of the respondents would like to be included in a task force or committee to further pursue ethanol production and use in Hawaii.

Future Action Needed to Move the Ethanol Industry Forward in Hawaii:

- Support of the petroleum companies
- Government funding; both federal and state incentives; promulgation of mandates
- Private and public communication and cooperation
- 2-3 day detailed workshop

In addition to the ethanol workshop, an innovative set of 2-hour evening "mechanic seminars" were conducted in advance of the workshop to promote the use of the fuel to Hawaiian drivers. The content focus of the seminars was fuel specifications, vehicle performance, compatibility issues, manufacturers' warranties and applications. Larry Johnson of Delta-T Corporation and Joe Collette an ethanol fuels instructor were both presenters at the seminars.

Nevada Ethanol Workshop

January 9, 2003
Atlantis Hotel
Reno, Nevada

The Nevada Ethanol Workshop took place on January 9, 2003, in Reno. There were 75 people in attendance, which was said to be significantly more than anticipated. Participants came from both northern and southern regions in Nevada, which showed a cooperative effort in the state for ethanol industry development and interests. There were also some participants from California and the Midwest states. Attendees represented government and private industries equally.

The workshop theme was "Developing a Pathway to Rural Economic Development through Ethanol." The planning committee (comprised of representatives from the Nevada Office of Energy; Nevada Association of Counties; Nevada Division of Environmental Protection; Clark County Department of Air Quality Management; Washoe District Health-Air Quality Management Division; and the Environmental Health & Safety Department) placed a strong focus on ethanol as a means to improve rural communities around the state.

Biofuels development is highly supported by the Governor's office. Carl Linvill, Energy & Economic Advisor, Office of the Governor, said that over $2 billion (of the $4 billion in total energy expenditures) are spent out-of-state on transportation fuels in Nevada annually. He addressed the impacts of energy security and dependency on imported energy, rolling blackouts, and fuel supply disruptions. The state's goal is to export energy in the next 10 years.

Pat Perez of the Office of Transportation Fuel Supply & Demand, California Energy Commission, addressed the concern that MTBE contamination is rising. There's a huge market opportunity for ethanol in California as a result. Approximately 70-80 percent of the MTBE market in California has already converted to ethanol.

Jeff James, Bioenergy Program Manager, Seattle Regional Office, U.S. DOE, discussed US oil dependence (55% from foreign sources) and the value of biomass feedstocks for ethanol production. DOE is supportive of an ethanol program and making biomass energy R&D a national priority. Biomass R&D Act of 2000 directs DOE and USDA to enhance and coordinate biomass R&D efforts while Energy Title IX of the Farm Bill supports increased use of biomass energy and production through R&D. DOE looks to continue development of biofuels and form partnerships for progress.

Neil Koehler, representing the Renewable Fuels Association, gave a historical perspective about how oil price spikes and supply instabilities became major drivers for renewable energy, followed by further support for the industry through the Clean Air Act Amendments of 1990. Currently, the interest in ethanol originates from rural areas. It is thought that climate change issues will be the next driver for ethanol and other renewable fuels. Right now, half of the US market for ethanol is for octane enhancement and as a fuel extender.

The final session *Developing an Ethanol Industry in Nevada… Where Do We Go from Here?* was an interactive discussion to lay a pathway for industry development in Nevada. Four major areas were identified for further discussion and action steps.

Issues Surrounding Market Development:
- What is the risk to the state from MTBE dumping?
- Storage implications: Is there enough storage space for separate tanks of ethanol and gasoline?
- Competition with other alternative fuels such as propane and compressed natural gas.
- How to further utilize flexible fuel market in fleet vehicles (11,000 vehicles in Nevada)

Support for Ethanol Production:
- Commission feasibility study for siting an ethanol plant
- Need to develop partnerships with oil companies, economic development agencies, and others to find the best location for an ethanol plant
- Develop legislation for ethanol funding for production
- Research and assess the most sustainable feedstocks for ethanol production in state
- Evaluate the importing of corn for ethanol production
- Review the USDA loan guarantee funds available for ethanol production

Air Quality:
- Assess the state's ability to maintain air/environmental quality and meet federal requirements
- Conduct study on life cycle analysis of ethanol production and use in the state

Developing Partnerships:
- Promote and seek out cooperation with industry associations and commodity groups such as the National Corn Growers Association and others who can provide resources for industry development
- Form coalition with Workshop participants to continue communication on steps towards industry development

Kentucky Ethanol Workshop

February 3, 2003
Holiday Inn Capital Plaza
Frankfort, Kentucky

The Kentucky Ethanol Workshop took place on February 3, 2003, in Frankfort. There were 77 in attendance, representing several agricultural organizations; industry associations; private industry; and state government officials (including 5 senators and representatives). In a state with virtually no ethanol sold, this number was far more than anticipated at this initial Workshop. Government agencies, eager to learn more about the possibilities of economic development for the state, constituted the majority of the audience, although private sector was well represented as well. The western part of the state had the higher interest in grain-based ethanol and the eastern part had greater interest in the eventual potential for biomass-ethanol.

The planning committee consisted of the Kentucky Farm Bureau, Kentucky Corn Growers Association, Kentucky Division of Energy, and the Clean Cities Program of Kentucky. The theme they chose, Ethanol in Kentucky – A Growing Opportunity, expressed the possibly tremendous potential that an ethanol industry could bring to Kentucky and that's what the committee wanted to share with the attendees.

It was the second time since 1999 that a legislator – in this case, Senator Joey Pendleton – took the center stage as Master of Ceremonies for an Ethanol Workshop. Following the initial overview of the big picture on ethanol, the presentation narrowed down to be more Kentucky specific with a review of the ethanol industry's past and present status in the state.

One ethanol plant has been in production in Louisville since 1991 using waste liquids such as beer, orange juice and sodas as feedstock. It recycles the containers as part of the overall program. The newest ethanol producer in Kentucky is Commonwealth Agri-Energy, LLC, who broke ground on January 22nd in Hopkinsville, which is in the western part of the state.

At lunch, two more legislators participated. Roger Thomas and Ernie Harris, Chairmen of the House and Senate Agriculture Committees respectively, expressed their support for the benefits of ethanol. The Luncheon Keynote, Bob Dinneen, President and CEO of the ethanol industry's trade organization, the Renewable Fuels Association, provided insight on the energy bill and other factors that impact the growing ethanol industry nationwide.
The afternoon discussions included a panel on Minnesota's success stories, programs and lessons learned that helped to demonstrate how the ethanol experience in a Corn Belt state can bring significant agricultural, environmental, community and statewide rewards.

Using all of the tremendous background information provided during the day, Todd Barlow, Kentucky Corn Growers Association, and Brian Alvey, Kentucky Farm Bureau, led all of the participants through a brainstorming session to identify issues, possible solutions and action items to increase the development of the ethanol industry in the state.

Discussion highlights of the final wrap session were:

- Develop a certified quality program that includes cattle + ethanol + mass marketing effort.
- Get refineries involved, including out-of-state refineries and also get to know your near-by terminal and encourage dedicated common storage.
- Seek the buy-in of various groups such as the beef industry by addressing the misunderstanding of ethanol being good for corn farmers and bad for feeders.
- Create methods for educating both legislators and consumers.
- Develop an in-state source for answers on ethanol.

- Consider an innovative type of incentive like an “off-road use” gasoline tax of ½-cent per gallon.
- Form an ethanol task force, or work group, to lead these efforts, that meets on a regular basis and embraces all sectors.

California Ethanol Workshop

April 14-15, 2003
Embassy Suites Hotel
Sacramento, California

The Ethanol Workshop in California, April 14-15, became the largest contingency that has ever gathered to discuss ethanol in California. Over 210 people gathered to discuss the opportunities and barriers to the development of a prosperous ethanol industry in the state. The rural economy and agriculture became the focus of the workshop bringing together farmer organizations, energy and environmental groups, policy makers and stakeholders to discuss the steps needed to support ethanol production.

California is the leading agriculture state in the country as well as the most diverse in the world. It is also the leading dairy state, offering a significant market for ethanol coproducts. The California Department of Food & Agriculture supports ethanol because it provides a value-added industry to help boost the rural economy by providing new products and new jobs.

"Ethanol would be a huge benefit to areas experiencing high unemployment rates, which is as high as 42% in the San Joaquin Valley," said to Dr. Ellen Burnes, California State University-Fresno. "A 40 mmgy plant would generate 41 full time jobs, 300 local jobs, and adds $8 billion to the local economy," said Burnes.

According to the California Energy Commission (CEC), California became the largest market for ethanol this year, replacing MTBE, which will be banned by the end of the year. Fred Keeley, Executive Director of the Planning and Conservation League, expressed that ethanol will help improve air quality in the state and stimulate the economy, which are important reasons why California should support an ethanol industry.

Bill Jones, Former Secretary of State, supported ethanol as a means to reduce the state dependency on petroleum. California's fuel demand has grown 3% of the past year, twice the projection. Biorefineries can produce ethanol and other bio-based products, which can be located in every region in the state, utilizing a variety of feedstocks. CEC estimates the demand for ethanol could reach 760-900 mmgy in 2004. As of April 2003, 70% of California's gasoline contains ethanol. BP, Shell, ExxonMobil, ChevronTexaco, and Valero have all switched to ethanol to meet CARBOB standards.

Dave Smith, Director of Regulatory Issues at BP, said that BP is very close to becoming MTBE-free. They have contracted with 6 ethanol producers to supply ethanol. Their refineries are being upgraded to produce CARBOB using ethanol. They are working on improving the infrastructure for ethanol use in California. Challenges include the RVP, permitting with terminals, and fuel quality.

Ethanol has the potential to grow in other markets, such as E85 (FFV's). Mike McCormack from CEC's office of Transportation Fuel Supply & Demand said that 175,000 vehicles in the state can operation on E85, equaling close to 100 mmgy in potential demand for ethanol. Jerry Esper, Senior Manager for Fuel Economy Planning, DaimlerChrysler, said there are 3 million E85 vehicles on the road (1 million manufactured by DaimlerChysler) largely due to CAFÉ credits and fleet requirements. One billion barrels of gasoline could be saved if E85 was used to its maximum capacity. He had also discussed the challenges with ethanol-diesel blends and fuel cells.

Bill Maloney from ED&F MAN Alcohol described the sources of ethanol being supplied to California. Approximately 98.7% of US ethanol production comes from the Midwest. Sources of alcohol outside the country come primarily from Carriabean Basin and Brazil. Various grades of alcohol are shipped in and

distilled to anhydrous for export to the US through the Carribean Basin Initiative. Other sources for potential ethanol supplies are developing from emerging ethanol programs in Central and South America.

There are numerous feedstocks available for ethanol production within the state including corn, sorghum, sugar cane, cheese whey, food and beverage wastes, various biomass feedstocks such as forestry residue and rice straw. Potential production from agriculture resources total 595 bdt, forestry 966 bdt, and urban sources 914 bdt. The CEC assumes 50-70 gallons per bdt (bone dry ton).

Jack King, California Farm Bureau Federation, and Lee Swenson, Community Alliance with Family Farmers, expressed the opportunities for California agriculture to produce ethanol for the state's ethanol market; addressed the fact that food is an infrastructure problem, not a supply issue which addresses the fuel vs. food issue; and new feedstock opportunities such as hull-less barley.

A number of representatives from ethanol development projects discussed the status of projects in the central valley including Yolo County (corn), Imperial Valley (sugar cane and sugar beets), and San Joaquin Valley (fruits). These projects all aim to boost the farming community by providing new jobs and economic development.

The day ended with a session on a discussion of the framework needed to policies forward in California that support ethanol. From waste streams alone, California has the potential to produce 2-4% of their fuel demand from ethanol. Numerous studies have been conducted by CARB, CEC and other agencies to evaluate the impact of the state's dependence on petroleum, the affects of changes in gasoline on fuel prices, and establishing a strategic fuel reserve. It is apparent that California has the right market, the right feedstocks, the right resources and a public that is receptive to renewable energy. The interest for ethanol development in the state was very high. The hurdle seems to be a consensus among decision makers on what is needed to move the industry forward.

Over 150 people attended the second day of the workshop, which featured a special half-day session on Biomass Ethanol Potential in California. This session provided an opportunity for cellulose-ethanol project developments to give an update on their projects and technology and how it could apply to efforts in the state. Presentations included an overview of cellulose-ethanol production technology and challenges, the history of California's efforts to build a cellulose-ethanol industry, potential for forest residue collection for ethanol production to help reduce the risk of forest fires, case studies on lignocellulosic feedstocks and technological options for ethanol production and remaining steps to achieving commercial biomass-ethanol production.

APPENDIX B

State Workshop
Electronic Announcements and Press Releases

HAWAII

(A second, more detailed announcement, was distributed by the planning committee chairperson)

Please Forward to Others Who May be Interested!

Plan To Attend!

November 14, 2002
Ethanol Workshop 8:00 am – 4:30 pm
Ala Moana Hotel
Honolulu, HI
Cost: $20 (includes continental breakfast and lunch)

"Ethanol Fuel: Coming Soon to a Car Near You"

Fuel ethanol production in America has reached historic levels. In some states, fuel ethanol production supports rural economies. In others, fuel ethanol reduces air pollution. All across the U.S., it reduces dependence on imported oil and provides consumers with energy diversification and added fuel choice. Could Hawaii tap its own resources to produce some of its own transportation fuel? What would be involved? What would be the costs and benefits? The workshop will address technical as well as policy issues.

Topics:

- Fuel cost and vehicle performance
- Environmental issues
- Fuel distribution & infrastructure
- Incentives
- Hawaii's ethanol content requirement law
- Emerging markets for ethanol

Who Should Attend:
Fuel producers, distributors, retailers, and consumers; regulators; decision-makers; financiers; automotive service technicians; salespeople; vehicle enthusiasts; environmentalists; media; and the general public.

Free Evening Classes (6:00-8:30pm):
Free evening classes for automotive service technicians are being scheduled for Kahului and Kona on November 11; Hilo and Lihue on November 12; and Honolulu on November 13. The ethanol fuels classes will cover fuel specifications; how changes in gasoline composition affect vehicle performance, fuel system materials compatibility; auto manufacturers' warranties; alternative fuels and vehicles; and oxygenated fuels in non-automotive applications. For more information, call Maria Tome at (808) 587-3809.

Sponsored by:
U.S. Department of Energy, Office of Fuels Development; Western Regional Biomass Energy Program; *City and County of Honolulu; Hawaii Department of Agriculture; Hawaii Department of Business, Economic Development & Tourism; Hawaii Department of Health; Hawaii Natural Energy Institute; Honolulu Clean Cities; JN Automotive Group*

For program information, contact:
Maria Tome, Alternate Energy Engineer,
Energy, Resources, and Technology Division, Hawaii Dept. of Business, Economic Development, and Tourism, phone: (808) 587-3809
e-mail: mtome@dbedt.hawaii.gov

For **registration information**, please use the attached document, or contact:
Anne Wester, BBI International, Workshop Coordinator, phone: 800-567-6411,e-mail: anne@bbiethanol.com

For the agenda, registration form and additional details
Please visit www.bbiethanol.com/doe

Please Circulate!

KENTUCKY

Please Forward to Others Who May be Interested!

Plan To Attend!

February 3, 2003
Kentucky-Ethanol Workshop 9:00 am – 4:00 pm
Holiday Inn Capital Plaza - Frankfort, Kentucky
Cost: $20 (includes meals and materials)

Ethanol in Kentucky-A Growing Opportunity

Senator Joey Pendleton will be the Master of Ceremonies for this exciting workshop. Please join us in learning more about the benefits of ethanol in the state of Kentucky. Also in attendance will be the Chairman of the House Agriculture and Small Business Committee, Robert Thomas, and the Chairman of the Senate Agriculture and Natural Resources Committee, Ernie Harris. These two chairmen will introduce our dynamic keynote speaker, Bob Dinneen, President of the Renewable Fuels Association in Washington D.C. There will also be two flex-fuel vehicles on display, which use an 85% blend of ethanol with gasoline (E-85).

Topics:
Ethanol in the Bluegrass and Beyond
Ethanol 101 - Knowing the Facts
Ethanol and the Three E's:
- Energy Security
- Economics
- Environment

An Interactive Discussion Between Presenters and Attendees-Where To Go From Here

Who Should Attend:
Fuel producers, distributors, retailers, and consumers; regulators; decision-makers; financiers; automotive service technicians; vehicle enthusiasts; environmentalists; media; and the general public

Sponsored by:
U.S. Department of Energy;
Kentucky Corn Growers Association
Kentucky Farm Bureau Federation

Hosted by:
Kentucky Division of Energy
Kentucky Clean Fuels Coalition

For program information, contact:
Todd Barlow, Executive Director, Kentucky Corn Growers Association
Phone: 502-243-4150
E-mail: toddbarlow@compuserve.com

For registration information, use the attached registration form or contact:
Anne Wester, BBI International, Workshop Coordinator, phone: 800-567-6411,e-mail: anne@bbiethanol.com

Holiday Inn Capital Plaza
405 Wilkinson Boulevard, Frankfort, Kentucky
Reservations: 502-227-5100
Reference: Ethanol Workshop for special room rates of $72 single/double
Must call by January 20 to guarantee this price

For the agenda, registration form and additional details
Please visit www.bbiethanol.com/doe

Please Circulate!

News Release

U.S. Department of Energy

Kentucky Ethanol Workshop

February 4, 2003

Kentucky-produced ethanol could boost state's farm economy, Pendleton says

FRANKFORT - Sen. Joey Pendleton, D-Hopkinsville, put a spotlight on the future of Kentucky-produced ethanol and its potential to boost the state's agricultural market during the Kentucky Ethanol Workshop, which was held in Frankfort yesterday.

"We've got a promising fuel source that could really help improve our state's agricultural economy if we do all we can to promote and expand the ethanol market," said Pendleton, who served as moderator of the workshop. "It's important for state leaders to recognize this is a key to diversifying our state's agricultural interests."

The workshop was one in a series of ethanol workshops the U.S. Department of Energy is sponsoring throughout the nation.

During the workshop, agriculture leaders discussed ways to expand the ethanol market, use ethanol by-products, promote ethanol as a value-added product for Kentucky farmers, and highlight its potential to help maintain a cleaner environment. Pendleton also noted that ethanol could help break the nation's dependency on foreign oil.

The workshop also gave Kentucky's agricultural leaders an opportunity to hear about how other states, such as Minnesota, are benefiting from a growing ethanol market.

Pendleton said he became even more convinced that ethanol production could help Kentucky farmers in recent years as he worked to establish a new ethanol plant in Hopkinsville. A groundbreaking ceremony for the plant was held last month. Once the plant is up and running, it will be capable of producing 20 million gallons of ethanol each year.

NEVADA

Please Forward to Others Who May be Interested!

Plan To Attend!
January 9, 2003
Nevada-Ethanol Workshop
9:00 am – 4:30 pm

Atlantis Hotel
Reno, Nevada
Cost: $20 (includes breakfast, lunch, and materials)

"Developing a Pathway to Rural Economic Development through Ethanol"

Fuel ethanol production in America has reached historic levels. In some states, fuel ethanol production supports rural economies. In others, fuel ethanol reduces air pollution. All across the U.S. ethanol reduces dependence on imported oil and provides consumers with energy diversification and added fuel choice. Could Nevada tap its own resources to produce some of its own transportation fuel? What would be involved? What would be the costs and benefits? The workshop will address these questions and others.

Topics:

- A National and Nevada-Specific Overview on Ethanol
- An Overview of Ethanol in California
- How Ethanol Impacts Energy Security, Environmental Improvements, and the Economy
- How Ethanol is Made
- Developing a Market in Nevada for Ethanol
- An Interactive Group Discussion to Create a Path Forward

Who Should Attend:
Fuel producers, distributors, retailers, and consumers; regulators; decision-makers; financiers; Automotive service technicians; vehicle enthusiasts; environmentalists; media; and the general public.

Sponsored by:
U.S. Department of Energy
Nevada State Energy Office
Nevada Association of Counties
University of Nevada-Environmental Health & Safety
Department Bureau of Air Quality Planning
Washoe District Health-Air Quality Management

Clark County Department of Air Quality Management
Ford Motor Company
U.S. Department of Agriculture
Truckee Meadows Clean Cities Coalition
Nevada State Motor Pool
Las Vegas Regional Clean Cities Coalition
University of Nevada-Environmental Health & Safety
Nevada Department of Agriculture
Nevada Department of Environmental Protection
Nevada Commission on Economic Development
Nevada State Parks

For **program and registration information**, contact:
Anne Wester, BBI International, Workshop Coordinator, phone: (800) 567-6411, e-mail: anne@bbiethanol.com

Registration form in PDF format attached. If unable to open, or for further information, see http://www.bbiethanol.com/doe/conference.cgi?doeid=43.

Atlantis Hotel
3800 South Virginia Street, Reno, Nevada 89502
Reservations: (800) 723-6500, Reference: Ethanol Workshop for room rates of $55 single/double. Must call by December 25, 2002

For the agenda, registration form and additional details
Please visit www.bbiethanol.com/doe

Please Circulate!

PRESS RELEASE

Ethanol Workshop

Set for JANUARY 9th in RENO, NEVADA

For Immediate Release
Reno, Nevada

For Media Information Contact:
Pete Konesky
(775) 684-8735

Can increased ethanol production create new markets for Nevada farmers, create new jobs and further help America's national energy independence?

Yes, say energy experts from around the country who will gather in Reno on January 9th for an ethanol workshop that is part of a U.S Department of Energy series that has taken place in over 25 other states.

This one-day workshop, titled *"Developing a Pathway to Rural Economic Development through Ethanol"*, will include panels of experts who will cover a wide range of ethanol related topics with special emphasis on Nevada. The workshop will be held at the Atlantis Hotel in Reno from 9:00 am to 4:30 pm.

The morning session will start with an overview of ethanol in the United States, with emphasis on Nevada and our neighbor, California. The Federal Biofuels Initiative will also be addressed. There will be three panels during the late morning and afternoon sessions. The first panel will focus on *The Three E's of Ethanol*: Energy Security, Environmental Improvements, and Economic Impact. The second and third panels will discuss *How Ethanol is Made*, and *How Ethanol is Used*, respectively. There will be an update presented on the proposed ethanol project in Winnemucca. During lunch there will be 2 flex-fuel vehicles on display. To wrap up the general session there will be discussion about the steps that need to be taken to develop an ethanol industry in Nevada.

This workshop is open to the public at a cost of $20, which includes an ethanol information packet and lunch.

For more information about the workshop please contact Pete Konesky (775) 684-8735 or go to the Workshop website, www.bbiethanol.com/doe and click on Nevada. The workshop will be held in facilities that meet the accessibility requirements of the Americans with Disabilities Act. If you require special accommodations to attend, participate in or understand the workshop, please let Konesky know in advance so arrangements can be made.

CALIFORNIA

(This was the 3rd announcement that included a complete program agenda and was also distributed to state legislators)

California Ethanol Workshop
Developing Ethanol's Role in California's Energy, Economic & Environmental Future

Embassy Suites - Sacramento, California
April 14-15, 2003

Seating is limited and filling fast. Register soon!

www.bbiethanol.com - Cost: $25 (includes meals and materials)
(*Legislators receive a complimentary registration)*

The California Ethanol Workshop is part of a workshop series sponsored by the U.S. Department of Energy Office of Biomass Programs and Office of Energy Efficiency and Renewable Energy. Over 30 states have been a host to the Ethanol Workshop Series, with each focusing on steps towards industry development, impacts of ethanol production and use, and opportunities for biomass-to-ethanol production.

California presents one of the largest market opportunities in the country. With the phase-out of MTBE, rising energy prices, increasing dependency on imported energy, and the need for new agriculture uses and markets to boost the rural economy, ethanol has become an important topic for decision makers and stakeholders in California.

Top-level officials from state government and industry will discuss the latest issues, hurdles and opportunities towards ethanol industry development in the state. Please join us for an engaging and informative event.

Preliminary Agenda
(see Appendix E)

Who Should Attend:
Public officials; regulators; agricultural communities; financiers; potential and current producers; distributors, retailers, and consumers; transportation and automobile industry; media and other interested stakeholders.

Sponsored by:
U.S. Department of Energy, Office of Biomass Programs and Office of Energy Efficiency and Renewable Energy

With Support from: California Energy Commission, California Department of Food & Agriculture, California Renewable Fuels Partnership and California State University-Fresno

For program and registration information, **contact:**
Anne Wester, BBI International, Workshop Coordinator
Phone: 800-567-6411, E-mail: anne@bbiethanol.com

Accommodations:
Embassy Suites Sacramento
100 Capitol Mall, Sacramento, California 95814
Reservations: 916-326-5006, Reference "*Ethanol Workshop"*

For program updates please visit www.bbiethanol.com/doe

Please Circulate!

APPENDIX C

Ethanol Workshop Media and Industry Coverage Links to Articles on the Internet

Partial List of Links to Articles, Announcements and Industry Coverage of EWS

Hawaii

http://www.state.hi.us/dbedt/ert/ewg/

http://www.hawaii.gov/dbedt/ert/archive/wksp-e02.html

George Nitta's Radio show - http://www.georgenitta.com/Radio.htm (click on 11/9/02)

Honolulu Advertiser - http://the.honoluluadvertiser.com/article/2002/Nov/10/ln/ln25a.html

http://www.hawaiimotorcycle.org/2002_November_Newsletter.htm

Pacific Business News - http://www.bizjournals.com/pacific/stories/2002/11/04/daily1.html

http://www.bbiethanol.com/doe/conference.cgi?doeid=41

Nevada

The Nevada Rancher - http://nevadarancher.com/news/2003/feb03a.htm

http://gov.state.nv.us/pr/2003/01-03ETHANOL.htm

http://www.energy.ca.gov/ethanol/documents/

http://www.ethanolrfa.org/ereports/er112602.html

http://www.bbiethanol.com/doe/conference.cgi?doeid=43

Kentucky

http://www.kycorn.org/ethanolworkshop.html

http://www.joeypendleton.com/eth/eth.htm

http://www.environment.ky.gov/nrepc/landairwater/summer03/ethanol.htm

http://www.kyfb.com/federation/News_Publications/kfbnews/2003/mar_03/pg8-9b.htm

http://www.bbiethanol.com/doe/conference.cgi?doeid=42

California

http://www.valleyvoicenewspaper.com/valleyvoicearchive/april162003.htm

http://www.bbiethanol.com/doe/conference.cgi?doeid=45

http://www.ncga.com/news/CC/volume10/ccVol10n16.html

http://www.cfbf.com/agalert/2002/aa-041702b.htm

http://www.ccities.doe.gov/pdfs/ccnews_mar2003.pdf

http://www.renewingindia.org/newsletters/ethanol/current/news_vol1_12.htm

APPENDIX D

U.S. DOE Ethanol Workshop Series
State Summaries
1999-2003

U.S. Department of Energy Ethanol Workshop Series

Highlights and Success Stories 1999-2003

(as of September 2003)

2003

California (Sacramento) – "*Developing Ethanol's Role in California's Energy, Economic and Environmental Future."* This was the largest gathering about ethanol to take place in the state. Several challenges to industry developments were addressed, but the consensus was that California has an abundance of feedstocks and economic and environmental incentives to foster ethanol production. As of this year, it holds the largest market for ethanol in the country and is expected to more than double in the next several years. Nearly every gasoline marketer has made the transition to ethanol (MTBE ban is in effect December 31, 2003). Legislation is being proposed to support renewables including ethanol in the state. Support for ethanol came from all sectors, including CARB, several agriculture associations, and environmental groups. There are more than three active development projects in the state that will utilize corn, sugar cane/sugar beets and/or fruit.

Kansas (Topeka) – *"Ethanol: Fueling Opportunities in Kansas Focusing on Utilization and Production."* Kansas has five ethanol plants currently in production, some of which are the most unique in the country. One plant processes seed corn into ethanol; another uses its CO_2 to force residual oil from oil fields; while another plant internalizes all of its distillers wet grains for use in its own feed lot. Several legislators participated in the workshop confirming their continued support of the state ethanol incentive legislation and the growth of the industry. Representatives from all proposed plants in the state attended the workshop, one of which has since begun their equity drive. One of the proposed projects is examining the option of corn stover as a feedstock, but the balance of the proposed projects are corn and sorghum based. An ethanol task force is being formed as a result of the workshop.

Kentucky (Frankfort) – *"Ethanol in Kentucky, A Growing Opportunity."* Around the time of the workshop, a groundbreaking was held for an ethanol plant in western Kentucky. This allowed for very good, positive media coverage. Excellent political support was shown during the workshop, as well as recognition of a great deal of interest in cellulose ethanol in eastern Kentucky. An ethanol task force or work group is being formed under the leadership of the planning committee; Kentucky Energy Division, Kentucky Corn Growers, Farm Bureau, and Clean Cities Program. The goal is to increase use of ethanol in the state and become a marketplace for their current and future production.

Nevada (Reno) – *"Developing a Pathway to Rural Economic Development through Ethanol."* Biofuels in Nevada are strongly supported by the state. In fact, the Governor's office has set a goal to become energy exporters (in recent years, they've become net importers). They view California as a major driver and source for new industry development in the state and a means to support the agriculture economy. A development group proposing an ethanol plant made a presentation on a preliminary economic impact study. The attendees, during the wrap-up session, recommended that a feasibility study be commissioned to locate an ethanol plant in the state with an evaluation of the economics of shipping in corn to help supplement the feedstock supply. That study has been completed and options are being evaluated.

Oklahoma (Tulsa) – *"Setting the Stage for Ethanol in Oklahoma."* A state legislator was the emcee for the workshop, signaling the growing legislative support for an ethanol industry in Oklahoma. A presentation on the favorable results of a feasibility study for a proposed ethanol plant using grain sorghum and eventually hull-less barley was part of the agenda. Since the workshop, legislation was passed in Oklahoma that allows a generous tax credit for ethanol plants. Funding is already in place for this legislation. At least one project is moving along quickly, while two to three more are still being evaluated. The Farmers Union, Sorghum Association and Department of Agriculture are instrumental organizations for keeping the momentum going in the state.

2002

Hawaii (Honolulu) – *"Ethanol Fuel: Coming to a Car Near You."* In 1996, legislation was passed in Hawaii requiring 10% ethanol in all gasoline in the state. No action was taken at that time because there was no ethanol produced in the state. Now, however, there are three proposed plants – all of which want to have the rule promulgated as soon as possible to create a market for their production. During the three days prior to the workshop, mechanics seminars were held in various locations throughout the state to address any misconceptions on performance that still lingered. The results of those seminars were part of the workshop. The leaders in Hawaii were very happy to have such a visible, high-caliber workshop held that helped position ethanol among key agencies, organizations and businesses. A task force is being formed and efforts are underway to make the proposed incentive a reality.

2001

Alaska (Ketchikan) – *"A Discussion of Issues and Opportunities Associated with Using Local Residues to Make Fuel Grade Ethanol in Southeast Alaska."* Alaska held a second, follow-on workshop to discuss in more detail the availability and viability of producing ethanol from wood residues from the milling and forestry industry in southeast Alaska. A feasibility study was conducted as a result of this workshop. Alaska is still evaluating the potential of building a cellulose-ethanol plant, perhaps using gasification technology

Idaho (Boise) – *"Ethanol and Idaho: Partners for the Future."* Maintaining the momentum after the workshop, several regional workshops were held to examine the needs of each proposed region. Experienced people from Minnesota were brought in to testify before the Idaho legislature. Three proposed ethanol plant projects have had studies done and a statewide assessment has been completed. One of the projects proposed for Idaho has moved to Oregon because more enticing incentives were offered locally.

Iowa (Des Moines) – *"Ethanol, Fueling Iowa's Economy."* Despite Iowa being such an advanced state for ethanol, they welcomed the opportunity to hold a workshop. It helped them in their quest to become the largest ethanol state in the country. They recognized there is never too much awareness and understanding. There are now upwards of 12 ethanol plants in various stages of development. Three new plants have come on line since the workshop and several are under construction. Iowa has an ethanol development council and a Renewable Fuels Association.

Maryland (Baltimore) – *"A Dialogue on the Potential for the Production and Use of Fuel Ethanol in Maryland."* Their workshop was held in October 2001. A statewide study was commissioned to determine the best location(s) in the state for an ethanol plant. Although they originally intended to have a barley plant of their own, they now have a joint project with Pennsylvania.

North Carolina (Raleigh) – *"Ethanol, Driving North Carolina's Energy, Economic and Environmental Future."* An effort was made to involve in the program all key state agencies that will play a role in the development of an ethanol industry in the state. The panel of primary importance was the legislative panel that was comprised of two state representatives and two senators. Strong support was expressed and innovative ideas to help set the groundwork for a new ethanol industry were expressed. The workshop set the stage to revitalize one proposed project on the eastern coast of North Carolina. Increasing the marketplace for ethanol was one of the more immediate goals.

Oregon (Eugene) - *"The Oregon Ethanol Forum: A Closer Look at Fuel Ethanol."* Oregon held a second, follow-on workshop to the one held in conjunction with the state of Washington in 2000. The purpose of this workshop was to clear up some of the issues and myths about ethanol in order to gain further support for biomass-ethanol. A study commissioned by the Oregon Office of Energy was released at this workshop. The study was a resource assessment of cellulosic biomass feedstocks in the state for ethanol production. It also included a preliminary economic analysis of an ethanol facility using various feedstocks available in the state. Oregon has one grain-ethanol project actively underway and studies are still being done for a proposed biomass-ethanol plant.

Puerto Rico (San Juan) – *"A New Frontier: Benefits & Opportunities for Ethanol Production & Use."* Puerto Rico is considering the possibility of using alternative energy sources, and the Puerto Rico Power Authority is beginning to become interested in technologies such as ethanol production. Oil is the major power source for energy production, all of which is imported. Furthermore, all gasoline is blended with MTBE. The local sugar cane producers and related industries have great interest in resurrecting their feedstock for ethanol production, utilizing sugar and cellulose as feedstocks.

Utah (Salt Lake City) **–** ***"Biofuels in Utah's Future: A Dialogue."*** The backdrop for the Utah Ethanol Workshop was Governor Mike Leavitt's announcement of the state's new Energy Policy. The Energy Policy supports and enforces the state's goal to become energy reliable, affordable, sustainable and clean. The purpose of the Workshop was to educate key people about how biomass ethanol meets the goals of the new Energy Policy. The result was a highly useful presentation and discussion about the benefits of ethanol's use and production as a reliable, sustainable source of energy for the state. Utah has since been reviewing potential sites for an ethanol plant and a proposed plant in the western part of the state intends to help fulfill California's need for ethanol.

2000

Colorado (Yuma) – *"Fuel Ethanol Production in Colorado: It's Potential and History."* The first DOE Ethanol Workshop was held in Denver in 2000. The Colorado Action Group for Ethanol (CAGE) was established and that has kept the momentum going. The group decided to hold a second workshop in 2001 that educated rural Colorado about what's involved in building an ethanol plant. There are three projects conducting feasibility studies right now. The plant proposed for northeast Colorado, an area with tremendous feedlots, will most likely be built. A smaller plant is planned for southeast Colorado. And the third plant is located in central Colorado and may use potatoes and railed-in corn.

Indiana (Indianapolis) – *"Ethanol: Growing Renewable Energy and Economic Development."* During February following the workshop, a series of Renewable Motor Fuels Workgroup meetings were held to discuss the primary difficulties in increasing ethanol (and biodiesel) consumption and potential means of further improving that consumption. The group met three times at one-month intervals and included state and city government, the corn and soybean growers, ethanol and biodiesel producers, the petroleum marketers association, and petroleum industry representatives. Although they have no state producer incentive, they set the stage to welcome a second ethanol plant. That plant is now under construction in Rensellear, Indiana.

New York (Albany) – *"Ethanol in New York: Today and Tomorrow."* Prior to the workshop, the general feeling was that ethanol wasn't an option for the Empire State. Two grain-ethanol plants are proposed for New York. One has completed its feasibility study and is seeking equity; the second completed a pre-feasibility study and will soon continue with a full study followed by a business plan. New York is also the home of the most imminent MSW-to-ethanol plant in the country – located in Middleton. That project has spent two years in regulations and mitigation because it is the first of its kind in the country.

Ohio (Columbus) - *"Exploring Fuel Ethanol, Climate Change, Energy, and Other Sustainability Issues."* Taking advantage of the enthusiasm and interest generated by the workshop, legislation for ethanol was introduced shortly afterward. The following year, an incentive in the form of tax benefits for the investors was passed. There are several proposed grain-ethanol projects quite far along, plus a proposed MSW-ethanol plant.

Oregon/Washington (Portland) **–** *"A Conversation about Ethanol in the Northwest: Exploring Fuel Ethanol, Climate Change, Energy, and Other Sustainability Issues."* Oregon and Washington held a joint workshop in conjunction with Transportation 2000. Since then, Oregon and Washington have both make strides to keep the momentum going by scheduling meetings in potential locations for ethanol production facilities to educate local communities and interest groups. Oregon, as reported, held a second workshop and Washington folded their further workshop efforts into the "Harvesting Clean Energy" conferences held annually in Washington by the organization, Climate Solutions.

Pennsylvania (Grantville) – *"Ethanol, for a Cleaner, More Prosperous Pennsylvania."* Pennsylvania also was a state that initially seemed unlikely for an ethanol industry. The workshop brought together key people within state government who previously hadn't worked together on biofuels. They continued their efforts and now a plant, Penn Mar LLC, will be breaking ground soon and one is also under consideration in western Pennsylvania.

Texas (Austin) – "*Renewable Fuels for Rural Economic Development & Clean Air in Texas - A Rural-Urban Partnership."* Prior to the workshop, ethanol only had a profile at Baylor University where testing was underway on ethanol as an aviation fuel. The workshop was attended by the Texas Ethanol Champion, Representative David Swinford from the panhandle area of Texas. He introduced legislation following the workshop, which after constant vigilance and persistence, passed in May 2001. There are three projects that have since conducted feasibility studies and all are planning to move forward

1999

Alaska (Fairbanks) – "*Meeting Mandates and Receiving Benefits from the Production and Use of Ethanol-Based Fuels in Alaska."* This was the first of two workshops that were held in Alaska. The purpose was to educate key people and correct some misinformation on performance issues especially in light of the ethanol program in place in Anchorage. A second workshop, as reported, was held in Ketchikan in 2000 to introduce the concept of a pilot plant for biomass ethanol. A pilot plant is currently under construction for producing ethanol from forest residues using gasification technology.

Maine (Waterville) – *"Ethanol Production Potential in Maine…We Can Get There from Here."* - There is a great deal of interest in developing an ethanol industry in the state using potatoes and forest residues. A steering committee was formed that met several times to investigate the potential and feasibility of ethanol production in the state. In February 2000, a follow-on seminar was held in Augusta to further expand the knowledge base of the key individuals in preparation for their support of ethanol production in the state. A statewide study was conducted following the workshop that determined that Maine may need to wait until cellulosic ethanol is commercially viable before developing an ethanol industry. When that occurs, many key elements are already in place in the state to move the development of the industry along expeditiously.

Michigan (Lansing) – *"Driving Michigan's Ethanol Future."* The first workshop in 1999 was so successful that Michigan chose to hold a second in 2000 and a third Ethanol Workshop was held in September 2001. Legislation that provided a $5,000,000 grant for the first ethanol plant was passed during the workshop. Resultantly, a 40-mmgy ethanol plant was constructed and is in production in Caro, Michigan. An Ethanol Work Group has been established which meets once every month and publishes an Ethanol Update newsletter. Another plant is currently conducting a feasibility study in southern Michigan

Mississippi (Raymond) – *"Renewable Energy for Mississippi: Developing Indigenous Supply Options."* The workshop in 1999 was the first time anyone had spoken about the remote possibility of an ethanol industry in Mississippi. It had, previously, seemed very unlikely. The core organizing group, via the Mississippi Biomass Council, continued meeting and kept the interest and possibility alive. In the fall of 2002, legislation was passed that provides an incentive for ethanol production. There are currently three projects in planning stages.

South Dakota (Rapid City) – The workshop helped elevate the understanding of the farmer-owned cooperative and the LLC. Beyond the three original ethanol plants that already were in the state, four new plants have come on line since the workshop and approximately three are under construction. Interest in cellulosic ethanol is still alive in the Black Hills region. A plant is proposed for the Wyoming Black Hills area by a group who met during the workshop.

Wisconsin *(Madison) – "An Ethanol Production Plant: A Doorway of Opportunity in Wisconsin."* Following the workshop in 1999, the level of interest increased tremendously. A second workshop was held in 2000. In 2000 legislation was written and then passed in 2001 that provides a 20¢ direct to the producer payment. Today there are three plants in production, one under construction and several on the drawing board.

Appendix E: Workshop Presentations

Hawaii Workshop

1. National Energy and Fuels Policy, Eileen Yoshinaka, Pacific Liasion–Honolulu, U.S. Department of Energy
2. Workshop Purpose and Objective, Maurice Kaya, P.E., Administrator, State of Hawaii, Energy, Resources and Technology Division
3. Ethanol Fuel: Coming Soon to a Car Near You, Doug Durante, Executive Director, Clean Fuels Development Coalition
4. Ethanol: An Important Role in Global Transportation Fuels, Gary Herwick, Director, Transportation Fuels, General Motors Corporation
5. Biofuels for Sustainable Transportation, Larry Schafer, Legislative Counsel, Renewable Fuels Association
6. Economic Impact Assessment for Ethanol Production and Use in Hawaii: An Interim Report, Mark Yancey, Director of Consulting Services, BBI International
7. Fuel Ethanol in Hawaii: A Historical Perspective, Warren Hall, Hawaii Manager, EA Engineering, Science and Technology
8. Ethanol Fuel for Hawaii: State Policy, Incentives, and Mandate, Maurice Kaya, Energy Program Administrator, Hawaii State Energy Office
9. Ethanol From Cellulosic Materials, Rick Elander, National Renewable Energy Laboratory
10. Ethanol from Cane Molasses, Jayant Godbole, Praj Industries Ltd.
11. Waste – Our Most Sustainable Resource, Bob Schleser, Aina Institute
12. Steps to Building an Ethanol Plant, Larry Johnson, Delta-T Corporation
13. California Ethanol Project Overview, Barry Duffin, Quality Control Specialist, ConocoPhillips
14. Mike Allen, Allen Oil
15. Larry Johnson, Delta-T Corporation
16. Biofuels for Sustainable Transportation: Ethanol and Fuel Cells, Larry Schafer, Legislative Counsel, Renewable Fuels Association
17. E-Diesel and Biodiesel: A Status Report to the Industry, Doug Vind, Regent International

Nevada Workshop

1. The United States Bioenergy Initiative—A Good Plan for the Country, Jeff James, Bioenergy Program Manager, Seattle Regional Office, U.S. Department of Energy
2. National Overview on Ethanol—Why this Industry is Growing, Neil Koehler, Renewable Fuels Association
3. Ethanol in California—What our Neighbors in the West are Experiencing, Pat Perez, Office Manager, Office of Transportation Fuel Supply and Demand, California Energy Commission
4. Ethanol in Nevada—Historic, Current, and Future, Andy Goodrich, Director, Washoe District Health-Air Quality Management Division
5. E85 and Nevada's Alternative Fuels in Fleets Program, Sigurd Jaunarajs, Environments Scientist, Nevada Division of Environmental Protection
6. Environmental Aspects of Ethanol as a Motor Fuel, David Andress, President, David Andress and Associates
7. Economic Impact for the Rural Economy, Dave Kolsrud, Agri-Energy LLC
8. Considerations and Steps to Take when Building an Ethanol Plant, Mark Yancey, BBI International
9. E10, E85 and Fuel Cells, Doug Vind, Regent International
10. E-Diesel: A Status Report to Industry, James Peeples, Vice President, AAE Technologies, Inc.

Kentucky Workshop

1. The Federal Bioenergy Initiative, David Waldrop, Division Director for the Atlanta Regional Office's Federal Programs, Transportation and Power Division
2. How Ethanol is Made: Grain and Cellulosic, Tim S. Morris, Fagen, Inc.
3. Ethanol Markets: E10, E85, E-Diesel, Fuel Cells, Fairman Thompson, Parallel Products, division of U.S. Liquids
4. Distillers Grains: A Top-Notch Feed, Pearse Lyons, Alltech, Inc.
5. Does the Impact Enjoyed in Minnesota Relate to Kentucky? Ralph Groschen, Minnesota Department of Agriculture
6. Ethanol-Blended Fuels and Minnesota's Environment, Tim Gerlach, American Lung Association of Minnesota

California Workshop

1. Welcoming Remarks, Steve Shaffer, Director, Office of Agriculture and Environmental Stewardship, California Department of Food and Agriculture
2. Overview of Program, Kim Penfold, Project Manager, Seattle Regional Office, U.S. Department of Energy
3. California's Transition from MTBE to Ethanol and Beyond, Mike McCormack, Office of Transportation Fuel Supply and Demand, California Energy Commission
4. Future of Ethanol Use in California's Gasoline Under Different Scenarios/Fuel Blends, Dave Smith, Director, Regulatory Fuel Issues, BP
5. Outlook for E85, Fuel Cells and Other Ethanol Markets in California, Jerry Esper, Senior Manager, Fuel Economy Planning, Daimler Chrysler Corporation
6. Fuel-Cycle Energy and Emission Impacts of Fuel Ethanol, Michael Wang, Environmental Analyst, Argonne National Laboratory
7. California's Ethanol Supply Options, William Maloney, Director of Business Development, ED&F MAN Alcohol
8. Status Report on Opportunities Fostering a California Ethanol Industry, Neil Koehler, Director, California Renewable Fuels Partnership
9. The Investment Climate for Ethanol Production in California, Mark Yancey, Director of Consulting Services, BBI International
10. Overview of Ethanol's Prospective Contribution to California Agriculture, Matt Summers, Air Resources Engineer, California Department of Food and Agriculture
11. Corn-to-Ethanol Project in Colusa County, Phil Cherry, Harvest Biofuels
12. Sweet Sorghum and Sugar Cane to Ethanol in Imperial County, Carson Kalin, Partner, Imperial Bioresources
13. San Joaquin Valley Ethanol Outlook, Ellen Burnes, Professor, California State University, Fresno
14. Next Steps for Ethanol in California, Scott Matthews, Director, Transportation Energy Division, California Energy
15. The Hard Realities of Commercializing Biomass to Ethanol in California, George Simons, PIER Renewable Program Manager, California Energy Commission
16. Biomass-to-Ethanol Process Technology Options, Jim McMillan, Senior Biochemical Engineer, National Renewable Energy Laboratory
17. Biomass Ethanol as a Potential Tool for Forest Fire Hazard Reduction, Doug Wickizer, California Department of Forestry and Fire Protection

Active Process Developers' Approaches and Progress to Date

18. Bob Walker, SWAN Biomass Company
19. Michael Fatigati, Arkenol Fuels, Inc.
20. Gene Jackson, Power Energy Fuels, Inc.
21. Solid Waste Stream to Ethanol in California, Greg Shipley, Genahol, Inc.

22. Dilute Nitric Acid Hydrolysis, Lee MacLean, HFTA, University of California Forest Products Lab
23. Biomass Ethanol Status, Daniel Musgrove, Universal Entech
24. Case Studies on Lignocellulosic Feedstocks and Technological Developments and Options for Ethanol Production, Fran Ferraro, Senior Technical Specialist, Merrick and Company
25. Remaining Steps to Achieving Commercial Biomass-to-Ethanol Process Technology, Bryan Jenkins, Professor, University of California – Davis, and Executive Director, California Biomass Collaboration

Office of Biomass Programs

Hawaii Ethanol Workshop

Honolulu, Hawaii

November 14, 2002

Topics

- Background
- Program Mission and Goals
- Office of Biomass Programs R&D Focus Areas
- Opportunities

Background
Petroleum Production – 2001

- Net crude imports totaled 9.3 Mil. Bbl/day
  - 4.8 Mil. Bbl/day imported from OPEC nations
- Net U.S. Production totaled 5.8 Mil. Bbl/day

Background (cont.)
Petroleum Consumption – 2001

- Imports are a large and growing share of U.S. petroleum consumption
  - 19.6 Mil. Bbl/day consumption
  - 10.9 Mil. Bbl/day net imports
    - 25% of these imports come from OPEC nations
- Petroleum product consumption in the transportation sector was approx. 14.9 Mil. Bbl/day
  - Motor gasoline: 8.61 Mil. Bbl/day

Background (cont.)
Ethanol Production - 2001

- 1.77 billion gallons of ethanol were produced in the U.S.
- 2002 estimates exceed 2 billion gallons
- 90% ethanol produced from the starch portion of the corn kernal

Program Goals

Goals

- Reduce U.S. dependence upon foreign sources of petroleum
- Support development of Industrial Biorefinery

The term 'biorefinery' means equipment and processes that:

- Convert biomass into fuels and chemicals; and
- May produce electricity

Program Mission

Mission

- To foster research and development on advanced technologies to transform our abundant biomass resources into clean, affordable, and domestically-produced biofuels, biopower, and high-value bioproducts for improving the economic development and enhancing the energy supply options of the U.S.

Biomass R&D is a National Priority

- The Biomass R&D Act of 2000 directs DOE and USDA to enhance and coordinate biomass R&D efforts.
- The Energy Title (Title IX) of the new Farm Bill provides supports for increased use of biomass energy and products and for R&D.
- Various pieces of legislation debated in Congress to provide energy tax incentives, funding for R&D, and other forms of tax relief

Opportunities

- On the horizon
  - Develop and integrate bioproducts to enable deployment of biofuels
  - Develop strong partnerships with industry leaders committed to technology deployment
  - Coordinate with USDA
  - Provide Americans with a stronger economy, healthier environment, and more secure future

- More Information:

www.ott.doe.gov/biofuels

www.afdc.doe.gov

www.ccities.doe.gov

www.eren.doe.gov

Hawaii
Fuel Ethanol
Workshop

WELCOME

Maurice H. Kaya, Administrator
State of Hawaii - Department of Business, Economic Development & Tourism - Energy, Resources, and Technology Division
www.state.hi.us/dbedt/ert

Sponsors

- U.S. Department of Energy, Office of Fuels Development
- Pacific Regional Biomass Energy Program
- City and County of Honolulu
- ED&F Man Alcohols
- Hawaii Department of Agriculture
- Hawaii Department of Business, Economic Development & Tourism
- Hawaii Department of Health
- Hawaii Natural Energy Institute
- Hawaiian Commercial and Sugar Company
- Honolulu Clean Cities
- JN Automotive Group

Working Group

Mr.	Richard	Akana	Akana Petroleum Inc.
Mr.	Barry	Ching	State Department of Health
Mr.	Wayne	Condit	Shell Oil Products US
Mr.	Eric	Darmstaedter	WEG-Kauai LLC
Mr.	Douglas	Durante	Clean Fuels Development Coalition
Mr.	Michael	Edwards	Sustainable Kauai
Ms.	Beverly	Harbin	Chamber of Commerce of Hawaii
Mr.	Mark	Hepburn	ChevronTexaco Corporation
Mr.	Steve	Holaday	Hawaiian Commercial and Sugar
Ms.	Sabra	Kauka	Garden Island RC&D
Mr.	David	Keith	Aloha Petroleum, Ltd.
Mr.	Daniel	Kenknight	Oahu Ethanol Corporation
Mr.	Alan	Kennett	Gay and Robinson
Mr.	Kal	Kobayashi	County of Maui Energy Office
Ms.	Susan	Kusunoki	Tesoro Hawaii Corporation
Mr.	Calvin	Lee	State Department of Agriculture
Mr.	Ray	Levinson	U.S. Postal Service Pacific Area Operations
Mr.	William	Maloney	ED & F Man Alcohol Inc.
Mr.	Brad	Nicolai	JN Automotive
Mr.	William	Pierpont	State Department of Agriculture
Mr.	Robert	Primiano	Honolulu Clean Cities
Dr.	Richard	Rocheleau	Hawaii Natural Energy Institute
Mr.	Ralph	Saito	Leeward Petroleum Inc.
Mr.	Glenn	Sato	County of Kauai
Dr.	Bob	Shleser	The 'Aina Institute
Mr.	Robert	Tam	State Department of Health
Ms.	Stephanie	Whalen	Hawaii Agriculture Research Center
Mr.	Gordon	Wong	Tesoro Hawaii Corporation
Mr.	Gordon	Yorke	Hawaiian Commercial and Sugar

Workshop Purpose and Objective

- Provide context
- Present information on current status of fuel ethanol nationally
- Present information on potential for production and use of fuel ethanol in Hawaii
- Provide an opportunity for community input
- Build a foundation for future discussion, work and collaboration in this area

Why Fuel Ethanol?

- Cars can use it.
- Consumers will benefit.
- Our economy will be stronger.
- Our air will be cleaner.

Ethanol Fuel: Coming Soon to a Car Near You

U.S. Department of Energy

Ethanol Workshop

Honolulu, Hawaii

November 14, 2002

Douglas A. Durante
Executive Director
Clean Fuels Development Coalition
Washington, DC

Clean Fuels Development Coalition Constituency

Alternative Fuel Providers

Automobile Manufacturers

Clean Fuel Technology Developers

and the . . .

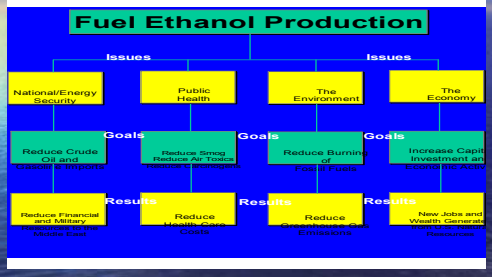
Federal and State Governments, Public and Private Organizations that Support Their Advancement

Ethanol has a Long History of Bipartisan Support

- Energy Security Act of 1978
- Energy Tax Act of 1980
- Alternative Motor Fuels Act of 1988
- Clean Air Act of 1990
- Energy Policy Act of 1992
- Energy Act of 2002??

All Identify Ethanol as a Way to Achieve a Variety of Public Policy Goals

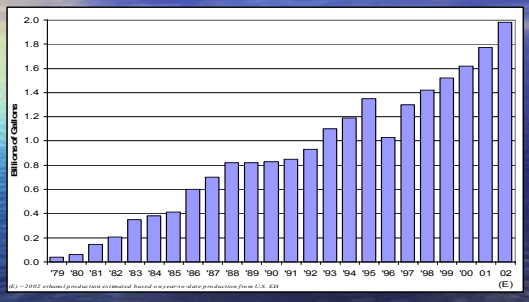
Ethanol is Moving the Nation in the Right Direction



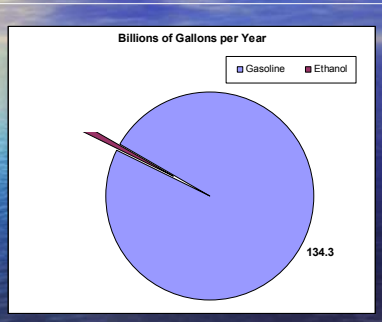
Ethanol Supported by a Variety of Federal and State Programs

- Increasing Ethanol Use:
  - Federal Tax Incentives
  - Clean Air & Control of Fuel Properties
  - Fleet Requirements
  - E-85 and Alt Fuel Credit Program
- Increasing Ethanol Production:
  - Financial Assistance
  - Commodity Programs
  - State and Local Incentives

U.S. Fuel Ethanol Production

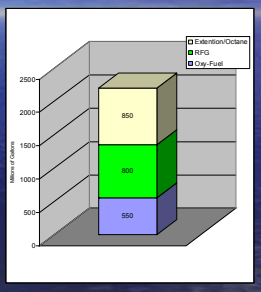


Ethanol Represents Small Sliver of U.S. Petroleum Pie



Current U.S. Ethanol Usage

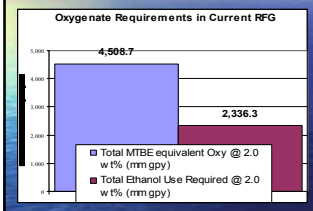
- **Extender and Octane Enhancer**
  - Used at 10 vol%
  - More than 1/2 of the market
- **Oxygenate for Cleaner Fuels**
  - RFG - Smog/Ozone reduction (at least 5.7 vol%)
  - Oxy-Fuels - Wintertime CO (at least 7.7 vol%)
- **Alternative Fuels**
  - OxyDiesel
  - E-85
  - Small market (about 0.5 - 1 million gallons)



Key U.S. Clean Gasoline Programs

- Carbon Monoxide Control
  - 39 Cities in violation of standard.
  - Required to use gasoline containing 2.7% (wt) oxygen during winter months.
  - Extremely effective -- nearly 2/3 have come into compliance -- 20-30% reduction.
- Ozone -- Reformulated Gasoline
  - 9 U.S. cities by law -- a dozen more by choice
  - Vapor pressure controls & oxygen -- 2% (wt)
  - Key emission categories affected:
    - VOCs (exhaust and evaps)
    - Toxics (benzene
    - NOx

Current RFG & Oxygenate Requirements



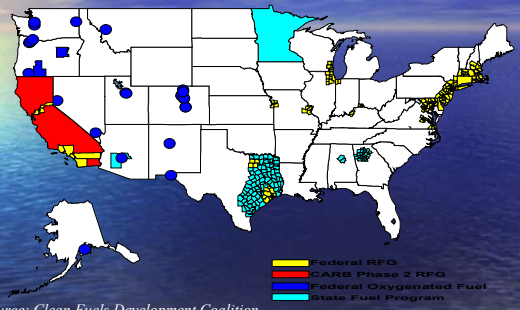
Source: Clean Fuels Development Coalition
Gasoline Demand: U.S. EIA

- The Federal RFG Program currently covers about 41 billion gallons of gasoline in the U.S., according to the U.S. DOE's Energy Information Administration's 1998 Petroleum Marketing Annual.
- Meeting the oxygenate requirement for this fuel with MTBE would require just over 4.5 billion gallons, with ethanol, just over 2.3 billion gallons would be needed.

Possible Banning of MTBE

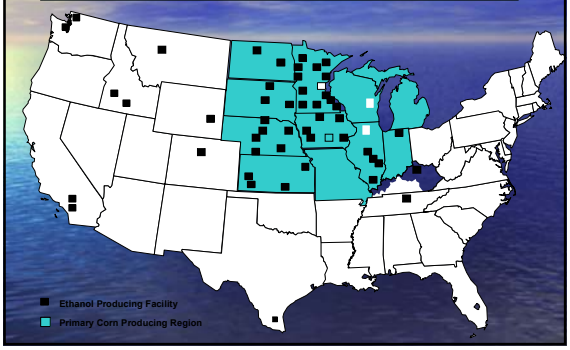
- **4.5 billion gallons used in the U.S.**
- **Proposed to be banned Nationwide**
- **California**
  - Scheduled for elimination in 2004
  - Most refiners already moving away from MTBE
- **Other States are also Banning**
  - Arizona (2003)
  - Connecticut (2003)
  - Maine (no date)
  - Minnesota (2005)
  - Nebraska (use limited)
  - New York (2004)
  - South Dakota (use limited)
- **More to follow when state legislatures begin work in January**

U.S. Clean Fuel Requirements

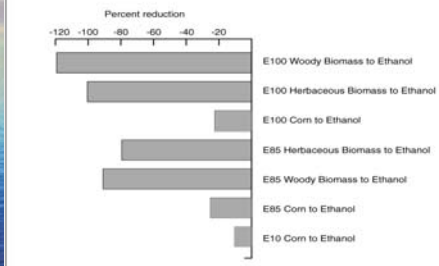


Source: Clean Fuels Development Coalition

U.S. Ethanol Production Centered in Corn-Growing Region

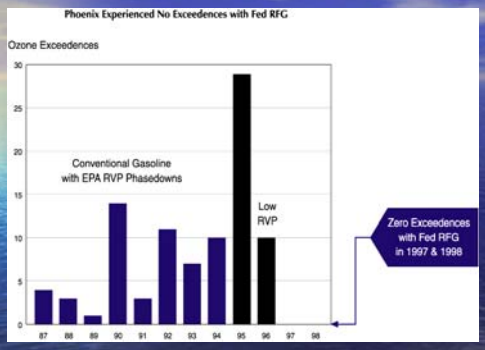


Greenhouse Gas Reductions Compared to Gasoline



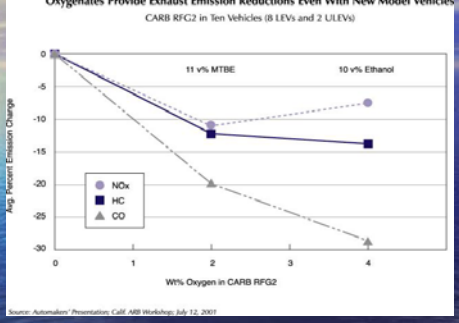
Source: U.S. Department of Energy, Office of Fuels Development and Congressional Research Service

Phoenix Experienced No Exceedences with Fed RFG



Oxygenates Provide Exhaust Emission Reductions Even With New Model Vehicles

CARB RFG2 in Ten Vehicles (8 LEVs and 2 ULEVs)



Source: Automakers' Presentation, Calif. ARB Workshop, July 12, 2001

Birth of the RFS: A Solution to Significant Problems

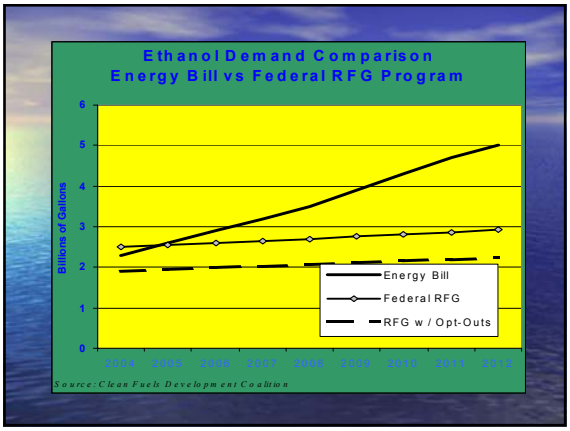
- MTBE In Water
  - Bans MTBE in Four Years
  - Provides Transition and Remediation Assistance
- Limited and Declining Oxygenate Market
  - Replaces Oxygen with Renewable for Demand Pull, Creating More than a Doubling of Market
- Environmental Concerns over Use of Ethanol (Evaporative Emissions)
  - Relieves Urban Areas of Oxygen Requirement
  - Allows for Continued Use in Areas of Success
- Extreme Opposition of Oil Industry to Ethanol Only Program
  - Addresses Difficulties in Meeting Vapor Pressure Restrictions
  - Provides Flexibility in Manner and Geography of Usage

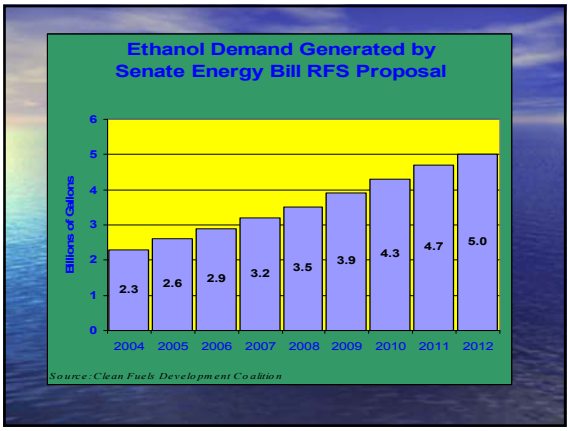
FACT SHEET ON FUEL PROVISIONS OF S.517

- Establishment of a renewable fuels standard requiring 2.3 billion gallons of either ethanol or biodiesel in 2004 and increasing to 5 billion gallons by 2012;
- Decisive vote in U.S. Senate 69-31, currently in Conference Committee
- Allows Refiners to meet requirement through a credits and trading program;
- Banning of MTBE in 4 years (from enactment);
- Repeal of the oxygen content of federal reformulated gasoline;
- Streamlining the process by which Governors can control vapor pressure;
- Authorizes funds for underground tank cleanup;
- Provides assistance for MTBE producers to convert to other, safer additives;
- Promotes development of biomass ethanol through some preferential treatment in the credits program;
- Treats biodiesel and ethanol as equal thus helping both industries.

WIDESPREAD SUPPORT FOR RFS

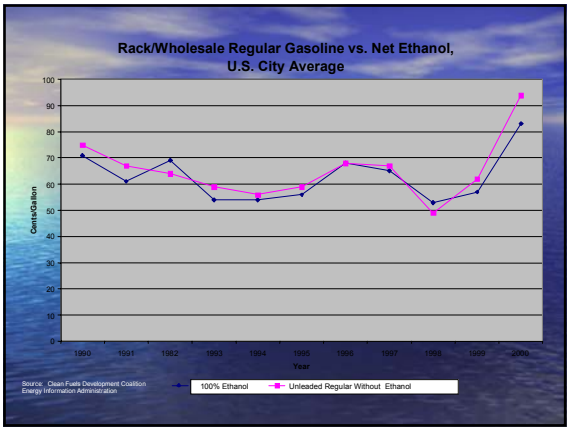
- Ethanol and Agriculture Communities Unified -- RFS Coalition
- U.S. Senate
- Bush Administration -- "*...urges adoption of RFS that will improve the Nation's Energy Security, farm economy, and environment,"* 6-27-02 Letter from DOE Secretary to Conferees
- Governors' Ethanol Coalition
- Key Environmental and Air Quality Organizations
- American Petroleum Institute
- Previous House Support of Oxygenates Likely to Translate to RFS Support

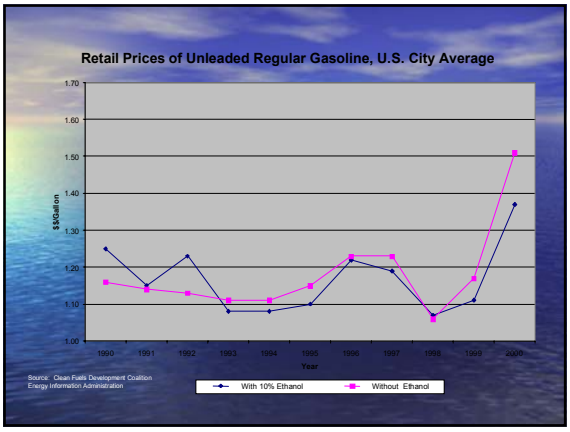




ONGOING ISSUES AND CONCERNS

- Cost and Price:
  - No Basis for Claims of Higher Gasoline Costs
  - CRDC Analysis of US and Nebraska Supports Lower Cost of Ethanol
  - Petroleum Industry Historically Identifies Supply Shortages/Disruptions as Source of Price Spikes
  - Adding Product Addresses Shortages and Holds Down Prices
- Supply Issues:
  - Meeting Production Goals
  - Drought
  - Capital Investment
  - MTBE Volume Loss
- Energy Balance
- "Food vs. Fuel"
- Boutique Fuels
- Concerns over Consolidation of the Industry
- Ethanol Plant Emissions





ENERGY SECURITY

Ethanol is Homegrown for the Homeland -- Capitalize on Strengths

- Imported Oil Remains a Key Issue:
  - 2001 U.S. Consumed 18 mmbd,
  - Transportation Sector Uses 68% of Total
  - 57% Imported, or 9.1 mmbd – 1/3 US Trade Imbalance
  - 2.5 mmbd, or 27% comes from Saudi Arabia and Iraq
  - New Estimates of 28 mmbd by 2020
- Last Week EIA Research Reveals Quarterly Increase in Demand Up One Percent from 2001 While Domestic Production down 3%!
  - Difference Met By Imports!
- Stationary Source Power Remains Critical -- Secretary Abraham Calls for One New Power Plant Per Week for Next 20 Years!
- New Technologies (e.g., gasification) Can Allow Ethanol Plants To Become Generators of Food, Fuel, and Power!

SUMMARY

The ethanol industry is growing throughout the United States. Ethanol offers a tremendous opportunity for Hawaii

- Value added to sugar industry
- Employment and economic development
- Increased supply of motor fuels
- Opportunity to become the first state to have all gasoline blended with 10% ethanol
- E-85 and Oxydiesel offer even more displacement

Go for it!!

Ethanol: An Important Role in Global Transportation Fuels

Hawaii – U.S. DOE Ethanol Workshop

Honolulu, Hawaii

November 14, 2002

Gary Herwick

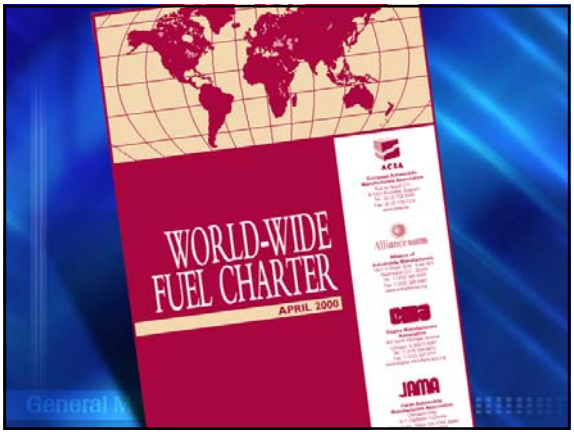
General Motors Corporation

General Motors

Transportation Fuel Quality

- **Fuel quality affects emissions, fuel economy, durability, driveability**
- **Vehicles and fuels must be considered a "system"**
- **Ability to meet stringent global emission requirements increasingly dependent on fuel quality**
  - Insure lowest emissions
  - Enable emission control technology
- **World-Wide Fuel Charter Category 4 (Tier 2/LEV II/Euro IV)**
  - <10 ppm sulfur
  - 1200 DI max
  - Ethanol blends up to 10%, comply with all specifications
- **Address energy use and greenhouse gas emissions concerns**

General Motors



General Motors

General Motors Promotes the Use of Ethanol in Transportation Fuel

- **Approved the use of 10% ethanol blended gasoline in all GM products for 20 years**
- **Owners manuals *recommend* the use of clean fuels containing oxygenates**
- **Largest producer of E85 Flexible Fuel vehicles**
  - Tahoe, Suburban, Yukon, Yukon XL SUV
  - S10, Sonoma, Silverado, Sierra Pickup
- **Strategic transportation fuels initiative**

General Motors

GM E85 Vehicles

General Motors

The Benefits of Ethanol

- **Clean burning fuel**
  - Ethanol blends reduce sulfur and aromatic hydrocarbons for improved exhaust emission performance
  - Evaporative emissions are increased, but are less reactive in forming ozone
- **Renewable fuel**
- **Domestically produced**
- **Ethanol made from corn reduces greenhouse gas emissions**
- **Longer-term, ethanol made from cellulose has the potential to virtually eliminate greenhouse gas emissions from automobiles**

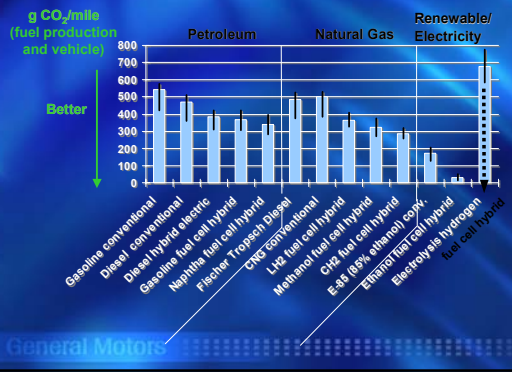
General Motors

Strategic Initiative

- **Promote the use of E85 as a renewable alternative fuel, and as a means of addressing CO2 emission concerns. Support the development of ethanol from cellulose.**
- **GM commissioned Well-to-Wheels life cycle analysis of energy use and greenhouse gas emissions**
  - Compares 15 propulsion technologies and 75 different fuel "pathways"
  - Ethanol (E85) reduces greenhouse gas emissions more than any other alternative fuel
- **"The alternative fuel that makes sense."**

General Motors

Well-to-Wheel Greenhouse Gases



General Motors

Ethanol and Emissions

- **More stringent emission requirements**
  - Zero evaporative emissions
  - Control of warm-up emissions = ability to meet standard
- **Fuel system permeation**
  - Swelling of fuel system elastomer materials
  - Increased evaporative emissions
- **Exhaust emissions**
  - Higher heat of vaporization contributes to incomplete vaporization during engine cold start and warm-up
  - Increased exhaust HC emissions
- **CRC test programs will quantify effects on LEV vehicles**
- **Mitigation strategies are needed**

General Motors

Gasoline DI Limit

- **A DI limit enhances the opportunity for ethanol blended fuels**
- **DI limit applies to the HC blendstock**
- **Mitigates impact of ethanol on cold start HC emissions**
- **Renewable Fuel Standard and a DI limit go together**

General Motors

Ongoing GM Support

- **Research on the development of ethanol from bio-mass**
- **Development of E85 fueling infrastructure**
  - Partnership with BP to provide E85 fueling capability for GM company vehicle fleet in Southeast Michigan
  - Additional infrastructure and education project plans
- **Membership in CFDC, NEVC**

General Motors

BP (Amoco) E85 Station
Rochester Hills, MI

General Motors

Summary

- Transportation fuels must address energy use and greenhouse gas emissions concerns.
- General Motors has supported the use of ethanol in transportation fuels for many years.
- GM is the largest producer of E85 Flexible Fuel vehicles.
- GM will continue to support increased use of ethanol through research and infrastructure development.
- A DI limit on US gasoline enhances the opportunity for ethanol, mitigates emissions impact of ethanol.

Biofuels for Sustainable Transportation

Hawaii

Larry Schafer
Legislative Counsel
Renewable Fuels Association

Overview

- The Ethanol Industry Today
- Current Markets for Ethanol
- Expectations for Industry Growth
- The "Renewable Fuels Standard"
- New Market Opportunities
- USDA Programs – Starting an Ethanol Facility

U.S. Ethanol Industry Today

- Annual production record in 2001 of 1.77 bgy
- 2.4 bgy capacity today
- 65 facilities in 20 states
- 12 plants under construction (>400 mgy) will increase capacity to 2.7 bgy by end of year
- Expansions to existing facilities underway
- Dozens of additional plants in various stages of development

U.S. Ethanol Production Facilities

Current U.S. Markets

▪ Octane/Extender ~	830 mgy
▪ Winter Oxyfuel Program ~	250 mgy
▪ Reformulated gasoline ~	450 mgy
▪ Minnesota oxygen program~	250 mgy
▪ Total	1.78 bgy

What's Leading Industry Growth?

- Concerns about MTBE contamination
- California market opportunity
  - California Switching to Ethanol
    - BP / Shell / Phillips / Exxon-Mobil
    - 56% of California Market
    - 400 – 500 mgy
- Need to expand U.S. fuel supply
- Energy and homeland security agenda

Senate Energy Bill Fuels Agreement

- Phases out MTBE use in 4 years
- Eliminates 2% RFG oxygen standard from the Clean Air Act
- Maintains current air quality gains of RFG program
- Creates Nationwide Transportation Fuels Program
- Creates Renewable Fuels Standard (RFS)

Renewable Fuels Standard in S. 517 (HR 4)

- Requires gradual and increasing percentage of renewable fuels, including ethanol and biodiesel, growing to 5 bgy in 2012
- Credit Trading and Banking
- DOE can adjust % upward or downward, depending on supply
- Temporary Waivers
- Small Refiner Exemption

Economic Impact of RFS

- Provide a one-time boost of $142 million to the local economy during construction.
- Expand the local economic base of the community by $110.2 million each year through the direct spending of $56 million.
- Create 41 full-time jobs at the plant and a total of 694 jobs throughout the entire economy.
- Increase the local price of corn by an average of 5-10 cents a bushel, adding significantly to farm income in the general area surrounding the plant.

Economic Impact of RFS

- Increase household income for the community by $19.6 million annually.
- Boost state and local sales tax receipts by an average of $1.2 million (varies depending on local rates).
- Provide an average 13.3 percent annual return on investment over ten years to a farmer who invests $20,000 in an ethanol production facility.

Senate Energy Bill Fuels Agreement

- Supported by:
  - American Petroleum Institute
  - Northeast States for Coordinated Air Use Management (NESCAUM)
  - American Lung Association
  - Renewable Fuels Association
  - Renewable Energy Action Project
  - Others

New Market Opportunities

- E-Diesel fuel blends
- Fuel Source for Fuel Cells
- Research underway to identify new uses and high-value co-products
- Worldwide demand for renewable fuels growing as means to reduce GHG and develop new agricultural markets

USDA Programs – Starting an Ethanol Facility

On the federal level, the U.S. Department of Agriculture (USDA) Rural Development Office provides financial assistance in the form of grants and loans to improve the economy and quality of life in rural America. Technical assistance and information resources are also available. These programs can assist entities seeking to develop and build an ethanol production facility.

USDA Programs – Starting an Ethanol Facility

USDA provides two types of Programs:

Business Programs
&
Cooperative Services.

USDA Business Programs

USDA through its "Rural Business-Cooperative Service" program creates partnerships with commercial lending institutions, the Farm Credit System, Farmer Mac, and other supplemental sources of funding to provide financing for qualified rural business enterprises.

Business Programs are available to businesses in areas outside the boundary of urban areas with populations under 50,000.

Recipients may include any legally organized entity, including cooperatives, corporations, partnerships, trusts, profit and nonprofit organizations, Indian tribes, private companies, municipalities, counties or individuals.

USDA Business Programs

Business and Industry (B&I) Guaranteed Loan Program: Provides financial backing for rural businesses to help create jobs and stimulate rural economies. Provides guarantees up to 90% of a loan made by a commercial lender. Loan proceeds may be used for working capital, machinery and equipment, buildings and real estate, and certain types of debt financing. The maximum loan amount to any one borrower is $25 million.

Cooperative Stock Purchase Program: Farmers can use B&I loan guarantees to help pay for stock in a start-up cooperative that processes an agricultural commodity into a value-added product. The cooperative must be a new venture. The cooperative (not the farmer) must make a written request to its USDA Rural Development State Office for determination of eligibility.

USDA Business Programs

Rural Business Opportunity Grants: Designed to promote economic development in rural communities by making grants to pay the costs of providing economic planning, technical assistance, or training. Applicants must be a public body, nonprofit corporation, Indian tribe, or cooperative with members that are primarily rural residents. Applicants must have expertise in the activities proposed and be able to demonstrate that funding will result in rural economic development. A maximum of $1.5 million is available for the program, with most grants of $50,000 or less.

USDA Business Programs

Rural Business Enterprise Grants: The Rural Business-Cooperative Service makes grants to facilitate development of small and emerging business enterprises in rural areas. Use of grant funds may include acquisition and development of land and the construction of buildings, plants, equipment, access roads, parking areas, and utility extensions; refinancing; fees; technical assistance and training; loans to third parties; production of television programs to provide information to rural residents; and distance learning networks.

USDA Business Programs

Intermediary Relending Program: The purpose of the Intermediary Relending Program (IRP) is to finance business facilities and community development projects in rural areas. This is achieved through loans made by the Rural Business-Cooperative Service (RBS) to intermediaries. Intermediaries re-lend funds to ultimate recipients for business facilities or community development. Intermediaries establish revolving loan funds so collections from loans made to ultimate recipients in excess of necessary operating expenses and debt payments will be used for more loans to ultimate recipients.

USDA Business Programs

Rural Economic Development Loans: Provides zero-interest loans to electric and telephone utilities financed by the Rural Utilities Service (RUS), an agency of the United States Department of Agriculture, to promote sustainable rural economic development and job creation projects.

RUS Electric Program: Makes insured loans and guarantees of loans to nonprofit and cooperative associations, public bodies, and other utilities. Insured loans primarily finance the construction of facilities for the distribution of electric power in rural areas. The guaranteed loan program has been expanded and is now available to finance generation, transmission, and distribution facilities in rural areas.

USDA Cooperative Service Programs

Promotes understanding and use of the cooperative as a viable organizational option for marketing and distributing agricultural products. Helps rural residents form new cooperative businesses and improve the operations of existing cooperatives.

Value-Added Agricultural Product Market Development Grants - Independent Producers: This grant program seeks to encourage independent agricultural producers to further refine their products for value-added benefits. These grants will facilitate greater participation by farmers in markets for value-added agricultural commodities and facilitate the opening of new markets for value-added products. The proposed project must change the form of an agricultural product, such as processing grain into ethanol, wheat into flour, etc.

USDA Cooperative Service Programs

Cooperative Development Technical Assistance: Provides assistance for those interested in forming a new cooperative, from an initial feasibility study to the creation and implementation of a business plan.

Technical Assistance: Could include helping a cooperative develop a strategic marketing plan, determine whether to merge or form a joint venture with other coops, or find a way to turn raw products into value-added products. Assistance often includes an analysis of operations or assessing the economic feasibility of new facilities or adding new products or services.

USDA Cooperative Service Programs

Cooperative Services also conducts research, provides education and information, and collects historical data and statistics. For further information or assistance for cooperatives, contact:

USDA Rural Development/Cooperative Services
Stop 3250
Washington, DC 20250-3250
(202) 720-7558 FAX: (202) 720-4641
email: coopinfo@rurdev.usda.gov

USDA Special Initiatives

Commodity Credit Corporation (CCC) Bioenergy Program: Under the program, the CCC has made up to $150 million available annually in incentive cash payments to bioenergy (ethanol and biodiesel) producers in the U.S. that increase their purchases of agricultural commodities over the previous fiscal year's purchases and convert that commodity into increased bioenergy production.

USDA Special Initiatives

Rural Cooperative Development Grants: USDA grants are available for establishing and operating centers for cooperative development to improve rural economies through the development of new cooperatives and to improve the operations of existing coops.

Biobased Products and Bioenergy Program: This program seeks to promote national economic interests through the conversion of renewable farm and forestry resources to affordable fuel (i.e. ethanol and biodiesel), chemicals, electricity, pharmaceuticals, and other materials in cost- competitive manner. Loans are eligible for financing under the Business and Industry Guaranteed and Direct Loan Programs (see above).

Contact Information:

Renewable Fuels Association
(202) 289-3835
Web site: www.ethanolRFA.org
Email: Info@ethanolrfa.org

Economic Impact Assessment for Ethanol Production and Use in Hawaii: An Interim Report

Hawaii Ethanol Workshop
sponsored by DOE and DBEDT
November 14, 2002

BBI International
Mark Yancey
602 Park Point Drive, Suite 250
Golden, Colorado 80401
(303) 526-5655 mark@bbiethanol.com

BBI International

- Bryan & Bryan, Inc. founded in 1995 by Mike and Kathy Bryan
- 18 full-time employees
- 80+ years ethanol and biofuels experience
- Services:
  - Ethanol and Bioenergy Project Development
  - International Conferences and Workshops
  - Ethanol Producer Magazine
- An independent source of information and data for owners, lenders and policy makers

Presentation Overview

- Economic impact assessments
- Resources for ethanol production on Hawaii
- Ethanol market potential
- Ethanol production scenario
- Capital and operating cost estimates for ethanol production in Hawaii
- Economic impact results

Economic Impact Assessments

- Determine the impact of new economic activity on jobs, income, total spending and taxes for a specific region or area
- Determine the direct impacts and then use “multipliers” to determine indirect and induced impacts
- Not a feasibility study

Hawaii’s Resources for Ethanol Production

- Ethanol is typically produce by fermentation of sugars by yeast
- All plants contain sugar, starch or cellulose – all can be used to make ethanol
- Hawaii has sugar and cellulose feedstocks and few starch crops
- MSW (garbage) can also be used

Feedstock Assessment

- There are only two crops grown in Hawaii at the scale required for production of ethanol:
  - Sugarcane and molasses
  - Pineapples (too expensive)
- Agricultural residues
- MSW and food waste
- Energy crops

Ethanol Potential

Feedstock Resource	Supply (dry tons)	Ethanol Yield (gal/ton)	Ethanol Potential (MMGY)
Sugar-based crops			
Raw sugar	300,000	150	45
Molasses	100,000	72	7
Food Waste	40,500	62	3
Organics in MSW	620,000	60	37
Lignocellulosics			
Pineapple residues	181,000	80	14
Sugarcane residues	535,000	75	40
State Total	**1,776,500**	**83**	**148**

Based on 2001 crop production data

Ethanol Market Potential

- Hawaii's transportation market is dependant on imported oil
- Present annual consumption of gasoline by the ground sector in Hawaii is on the order of 400 MMGY
- At 10% ethanol blend by volume = 40 million gallons of ethanol per year

Ethanol Production Scenario

- There are many possible scenarios for ethanol production in Hawaii
- After considering many different scenarios, BBI selected:
  - ❖15 MMGY on Oahu from MSW
  - ❖15 MMGY on Maui from Molasses
  - ❖10 MMGY on Kauai from Molasses

Oahu Ethanol Plant

- 15 million gallon per year capacity
- Assume that at this size the operation of the H-Power facility will not be affected
- Would utilize lignocellulosic biomass to ethanol technology (not commercial)
- An option for future consideration is to integrate an organic recycling program focused on generating biogas from food wastes to fuel the ethanol plant

Maui Ethanol Plant

- 15 million gallon per year capacity
- The Maui plant would utilize molasses from current sugar operations, supplemented with sugar from existing operations or from new sugarcane production

Kauai Ethanol Plant

- 15 million gallon per year capacity
- The Kauai plant would utilize molasses from current sugar operations, supplemented with sugar from existing operations or from new sugarcane production

Capital Cost Estimates

Ethanol Plant Site	Oahu	Maui	Kauai
Ethanol Production (Gal/Year)	**15,000,000**	**15,000,000**	**10,000,000**
Project Costs			
Ethanol Plant Cost per Gallon	$2.67	$1.94	$2.17
Engineering & Construction	$39,981,000	$29,143,000	$21,714,000
Inventory - Biomass	$136,000	$240,000	$160,000
Inventory - Chemicals/Denaturant	$66,000	$67,000	$45,000
Inventory - Ethanol & Lignin	$453,000	$435,000	$290,000
Spare Parts	$300,000	$300,000	$200,000
Startup Costs	$700,000	$700,000	$500,000
Land	$300,000	$300,000	$200,000
Administration Building & Furnishing	$200,000	$200,000	$200,000
Site Development Costs	$500,000	$500,000	$500,000
Tools and Laboratory Equipment	$200,000	$200,000	$200,000
Organizational Costs	$700,000	$700,000	$500,000
Capitalized Fees and Interest	$1,079,000	$787,000	$586,000
Working Capital	$400,000	$291,000	$217,000
Estimated Total Project Cost	**$45,015,000**	**$33,863,000**	**$25,312,000**

Operating Cost Estimates

Ethanol Plant Site	Oahu	Maui	Kauai
Production & Operating Expenses			
Feedstocks	$4,809,524	$8,487,395	$5,658,263
Purchased Cellulase Enzymes	$1,454,400	$0	$0
Other Chemicals	$1,115,329	$1,154,286	$769,524
Fuel Oil	$2,980,950	$2,833,333	$1,888,889
Electricity	$2,040,000	$1,165,714	$777,143
Denaturants	$655,714	$655,714	$437,143
Other costs	$484,757	$196,856	$137,585
Direct Labor & Benefits	$1,059,537	$1,059,537	$753,729
Total Production Costs	$14,600,211	$15,552,836	$10,422,275
Administrative Expenses	$2,777,196	$2,387,153	$1,910,661
Principal & Interest - Debt	$4,044,757	$3,010,711	$2,259,877
Annual Operating Expense	**$21,422,164**	**$20,950,700**	**$14,592,813**
Number of Employees	**31**	**31**	**22**

Economic Impacts

- The expenditures of the ethanol plants will become the income of other businesses or individuals, which in turn is re-spent in the economy to provide income for others
- The initial economic activity has a multiplier effect that ripples through the economy
- Economic impact analysis is an analytical method that provides a measure of the economic effects of an activity within a specified region

Economic Impact Results

Construction Phase Impacts	Oahu	Maui	Kauai
Ethanol Plant Capital Cost (millions)	$45.0	$33.9	$25.3
Final Demand Impact (millions)	$109.2	$82.2	$61.4
Earnings Impact (millions)	$35.5	$26.7	$19.9
Employment Impacts (indirect jobs)	1,108	833	623

Operations Phase Impacts	Oahu	Maui	Kauai
Operating Expenditures (millions)	$21.3	$20.8	$14.5
Final Demand Impact (millions)	$42.0	$41.1	$28.6
Earnings Impact (millions)	$7.5	$7.3	$5.1
Employment Impacts (direct jobs)	31	31	22
Employment Impacts (indirect jobs)	226	221	154
Total Jobs	257	252	176

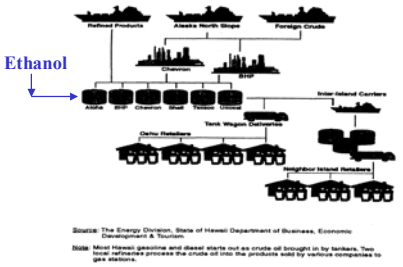
Tax Impacts

Impact of State Producer Payment	Oahu	Maui	Kauai
Ethanol Plant Average Pre-Tax Income (millions)	$3.6	$4.1	$2.0
Hawaii & Federal Corporate Income Tax Revenu	$1.5	$1.7	$0.8
Hawaii Personal Income Tax on Earnings	$0.6	$0.6	$0.4
Total Tax Revenue (millions)	$2.1	$2.3	$1.3
State Producer Payment (millions)	$4.2	$4.2	$2.7
Annual Return to State (millions)	($2.1)	($1.9)	($1.4)

Impacts to Fuel Refining and Distribution Systems

- Dr. Joseph Masin conducted a study to determine the capital and operating cost impacts of blending fuel grade ethanol with gasoline in Hawaii
- Ethanol is assumed to be manufactured in Hawaii and blended with gasoline at 10% by volume

Hawaii's Gasoline Distribution System



Source: The Energy Division, State of Hawaii Department of Business, Economic Development & Tourism

Note: Most Hawaii gasoline and diesel starts out as crude oil brought in by tankers. Two local refineries process the crude oil into the products sold by various companies to gas stations.

Ethanol Blending

- Petroleum refiners will need to remove light gasoline components, like butanes and pentanes, from current blend recipes in order to accommodate the relatively high vapor pressure that results when ethanol is blended with gasoline at 5 to 10 percent by volume ethanol
- This may require modification of distillation and storage facilities, as well as finding markets for the removed components

Ethanol Blending Scenarios

Component	Volume 10^6 gal/yr	RVP psi	Octane RM/2	Weight 10^3 T/yr	LHV 10^9Btu/yr
Case 1	Existing Blend				
Butane	24	51.5	92	58	-2295
LVN	16	12.0	61	43	-1685
Other Gasoline Base	360	8.8	89	1206	-45828
Total	400	11.5	88.2	1308	-49807
Content per gallon (# or Btu)				6.54	-124518
Case 2	Add ethanol, waive RVP limit				
Ethanol	44	18.0	113	145	-3454
Butane	24	51.5	92	58	-2295
LVN	14	12.0	61	38	-1464
Other Gasoline Base	360	8.8	89	1206	-45828
Total	442	12.1	90.8	1447	-53041
Content per gallon (# or Btu)				6.55	-120027
Case 3	Add ethanol, keep RVP limit				
Ethanol	43	18.0	113	141	-3375
Butane	18	51.5	92	43	-1675
LVN	14	12.0	61	38	-1469
Other Gasoline Base	360	8.8	89	1206	-45828
Total	434	11.5	90.7	1428	-52348
Content per gallon (# or Btu)				6.57	-120485
Case 4	Replace lights with Ethanol, keep RVP				
Ethanol	41	18.0	113	135	-3211
Butane	8	51.5	92	19	-765
LVN	0	12.0	61	0	0
Other Gasoline Base	360	8.8	89	1206	-45828
Total	409	10.6	91.6	1360	-49803
Content per gallon (# or Btu)				6.65	-121799

Summary of Refinery and Fuel Distribution Impacts

Ethanol Blending Description	Case 2 Waive RVP Limit	Case 3 Keep RVP Limit	Case 4 Replace Lights with Ethanol
Vapor Pressure (psi) *	12.1	11.5	10.6
Refiner's Capital Costs ($MM)	$3.00	$4.30	$5.70
Additional Labor (FTE)	8.90	8.80	8.60
Net Refiner Revenue ($/gal)	$0.07	$0.06	$0.02
Net Decrease in Energy ($/gal)	($0.05)	($0.05)	($0.03)
Net Savings with Ethanol ($/gal)	$0.02	$0.01	($0.01)

* Vapor pressure limit for gasoline in Hawaii is 11.5 psi

Conclusions for Ethanol Production Impacts

- These results are preliminary! Refinery side impacts are not incorporated
- Sugar and starch feedstocks are in short supply due to declining sugarcane acreage
- Lignocellulosic feedstocks are plentiful, but the corresponding ethanol technology is not yet commercial
- The potential ethanol market on Hawaii is 40 MMGY and growing

Conclusions

- Ethanol production brings significant positive economic impacts:
  - Total constructions costs = $104 million
  - The resulting total economic impact during construction is estimated to be $253 million
  - Total jobs created during construction are approximately 2,564 with an increase in personal income of $82 million
  - Combined annual operating costs = $57 MM
  - Creating $112 million in total annual economic activity and 686 new jobs

Fuel Ethanol In Hawaii:
A Historical Perspective

Prepared for:
U.S. Department of Energy
Ethanol Workshop

Ethanol Fuel:
Coming Soon to a Car Near You

Honolulu, Hawaii
November 14, 2002

Historical Perspective

- Early ethanol fuel use
- Notable non-fuel uses
- Chronology of ethanol fuel use
- Past problems experienced in Hawaii
- Typical types of problems reported
- Possible causes and solutions
- Simple steps to eliminate problems

Early Ethanol Fuel Use

- Maui Agriculture Co. (Paia mill) built the first distillery in U.S. to produce ethanol from molasses for fuel use in 1917!
- Ethanol used to operate cars, trucks, and camp stoves during WWI.
- Continued to use ethanol fuel until 1922(?) when gasoline and kerosene supplies became cheaper and more consistent.

Notable Non-Fuel Uses

- Seagram's constructs a distillery at HC&S Puunene (Maui) to produce rum in 1963. Rum is sold under the Leilani brand.
- Distillery closes in 1969.
- A&B acquires distillery in 1976.
- A&B sells facility to Maui Distillers in 1980 to produce "Hana Bay" and "Whaler's" brand rum.
- Closed in 1986.
- Hawaiian brand rums still exist today.

Chronology of Ethanol Fuel Use

- Worldwide oil shortages causes gasoline prices to skyrocket in 1970s.
- Midwestern farmers focus on using corn to produce ethanol as a gasoline "extender."
- Various studies in Hawaii focus on using ethanol from molasses to accomplish same thing.
- Local sugar industry is optimistic and invests heavily into research in this area.
- HSPA (now HARC) studies indicate profitability of producing ethanol from molasses will rely heavily on government incentives.

Chronology of Ethanol Fuel Use

- Aloha Petroleum imports ethanol to blend with gasoline and begins marketing "gasohol" in 1979.
  - *Hawaii is a national leader by being one of the first locations to offer gasohol to the general public.*
  - *Customer problems attributed to gasohol arise immediately. (Discussed in more detail later)*
- In 1979, A&B and Maui Distillers agree to reopen Maui distillery to produce ethanol for both fuel and alcoholic beverages.

Chronology of Ethanol Fuel Use

- In 1980, the legislature contemplates a $0.06 per gallon tax to underwrite construction of a $40 million fuel ethanol plant. Proposal goes nowhere.
- C. Brewer (now BEI) completes a feasibility study in March 1981 to build an 11.4 million gallon per year molasses to ethanol plant on Big Island. Plans to build the facility continue to move ahead.
- Nationally, average retail gasoline prices peak at $1.94 per gallon in 1981.

Chronology of Ethanol Fuel Use

- State demonstrates a 10% ethanol blend in DAGS fleet in early 1981.
  - *Conducted between February and May 1981*
  - *Involved 127 vehicles (1972 to 1980 model years)*
  - *Over 348,000 miles*
  - *No unusual problems noted*
- Average national gasoline prices begin to drop in 1982.

Chronology of Ethanol Fuel Use

- Aloha Petroleum discontinues their 2.5 year-old gasohol program in 1982.
  - *Weak demand and less overall interest spur decision.*
  - *Overall program was not doing well financially.*
- By 1984, the average national gasoline price had dropped over 22% from the 1981 peak.
- C. Brewer decides to cancel plans to build Big Island ethanol plant in 1984.
  - *Unable to finalize long-term ethanol purchase agreement with local refineries*
  - *Unable to justify investment since they do not directly market gasoline*

Chronology of Ethanol Fuel Use

- Pacific Ethanol Products builds a small ethanol production facility on Oahu in 1985.
  - *Molasses obtained from Oahu Sugar.*
  - *Completed by end of 1985 to obtain federal tax credits.*
- Nationally, U.S. EPA mandated phase-down of lead levels in gasoline reaches 0.1 gram per gallon. Alternative octane enhancers, including ethanol, gain favor.
- In 1986, Aloha Petroleum imports ethanol to blend and market an "ethanol-enhanced" unleaded fuel.

Chronology of Ethanol Fuel Use

- State again demonstrates a 10% ethanol blend in the DAGS fleet in late 1986.
  - *Uses only Hawaii-produced, molasses-derived ethanol from Pacific Ethanol Products.*
  - *Problems with vapor lock on about 1% of fleet every week.*
  - *Vapor pressure of blend was found to be excessive. Can be corrected with proper blending.*
- By 1987, national average gasoline price had dropped to $1.10 per gallon.

Chronology of Ethanol Fuel Use

- By the late 1980s, Pacific Ethanol Products was the only entity offering ethanol for fuel blending in state.
- Many of the economic incentives driving the production of ethanol in Hawaii were gone.
- Due to naturally clean air, Hawaii was not mandated to reduce CO emissions through use of oxygenates (e.g., ethanol, MTBE)
- National average gasoline price was under $1.06 per gallon by 1993.

Past Problems Experienced in Hawaii

- There were problems reported by automotive service technicians believed to be related to the use of gasoline blended with ethanol.
- Mostly anecdotal.
- Controlled studies showed few of these same problems (e.g., State DAGS fleet, 1981).
- Very few problems ever reported regarding engine power, mileage, or performance.
- Similar problems were initially seen in other U.S. mainland locations and have been overcome.

Typical Types of Problems Reported

- Deterioration of rubber components in carburetors, fuel lines, and fuel pumps.
- Fuel filter plugged with debris.
- Vapor lock.
- Water in fuel line.

Possible Causes and Solutions

- Deterioration of rubber components in carburetors, fuel lines, and fuel pumps.
  - *Appeared to only affect certain makes and models of vehicles.*
  - *Components in newer vehicles have been updated and are fully compatible.*
  - *All vehicle warranties now cover use of ethanol blended fuel.*
  - *Most older cars have already had these parts replaced with newer materials.*

Possible Causes and Solutions

- Fuel filter plugged with debris.
  - *No evidence that ethanol contained debris.*
  - *Ethanol has inherent solvent and detergent qualities. If any system is dirty (i.e., vehicle fuel system, UST at dispensing location, transport truck, etc.), the addition of ethanol may loosen and suspend this debris.*
  - *Fuel systems on newer vehicles very clean.*
  - *More detergents being used in gasoline now than previously.*
  - *Filter is doing its job.*

Possible Causes and Solutions

- Vapor lock.
  - *Can be caused by high vapor pressure or a high vapor/liquid ratio of the fuel.*
  - *Ethanol has a high vapor pressure and raises the vapor pressure of the blended fuel.*
  - *Current formulation of gasoline refined in Hawaii has a vapor pressure too high to allow direct blending with ethanol without exceeding the U.S. EPA maximum vapor pressure parameter.*
  - *Blending ethanol with gasoline refined in Hawaii would necessitate refiners to reformulate the vapor pressure or their gasoline.*

Possible Causes and Solutions

- Water in vehicle fuel line
  - *Water may have come from vehicle's fuel tank or the gasoline UST.*
  - *Water in vehicle's fuel tank*
    - *Extremely rare to have water in fuel system in newer vehicle.*
    - *If older vehicle has water in fuel tank, addition of ethanol may move water into fuel line.*

Possible Causes and Solutions

- Water in vehicle fuel line (continued)
  - *Water in gasoline UST*
    - *Older gasoline USTs may have contained water. This water may have mixed with the ethanol and caused water to be transferred to vehicle.*
    - *Hawaii Department of Health UST program became operational in 1986. UST operations are now regulated to a much higher degree than before.*
    - *Critical that USTs must be free of water before ethanol blends are added. However, once UST is free of water, ethanol blend will keep UST water free.*
    - *Normal practice now to place a filter on dispensing pump to prevent transfer of any free water in UST to vehicle. This was not a common practice previously.*

Simple Steps to Eliminate Problems

- Be certain that gasoline USTs are free of any free water before being used for ethanol blends.
- Work with refiners to obtain gasoline with the correct vapor pressure so that ethanol can be blended without exceeding U.S. EPA maximums.
- Install filters on dispensing pumps to remove free water.
- Be prepared to replace some rubber seals, etc. on older and vintage vehicles.

Ethanol In Perspective… Then and Now

THEN

- Used as a gasoline "extender"
- Octane boost came from lead
- Very few concerns of gasoline's effect on air quality
- Very little experience with ethanol blends
- Vehicle manufacturers generally not supportive

Ethanol In Perspective… Then and Now

NOW

- Used as a gasoline extender, oxygenate, and octane booster
- Used in more than 40 states
- ALL automobile manufacturers approve of use of E10
- Strong Federal and State support for reasons of economic and energy security
- Clearly defined handling and storage standards based on "real world" experience

Ethanol Fuel for Hawaii: State Policy, Incentives, and Mandate

State of Hawaii
Department of Business, Economic Development & Tourism
Energy, Resources, and Technology Division
www.state.hi.us/dbedt/ert

Maurice H. Kaya, Administrator

State Laws Supporting Fuel Ethanol

- Ethanol production credit
- Exemption from 4% state excise tax on retail sales
- Reduced highway taxes on E85
- Ethanol content requirement

State Tax Credit for Investment in Ethanol Production Facilities

- Equivalent to 30 cents per gallon of fuel-grade ethanol produced
- Credit for up to 15 million gallons / year / facility
- Available up to 8 years if investment was less than $50 million; up to 10 years for investment greater than $50 million
- Facility must be in Hawaii and in production before January 1, 2012.
- www.state.hi.us/dbedt/ert/ethanol-incentive.html

Exemption from 4% state excise tax on retail sales for alcohol fuels

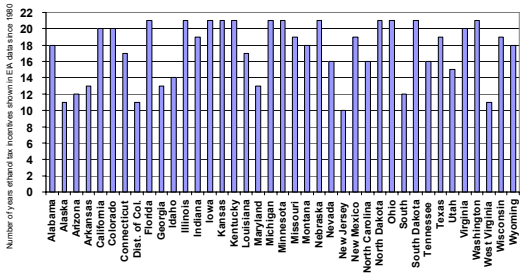
- Fuel mixture consisting of at least 10% biomass-derived alcohol
- Applies to E10 and E85
- Exemption terminates on December 31, 2006
- www.capitol.hawaii.gov
  (find Hawaii Revised Statutes section 237-27.1)

Reduced Rate of State Highway Tax

- Alternative fuels are subject to one-half the effective state highway tax rate of diesel fuel
- Applies to E85
- Does not apply to E10 or oxydiesel
- www.state.hi.us/dbedt/ert/fueltax-act143.html

State plus County taxes for on-highway use of alternative fuels:							
	Honolulu		Maui		Hawaii		Kauai
Ethanol (E100)	$	0.094	$	0.084	$	0.072	$ 0.084
Gasoline	$	0.325	$	0.290	$	0.248	$ 0.290

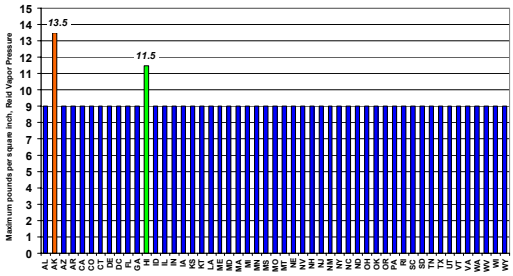
States with 10 or more years of fuel ethanol use



Fuel ethanol on the Mainland

- On the Mainland, "independent" gasoline stations were the first to offer E10.
- Adding 10% ethanol to gasoline:
  - raises octane 3 points
  - raises vapor pressure (RVP) 1 pound / sq. in. (psi)
- EPA imposed summertime volatility limits of 7.0-9.0 psi in all areas of the U.S. – except Alaska and Hawaii
- EPA allows a 1.0 psi "volatility waiver" for gasoline ethanol blends - but it does not apply in Hawaii

*Summertime vapor pressure limits**



(maximums; some areas subject to limits as low as 7 psi). Areas subject to EPA's 9 psi limit, but without serious air quality problems, are allowed a 1 psi waiver for gasoline ethanol blends.

Why no fuel ethanol in Hawaii?

- According to ASTM specification D4814, Hawaii is volatility class "C" all year: gasoline may not have a RVP (Reid vapor pressure) greater than 11.5 pounds per sq.in.
- Gasoline testing report in 1989 showed that vapor pressures ranged from 9.7 to 11.4 psi.
- Adding ethanol to gasoline near the 11.5 psi limit would result in out-of-spec fuel
- To blend ethanol in Hawaii, refiners would have to produce a suitable blendstock
- Bottom line: in Hawaii, refiner participation is necessary.

Hawaii Ethanol History (abridged)

1984 **C. Brewer cancels plans to construct an ethanol plant on the Big Island.** According to their press release, " ... we cannot invest $15 million in capital to produce a product we cannot be assured of marketing ..."

1991 "Ethanol blending letter" sent to refiners & gasoline retailers asking: "for ethanol/gasoline blends to be cost-competitive, ethanol would have to be available for $_____?" Responses indicated a lack of interest.

1992 Meeting of energy & agriculture people to see if there are ethanol & electricity opportunities at Hamakua.

1994 Numerous articles on "ethanol will (or won't) help save sugar."

1994 **Ethanol Content Requirement** signed into law. The law states: "DBEDT shall adopt rules ... to require that gasoline ... contain 10% ethanol... "

1995 National Energy Policy Act requires centrally-fueled State fleets on Oahu to purchase **alternative fuel vehicles**.

1995 "Transportation Energy Strategy" completed. Various approaches considered. E10 recommended as cost-effective approach.

1995 Oil company representatives say "we're energy companies," will blend ethanol if the price is right, mandate is not necessary.

2000 **Ethanol production incentive** signed into law. Incentive is 30 cents per gallon of fuel grade ethanol.

2002 Several ethanol producers are **ready to start construction of ethanol production facilities in Hawaii.** Ethanol production expected in 2004.

§486J-10 (a) - Ethanol Content Requirement

- The commissioner shall adopt rules ... to require that gasoline sold in the State for use in motor vehicles contain ten per cent ethanol by volume.
- The amounts of gasoline sold in the State containing ten per cent ethanol shall be in accordance with rules as the commissioner may deem appropriate.
- The commissioner may authorize the sale of gasoline that does not meet these requirements as provided in subsection (d).

§486J-10 (b) and (c)

(b) Gasoline blended with an ethanol-based product, such as ethyl tertiary butyl ether, shall be considered to be in conformance with this section if the quantity of ethanol used in the manufacture of the ethanol-based product represents ten per cent, by volume, of the finished motor fuel.

(c) Ethanol used in the manufacture of ethanol-based gasoline additives, such as ethyl tertiary butyl ether, may be considered to contribute to the distributor's conformance with this section; provided that the total quantity of ethanol used by the distributor is an amount equal to or greater than the amount of ethanol required under this section.

§486J-10 (d) - Ethanol Content Requirement

(d) The commissioner may authorize the sale of gasoline that does not meet the provisions of this section:

(1) To the extent that sufficient quantities of competitively-priced ethanol are not available to meet the minimum requirements of this section; or

(2) In the event of any other circumstances for which the commissioner determines compliance with this section would cause undue hardship.

§486J-10 (e) - Ethanol Content Requirement

(e) Each distributor, at such reporting dates as the commissioner may establish, shall file with the commissioner, on forms prescribed, prepared, and furnished by the commissioner, a certified statement showing:

(1) The price and amount of ethanol available;

(2) The amount of ethanol-blended fuel sold by the distributor;

(3) The amount of non-ethanol-blended gasoline sold by the distributor; and

(4) Any other information the commissioner shall require for the purposes of compliance with this section.

§486J-10 (f), (g) and (h)

(f) Provisions with respect to confidentiality of information shall be the same as provided in section 486J-7.

(g) Any distributor or any other person violating the requirements of this section shall be subject to a fine of not less than $2 per gallon of nonconforming fuel, up to a maximum of $10,000 per infraction.

(h) The commissioner, in accordance with chapter 91, shall adopt rules for the administration and enforcement of this section.

§486J-1 - Definitions

"Competitively priced" means fuel-grade ethanol for which the wholesale price, minus the value of all applicable federal, state, and county tax credits and exemptions, is not more than the average posted rack price of unleaded gasoline of comparable grade published in the State.

§486J-1 - Definitions

"Distributor" means and includes:

(1) Every person who refines, manufactures, produces, or compounds fuel in the State, and sells it at wholesale or at retail, or who utilizes it directly in the manufacture of products or for the generation of power;

(2) Every person who imports or causes to be imported into the State or exports or causes to be exported from the State, any fuel; and

(3) Every person who acquires fuel through exchanges with another distributor.

§486J-1 - Definitions

"Petroleum commissioner" or "commissioner" means the administrator of the energy, resources, and technology division of the department of business, economic development, and tourism.

Ethanol Content Requirement

- Rules have not been finalized.
- Rulemaking takes several months.
- There is an opportunity for public input.
- If private companies can reach agreements that result in local production and availability of fuel ethanol, regulation may not be necessary.

Summary

- Incentives and mandates are in place to support the local production and use of fuel ethanol.
- Fuel ethanol is not currently available in Hawaii.
- We expect it to be available in 2004.
- Working together, we can make it happen.
- Thank you

Websites with More Information

- Hawaii State Energy Office: www.hawaii.gov/dbedt/ert
- Hawaii State Department of Taxation: www.hawaii.gov/tax
- Hawaii State Legislature: www.capitol.hawaii.gov

Ethanol From Cellulosic Materials

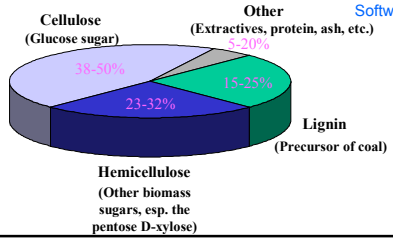
Rick Elander
Pretreatment R&D Team Leader
Biotechnology Division for Fuels and Chemicals
National Renewable Energy Laboratory
Golden, CO

U.S. DOE Fuel Ethanol Workshop
Honolulu, HI
November 14, 2002

Operated for the U.S. Department of Energy by Midwest Research Institute • Battelle • Bechtel

Lignocellulosic Biomass

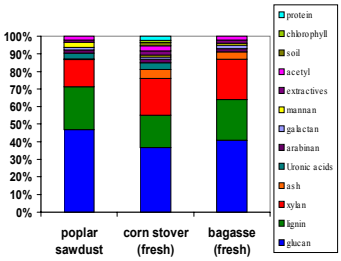
Corn Stover | Bagasse | Hardwood | Softwood



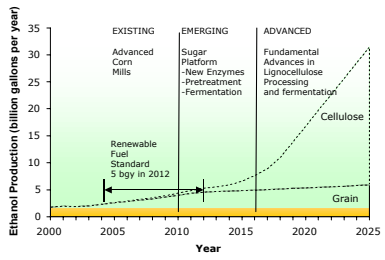
Corn Stover—the "hot" feedstock

- Up to 60 MM dry tons per year available from the 10 leading corn production states can be collected in a sustainable manner
  - -erosion control
  - -soil carbon levels
- Enough to produce over 4 billion gallons of ethanol per year

Stover and Bagasse—Many Similarities



Ethanol from Starch and Lignocellulose



Existing and emerging technology supports targets of a renewable fuel standard

Advanced technology provides the leap to substantial oil displacement

Government role in high risk R&D

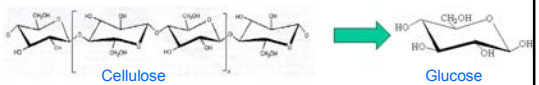
Industry role is to commercialize

Lignocellulose Conversion Processes

- Concentrated acid hydrolysis (sulfuric or hydrochloric acid)
  - Thermochemical hydrolysis of cellulose and hemicellulose
  - Relatively low temperature, requires acid recovery and recycle
- Dilute acid hydrolysis (sulfuric or hydrochloric acid)
  - Thermochemical hydrolysis of cellulose and hemicellulose
  - Relatively high temperature, no acid recovery
  - Difficult to achieve high glucose yields without complex reactor configurations
- Pretreatment/enzymatic hydrolysis
  - Partial to complete thermochemical hydrolysis of hemicellulose
    - Various pretreatment approaches available
  - Enzymatic hydrolysis of cellulose and any remaining hemicellulose
    - Enzymes are currently too costly

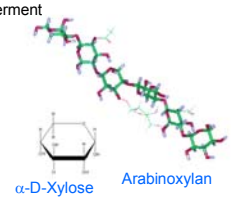
Challenges for Lignocellulosic Ethanol

Cellulose is much more recalcitrant than starch



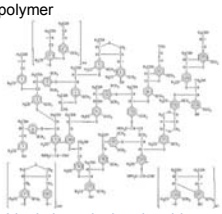
Cellulose Glucose

Hemicellulose largely consists of pentose sugars—more difficult to ferment



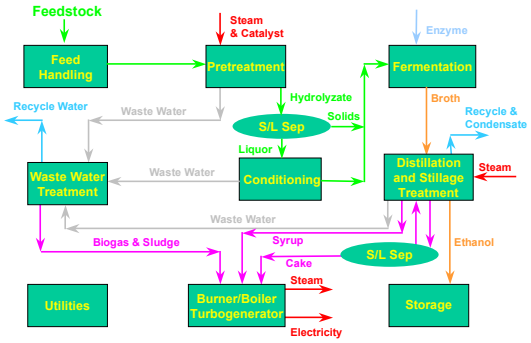
α-D-Xylose Arabinoxylan

Lignin—a highly aromatic, refractory heteropolymer

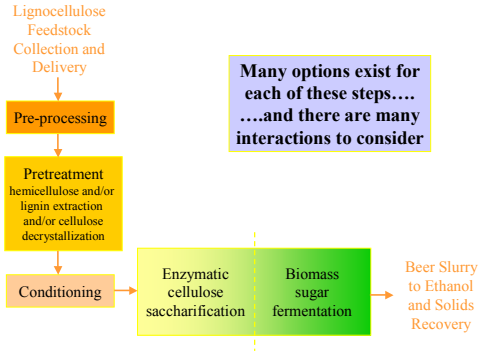


Lignin in agricultural residues

Generic Bioethanol Process Flow

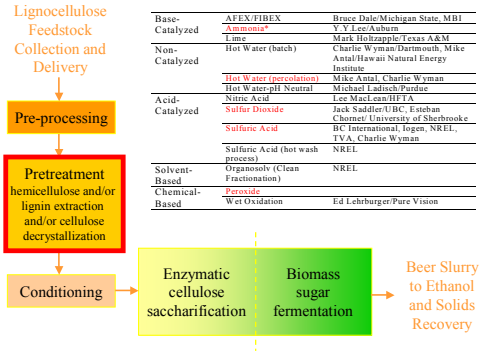


The Key Steps



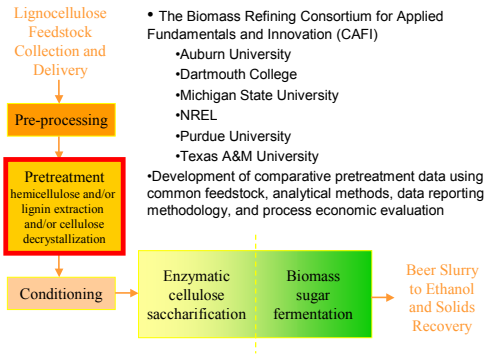
Many options exist for each of these steps….
….and there are many interactions to consider

Pretreatment



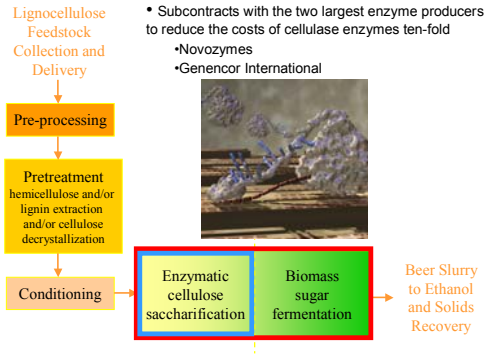
Base-Catalyzed	AFEX/FIBEX	Bruce Dale/Michigan State, MBI
	Ammonia*	Y.Y.Lee/Auburn
	Lime	Mark Holtzapple/Texas A&M
Non-Catalyzed	Hot Water (batch)	Charlie Wyman/Dartmouth, Mike Antal/Hawaii Natural Energy Institute
	Hot Water (percolation)	Mike Antal, Charlie Wyman
	Hot Water-pH Neutral	Michael Ladisch/Purdue
Acid-Catalyzed	Nitric Acid	Lee MacLean/HFTA
	Sulfur Dioxide	Jack Saddler/UBC, Esteban Chornet/ University of Sherbrooke
	Sulfuric Acid	BC International, Iogen, NREL, TVA, Charlie Wyman
	Sulfuric Acid (hot wash process)	NREL
Solvent-Based	Organosolv (Clean Fractionation)	NREL
Chemical-Based	Peroxide	
	Wet Oxidation	Ed Lehrburger/Pure Vision

Pretreatment



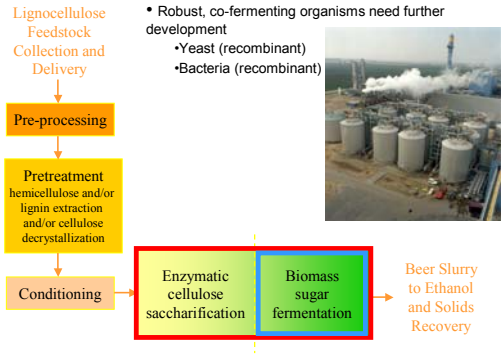
- The Biomass Refining Consortium for Applied Fundamentals and Innovation (CAFI)
  - •Auburn University
  - •Dartmouth College
  - •Michigan State University
  - •NREL
  - •Purdue University
  - •Texas A&M University
- •Development of comparative pretreatment data using common feedstock, analytical methods, data reporting methodology, and process economic evaluation

Saccharification and Fermentation

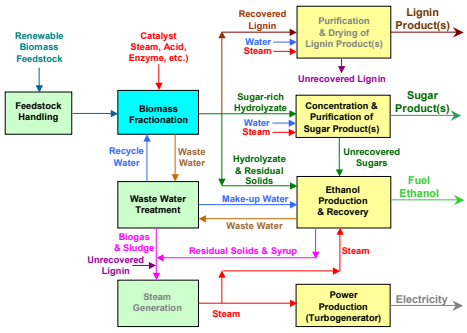


- Subcontracts with the two largest enzyme producers to reduce the costs of cellulase enzymes ten-fold
  - •Novozymes
  - •Genencor International

Saccharification and Fermentation



Sugar and Lignin Platform Biorefinery



The Biotechnology Division for Fuels and Chemicals at NREL

http://www.nrel.gov/biotechnology/

http://www.ott.doe.gov/biofuels/

Acknowledgements

•U.S. Department of Energy, Office of Biomass Programs

•State of Hawaii; Department of Business, Economic Development & Tourism; Energy, Resources, and Technology Division

•BBI International

Ethanol from Cane Molasses

Jayant Godbole
PRAJ INDUSTRIES LTD.
PUNE, INDIA

DOE+BBI Hawaii Ethanol Workshop, November 14, 2002
Honolulu, Hawaii.

PRAJ - Background

- Over 250 customers around the world.
- Over 60 distilleries attached to sugar mills.
- Fermentation process using cane molasses , syrup of sugarcane juice or mixture, grains, cassava etc.
- Has mapped molasses characteristics by analyzing more than 1500 cane molasses samples across the world.

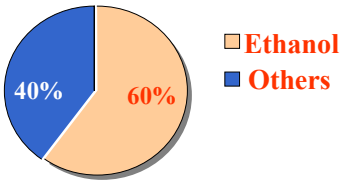
PRAJ - Infrastructure & Strengths

- Established knowledge based company with expertise in Fermentation,Distillation and in value added options for vinasse treatment & disposal.
- *MATRIX* - Technology Development Center with Analytical Laboratory & Pilot Plant Facilities.
- Central Technology and Engineering Facility with over 200 Experts for Design, Engineering, Project Management, Manufacture ,Installation & Commissioning of Alcohol Plants.
- Manufacturing facility for stainless steel, copper titanium etc.with ISO 9002 and ASME-U & H.

PRAJ - Customers

- Seagram India.
- Allied Domeque.
- PT Molindo Raya, Indonesia.
- La Tondena, Philippines.
- Destilerias Unidas, Peru.
- Sucromiles, Colombia
- Destileria Brugal, Dominican Republic.
- West Indies Rum, Barbados.
- Thai Alcohol Company.
- McDowell & Company.
- Shaw Wallace.

Utilization of Molasses
.....An overview



Ethanol Production from Cane Molasses is Over 20 billions Litres per Annum.

Availability of Molasses

- Tropical Climatic Conditions Influence Many Technical Aspects of Molasses to Ethanol Fermentation.
- Majority of Molasses to Ethanol Plants are Concentrated in Tropical & Sub-tropical Regions.
- India has more than 200 distilleries using cane molasses. Other major producers od ethanol from cane molasses are Thailand, Indonesia, Philippines, Brazil, Guatemala, Mexico etc.

Factors Affecting Composition of Molasses

- Variety of cane
- Composition of soil
- Climatic conditions
- Harvesting practices
- Sugar manufacturing process
- Handling and storage

Typical Composition of Molasses

- Total Solids : 75 to 88 % Wt.
- Total reducing sugars : 44 to 60 % Wt.
- Unfermentable Sugars : 4 to 5 % Wt.
- Fermentable Sugars : 40 to 55 % Wt.
- Total Inorganics : 8 to 12 % Wt.
- Settlable dry sludge : < 3.5% Wt.
- Specific Gravity : 1.38 to 1.52
- Titrable volatile acidity : 3000-20,000 ppm
- pH at 40 deg. Diluion : 4.5 to 5.6
- Caramel(OD) : 0.2 to 0.6

Mapping Characteristics of Cane Molasses

	Analytical Parameter	SOUTH AMERICA	AFRICA	SOUTH EAST ASIA	CARRABIAN
A	Chemical Analysis				
1	Brix (Degree Brix) At ambient temp.	87- 93	83 - 91	78 - 85	84 - 93
2	Total Solids (% w/w)	81 - 86	82 - 85	78 - 85	74 - 79
3	Total sugars as reducing matter (% w/w)	49 - 54	48 - 55	50 - 60	52 - 56
4	Un-fermentable sugars as reducing matter (% w/w)	2.5 - 5.2	2.3-5.4	3.7-4.9	3.5 - 4.5
5	Fermentable sugars (% w/w)	43.5 - 50	43- 49.5	45 - 60	47.5 -52
6	F/N Ratio	1.0 - 1.6	1.0 - 1.5	1.2 - 2.8	1.7- 2.8
7	Total inorganic matter (% w/w)	7.8 - 14	6.5 - 8.5	4 - 5	9 - 12
8	Calcium as CaO (% w/w)	1.3 - 3.9	2 - 3	1.9 - 2.5	1.8 - 2.6
9	Total Settlable dry sludge at pH 4.5 and 40 Brix dilution (% w/w of raw molasses)	0.7- 4.5	0.5 - 3.0	0.5 -1.0	1 - 1.5
10	Total settlable sludge at pH 4.5 – 4 Hr settling (by Vol. %)	15 - 26	5 - 20	1- 5	9 - 12
11	Specific Gravity(at ambient temperature)	1.46 - 1.50	1.43 - 1.51	1.40 - 1.45	1.44 - 1.49
12	Titrable volatile acidity in terms of acetic acid and acetate salts (PPM)	6500 - 22600 Average 12000	6500-12500	5500-11500	4000 - 5500
13	PH at 40 Brix dilution	5-6.5	4.8-5.5	4.6-5.3	4.8 - 5.4
14	Dry suspended particles (> 100 µ) (% w/w)	ND	ND	ND	ND
15	Colour in terms of optical density (OD) at 375 nm with 0.1 % w/v dilution.	0.2- 0.32	0.3 - 0.49	0.2 - 0.55	0.35 - 0.4
B.	Microbiological Analysis				
1	Total Viable count cfu/gm	100 - 20000	100-600	3000-40000	1000-4000
C	Instrumental (GC) analysis of Individual Free Volatile fatty acids (By-products of bacterial metabolism)				
1	Acetic Acid (PPM)	4000-22000	2000-3000	5000-7000	4000-5000
2	Propionic Acid (PPM)	30-230	30-50	80-90	35-40
3	Isobutyric acid (PPM)	300-600	10-20	40-60	20-40
4	Butyric acid (PPM)	100-220	60-70	40-60	300-355
5	Isovaleric acid (PPM)	10-50	200-230	100-114	400-430
6	Valeric acid (PPM)	10-40	5-10	5-10	5-10
7	Total Acids by GC (PPM)	4450- 23200	2300-3400	5300-7360	4700- 5900

General observations about Cane Molasses

- South American molasses is generally high in fermentable sugars, high in calcium, inorganic ash and volatile acidity.
- Caribbean molasses is normal in calcium and volatile acidity & high in fermentable sugars.
- Molasses in Central America has moderate fermentables, medium VA & high in caramel
- African molasses is high in fermentable sugar low calcium & sludge content and normal VA.
- South East Asian molasses is high in fermentable sugars, high volatile acidity & higher in caramel.
- Molasses in northern & southern India has low fermentable sugars, higher VA & caramel.

Fermentation of Molasses to Ethanol

What is Fermentation ?

Fermentation of Sugar.

Fermentable sugar gets converted in to ethanol with yeast as catalyst.

Reaction:

Di-saccharide ----------> Mono-saccharide

Mono-saccharide ----------> Ethanol + CO_2

Yeast

Factors in Molasses Influencing Fermentation

➢**Fermentable Sugars**

Yeast uses fermentable sugar for ethanol production.

➢**Inorganic Salts**

Salts inhibits yeast activity due to Osmotic pressure.

➢**Volatile Acidity**

Volatile acids reduce yeast growth and ethanol formation.

➢**Hygienic Conditions**

Hygienic condition controls contamination.

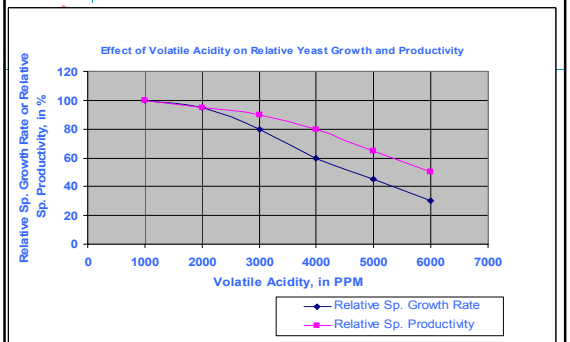
Composition of Molasses & Effects on Fermentation Kinetics

➢F:N ratio < 0.9 retards fermentation rate by average 15 - 20 %

➢Ash content above 10 % can retard the rate of fermentation by 5 - 10 %.

➢Extent of caramelization : (Measured as color in OD units at 375 nm of 0.1 % molasses solution)> 0.40 OD retards fermentation rate by 20-25%.Reaction ceases beyond 0.65.

➢Volatile acids in mash > 2500 ppm reduce the rate of fermentation and yeast growth.
Volatile acids in mash > 5000 ppm reduce fermentation rate by 30 - 40 %.
Volatile acids in mash > 7000 ppm can kill the yeast reducing viability up to 40-50 %.



Parameters For Fermentation

- Alcohol concentration in Mash.
- Sugar & Yeast Concentration in Mash.
- Temperature & pH of Mash.
- Volatile acidity in Mash.
- Residence Time In Fermentors.
- Fermentation Efficiency.

Fermentation Plant

■**Main Sections:**
- Yeast Propagation.
- Fermentation.
- Yeast Separation and Recycle.
- Sludge Separation.

■**Auxiliary Sections:**
- Handling & distribution of Inputs.
- Cooling System.
- Acid, Nutrients, Antifoam Supply.
- Cleaning in Place System.

Continuous Fermentation….

➢More than 100 distilleries in Asia & India use continuous fermentation on cane molasses.

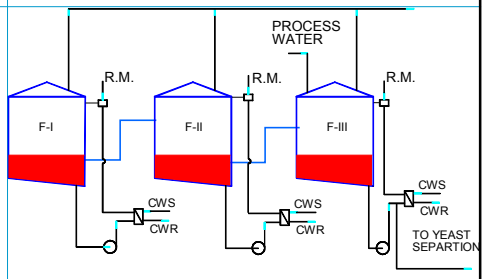
➢Easier to operate with 2-4 fermentors , consistent quality & no need to propagate yeast daily.

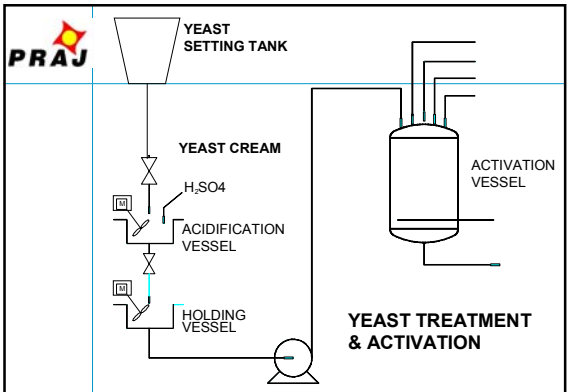
➢Higher efficiency of 89-90 % instead of 80-84 % in a batch process.

➢Alcohol yield of 270-274 Lit of 99.5 % v/v Ethanol/ MT molasses with 48 % Fermentable Sugars (64-65 gallon/short ton).

➢Alcohol concentration increases from 5-6 % in the 1st fermentor to 8-9.5 % in the last one.

Continuous Fermentation





Ethanol Distillation

What is Distillation ?

Separation of Liquid Mixture(s)
of Different Components
into a Number of Fractions of
Different Compositions
OR
into its Pure Components.

Objective of Distillation

- Stripping of alcohol from Fermented Mash.
- Concentration of stripped alcohol to 95 - 96.5%v/v for industrial alcohol & further concentration to 99.5 - 99.8%v/v in dehydration plant for ethanol.
- Concentration of stripped Ethanol to 96 - 96.5 %v/v for Potable application. Separation of impurities become prime importance. Achieved by controlling-
  - Dilution & Extraction
  - Temperature.

Parameters for Distillation.

- Number of distillation columns depend on required product composition.
- Selection of parameters like pressure & temperature
- Energy conservation by - ***Heat Recovery, Thermal Integration.***
- Automation for consistency in quality.
- Plant Design to Take Care Fouling Nature of Mash.

Distillation Scheme Selection

- Energy cost being a significant potion of operating cost, configuration is designed to minimize energy.
- Use of re-boilers to minimize volume of effluent.
- Using cascading pressure for integration of heat & saving in energy.
- Automation to get consistent quality product.

Multi-pressure Vacuum Distillation

- Lower consumption of steam
- Multi-pressure vacuum configuration eliminates problems of scaling in mash column
- Consistently high quality of product
- Higher degree of instrumentation and automation

Effluent Treatment

AN OVERVIEW OF

TECHNOLOGIES FOR TREATMENT OF VINASSE FROM CANE MOLASSDES DISTILLERIES

Characteristics of Effluent

Effluent generated by molasses based distilleries has following characteristics:

Volume**:** 9 to 12 KL per KL of alcohol produced.

B.O.D.**:** 40,000 to 60,000 mg./ lit or ppm.

C.O.D.**:** 80,000 to 120,000 mg./lit or ppm.

Total solids**:** 7 to 12 % w/w.

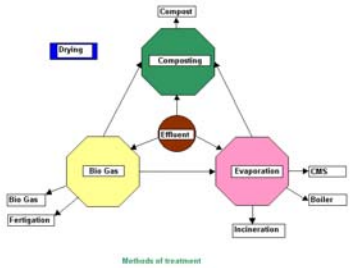
Organic solids**:** 4 to 8 % w/w

Objective For Effluent Treatment

➢To ensure safe treatment of the organic part of the effluent

➢To ensure safe and proper disposal of the treated effluent.

Options of Treatment of Vinasse



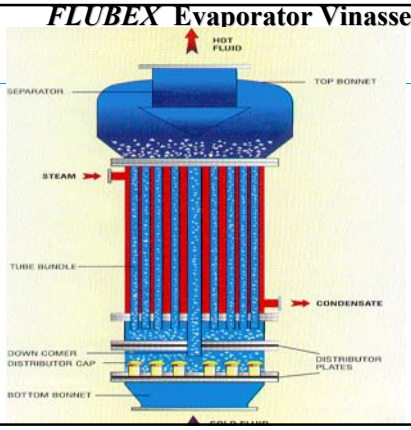
Options / Schemes

- Anaerobic Bio-Methanation followed by aerobic, activated sludge treatment: almost 80 % of the energy requirement can be derived from vinasse.
- Aerobic, Biological Composting.
- Concentration and usage in Animal Feed (CMS).
- Concentration and Incineration, with and without Steam Generation.
- Ferti - Irrigation with bio-methanated or with partially evaporated vinasse.
- Disposal in water bodies like river,lake or sea.

Recycle of Vinasse

- When using cane molasses or juice syrup, up to 50 % of vinasse can be recycled.
- Vinasse gets concentrated to 25-30 % solids.
- Careful process design required to avoid excessive build-up of bacterial contamination.
- Aspects like content of calcium & inorganic ash and content of bacteria & volatile acids need to be considered carefully.

FLUBEX Evaporator Vinasse



Evaporation of Vinasse - '*FLUBEX*'. . . . .

- Deposition and scaling in falling film evaporators due to presence of calcium salts in vinasse is the major problem in evaporation of vinasse.
- Self-cleaning fluidized bed *FLUBEX* evaporators of PRAJ employs metal wire-bits which get fluidized in the exchanger and gently scour the tube-walls
- *FLUBEX* enables use of vinasse evaporator for a longer duration of 30-90 days without cleaning.

Integration of *FLUBEX* Evaporator with Distillation

- Evaporation of Mash before distillation to produce high wine
- Vinasse gets concentrated to 50 % solids
- Use of vapors from Rectifier column under high pressure to heat the evaporator
- Steam consumption of < 3.7 kg/lit (31 lb/gallon) of alcohol for evaporation + distillation
- System eliminates use of Mash column and thus avoids related problems of scaling.

FLUBEX Mash/Vinasse Evaporator

Bio-methanation of Vinasse

Aerobic Open Wind-Row Bio-Composting of Vinasse

Conclusions

- Appropriate technologies at affordable project investment are available for production of ethanol from cane molasses.
- Valuable energy and organic soil conditioner compost can be produced by treatment of vinasse.
- Variable cost of production will is between US Cents 75-95/gallon, depending upon factors like cost of molasses, technology used and the choice of vinasse treatment.

PRAJ INDUSTRIES

Thanks Indeed !

THE 'AINA INSTITUTE
FOR BIOCONVERSION TECHNOLOGY

- The 'Aina Institute is a 501 (C) (3) Non-Profit Organization
- Established in 1991
- **GOAL**
- Developing sustainable technology in food production and energy production.
  - Education ,
  - Research,
  - Demonstration ,
  - Technology Transfer
  - Development,

Activities include the application of bioconversion technologies to meet local needs for food, water and energy while maintaining or improving the quality of the environment.

This is a discussion about:

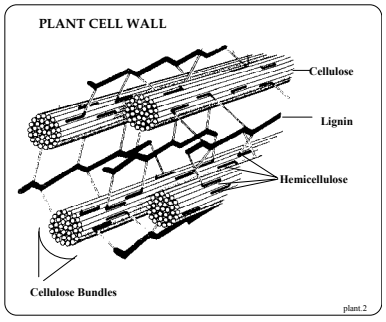
ETHANOL TECHNOLOGY

&

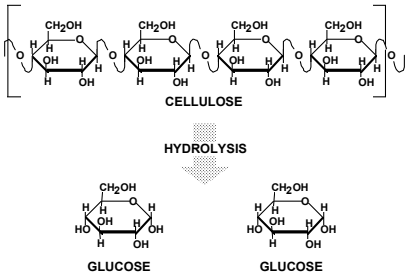
"Waste Our Most Sustainable Resource"

Wasting Waste is Wasteful !

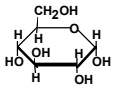
BIOMASS – ETHANOL BACKGROUND



BIOMASS – ETHANOL BACKGROUND

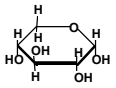


Sugar Fermentation



fermentation → CH_3CH_2OH + CO_2
fermentation → CH_3CH_2OH + CO_2

(1) GLUCOSE —fermentation→ (2) ETHANOL + (2) CARBON DIOXIDE



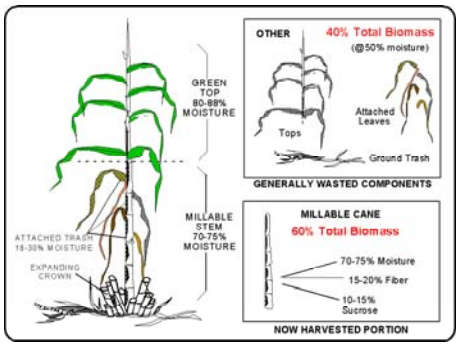
fermentation → CH_3CH_2OH + CO_2 + H_2O

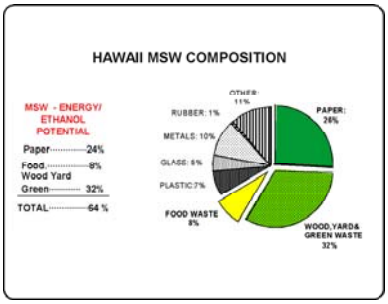
XYLOSE —fermentation→ ETHANOL + CARBON DIOXIDE + WATER

BIOMASS COMPOSITION
(% by dry-weight)

Biomass Source	Sugars	Cellulose	Hemicellulose	Lignin	Other
Bagasse	3	38	27	20	12
Sugarcane ("prepared" cane)	43	22	15	11	9
Sugarcane leaves	--	36	21	16	27
Sugarcane (whole plant)	33	25	17	12	13
Napier grass	--	32	20	9	39
Sweet sorghum	34	36	16	10	3
Eucalyptus grandis	--	38	13	37	12
Eucalyptus saligna	--	45	12	25	18
Leucaena leucocephala	--	43	14	25	18
Municipal Solid Waste	--	33	9	17	41
Newspaper	--	62	16	21	1

Sugar Crop Biomass

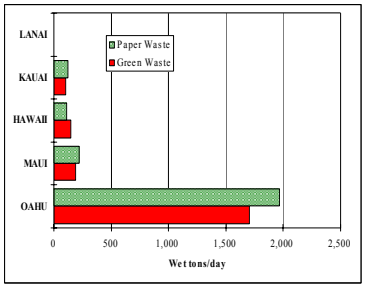




There are major opportunities to produce biomass from waste

- Producing Ethanol from sugar limits opportunities
- Producing Ethanol from corn seed alone limits opportunities
- Substantial research has focused on producing ethanol from biomass and wastes
  - **CO_2 loss in fermentation reduces yields**
  - **Enzyme cost and performance must be considered**.
- Process costs and reliability are still major issues

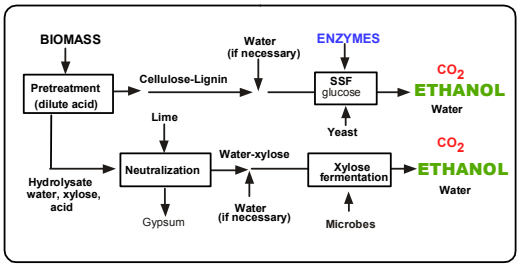
Hawaii Paper &Green Waste



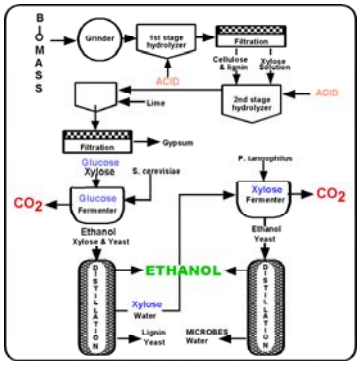
TECHNOLOGY REVIEW

- A Brief Survey of Biomass-Ethanol Technologies
- A Look at Present and Future Opportunities

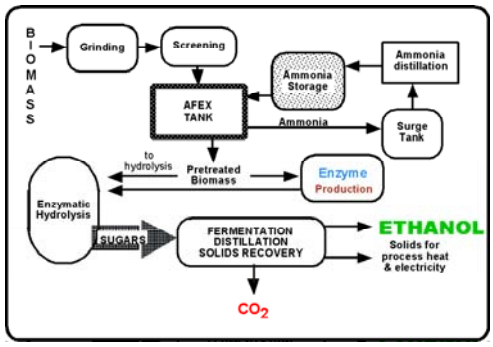
SIMULTANEOUS SACCHARIFICATION and FERMENTATION



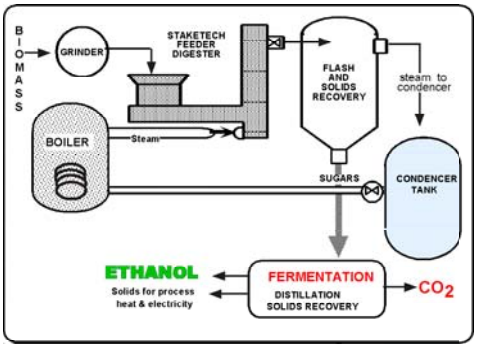
CONCENTRATED ACID HYDROLYSIS NUTRALIZATION & FERMENTATION



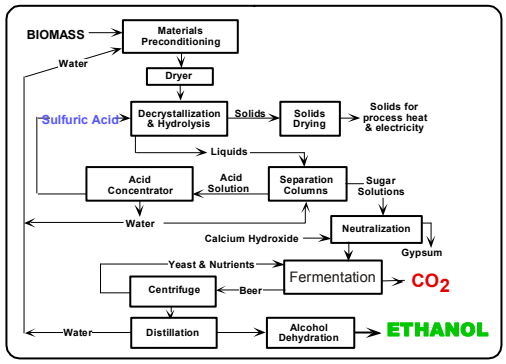
AMMONIA DISRUPTION HYDROLYSIS & FERMENTATION



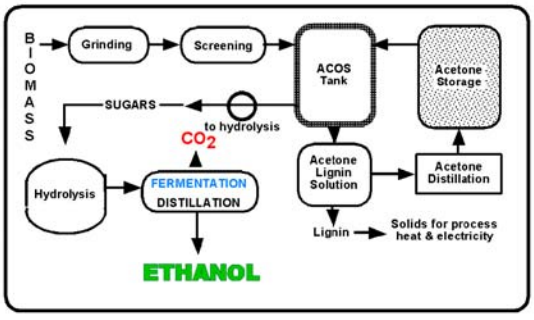
STEAM DISRUPTION HYDROLYSIS FERMENTATION



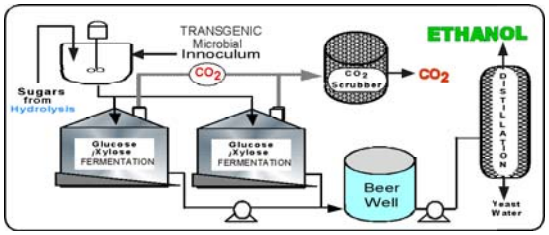
CONCENTRATED ACID HYDROLYSIS, ACID RECYCLE, & FERMENTATION



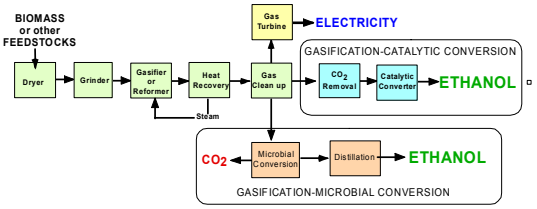
ACIDIFIED ACETONE EXTRACTION HYDROLYSIS & FERMENTATION



ACID DISRUPTION AND TRANSGENIC MICROORGANISM FERMENTATION



GASIFICATION - ETHANOL TECHNOLOGY

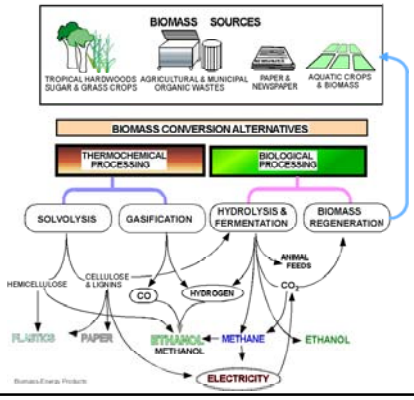


ETHANOL PROCESSES COMPARISONS

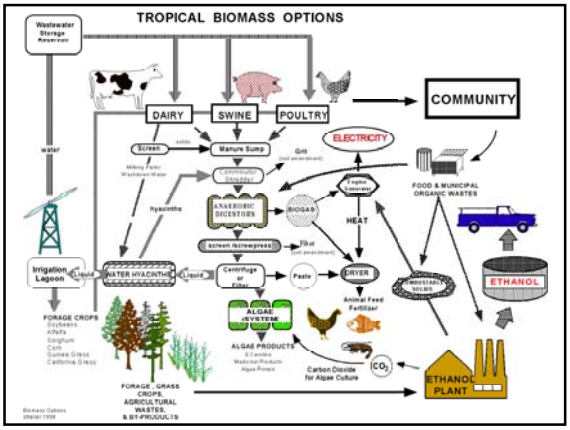
STATUS OF ETHANOL PRODUCTION TECHNOLOGY

METHOD	PRODUCTS	ADVANTAGES	DISADVANTAGES	COMMENTS	YIELD (gal./ dry ton)
Molasses > Fermentation> Ethanol	Ethanol , Carbon Dioxide, Concentrated Molasses solids	Simple traditional yeast fermentation method	Limited supply- Half sugar becomes carbon dioxide, residue is concentrated molasses solids / may have disposal problem	Depends on Molasses from sugar indstry Lack of efficiency, Only 50% of sugars converted to ethanol	70-80
Corn> Processing > **Fermentation** > Ethanol	Ethanol Distillers dried grains Carbon Dioxide	Good for corn industry	Not applicable to Hawaii at this time	Lack of efficiency, only 50% of sugars are converted to ethanol	110-120
Fiber treatment by acid, ammonia, steam, or solvents to release sugars that can be fermented to produce ethanol	Ethanol, Carbon Dioxide, Lignin (SSF-BCI)	Converts any fiber source including paper and yard waste to ethanol	Half sugar becomes carbon dioxide, residue may have disposal problem	Lack of efficiency, only 50% of sugars are converted to ethanol	50 - 90
Wood fiber and Carbon containing molecules>gasification> carbon monoxide>with **bioconversion>ethanol**	Ethanol ,Water microbes	Can use most carbon containing materials that can be gasified to produce carbon monoxide and hydrogen	Depends on performance of microorganisms concerns about stability -reliability of culture	Technologies are not yet demonstrated commercially	80-100
Wood fiber and Carbon containing molecules>gasification> carbon monoxide/ hydrogen> **catalytic conversion >ethanol**	Ethanol Butanol Propanol	Can use most carbon containing materials that can be gasified to produce carbon monoxide and hydrogen. Ethanol is produced as a gas	Sensitive to performance of catalyst	Technology not demonstrated commercially	180 +

BIOMASS-ENERGY PRODUCTS



TROPICAL BIOMASS OPTIONS



THE 'AINA INSTITUTE
FOR BIOCONVERSION TECHNOLOGY

WASTING
WASTE
IS
WASTEFUL !

Delta-T

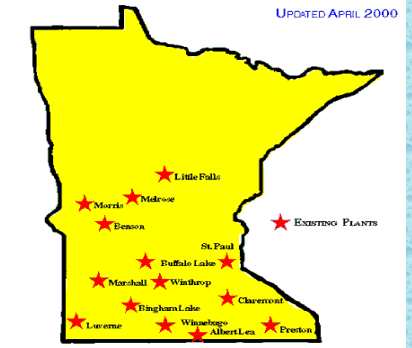
Unconventional solutions, unrivaled results.

Larry Johnson

- 25 years Production Agriculture.
- 15 years Ethanol Consultant
- 3 years Delta-T Corporation
  Business Development Manager

Ethanol Plants in Minnesota

Updated April 2000



"It is a goal of the state that ethanol production plants in the state attain a total annual production level of 240,000,000 gallons."
–Minnesota Statute § 41A.02 Subd. 1a.

FROM GROUND BREAKING TO FULL PRODUCTION IN 12 MONTHS.

Chippewa Valley Ethanol, Benson, Minnesota

ACE Ethanol

ACE Ethanol

WHAT'S DRIVING ETHANOL DEMAND?

- World energy demand and high crude oil prices
- The Clean Air Act Amendments of 1990
- Unprecedented U.S. gasoline demand
- The phase-out of MTBE from U.S. gasoline
- Continued demand for gasoline octane
- U.S. oil refineries are operating at capacity
- A general movement toward renewable energy

WHAT MISTAKES WERE MADE PREVIOUSLY BY ETHANOL PLANTS?

- Inadequate Technology
- Inefficient Plant Design
- Inaccessible Markets
- Under Capitalization
- Poor Management

Ethanol Plant Requirements

1. SITE QUALIFICATIONS
2. BUSINESS ECONOMICS
3. PROJECT FINANCING

1. Site Qualifications

- Rail
- Roads
- Water
- Boiler Fuel
- Electricity
- Permits
- Community Acceptance

2. Business Economics

- Feedstocks
- Markets
- Costs and Efficiencies
- Livestock

3. Project Financing

- Grants
- In-Kind
- Investor Equity
- Debt Finance

Intangibles

- Leadership
- Timing
- Image
- Dedication and Hard Work

In Summary...

THE OVERRIDING AND MOST IMPORTANT ISSUE IS,

PROFIT!

and...

The Most Important Profit Factor Is...

THE RELATIONSHIP BETWEEN THE FEEDSTOCK PRICE AND THE PRICE OF ETHANOL.

What Level Profitability??

- Ethanol will Definitely Add Value!
- Energy up? Agriculture Down?
- Agriculture up? Energy Down?

The Correct Decision Will Require Accurate Information, Good Planning, a Little Luck and Dedication...

Hawaii Specific Considerations

- Maintaining the Unique Island Character
- Enhancing and Diversifying State Economy
- Promoting Desirable Land Use
- Maintaining Clean Environment
- Providing a High Performance Fuel
- Considering Future Technology
- Insuring Energy Security
- Creating a Workable Public Policy Environment
- Serving the Hawaiian Citizens

ConocoPhillips

CALIFORNIA ETHANOL Project Overview

Ethanol Conversion
Barry Duffin

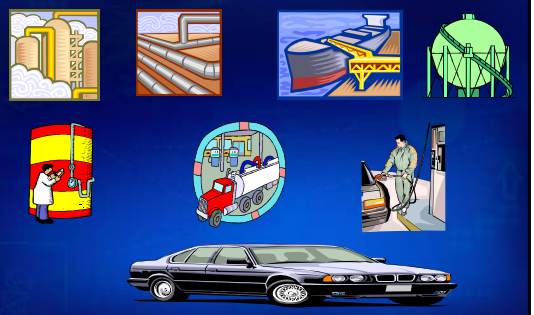
ConocoPhillips

Project Goals

- Eliminate MTBE in California Gasoline
- Introduce Ethanol through oxygenate blending at terminal load racks
- Maintain consistent supply and quality of California Gasoline at all retail outlets.

ConocoPhillips

Considerations



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Scope Description

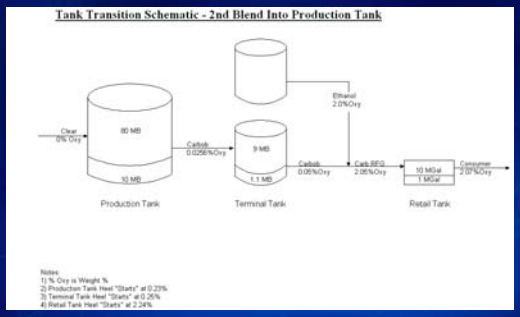
- Project Planning and Management
- Refinery Blend Slate vs. Ethanol Specifications
- Refinery and Terminal MTBE Phase out and CARBOB Conversion
- Ethanol compatibility with Terminal and Retail equipment
- Terminal load rack preparation for ethanol blending
- Retail UST preparation for Ethanol Blended gasoline conversion
- Ethanol Supply, Logistics and Storage
- Quality Oversight of Ethanol Inventory and Blending

ConocoPhillips

Refinery and Terminal Preparation

- Refineries (2 Internal)
  - Blend Slate / RVP / Octane / Specifications
  - Ethanol Storage / Tank realignment
  - Blend certification
- Terminals (4 Internal)
  - Ethanol storage tank preparation
  - Ethanol receipt and shipping modes
  - Blending, load rack piping, blend meter calibration (VCFs)
  - Blending oversight (sequential vs. ratio)
  - Ethanol fire fighting foam

ConocoPhillips



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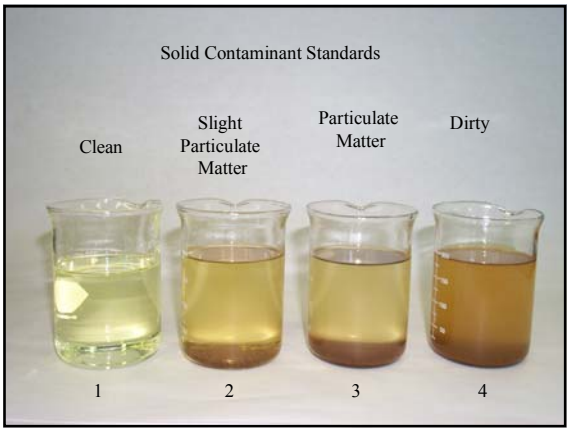
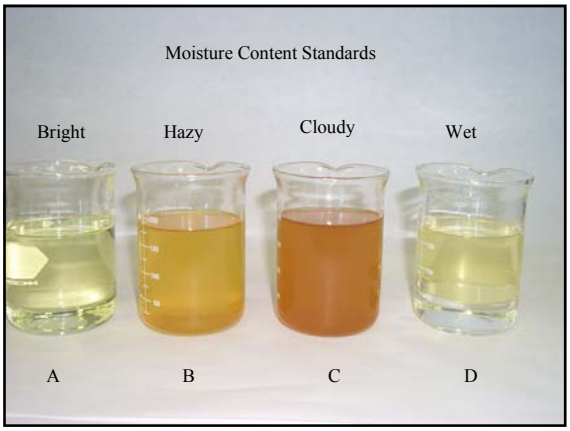
Retail Preparation

- Resources
  - 4 Managers
  - Special Training
  - Special Procedures
  - 5 Contractors
  - 120 Days
- 3000 USTs
  - 2600+ Inspected
  - 185 Cleaned (7%)
- Compatibility
  - Filters,
  - Pumps
  - Labels
  - Ethanol Water Paste





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Ethanol Supply Issues

- Lack of consistent Volumetric Measurement
- Inconsistent Quality Certifications
  - Test results seldom include all ASTM D-4806 requirements
  - Product Identification and Traceability needs improvement

ConocoPhillips

Specification

Denatured Fuel Ethanol (1)
Basic Requirements
On each occasion that Ethanol is supplied, the following shall apply:
Suppliers shall provide a Certificate of Conformance identifying the test results which show that the denatured ethanol complies with ASTM D4806 and the specifications below.
The only denaturants shall be natural gasoline, gasoline components, or unleaded gasoline.
Specification Requirements

Specification	Test Method	Value		Notes
		Min	Max	
Fuel Ethanol	ASTM D5501	96.0		(6)
Neat Ethanol Vol%	ASTM D5501	92.1		(7)
Methanol Vol%			0.5	
Denaturant Content, vol.%,		1.96	4.76	
Existent Gum, mg/100ml	ASTM D-381		5.0	
Water Content, vol%	ASTM E203 or E1064		1.0	
Inorganic Chloride Content, ppm, (mg/L)	ASTM D512, Proc. C (modified)		40 (32)	(4)
Copper Content, mg/kg	ASTM D1688, Proc. D (modified)		0.1	(4)
Acidity (as acetic acid), wt%, (mg/L)	ASTM D1613		0.007 (56)	(5)
Phe	ASTM D 6423	6.5	9.0	
Appearance	ASTM D4806	C&B		(2)
Sulfur	ASTM D2622	Report		
Corrosion Inhibitor XXX	XXX	20	40	(3)
Reid Vapor Pressure Psi	ASTM D5191		4.5	
Nace Rust	TM-01-73	Report		

ConocoPhillips

Lessons Learned

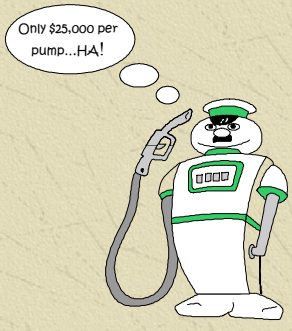
- Have a Tactical Implementation Plan
  - Monitor progress on a scheduled basis
- Volumetric measurement of ethanol should be performed using API Table 6C in place of Table 6B
- Require inspection and removal of any water bottoms from third party terminal tanks
- Inspect as many Retail outlet USTs as possible
- Train retail operators on proper housekeeping
- Plug overfill drains at retail outlets

Ethanol

Michael W. Allen, Presenter

P.O. Box 5990
Helena, MT 59604
(406) 442-7703
Mikea@AllenOilCompany.com

Ethanol



Ethanol

Ethanol…

- Made from grain
- Clean burning
- Benefits local farmer
- Competitive Priced

Ethanol

Yellowstone National Park

Information provided by Howard Haines , State of Montana, Department of Environmental Quality

- **E-10 Blends Reduces CO Emissions by 11-25% Over Traditional Gasoline**
- **E-10 Blends Reduces Hydro-carbon Emissions by 36% Over Traditional Gasoline.**
- **E-10 Blends Reduce Particulate Matter Over Traditional Gasoline by 25%.**

Ethanol

- **Good for the environment**
- **Good for the agricultural community**
- **Good for my customer….**
- **Good for my business**

Ethanol

Ethanol

Gasoline Spill = 

Ethanol Spill = 

Ethanol

Ethanol

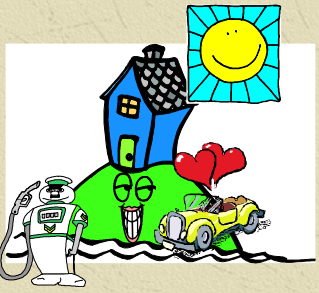
Yellow Dime Promotion

Ethanol

PROMOTION…PROMOTION!

- Yellow Dime Give-A-Ways
- Join one of the non-profit trade associations (EPAC, ACE, RFA)
- Flyers and brochures on your store counters
- Local News
- WORD OF MOUTH!!!
- Educate your employees…they must be informed.

Ethanol



Ethanol

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P.O. Box 5990
Helena, MT 59604
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Mikea@AllenOilCompany.com

Ethanol

Delta-T

Unconventional solutions, unrivaled results.

Larry Johnson

Delta-T 25 years Production Ag.

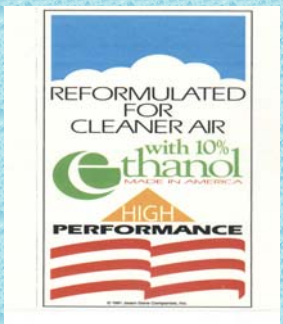
15 years Ethanol Consultant

3 years Delta-T Corporation

Holiday Label

Super America Label

PDQ Label



Why Ethanol – The Discussion Agenda and History

Initially Politically Driven – Today also Market Driven

➢Agriculture – Historic	1900s and 1930s
➢Energy – Iranian Revolution	1979
➢Octane – CAA Lead Phase-out	1985
➢Energy – Gulf War	1991
➢Air Quality – CAAA Oxy and RFG	1992
➢Refinery Demand – At Capacity	2000
➢Renewable Energy – All of the Above	TODAY

Mechanical and Performance Issues

- **Octane**
- **Volatility**
- **Distillation**
- **Deposits**
- **Materials Compatibility**
- **Enleanment**
- **Mileage**
- **Phase Separation**

Biofuels for Sustainable Transportation

Ethanol and Fuel Cells
The Future is Now!

November 14, 2002 - Honolulu, HI

What is a Fuel Cell?

Fuel cells work by combining hydrogen and oxygen in a chemical reaction to create electricity, without the noise and pollution of conventional engines.

In principle, a fuel cell works like a battery.

Unlike a battery, however, a fuel cell does not run down or require recharging.

It will produce energy in the form of electricity as long as fuel is supplied.

Ethanol C_2H_5OH

Why does ethanol have a future as the fuel source for fuel cells?

Ethanol is a hydrogen-rich liquid, which overcomes both the storage and infrastructure challenges of hydrogen for fuel cell applications.

Why Ethanol?

- **Ethanol promotes fuel flexibility/diversity**
  - Coexists with Gasoline, Natural Gas
- **Ethanol will leverage existing investments**
  - Ethanol production/distribution infrastructure
  - Fuel Cell R&D- Government and Commercial
- **3 market areas- with different timing**
    - Stationary power
    - Ethanol-Hydrogen refueling stations
    - Ethanol/Gasoline fuel cell vehicles
- **Ethanol will continue to receive government focus because of it's high societal benefits**
  - Economic, Energy Security, Environmental.

Societal Benefits are High

- **Improved air quality,**
- **Increased energy security,**
- **Economic opportunities for farmers and fuel distributors.**
- **Production from cellulosic biomass feedstocks, such as corn stover, rice straw, and forestry residues.**
- **Spills or leaks will not pollute groundwater**

The Societal Benefits of Ethanol are High

Ethanol and fuel cells together create significant synergy, reaching markets and bringing benefits that are *not* achievable with any other fuel or with any other power technology**.**

Ethanol is a renewable resource *that is playing an increasingly important role in assuring the nation's air quality, improving the economic security of America's farming communities, and addressing the challenges of homeland energy security***.**

Ethanol & Fuel Cells – The Power of 2

•Ethanol blends seamlessly with gasoline fuels to create an improved, fuel cell fuel that is easily stored and dispensed. These blends can be varied over time, providing fuel source flexibility.

•Ethanol, a renewable fuel, used in fuel cell vehicles or for stationary power plants generates far fewer greenhouse gases than conventional fuels such as gasoline or natural gas.

•Fuel cells are extremely efficient powerplants, reducing the importance of fuel cost and leveling the playing field vs. fossil fuels.

•Ethanol's distribution infrastructure is complete to the terminal level, meaning that only very limited investment in local distribution could enable ethanol to power fuel cells for remote residences and cell towers far from the electric grid.

•Unlike other fuel cell alternative fuels like hydrogen or methanol, ethanol has a very positive environmental, health, and safety footprint with no major uncertainties or hazards.

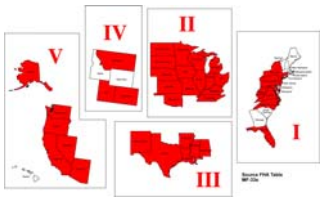
•The technology to use ethanol in fuel cells already exists and has been demonstrated. Only minor changes are required to existing systems to introduce ethanol as a fuel cell fuel.

Driving On Ethanol

- **An ethanol fuel cell vehicle (FCV) will emit about 13% of the tailpipe pollutants compared with a gasoline vehicle and less than half the pollutants of even a gasoline hybrid vehicle.**
- **Greenhouse gas emissions from an ethanol FCV would be substantially less than even an advanced vehicle using a gasoline internal combustion engine. The ethanol FCV contributions to greenhouse gases could be close to zero if cellulosic biomass is used for the ethanol feedstock.**
- **Unlike hydrogen and methanol, ethanol poses no unique or potentially "show-stopping"health and safety hazards.**
- **Unlike other fuel cell alternative fuels like hydrogen or methanol, ethanol has a very positive environmental, health, and safety footprint with no major uncertainties or hazards.**

Source: Based on 2001 California Fuel Cell Partnership Study

Ethanol is Already Widely Available



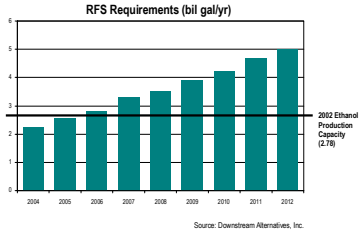
"The outlook for ethanol has never been brighter. Demand for clean-burning, domestic, renewable fuels is at an all-time high, and the US ethanol industry is rising to the challenge."

Bob Dinneen
President & CEO
Renewable Fuels Association

Source: FHA Table MF-33e

The ethanol infrastructure is second only to gasoline as a passenger car fuel.

Ethanol Use Will Grow



Source: Downstream Alternatives, Inc.

The Renewable Fuels Standard (RFS) would gradually increase the use of renewable fuels such as ethanol by 0.3 to 0.4 billion gallons per year (bgy), reaching 5.0 bgy by 2012. This increase in demand will require a substantial investment in new ethanol production facilities – an investment that largely will be made in the nation's rural communities.

Benefits of an RFS

An RFS that grows to 5 billion gallons of ethanol by 2012 would have a significant impact on both the farm and overall economy over the next decade:

•Reduce crude oil imports by 1.6 billion barrels.

•Reduce the US trade deficit by $34 billion.

•Create 214,000 new American jobs.

•Increase US household income by $51.7 billion.

•Create $5.3 billion in new investment in renewable fuel production facilities.

•Increase demand for grain (mainly corn) an average of 1.4 billion bushels and soybeans 144 million bushels.

Source: AUS Consultants, Inc.

California Fuel Cell Partnership
Conclusions about Ethanol

The fuels assessment study released by the Partnership in October 2001 presented the following conclusions about ethanol as a fuel for fuel cell vehicles:

- A ***"major advantage"*** of ethanol is its compatibility with gasoline reformer technology and its flexibility to be used neat (i.e., only ethanol) or in a range of gasoline/ethanol blends.

- Flexibility, combined with ethanol's compatibility with the gasoline infrastructure, means that ethanol can be optimized regionally and according to ethanol economics and availability vs. gasoline. This is the only proposed fuel cell vehicle fueling strategy that does not require the commitment of major infrastructure investments to a single fuel.

•An ethanol reformer could be simpler, more reliable, and less costly than a gasoline/multifuel reformer, increasing ethanol's attractiveness as a neat fuel for fuel cell vehicles

3 Market Areas

Hydrogen Fueling Stations- Ethanol converted to hydrogen at a service station site. Would support early vehicle demonstrations.

Stationary Power- Ethanol can be used to make power locally. Cost competitiveness depends on:
- FC cost & efficiency improvements
- Ethanol pricing vs. propane and natural gas
- State/federal incentives for renewables

Fuel Cell Vehicle Fuel- Ethanol (or blend) used in "gasoline" fuel cell vehicles.

Stationary Power Demonstration

NUVERA CATERPILLAR Williams

Program Partnership

NUVERA
- PEM Fuel Cell and Reformer
- Fuel Cell Control
- System Testing and Key System Variables Data Acquisition
  - Fuel Processor, Fuel Cell, Byproduct Management
  - Fuel Cell Control, System Control Interface

CATERPILLAR
- Program Management
- System Control
- System Testing and Data Acquisition
  - Inverter, Supporting Electronics
  - Electrical Power System Components

WILLIAMS BIO-ENERGY
- Ethanol Fuel Source
- System Test Facility
- System Test Monitoring
  - Installation & Integration
  - Facility Monitoring

Homeland Security & Energy Independence

"America cannot have homeland security without energy independence."

President George W. Bush

"73 percent of Americans believe the US should develop new energy sources to diminish its dependence on Mideast oil supplies."

Newsweek Poll, November 2001

Ethanol Around The World

Brazil-Volkswagen plans to produce 100,000 ethanol-fueled cars in Brazil, exchanging the finance for Kyoto carbon credits with the Brazilian government.

India- August 14 2002 The Indian government ordered the compulsory sale of ethanol-blended gasoline from January 2003 in 13 of the country's states and territories.

China- In November 2001 started to construct its first ethanol plant in Jilin province.

France- bio-ethanol is "a boon to… Agriculture! Bio-Fuels produce some unsuspecting benefits for the environment. Notably in agriculture where once fallow fields are again in use, and jobs are created in rural areas. Even better, increased plant growth reduces CO2 in the air, as the growing plants "trap" it by photosynthesis." -*Oxygen*, Peugeot Citroen Magazine

Near Term Actions Awareness and Engagement

1. Raise stakeholder awareness
   - Economic analyses to define competitive markets
   - Ethanol supply, and infrastructure development status
   - Conference presentations
2. Identify Fuel Cell companies willing to include ethanol in market development.
3. Evaluate technical and economic feasibility of building an ethanol-hydrogen fueling station.
4. Engage the automotive industry to gain further acceptance of ethanol
5. Work with the DOE to tailor existing technology programs to the use of ethanol.
6. Work with state and local governments to define ethanol role in renewable power programs.

The RFA Fuel Cell Task Force

Mission

The Renewable Fuels Association's Fuel Cell Task Force, seeks to promote the advantages of renewable ethanol as a fuel source for fuel cells, which offer significant promise in reducing fossil fuel use and increasing energy efficiency. In doing so, we also seek to advance ethanol fuel cells in all practical applications including mobile and stationary power.

The RFA is an active member of the U.S. Fuel Cell Council.

Fuel Cell Task Force Members

- Jeff Oestmann, Cargill Inc.
- Randall Doyal, Al-Corn Clean Fuel
- Charles Corr, Archer Daniels Midland
- Jacki Fee, Cargill Inc.
- Robert Reynolds, Downstream Alternatives Inc.
- Glenn Kenreck, GE Betz
- Jeff Roskam, ICM, Inc.
- Philip Shane, Illinois Corn Growers Association
- David Loos, Illinois Department of Commerce and Community Affairs
- Neil Koehler, Kinergy, LLC
- Duane Adams, Minnesota Corn Growers Association
- Jon Doggett, National Corn Growers Association
- Todd Allsop, New Energy Corp.
- Gary Welch, Williams Bio-Energy
- Mary Giglio, Renewable Fuels Association

"E-Diesel and Biodiesel: A Status Report to the Industry"

U.S. Department of Energy Fuel Ethanol Workshop

Presented by

Douglas Vind
Western Ethanol Company LLC
Regent International

Honolulu, Hawaii

November 14, 2002

Introduction

AAE TECHNOLOGIES, INC.

- Established in 1997, holder of numerous worldwide patents for fuel additive technologies
- O²Diesel™ efforts in U.S. underway since 1998 – focused on cost-effective, commercially viable products

OCTEL STARREON, LLC

- Over 60 years as a leading world fuel additive supplier
- Leading manufacturer and supplier of diesel additives
- North American sales and distribution network for Performance & Petroleum Specialty Chemicals

Introduction (continued)

Western Ethanol Company LLC
Regent International

- 20 years as an ethanol producer and distributor, both domestic and international.
- Detailed experience in shipping, storing, and delivering fuel ethanol throughout Europe and North America.
- Committed to identifying and developing new uses and markets for ethanol fuels.

Diesel Market Overview

- Diesel emissions under scrutiny on a global level
- Global policies challenge operators, refiners and marketers
- Targeted emissions from diesel: NOx, CO, PM and air toxics
- Other solutions such as CNG, catalysts & DPFs are costly, some still untested, and many require major infrastructure changes
- Fleets affected include: urban transit vehicles, delivery & service fleets, construction and other off-road equipment
- U.S. market: ~50 billion gallons and growing (highly segmented)

What is E-Diesel?

A diesel fuel containing conventional diesel blendstock(s) with:

- Up to 15 vol% Anhydrous Ethanol
- Stabilized with ~1.0 – 5.0 vol% proprietary additive(s), and
- Cetane enhancement where required

The AAE-Octel Starreon *Octimax™ 4931* (includes cetane improver) makes commercially viable O²Diesel™ at <1.0 vol% additive treat rate

- Premium Diesel performance – lubricity, stability, conductivity
- Little or no infrastructure or engine changes required
- Can be used in heavy-duty on- & off-road CI engines now!

What is E-Diesel? (continued)

Why Ethanol is an Ideal Diesel Oxygenate

- Benefits:
  - Renewable, domestic replacement for imported petroleum
  - No significant environmental side-effects
  - Widely proven as a gasoline oxygenate in world markets including USA, Canada & Brazil
  - Supply & infrastructure already exists in key global markets
  - Greenhouse gas reduction impacts

However, historically unable to 'blend' ethanol with diesel largely due to ethanol's hygroscopic nature -- *UNTIL NOW!*

Emissions Benefits

"Typical" E-Diesel Emissions Test Results

Colorado School of Mines: Nov. '99 – Dec. '00

EPA No.2 Diesel vs. No.2 O²Diesel™ (7.7vol% ethanol)

CO	NOx	PM	BHP
▼	▼	▼	▼▲
20-28%	2-6%	34-40%	-1/+2%

EPA 13-mode Transient Cycle Engine Tests (1991 DDC Series 60)

Summary: O²Diesel™ Fleet Testing

- Ease of logistics, distribution, and handling
- "Drop-in" clean fuel solution
- Little or no infrastructure or engine changes
- Excellent cold weather operability
- Visible and measurable emission benefits

- Good engine performance and driveability
- Fuel is fully fungible with regular diesel
- No reported mileage demerits (urban fleets)
- Economics better than alternative technologies
- No significant capital investment required

Summary: O²Diesel™ Fleet Testing

- Nevada Ready Mix (Las Vegas, NV): Feb. 2000 – July 2001 (quarry trucks)
- Lincoln StarTran (Lincoln, NE): August, 2000 – current (urban buses)
- Pepsi-Cola (The Bronx, NY): Nov. 2000 – current (>200 delivery trucks)
- Zachry Const. (San Antonio, TX): Mar. 2001 – current (const. equipment)
- Pearl City Co-op (Pearl City, IL): June 2000 – current (fuel delivery trucks)
- Winnipeg Transit (Winnipeg, Manitoba): Oct. 2001– Aug. 2002 (20 buses)
- Citizen Area Transit (Las Vegas, NV): Started Nov. 2002 (17 urban buses)

Also:

- OCTranspo (Ottawa, Ontario): Starts 1st Qtr. 2003 (20 urban buses)
- 5 Municipalities (So. Calif.): Starts 1st Qtr. 2003 (120 diesel engines)

E-Diesel Technical Agenda: 2002

- "Ethanol-Blended Diesel Fuel Handbook" -- initiated Summer, 2001 and to be completed Fall, 2002 (Argonne Nat'l. Labs)
- Uniform Safety and Handling procedures -- Evaluation underway in 2001/02 at Southwest Research Institute
- Greenhouse gas impact analysis -- initiated Summer, 2001 by Argonne Nat'l. Labs (Michael Wang, et al)
- Health effects testing req'd. per Section 211(b) of the Clean Air Act
- John Deere cooperative test program (>$2 million + 2 years)

E-Diesel Consortium: Organization

- Draft Consortium Charter approved Dec. 4, 2001
- Established under the Renewable Fuels Foundation
- Consortium began work in early 2002
- Significant technical & regulatory agenda (2002 – 03)
- Broad industry/government participation anticipated

E-Diesel Consortium: Participants

- State of Illinois "Core Group" (original E-Diesel Task Force)
- Additive Suppliers (AAE Technologies/Octel Starreon, Akzo Nobel, GE/Betz, Lubrizol, Pure Energy Corp., etc.)
- Engine Manufacturers (John Deere, etc.)
- US Dept. of Energy (including NREL, Argonne National Lab)
- Renewable Fuels Association (U.S. and Canada)
- National Corn Growers Association (and state chapters)
- State and local, public & private groups (e.g., Nebaska Ethanol Board)

E-Diesel Consortium: Technical Issues

- Managing flash point & flammability
- Determining materials compatibility & durability
- Establishing storage & handling requirements
- Meeting ASTM/CGSB fuel standards & acceptability ("Fill & Go")
- Completing EPA health effects testing
- Obtaining additional emissions benefits
- Complying with federal, state & local laws & regulations

Conclusions

Challenges:

- E-Diesel faces a substantial technical & regulatory agenda
- Tax incentive issues must be addressed for full commercialization
- Meaningful public & private support for E-Diesel needed
- Major competition from other new diesel fuels & technologies expected
- OEM skepticism will be significant for a while to come

But E-Diesel has *Momentum*.....

- E-Diesel Consortium is now in place to address all outstanding issues
- E-Diesel will be "ready for prime time" well before 2006 – 07!

Biodiesel Overview

- What is Biodiesel?
- How is Biodiesel made?
- Biodiesel market
- Benefits of Biodiesel
- Biodiesel Challenges
- Ethanol and Biodiesel

What is Biodiesel?

- Biodiesel (fatty acid alkyl esters) is a cleaner-burning diesel replacement fuel.
- Made from natural, renewable sources such as new & recycled vegetable oils and animal fats.
- Just like petroleum diesel, biodiesel operates in combustion-ignition engines.
- Blends of up to 20vol% biodiesel + 80vol% petroleum diesel fuels (B20) can be used in nearly all diesel equipment and are compatible with most storage and distribution equipment.
- Higher blends, even neat biodiesel (B100), can be used in many engines built since 1994 with little or no modification.

How is Biodiesel Made?

- Biodiesel fuel can be made from "virgin" or recycled vegetable oils and animal fats, which are non-toxic, biodegradable, renewable resources.
- Fats and oils are chemically reacted with an alcohol (typically methanol, but ethanol is also used) and a catalyst to produce fatty acid methyl (or ethyl) esters and glycerine co-products.
- Biodiesel can be produced by a variety of esterification technologies.
- Approximately 50% of the U.S. biodiesel industry can use any fat or oil feedstock, including recycled cooking grease. The other half is limited to vegetable oils, the least expensive of which is soybean oil.

Biodiesel Fuel Market

- The use of biodiesel has grown dramatically in the United State during the last few years. (Currently about 25 mil. gallons per year).
- The Energy Policy Act (EPACT) was amended in 1998 to include biodiesel fuel use as a way for federal, state, and public utility fleets to meet requirements for using alternative fuels.
- Biodiesel users include the U.S. Postal Service and the U.S. Departments of Energy and Agriculture. In addition, many school districts, transit authorities, national parks, public utility companies, and garbage and recycling companies also use the fuel.
- With sufficient government incentives, biodiesel sales could reach about 2 billion gallons per year, or about 8% of highway diesel consumption.

Benefits of Biodiesel

- Every gallon of biodiesel displaces 0.95 gallons of petroleum-based diesel over its life cycle.
- Biodiesel reduces the amount of carbon dioxide (CO2) being released into the atmosphere.
- Biodiesel is nontoxic and biodegradable.
- Biodiesel can provide substantial lubricity benefits to premium diesel fuels.
- Biodiesel is an oxygenated fuel, so it contributes to a more complete fuel burn and a greatly improved emissions profile.
- Biodiesel reduces air toxics that are associated with petroleum diesel exhaust and are suspected of causing cancer and other human health problems.

Challenges for Biodiesel

- Biodiesel currently costs between $1 and $2 per gallon to produce.
- Fats and greases cost less and produce less expensive biodiesel but feedstock costs alone are at least $1.50 per gallon of soybean oil-based biodiesel.
- According to the National Renewable Energy Laboratory (NREL), there is only enough U.S. feedstock to supply 1.9 billion gals. of biodiesel.
- Biodiesel's fuel economy, torque, and power are somewhat less than diesel (8% to 15%) because of its lower energy content.
- Biodiesel derived from some feedstocks tends to increase NOx emissions.
- In colder weather, tank heaters or agitators may be required.

Ethanol and Biodiesel

- Ethanol can be utilized to produce an *ethyl ester* (instead of a methyl ester derived from using methanol).
- Ethyl esters can have lower smoke opacity, exhaust temperatures and pour point temperatures than methyl esters.
- Ethyl esters meet the same ASTM standard specification for biodiesel as methyl esters (D6751)
- Ethanol is a preferred process alcohol compared to methanol because it is renewable and more environmentally benign.
- In Hawaii, recycled vegetable oils & ethanol represent the most promising biodiesel (ethyl ester) feedstocks due to their availability.
- For more Biodiesel information contact the National Renewable Energy Laboratory (NREL)

For more information contact:

AAE Technologies, Inc.
200 Executive Drive
Newark, Delaware 19702 USA

(302) 266-6000 (office)
(302) 266-7076 (fax)
www.aaetech.com

Western Ethanol Company LLC
Regent International
1075 Yorba Place, Suite 101
Placentia, California 92870

(714) 854-1333 (office)
(714) 854-1330 (fax)
www.regentinternational.com

Octel Starreon, LLC
Refinery & Performance Fuel Additives
8375 S. Willow Street
Littleton, Colorado 80124 USA

(303) 566-0530 (office)
(303) 792-5668 (fax)

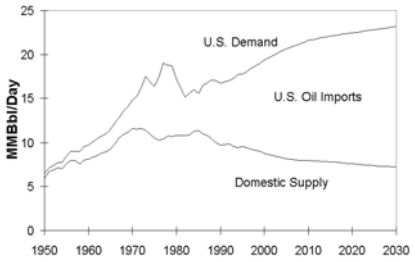
The Biorefinery and Sugar Platform Strategy

Nevada Ethanol Workshop

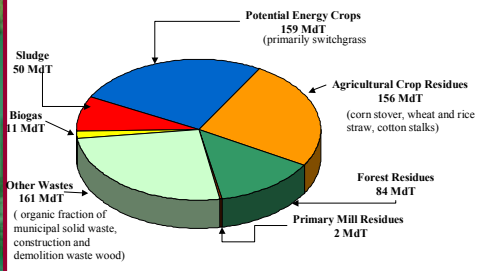
Reno, NV

January 9, 2003

The National Security Problem



U.S. Feedstocks Available by Biomass Type



Total Feedstocks Available: 623 Million dry Tons (MdT) per year

Energy Equivalent: 11 quadrillion Btu

Source: Biobased Products and Bioenergy Roadmap, July 2001 Draft

Background, Energy Policy & the Biorefinery
Oil Import Situation

- Imports are a large and growing share of U.S. petroleum consumption
  - Imports were 55% of petroleum consumption in 2001
    - 19.6 Mil. Bbl/day consumption
    - 10.9 Mil. Bbl/day net imports
  - EIA projects imports to reach 62% of consumption in 2020
- Petroleum product consumption in the transportation sector in 2001 was 26.21 Quads (approx. 228 billion gallons, or 14.9 Mil. Bbl/day)
  - Motor gasoline: 8.61 Mil. Bbl/day
  - Distillate fuels* (e.g. diesel): 2.52 Mil. Bbl/day
- In 2001, 1.77 billion gallons of ethanol were produced in the U.S. 2002 estimates exceed 2 billion gallons
- Approximately 6.7 million gallons of biodiesel were produced in the U.S. in 2000

*Distillate fuel for transportation figure is for 2000.

Restructuring Biomass Program – 2002

- Major restructuring of EERE
- Previous focus on biofuels, biopower and bioproducts
- Current focus biorefinery and technology development pathways for fuels, power, and bioproducts

Background, Energy Policy & the Biorefinery
Biomass RD&D is a National Priority

- The President's National Energy Policy includes multiple recommendations that support Bioenergy.
- The Biomass R&D Act of 2000 directs DOE and USDA to enhance and coordinate biomass R&D efforts.
- The Energy Title (Title IX) of the new Farm Bill provides supports for increased use of biomass energy and products and for R&D.
- The comprehensive energy bill now pending in Congress contains provisions to encourage expansion of biomass utilization, including a Renewable Fuels Standard for transportation fuels.

Background, Energy Policy & the Biorefinery

Program Mission and Goals

Mission

- To foster research and development on advanced technologies to transform our abundant biomass resources into clean, affordable, and domestically-produced biofuels, biopower, and high-value bioproducts for improving the economic development and enhancing the energy supply options of the U.S.

Goals

- Reduce U.S. dependence upon foreign sources of petroleum
- Realization of the Industrial Biorefinery

Background, Energy Policy & the Biorefinery

What is a Biorefinery?

According to the 2002 Farm Bill, "The term 'biorefinery' means equipment and processes that:

- Convert biomass into fuels and chemicals; and
- May produce electricity

Background, Energy Policy & the Biorefinery

Biorefinery Concept

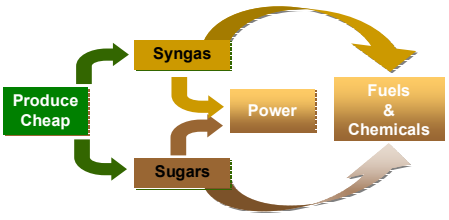
- Thermochemical and/or biochemical processes
- Multiple product capability (some combination of ethanol, hydrogen, electricity, sugars, syngas, and specialty chemical products)
- Multiple feedstock capability

Background, Energy Policy & the Biorefinery

BioIndustry Challenges

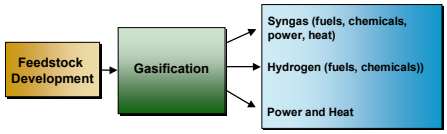
- Market Competition
- Feedstock Infrastructure
- Sustainability
- Policy – internalizing externalities, carbon, thinnings, ethanol tax credit, PURPA, Renewable portfolio standards
- Adoption of Technology by Industry

OBP R&D Focus Areas



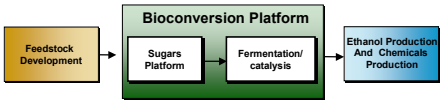
- Portfolio of production technologies
- Common, high-volume chemical intermediates

Thermochemical Conversion



- Increased emphasis for thermochemical pathways that use biomass to produce:
  - Synthesis gases for producing diesel, gasoline, or fuel alcohols
  - Hydrogen production from synthesis gas, providing a fuel for fuel cells
  - Steam and electric production in pulp & paper mills

Bioconversion



- Increased emphasis for Bio-Conversion Platform per the Biomass R&D Act of 2000
  - Fermentation platform
  - Sugar Platform
  - Enzyme Systems Development
  - Catalytic pathways
- Decreased emphasis for near term demonstrations of acid-based ethanol production technology
- Feedstock collection and handling Logistics

Opportunities

- On the horizon
  - Develop and integrate bioproducts to enable deployment of biofuels
  - Develop strong partnerships with industry leaders committed to technology deployment
  - Coordinate with USDA
  - Demonstrate utilization of corn stover in existing dry mills for fuel and co-products
  - Improve profitability of existing wet & dry mills

Ethanol Workshop
Reno, Nevada

Neil Koehler for the
Renewable Fuels Association

January 9, 2003

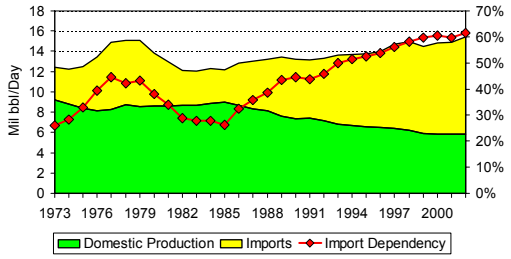
RFA
Renewable Fuels Association

Why Ethanol

- **Policy Drivers:**
  - **Energy security and diversification**
  - **Agricultural economic support**
  - **Clean air attributes**
  - **Local economic development strategy**
  - **Greenhouse gas reductions**
- **Market Drivers:**
  - **Competitively priced supply of necessary fuel component**
  - **Price hedge against fossil fuels**
  - **Renewable trading credits**

RFA
Renewable Fuels Association

America's Dependence on Imported Oil Continues to Grow

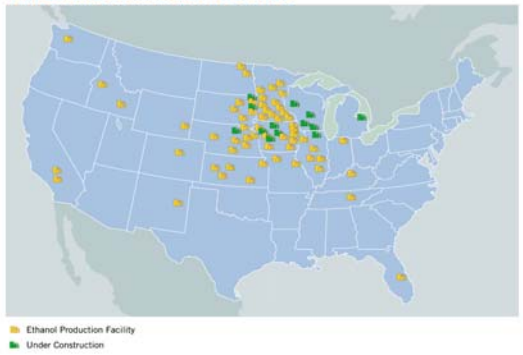


U.S. Ethanol Industry Today

- Annual production record in 2002 of 2.1 bgy
- 68 plants in 20 states with 2.7 bgy capacity today
- 8 plants under construction; w/ expansions, capacity will reach 3 bgy in 2003
- Dozens of additional plants in various stages of development

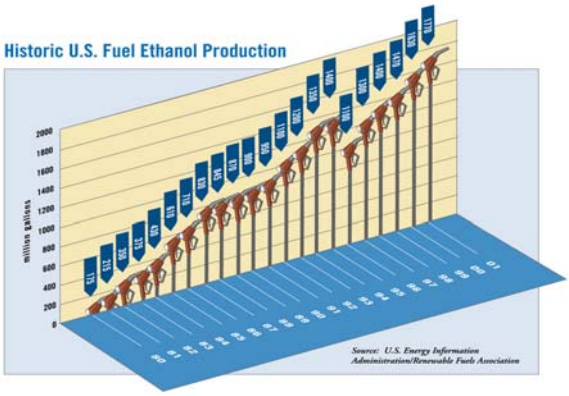
RFA
Renewable Fuels Association

U.S. Ethanol Production Facilities



2002 a Year of Industry Records;

- Record Number of New Plants Completed (12)
- Record Ethanol Production Capacity (2.7 bgy)
- Record Ethanol Production and Use (2.1 bgy)
- Record Market Penetration (18% of U.S. gasoline blended with ethanol)

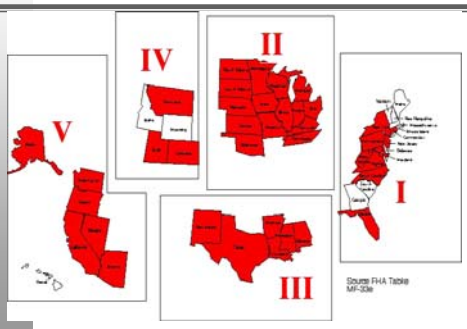


Current U.S. Markets

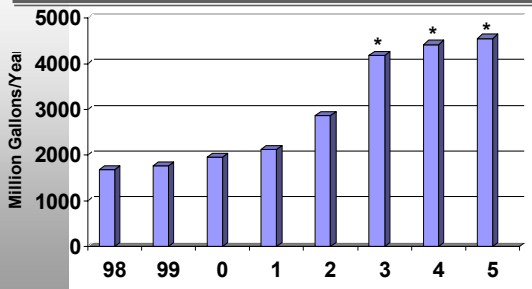
- Octane/Extender ~ 900 mgy
- Winter Oxyfuel Program ~ 250 mgy
- Reformulated gasoline ~ 700 mgy
- Minnesota oxygen program~ 250 mgy

RFA
Renewable Fuels Association

States with Ethanol Sales in 2000



U.S. Ethanol Production Capacity



* California Energy Commission Estimates

What's Leading Industry Growth?

- Concerns about MTBE contamination
- California market opportunity
- Energy and homeland security agenda
- Need to expand U.S. fuel supply

RFA
Renewable Fuels Association

Industry Responds to Rising Demand for Alternative to MTBE

- ***2002 Production*** represents a 20% increase from 2001 production and a 40% increase from 1999
- Seeds for growth planted in California
  - While MTBE ban delayed until '04, most refiners voluntarily switching to ethanol Estimate ethanol-blended fuels will account for 60-80% of the California market in 2003

Farmers Leading the Fight for Energy Independence

- 27 of the 68 current ethanol plants are owned by farmers
- 6 out of 8 ethanol plants under construction are farmer-owned
- Majority of ethanol plants under development are farmer-driven projects

Historic Fuels Agreement Debated in last Congress

- Phases out MTBE use in 4 years
- Eliminates RFG oxygen standard
- Increases flexibility in fuels marketplace
- Maintains air quality gains of RFG program
- Creates Renewable Fuels Standard (RFS)
- Supported by petroleum, agriculture and environmental interests

RFA
Renewable Fuels Association

Renewable Fuels Standard

- Provides for gradual and increasing phase-in of the use of renewable fuels, such as ethanol and biodiesel, growing to 5 bgy in 2012
- Provides for orderly transition allowing renewable fuel capacity expansion and infrastructure modifications
- Doesn't require renewable fuels to be used in any particular state or region, ensuring renewable fuels will be used where most economical and cost-effective

Cont.

- Allows for Credit Trading and Banking
- Temporary Waivers
- Small Refiner Exemption

RFA
Renewable Fuels Association

Benefits of the RFS

- Reduce crude oil imports by 1.6 billion barrels
- Reduce the U.S. trade deficit by $34 billion
- Create 214,000 new American jobs
- Increase U.S. household income by $51.7 billion
- Create $5.3 billion in new investment in renewable fuel production facilities
- Increase demand for grain (mainly corn) an average of 1.4 billion bushels and soybeans 144 million bushels per year.

Logistics of Nationwide RFS

- Ethanol is transported cost-effectively nationwide via barge, railcar and oceangoing vessel
- According to DOE, "***no major infrastructure barriers exist***" to achieving 5 bgy market, and logistics modifications needed can be achieved ***cost-effectively***
- EIA states consumer price impact of the RFS <one cent/gal; expects price to fall due to positive impact of banking and trading credits

RFA
Renewable Fuels Association

Nationwide Economic Benefits of Ethanol Demand

- Increases net farm income by $4.5 bil
- Boosts total employment 195,200 jobs
- Adds over $450 mil to state tax receipts
- Improves U.S. trade balance by $2 bil
- Saves Treasury more than $3.6 bil
- 100 mgy plant creates 2,250 local jobs for a community (USDA)

Local Economic Benefits of a 40 mgy facility

- Provide a one-time boost of $142 million during construction
- Expand the local economic base $110.2 million each year through the direct spending of $56 million
- Create 41 full-time jobs at the plant and 694 jobs throughout the entire economy
- Increase local price of corn by an average of 5-10 cents a bushel
- Increase household income for the community by $19.6 million annually
- Boost state and local sales tax receipts by an average of $1.2 million (varies depending on local rates)
- Provide an average 13.3% annual return on investment over 10 years to a farmer who invests $20,000

Source: "Ethanol and the Local Community," John Urbanchuk, AUS Consultants and Jeff Kapell, SJH & Company, June 2002

Ethanol's Environmental Benefits

- Reduces emissions of CO, VOCs, NOx and particulates
- Replaces water contaminating MTBE
- Displaces toxics – benzene, toluene
- Renewable – reduces greenhouse gas emissions
- Displaces fossil energy use

Energy Security Benefits

- 2/3 known oil reserves in Mideast
- Use of ethanol displaces imported oil (23.3 gallons of ethanol = 1 barrel of oil)
- Today 97% of transportation energy comes from petroleum, of which 61% is imported
- U.S. energy imports to grow from 57% in 2002 to 68% in 2025
- A dispersed energy infrastructure is less vulnerable to terrorist attack

The Future is Bright

- Ethanol and diesel fuel blends
- Fuel Source for Fuel Cells
- Research underway to identify new uses and high-value co-products
- Commercialization of cellulose to ethanol technology
- Worldwide demand for renewable fuels growing as means to reduce greenhouse gases and develop new agricultural markets

RFA
Renewable Fuels Association

California's Ethanol Market

NEVADA ETHANOL WORKSHOP

Reno, Nevada

January 9, 2003

Pat Perez, Manager
Transportation Fuel Supply & Demand Office
CALIFORNIA ENERGY COMMISSION
pperez@energy.state.ca.us

Presentation Topics

- Research and Development Programs
- Ethanol Demand & Supply Outlook
- MTBE Phaseout
- Challenges and Opportunities

Research & Development Efforts - 1980s

- Commercial Scale Ethanol Production Feasibility Studies 1980s - CEC
  - Selma (CA) Demonstration Project - 8 mgy capacity
- Alcohol Vehicle Fleets - CEC
- Alcohol Fuel Plant Design Competition - CDFA
- Parallel Products Facility Begins Operation

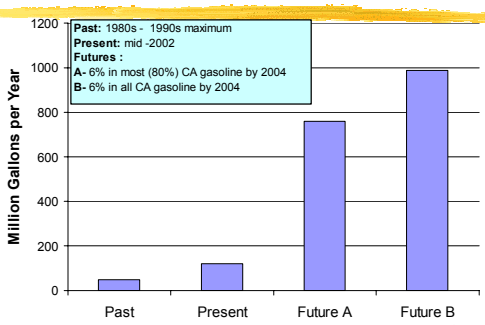
Research & Development Efforts - 1990s to Present

- Gridley Project in Butte County
- Collins Pine Project in Plumas County
- 20 conventional based ethanol projects are in some stage of evaluation or planning today
  - Corn based projects in Northern and Central California
  - Sugarcane -based projects in Imperial Valley

MTBE Phaseout and Ethanol Substitution

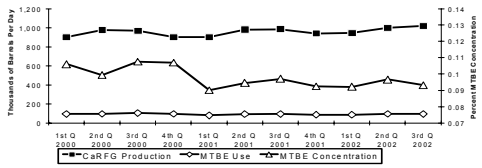
- Governor's 1999 Executive Order…
  - Orders end of MTBE use by 2003 (later extended to 2004)
  - Directs studies of ethanol use as a replacement for MTBE
  - Directs evaluation of the potential for an in-state ethanol industry
- Environmental Policy Council determines ethanol as acceptable substitute for MTBE (2000)

Ethanol Demand Scenarios



California Gasoline MTBE Concentration

Figure 1
California Gasoline
MTBE Concentration

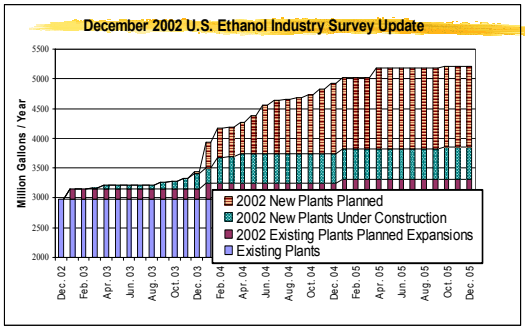


Public Announcements to Replace MTBE With Ethanol in Early 2003

- Phillips-Conoco - Completed
- British Petroleum -Amoco
- Shell Oil
- Exxon-Mobil
- Others California Refiners are Considering

California's Supply Sources

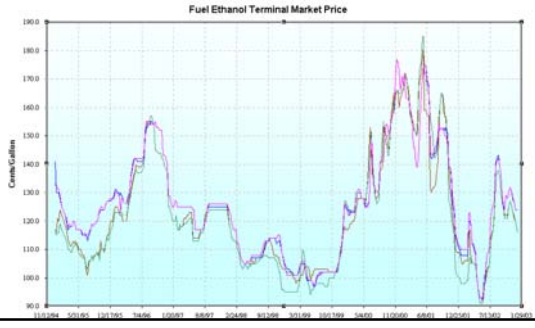
- Domestic U.S. Sources
- Foreign Sources
- California
  - Current
  - Projected



Energy Commission Proprietary Survey Results
U.S. Ethanol Production Capacity
@End of Year - MGY

	2001	2002	2003	2004	2005
Existing Plants	2219	2967	2967	2967	2967
Existing Plant Expansions			147	242	320
New Plants Planned			40	1190	1354
New Plants Under Construction			262	502	542
Total	2219	2967	3416	4901	5183

Fuel Ethanol Prices
1994 to Present



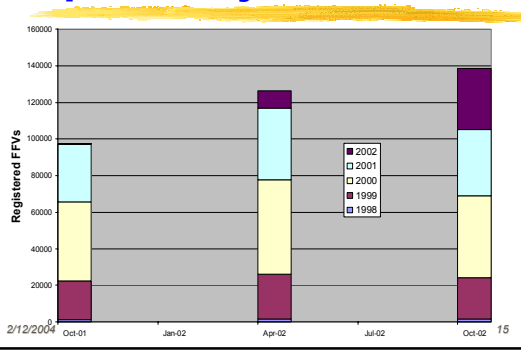
Ethanol Challenges

- Uncertainty in California Ethanol Market
- Difficulty in Securing Project Financing
- Status of Federal Energy Legislation
- Lack of Commercially Demonstrated Technology
- Uncertain Economics
- Siting/Environmental and Permitting Issues

Ethanol Opportunities

- Growing transportation fuel market
- Large agricultural sources as well as cellulosic wastes and residues.
- E-10 Blends - up to 600 MGY
- E-85 Market
- Fuel Cell Applications
- Ethanol/Diesel Blends

Growth in California FFV Population by Model Year



For More Information About Ethanol Activities...

- Visit California Energy Commission's Web Site at: www.energy.ca.gov/ethanol
- Other Websites:
  - CARB: www.arb.ca.gov/cbg/ethanol
  - Imperial Bioresources LLC: www.imperialbioresources.com
  - Northern CA Ethanol LLC: www.northerncaliforniaethanol.com
  - Lawrence Livermore Natl Lab: www.erd-llnl.gov/ethanol

CO and Ethanol as an Oxygenate

January 9, 2003

Andrew C. Goodrich
Washoe District Health
Air Quality Management Division

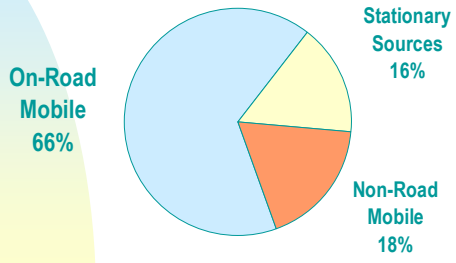
Introduction

- Air quality in Washoe County.
- Oxy-fuel Program.
- Future Fuels.

Air Quality in the Truckee Meadows

- Non-attainment for CO, Ozone, PM10.
- Eight (8) air quality monitoring sites throughout southern Washoe County.
- Regulations for fireplaces, wood stoves, and oxygenated gasoline.

Carbon Monoxide in the Truckee Meadows



Oxygenated Fuel Regulation

- Originally adopted in 1989, revisions in 1992, 2000.
- Simple - 1/2 page rule, sets O2 minimum.
- MTBE Prohibition tied to CA

Oxygenated Fuel

Minimum O2

- First two years O2 set at 2.0 percent by weight
- Since 1991; O2 set at 2.7% weight

Market Share

- First 6 years: 85-90 % MTBE
- Since 1995: 95-100 % Etoh

Oxygenated Fuel Program Results

- 592 Million gallons of Oxy-fuel.
- 61,660 Tons of CO avoided.
- Average of 13.3 percent reduction in CO emissions.
- Last CO violation 1991; 8.6ppm in 1999.

Future Fuels

- “Bio-” Fuels…
- E-85
- Hydrogen

State of Nevada Division of Environmental Protection

E-85 and Nevada's Alternative Fuels in Fleets Program

Sig Jaunarajs
January 9, 2003

What is E-85?

- Blended mixture of 85% Ethanol and 15% Unleaded Gasoline
- Most popular form of ethanol in use as a motor fuel in the U.S.
- Planned introduction in NV in 2003

Vehicles that can use E-85

- Only specially-equipped vehicles may run on E-85, however, you may be driving one and not even know it
- Fuel system materials must be compatible with an alcohol; vehicle's computer adjusted to optimize performance with E-85
- Flexible-Fuel (Flex-Fuel) vehicles can burn either unleaded gasoline, E-85 or any combination of both

All three U.S. manufacturers produce flex-fuel vehicles

Cost, Drivability, and Maintenance

- Vehicle cost is comparable to gasoline-powered vehicles
- Fuel price somewhat higher - enjoys tax break
- Power is similar, however, fuel mileage is 25 to 30% less
- Reduced "knock" - but cold start is an issue
- No major difference in maintenance practices

Environmental Benefits of using E-85

(source: USEPA and Argonne National Labs)

- CO emissions are 30% to 40% less
- Particulates are 20% less
- NOx is 3% to 10% less
- Sulfates are 80% less
- Ozone-forming compounds are 15% less
- Fewer toxic compounds produced
- Concerns over aldehyde emissions from combustion of E-85 and VOC emissions from production facilities

Ethanol Use in NV

- Limited experience with ethanol; E-10 used as a wintertime oxygenated fuel
- Closed production facility at Wabuska

Nevada's First E-85 Dispenser – NV State Motor Pool facility at Reno/Tahoe Airport – Opening soon!

Nevada's Alternative Fuels in Fleets Program

- Requires that city, state, and county fleets acquire and use alternative fuel vehicles in Washoe and Clark counties
- E-85 is a listed alternative fuel
- Public fleets will likely be the first significant consumers of E-85

Ethanol is perhaps not the perfect fuel, but is an environmentally responsible alternative for Nevada

Environmental Aspects of Ethanol as a Motor Fuel

Nevada Ethanol Workshop

January 9, 2003

David Andress

David Andress & Associates, Inc

Recent Developments

- The potential expansion in ethanol due to restrictions on MTBE has heightened public interest in the air and water quality impacts of using ethanol fuels
- Major concerns for air quality are:
  - VOC and NOx emissions
  - Acetaldehyde and PAN emissions

Commandment for Groundwater Protection

Thou shalt neither discharge nor release any substance to the ground which is:

	Ethanol	MTBE
water soluble,	Yes	Yes
resistant to biodegradation, and	No	Yes
imparts toxicity, taste, or odor at low concentrations in water	No	Yes

James Giannopoulos, California State Water Resources Control Board

Current MTBE Situation

- 18 states have passed legislation to ban MTBE

AZ	CA	CO	CT	IA	IL
IN	KS	KY	OH	ME	MI
MN	MO	NY	NE	SD	WA

- More than 60 percent of the MTBE is used in these 18 states
- A national MTBE ban is possible.

Assessing Air Quality

- Composition of vehicle fleet including the types of emission control technologies used and the number of poorly operating vehicles
- Driving patterns and population densities
- Type of fuel used
- Tailpipe and evaporative emissions from each vehicle
- Chemical pathways for secondary emissions
- Meteorological and geographic conditions
- Identification of emissions of concern and establishing monitoring programs

Air Quality Concerns

- Ozone – primarily a summer problem
  - Harsh irritant that causes respiratory problems and can inhibit plant growth
  - Precursors are VOCs, NOx, and CO
- Toxic air pollutants (TAP)
  - Can cause cancer or other serious health problems
  - EPA regulates benzene, formaldehyde, acetaldehyde, 1,3 butadiene, and polycyclic organic matter
- Carbon monoxide – primarily a winter problem
  - Inhibits the bloods capacity to carry oxygen and causes a variety of health problems

Clean Air Act Programs

Reformulated Gasoline (RFG)

- Required in areas with ozone problems
- Standards for VOCs, NOx, and TAP
- Minimum 2.0 weight percent oxygen and maximum one percent benzene
- Has achieved an over compliance in TAP reductions, which EPA attributes in part to use of oxygenates

Clean Air Act Programs (Continued)

Oxygenated fuels program

- Required in CO non attainment areas
- Minimum of 2.7 weight percent oxygen (2.0 in CA)
- Program has been successful. Most areas outside southern CA are expected to be in compliance by 2005
- Minnesota requires a minimum 2.7 weight percent oxygen year round

Refinery Blending and Ethanol Properties

Gasoline Volume	Ethanol provides volume (loss of MTBE presents volume problems)
RFG Emissions	Ethanol reduces most toxic air pollutants (except acetaldehyde) through dilution, but increases evaporative VOC emissions (summer issue) and perhaps NOx
Octane	Ethanol (like MTBE) is a high-octane blendstock
RVP in CG	Ethanol increases RVP (summer issue), but most CG containing 10% has one psi waiver
Oxygen and CO	Ethanol is an oxygenate, reduces CO emissions, EPA/CA now give an ozone-related VOC credit for CO reductions
Sulfur	Ethanol reduces sulfur through dilution

Differences Between CG and RFG

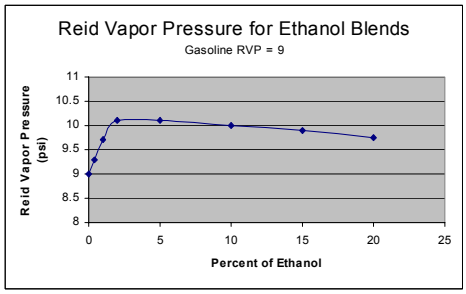
- Conventional Gasoline (CG)
  - Base gasoline must meet specs
  - 10% ethanol blends are granted a one psi RVP waiver -- evaporative VOC emissions increase
  - Suboctane CG for ethanol blending is just starting to be used
- Reformulated Gasoline (RFG)
  - All RFG blends must meet specs, whether or not ethanol is used
  - RFG is VOC, NOx, and TAP controlled
- VOC emissions are a summer problem only

Directional Changes in Emissions When Ethanol Is Blended with Conventional Gasoline and RFG

The Directional Changes Refer to Changes When Comparing Conventional Gasoline Containing Ethanol with Ethanol-Free Conventional Gasoline and RFG Containing Ethanol with RFG Containing MTBE

	Conventional Gasoline	RFG
Toxic air pollutants		
Acetaldehyde	increase	increase[2]
Benzene	decrease	decrease
1,3-butadiene	decrease	decrease
Formaldehyde	increase[1]	decrease
Criteria air pollutants		
CO	decrease	decrease
NOx	increase	no change
Tailpipe VOC	decrease	no change
Evaporative VOC	increase	no change
Total VOC	increase	no change
Particulate matter	decrease	decrease
Other		
PAN	increase	increase[2]
Isobutene	decrease	decrease
Toluene	decrease	decrease
Xylene	decrease	decrease

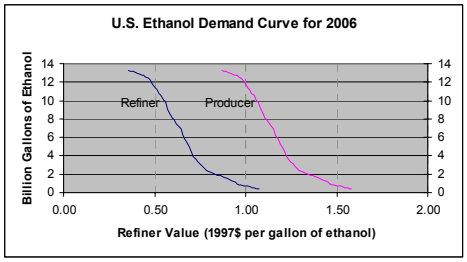
[1]Formaldehyde emissions decrease for ethanol blends compared with MTBE blends.
[2]A California study concluded that the ambient air concentrations of acetaldehyde and PAN increased only slightly for California RFG3 containing ethanol, despite the fact that the increase in primary acetaldehyde emissions is significant. The study concluded that most of the increase in acetaldehyde and PAN concentrations were due to secondary emissions. No comparable study has been done for Federal RFG for areas outside California.



- Gas tank commingling
- Additives to reduce RVP increase
- Better vehicular evaporative emission controls

Refinery Demand for Ethanol

- Refiners must consider
  - Available refinery technology
  - Finished product demand
  - Emissions requirements
- Like all blending components ethanol has its advantages and disadvantages
- Ultimately it is the economics -- relative cost of ethanol and other gasoline blending components



Producer Price = Refiner Value + Federal Tax Incentive of $0.51
Transportation costs from the Midwest are accounted for, but no shown in chart.

Refinery analysis assumed:
- Gasoline production was based on EIA oil price projection is $20.50 per barrel and MTBE price prior to recent increase in natural gas prices
- MTBE is banned in Midwest and California and limited to 3 percent elsewhere
- low sulfur gasoline standards and no toxic backsliding

Acetaldehyde and PAN Emissions

- Most comprehensive analysis to date was done by California (December 1999)
- Used a detailed atmospheric model for summer Los Angeles Basin
- Concluded that other components of gasoline, such as aromatic compounds and olefins, are primarily responsible for the formation of acetaldehyde and PAN, because of their greater abundance in gasoline and their shorter atmospheric lifetimes.
- Results apply to complying California RFG3, other areas may have different meteorological conditions, etc.

Acetaldehyde Emissions and Air Quality Impacts

Changes in Vehicular Primary Acetaldehyde Emissions Relative to 2003 MTBE Baseline Gasoline

Scenario / Type of Change	Percent Change
2003 Ethanol at 2.0 wt% Oxygen	27%
2003 Ethanol at 3.5 wt% Oxygen	132%
2003 Non-Oxygenate	-5%

Comparison of Modeled Air Quality Changes from 2003 MTBE Baseline

Compound	2003 Et2.0%	2003 Et3.5%	2003 NonOxy
Acetaldehyde (Total)	0%	4%	-1%
Acetaldehyde (Primary)	4%	39%	-1%
Acetaldehyde (Secondary)	0%	2%	-1%

Air quality changes are based on changes in population-weighted daily-average model results for a gridded region. Negative changes mean improvements.

Acetaldehyde Emissions and Air Quality Impacts (continued)

Comparison of Modeled Air Quality Changes from 1997 MTBE Baseline

Compound	2003 MTBE	2003 Et2.0%	2003 Et3.5%	2003 NonOxy
Acetaldehyde (Total)	-13%	-13%	-10%	-14%
Acetaldehyde (Primary)	-25%	-23%	4%	-26%
Acetaldehyde (Secondary)	-12%	-12%	-11%	-13%

Air quality changes are based on changes in population-weighted daily-average model results for a gridded region. Negative changes mean improvements.

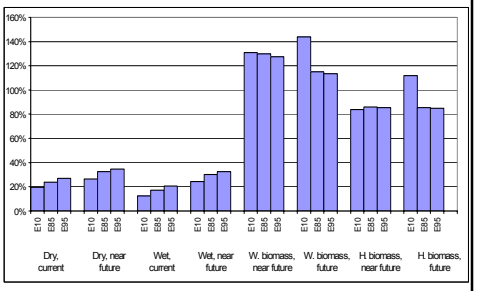
Acetaldehyde Conclusions

- The small increase in atmospheric acetaldehyde concentrations does not present a health problem
- Ethanol blends reduce formaldehyde emissions relative to MTBE blends
- Ethanol blends meet the requirements for no increase in toxic air pollutants

Greenhouse Gases

- Major GHG emissions are CO_2, CH_4, and N_20 (not regulated by EPA)
- Climate change is a global problem
  - Emissions from the total fuel cycle are important (feedstock, fuel conversion, and vehicle combustion)
  - For urban pollution, vehicular emissions are important
- Biomass fuels emit zero net carbon emissions from fuel combustion
- Feedstock growth, fuel conversion, and transportation of feedstock and fuel produce GHG emissions
- Cellulosic ethanol uses renewable energy for the conversion process and sells excess electricity to the grid

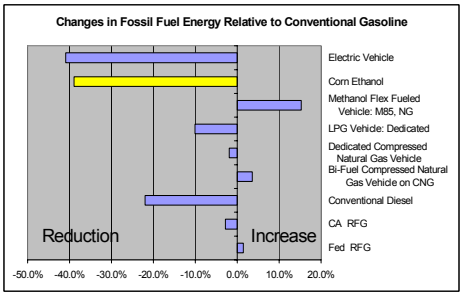
Per-Gallon Ethanol Effects: GHGs Emissions Reductions Relative to Gasoline



Note: Use of a gallon of ethanol in E10 requires a lot more miles than use of a gallon of ethanol in E85 or E95.

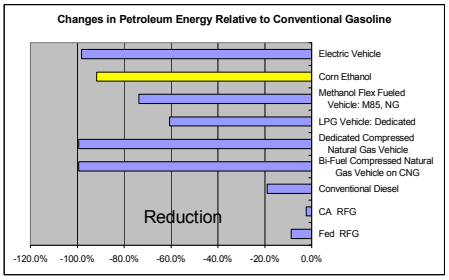
Source: Argonne National Laboratory GREET Model

Fossil Fuel Energy



Source: Greet Model

Petroleum Energy

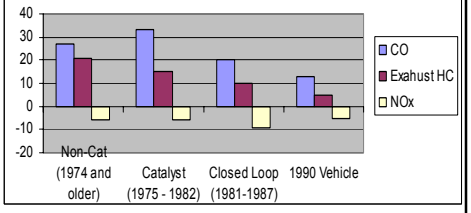


Source: Greet Model

Benefit of Ethanol Blends is Greater for Vehicles with Older Emissions Technology

- Oxygen content is more important for older vehicles
- Reduces exhaust emissions of HCs and CO, but increases NOx in normal emitters
- Higher RVP means an increase evaporative HC Emissions
- Overall decrease in toxic emissions is greater for older vehicles

Percent Decrease in Emissions for 10% Conventional-Gasoline Ethanol Blend with one-psi RVP increase for Normal Emitters



High Emitters and Ethanol

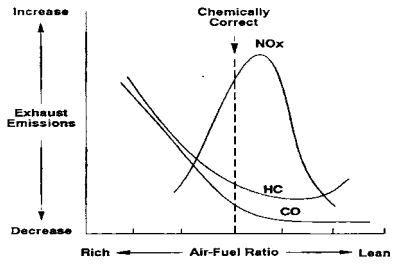
For high emitters, the EPA emissions model (Complex Model) estimates:

- ⇨ **Significant reductions in NOx emissions**
- ⇨ **Large reductions in exhaust benzene and 1,3 butadiene emissions**

More on NOx Emissions and Oxygenates

- ⇨ **The EPA Complex Model estimates a small decrease for all vehicles -- primarily due to the reduction in NOx emissions from high emitters**
- ⇨ **The California Predictive Model estimates an increase in NOx emissions -- high emitters are not separately identified**

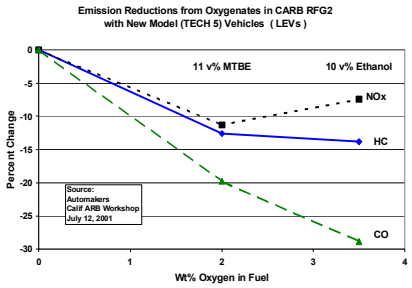
Typical Relationship Between Engine Exhaust Emissions and Air-Fuel Ratio



Future Fuel Trends

- ⇨ **With modern control systems that dynamically adjust the air-to-fuel ratio, the effect of oxygen in the fuel will diminish**
- ⇨ **Ethanol will be valued more for:**
  - – **toxic emission reductions**
  - – **high octane**
  - – **virtually no sulfur**
- ⇨ **These properties will become more important with the elimination of MTBE**
- ⇨ **Ethanol's major disadvantage is the RVP increase**

Limited Emissions Tests on New Vehicles



Conclusion: More tests are needed to understand relationship between fuel properties and emissions in new vehicles with advanced emission control system.

Summary of Effects for E85 Compared to CaRFG2

	Lab 1	Lab 2
NMHC	-20%	-22%
NOx	-25%	-32%
CO	-24%	-12%
CO2	-7%	-6%
Evaporative emissions	-3%	0%
Fuel economy (equivalent energy basis)	+1%	-1%
Exhaust Toxics		
- Benzene	-79%	
- 1,3-Butadiene	-80%	
- Formaldehyde	+20%	
- Acetaldehyde	+1949%	
Specific Reactivity	-30%	
Ozone Forming Potential	-25%	

Federal Test Procedure Emissions Test Results from Ethanol Variable-Fuel 1992 and 1993 Chevrolet Luminas

Mass and Potency Weighted Exhaust Toxic Emissions

		Mass Emissions (mg/mile)		Potency-Weighted Emissions (pwmg/mile)	
	Potency Weighting Factors	CaRFG	E85	CaRFG	E85
Benzene	0.170	8.90	1.83	1.51	0.31
1,3-Butadiene	1.000	0.87	0.17	0.87	0.17
Formaldehyde	0.035	2.79	3.36	0.10	0.12
Acetaldehyde	0.016	0.84	17.21	0.01	0.28
Total		13.40	19.25	2.49	0.88

Ethanol also reduces evaporative benzene emissions

Environmental Aspects of Ethanol as a Motor Fuel

Nevada Ethanol Workshop

January 9, 2003

David Andress

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	Ethanol	MTBE
water soluble,	Yes	Yes
resistant to biodegradation, and	No	Yes
imparts toxicity, taste, or odor at low concentrations in water	No	Yes

James Giannopoulos, California State Water Resources Control Board

Current MTBE Situation

- 18 states have passed legislation to ban MTBE

AZ	CA	CO	CT	IA	IL
IN	KS	KY	OH	ME	MI
MN	MO	NY	NE	SD	WA

- More than 60 percent of the MTBE is used in these 18 states
- A national MTBE ban is possible.

Assessing Air Quality

- Composition of vehicle fleet including the types of emission control technologies used and the number of poorly operating vehicles
- Driving patterns and population densities
- Type of fuel used
- Tailpipe and evaporative emissions from each vehicle
- Chemical pathways for secondary emissions
- Meteorological and geographic conditions
- Identification of emissions of concern and establishing monitoring programs

Air Quality Concerns

- Ozone – primarily a summer problem
  - Harsh irritant that causes respiratory problems and can inhibit plant growth
  - Precursors are VOCs, NOx, and CO
- Toxic air pollutants (TAP)
  - Can cause cancer or other serious health problems
  - EPA regulates benzene, formaldehyde, acetaldehyde, 1,3 butadiene, and polycyclic organic matter
- Carbon monoxide – primarily a winter problem
  - Inhibits the bloods capacity to carry oxygen and causes a variety of health problems

Clean Air Act Programs

Reformulated Gasoline (RFG)

- Required in areas with ozone problems
- Standards for VOCs, NOx, and TAP
- Minimum 2.0 weight percent oxygen and maximum one percent benzene
- Has achieved an over compliance in TAP reductions, which EPA attributes in part to use of oxygenates

Clean Air Act Programs (Continued)

Oxygenated fuels program

- Required in CO non attainment areas
- Minimum of 2.7 weight percent oxygen (2.0 in CA)
- Program has been successful. Most areas outside southern CA are expected to be in compliance by 2005
- Minnesota requires a minimum 2.7 weight percent oxygen year round

Refinery Blending and Ethanol Properties

Gasoline Volume	Ethanol provides volume (loss of MTBE presents volume problems)
RFG Emissions	Ethanol reduces most toxic air pollutants (except acetaldehyde) through dilution, but increases evaporative VOC emissions (summer issue) and perhaps NOx
Octane	Ethanol (like MTBE) is a high-octane blendstock
RVP in CG	Ethanol increases RVP (summer issue), but most CG containing 10% has one psi waiver
Oxygen and CO	Ethanol is an oxygenate, reduces CO emissions, EPA/CA now give an ozone-related VOC credit for CO reductions
Sulfur	Ethanol reduces sulfur through dilution

Differences Between CG and RFG

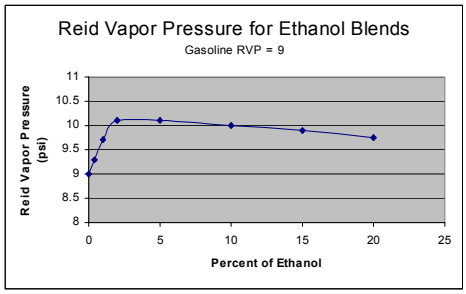
- Conventional Gasoline (CG)
  - Base gasoline must meet specs
  - 10% ethanol blends are granted a one psi RVP waiver -- evaporative VOC emissions increase
  - Suboctane CG for ethanol blending is just starting to be used
- Reformulated Gasoline (RFG)
  - All RFG blends must meet specs, whether or not ethanol is used
  - RFG is VOC, NOx, and TAP controlled
- VOC emissions are a summer problem only

Directional Changes in Emissions When Ethanol Is Blended with Conventional Gasoline and RFG

The Directional Changes Refer to Changes When Comparing Conventional Gasoline Containing Ethanol with Ethanol-Free Conventional Gasoline and RFG Containing Ethanol with RFG Containing MTBE

	Conventional Gasoline	RFG
Toxic air pollutants		
Acetaldehyde	increase	increase[2]
Benzene	decrease	decrease
1,3-butadiene	decrease	decrease
Formaldehyde	increase[1]	decrease
Criteria air pollutants		
CO	decrease	decrease
NOx	increase	no change
Tailpipe VOC	decrease	no change
Evaporative VOC	increase	no change
Total VOC	increase	no change
Particulate matter	decrease	decrease
Other		
PAN	increase	increase[2]
Isobutene	decrease	decrease
Toluene	decrease	decrease
Xylene	decrease	decrease

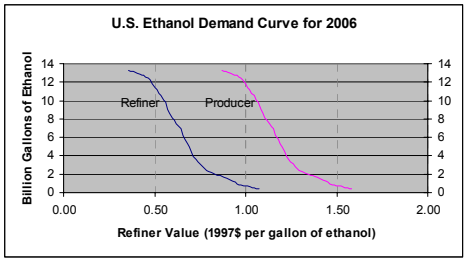
[1]Formaldehyde emissions decrease for ethanol blends compared with MTBE blends.
[2]A California study concluded that the ambient air concentrations of acetaldehyde and PAN increased only slightly for California RFG3 containing ethanol, despite the fact that the increase in primary acetaldehyde emissions is significant. The study concluded that most of the increase in acetaldehyde and PAN concentrations were due to secondary emissions. No comparable study has been done for Federal RFG for areas outside California.



- Gas tank commingling
- Additives to reduce RVP increase
- Better vehicular evaporative emission controls

Refinery Demand for Ethanol

- Refiners must consider
  - Available refinery technology
  - Finished product demand
  - Emissions requirements
- Like all blending components ethanol has its advantages and disadvantages
- Ultimately it is the economics -- relative cost of ethanol and other gasoline blending components



Producer Price = Refiner Value + Federal Tax Incentive of $0.51
Transportation costs from the Midwest are accounted for, but no shown in chart.

Refinery analysis assumed:
- Gasoline production was based on EIA oil price projection is $20.50 per barrel and MTBE price prior to recent increase in natural gas prices
- MTBE is banned in Midwest and California and limited to 3 percent elsewhere
- low sulfur gasoline standards and no toxic backsliding

Acetaldehyde and PAN Emissions

- Most comprehensive analysis to date was done by California (December 1999)
- Used a detailed atmospheric model for summer Los Angeles Basin
- Concluded that other components of gasoline, such as aromatic compounds and olefins, are primarily responsible for the formation of acetaldehyde and PAN, because of their greater abundance in gasoline and their shorter atmospheric lifetimes.
- Results apply to complying California RFG3, other areas may have different meteorological conditions, etc.

Acetaldehyde Emissions and Air Quality Impacts

Changes in Vehicular Primary Acetaldehyde Emissions Relative to 2003 MTBE Baseline Gasoline

Scenario / Type of Change	Percent Change
2003 Ethanol at 2.0 wt% Oxygen	27%
2003 Ethanol at 3.5 wt% Oxygen	132%
2003 Non-Oxygenate	-5%

Comparison of Modeled Air Quality Changes from 2003 MTBE Baseline

Compound	2003 Et2.0%	2003 Et3.5%	2003 NonOxy
Acetaldehyde (Total)	0%	4%	-1%
Acetaldehyde (Primary)	4%	39%	-1%
Acetaldehyde (Secondary)	0%	2%	-1%

Air quality changes are based on changes in population-weighted daily-average model results for a gridded region. Negative changes mean improvements.

Acetaldehyde Emissions and Air Quality Impacts (continued)

Comparison of Modeled Air Quality Changes from 1997 MTBE Baseline

Compound	2003 MTBE	2003 Et2.0%	2003 Et3.5%	2003 NonOxy
Acetaldehyde (Total)	-13%	-13%	-10%	-14%
Acetaldehyde (Primary)	-25%	-23%	4%	-26%
Acetaldehyde (Secondary)	-12%	-12%	-11%	-13%

Air quality changes are based on changes in population-weighted daily-average model results for a gridded region. Negative changes mean improvements.

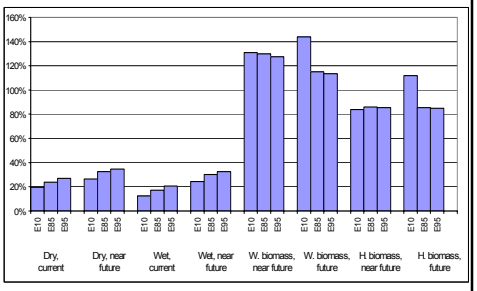
Acetaldehyde Conclusions

- The small increase in atmospheric acetaldehyde concentrations does not present a health problem
- Ethanol blends reduce formaldehyde emissions relative to MTBE blends
- Ethanol blends meet the requirements for no increase in toxic air pollutants

Greenhouse Gases

- Major GHG emissions are CO_2, CH_4, and N_20 (not regulated by EPA)
- Climate change is a global problem
  - Emissions from the total fuel cycle are important (feedstock, fuel conversion, and vehicle combustion)
  - For urban pollution, vehicular emissions are important
- Biomass fuels emit zero net carbon emissions from fuel combustion
- Feedstock growth, fuel conversion, and transportation of feedstock and fuel produce GHG emissions
- Cellulosic ethanol uses renewable energy for the conversion process and sells excess electricity to the grid

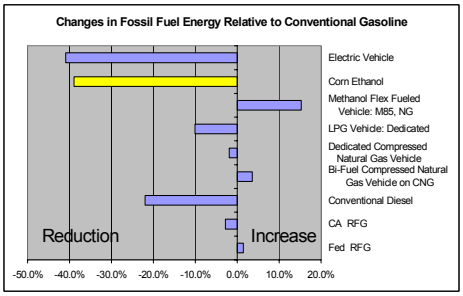
Per-Gallon Ethanol Effects: GHGs Emissions Reductions Relative to Gasoline



Note: Use of a gallon of ethanol in E10 requires a lot more miles than use of a gallon of ethanol in E85 or E95.

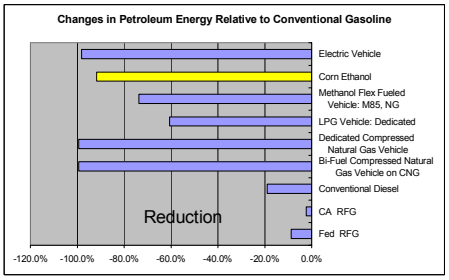
Source: Argonne National Laboratory GREET Model

Fossil Fuel Energy



Source: Greet Model

Petroleum Energy

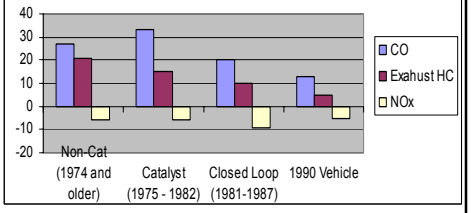


Source: Greet Model

Benefit of Ethanol Blends is Greater for Vehicles with Older Emissions Technology

- Oxygen content is more important for older vehicles
- Reduces exhaust emissions of HCs and CO, but increases NOx in normal emitters
- Higher RVP means an increase evaporative HC Emissions
- Overall decrease in toxic emissions is greater for older vehicles

Percent Decrease in Emissions for 10% Conventional-Gasoline Ethanol Blend with one-psi RVP increase for Normal Emitters



High Emitters and Ethanol

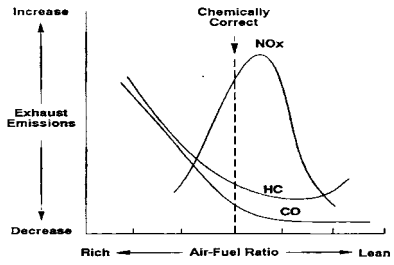
For high emitters, the EPA emissions model (Complex Model) estimates:

- ⇨ **Significant reductions in NOx emissions**
- ⇨ **Large reductions in exhaust benzene and 1,3 butadiene emissions**

More on NOx Emissions and Oxygenates

- ⇨ **The EPA Complex Model estimates a small decrease for all vehicles -- primarily due to the reduction in NOx emissions from high emitters**
- ⇨ **The California Predictive Model estimates an increase in NOx emissions -- high emitters are not separately identified**

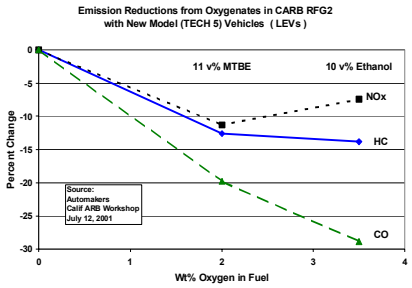
Typical Relationship Between Engine Exhaust Emissions and Air-Fuel Ratio



Future Fuel Trends

- ⇨ **With modern control systems that dynamically adjust the air-to-fuel ratio, the effect of oxygen in the fuel will diminish**
- ⇨ **Ethanol will be valued more for:**
  - – **toxic emission reductions**
  - – **high octane**
  - – **virtually no sulfur**
- ⇨ **These properties will become more important with the elimination of MTBE**
- ⇨ **Ethanol's major disadvantage is the RVP increase**

Limited Emissions Tests on New Vehicles



Conclusion: More tests are needed to understand relationship between fuel properties and emissions in new vehicles with advanced emission control system.

Summary of Effects for E85 Compared to CaRFG2

	Lab 1	Lab 2
NMHC	-20%	-22%
NOx	-25%	-32%
CO	-24%	-12%
CO2	-7%	-6%
Evaporative emissions	-3%	0%
Fuel economy (equivalent energy basis)	+1%	-1%
Exhaust Toxics		
- Benzene	-79%	
- 1,3-Butadiene	-80%	
- Formaldehyde	+20%	
- Acetaldehyde	+1949%	
Specific Reactivity	-30%	
Ozone Forming Potential	-25%	

Federal Test Procedure Emissions Test Results from Ethanol Variable-Fuel 1992 and 1993 Chevrolet Luminas

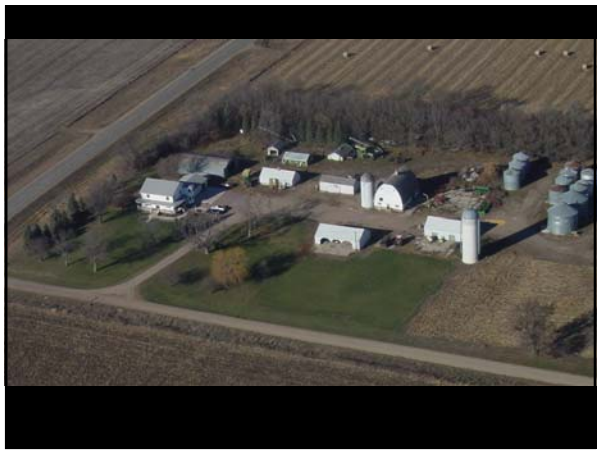
Mass and Potency Weighted Exhaust Toxic Emissions

		Mass Emissions (mg/mile)		Potency-Weighted Emissions (pwmg/mile)	
	Potency Weighting Factors	CaRFG	E85	CaRFG	E85
Benzene	0.170	8.90	1.83	1.51	0.31
1,3-Butadiene	1.000	0.87	0.17	0.87	0.17
Formaldehyde	0.035	2.79	3.36	0.10	0.12
Acetaldehyde	0.016	0.84	17.21	0.01	0.28
Total		13.40	19.25	2.49	0.88

Ethanol also reduces evaporative benzene emissions

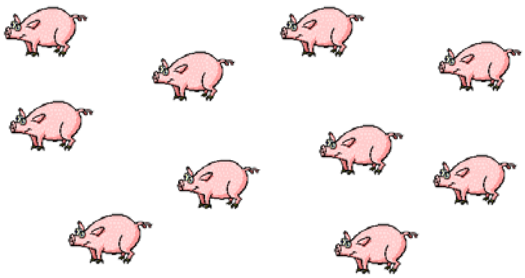
Dave Kolsrud

Nevada Ethanol Workshop
January 9, 2003
Reno, Nevada



Hard Work = Success

Don't put all your eggs in one basket

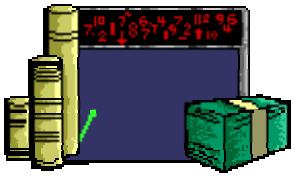


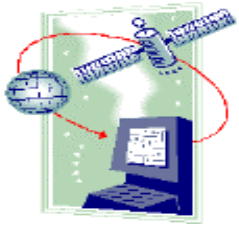
Need to Specialize

Bigger is Better

Low Cost Producer

Better Marketing



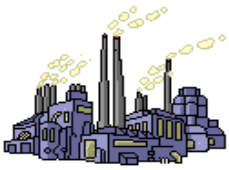


Embracing New Technology

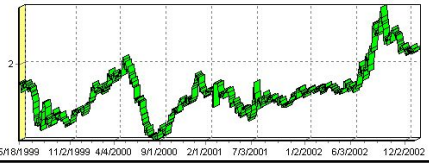
Creative Thinking

Need to be Active Politically

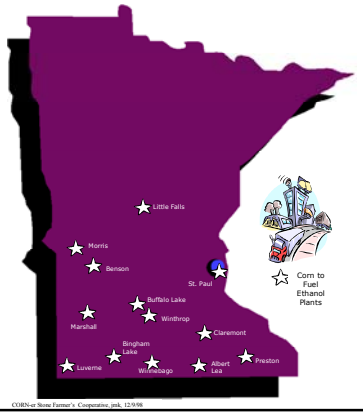
Farmer Owned



Further Processing



Ethanol Plants



MINNESOTA MODEL

2 KEY COMPONENTS

1. <u>Markets</u>

Oxygenated Fuel Statue

2. <u>PRODUCER INCENTIVE</u>

20 cents a gallon up to 15 million gallon a year for 10 years

CORN PRODUCTION

ROCK COUNTY MINNESOTA

Average production (95-99)	16,540,760
Feed Usage	(5,510,000)
	11,030,760

1 Bushel Corn Equals

2.6 Gal. Ethanol	17 # DDGS
X $1.20	X 3.5 cents/lb.
$3.12	59.5 cents

$3.12
+ .60
$3.72

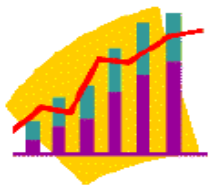
Export vs Export + Processing

11,030,760	5,030,760	6,000,000
X $2.00	X $2.00	X $3.72
$22,061,520	$10,061,520	$22,320,000

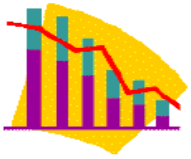
$32,381,520
(22,061,520)
$10,320,000 Additional Cash

$10,320,000 Additional Cash
X 13 Plants
$134,160,000 Additional Cash

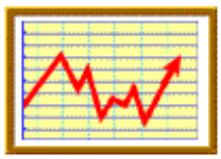
(Most is spent in Minnesota)



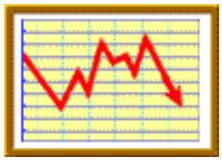
CORN PRICES



CORN PRICES

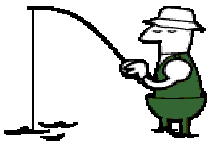


GAS PRICES



GAS PRICES

Farmer Owned Wind Towers



Points to Consider when Building an Ethanol Plant

Nevada Ethanol Workshop
January 9, 2003

Mark Yancey
BBI International
602 Park Point Drive
Suite 250
Golden, CO 80401
mark@bbiethanol.com

Presentation Overview

- Project Development Overview
- Feasibility Studies
- Cellulosic Ethanol
- Addition Information

Project Development Path

- Organize board/business
- Secure seed money
- Feasibility Study
- Business Plan
- Prospectus
- Raise Equity
- Secure Debt Financing
- Construction and Startup

Key Elements of an Ethanol Feasibility Study

- Site selection
- Feedstock analysis
- Fuel ethanol, DDGS & CO2 markets
- Financial analysis
  - Construction costs
  - Owner's costs
  - Operating costs
  - Sensitivity studies

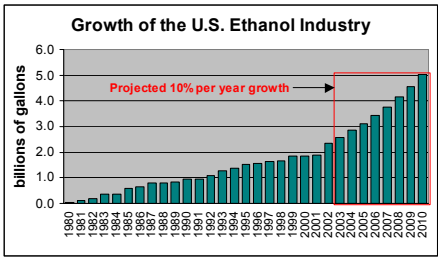
Site Selection

- Typically 20 to 40 acres in a rural area with:
  - Low cost feedstock (typically corn)
  - Good rail access
  - Good road access
  - Adequate utilities at reasonable cost
  - Close proximity to co-product markets
  - Access to ethanol markets
  - Access to labor

Feedstock Analysis

- Local or imported feedstock?
- Availability and price (10-yr history)
- Ethanol yield
- Co-product yield
- Competition

Ethanol Market Growth



MTBE Phase Out

States requiring the removal of MTBE

Source: BBI International

Co-Product Markets

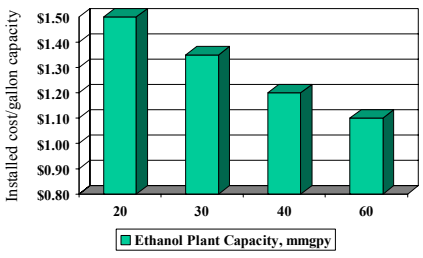
- Are there nearby markets for the coproducts?
- Distillers Grains – traditionally marketed wet or dry to cattle feedlots and dairies; dry to poultry
- Carbon Dioxide – strong markets in So. California and the East coast; poor markets in the Midwest

Financial Analysis

- Use conservative assumptions
- Evaluate 2 or 3 plant sizes
- Use ROI or IRR for profitability
- 20% minimum ROI, 25-30% for better projects
- Returns are most sensitive to corn and ethanol pricing

Construction Costs

Typical Corn Dry Mill Ethanol Plant



Owner's Costs

- Land, roads, rail & site development
- Administration building/furnishings
- Utilities, water treatment, fire water
- Permits
- Startup costs and training
- Construction interest and loan fees
- Inventory costs
- Owner's Costs add 20-30¢ per gallon to the overall project cost

Operating Costs & Revenue

- Production costs ……..… $1.20/gal
  - Corn
  - Energy
  - Chemicals, enzymes, yeast, denaturant
  - Labor
  - Water
- Administrative costs …..…… $0.07/gal
- Debt service ……..…… $0.13/gal
- Revenue ……..…. $1.55/gal
  - Ethanol
  - Distillers grain and possibly CO2
- Pre-tax income ……..…. $0.15/gal

Gaining an Advantage

- Strong local/regional ethanol market
- Low feedstock price
- Low energy costs
- Sell wet distillers grain
- Developed site/co-location
- Risk management
- State incentives

After the Feasibility Study

- Obtain commitment for the site
- Select process design company and begin preliminary engineering work
- Begin discussions with lenders
- Complete a business plan
- Complete prospectus for stock offering
- Obtain required permits
- Secure equity and debt financing
- Hire a project coordinator
- Begin construction

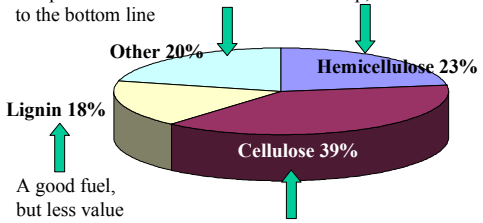
Cellulosic Ethanol

- Ethanol can be produced from "biomass" – agricultural and forest residues, garbage, energy crops, etc.
- All plants are made up of various types of sugars – primarily cellulose and hemicellulose – plus lignin which is the "glue" that holds the plant together

Biomass Composition

High percentage of other compounds do not contribute to the bottom line

Chains of other sugars that are easy to break up, but difficult to ferment



A good fuel, but less value than DDGS

Chains of glucose that are difficult to break up without destroying the sugar; easy to ferment glucose

Ethanol from Biomass

- Not commercial – R&D underway worldwide
- Many processes under development:
  - Dilute acid
  - Concentrated acid
  - Enzymatic
  - Gasification/fermentation
  - Gasification/catalytic conversion
- High capital costs – 2-4x dry mill cost

Additional Information

- BBI – Ethanol Plant Development Handbook
  - a guide for those considering building an ethanol production facility
  - written by industry experts
  - 4th edition available February 2003
- Alltech – Alcohol Textbook
- RFA – www.ethanolrfa.org

Thank You!

BBI INTERNATIONAL

www.bbiethanol.com

Commercial Uses for Ethanol

Presented by Doug Vind
President
Western Ethanol Company
Regent International

Markets for Ethanol

- E-10 Unleaded Gasoline
- E-85
- Fuel Cells
- Ethanol Powered Turbine Generators

What is E – 10?

- 10vol% denatured motor fuel grade ethanol in a mixture with 90vol% unleaded gasoline.
- ASTM specifications have typically defined the quality parameters for denatured ethanol.
- CARB has set separate specifications for denatured ethanol.
- Ethanol industry continues to review and evaluate implementing additional, voluntary controls on specific quality issues.

E-10 in the US (a chronology)

- Product Extender
- Margin Improver
- Octane Enhancer
- Carbon Monoxide non-attainment strategy
- Carbon Monoxide attainment maintenance
- Federal Reformulated Gasoline
- CARB Cleaner Burning Gasoline
- MTBE Phase-Out (replacement oxygenate)
- Federal Renewable Fuels Standard?

E – 10 in Nevada (a chronology)

- Margin Improver
- Carbon Monoxide attainment (maintenance strategy)
- Clark County Cleaner Burning Gasoline Program
- Octane Enhancer (sub-octane pipeline grades of gasoline shipped from California)
- MTBE Phase-Out
- Federal Renewable Fuels Standard?

CO Control Strategy

- Clark County and Washoe County have benefited from aggressive and tailored Oxygenated Fuels Programs to achieve compliance with Federal CO attainment standards.
- The continued mandatory use of oxygen is a cornerstone in maintaining CO compliance in view of projected strong growth in local population and vehicle miles traveled.

Ethanol's Cost/Value

- Historically ethanol has been utilized to improve the gross margin (per gallon) of the blender or retailer by creating a higher octane grade of gasoline at a reduced cost.
- During the mandatory wintertime oxygenated fuels season, refiners have taken advantage of the increased octane blending value of ethanol and have shipped sub-octane base gasoline via common pipeline.

Ethanol's Cost/Value (cont.)

- Starting this month, ethanol will be utilized by most refiners as a replacement oxygenate to MTBE throughout Southern and Northern California .
- Relative to other available blending component choices, ethanol will provide California refiners with a cost effective solution to replace the lost octane resulting from the removal of MTBE.

Ethanol's Cost/Value (cont.)

- Because the majority of California refiners have elected to remove MTBE at nearly the same time, the transition to ethanol is expected to be well coordinated and will result in establishing a uniform California base gasoline blend-stock for ethanol blending (CARBOB).
- CARBOB will, within the Oil Companies proprietary pipeline distribution networks, replace CARB gasoline.
- Ethanol will be treated as an additive and in-line/rack blended. This practice is consistent with other additive "packages" currently a part of proprietary Oil Company branded gasoline.

E -10 resources and additional information

- Renewable Fuels Association
  Phone (202)289-3835, Fax (202)289-7519
  e-mail info@ethanolrfa.org
- Clean Fuels Development Coalition
  Phone: (301)718-0077, Fax: (301)718-0606
  e-mail: CFDCInc@aol.com

What is E85?

- A mixture of 15vol% unleaded gasoline and 85vol% fuel grade ethanol.
- Designed to run in Flexible Fuel Vehicles capable of operating on a range of gasoline and ethanol mixtures (from 100vol% gasoline to 85vol% ethanol).
- Considered an Alternative Fuel under Federal & State Alternative Fuel Vehicle (AFV) programs.

E85 Vehicles

- Currently over two million E85 Flexible Fuel vehicles on America's roads today.
- DaimlerChrysler, Ford and General Motors provide the flexible fuel engine as standard on several models, including mid-size cars, minivans and trucks.
- The Energy Policy Act of 1992 requires federal agencies to buy vehicles that run on alternative fuels.

What are the latest types of Flexible Fuel Vehicles?

- ***Ford***
- 2002-2003 4.0L Explorers (4-door)
- 3.0L Taurus LX, SE and SES sedan and wagon
- 3.0L 4x2 Ranger pickup
- 2001 3.0L 4x2 Ranger
- 3.0L Taurus LX, SE and SES sedan
- 1999-2000 3.0L Ranger pickup, 4WD & 2WD
- 3.0L Taurus LX, SE and SES sedan
- (Many 1995-98 Taurus 3.0L Sedans are also FFVs)
- ***DaimlerChrysler***
- 2003 2.7L Dodge Stratus Sedan
- 2.7L Chrysler Sebring Sedan & Convertible
- 3.3L Dodge Cargo Minivan
- 2000-2003 3.3L Chrysler Voyager
- 3.3L Dodge Caravan Minivan
- 3.3L Chrysler Town & Country
- 1998-1999 3.3L Plymouth Voyager
- 3.3L Dodge Caravan Minivan
- 3.3L Chrysler Town & Country

What are the latest types of Flexible Fuel Vehicles? (cont.)

- ***General Motors***
- 2002-2003 5.3L V-8 engine Chevy Silverado & GMC Sierra half-ton pickups
- 5.3L Vortec-engine Suburban, Tahoe, Yukon, and Yukon XL
- 2000-2001 2.2L Chevrolet S-10 pickups & 2002 2.2L Sonoma pickups
- ***Isuzu***
- 2000-2001 Isuzu 2.2L Hombre pickup
- ***Mazda***
- 1999-2001 Selected Mazda 3.0L B3000 pickups
- ***Mercury***
- 2002-2003 4.0L Selected Mountaineers
- 2001 3.0L Selected Sables (look for the "Road & Leaf" symbol)

E85 Fueling

- Compatible with existing retail gasoline storage tanks and dispensing equipment.
- Can be splash blended at the terminal and delivered via conventional gasoline tank truck.
- Government sponsored programs available to assist in cost of installing E85 fueling stations.

E85 Opportunities

- Flexible Fuel Vehicles can be used to meet EPACT requirements.
- Increasing commitment from Auto Manufactures to produce Flexible Fuel Vehicles.
- Growing commitment by some Fleets to consistently purchase E85 fuel.
- State and Federal tax incentives exist for E85.
- Pricing can be competitive with unleaded gasoline.

E85 Challenges

- Fueling Infrastructure
- Volume
- Lack of clear requirement to use the fuel in Flexible Fuel Vehicles
- Price

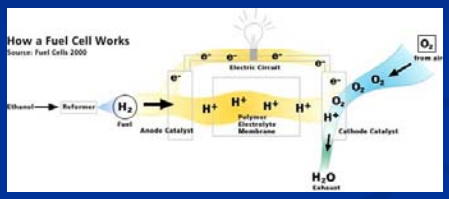
E85 Resources and additional information

- **Call the National Ethanol Vehicle Coalition at (573) 635-8445, toll-free at (877) 485-8595 or via e-mail at nevc@e85fuel.com.**
- **National Alternative Fuels Hotline (800)423-1DOE**

What is a Fuel Cell?

- A fuel cell is an **electrochemical** energy conversion device that converts hydrogen and oxygen into electricity and heat.
- Operates like a battery but does not run down or require recharging.
- Relies on chemistry, not combustion.
- Emissions consist primarily of water and steam.

How a Fuel Cell works



Why use ethanol in fuel cells?

- Renewable and domestically produced hydrogen-rich liquid.
- Ethanol is widely available today throughout the U.S. as a transportation fuel.
- Ethanol infrastructure is second only to gasoline.
- Ethanol production capacity continues to expand.
- Cost of production continues to decline.

Ethanol in Fuel Cell Advantages

- Automotive
- Ethanol is compatible with gasoline reformer technology.
- Flexible and can be optimized regionally.
- Ethanol reformer simpler, more reliable and less costly than a gasoline/multi-fuel reformer.

Ethanol in Fuel Cell Advantages

- Distributed Power
- Low emissions, noise and environmental footprint.
- Local ethanol production creates regions of energy self-sufficiency.
- Local ethanol production will expand the economic base of the local economy and create jobs and tax revenue.

Fuel Cell resources and additional information

- RFA publication "Ethanol and Fuel Cells: Converging Paths of Opportunity" available at www.ethanolrfa.org
- California Fuel Cell Partnership www.fuelcellpartnership.org

Ethanol Powered Turbine Generators

"Green Electricity"

- Small 150kw to 450kw turbines create "dispatch-able" power.
- Available to supplement existing intermittent renewable power sources (wind)
- "Peak Load" renewable power supply.
- Utilizes existing turbine generator technology.
- Expands local/regional renewable electricity generating capacity.

For more information on ethanol powered turbines

Please contact:

Doug Vind at

dbv@regentinternationl.com

Commercial Uses for Ethanol

Presented by Doug Vind
President
Western Ethanol Company
Regent International

"E-Diesel: A Status Report to the Industry"

U.S. Department of Energy Fuel Ethanol Workshop

Presented by

James Peeples
AAE Technologies, Inc.

Atlantis Hotel
Reno, Nevada

January 9, 2003

Introduction

- AAE TECHNOLOGIES, INC.
  - Established in 1997, developer and holder of numerous worldwide patents for fuel additive technologies
  - O²Diesel™ efforts in U.S. underway since 1998: focused on cost-effective, commercially viable products
- OCTEL STARREON, LLC
  - Over 60 years as a leading world fuel additive supplier
  - Leading manufacturer and supplier of diesel additives
  - North American sales and distribution network for Performance & Petroleum Specialty Chemicals

Diesel Market Overview

- Diesel emissions under scrutiny on a global level
- Global policies challenge operators, refiners and marketers
- Targeted emissions from diesel: NOx, CO, PM and air toxics
- Other solutions such as CNG, catalysts & DPFs are costly, some still untested, and many require major infrastructure changes
- Fleets affected include: urban transit vehicles, delivery & service fleets, construction and other off-road equipment
- U.S. market: ~50 billion gallons and growing (highly segmented)

What is E-Diesel (O²Diesel™) ?

A diesel fuel containing conventional diesel blendstock(s) with:

- Up to 15vol% Anhydrous Ethanol,
- Stabilized with ~1.0 – 5.0vol% proprietary additive(s), and
- Cetane enhancement where required

The AAE-Octel Starreon *Octimax™ 4931* (includes cetane improver) makes commercially viable O²Diesel™ at <1.0vol% additive treat rate

- Premium Diesel performance: lubricity, stability, conductivity
- Little or no infrastructure or engine changes required
- Can be used in heavy-duty on- & off-road CI engines now!

What is E-Diesel? (continued)

Why Ethanol is an Ideal Diesel Oxygenate

- Benefits:
  - Renewable, important replacement for imported petroleum
  - No significant environmental side-effects
  - Widely proven as a gasoline oxygenate in world markets including USA, Canada & Brazil
  - Supply & infrastructure already exists in key global markets
  - Greenhouse gas reduction impacts

However, historically unable to 'blend' ethanol with diesel largely due to ethanol's hygroscopic nature -- *UNTIL NOW!*

O²Diesel™ Emissions Benefits

"Typical" E-Diesel Emissions Test Results

Colorado School of Mines: Nov. '99 – Dec. '00

EPA No.2 Diesel vs. No.2 O²Diesel™ (7.7vol% ethanol)

CO	NOx	PM	BHP
▼	▼	▼	▼▲
20-28%	2-6%	34-40%	-1/+2%

EPA 13-mode Transient Cycle Engine Tests (1991 DDC Series 60)

Summary: E-Diesel Fleet Testing

- Ease of logistics, distribution, and handling
- "Drop-in" clean fuel solution
- Little or no infrastructure or engine changes
- Excellent cold weather operability
- Visible and measurable emission benefits

- Good engine performance and driveability
- Fuel is fully fungible with regular diesel
- No reported mileage demerits (urban fleets)
- Economics better than alternative technologies
- No capital investment required

Summary: O²Diesel™ Fleet Testing

- Nevada Ready Mix (Las Vegas, NV): Feb. 2000 – July 2001 (quarry trucks)
- Lincoln StarTran (Lincoln, NE): August, 2000 – current (urban buses)
- Pepsi-Cola (The Bronx, NY): Nov. 2000 – current (~150 delivery trucks)
- Zachry Const. (San Antonio, TX): Mar. 2001 – current (const. equipment)
- Pearl City Co-op (Pearl City, IL): June 2000 – current (fuel delivery trucks)
- Winnipeg Transit (Winnipeg, Manitoba): Oct. 2001– Aug. 2002 (20 buses)
- Denny Wessels Transport (Buffalo Center, IA): Nov. 2001 – May 2002

Also:

- OCTranspo (Ottawa, Ontario): Starts 1st Qtr. 2003 (20 urban buses)
- 5 Municipalities (So. Calif.): Starts 1st Qtr. 2003 (120 diesel engines)

O²Diesel™ Fleet Testing: Nevada

- Project Participants: DOE/NREL, CE-CERT (Riverside, CA), AAE Technologies, RTC/ATC (Las Vegas Transit), SwRI, Clark County (NV), Rebel Oil Co, Western Ethanol/Regent International
- Fleet: 17 out-of-warranty DDC transit buses (Series 50 & 6V92 engines)
- Length of demonstration: 10 – 12 months (starts January 9, 2003)
- Real-world, in-use emissions testing planned (an e-diesel first)
- Full demonstration of fuel delivery systems, handling & logistics
- Detailed analysis of fuel effects on engines and fuel system components

E-Diesel Technical Agenda: 2003

- "Ethanol-Blended Diesel Fuel Handbook" -- initiated Summer, 2001 and to be completed Fall, 2002 (Argonne Nat'l. Labs)
- Uniform Safety and Handling procedures -- Evaluation begun in 2001/02 at Southwest Research Institute (SwRI)
- Greenhouse gas impact analysis -- initiated Summer, 2001 by Argonne National Labs (Michael Wang, et al)
- Health effects testing req'd. per Section 211(b) of the Clean Air Act
- John Deere cooperative test program (>$2 million + 2 years)

E-Diesel Consortium: Organization

- Draft Consortium Charter approved Dec. 4, 2001
- Established under aegis of the Renewable Fuels Foundation
- Consortium began work in early 2002
- Significant technical & regulatory agenda (2002 – 04)
- Broad industry/government participation anticipated

E-Diesel Consortium: Participants

- State of Illinois "Core Group" (original E-Diesel Task Force)
- Major U.S. ethanol producers (ADM, Cargill, Williams)
- Additive Suppliers (AAE Technologies/Octel Starreon, Akzo Nobel, GE/Betz, Lubrizol, Pure Energy Corp., etc.)
- Engine Manufacturers (John Deere, etc.)
- US Dept. of Energy (including NREL, Argonne National Laboratory)
- Renewable Fuels Association (U.S. and Canada)
- National Corn Growers Association (and state chapters)
- State and local, public & private groups (e.g., Nebaska Ethanol Board)

E-Diesel Consortium: Technical Issues

- Managing flash point & flammability
- Determining materials compatibility & durability
- Establishing storage & handling requirements
- Meeting ASTM/CGSB fuel standards & acceptability ("Fill & Go")
- Completing EPA health effects testing
- Obtaining additional emissions benefits
- Complying with federal, state & local laws & regulations

Conclusions

- E-Diesel faces large technical & regulatory challenges
- Tax incentive issues must be addressed for full commercialization
- Meaningful public & private support for E-Diesel will get results
- Major competition from other new diesel(s) expected
- OEM skepticism will be significant for a while to come
- E-Diesel Consortium is now in place to address all issues
- E-Diesel will be "ready for prime time" well before 2006 – 07!

AAE Technologies, Inc.
200 Executive Drive
Newark, Delaware 19702 USA

(302(266-6000 (office)
(302) 266-7076 (fax)

www.aaetech.com

Octel Starreon, LLC
Refinery & Performance Fuel Additives
8375 S. Willow Street
Littleton, Colorado 80124 USA

(303) 566-0530 (office)
(303) 792-5668 (fax)

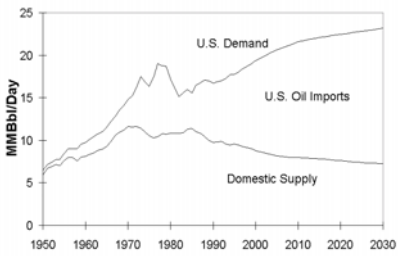
The Biorefinery Strategy

Kentucky Ethanol Workshop

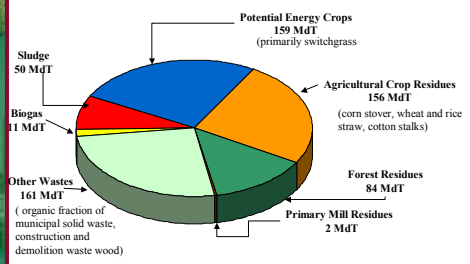
Frankfort, KY

February 3, 2003

The National Security Problem



U.S. Feedstocks Available by Biomass Type



Total Feedstocks Available: 623 Million dry Tons (MdT) per year

Energy Equivalent: 11 quadrillion Btu

Source: Biobased Products and Bioenergy Roadmap, July 2001 Draft

Background, Energy Policy & the Biorefinery

Oil Import Situation

- Imports are a large and growing share of U.S. petroleum consumption
  - Imports were 55% of petroleum consumption in 2001
    - 19.6 Mil. Bbl/day consumption
    - 10.9 Mil. Bbl/day net imports
  - EIA projects imports to reach 62% of consumption in 2020
- Petroleum product consumption in the transportation sector in 2001 was 26.21 Quads (approx. 228 billion gallons, or 14.9 Mil. Bbl/day)
  - Motor gasoline: 8.61 Mil. Bbl/day
  - Distillate fuels* (e.g. diesel): 2.52 Mil. Bbl/day
- In 2001, 1.77 billion gallons of ethanol were produced in the U.S. 2002 estimates exceed 2 billion gallons
- Approximately 6.7 million gallons of biodiesel were produced in the U.S. in 2000

*Distillate fuel for transportation figure is for 2000.

Restructuring Biomass Program – 2002

- Major restructuring of EERE
- Previous focus on biofuels, biopower and bioproducts
- Current focus biorefinery and technology development pathways for fuels, power, and bioproducts

Background, Energy Policy & the Biorefinery

Biomass RD&D is a National Priority

- The President's National Energy Policy includes multiple recommendations that support Bioenergy.
- The Biomass R&D Act of 2000 directs DOE and USDA to enhance and coordinate biomass R&D efforts.
- The Energy Title (Title IX) of the new Farm Bill provides supports for increased use of biomass energy and products and for R&D.
- The comprehensive energy bill now pending in Congress contains provisions to encourage expansion of biomass utilization, including a Renewable Fuels Standard for transportation fuels.

Background, Energy Policy & the Biorefinery
Program Mission and Goals

Mission

- To foster research and development on advanced technologies to transform our abundant biomass resources into clean, affordable, and domestically-produced biofuels, biopower, and high-value bioproducts for improving the economic development and enhancing the energy supply options of the U.S.

Goals

- Reduce U.S. dependence upon foreign sources of petroleum
- Realization of the Industrial Biorefinery

Background, Energy Policy & the Biorefinery
What is a Biorefinery?

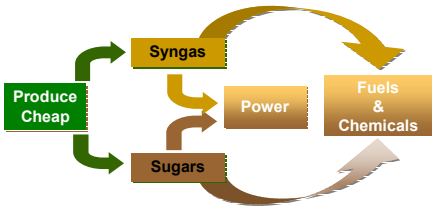
According to the 2002 Farm Bill, "The term 'biorefinery' means equipment and processes that:

- Convert biomass into fuels and chemicals; and
- May produce electricity

Background, Energy Policy & the Biorefinery
Biorefinery Concept

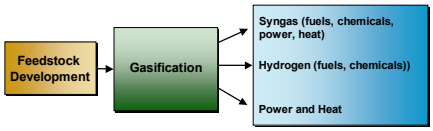
- Thermochemical and/or biochemical processes
- Multiple product capability (some combination of ethanol, hydrogen, electricity, sugars, syngas, and specialty chemical products)
- Multiple feedstock capability

OBP R&D Focus Areas



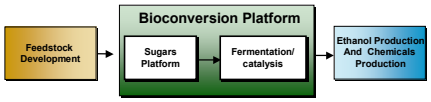
- Portfolio of production technologies
- Common, high-volume chemical intermediates

Thermochemical Conversion



- Increased emphasis for thermochemical pathways that use biomass to produce:
  - Synthesis gases for producing diesel, gasoline, or fuel alcohols
  - Hydrogen production from synthesis gas, providing a fuel for fuel cells
  - Steam and electric production in pulp & paper mills

Bioconversion



- Increased emphasis for Bio-Conversion Platform per the Biomass R&D Act of 2000
  - Fermentation platform
  - Sugar Platform
  - Enzyme Systems Development
  - Catalytic pathways
- Decreased emphasis for near term demonstrations of acid-based ethanol production technology
- Feedstock collection and handling Logistics

Opportunities

- On the horizon
  - Develop and integrate bioproducts to enable deployment of biofuels
  - Develop strong partnerships with industry leaders committed to technology deployment
  - Coordinate with USDA
  - Demonstrate utilization of corn stover in existing dry mills for fuel and co-products
  - Improve profitability of existing wet & dry mills

HOW ETHANOL IS MADE:

GRAIN
&
CELLULOSIC

Tim S. Morris

Project Coordinator – FAGEN INC.

General Manager - Fagen Management LLC

50,000 foot view

Big Picture

Little Detail

CELLULOSE & STARCH

Fuel Ethanol

CELLULOSE

Structural Material

STARCH

Stored Food

CELLULOSE & STARCH

Polymers of Sugar

CELLULOSE/STARCH $\xrightarrow[\text{acid, enzymes}]{\text{heat}}$ Sugar

Sugar $\xrightarrow{\text{fermentation}}$ Alcohol & Water + CO_2

Alcohol & Water $\xrightarrow[\text{dehydration}]{\text{distillation}}$ Alcohol

Alcohol & Denaturant → Fuel Ethanol


Thank You

ETHANOL 101 - KY

- E 10
- E 85
- E Diesel
- FUEL CELLS

Kentucky ethanol production 5 million gallons per year

PARALLEL PRODUCTS

Ethanol Demand in Kentucky 81 million gallons per year

Ethanol Demand in Kentucky

Location	Monthly Volume
Catlettsburg, Ky.	500,000
Covington, Ky.	1,000,000
Lexington, Ky.	500,000
Louisville, Ky.	4,500,000
Paducah, Ky.	75,000
Somerset, Ky.	130,000
Evansville, In.	20,000
Cape Girardeau, Mo.	10,000

E 85

- University of Kentucky, Lexington
- City of Lexington
- State Fleet Frankfort
- Murray State University, Murray
- Mammoth Cave State Park
- CECIL'S SERVICE 447 South 8th St. Louisville (Chevron)

E DIESEL

PRO

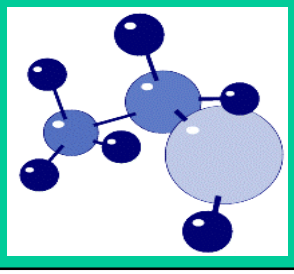
- PARTICULATE IMISSIONS SUBSTANTIALLY IMPROVED
- CONTAINS UP TO 15% ETHANOL

CON

- CLASS 1 FALMMABLE LIQUID
- LOWER BTU CONTENT REDUCES FUEL ECONOMY

FUEL CELLS

Ethanol's molecular structure is CH3CH2OH



The Key to a Distillery's Success:

How it designs its process with Distillers Grains in mind

Alltech ...naturally

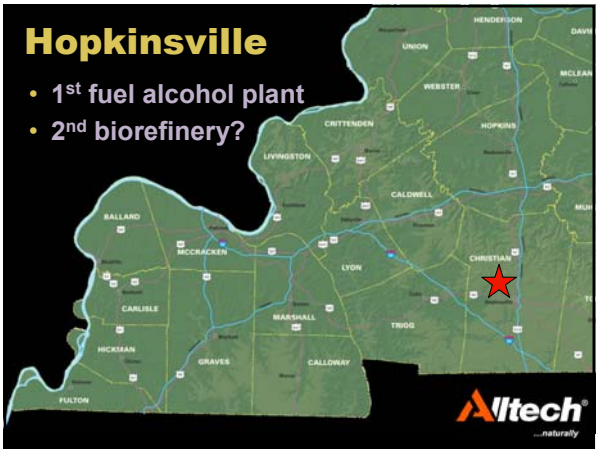
Kentucky

- a wonderful opportunity

Alltech ...naturally

Hopkinsville

- 1st fuel alcohol plant
- 2nd biorefinery?



Alltech ...naturally

Alltech
The 1st biorefinery

- 1300 employees
- 65% export
- 17th largest animal health company in the world
- Founded in the 'gasohol' industry
- 23% growth per annum

Alltech ...naturally

The Challenge

- Add value to agricultural products
- Replace tobacco revenue

Alltech ...naturally

Solution

- Fuel ethanol? --- NO
- Add value? --- YES!

Alltech ...naturally

A few misconceptions...

- Our DDGS (fuel alcohol) is better than beverage plant DDGS
- Our technology is better than beverage plants

Alltech ...naturally

The Key

- Maximize alcohol production (yield)
  - Thus minimize DDGS production
- Lower DDGS production costs
- Add value to DDGS

The 4 steps of alcohol process

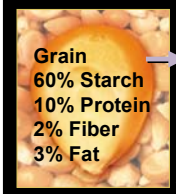
Extraction of Fermentable Carbohydrate

Fermentation of carbohydrate to ethanol

Distillation of Ethanol to more concentrated form

Processing of Spent Raw Materials

The Process of Making DDGS



Grain
60% Starch
10% Protein
2% Fiber
3% Fat

Ground Cooked Fermented

Distillation

Alcohol

Stillage

Thin Stillage

Light Grains

Evaporation

Syrup

Dryer

DDGS
5% Starch
30% Protein
8% Fiber
8% Fat

Maximize alcohol production

- Increase percentage ethanol in fermentation
- Extract more sugar from cereal

Alltech ...naturally

Increasing percentage ethanol in fermentors

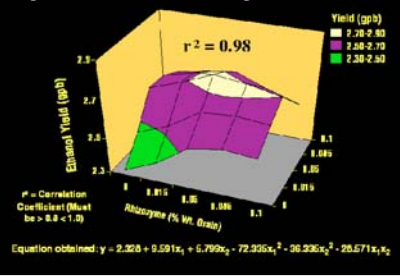
HOW?

- Use of high ethanol-tolerant yeast
- Look after your yeast
  - Lowest cost item in the distillery
    - Enzymes: 5-6 cents/gallon
    - Yeast: 0.5-1 cent/gallon

Alltech ...naturally

Extract more ethanol from cereal

- A combination of "conventional" enzymes and Rhizozyme



What's possible?

- Today yield is 2.55-2.7 gallons per bushel
- With the model . . . . 3.1 gallons/bushel

Alltech ...naturally

Can it be done?

- 3.1 gallons/bushel is now possible

Karl Dawson
University of Kentucky
Alltech Inc.

Alltech ...naturally

For Hopkinsville: 20 million gallons

Yield	2.65	3.1
Corn required Bushels, m	7.54	6.54
Tons	211,000	180,000
Savings, m		$200,000+

*Corn: $2.50/bu
*Allowance less DDGS

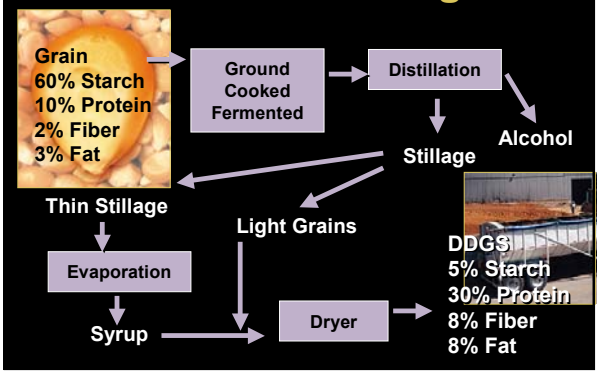
Alltech ...naturally

Lower DDGS production costs

- Evaporate to higher percent solids
- Don't dry
- Develop new markets for solubles

Alltech ...naturally

The Process of Making DDGS



DDGS

Starch Rich Grain → Protein Rich DDGS

Alltech ...naturally

So What is the DDGS Problem

- Recognized as a commodity
- Used as a feed material for ruminants
  - High fiber content (poorly used by monogastics)
- Sold on the basis of its protein content not as value
- Sold via brokers
  - Whose concept is more meaningless price
- NO attempt to brand

Alltech ...naturally

The Problem Will Get Worse

By 2012

- An extra 4.5 million tons of DDGS . . . USA as production goes to 5 billion gallons
- An extra 7 million tons of DDGS . . . Europe as European alcohol production starts
  - Total . . . . 11.5 million additional tons DDGS expected by 2012
  - 3-fold increase!!!!
  - No allowance for Austrailia, China, India

The Future?

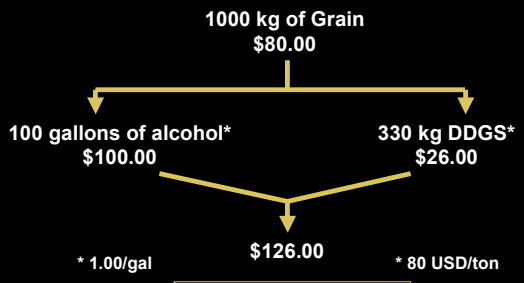
More, More, More DDGS

Less, Less, Less Price

Steve Marcum

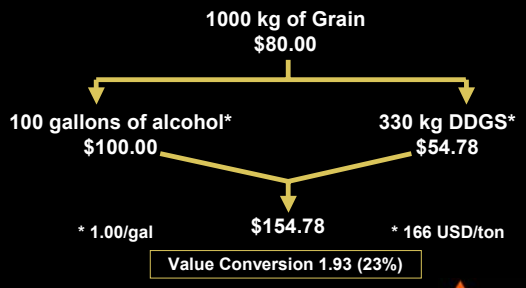
Alltech ...naturally

Economics of Ethanol Production



Alltech ...naturally

Potential Economics of Ethanol Production if DDGS was $166/ton



Is it Possible?

- DDGS: $166 USD per ton
- Additional revenue $32 USD per ton processed
- 82 cents/bushel
- 32 cents/gallon
- Value Added $320,000 per million gallons

Can we do it?

VA 101

A successful story of how to add value to a by-product

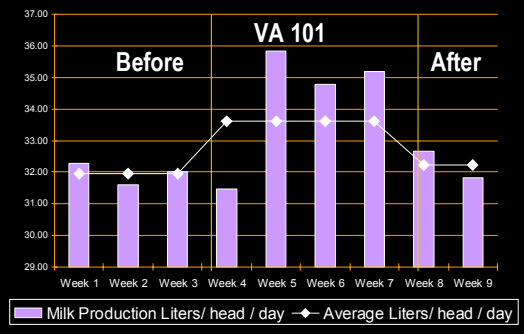
What is VA 101?

- A DDGS where an additional step gave additional value
- A product developed by Alltech

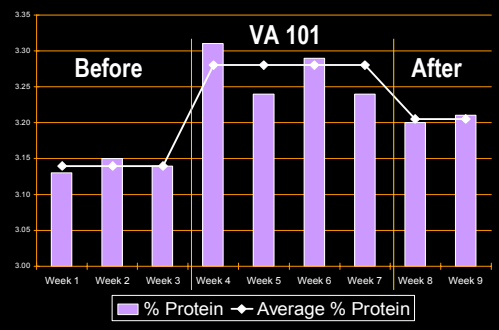
Protocol

- 300 dairy cows were fed:
  - 3 weeks with 3.5 lbs of DDGS/head/day
  - 4 weeks with 3.5 lbs of VA 101/head/day
  - 2 weeks with 3.5 lbs of DDGS/head/day

Milk Production



Milk Protein

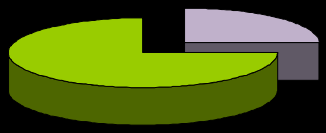


Facts behind success

Economics:

- **3.65 more lbs milk per head per day**
  - Price of milk = $0.12 /lb
  - Extra milk income = $0.44 per head per day
- **More protein in the milk, in this case 4.45%, gives a premium price:**
  - Or $0.03 per head per day
  - Total = $0.47 per head per day

Farmers need 3:1 ratio



Alltech ...naturally

Facts behind success

Return = $0.47 / head / day

Cost of Adding Value

1. VA 101 = $0.05 /hd/d
2. Margin = $0.10 /hd/d
3. Total =$0.15 /hd/d

Return on extra outlay
= 3.1 : 1 for producer

$80.00 / ton DDGS
+ $86.00 / ton DDGS converted to VA 101 + margin

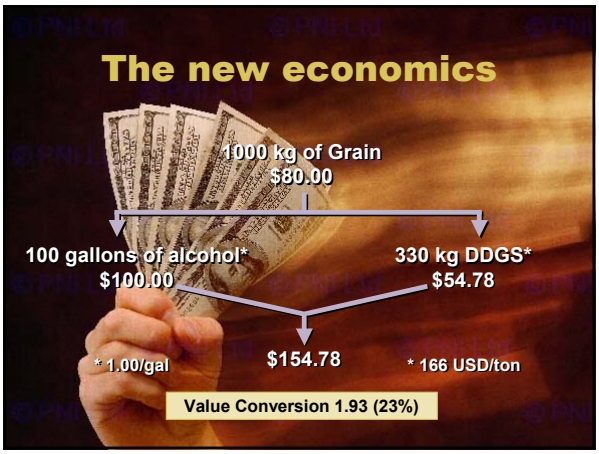
$166.00 / ton DDGS converted to VA 101

Alltech ...naturally

Now DDGS (VA 101) sells $166/ton

Alltech ...naturally

The new economics



However, for VA 101 to work we need. . .

Alltech ...naturally

Commitment to market

- A corporate commitment must be made by the distillery to
  - Value-added production
  - Sell and market that value
  - Build and maintain markets

Alltech ...naturally

Other "VA 101"?

Alltech ...naturally

Non-Ruminant Market

- Less than 4% of DDGS goes to swine, poultry and agriculture
- If every broiler got 7g/head/day all DDGS gone in USA
- If every pig got 1/3 lbs/day - all DDGS gone in USA

Tilstra, 2002

Alltech ...naturally

Can we help?

Alltech ...naturally

Think outside the box

Alltech ...naturally

Alltech

- Form strategic alliance with distillery
- Use our process
- Work together to market product

Alltech ...naturally

The New York Times

Why successful?

- It's not about brilliant ideas…
  - It's about building support for them

Former President Vaclav Havel
"Exit Havel, to muted applause from Czechs"
January 25, 2003

Alltech ...naturally

We must build a branded value-added product

- We must form strategic alliances
  - Technology
  - Marketing

Alltech ...naturally

The coffee commodity

Reinventing a 900 year old commodity product into a great coffee experience

The Starbuck Story: Rewarding every day moments

Reference: A new brand world, Scott Bedbury, 2002

GO CATS!!!!!!!

Alltech ...naturally

Minnesota's Ethanol Program

Ralph Groschen
Minnesota Department of Agriculture
www.mda.state.mn.us

Minnesota's Ethanol Program

- Historical program goals:
  - Boost farm and rural economy
  - Reduce reliance on foreign energy sources
  - Clean up environment by reducing toxic auto emissions

Minnesota's Ethanol Program

- The situation in 1979:
  - OPEC oil embargo leads to long lines and high prices at gas pumps
  - Concerns grow about U.S. dependence on imported oil
  - Federal legislation bans leaded gasoline

Minnesota's Ethanol Program

- Minnesota responds:
  - 1980 State Legislature creates "Blender's Credit"
    - Blenders get tax credit of 4 cents/gallon for gas blended with 10 percent ethanol
    - Leads to increased use of ethanol-blended fuels

Minnesota's Ethanol Program

- Initial success - 40% market share brings:
  - Impact on state highway fund grows
  - Blender credit reduced to 2 cents / Gal
  - Work begins on state fuels requirement
  - Corn exported, ethanol imported
  - Desire for in-state Production grows

Minnesota's Ethanol Program

- Problems arise:

-Gasoline marketers resist

-1986 ethanol sales down to 7 percent

-Ethanol production only 1 million gallons

Minnesota's Ethanol Program

- 1980s Farm crisis gives ethanol new life:
  - Minnesota loses 8,000 farms between 1984 and 1986
  - Two-thirds of corn crop exported as raw commodity
  - Virtually no industrial processing of corn

Minnesota's Ethanol Program

- MDA sets goals for revitalized program:
  - Increase market share for ethanol blends
  - Educate consumers about ethanol facts
  - Build ethanol production capacity and infrastructure
  - Revitalize rural communities through farmer-owned, value-added processing

Minnesota's Ethanol Program

- Air quality emerges as third driver:
  - Clean Air Act requires Minneapolis-St. Paul to include 2.7% oxygen in all gas sold from October 1 to February 1
  - Expanded to year-round in 1995
  - Expanded statewide in 1997

Minnesota's Ethanol Program

- Minnesota's Ethanol Dream Team:
  - Farm organizations
  - Commodity Groups
  - Rural electrification associations
  - Governor's Office
  - State Attorney General's Office
  - Department of Agriculture and other agencies
  - Legislature

Minnesota's Ethanol Program

The MDA's Role:

- Public education
- Help increased ethanol production
- Encourage farmer-owned developments

Minnesota's Ethanol Program

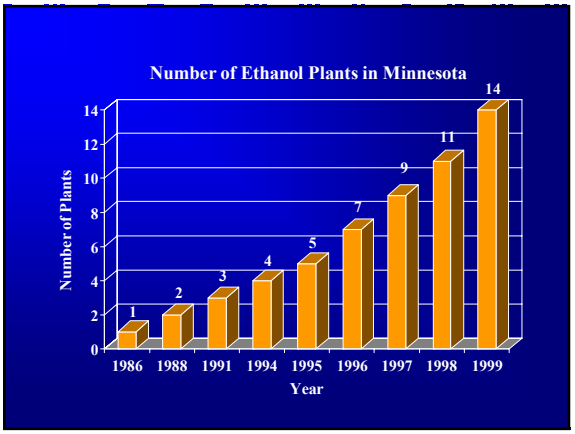
1. Public education:
   - Educational materials
   - Public and private presentations
   - Respond to media and policy queries
   - Sponsorships, technical experts, spokespeople
   - Oxy-fuel Hotline
   - Troubleshooting performance problems

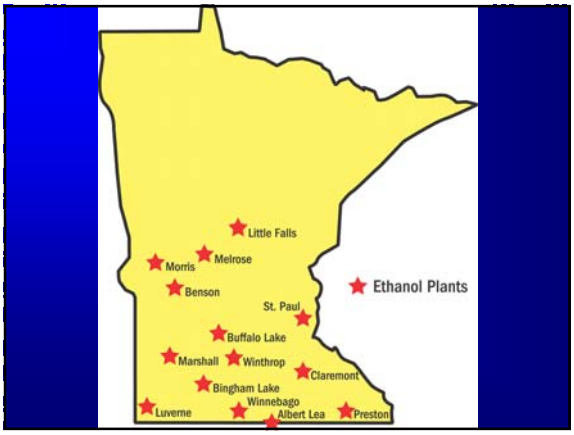
Minnesota's Ethanol Program

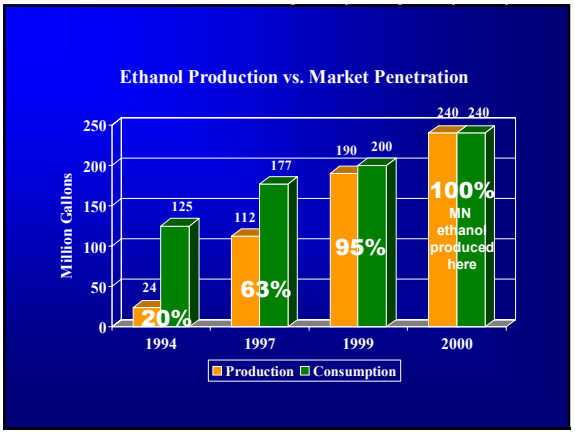
2. Increasing Production:
   - – Statutory Goal:
     - • Production of 240 million gallons in MN.
   - – Key elements
     - • 20-cent per gallon producer incentive
     - • Financial, technical & organizational support
     - • Local market development

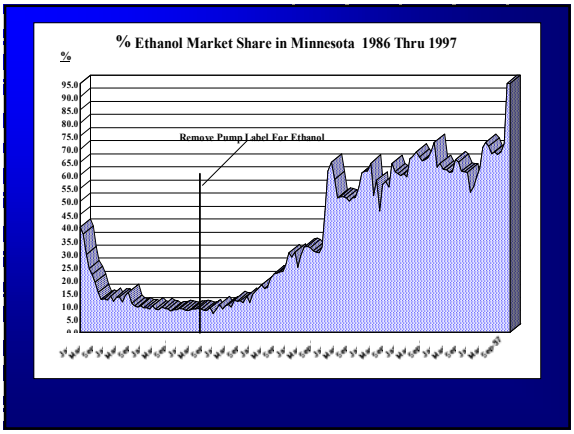
Minnesota's Ethanol Program

3. Assist local developers/ farmer investors:
   - – Financial
     - • $500,000 loans to developers
     - • Stock loan program helps farmers buy into co-ops
   - – Technical and organizational
     - • MDA staff help draft project work plans, schedules
     - • MDA staff help conduct organizational meetings
     - • Liaison with state and federal agencies
     - • MDA staff review marketing, business plans





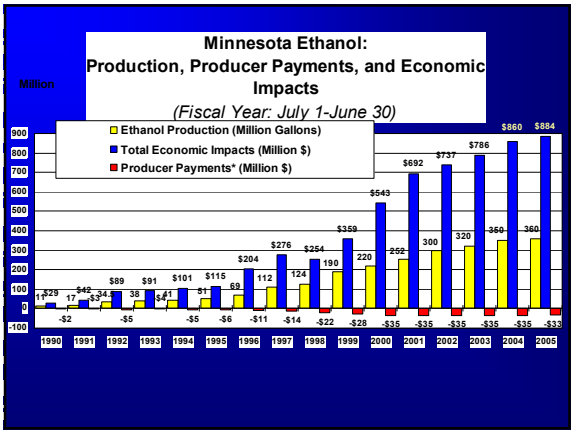




Minnesota's Ethanol Program

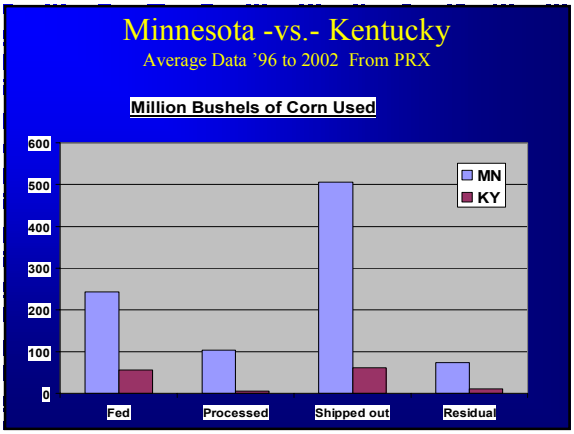
Addressing fears:

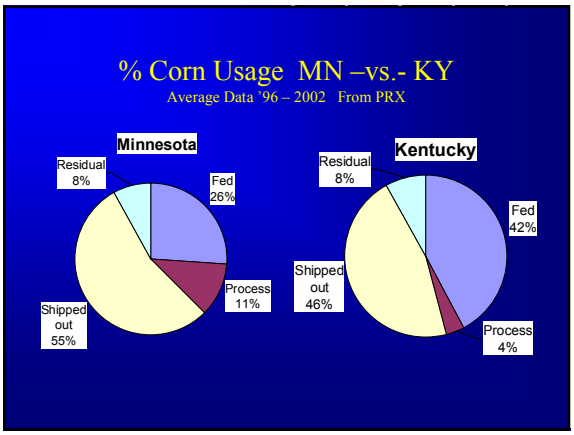
- Heavy enforcement burden? : No
- Underground tanks damaged? : No
- Remote terminals short of ethanol? : No
- Gas prices forced up? : No
- Consumer acceptance? : Good

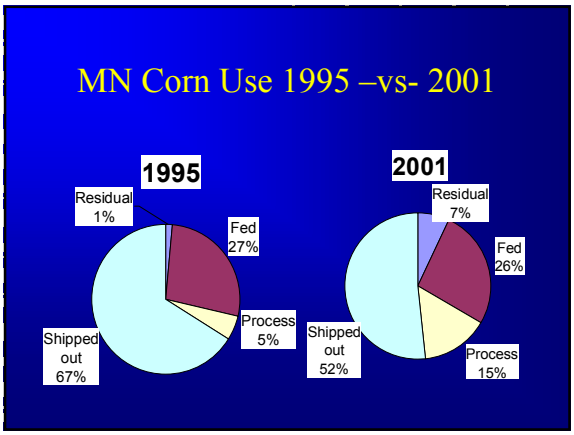


Minnesota's Ethanol Program

- For 2001 production year
- Based on IMPLAN economic Impact model
- $1 producer payment returns $20 economic benefit to the state.







Minnesota's Ethanol Program

- The results:
  - **14 ethanol plants, 11 owned by farmers**
  - **Production capacity surpasses 240 million gallons by August 2000, now 360 million.**
  - **17 % of corn crop used for industrial processing**
  - **$200 million in value added to commodities**
  - **750 new jobs in the plants**
  - **4,000 external jobs supported by plants**
  - **25-35 good jobs or more per plant**

Minnesota's Ethanol Program

- Impacts of farmer-owned processing:
  - Corn-to-ethanol adds $2 to $2.50 in value per bushel
  - Each 15-million gallon plant adds up to $14 million in value to 5.5 million bushels of corn each year
  - Money pumped into local communities

Minnesota's Ethanol Program

- Ethanol as a Farmer Investment:
  - Hedge on traditional corn market prices
  - Farmers to capture more of total profit
  - Farmers diversify, smoothing out peaks and valleys in farm income

Minnesota's Ethanol Program

- Goals achieved:
  - Boost farm and rural economy ✓
    - Value added on 17 percent of corn crop
    - 12 farmer-owned value-added cooperatives
  - Reduce reliance on foreign energy ✓
    - Utilizes abundant natural gas to convert corn into ethanol "that can replace petroleum by a factor of 7 to 1."
  - Clean up environment ✓
    - Twin Cities in attainment for carbon monoxide

Value of Corn

Raw Commodity vs. Value-Added

(per bushel of corn)

October 1996 Prices

	Corn	Value-Added
		Dry-Milling
	Cash	Ethanol &
Products	Price	DDG
Corn	$2.82	
Ethanol		$3.77
DDG		$1.26
Total Value	**$2.82**	**$5.03**

Value of Corn

Raw Commodity vs. Value-Added

(per bushel of corn)

July 1996 Prices

	Corn	Value-Added
		Dry-Milling
	Raw	Ethanol &
Products	Commodity	DDG
Corn	$5.18	
Ethanol		$3.76
DDG		$1.45
Total Value	**$5.18**	**$5.20**

Energy Yield / Ethanol -vs- Gasoline

Investment of Fossil Fuel Energy Resources

- Ethanol - 1.34 Btu from each Btu invested
- Gasoline- 0.81 Btu from each Btu invested

- Ethanol consumes only 60% of the energy per Btu yielded compared to gasoline.

- USDA July 2002

What's Up Your Tailpipe?

clean air choice
AMERICAN LUNG ASSOCIATION of Minnesota

Kentucky Ethanol Workshop
February 3, 2003
American Lung Association of Minnesota
Outdoor Air Programs

Today's Discussion:

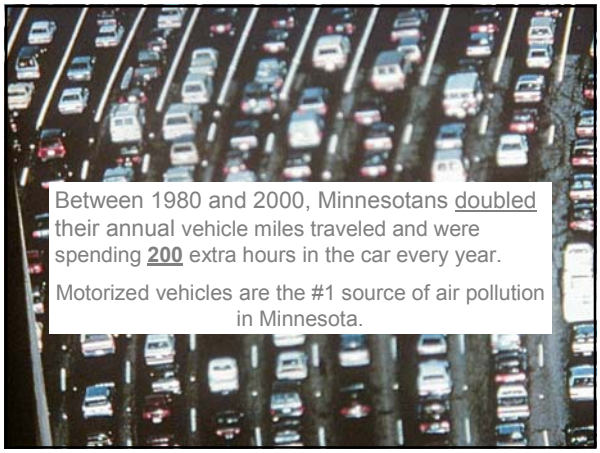
- ALAMN Mission
- MN Air Quality
- AQ & Motor Vehicles
- Fuel Ethanol
  - E10
  - E85

Our Mission:

"Improve Air Quality. Reduce the impact of tailpipe emissions on the environment and human health."

clean air choice
AMERICAN LUNG ASSOCIATION of Minnesota

- Drive Less - Use Less
- Use Cleaner Traditional Fuels
- Use Cleaner Alternative Fuels



Between 1980 and 2000, Minnesotans doubled their annual vehicle miles traveled and were spending **200** extra hours in the car every year.

Motorized vehicles are the #1 source of air pollution in Minnesota.

"What? Minnesota? Isn't that the land of clean air and sky blue waters?"

Trends?

- 2002: *JAMA* - Lung cancer deaths **+8%** for every 10 $\mu g/m^3$ increase of fine particulates. PCA concern PM2.5 non-attainment may be of more immediate concern than O_3
- 2001: Worst MN O_3 season in 30 years.
- 1999: **10** air toxics exceed health benchmarks. **61%** of excess cancer risk associated with motorized vehicles.

"Traditional? Alternatives? I just gotta get the kids to hockey practice!"

- Nearly 90% of respondents claimed ALAMN 'recognition' would be important in choosing a fuel.
- Hundreds of millions of 'impressions' via earned media and consumer education in 1999-2002.
- ALAMN national recognition for MN cleaner fuels efforts (USEPA; USDOE & even Gov. Jesse).

AMERICAN LUNG ASSOCIATION® of Minnesota

Ethanol-blended or "oxygenated" is one tool Minnesota uses to fight vehicle pollution.

E10

"Oxygenated" gasoline is part of the state implementation plan for reducing carbon monoxide. EPA has granted MN "maintenance" status for CO.

E10

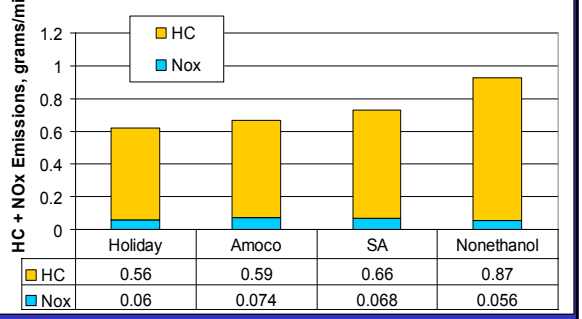
- Renewable resource.
- GHG reduction tool.
- Clean octane - reduces ozone-formers and air toxics by diluting/displacing benzene, olefins, aromatics, and sulfur. (EPA, 1999a)
- Favorably alters fuel distillation index to reduce cold-start emissions. (EPA, 1999b)
- 18% less CO with California vehicles using fuel with 2.1 wt% oxygen. (Johnson et al., 1998)
- Less CO and HC emissions compared to non-ethanol blend. (Knapp et al., 1998)

Twin Cities Gasoline Survey & Comparison

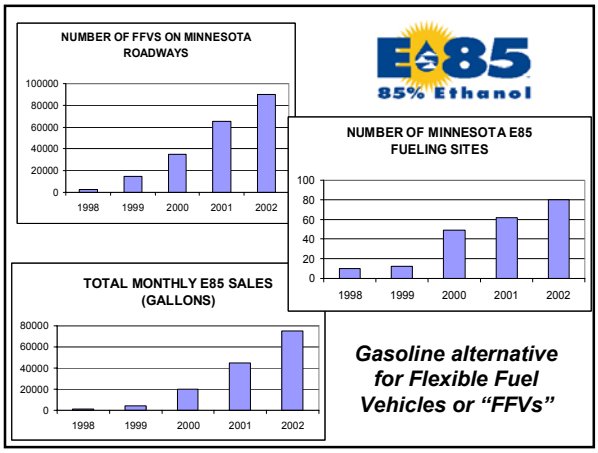
- Partner with UND EERC fuels lab
- Random at-the-pump samples
- Top-selling 87-octane brands (BP Amoco, SuperAmerica, Holiday)
- Composition (all E10)
- On-road vehicle testing (non-FTP)
- EPA MOBILE6.2 emissions modeling

Single-point average emissions over six 30-second acceleration tests

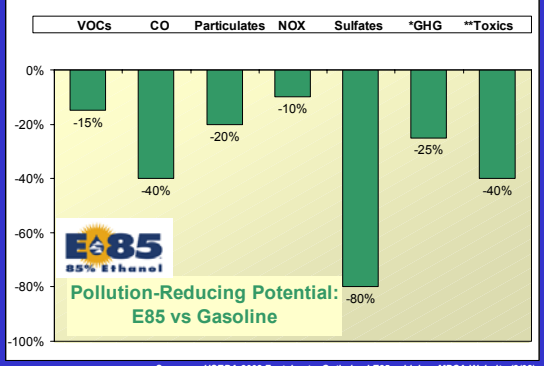
ALAMN-UNDEERC, Summer 2001 Twin Cities Gasoline Survey & Comparison



	Holiday	Amoco	SA	Nonethanol
HC	0.56	0.59	0.66	0.87
Nox	0.06	0.074	0.068	0.056



Gasoline alternative for Flexible Fuel Vehicles or "FFVs"



Sources: USEPA 2002 Factsheet – Optimized E85 vehicles; MPCA Website (8/02)
** Wang et al; Argonne National Laboratory fuel lifecycles; 1997*
*** Winebrake et al; 2001 [CARB CUREs]*


Holiday
Holiday
E85
85% Ethanol


If industry can make $$ doing the 'right thing' . . . They'll do more.
AIR

Welcoming Speech
Ethanol in California workshop
April 14, 2003
8:30 a.m.
Embassy Suites Hotel, Sacramento

- It is my pleasure to welcome you to the Ethanol in California Workshop.

- I would like to thank US Department of Energy, BBI International, the CEC and my staff for putting together a most informative agenda to highlight the opportunities and benefits of an agrifuels industry in California.

- I am pleased to have CDFA participate along with our sister agencies, the California Air Resources Board in CalEPA, the California Energy Commission and the California Department of Forestry and Fire Protection.

- As many of you know, California is the leading agricultural state in the Nation. It has been for more than 50 years.

- California farmers are the most diverse and innovative in the world. They have an ability to respond effectively and efficiently to new markets.

- California is the leading dairy state, and as such is the largest market for high protein corn residuals. It has been for nearly a decade.

- However, nearly every commodity we produce is suffering from record low market prices at the same time that inputs costs continue to rise and environmental regulatory pressures increase.

- One of the primary reasons CDFA supports efforts to develop a California agrifuels industry is that it presents a significant opportunity for growers to diversify into new, profitable value-added products that provide many environmental and energy security benefits.

- We at CDFA also view fuel ethanol production as one tool in the technology toolbox that can assist growers in meeting future air quality and water quality regulatory challenges in an economically feasible and environmental beneficial manner.

- Early this year, California became the largest consumer of fuel ethanol in the United States as MTBE is successfully phased out of our gasoline. It is likely this market for "agrifuels" will continue to grow.

- Yet, less than 10 million gallons of the 600 million gallons of fuel ethanol currently required is produced in the state. As I see it, there now exists a great opportunity for an agriculture based industry to develop in California to meet these new market demands. This afternoon we will hear from several project proponents who expect to take advantage of the opportunity.

- The key to successful development of an in-state production industry is a positive business and investment climate based on reasonable market assurances. We at CDFA recognize this need.

- The potential benefits of an in-state fuel ethanol production industry are far-reaching.

- First and foremost, the industry can provide valuable economic development and job creation especially in economically depressed rural communities.
- Investments in ethanol production provide huge local economic development benefits in plant construction, operation and maintenance, transportation, farm production and support services.
- Every dollar spent on imported gasoline supplies is a dollar that leaves the California economy. Every dollar spent on fuel ethanol produced in California is a dollar that recycles through the economy two or three times.
- California ethanol production will add to energy supplies while replacing fossil fuels and reducing greenhouse gases.
- The industry can supply a significant portion of the State's fuel needs, providing a price buffer to imported gasoline blend-stocks.
- Ethanol can and does provide significant environmental benefits, and is the only renewable transportation fuel currently available for light duty vehicles.
- Developing an ethanol production industry based on conventional feedstocks such as corn, sugar cane, sweet sorghum, cheese whey and other sugar and starch residuals will provide the economic and technical foundation to transition to cellulose based ethanol.

- Cellulose containing agricultural and forestry residues, and urban paper, wood and green waste can be converted to fuel ethanol resulting in conservation of landfill space, reduction of catastrophic wildfire potential and reduction of open field agricultural burning.

- Finally, I want to emphasize the concept of ethanol as flexible fuel. Many of us are aware of the ability to use 85% ethanol (E-85) in hundreds of thousands of flexible fuel vehicles produced by the major automobile manufacturers. In fact, we at CDFA are developing an opportunity to refuel our fleet of more than 100 FFVs on E-85 in partnership with InterState Oil Company and a US Department of Energy grant administered by the National Ethanol Vehicle Coalition.

- We are well aware of the current major market in reformulated gasoline. We should also explore opportunities to use ethanol in other applications including but not limited to 10% gasoline blends, hybrid FFVs, heavy duty engine applications and as a fuel cell feedstock.

- Thank you for your attention, and I look forward to supporting efforts to make a vibrant fuel ethanol production industry a reality in California.

Developing Innovative Bioenergy Technologies – Biomass R&D Activities at the Office of Biomass Program (OBP)

Developing Ethanol's Role in California's Energy, Economic & Environmental Future

Sacramento, California

April 14, 2003

Topics

- Background
- Restructuring Biomass Program
- Biorefinery Concept
- Ongoing R&D in Bioproducts
- Key Technical Barriers
- Challenges
- Opportunities
- Find Out More

Background Oil Import Situation

- Imports are a large and growing share of U.S. petroleum consumption
  - 19.6 Mil. Bbl/day consumption
  - 10.9 Mil. Bbl/day net imports
  - 25% of these imports come from OPEC nations
- Petroleum product consumption in the transportation sector was approx. 14.9 Mil. Bbl/day
  - Motor gasoline: 8.61 Mil. Bbl/day

Restructuring Biomass Program

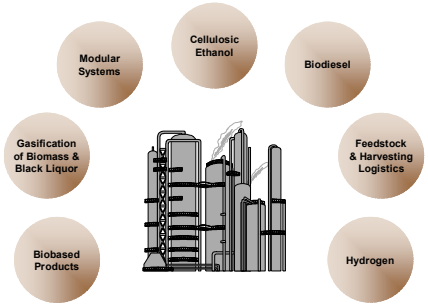
- Biomass Program is a Consolidation of:
  - Biopower Technologies
  - Biofuels Technologies
  - Agriculture IOF and Black Liquor Gasification Research
  - Parts of Forest and Paper Products Vision
- Reorganization of Biomass Program responds to Congressional Directives and EERE Management Expectations
  - Biomass R&D Act of 2000
  - Implementation of Energy Title of New Farm Bill
  - EERE Strategic Program Review
- Mission

  To foster research and development on advanced technologies to transform our abundant biomass resources into clean, affordable, and domestically-produced biofuels, biopower, and high-value bioproducts for improving the economic development and enhancing energy supply options of the U.S.

Restructuring Biomass Program Benefits & Goals

- Benefits of Reorganization
  - Provides for an integrated approach to biomass R&D planning
  - Reduces duplication and maximizes utilization of resources
  - Single point of contact for the biomass community
- Goals
  - Reduce U.S. dependence upon foreign sources of petroleum
  - Support development of an Industrial Biorefinery

Restructuring Biomass Program R&D Focus Areas



Major goals: Development of biorefinery and oil displacement

Biorefinery Concept
The Potential of Biomass

Petroleum transitioned from a single product to a multi-product industry…

Early 1900's → Kerosene

Late 1900's to Early 2000's

Fuel gas, LPG, Gasoline, Jet fuel, Naptha, Diesel fuel, Lube oil, Coke, Fuel oil, Asphalt, Chemicals

Biomass for Energy/Products – to bridge fossil & renewables industries with multiple complementary products

Early 1900's and before → Heat

Late 1900's → Heat, Electricity, Ethanol (corn), Charcoal

Vision: Mid 2000's → Chemicals, Plastics, Materials, Ethanol, Biogas, Heat, Electricity, Other fuels, Charcoal

Biorefinery Concept
Abundant Feedstock

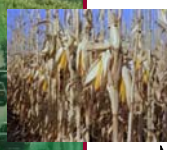


Wood Residues
- Sawdust
- Wood chips
- Wood waste
  - pallets
  - crate discards
  - wood yard trimmings

Agricultural Residues
- Corn stover
- Rice hulls
- Sugarcane bagasse
- Animal waste

Energy Crops
- Hybrid poplar
- Switchgrass
- Willow

Biorefinery Concept




Biomass Feedstock
- Trees
- Grasses
- Agricultural Crops
- Agricultural Residues
- Animal Wastes
- Municipal Solid Waste

Conversion Processes
- Enzymatic Fermentation
- Gas/liquid Fermentation
- Acid Hydrolysis/Fermentation
- Gasification
- Combustion
- Co-firing

USES

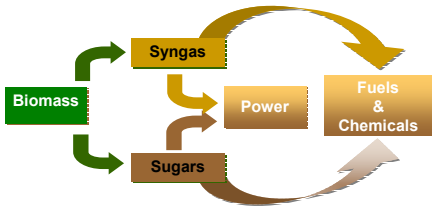
Fuels:
- Ethanol
- Renewable Diesel

Power:
- Electricity
- Heat

Chemicals
- Plastics
- Solvents
- Chemical Intermediates
- Phenolics
- Adhesives
- Furfural
- Fatty acids
- Acetic Acid
- Carbon black
- Paints
- Dyes, Pigments, and Ink
- Detergents
- Etc.

Food and Feed

Biorefinery Concept
Syngas and Sugar Platforms



- Portfolio of production technologies
- Common, high-volume chemical intermediates

Ongoing R&D in Bioproducts

- Since FY 99, DOE has funded over 100 projects in bioproducts R&D*
- Some highlights include:
  - Clean Fractionation of Cellulose
  - Vegetable Oils to Polymers
  - Chemicals from Lignocellulose
  - Separation Technologies for Bio-based Feedstocks

*includes Office of Biomass Program funding as well as SBIR, I&I, and NICE[3]

Ongoing R&D in Bioproducts
Clean Fractionation of Cellulose

- Cleanly separates cellulose, hemicellulose, and lignin from wood/biomass
- Provides purified polymer grade cellulose
- Enables the utilization of lignin and hemicellulose in value-added products
- Reduces energy consumption and process emissions as compared to the traditional pulping processes

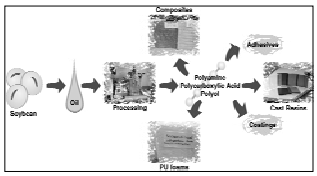

Partners:
- NREL

Ongoing R&D in Bioproducts
Vegetable Oils to Polymers

- Converts vegetable oils into polymer building blocks
- Offers a higher value-added product alternative to farmers and other agribusiness
- Reduces consumption of fossil feedstocks

Partners:

- Pittsburgh State University
- Noveon



Ongoing R&D in Bioproducts
Chemicals from Lignocellulose

Chemicals From Lignocellulose

Uses wood waste, rice straw, or waste sugar to produce plastics and commodity chemicals

Partners:

University of California-Davis, ANL, BC International, NTEC-Versol

Lignocellulosic Feedstock
(Rice Straw)

↓ Hydrolysis

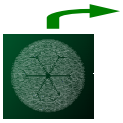
C6 and C5 Sugars

↓ Fermentation& Electrodialysis

Products
(Ethyl Lactate Solvent)

Ongoing R&D in Bioproducts
Separation Technologies for Biobased Feedstocks

- Novel membrane and fractal chromatography separations technology
- Provides low energy, low-capital alternative to conventional separation/purification technologies
- Lowers processing costs of biobased products
- First application: lower cost sugars



Fractal pattern enables even distribution of liquid stream into separation columns (chromatographic, ion exchange) for energy-efficient separation.

Partners:

- Amalgamated Research Inc.
- INEEL

Ongoing R&D in Bioproducts
Key Technical Barriers

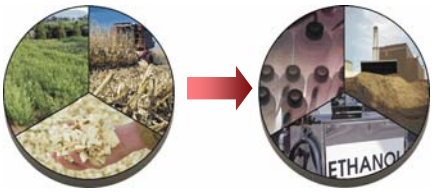
- Cost of enzymes necessary for the production of sugars
- 2 U.S. Companies have successfully reduced costs by ½ of the tenfold goal
- Development of affordable feedstocks
- Development of feedstock R&D roadmap focusing on harvesting & logistics




Challenges

- Market competition from inexpensive petroleum and other fossil fuels
- Policy-compensating for the public benefits of biomass (i.e., reduced greenhouse gas and other emissions, landfill diversion); tax credits, renewable portfolio and fuel standards
- Adoption of technology by industry
- Feedstock infrastructure
- Sustainability

Opportunities



Biomass Resources

Bioenergy and Biobased Products

Find Out More!

www.bioproducts-bioenergy.gov

Contact Information

Kim Penfold
DOE Seattle Regional Office
Phone: (206) 553-2166
Fax: (206) 553-2200
Email: kim.penfold@ee.doe.gov

The Role of Ethanol in the California Market

California's Transition from MTBE to Ethanol and Beyond

Presented by Mike McCormack, P.E.
Transportation Fuel Supply & Demand Office
Transportation Energy Division
CALIFORNIA ENERGY COMMISSION
mmccorma@energy.state.ca.us

Topics

- *Background - History of MTBE use in California*
- *Gasoline Demand and Supply/oxygenate use*
- *Refinery Announcements / Phase-out schedule*
- *Ethanol Demand Scenarios 2004 and 2012*
- *Ethanol Supplies - California survey*
- *Summary and Conclusions*

Background - MTBE Use

- **Required seasonal use beginning 1992**
  - Federal winter oxygenated fuels program
  - Designed to reduce carbon monoxide emissions
  - Most refiners selected MTBE- some use of ethanol
  - MTBE blended at about 11 percent of gasoline volume in California
- **Mandated year-round use in 1995 & 1996**
  - Federal reformulated gasoline (RFG) program to control emissions of toxics and pollutants that contribute to the formation of photochemical smog
  - Federal law requires minimum use of oxygenates in all RFG regions (2 percent by weight)
  - California reformulated gasoline regulations permit discretionary use, but federal mandate applies to 80 percent of State

Background-Gasoline Demand and Supply

- California demand is nearly 12 percent of United States gasoline demand
  - Gasoline demand in California during 2003 estimated to be in the range of 15.6 to 16 billion gallons
  - 13 refineries located in California produce the majority of gasoline for California, Nevada and Arizona (about 60 percent)
  - Imports of gasoline and blending components increase each year, while refinery capacity remains relatively flat (annual growth rate of 0.5 percent)
  - Demand expected to increase between 1.6 and 3 percent per year in the future (i.e., 250 to 480 million gallons in 2004)

Fuel oxygenate use

- **Types and quantities of fuel oxygenates**
- MTBE has been the oxygenate of choice
  - Blending properties like hydrocarbons
    - CaRFG (with MTBE) can be shipped by pipeline to gasoline terminals
    - high octane value
  - 1.4 billion gallons blended in California gasoline during 2002
  - Blending concentration of over 9 volume percent for entire gasoline pool
- Ethanol use limited, but a long history in California
  - Blending properties less like hydrocarbons
    - alcohols cause gasoline vapor pressure to increase more than ethers
    - water absorption/phase separation - must dry-out storage tanks and pipelines
    - California's common carrier pipeline company does not plan to ship gasoline containing ethanol at this time
  - 100 million gallons blended during 2002
  - ConocoPhillips was first company to use ethanol in California reformulated gasoline(2002)

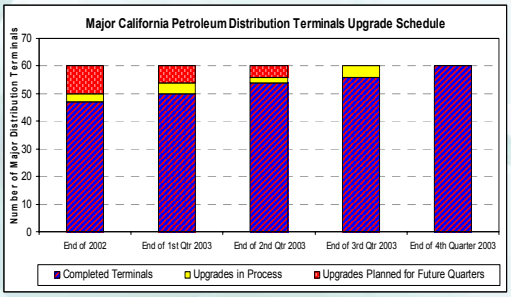
Public Announcements - Early MTBE Phase-out

- **ConocoPhillips** - "76" - "Circle K"
- **British Petroleum** - "ARCO"
- **Shell Oil** - "Shell" - "Texaco"
- **ExxonMobil** - "Exxon"
- **ChevronTexaco:** MTBE-free in Southern California beginning January 2003; MTBE-free in Northern California later this year
- **Tesoro:** Announced compliance by December 2003 and ability to market both MTBE-based (CaRFG"2") and ethanol-based (CaRFG"3") reformulated gasoline

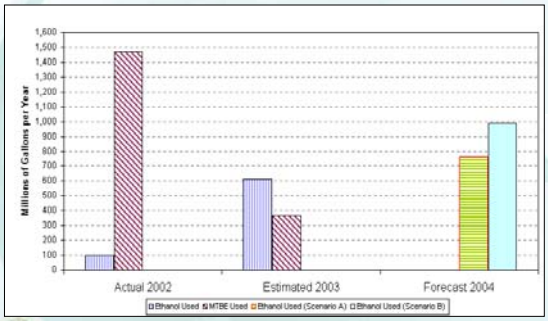
MTBE Phase- out Status in California Refineries- April 2003

Northern California Refiners	Location	Notes
ChevronTexaco	Richmond	Phaseout later this year
ConocoPhillips	Rodeo	Have been using ethanol for more than one year
Kern Oil	Bakersfield	Blending ethanol
Shell	Bakersfield	Blending ethanol
Shell	Martinez	Blending ethanol
Tesoro	Concord (Avon)	Using limited quantity of ethanol, complete phaseout later this year
Valero	Benicia	Phaseout later this year
Southern California Refiners		
BP	Carson	Blending ethanol
ChevronTexaco	El Segundo	Blending ethanol
ConocoPhillips	Wilmington	Have been using ethanol for more than one year
ExxonMobil	Torrance	Blending ethanol
Shell	Wilmington	Blending ethanol
Valero	Wilmington	Using limited quantity of ethanol, complete phaseout later this year

Terminal Upgrade Schedule



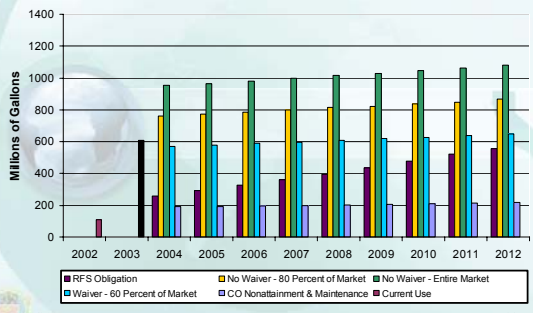
MTBE to Ethanol Transition - Volume Shift 2002-2004



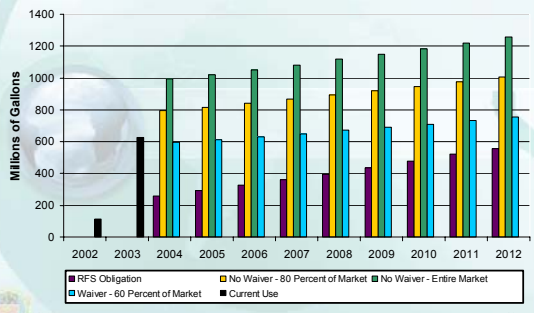
Summary of MTBE phase-out and CaRFG3 Implementation

- Progressing without significant problems or issues
- Most terminals are able to store, blend, and distribute CaRFG3 with ethanol
  - About 70 % of California's gasoline contains ethanol (April 2003)
- 50 completed terminals, 4 upgrades in progress, 6 upgrades scheduled
- Ethanol supplies now routinely delivered to all 50 (of 60) terminals
- March switch to summer grade gasoline went relatively smoothly
  - Refiners were able to make low volatility CARBOB for ethanol blending
  - CARBOB moved through the Kinder Morgan Pipeline system to terminals without major issues
- Report to Governor on causes of recent gasoline price spikes completed in March

Projected California Ethanol Use
Base Case Gasoline Demand - 1.6 Percent Per Annum



Projected California Ethanol Use
High Case Gasoline Demand - 3 Percent Per Annum



Ethanol Demand Scenarios - CaRFG blending 2004-2012

- Ethanol demand follows gasoline demand growth (6% blending case)
  - 1.6 to 3% per annum growth to 2012 assumed
  - 760 to 990 million gallons in 2004 (high certainty)
  - 560 to 1258 million gallons in 2012 (less certain)
    - low end is RFS obligation - CAA oxy requirement waived
    - lower yet if RFS + regional RFS credit trading allowed
    - lowest demand as air quality CO maintenance measure in South Coast Air Basin = 216 million gal/yr
- Future ethanol demand at 7.7 or 10% blending
  - 710 to 1600 million gals in 2012 (7.7% blending)
  - 920 to 2100 million gals in 2012 (10% blending)
    - AQ maintenance volume(lowest case) - 360 million gal/yr
  - Currently limited by vehicle NOx emission considerations
  - Would require new CARBOB formulations/no emissions impacts
  - Multiple CARBOBs could be difficult to distribute; probably just one as exists today

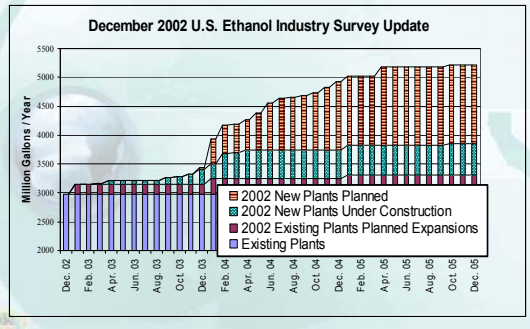
Ethanol Demand Scenarios - E-85 use 2004-2012

- Fleet of E-85 Flexible fuel vehicles (FFVs) in California is growing
  - 175,000 FFVs identified in DMV database - April 2003
  - Growth rate of 32,500 vehicles per year since 1999
  - 64% general public, 13% car rentals, 12.5% corporate, 5.6% government, 5.1% fleet leasing
  - 2004 ethanol demand scenario
    - 180 million gal/yr (full time use)
    - 90 million gal/yr (1/2 time use)
    - 95 million gal/yr (fleets only)
  - 2012 ethanol demand scenario(flat vehicle growth rate - 32,500 veh/yr)
    - 415 million gal/yr (full time use)
    - 207 million gal/yr (1/2 time use)
    - 221 million gal/yr (fleets only)
  - 2012 scenario - FFVs comprise 1.8 % of the 2012 fleet
    - more aggressive scenario - yields **5 % FFVs** in 2012 and potential demand of **1.2 billion, 600 and 640 million gal/yr**
    - Assumes AMFA dual-fuel CAFÉ incentives retained beyond the 2008 model year

Ethanol Demand Scenarios- Summary

- Two possible future markets - ethanol blending in CaRFG and E-85 for use in Flexible Fuel Vehicles
  - 2003/2004 all ethanol for blending in CaRFG
    - 760 to 990 Million gal/year (2004) .....quite certain
    - None to some E-85 if FFV fleet fueling facilities become reality
      - Upper limit if all fleets installed fueling capability - 95 million gal/yr
  - 2012 combined demand is less certain, but potentially large
    - Depends on the price of ethanol relative to gasoline, outcome of federal energy legislation (RFS), CAA oxygenate waiver process, outcome of state policy and actions, potential growth in ethanol supplies (in-state, U.S. imports, international imports), refiner's blending decisions, fuel distribution segregation capabilities and other factors
    - **Low end - 440 million gal/yr** -220 million gal/yr E-85 fleets / 220 million gal/yr for AQ maintenance (wintertime CO in Couth Coast), RFS obligation in California avoided through regional credit trading
    - **High end - 1.6 to 2.5 billion gal/yr -** 1 to 1.5 billion gal/yr for CaRFG blending, and 600 million to 1 billion gal/yr for E-85 in FFVs

U.S. Ethanol Production Capacity Survey Update



Summary and Conclusions

- The phase-out of MTBE and its replacement with ethanol is proceeding smoothly - 70 % of California's gasoline now contains ethanol
- Terminal conversions to handle ethanol will be completed prior to the December 31, 2003 deadline for MTBE phase-out
- Ethanol supplies are adequate to meet California's CaRFG3 blending needs in 2003 - staff will examine implications of the New York and Connecticut MTBE phase-out plans, as well as a future national MTBE ban
- Future use of ethanol in California depends on many factors - some of which were discussed today
- Demand scenarios for 2012 indicate ethanol use in the range of 440 million to over 2 billion gallons per year
- The population of E-85 Flexible Fuel Vehicles is growing and an opportunity for supplying E-85 exists

Future of Ethanol Use in California's Gasoline Under Different Scenarios/Fuel Blends

Dave Smith, bp

- May 2, 2002: Announced Early MTBE Phase-out
- MTBE Free – at Refinery – 1/1/03 Target
  - MTBE Unit Shutdown Jan. 2
  - MTBE Out of Blender Jan. 3
  - 1st CBOB into Proprietary P/L Jan 5-6
  - 1st CBOB into Kinder Morgan P/L Jan 8
    - Arrive San Diego Jan 10
    - Arrive Colton Jan 12
- All Refinery production MTBE Free – late January
- All Terminals MTBE Free before March
- All Service Stations Expected MTBE Free before April

Challenges with Current Transition

- Ethanol Supply Contracts & Logistics
- Major SC Refinery Turnaround Previously Scheduled
- Refinery and Terminal modifications
  - S. Cal. Refinery
  - Proprietary Terminals
  - Common Carrier Terminals
- Ca Retail Sites
  - 1000+ ARCO Branded Service Stations
- Ca Summer RVP Season
- 80% of Cal. Gasoline must meet Federal RFG Oxy. Mandate
- CARB Phase 3 New Regulations
  - New CARBOB Model
  - EtOH Conc. Vs Emissions
- Unexpected Surprises

Ethanol Supply & Logistics

- Contracted with six ethanol suppliers by time of announcement
  - No W. Coast Producers of ethanol
  - Transportation costs may provide an opportunity for California
- Ethanol Storage Needs
  - Converted existing tankage to ethanol storage
  - Ethanol began arriving in late 2002
- Ethanol Terminal Strategy – So. Cal
  - Third party marine terminal is the main Southern terminal. Extensive work required – rail, rack, tanks.
  - San Diego: Will be supplied by truck from LA until rail modifications are completed. Will have ability to load out by truck.
  - S.Cal. Proprietary Terminals - In by truck. Will have ability to load out by truck as a contingency.

Ethanol Terminal Strategy - NoCal

- Sacramento:
  - In by truck or rail, out by truck. Issues with the city delayed rail work supply by truck until resolved.
- Richmond & Stockton:
  - In by rail, out by truck.
- Kinder Morgan Terminals (Chico, Brisbane, San Jose, Fresno)
  - Supplied from BP Terminals

S. California Refinery Turn-Around

- T/A started early January
- 6 Major Refinery units impacted
  - Major gasoline producing units included
- Longest Unit T/A – 49 days
- Significant reduction in crude throughput and production

Supply Plans – Jan-Mar 2003

- Supply Options during the turnaround & Phaseout
  - Maximize Carson Refinery production prior to T/A and Phaseout
    - Component build plan in Nov-Dec
    - Component import plan for Jan-Mar
  - Other BP WC refinery to blend winter CARBOB
    - Imported significant Barrels from BP refinery of Phase 2 CARBOB
    - Storage Tank Challenges
    - No significant problem at LA import facility – CARB assisted
  - CARBOB purchases
    - Local
    - Imports
  - Voluntarily Reported Production and Imports to CEC

Shipping

- **Products moved with Jones Act ships:**
  - Blend stocks and Products from PNW to LA
  - Products to PNW and Canada
  - Exports from Carson
  - Gasoline from LA to Bay
  - Component imports to LA from GC
- **In addition, import/export gasoline and components and ship exports on foreign flag ships to other countries**

Future Use of Ethanol

- **New infrastructure getting in Place for widespread use of Ethanol in California**
- **Experience with ethanol blending in California may effect future use.**
  - Pipelines only taking CBOB that requires 5.7 vol.% EtOH
  - Provides fungibility
- **Federal Renewable Oxygenate is adopted & Fed. RFG Oxy Mandate Eliminated**
  - National refiners would likely maximize ethanol use close to the EtOH sources
  - N. Cal. Refiners have produced non-oxygenated CARB gasoline
    - No significant impact on volumes
  - Ethanol use would continue as a blending component.
- **Winter Oxygenate Season Eliminated in S. California**
  - Ethanol use would continue as a blending component.
  - Similar experience in PNW.
- **San Diego Could be Reclassified to Ozone Attainment**

Oxygen Impact Within CARB Model

- CARB Phase 3 Predictive Model
  - **Modeled increase of ethanol from 2.0 wt.% to 3.5 wt.%:**
    - At 2.0 wt.% - NOx PM results: – 0.4 %
    - At 3.5 wt.% - NOx PM results: + 4.6 %
    - **To accommodate NOx increase the following changes would needed to be made**:
      - Sulfur reduced by 15 ppm (Compared to a ref. standard of 20 ppm)
      AND
      - Olefins reduced by 7 vol. % (Compared to a ref. standard of 6 vol.%)
    - **Fungibility a major concern for varying ethanol concentration**

Unexpected Challenges

- Ethanol Logistics – SD, LA, SF
- Permitting Concerns @ terminals
- San Diego Terminal EtOH Blending Equipment Failure
  - Blending computer failed to add ethanol to CBOB in truck
  - ~60 Stations delivered non-oxygenated CBOB in ~12 hrs. .
  - Over a week to fix all the stations
    - Pumped out UST's
    - Deliver properly oxygenated CBOB
- Returning oxygenated CBOB to Terminals

Other EtOH Scenarios

- Summer-time ethanol blending just beginning
  - Increased imports of blend stocks & finished products
  - Low-RVP CARBOB reduces production volumes
- Drivability Index still an outstanding issue
- Impact of EtOH on Groundwater contamination may be an issue – whether real or otherwise.
- Results of ARB's EtOH permeation study could be an important factor for future use.
- Unexpected events……

DAIMLERCHRYSLER

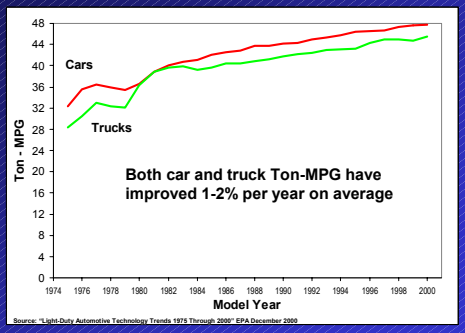
California Ethanol Workshop

Gerald A. Esper, Senior Manager
Product Fuel Economy Planning
DaimlerChrysler Corporation
April 14, 2003

Ready, Fire, Aim

- Clear statement of the objective is critical:
  - CO_2 emission reductions?
  - Independence from foreign oil?
  - Agricultural policy?
  - Replacement of petroleum as it is depleted worldwide?
- The target needs to be clearly defined, scientifically based, and achievable:
  - Stabilize atmospheric CO_2 at 500ppm? Pre-industrial levels?
  - Reduce U.S. imports to 40%? …20%? …0%?
- Appropriate strategies, including transportation technologies, can then be appropriately judged.

With Clear Goals, Engineers Will Deliver



Large Car Utility and Performance at Sub-Compact Car Fuel Economy Levels

1978 Dodge Omni

2003 Chrysler Concorde

- **Increased safety content (air bags, energy absorption..)**
- **Emissions reduced 95% (EPA75 to NLEV)**
- **Increased interior volume by 21 %**
- **Improved unadjusted combined fuel economy (Omni 26.2 MPG vs. Concorde 28.4 MPG)**

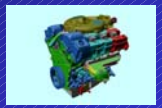
Near-, Mid-, and Long-Term Technologies

- Vehicle Fuel Economy Technologies
  - Near-term are generally incremental improvements on existing internal combustion engines, including diesels.
  - Mid-term technologies deploy existing ICE technologies in new contexts the most publicized of these being hybrids.
  - Alternative fuels, including ethanol, and bio-diesel present both short-, and mid-term opportunities to reduce petroleum usage.
  - Long-term technologies contemplate entirely new approaches to motive power -- Electric Vehicles, Fuel Cells, the "Hydrogen Economy."

Near Term: Advanced Technology

Manufacturers must try to identify which promising new technologies will win in the marketplace

2.5L Turbo Diesel



Direct Injection Gasoline

EMAT Electro-Mechanical Automatic Transmission

Improved Drivelines

Diesel Benefits and Obstacles

- Modern diesel engines are very popular in Europe.
- Diesels in the U.S. face serious challenges due to extremely strict NOx standards and poor U.S. fuel quality.
- This is a good example of conflicting societal goals:
  - Fuel economy vs. NOx reductions?
- A fundamental question, beyond fuel economy, and emissions, is: "Will the American public embrace the diesel?" Can we build a business case for volume production of diesel-powered light duty vehicles?

DaimlerChrysler Advanced Diesel

Jeep Liberty Diesel

Jeep Liberty Market Test

- DaimlerChrysler will conduct a market test introduction of the Jeep Liberty with a 2.8L, 4-cylinder diesel with high pressure, electronically controlled, common rail direct fuel injection.
- The vehicle is expected to achieve about 25-30% better fuel economy than a comparably-performing 3.7L V-6 gasoline engine.
- The emissions performance is not yet finalized, but we will meet the EPA Tier 2 standards.

Bio-Fuels (E-85)

- DaimlerChrysler is a leader in the E-85 market:
  - About 3 million E-85 capable vehicles (FFVs) in operation, 1 million of those were produced by DaimlerChrysler.
  - All DaimlerChrysler FFVs are "50 State" vehicles.
  - The E-85 fuel infrastructure has not yet materialized.
  - If these 3 million vehicles operated on E-85, over a billion gallons of gasoline could be saved per year, and over 10 billion pounds of CO_2 emissions could be avoided.
  - Now is not the time to abandon this program, but to strengthen it, and add additional incentives for the production and distribution of E-85.
- We expect NHTSA to extend the FFV CAFE credit program through the 2008 MY.

Available DaimlerChrysler E-85 FFVs

Starting in 2003 MY

C-Class Sedan, Wagon and Coupe
Equipped with 3.2L V-6 Automatic

From 1998 to 2003 MY

Chrysler & Dodge Minivans
Equipped with 3.3L V-6 Automatic

Starting in 2003 MY

Chrysler Sebring/Dodge Stratus
Equipped with 2.7L V-6 Automatic

Bio-Fuels (Bio-diesel)

- Currently, DaimlerChrysler diesel vehicles are warranted for operation on bio-diesel only up to B-5 (5% FAME in conventional diesel fuel).
  - Given a stronger ASTM specification for B-20, and incentives for production of B-20, we could consider upgrading of engine materials to tolerate a higher level of bio-diesel.
- All bio-fuels should be subject to a rigorous life cycle analysis, to ensure that the programs are not just converting petroleum to a different liquid fuel, while incurring great costs to the taxpayer.

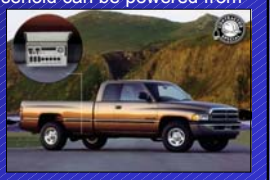
Ethanol and Diesel Fuel Don't Mix

- DaimlerChrysler is very concerned about proposals to blend ethanol into diesel fuel.
- Even very small percentages of ethanol in diesel fuel lowers the flashpoint of the fuel mixture.
- This could create a flammable mixture in the fuel tank and presents a very serious safety concern.
- We do not support blending of ethanol with diesel fuel.
- Ethanol may have a role to play as the alcohol feedstock for the esterification of bio-diesel (Fatty Acid ***Ethyl*** Ester instead of ***Methyl*** Ester).

Medium Term: DaimlerChrysler HEVs

Dodge Ram Contractor Special

- Integrated starter-generator hybrid powertrain
- Achieves up to 10% better fuel economy
- Converts to a clean electric generator when parked
- A complete work-site or household can be powered from the electric outlet box



DODGE

Commercially Based Tactical Truck - ComBaTT

- Hybrid Electric Vehicle for the U.S. Military
- 4WD, 5.9 L Turbo-diesel, with integrated 35kW electric Traction Motor
- Generator provides up to 20 kW @ 60 Hz AC
- Traction Assist, Regenerative Braking, Silent AC Power Generation, Improved Fuel Economy, Enhanced off-Road and Structural Features

- Limited Range of "Stealth" operation on electric power
- Meets the DoD strategic target of utilization of a single battlefield fuel
- **A positive business case exists, at least for limited production**

Long Term: Fuel Cell Vehicles (FCVs)

- DaimlerChrysler has begun the deployment of 30 Fuel Cell powered city transit buses around the world.
- Beginning in 2003, DaimlerChrysler will market 60 A-Class based, compressed H_2 "F-cell" vehicles.
- Volume production is at least ten years away, due to cost, complexity, and fuel infrastructure issues.

Compressed H_2 Fuel Cell Bus

F-Cell Compressed H_2 Fuel Cell Vehicle

The biggest question regarding fuel cell vehicles is not the fuel cell, but the fuel

- Fuel Cells run on hydrogen.
- Choosing the source of the hydrogen will require a balance between distribution, on-board storage, and on-board processing.
- Several hydrogen sources have been evaluated:
  - Pressurized or liquefied hydrogen stored on-board
  - Methanol for on-board reforming
  - Gasoline for on-board reforming
  - DaimlerChrysler has shown that materials not normally considered as fuels can be used to generate hydrogen on board as demonstrated in the sodium borohydride powered Natrium Minivan.

Conclusions

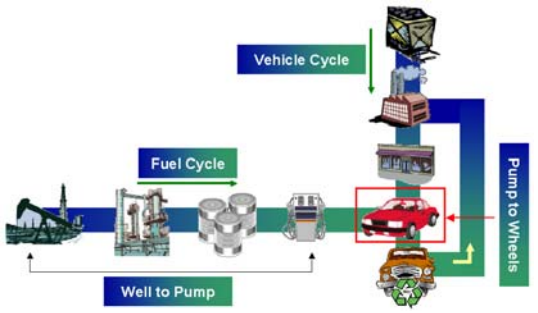
- **Development of energy policy should be preceded by clear definition of objectives and targets.**
  - **Energy objectives and targets will drive technology deployment.**
  - **In the absence of clear objectives, resources will be wasted.**
- **Customer expectation cannot be ignored as a driving force in the automobile market.**
- **Enhanced use of bio-fuels can have a big impact on petroleum consumption in future vehicles, and also reduce petroleum usage in the existing fleet.**
- **The promise of technology is constrained by cost and conflicting requirements including regulatory standards.**

Fuel-Cycle Energy and Emission Impacts of Fuel Ethanol

Michael Wang and Ye Wu
Center for Transportation Research
Argonne National Laboratory

U.S. Department of Energy – California Ethanol Workshop
Sacramento, CA, April 14-15, 2003

Vehicle and Fuel Cycles: Petroleum-Based Fuels



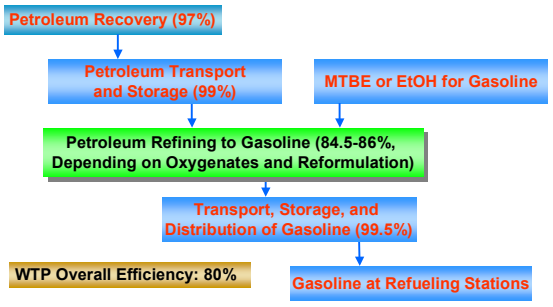
The GREET (*G*reenhouse gases, *R*egulated *E*missions, and *E*nergy use in *T*ransportation) Model

- **GREET includes emissions of greenhouse gases**
  - CO_2, CH_4, and N_2O
  - VOC, CO, and NO_x as optional GHGs
- **GREET estimates emissions of five criteria pollutants**
  - VOC, CO, NO_x, PM_{10}, and So_x
  - Total and urban emissions separately
- **GREET separates energy use into**
  - All energy sources
  - Fossil fuels (petroleum, natural gas, and coal)
  - Petroleum
- **The GREET model and Its documents are available at http://greet.anl.gov; there are 790 registered GREET users**

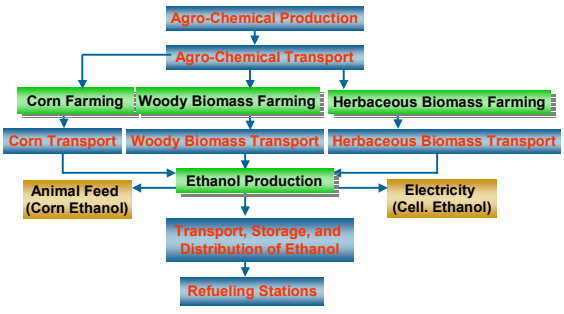
Energy Effects of Fuel Ethanol Have Been Subject to Debate

- Some studies, especially those completed between late 1970s and early 1990s, concluded negative energy balance value of ethanol
- Those past studies basically examined energy use of producing ethanol
- Though self evaluation of ethanol's energy balance is easy to understand, it may not be useful to fully understand true energy benefits of fuel ethanol
- A more complete way is to compare fuel ethanol with the fuels to be displaced by ethanol (i.e., gasoline)
- The GREET model has been applied here to conduct a comparative analysis between ethanol and gasoline

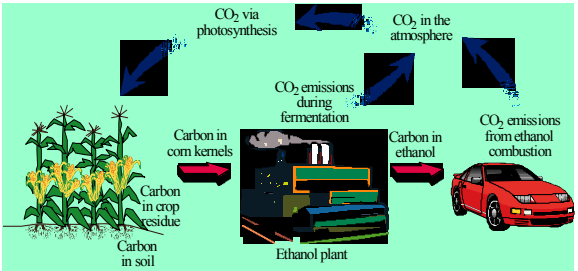
Petroleum Refining Is the Key Energy Conversion Step for Gasoline



Ethanol Pathways Include Activities from Fertilizer to Ethanol at Stations



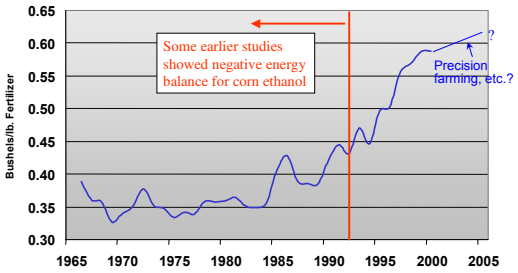
Recycling of Carbon by Ethanol Fuel Results in Large CO_2 Benefits for It



Key Parameters for Ethanol's Energy and Emission Effects

- **Energy use for chemicals production**
  - Fertilizers (N, P_2O_5, K_2O)
  - Herbicides
  - Insecticides
- **Farming**
  - Corn and biomass yield
  - Chemicals use intensity
  - Energy use intensity
  - Soil N_2O and NO_x emissions
  - Soil CO_2 emissions or sequestration
- **Ethanol production**
  - Corn ethanol: wet vs. dry milling
  - Ethanol yield
  - Energy use intensity
  - Co-product types and yields
- **Vehicle fuel economy**
  - Gasoline vehicles with E10
  - Flexible-fuel vehicles with E85

U.S. Corn Output Per Pound of Fertilizer Used Has Risen (3-yr Moving Average)

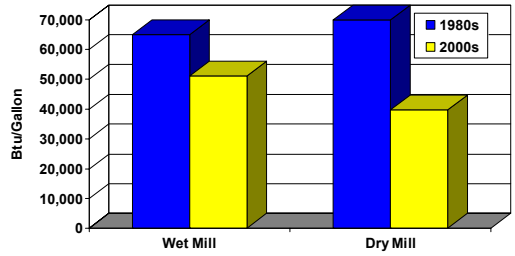


Source: from USDA data.

N_2O Emissions from Nitrogen Fertilizer Are a Major GHG Source

- Some nitrogen fertilizer is converted into N_2O and NOx via nitrification and denitrification in farmland
- Depending on soil type and condition, 1-3% of N in nitrogen fertilizer is converted into N in N_2O
- On the well-to-wheels basis, N_2O emissions from nitrogen fertilizers could account for up to 25% of total GHG emissions from corn ethanol

Technology Has Reduced Energy Use Intensity of Ethanol Plants



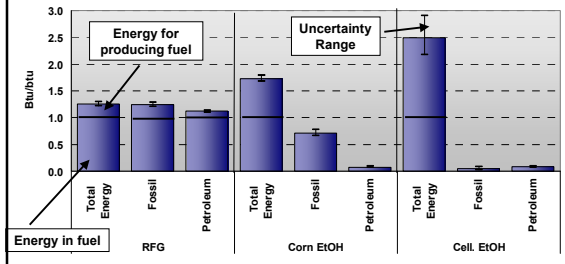
Source: from Argonne's discussions with ethanol plant designers and recent USDA data.

Well-to-Gate Energy and Emissions Allocated to Co-Products (Animal Feed) Vary by Allocation Method

Allocation Method	Wet milling	Dry milling
Weight	52%	51%
Energy content	43%	39%
Process energy	31%	34%
Market value	30%	24%
Displacement	~16%	~20%

- Weight and energy methods no longer used
- Some studies did not consider co-products at all

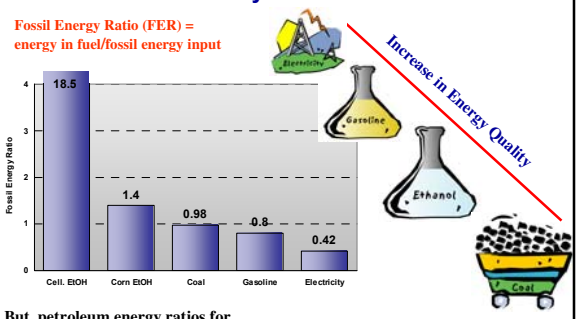
Energy Benefits of Fuel Ethanol Lie in Fossil Energy and Petroleum Use



Energy Use for Each Btu of Fuel Used

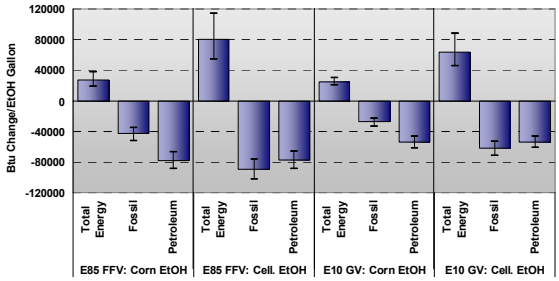
Energy in Different Fuels Can Have Very Different Qualities

Fossil Energy Ratio (FER) = energy in fuel/fossil energy input

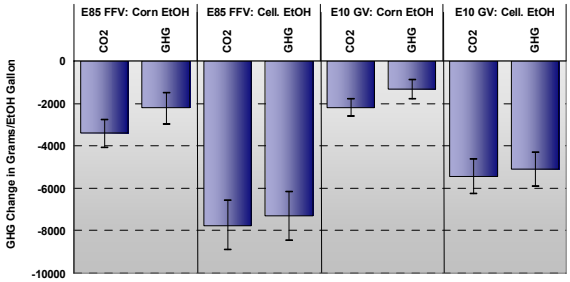


But, petroleum energy ratios for ethanol, coal, and electricity are much greater than one!!

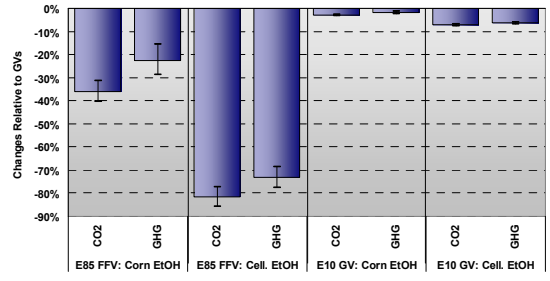
Changes in Energy Use Per Gallon of Ethanol Used (Relative to Gasoline)



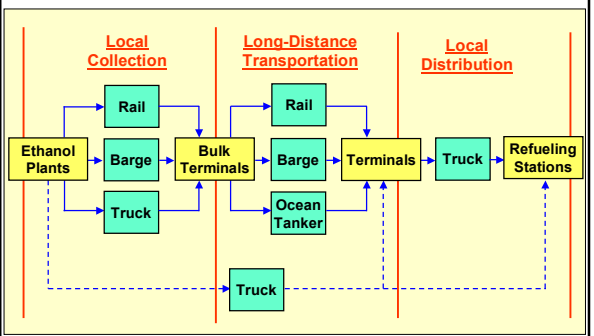
Changes in Greenhouse Gas Emissions per Gallon of Ethanol Used (Relative to Gasoline)



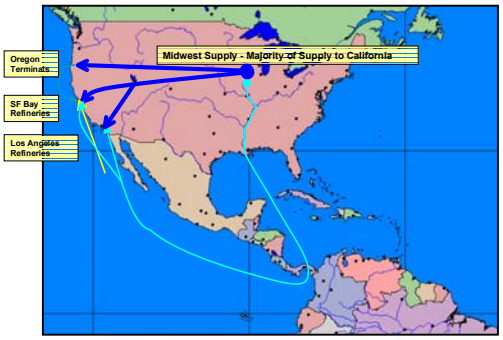
Changes in Greenhouse Gas Emissions per Mile Driven (Relative to GVs)



Transportation Logistics Could Affect Ethanol Energy and Emissions

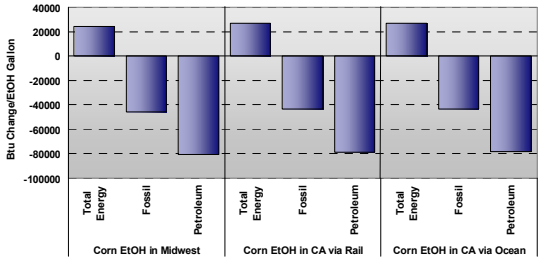


Transportation of Midwest Ethanol to California Is By Rail and Ocean



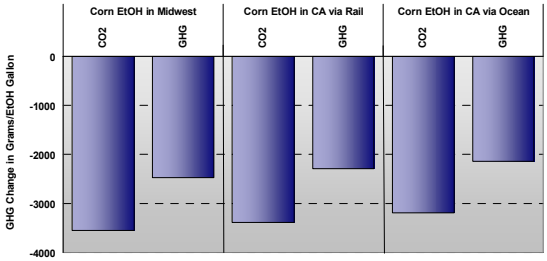
Based on Pat Perez, CEC, 02/21/03

Changes in Energy Use by Corn Ethanol: Midwest Use vs. California Use



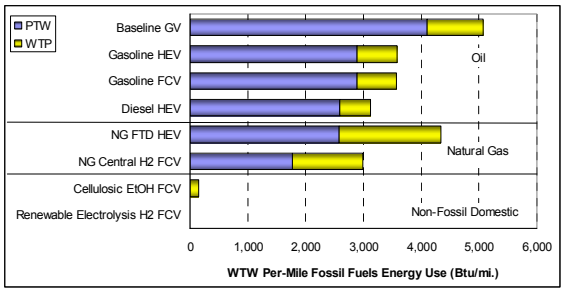
Results are based ethanol in E85

Changes in Greenhouse Gas Emissions by Corn Ethanol: Midwest Use vs. California Use

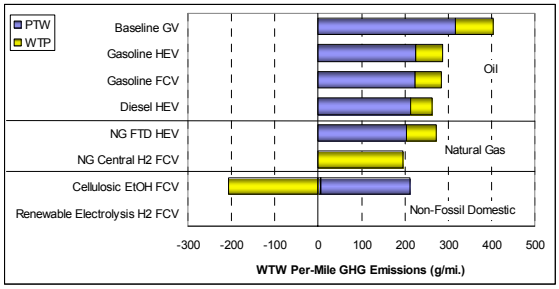


Results are based ethanol in E85

In long Run, Cellulosic Ethanol Could Play an Important Role in Energy Benefits



Cellulosic Ethanol Could Also Play an Important Role in GHG Reductions



Conclusions

- Any type of fuel ethanol helps substantially reduce transportation's fossil energy and petroleum use
- Ethanol's energy balance alone is not meaningful
- Corn-based fuel ethanol achieves moderate reductions in GHG emissions
- Cellulosic ethanol will achieve much greater energy and GHG benefits

California's Ethanol Supply Options

California Ethanol Workshop
Developing Ethanol's Role in California's Energy, Economic & Environmental Future
April 14, 2003
William Maloney
ED & F Man Alcohol Inc.

ED&F MAN

California's Ethanol Supply Options

- Domestic US Supply
- CBI Supply
- Other Foreign Supply
- Pacific Northwest Supply

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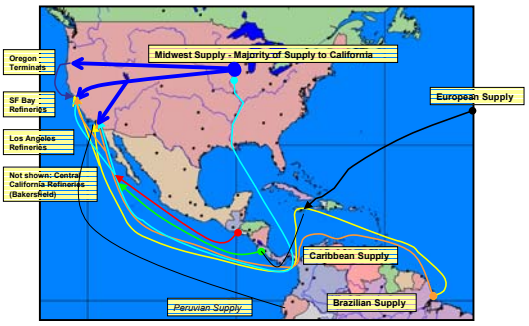
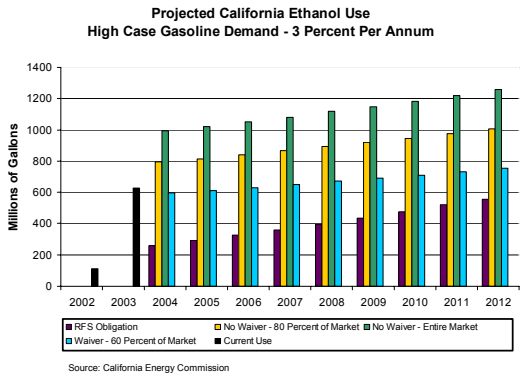
California's Ethanol Flows



Source: California Energy Commission



Source: California Energy Commission

US Domestic Production

- 98.7% of US Ethanol Production is in PADD 2 (Midwest).
- PADD 2 Currently Supplies Approximately 92% of all ethanol to California.
- Major States Supplying CA are Iowa, Illinois and Nebraska.

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Logistical Method of Supply

- Oil Companies expressed desired method of delivery is 2/3 via rail and 1/3 via bulk marine.
- Current difficulties being experienced in Southern CA due to incomplete rail infrastructure (should be completed summer 2003).
- Some Southern CA delivered via barge from Northern CA.

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Caribbean Basin Initiative

What is the Caribbean Basin Initiative and how is it relevant to California fuel ethanol supplies?

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The Caribbean Basin Initiative (CBI) is a Unilateral US trade agreement allows the export of ethanol into the United States tariff free.

The Fuel Ethanol tariff is US cents 54 per USG.

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What are the rights for CBI ethanol dehydration plants?

- A tariff quote allowed into the USA of 7% of US demand for fuel ethanol with 60 million USG minimum, 30% indigenous required to go above 7%.
- No limit on volume produced from local feedstock.

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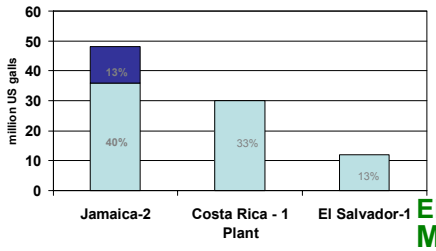
CBI Process Capacity - four active plants



Total current capacity 90m usg (3.4m hl)

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Kingston, Jamaica Ethanol Plant

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CBI Feedstock Supply

- European surplus wine ethanol from France, Italy, Spain.
- Brazilian sugar cane alcohol.

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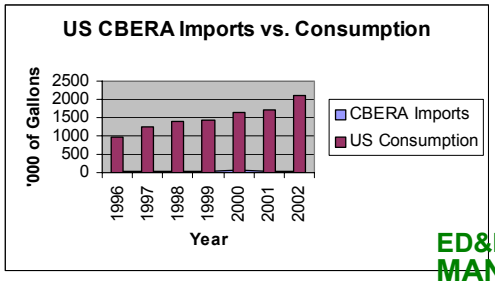

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Variables to CBI Imports

- **Fall off in availability of wine ethanol in Europe (WTO Restrictions).**
- **Brazilian internal & external sugar & ethanol prices vs. US fuel ethanol prices.**
- **Exposure to currency movements & freight rates.**

Make CBI a Relatively High Cost Producer, i.e., not in market in significant way if prices are below $1.25.

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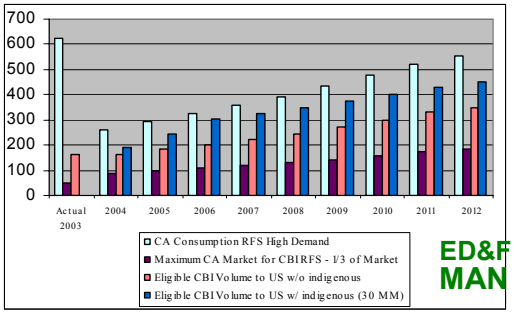
CA Ethanol Demand & CBI Supply - RFS



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Indigenous CBI Production

- **Has to be fermentation.**
- **No limit to volume allowed under CBI for full fermentation process ethanol.**
- **Driven by molasses prices or very low sugar prices.**
- **Opportunity price of molasses in rum and animal feeds.**
- **Land available in certain CBI countries, but insufficient returns to spur sugar cane planting for ethanol.**

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Indigenous CBI Production

- Guatemala – several projects, 20 MM+ gallons per annum potential.
- Nicaragua – project 10 MM gallons per annum potential.
- Dominican Republic – Potential, but more likely to East Coast.

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Other Potential Int'l Suppliers

- **Andean Pact** – Peru, Bolivia, Colombia, Venezuela & Ecuador.
  - Peru Project – Plan for 200 million gallons per annum from sugar cane (PetroPeru).

Much publicized, but uncertain at this time.

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Other Potential Int'l Suppliers

- **Brazil Directly – Possible under FTA (Free Trade of the Americas)**
  - Current $0.54 Duty plus Transport, need $1.40's + Prices
  - Expect Strong US Producer Led Political Resistance to duty-free imports
- **Mexico** (Under NAFTA)
  - No Current Projects, but potential exists for moderate quantities (e.g., 20 MM gallons).
- **Canada** (Under NAFTA)
  - Target markets internal to Canada.

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New Western US Suppliers?

- Pac Northwest Projects Target California
  - Oregon, 130 MM Annual Production
  - Washington, 40 MM Annual Production
  - Idaho, 15 MM Annual Production
  - Montana, 100 MM Annual Production

Pac NW Market – Approximately 120 MM

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Conclusions

- Midwest will continue to supply most CA ethanol demand.
- CBI Suppliers (mostly Brazil feedstock) have opportunity to supply 1/3 of demand (under RFS). Capability limited by Brazilian commitment to market.
- Some potential for new int'l suppliers, e.g., Peru.
- Pac NW suppliers look to CA, but may be a very competitive market.
- Local CA production possible, but will have to compete with efficient low-cost Midwest producers.

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STATUS REPORT ON OPPORTUNITIES FOSTERING A CALIFORNIA ETHANOL INDUSTRY

Neil Koehler
California Renewable Fuels Partnership

CALIFORNIA ETHANOL WORKSHOP
Sacramento, California
April 14, 2003

CALIFORNIA RENEWABLE FUELS PARTNERSHIP

- Coalition of Agricultural, Environmental, Local Government, and Ethanol groups giving a voice to the California ethanol opportunity
- Creating a California Brand Ethanol Industry

CALIFORNIA RENEWABLE FUELS PARTNERSHIP MEMBERS

- California Farm Bureau
- Bluewater Network
- Community Alliance With Family Farmers
- Californians Against Waste
- California Rice Commission
- Sacramento Area Council of Governments
- Silicon Valley Toxics Coalition
- Imperial County Community Economic Development
- Ventura County (Solid Waste Department)
- Nevada County
- Arkenol Inc.
- Harvest Biofuels LLC
- Imperial Bioresources
- Kinergy Resources
- Masada Resource Group
- Northern California Ethanol
- Pacific Ethanol
- Plumas Corporation

RAPID NATIONAL ETHANOL INDUSTRY EXPANSION

- MTBE Phaseout
- Strong Policy Support
  - Agricultural Economic Development
  - Energy Security Concerns
  - Air Quality Regulations
  - Climate Change Issues
- Dominated by Midwest Corn Ethanol Industry
- New Market Growth Outside of Midwest

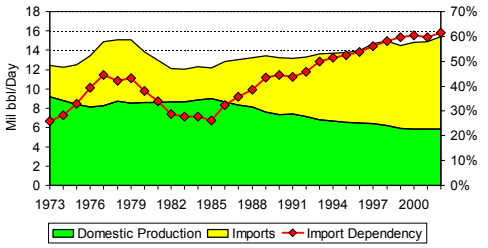
THE CALIFORNIA ETHANOL PRODUCTION OPPORTUNITY

- Exploding ethanol market demand
  - Minimum 750 million gallon market in 2004 with only 8 million gallons of production
- Growing gasoline demand with no new refineries to be built in state
- Intersection of the nation's largest fuel and dairy feed markets
- Large and diverse raw material supply
  - Primary and waste
  - Sugar, starch and cellulose
- Rural and Urban opportunities

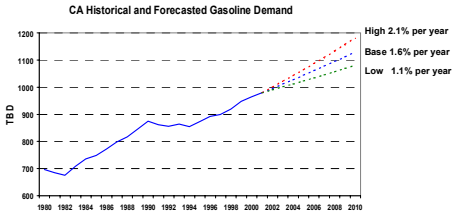
BENEFITS OF A CALIFORNIA ETHANOL INDUSTRY

- New supplies of Renewable Transportation Fuel
- Cost Effective Source of Octane and Dilution of Toxic components of gasoline
- Production of High Protein Feed for the California Dairy Industry
- Reduction in Petroleum Dependence
- New source of Economic Development
- CO2 Reductions
  - 6.4 million tons on CO2 reductions with ten percent ethanol blends and current ethanol production technology

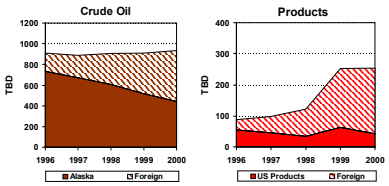
America's Dependence on Imported Oil Continues to Grow



CA Gasoline Demand Forecast



CA Petroleum Import Trends



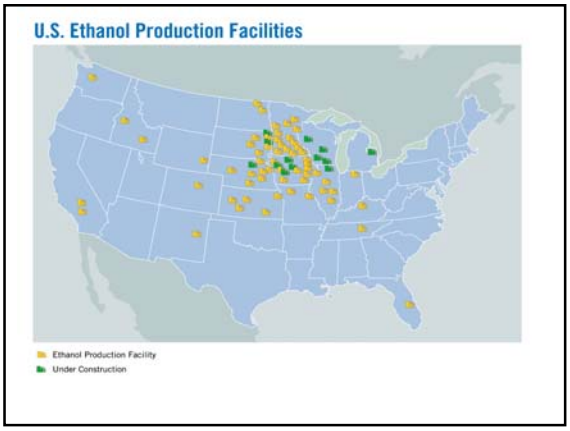
LOCAL ECONOMIC BENEFITS OF A 40 MILLION GALLON PER YEAR ETHANOL FACILITY

- Provide a one-time boost of $142 million during construction
- Expand the local economic base $110.2 million each year through the direct spending of $56 million
- Create 41 full-time jobs at the plant and 694 jobs throughout the entire economy
- Increase local price of corn by an average of 5-10 cents a bushel
- Increase household income for the community by $19.6 million annually
- Boost state and local sales tax receipts by an average of $1.2 million (varies depending on local rates)

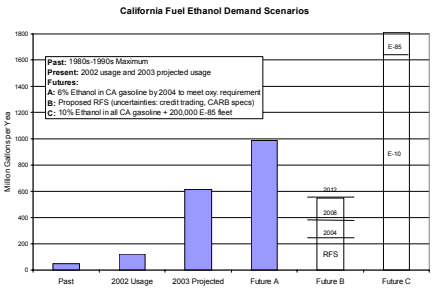
Source: "Ethanol and the Local Community," John Urbanchuk, AUS Consultants and Jeff Kapell, SJH & Company, June 2002

CALIFORNIA ETHANOL CHALLENGES

- Competition from Existing Industry
- Market Uncertainty
- Technology Risks for Cellulose Conversion
- Lack of Coherent State Policy Support



CALIFORNIA ETHANOL MARKET



CALIFORNIA ETHANOL STRATEGY

- Integration with local markets for raw materials and products
- Develop 5 to 10 Conventional Ethanol Facilities in near term with 300 to 400 million gallons of annual production
- First Round of development platform for Cellulose Conversion
- Focused Public/Private Partnership

CALIFORNIA ETHANOL POLICY NEEDS

- State Renewable Fuels Standard
- Extra Credit for Cellulose
- Recalibrate CARB Predictive Model
- Effective implementation of new CO2 reduction law (AB1493) to maximize the cost effective use of renewable fuels
- Loan guarantees (cellulose)
- Production Incentives

CURRENT PROGRESS

- Companies in Northern, Central and Southern California have secured sites, seed capital and announced development plans
- Significant progress on cellulose conversion technologies
- 2003 California Legislative bills SB 820 (Denham) and SB671 (Florez) promoting ethanol production and use
- AB 1493 CO2 regulatory implementation and CEC AB 2076 Petroleum Dependence process supporting coherent Renewable Fuels Policy in California
- Smooth transition from MTBE to ethanol in California securing the market

The Investment Climate for Ethanol Production in California

California Ethanol Workshop
April 14, 2003

Mark Yancey
BBI International
602 Park Point Drive
Suite 250
Golden, CO 80401
mark@bbiethanol.com

BBI INTERNATIONAL CONSULTING

Presentation Outline

- The Ethanol Project "Model"
- Equity
- Debt
- California versus Midwest Ethanol

Ethanol Project "Model"

1. Initial meeting
2. Organization formed
3. Secure seed money
4. Feasibility study
   - Sites, Feedstocks
   - Markets, Technical
   - Financial
5. Develop business plan
   - Operation plan
   - Marketing plan
   - Management plan
   - Financial plan
6. Develop prospectus
7. Membership drive
8. Finance project
9. Hire manager
10. Project construction
11. Begin operation

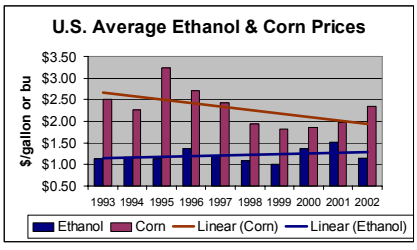
Project Equity

- Plan to have 40-50% equity
  - Subordinated debt and grants count as equity
- A 40 million gallon per year dry mill ethanol plant should cost approx. $55 million
- Equity required is $22 to $28 million

Equity Investment

- Based upon historic corn and ethanol pricing and current fixed ethanol production cost estimates, investors should receive a 25% - 30% annual return on investment
- At times of low corn prices and high ethanol prices (2000 and 2001), investors have received up to 75% annual return on investment
- 1998 and 1999 - $1.00 to $1.10/gal

Historical Ethanol and Corn Prices



Historical Returns

Year	Etoh	Corn	Avg. Annual ROI
1993	$1.12	$2.50	7%
1994	$1.16	$2.26	23%
1995	$1.14	$3.24	-30%
1996	$1.37	$2.71	37%
1997	$1.20	$2.43	22%
1998	$1.08	$1.94	23%
1999	$1.01	$1.82	17%
2000	$1.37	$1.85	72%
2001	$1.52	$1.97	90%
2002	$1.14	$2.35	16%
Average	$1.21	$2.31	28%

Debt (Bank) Perspective

- Markets
- Management
- Money

Marketing Plan

- Ethanol Marketing Alliance
- Market Development Plan
- Customers
  - Distribution channels to your customers
- Competitors
  - Your advantage?
- Ethanol Supply and Demand
  - Difficult for new lenders to understand

Management Plan

- Management Team
  - Board of Directors
  - Officers
  - Design/Build "Partner"
  - Legal Council and Project Consultants
- Management Team Experience
- Startup and Operating Plans
- Risk Management Plan

Financial Plan

- Projected Return on Investment
- Strong Cash Flow
- Adequate Working Capital
- Source of Funds
- Use of Funds
- Guarantees
  - Cost and performance of plant; startup date

CA vs. Midwest Ethanol

- What is the cost of ethanol produced in Nebraska or Iowa and delivered to California markets?
- How does ethanol produced in California compare?

CA vs. Midwest Ethanol

	California Ethanol	Nebraska Ethanol	Iowa Ethanol
Denatured Ethanol Production (Gal/yr)	**40,000,000**	**40,000,000**	**40,000,000**
Project Costs			
Cost per Gallon	$1.13	$1.13	$1.13
Ethanol Plant Engineering & Construction	$45,200,000	$45,200,000	$45,200,000
Project Development/Owner's Costs	$11,000,000	$10,000,000	$10,000,000
Total Project Cost	**$56,200,000**	**$55,200,000**	**$55,200,000**
Corn Pricing			
Corn, 10-year average price ($/Bu)	2.29	2.29	2.23
Grain Handling/Shipping ($/Bu)	0.60	0.05	0.05
Delivered Grain Price ($/Bu)	2.89	2.34	2.28
DDGS and Other Pricing			
Local DDGS Price ($/Ton)	120.00	80.00	80.00
Denaturant ($/Gal)	0.70	0.70	0.70
Natural Gas ($/MCF)	4.00	4.00	4.00
Electricity ($/kWh)	0.08	0.04	0.04
Makeup Water ($/1000 Gal)	0.50	0.50	0.50
Wastewater ($/1000 Gal)	2.00	2.00	2.00

CA vs. Midwest Ethanol

Production & Operating Expenses ($/gallon ethanol)			
Grain	$1.03	$0.84	$0.81
Chemicals, Enzymes & Yeast	$0.07	$0.07	$0.07
Natural Gas	$0.10	$0.15	$0.15
Electricity	$0.06	$0.03	$0.03
Denaturants	$0.04	$0.04	$0.04
Makeup Water Supply	$0.00	$0.00	$0.00
Effluent Treatment & Disposal	$0.00	$0.00	$0.00
Production Labor	$0.02	$0.02	$0.02
Administrative Expenses	$0.07	$0.07	$0.07
Financing Costs	$0.12	$0.12	$0.12
Ethanol Production Cost	**$1.53**	**$1.35**	**$1.32**
Coproduct Revenue			
DDGS Revenue	$0.39	$0.26	$0.26
State Producer Payment	$0.00	$0.07	$0.00
Total Coproduct Revenue	**$0.39**	**$0.33**	**$0.26**
Plant Gate Ethanol Cost	**$1.14**	**$1.02**	**$1.07**
Ethanol Shipping Cost to CA Markets	$0.04	$0.15	$0.15
DELIVERED ETHANOL COST	**$1.18**	**$1.17**	**$1.22**

Demand for Capital

- There are about 100 ethanol projects being considered in the U.S. right now!
- To reach 5 billion gpy = 40 new ethanol plants @ 50 mmgpy each
- => $2 billion in debt and equity capital
- Your business plan must be sound and complete with a strong risk management plan to attract capital

Thank You!

BBI INTERNATIONAL

www.bbiethanol.com

Overview of Ethanol's Prospective Contribution to California Agriculture

Matt Summers
Office of Agriculture and Environmental Stewardship
California Department of Food and Agriculture

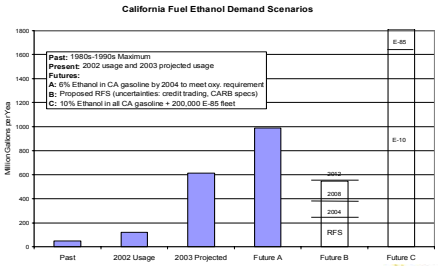
California Ethanol Workshop
April 14, 2003
Sacramento

Overview

- California Ethanol Market
- Feedstock and Production Opportunities
- California Production Potential
- Challenges
- Fuel Applications
- Important Messages and Considerations

California Ethanol Market

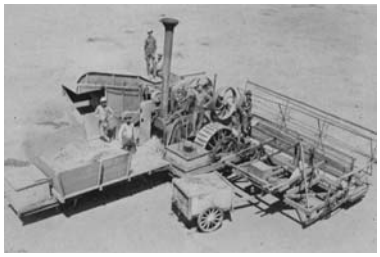
(Future Still Uncertain)



California Ethanol Feedstock

- Conventional Feedstock
  - Corn
  - Sorghum
  - Sugar Cane
  - Cheese Whey
  - Food and Beverage Wastes
  - New crops
- Biomass Feedstock
  - Ample resources (agriculture, forest, urban)
  - When will it be commercially viable?

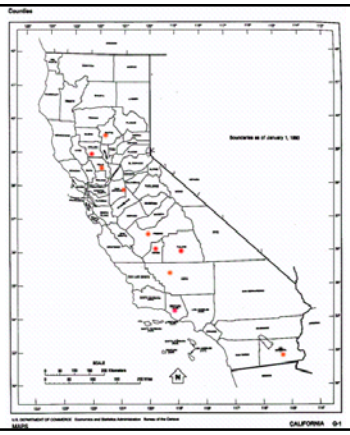
Back to the future?



The first self-propelled combine used straw as fuel!!
The Berry Combine, Lindsey, California 1886

Current CA Ethanol Production Opportunities

- Butte County
- Yolo, Colusa County
- San Joaquin County
- Fresno, Kern, Kings, Tulare Counties
- Imperial County
- Ventura County

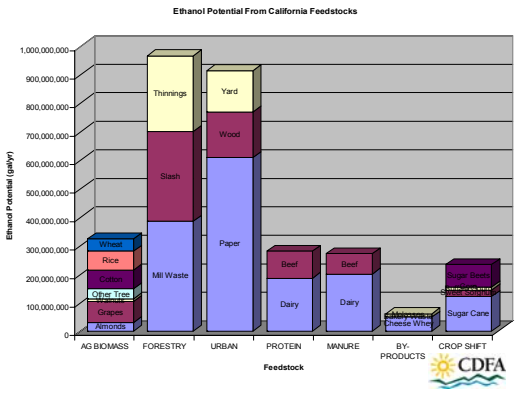


CA Production Potential: Conventional Feedstock

- Agriculture (in millions gallons ethanol)
  - Protein - 280
  - Crop shift - 233
  - By-products - 61
  - *TOTAL –* *574*
- Assumptions
  - Protein – All feed protein provided by corn by-products, 600,000 acres of corn required.
  - Crop shift of 245,000 acres to non-corn feedstock (sugar cane, etc.)

CA Production Potential: Biomass Feedstock

- Agriculture
  - Biomass - 324
  - Manure - 271
  - *TOTAL -* *595*
- Forestry
  - Mill Waste - 385
  - Slash - 315
  - Thinings - 266
  - *TOTAL -* *966*
- Urban
  - Paper - 609
  - Wood - 160
  - Yard - 145
  - *TOTAL -* *914*
- Assumptions
  - CEC biomass data
  - 50 to 70 gallons of ethanol per BDT



California Production Advantages

- Proximity to large/growing ethanol market
- Proximity to large/growing feed market
- Growing season and variety of feedstock
- Large underutilized biomass resources
- Hotbed of innovation

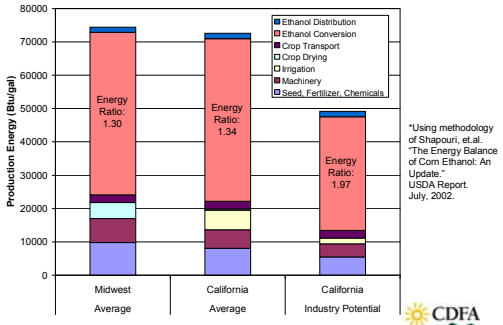
California Production Challenges

- Uncertainty in future demand for product
- Availability of feedstock if changes in cropping are required
- Cost of feedstock and energy inputs
- Regional regulatory requirements
- Conversion technology and acquisition costs not established for biomass

Corn Ethanol Production in California vs. Midwest

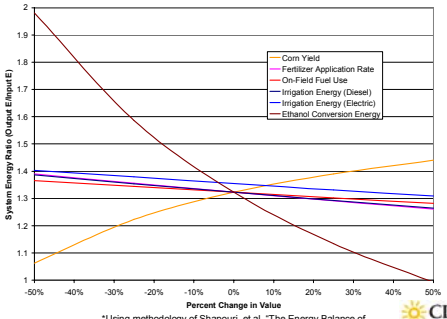
- Higher per acre yields
- Higher per acre inputs
- Irrigation is required
- Field drying of grain is typical
- Opportunities for feeding wet protein

Energy Inputs for Ethanol Production



*Using methodology of Shapouri, et.al. "The Energy Balance of Corn Ethanol: An Update." USDA Report. July, 2002.

Ethanol Energy Ratio Sensitivity



*Using methodology of Shapouri, et.al. "The Energy Balance of Corn Ethanol: An Update." USDA Report. July, 2002.

The Flexible Fuel

- Reformulated gasoline – up to E-10?
- E-85 (over 150,000 FFV's and growing in CA)
- Heavy duty applications
  - E-Diesel and Biodiesel
  - E-95 and E-100
- E-22 – E-24
- Flex-fueled hybrids
- Fuel cells

Messages To Policy Makers about Ethanol in California

- Ethanol reduces CA dependence on imported fossil fuels and delivers environmental benefits
- Ethanol can help temper volatility in fuel prices
- Signals of future stability in CA ethanol market essential for establishing CA production
- The Minnesota Model works! Production incentive can be a cost-effective jump-start to industry, diversifies and strengthens the rural economy– creates jobs and markets
- Consider a renewable portfolio standard for transportation fuels (as exists for electricity)

California Policy and Ethanol

- California policy makers have prioritized reduction of greenhouse gasses from transportation (AB1493) and reduced dependence on petroleum (AB 2076)
- Jobs a major concern, particularly in the current economy in some regions

Key Considerations

- California agriculture is a significant feature of the existing environment
- California agriculture's strengths are in its diversity, favorable climate, and high technology, which should be further exploited
- New markets and products can enhance the agricultural and rural economy of California
- Strategic partnerships will be required to fully exploit these opportunities

Contact Information

Matthew D. Summers, P.E.

California Department of Food and Agriculture
1220 N. Street
Sacramento, CA 95814
916-651-7178
msummers@cdfa.ca.gov

Data Sources

- CDFA Crop Statistics - 2001 (for 2000)
- CEC Report - Evaluation of Biomass-to-Ethanol Fuel Potential in California, December, 1999
- Dr. Paul Sebesta, UC Riverside (sugar cane)
- Ethanol Conversion factors – The Energy Balance of Corn Ethanol: An Update, USDA, 2002 .

CORN-TO-ETHANOL PROJECT IN COLUSA COUNTY

Phil Cherry
California Biofuels Development Group, LLC
U.S. DOE - California Ethanol Workshop
April 14, 2003

Why Corn-to-Ethanol in California?

- Develop In-state Industry to Meet New Demand Before Midwest Captures Market
- Technology/Process is Proven and Commercialized
- Large Dairy Market for Co-product
- Greater Chance of Success

Why Sacramento Area?

- Local Corn Grown / Can Be Grown
- Closure of Sugar Beet and Tomato Processing Plants
- Agricultural / Industrial Area
- Proximity to Gasoline Terminals, Feed Markets, and State Government

Initial Activities

- Contact Made with Yolo County Farm Bureau in March 2001
- Yolo County Farm Bureau Sponsored Three Ethanol Forums
  - May 2001
  - August 2001
  - April 2002
- Yolo County Ethanol Task Force Formed in August 2001

Yolo County Ethanol Task Force

- Supervisor Rosenberg Appointed a Blue-Ribbon Panel to Explore the Benefits and Constraints of Siting a Facility in the Area
- 20-Member Team Composed of Local Government, Universities, Industry, and Growers
- Consisted of Four Sub-committees
  - Economics / Financing / Marketing
  - Environmental Issues
  - Infrastructure / Potential Sites
  - Raw Material Supply / Transportation / Technology

Yolo County Ethanol Task Force

- Concluded That Ethanol Production was Feasible and the County Provided a Viable Location for Development of the Industry
- Report Submitted to and Approved by Economic Development Council in January 2002
- Board of Supervisors Unanimously Endorsed Local Efforts to Bring Ethanol Facility to the County in February 2002

Early Project Development

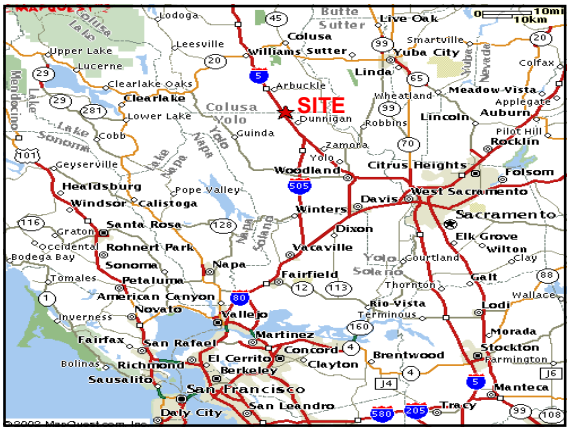
- Ethanol Company Formed
- Potential Sites Evaluated
- Engineering and Construction Firms Assessed and Midwest Plants Toured
- Grain Suppliers and Product Marketers Interviewed
- Preliminary Meetings with Permitting Agencies

Project Milestones

- Property Selected, Land Surveyed, and Site Plan Completed
- Contract with Design - Build Firm and Preliminary Facility Layout Completed
- Agreements in Place for Grain Supply, Ethanol Marketing, and DDGS Sales
- Business Plan Developed

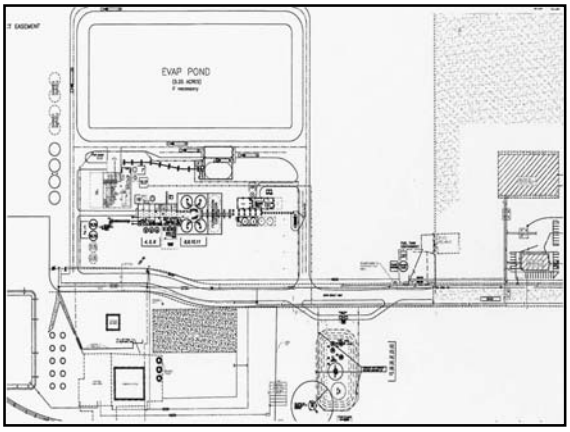
Project Description

- 20 Million Gallons per Year Facility
  - Utilize Dry-Mill Process Technology
  - Require 210,000 tons of Corn
  - Produce 64,000 tons DDGS as Co-product
  - Incorporate CHP System to Supply Energy
  - Designed for Expansion to 40 MGPY
- Located in Colusa County Near Arbuckle
  - Site of The Adams Group, Inc. Headquarters, Trucking Company, and Specialty Oils Plant



Project Advantages

- Located Near Sacramento Area Ethanol Market – 57 million gallons per year
- Industrial Zoned Property with Existing Infrastructure
- Reduced Capital and Operating Costs
- Local Community and Agency Support



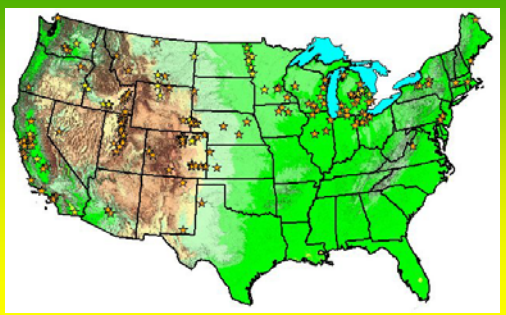
Project Status

- Finalizing Engineering Design with Integration of Grain Handling Facility and CHP System
- Finalizing Infrastructure Requirements and Site Improvements
- Compiling Required Information to Complete and Submit Permit Applications
- Anticipate Ground-breaking During Summer with Production Start-up in August 2004

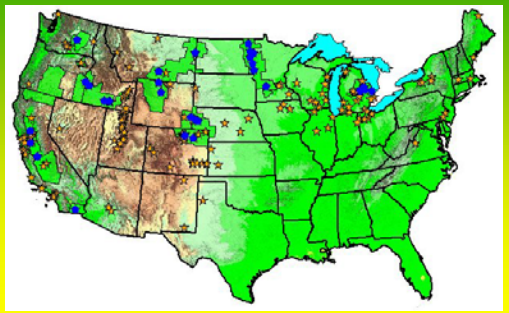
IMPERIAL BIORESOURCES LLC

Energy Solutions From Renewable Resources

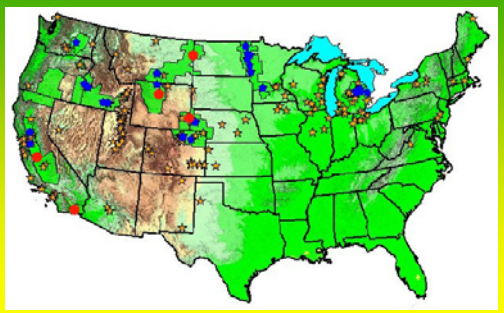
Sugar Beet Refineries built in U.S.



Sugar Beet factories operating 1998



Imperial Sugar Beet factories operating today



93’ 2 Mil bags 30.9 T/Ac. 16.5% Sugar

01’ 2.6 Mil bags 41.63 T/Ac. 15.46% Sugar
30% Increase in throughput / efficiency

Profitability has remained the same.

Sugarcane!
In the low desert?

A vision whose time has come.

Florida Cane Fire

IV Sugarcane Harvest

Harvested Billets

- Average commercial yields of 11 varieties. 64.89 Tons/acre
- 282.27 lbs. Sugar/T of cane
- 10.17 Tons sugar/A
- 20,345.45 pounds sugar/acre
- 15.79% Sugar
- With 15,000 acres, about 305,182,000 lbs of sugar will be produced

Imperial Bioresources LLC now seeks to apply the latest and most advanced methods of conversion of biomass to ethanol and other high value byproducts.

- Cane & Beet Molasses to Ethanol
- Biomass to Renewable Energy
- Beneficial By-products
- Sugar Beet to Refined Sugar
- Sugarcane to Refined Sugar
- Corn to Ethanol

Baled Cane Trash

Distillers Grains

- By product of Corn Ethanol
- Dry Milling Process
- 60 Lbs Corn yields about 18 lbs of DG (d.m.) of a high quality high protein feed.
- Up to 30% of concentrates can be replaced with DG
- DG fed as wet feed is superior to DDG

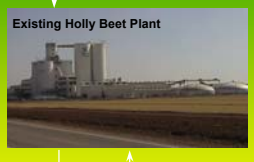
IMPERIAL BIORESOURCES LLC
Energy Solutions From Renewable Resources

Imperial Valley Sugar Industry. . .

Beet Growers

IMPERIAL BIORESOURCES LLC
Energy Solutions From Renewable Resources

Existing Holly Beet Plant



Molasses
Sugar

Cane Growers

Proposed Cane Mill

Refined Sugar

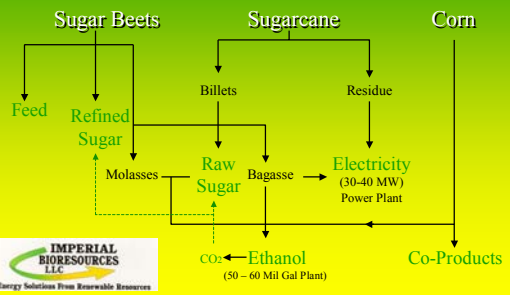
Electricity, Steam, Carbon Dioxide

Raw Sugar, Cane Molasses

Sugar, Ethanol, Electricity

. . . success through innovation

Sugarcane Commercialization Flow Chart



IMPERIAL BIORESOURCES LLC
Energy Solutions From Renewable Resources

Project Highlights

- Provides California with a New Energy Crop
- Meets California's need to replace MTBE
- Improves Ambient Air Quality by replacing fossil fuel use
- Delivers substantial quantities of Low Cost Sugar
- Creates Substantial Economic and Employment Opportunities in the Imperial Valley
- Helps to keep the Sugar Beet industry here in the Imperial Valley viable

Project Public Benefits

- **Adds renewable energy to California power portfolio**
- **Helps State achieve more Energy Independence**
- **New local energy supply helps meet new growth**
- **Renewable fuel displaces fossil fuel**
- **Renewable fuels burn cleaner, air quality improves**
- **Local fuel source provides Price Stability**
- **Plant demand is lowest in Peak Months**
- **All sectors and rate payers benefit equally**

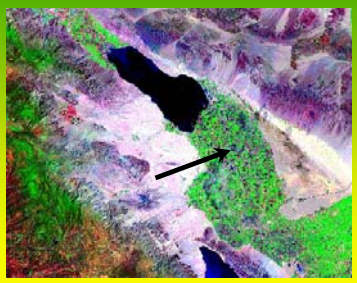
What Has Been Accomplished?

- **Conducted successful preliminary growing trials on several cane varieties**
- **Identified an integrated project concept where the principle plant elements are optimized**
- **Developed project integration arrangement whereby product / co-product synergies are fully exploited**
- **Lobbied successfully for language in the farm bill that will allow a Cane sugar quota for California**

What Has Been Accomplished?

- **Identified principle environmental concerns and developed solutions.**
  - **No field burning of cane – yields co-generation fuel for year round generation of power**
  - **CO_2 from fermentation will be used in sugar refining process**
  - **Solar drying of beet pulp and distillers grains reduce emissions and increases nutritional value of co-products**
  - **Entire plant should very close to 100% renewable energy powered and 100% energy self-sufficient**

Where Are We Today?



We are here.

Where Are We Today?

- Currently there are 700 acres planted in I.V.
- Field trials are being conducted
  - Variety selection trials
  - Fertilization optimization trial
  - Seed planting rate trial

Where Are We Today?

- Project feasibility study about 50% complete
- Project has received grant funding from Imperial Irrigation District
- Very strong community support

What Are The Missing Pieces?

- Financing - Corn to Ethanol Model
  - 60% Owner equity required due too
    - High risk, lack of long term supply contracts
- Markets must be developed
  - Long term off-take contracts for co-products reduce risk, help to stabilize pricing

What Can California Do?

- Develop a long term plan to support the growth of an in-state ethanol industry
- Support publicly, ethanol use in California

Project Team/supporters

- Holly Sugar
- Imperial Irrigation District
- I.V. Sugarbeet Growers
- I.V. Sugarcane Growers
- Advanced Crop Technologies (Amin Abdelmoien)
- Imperial County
- Rain for Rent
- T Systems
- Western Farm Services
- Everfelt Company
- COLAB
- Farm Bureau of Imperial County
- Imperial Valley Veg Growers
- University of California
- U.F.C.W.

IMPERIAL BIORESOURCES LLC

Energy Solutions From Renewable Resources

WWW.IMPERIALBIORESOURCES.COM

San Joaquin Valley Ethanol Outlook

Biofuels for Sustainable Transportation
April 14, 2003
Sacramento, California

Ellen I. Burnes, Ph.D.
Department of Agricultural Economics
CSU Fresno

Outline

- The Top Questions
- Biomass Availability
- Biomass Cost
- Ethanol Yield
- The Role of Surplus
- Local Economic Impact
- How Ethanol Fits

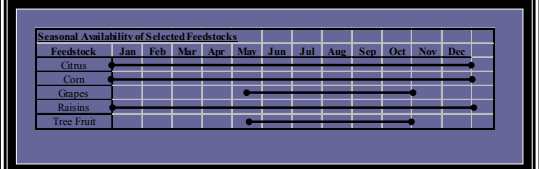
Top Questions

- What is the Role of Locally Produced Feedstocks?
- American Vineyard, "What to do with All the Raisins…Ethanol?"
- Will it help the local economy?
- Where Does it Fit?

The Perfect World

- A California ethanol plant that uses locally grown feedstocks, accepts multiple feedstocks, pays for transportation, bases feedstock price on comparative markets, and has no environmental impact.

Biomass Availability: Timing



Biomass: The Low Hanging Fruit

Summary of Potential Feedstocks

	Produced (thousand tons)	Cull (thousand tons)	Value ($/ton)	Ethanol Yield (gallons/ton)
Oranges	2060	515	51	13
CA Corn	1840	920	108	89
Table Grapes	147	204	161	21.7
Raisins	368	103	329	98
Raisins 01	437	205	250	98
Tree Fruit	664	164	17	12
MW Corn			82	89

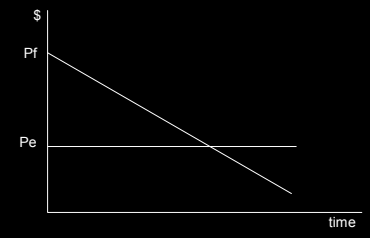
Feedstock Cost/Gallon Ethanol

Feedstock	Feedstock Cost/gallon	Co Product Value	Adjusted Feedstock Cost/gallon
Citrus	3.92	0	3.92
Corn -- CA	1.21	0.255	0.955
Grapes	7.42	0.26	7.16
Raisins	3.35	0.06	3.29
Raisins- low	2.55	0.06	2.49
Tree Fruit	1.41	0	1.41
MW Corn	0.9	0.255	0.645

Potential Role of Surplus

- Raisins cost $11/ton/month to store
- Grape juice
- Orange juice
- **Storage is important

Ethanol Markets As Surplus Outlets



Production Potential of Surplus

Contributions of Surplus Sources to 40 Million Gallon Facility				
Feedstock	Ethanol/ Ton	Tons Required	Tons Available	% Met
Citrus	13	3,076,923	515,000	17%
Corn	89	449,438	924,000	206%
Grapes	21.7	1,843,318	203,900	11%
Raisins	98	408,162	103,000	24%
Raisins 01	98	408,162	205,000	50%
Treefruit	12	165,916	165,916	5%

Ethanol and the Local Economy

- A 40 million gallon plant
  - ~41 Facility Jobs
  - ~300 Local Jobs
  - Add $8 million to local economy
- Regions of ethanol plant considerations have 16-34% year round unemployment

How Ethanol Fits

- Potential Contribution to larger energy goals
- Use for co-gen/biomass electric plants
- Transition to other fuel types
  - E85
  - Fuel Cells
  - Biodiesel
- Strategic implications if transition to national RFS

Acknowledgements

- CDFA, especially Steve Shaffer
- John Hagen, Department of Agricultural Economics, CSU Fresno
- Agricultural Research Initiative
- Great Valley Center, USDA Rural Development
- California Agricultural Technology Institute
- Center for Ag Business, CSU Fresno

Next Steps for Ethanol in California

Website Links to State Programs Involving Ethanol

California Ethanol Workshop

Sacramento, California

April 14-15, 2003

Scott W. Matthews
Deputy Director for Transportation Energy
CALIFORNIA ENERGY COMMISSION
smatthew@energy.state.ca.us

MTBE Phaseout and Ethanol Substitution

- Air Resources Board
  - www.arb.ca.gov/cbg/cbg.htm
- Energy Commission
  - www.energy.ca.gov/mtbe
- Cal EPA
  - www.calepa.ca.gov/programs/mtbe

Ethanol Production Studies/PIER

- Energy Commission
  - www.energy.ca.gov/ethanol
  - www.energy.ca.gov/pier/renew/ethanol

AB 2076 Reduce Petroleum Dependence Study

- Energy Commission
  - www.energy.ca.gov/fuels/petroleum_dependence

AB 1493 Climate Change Initiative

- Air Resources Board
  - www.arb.ca.gov/gcc/gcc.htm
- Energy Commission
  - www.energy.ca.gov/global_climate_change

Integrated Energy Policy Report

- Energy Commission
  - www.energy.ca.gov/energypolicy

The Hard Realities of Commercializing Biomass to Ethanol in California

California Ethanol Workshop
April 14, 2003

George Simons
California Energy Commission
PIER Renewables

Opportunities and Benefits

- **Opportunities**
  - ✓ CA EtOH Market Potential
    - ✶ Over 500 MM gal/yr
  - ✓ Widespread and Variety of Feedstocks
    - ✶ 60 MM BDT/yr
  - ✓ Existing Biomass Industry
    - ✶ Power plants
    - ✶ Collection & transportation infrastructures
- **Benefits**
  - ✓ Economy
    - ✶ Over $1 billion
  - ✓ Jobs
    - ✶ Over 1500 jobs for 200 million gals/yr capacity
  - ✓ Environment
    - ✶ Air quality
    - ✶ Wildfires
    - ✶ Landfill capacity
  - ✓ Energy
    - ✶ Net increase of 600-1450 GWhrs/yr for 200 million gals/yr capacity

Why Rain on the Parade?

- MTBE Phase-Out Has Raised the Stakes
- Biomass to Ethanol Offers Great Benefits on Many Fronts
- Key Breakthroughs Implied; Not Assured
- Economic Situation Won't Allow Failures
- Good Time to Assess Risks and Pathways

CA Biomass to Ethanol Perceptions

- MTBE Phase Out Creates Opportunity for CA EtOH Production
  - ➢ Over 500 million gals/year and growing
- California Rich in Biomass Resources for Making Ethanol
  - ➢ 60 million BDT/yr of residues for EtOH
    - ✶ Ag Residues: 1.17 billion gals/yr of EtOH
    - ✶ Forestry Residues: 966 million gals/yr of EtOH
    - ✶ Urban Residues: 914 million gals/yr of EtOH
- Biomass to Ethanol Will be Cheaper Than Sugar or Starch Based Processes
- Technology Breakthroughs Imminent

EtOH Opportunities From MTBE Phase Out

- Phased Out for Environmental Reasons
  - ✶ Not a Direct Call for EtOH Production
- Does Create EtOH Demand in CA
- Many Sources of EtOH Aside from CA
  - ✶ US Supplies in 2003 of 2.7 billion gals/yr
  - ✶ Brazil can supply 15% of its supply as US imports
- Ultimate Supplies Likely to be Economically Driven

CA Biomass Resources and EtOH

Resource	Generated (MMBDT/YR)	Available (MMBDT/YR)	EtOH (MM gal/yr)
Ag	19.8	5.8	370
Forestry	13.8	3.9	300
Urban	20.8	5.8	480
Totals:	54.4	15.5	1,150

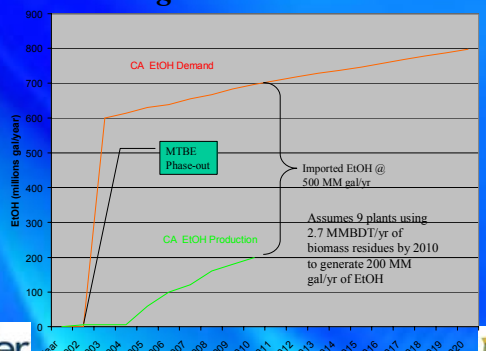
EtOH Cost Comparisons

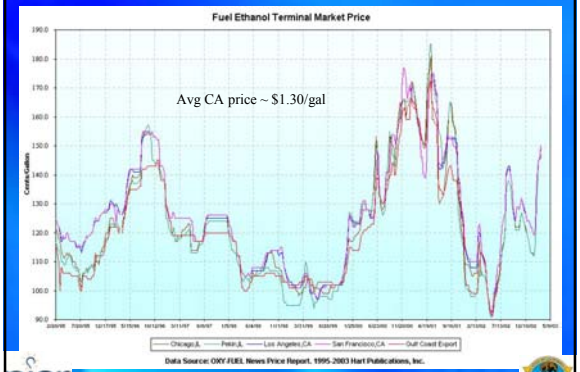
- Expanding Wet or Dry Milling Plant: $0.60/gallon
- New Dry Milling Plant: $1.25-$1.5/gallon
- Cellulose Based Plant: $1.6-$1.9/gallon
  (Based on volumes of over 200 million gals/yr)
- Consequently:
  - Tough to compete against an expansion if considering starch or sugar based approach
  - Even tougher when considering cellulosic feedstocks

Cellulosic EtOH Conversion Technology Status

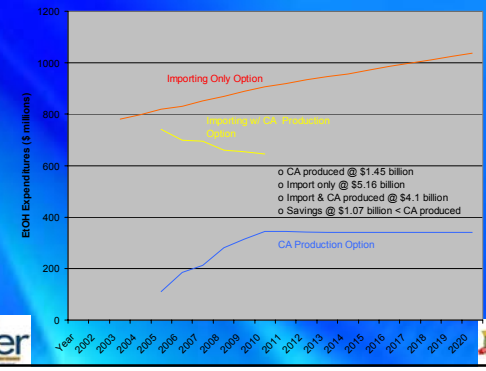
- No commercial technology available
- Developing technologies include:
  - Enzymatic hydrolysis (early pilot-scale)
  - Dilute acid hydrolysis (pilot-scale)
  - Concentrated acid hydrolysis (pilot-scale)
  - Gasification and fermentation (?)
- Fundamental data are still not available
- Don't Expect Single Step Breakthroughs

Getting to 200 MM Gals/Year



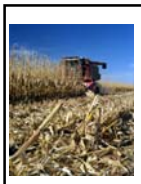


Costs of Getting to 200 MM Gals/Yr



Conclusions

- Cellulosic Based Processes Will Likely Take Longer Than Anticipated
  - Don't Count on Rapid Breakthroughs
- Industry Development Will Cost More Than Anticipated
  - Research and Development Costs
  - Commercialization Incentives & Subsidies
- Need Pathways That Help Ensure Success
  - Deliberate Steps



Biomass-to-Ethanol Process Technology Options

James D. McMillan
National Bioenergy Center
National Renewable Energy Laboratory

http://www.nrel.gov/bioenergy.html

Sacramento, CA
April 15, 2003

NREL

Biomass Resources and Issues

Wood Residues
- Sawdust
- Wood waste
- Pulp mill wastes

Agricultural Residues
- Corn stover
- Rice hulls
- Sugarcane bagasse
- Animal waste

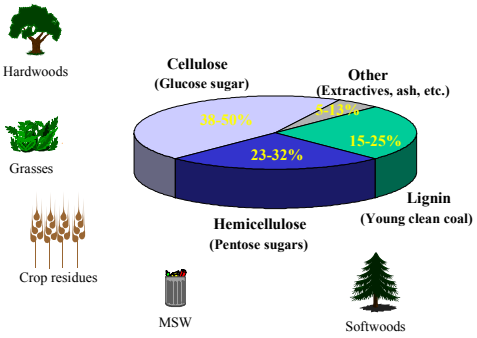
Energy Crops
- Switchgrass
- Hybrid poplar
- Willow

- **Quality**
  - Composition
  - Ease of Conversion
- **Cost**
  - Production
  - Collection and Transportation
  - Quantity Available
- **Sustainability**
  - Land, Air and Water Resources

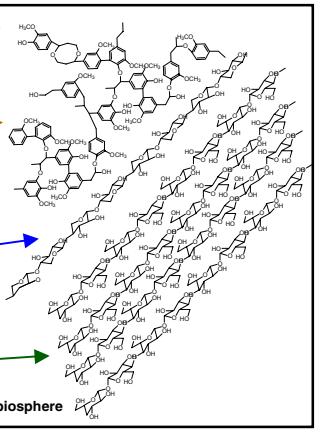
Biomass Basics

- Lignocellulosic biomass contains
  - 60-70% carbohydrates, dry basis
  - Major components are cellulose, hemicellulose, and lignin
- Biomass types exhibit differences in
  - Macro structure and cell wall architecture
  - Types and levels of lignins and hemicelluloses
  - Types and levels of minor constituents

Biomass Composition



Biomass' Major Molecules

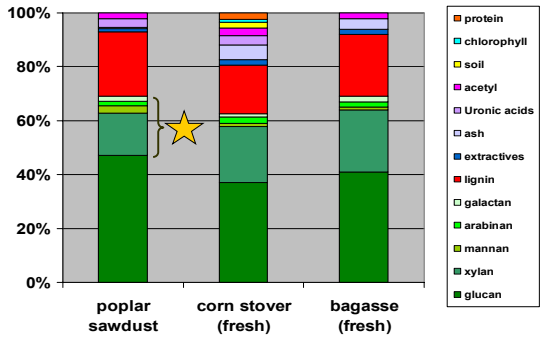


Lignin: 15-25%
- Complex network of aromatic compounds
- High energy content
- Treasure trove of novel chemistry

Hemicellulose: 23-32%
- A collection of unusual 5- and 6-carbon sugars linked together in long, substituted chains
- Xylose is the 2nd most abundant sugar in biosphere

Cellulose: 38-50%
- Long chains of glucose
- Most abundant form of carbon in biosphere

Not All Biomass is Created Equal



Biomass Fractionation

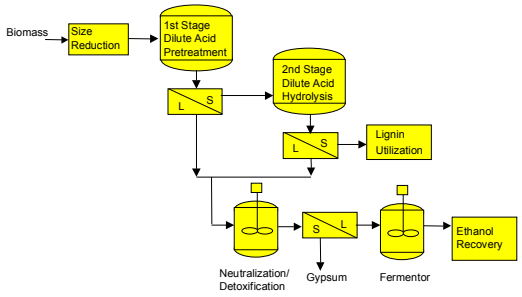
- Approaches
  - Mechanical
    - e.g., milling, comminution, decompression
  - Thermal
    - e.g., hot water, steam, heat
  - Chemical
    - e.g., acids, alkalis, solvents
  - Biological
    - e.g., cellulases, hemicellulases, ligninases

➢ *Most processing schemes employ a combination of methods*

Process Technology Options

- Major categories of biomass conversion process technology
  - Sugar Platform
    - Dilute acid cellulose conversion
    - Concentrated acid cellulose conversion
    - Enzymatic cellulose conversion
      - Using any of a variety of different primary fractionation or "pretreatment" methods
  - Syngas Platform
    - Gasification followed by synthesis gas fermentation

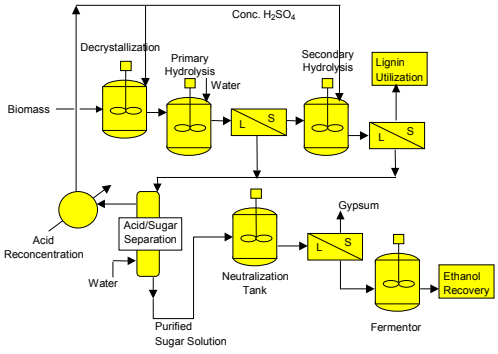
Two-Stage Dilute Acid Process



Dilute Acid Hydrolysis

- Driving Forces
  - Adapt existing infrastructure, use recycled equip.
  - Exploit recombinant fermentation technology for hexose *and pentose* sugar conversion
- Strengths
  - Proven: oldest, most extensive history of all wood sugar processes, with the first commercial process dating back to 1898.
- Active Companies/Institutions include
  - BC International
  - Swedish government

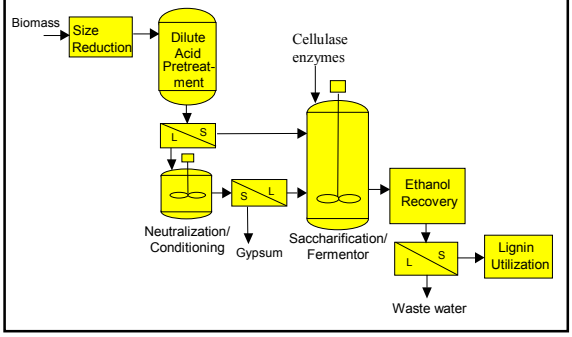
Concentrated Acid Process



Concentrated Acid Process

- Driving Forces
  - Cost effective acid/sugar separation and recovery technologies
  - Tipping fees for biomass
- Strengths
  - Proven: large scale experience dates back to Germany in the 1930s; plants still may be operating in Russia today.
  - Robust: able to handle diverse feedstocks
- Active Companies include
  - Arkenol
  - Masada Resources Group

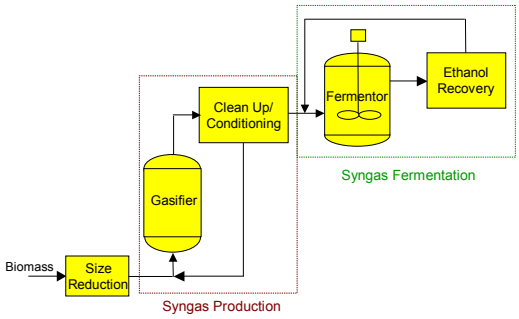
Enzymatic Process



Enzymatic Hydrolysis

- Driving Forces
  - Exploit lower cost cellulases under development
  - Conceptually compatible with many different fractionation/pretreatment approaches
- Strengths
  - Potential for higher yields due to less severe processing conditions
  - Focus of USDOE's core R&D
- Active companies include
  - Iogen/PetroCanada, BC International, SWAN Biomass, and many others, including some of the recent Bioenergy Initiative solicitation awardees

Syngas Fermentation Process



Syngas Fermentation

- Bacterial fermentation of CO, CO_2 and H_2 to ethanol

$$6\ CO + 3\ H_2O \longrightarrow C_2H_5OH + 4\ CO_2$$

$$6H_2 + 2\ CO_2 \longrightarrow C_2H_5OH + 3\ H_2O$$

- Syngas fermentation strains and processes remain relatively poorly characterized compared to other routes; many issues need to be resolved
  - Overall process economics
  - Required performance targets for
    - Gasification, e.g., yield = f(gas mixture)
    - Syngas fermentation, e.g., ethanol prod. yield, titer, and rate

Syngas Fermentation Process

- Driving Forces
  - While unproven, may enable higher yields through conversion of non-carbohydrate fractions (e.g., lignin) to syngas components
- Strengths
  - Build off previous gasification/clean up knowledge
  - Ability to process a diverse range of feedstocks to a common syngas intermediate
- Active groups include
  - Bioresource Engineering Inc.
  - Oklahoma State, Mississippi State

Challenges to Efficient Process Development

- Processing at high solids levels
- Understanding process chemistries
- Closing carbon, mass & energy balances
  - Requires accurate measurement/analysis methods
- Identifying critical process interactions
  - Integration efforts must focus on key issues
- Producing realistic intermediates and residues
  - Essential to evaluate potential coproduct values

Conclusions

- Many options based on Sugar and Syngas Platform technology routes exist and are being pursued
- Sugar Platform technologies are at a more advanced development stage because of their long R&D history
- Further information on process options is available at:
  - http://www.ott.doe.gov/biofuels/
    - National Renewable Energy Laboratory
    - (Re-organized Biomass Program website under development)
- Also see:
  - http://www.bioproducts-bioenergy.gov/
    - National Biomass Coordination Office, U.S. Department of Energy, Energy Efficiency and Renewable Energy (EERE)

Acknowledgment

- Funding provided by the Office of the Biomass Program of the U.S. Department of Energy

Need for Fuels Reduction

California Fire Plan | **National Fire Plan**

- reduce fuels near homes and communities,
- establish fuel breaks,
- modify forest fuels to lessen fire spread.

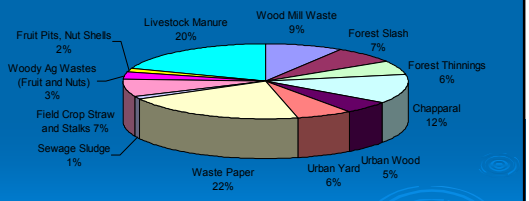
Need for Disposal and Treatment Methods

- Burning (broadcast, piles)
- Landfill disposal
- Composting
- Energy production (ETOH, electric generation)

Difficulties Implementing Fuels Reduction

- Risk of burning in the interface
- Air pollution from open burning
- CO^2 Reductions
- Landfill Diversions

Opportunities for Biomass Utilization

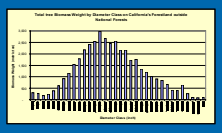


Over 60 million bone dry tons of biomass are generated each year in California

Source: Overview of the Biomass Energy Industry in California. Tiangco, Valentino Ph.D, California Energy Commission, February 19, 2002

Current Forest Biomass Sources

- Chaparral covered lands
  - 9-20 million acres
  - 56-459 million tons of biomass
  - 2 million tons burned annually



- Forest Lands
  - Sawmill residue, logging slash, forest thinning, fuel hazard reduction
  - 13.8 – 18 million tons
  - Most left on site

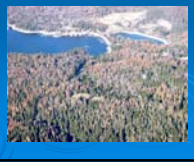
Sources: Shih, Tian-Ting, Ph.D. 2002. TREE BIOMASS ESTIMATES ON CALIFORNIA'S FORESTLAND, CDF/FRAP

CEC, *Evaluation of Biomass-to-Ethanol Potential in California*, Report to the Governor and the Agency Secretary, Cal EPA, December, 1999, Sacramento

Opportunities for Fuels Reduction

- Timber Harvest Residues
  - From timber harvesting
  - Low potential for burning due to current high level of utilization

- In-forest Residues
  - From fuels reduction
  - High potential for increased usage as biomass



Current CA Woody Biomass Supply and Use

Waste Source	Gross Production (MM BDT/yr)	Current Use (MM BDT/yr) Fuel	Other	Est. Available (MM BDT/yr)
Lumber Mill	5.5	1.75	3.25	0
Forest Slash	4.5	0.25		2.5
Forest Thin.	3.8	0.25		1.4
Urban Wood	3.2	1.0	0.5	0.7
Urban Yard	3.9	0.2	0.5	1.2

Source: Bruce Springsteen, Assessment of California Waste Resources for Gasification, paper prepared for California Energy Commission, May 2002. (rows do not add)

Tree Biomass on CA Forestland

Note: Draft representation of methodology, not currently statistically accurate

Barriers to Fuels Reduction

Technological Barriers:

- Cost to chip, deliver, store, and handle woody biomass
- Efficiencies of DE equipment

Institutional Barriers:

- Non-standardized grid access
- Monopoly practices by utilities
- Emissions standards

State Renewable Energy Legislation

- SB 1078 Renewable Energy Portfolio Standard
  - Mandates 20% renewables by 2017
- SB 1038 – Funding of Renewable Portfolio Standard and Public Interest Energy Research
  - Funding existing and emerging renewable resource technologies
- AB 58 – Net metering interconnection deadlines
  - Extend net metering terms to installations completed by 9/30/2003

State Renewable Energy Goals

- Governor challenged the state's higher education institutions to make their buildings energy self-sufficient through distributed generation.
- Governor's *Commission on Building for the 21st Century* recommended that the State achieve a 25% renewable portfolio by the year 2020.

Biomass Energy Capacity

- Large Scale Generators
  - 35 plants – 685 MW generating capacity
  - Many under short-term contracts, thru 2002
  - No long-term security

- Small Scale Generators
  - Distributed Generation
  - Typically 5KW – 5 MW

Ethanol as an Gasoline Oxygenate

- MTBE to be phased out as an oxygenate in 2003.
- December 31, 2003 - ethanol will be only approved oxygenate per ARB

Washington Ridge Bio-Energy Project

…will construct, install, operate and maintain innovative biomass/energy conversion equipment so as to economically and environmentally demonstrate that the utilization of forest fuels can provide employment and business opportunities through the appropriately scaled production of energy.

Public Cooperators

- Sierra Economic Development District
- CA Department of Forestry & Protection
- California Youth Authority
- USDA Forest Service
- N. Sierra Air Quality Management District
- County of Nevada
- Fire Safe Council of Nevada County

Private Cooperators

- Chiptec Wood Energy Systems
- Capstone Turbine Corporation
- Foresters Co-op

Washington Ridge Bio-Energy Project

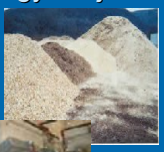
Location: Washington Ridge Conservation Camp, Nevada County, California

Specs: 5MM-BTU/Hr Chiptec Gassifier
Three 30 kW Capstone Turbines

Fuel: 3000 BDTs Biomass

Goal: For the Camp to operate independent of the grid

Offset: $50,000 Electricity (annually)
$17,000 Propane



Washington Ridge Bio-Energy Project

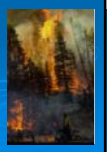
Future opportunities

- Over forty conservation camps in California
- Typically in rural setting near biomass supply
- Generally reliant on a costly and oftentimes unreliable energy supply
- Workforce available on site
- Fleet of 229 Engines, and an equal amount of administrative vehicles.

Bio-Energy or Ashes

Whether Ethanol, Biodiesel, Minor Products, or Biomass to Electricity –

- Forest biomass must be managed to maintain Forest Health and reduce Fire Hazard.
- Utilization of forest wood waste adds to the local economy (jobs – product)
- Co-benefits such as water quality, wildlife habitat, biodiversity, and recreational opportunities depend on maintaining good forest health.



California Ethanol Workshop

April 15, 2003

SWAN Biomass Company

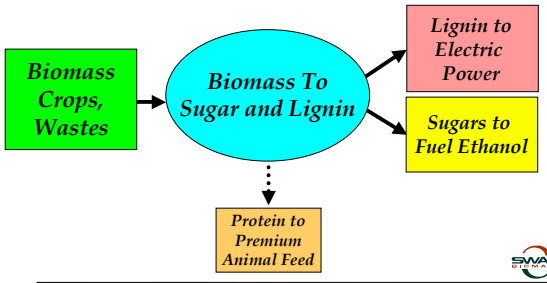
Acknowledgments

- Examples, analyses based on Imperial Valley energy crops, biomass wastes
- Information on wastes applicable to most of California
- Valuable contributions from:
  - Trisha Ferrand, Imperial Valley Economic Development
  - Paul Sebesta, UC Desert Research Extension Center

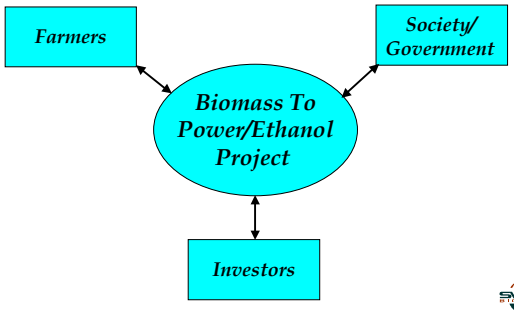
SWAN Business Model

- **Licensing of Technology Package**
  - **Internally developed technology**
  - **Predictive process modeling**
  - **Sublicensing of third party technology**
- **Structure to Support Concurrent Projects**

Project Fundamentals



Project Stakeholder Groups



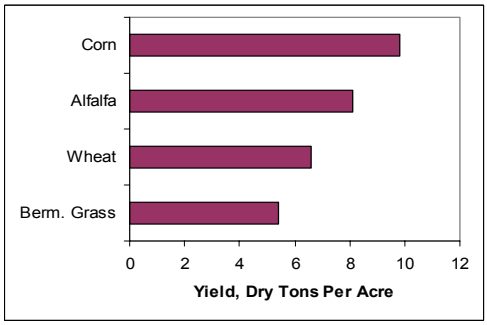
Stakeholder Satisfaction

- **Investors**
  - Rates of return matching financial risks
  - Large investments, lower transaction costs
  - Availability of facility management services
  - Public benefit element in projects
  - Defined exit strategy
- **Biomass to Power/Ethanol Facilities**
  - SWAN restructuring business strategy to meet investor needs

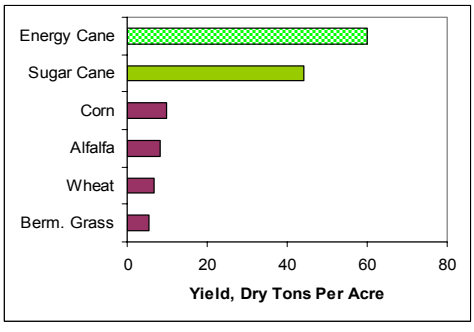
Stakeholder Satisfaction

- **Farmers**
  - Revenue per acre
  - Retain land value
- **Biomass to Power/Ethanol Facilities**
  - Higher revenue per acre possible
  - Fertilizer recycling
  - Waste converted to valuable product
  - Resources from land are renewable

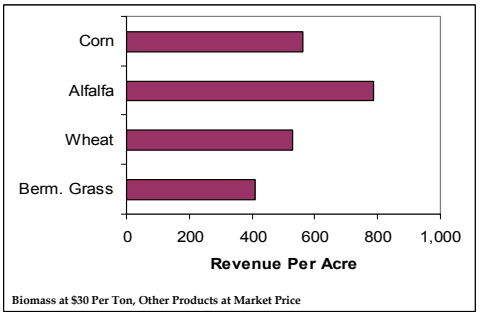
Yield Per Acre, Whole Plant



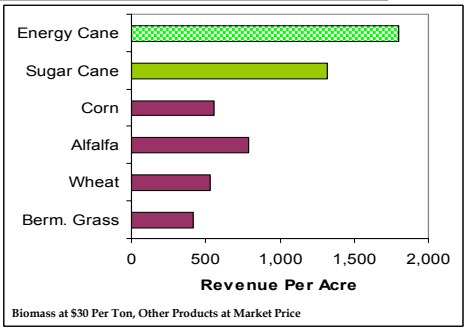
Yield Per Acre, Whole Plant



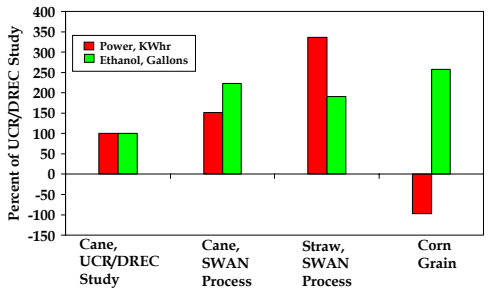
Revenue Per Acre, Whole Plant



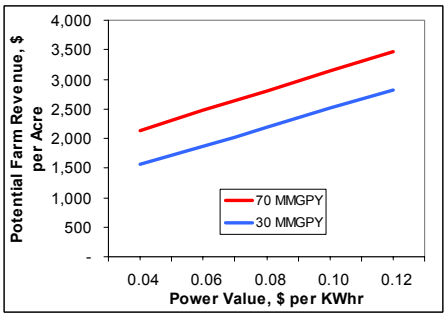
Revenue Per Acre, Whole Plant



Export Power and Ethanol Production per Bone Dry Ton Biomass Feedstock



Relationship Between Farm Revenue and Power Value, SWAN Technology



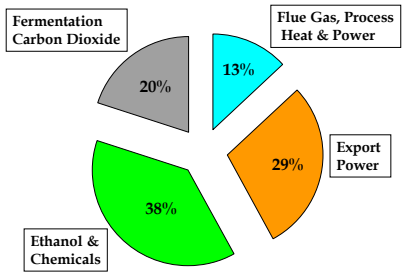
Stakeholder Satisfaction

- **Society/Government**
  - Improved air, water quality
  - Increased power supplies, lower cost
  - Increased employment, economic development
  - Increased use of local, renewable resources
- **Biomass to Power/Ethanol Facilities**
  - Meet these society/government needs

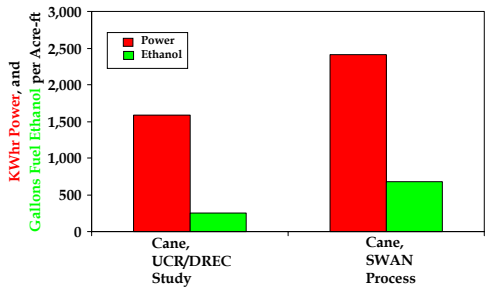
California Potential -- Imperial Valley

- Industry Producing
  - 2.2 Billion gallons per year fuel ethanol
  - 1,500 Megawatts export power capacity
  - 12,800 Gigawatt-hrs generated power
- Economic Development
  - $6 Billion investment
  - 12,400 new jobs
  - $8 Billion per year economic activity

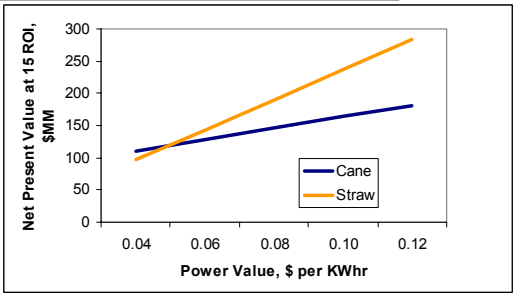
Product Carbon Distribution
SWAN Process, Wheat Straw Feedstock



Water Productivity, Export Power and Fuel Ethanol Co-Products



Power Value Effect on Project Profits
SWAN Technology



SWAN Biomass Conversion Center of Excellence (BCCE)

- Generate data to support construction and operation of high profit commercial facilities using California crops and wastes
  - Data for two more feedstocks six months after funding
  - Data for third feedstock by end of first year of operation
- Train operators for licensed facilities
- Continue process development
- Complement operation of Western Demonstration Facility

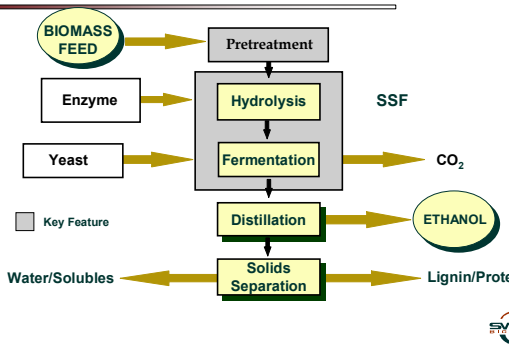
Western Biomass Conversion Demonstration Facility

Summary -- California Outlook

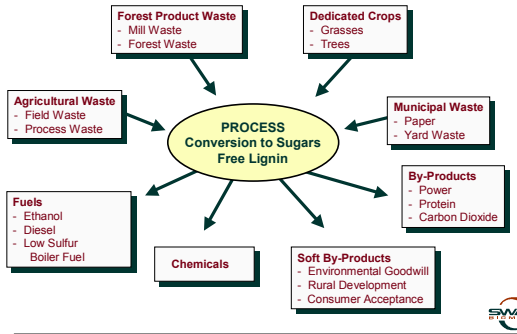
- Waste-based Component
  - Straw feedstock for initial waste based projects
  - Other wastes added based on cost, value, availability
  - Opportunities throughout California
- Crop-based Component
  - Sugar cane feedstock planned for initial crop-based projects
  - Advanced cane feedstock development planned to further improve process economics
  - Crop opportunities focused in Imperial Valley

Backup Slides

SWAN Process Overview



SWAN Feedstock and Product Flexibility



Arkenol Fuels, Inc.

US DOE
Ethanol Workshop Series

"Technology Status and Review of Ethanol Opportunities in California"
April 14-15, 2003
Sacramento, CA

Mission Viejo, CA Office

Izumi (Japan) Biorefinery

Michael A. Fatigati, VP
Arkenol, Inc.
26001 Pala St.
Mission Viejo, CA 92691
Contact: ***Mfatigati@arkenol.com***

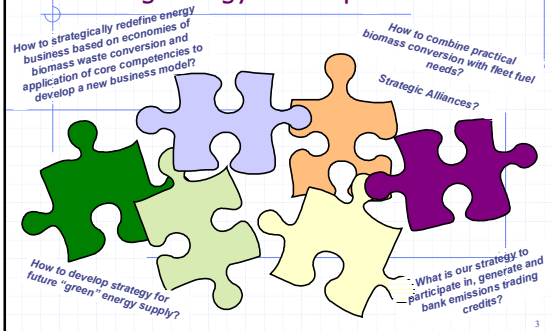
The Opportunity for Ethanol Production – a Basis for a Business

State Level

- Large transportation fuel market *(some estimates for demand at 900 MGPY of ethanol!)*
- Current in-state ethanol production limited, dependency upon imports
- Grain feedstock production limited – tied to total livestock available
  - Traditional grain-to-ethanol depends upon sale of DDG's
  - Current pricing level of DDG's in CA can offset costs of transportation of Midwest grain.
  - Displacement of grain blends for beef, dairy, swine, poultry suggests upper level of ethanol production at about 200 MGPY before pricing pressures lower DDG pricing.
- In-state production opportunities exist from use of indigenous biomass waste materials
  - *Agricultural wastes (rice, wheat, bagasse, etc.)* ← **Available, but not financeable**
  - *Forest thinnings*
  - *Urban green wastes* } **Realistic targets**
  - *Sorted MSW*

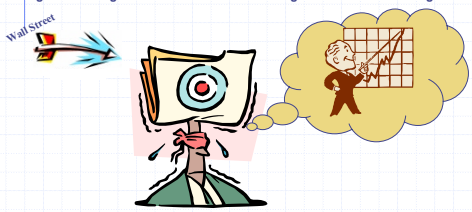
Note: 17,000 TPD of sorted MSW and green waste are dumped into the Puente Hills landfill (operated by LA Sanitation District), representing the potential production of 650 MGPY of fuel ethanol from this resource alone.

Developing a Response to the Evolving Energy Marketplace



Problem Statement

"If fuel ethanol is to provide significant displacement of imported oil to insure energy security, the industry must evolve from an increasingly mature marketplace that depends upon the sale of DDG's by using the innovative solution of biomass waste to ethanol to become the lowest cost provider of transportation fuels, utilizing renewable energy in strategic territories, with the goal of a long-term commitment to fostering continued economic growth."

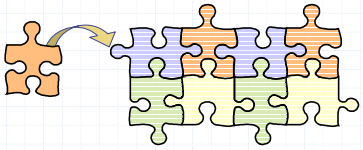


A solution……

"Arkenol Fuels, LLC."

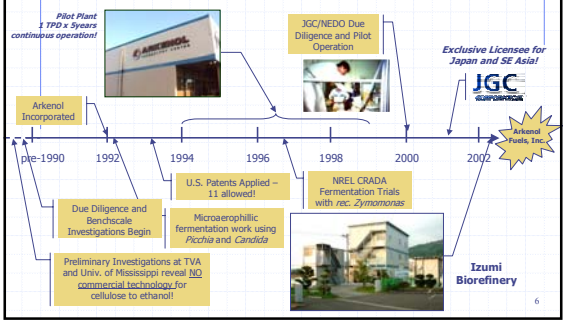
Vision Statement

"To become a world-class producer and supplier of renewable liquid fuels by the production of ethanol from opportunistic sources of cellulose from green waste generated by utility and municipal sources."

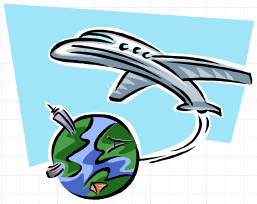


Arkenol….*12 years from Idea to Deployment!*

It starts with the search for a portable thermal host…

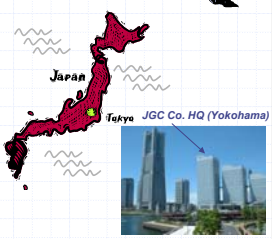


Let's go to Japan.....



- Izumi 2002 -

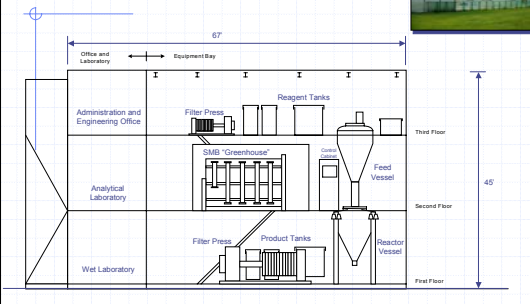
"NEDO's Application of Arkenol's Concentrated Acid Hydrolysis Technology for the Conversion of Biomass to Ethanol"



JGC Co. HQ (Yokohama)

…a collaboration of Arkenol and JGC Corp.

Simplified Arrangement of Izumi Facility



Drawing Not to Scale

Chips arrive in sacks just as they are produced and are sized on-site to a nominal 10 mm, with high fines fraction.

Waste wood chips, comprised of a mix of primarily cedar, pine, and hemlock, are supplied by the local furniture and paper industry, and are used as target feedstock.

A full charge for the feed vessel is 260 kg. It is very convenient to fill the vessel with pre-weighed 10 kg. bags of feed to the desired level for a given run.

Third Floor – Equipment Bay

Automated feeding considered for installation in FY 2003.

The third floor of the equipment bay is where feedstock is loaded in the feed vessel. Storage tanks, chillers and a gypsum filter press may be found on this floor.

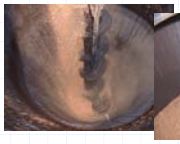
Through the doorway (at right) is the engineering office and its meeting room.

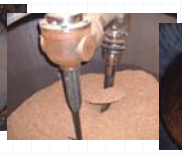
A touchscreen panel controls and monitors the reactor, while trending data .

The second floor of the equipment bay provides access to the hydrolysis reactor, a 600 liter (working volume) conical reactor with swept wall auger and central thermoprobe. The stainless steel reactor is jacketed for use with steam and internally coated with Teflon. Vacuum cooling is available to speed the cooling of the slurry.

Second Floor – Equipment Bay

Feedstock is metered from the vessel on the third floor where it is mixed with acid at temperatures from 35-65ºC. During hydrolysis, the structure of the feed breaks down into a slurry.





The third floor houses the drain and pump for the main reactor vessel, the filter press, steam boiler, plant air, water treatment, liquid storage tanks, and the acid reconcentration system.

The acid reconcentrator receives the acid stream at about 18% sulfuric acid and efficiently removes enough water to reach 75% working strength.

The filter press is used to separate inert solids in the hydrolyzate slurry from the liquid that contains the soluble sugars.

First Floor – Equipment Bay

For maximum efficiency, the unit is housed in a climate controlled "greenhouse" that maintains temperature at about 28°C.

Second Floor – Equipment Bay

The simulated moving bed (or "SMB") chromatographic separations unit is the key to separating the acid fraction of the hydrolyzate from the sugar stream. Using small plastic beads made of either a cation or anionic resin, the SMB makes it possible to recover and recycle acid at high efficiency and with low energy expenditure.

SMB's may be found within the sugar industry and are used for glucose-fructose separation and for separating sugar from molasses.

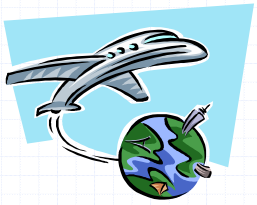
Third Floor – Equipment Bay

Ethanol fermentation takes place in a fluidized reactor with immobilized media. Use of the immobilized media in this configuration greatly reduces the amount of cell biomass debris typically produced during fermentation, thus greatly reducing the BOD loading of effluent from any plant using this technology

During the operating life of the facility, six Japanese universities will use the facility as an operating platform to test new recombinant microbes for the production of ethanol. Included in this mix will be a variant of rec. Zymomonas mobilis supplied by the U.S. National Renewable Energy Laboratory in Golden, Colorado. Fine example of cooperation and partnership to further mutual goals.

However, recent work by Japanese Universities focuses on use of naturally occuring Rhizopus strains to counter Japanese concerns of use of recombinant strains in industry.

Back to California…..



Project Development Considerations for Future Ethanol Production in California

- ***Air Quality Offsets***
  - Little to no availability of NOx and VOC credits in most jurisdictions.
  - Estimated costs of offsets for a typical 40 MGPY grain-to-ethanol plant is $5-7 million for TO, else at risk from farmers for DDG pricing.
  - Costs for offsets in Colusa County for a proposed 15 MGPY ethanol facility is in excess of $3 million – for TO, else same DDG risk.
- ***Zoning***
  - Risk of challenge if project seen as controversial = time = money!
  - Potential need to rezone to M1 even for ag-related uses in ag zones.
  - Requirement for rezoning possible if MRF-related uses within MRF boundaries.
- ***Time (…is money!)***
  - Lengthy regulatory approval process requires outlay of capital at risk for preliminary engineering and processing of permit approvals well in advance of any significant project financing.

Our History of Ethanol Project Development Experience in California

- ***Permitted a rice straw-to-ethanol plant (1995)***
  - Reviewed and approved by the CEC as part of a gas-fired cogeneration power plant.
    - Sunk costs for permitting in excess of ***$15 million***.
      - Swenson hawk biome preservation.
      - Vernal pools, fairy shrimp mitigation
      - Burrowing owls
      - Emissions offsets purchases
      - Funded county requests for expansions to infrastructure such as park and fire department.
    - Plant not built – economics of building the combined facility were overwhelmed by cost of conditions imposed by State and County.
- ***Inability to satisfy requirements of funding sources for feedstock contracts***
  - Contracts/LOI's for commitments with individual farmers to supply 120% of required rice straw deemed worthless after "investing" over $1 million with ag consultants – not considered financeable by banking institutions.
- ***Existing product off-take terms for ethanol not considered sufficient for project financing by non-grain, non-Midwest institutions.***
  - Brightline as market evolves due to MTBE ban.

Improve the process….

- Prefer single-point contact for permitting, coordination state and local requirements.
- Coordinated zoning designation for ethanol facilities – in 1995, the proposed rice straw-to-ethanol facility, adjoining a power plant, was characterized as a 'heavier' industrial use requiring additional time/money for rezoning.
- Infrastructure needs of facility require proximity to natural gas, water, power, transportation modes.
- Studies show that typical feedstock transportation costs become unattractive at a 15 mile radius from the plant, and untenable at a 50 mile radius.
- Joint powers authority formation to insure credit worthiness of feedstock supplier.

Where Are Project Siting Opportunities?

- Locations in territories with abundant feedstocks, particularly those associated with tip fees.
- Locally produced fuel ethanol in major transportation fuel markets *outside* cornbelt!
- Any city or country with a population of 250,000 or more sustains feedstock demand.

Some Recommendations for Consideration by State officials*

- State MUST play a more active role in developing enabling strategies!
- Possible areas of exploration…
  - *Capital Gains Tax Cut* – establish legislation targeting individuals and institutions making venture capital investments in early stage CA technology companies.
  - *Seed Capital Tax Credit* – encourage angel investment through tax incentives
  - *Unused Tax Credits and Losses* – establish legislations allowing transfer of unused tax credits and losses from early stage technology companies or investors to other state taxpayers in exchange for funds used for R&D.
  - *Establish A California Seed Fund* – many states have already established seed and early stage funding programs economic development purposes, given the dynamics of the venture capital market.

*Arizona Technology Summit, Capital Formation Workgroup, January 9, 2003

Summary of First Biorefinery Sizing, Costs, and Potential Returns

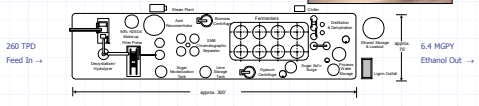
- 260 TPD Biomass (green waste and waste wood).
- 6.4 MGPY Ethanol for fuel, with potential for upsizing.
- 5 to 10 acres (including feedstock storage on site).
- Capex estimated at $6.50/installed gallon ethanol.
- Ethanol produced for sale at $1.11/gallon.
- Tip Fees for greenwaste at $10+/ton.
- 12% ROE, 10 years

Biorefinery Layout – Plant #1

Urban MRF

~ 260 TPD of post-recycled MSW processed to 6.4 MGPY fuel ethanol

~ Competitive tip fees: ***at or below landfill!!***



~ total of 22,500 sq.ft. (not inclusive of tip floors and product loadout)

~ 3,000 sq. ft. required for admininistrative and labs

Follow-on Biorefinery Sizing & Costs

(suitable as Cogeneration Thermal Host)

- 500 & 2000 TPD Biomass (green waste, waste wood and MSW).
- 17 & 52 MGPY Ethanol for fuel.
- 5 to 20 acres (including feedstock storage on site).
- Cost estimated at between $3.50 to $4.50/installed gallon ethanol.
- Investment grade returns

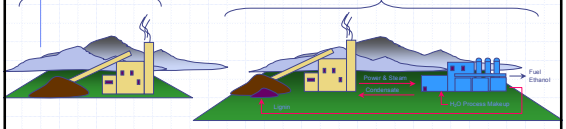
Impact of Arkenol Fuels Thermal Host on Biomass Power

Original Configuration

Heat Rate
12,200 Btu/kWh
Input = 597.8 mmBtu/hr
Output = 49 MWe (net)

With Cogen

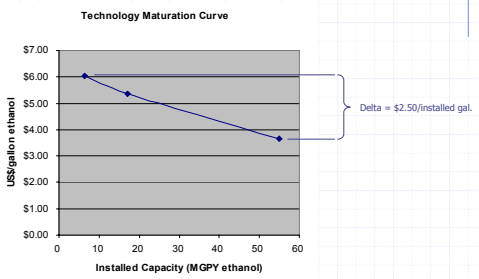
Heat Rate
10,745 Btu/kWh
Input = 513.6 mmBtu/hr
Output = 47.8 MWe (net)



Cogen Parameters

Steam = 84.2 mmBtu/hr (150 psat, min)
Electricity = 1.2 MWe
Water = 322 gpm
Lignin = 4.4 TPH (wet, 5,000 Btu/lb))
Feed = 260 TPD (as received)
Fuel Ethanol = 6.3 MGPY

Improvements in Cost of Deployment due to Economies of Scale



Status of Arkenol Technology

- Ready for commercial deployment.
- Transitioned from batch to continuous mode.
- Exclusive licensee in Japan & SE Asia – JGC Corporation.
- Ongoing discussions with local jurisdictions regarding eco-industrial park concepts in urban setting.
- First commercial plant in Japan scheduled to start construction in March 2004.
- 13 plants x 5 years at 50 TPD feed planned in Japan.

Special thanks to:

- US Department of Energy
- California Energy Commission
- Clean Fuels Partnership
- BBI Ethanol

Michael A. Fatigati, VP

Arkenol, Inc.
26001 Pala St.
Mission Viejo, CA 92691

Contact: ***Mfatigati@arkenol.com***

Power Energy Fuels Inc.

POWER ENERGY FUELS, INC.

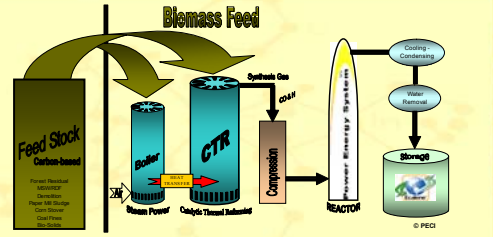
SUSTAINABLE TECHNOLOGY
BIOREFINERY PROCESS
SOLVING ENVIRONMENTAL AND ENERGY PROBLEMS

Power Energy Fuels Inc.

Featuring:

- The Power Energy System™
- Thermochemical process
- Catalytic Thermal Reforming (CTR), Ecalene™ (other)

Power Energy Fuels Inc.



Biomass to Ecalene Conversion

Power Energy Fuels Inc.

Catalytic Thermal Reforming (CTR)

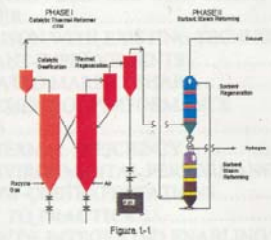
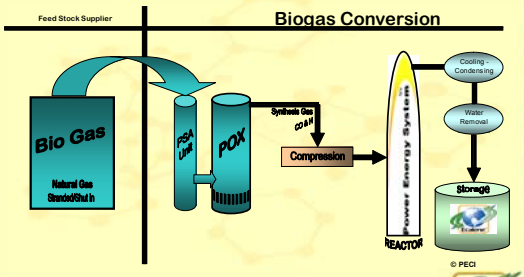


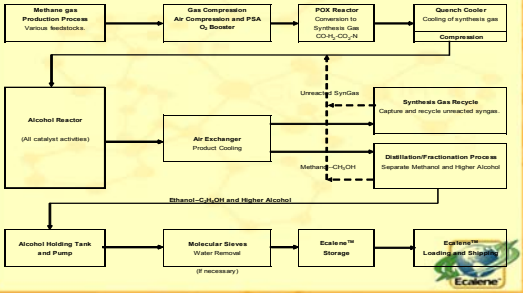
Figure 1-1

Power Energy Fuels Inc.



Power Energy Fuels Inc.

Synthesis Gas to Ecalene



Power Energy Fuels Inc.

Ecalene

Power Energy System™

- ✓ An alternative motor vehicle fuel suitable as either a 100% alcohol fuel or a 10%+ blend with gasoline
- ✓ EPA registered as fuel blending additive
- ✓ A patented Catalyst converting synthesis gas from any carbon-based material into mixed alcohols (Ecalene™)

Power Energy Fuels Inc.

WE OFFER:

- **Renewable Energy**
- **Environmental Solutions**
- **Sustainable Energy**
- **Value Added Product**

Power Energy Fuels Inc.

The Company

- **Formed in 1996 to develop and commercialize the Power Energy System™ and Ecalene™**
- **A proven catalytic process converting any carbon based material into Ecalene™; patent issued in June 2001**
- **PEFI holds the EXCLUSIVE rights to the technology.**

Power Energy Fuels Inc.

ENVIRONMENTAL BENEFITS OF THE PEFI SYSTEM

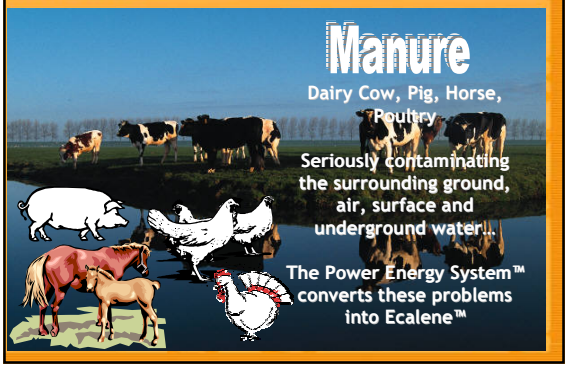
- Forest Residue
- Municipal Solid Waste (MSW)
- Manure: Dairy cow hog, horse, chicken liter
- Biosolids
- Flared Natural Gas
- Agricultural waste

Power Energy Fuels Inc.

"THE PEFI SYSTEM"

- Biomass - 250 dry tons/day
- 30,000 gallons per day - 5 MW Electricity
- Biogas - 5,000 to 20,000 gallons per day
- Retrofit existing or new fermentation ethanol plants (furnish needed power)
- Flexible in size and feedstock

Power Energy Fuels Inc.



Power Energy Fuels Inc.

Gas and Oil

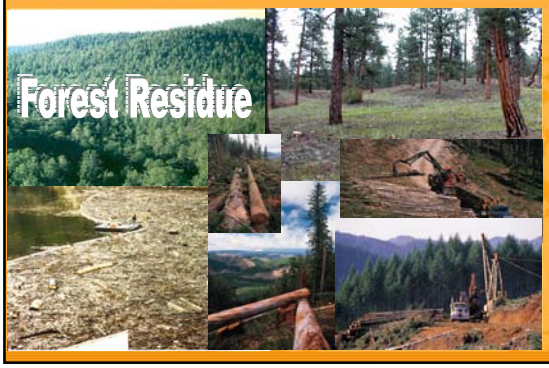
- Depletion of North American oil reserves
- Growing dependence on foreign oil
- U.S. Energy Policy
- The Power Energy System™ can help alleviate our dependency on foreign oil!

Power Energy Fuels Inc.

Multiple Feed Stocks

Power Energy Fuels Inc.

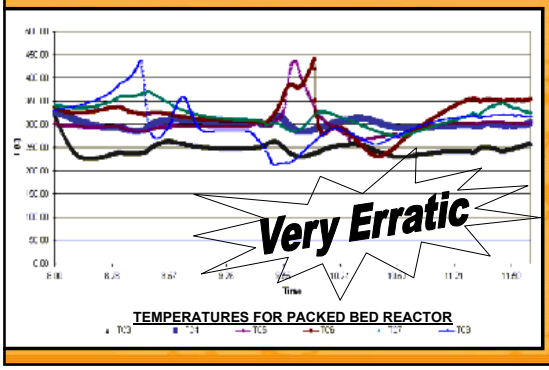
Forest Residue



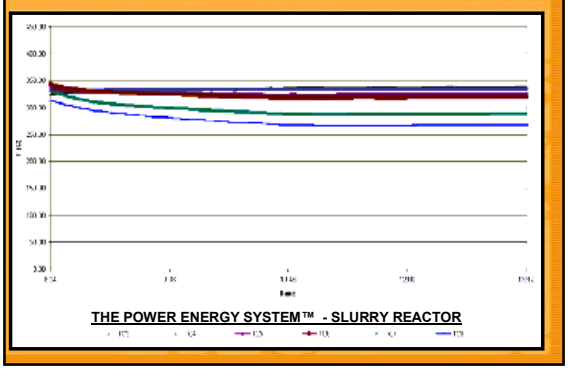
Power Energy Fuels Inc.

TECHNOLOGY

Power Energy Fuels Inc.

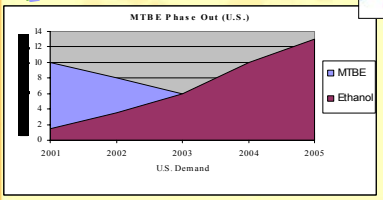


Power Energy Fuels Inc.



Power Energy Fuels Inc.

Final Product



Ecalene™

Great Market

Great Market

Power Energy Fuels Inc.

Ecalene™

- Registered with EPA as fuel additive per 40 CFR 79.23
- Federal registration permits the blending with gasoline in all 50 States
- Octane rating of 124+
- Adds all oxygen required by Federal law
- Can be blended with gasoline or used as straight fuel (E100)
- Biolene - bio-diesel - or blended with fossel fuel diesel
- Is an effective replacement for MTBE

Power Energy Fuels Inc.

Ecalene™

Component	Weight
Methanol	25-30%
Ethanol	45-50%
Propanol	15%
Butanol	5%
Pentanol	3%
Hexanol +	2%

Power Energy Fuels Inc.

Power Energy Fuels Inc.

Power Energy System™

THE WORLD NEEDS IT!

Solid Waste Stream To Ethanol in California

U.S. Department of Energy - California Ethanol Workshop
April 14-15, 2003
Sacramento, CA

A Genahol, Inc. Presentation
by
Greg Shipley

Genahol, Inc.

GENAHOL INCORPORATED

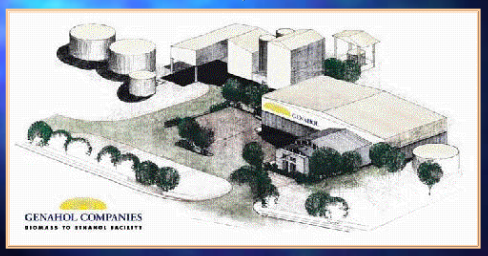
Waste to Energy

GENAHOL INCORPORATED

- Is protected by US Patent # 5,411,594 Developed by Brelsford Engineering, Inc.
- Genahol - exclusive license rights to the BEI Process for converting solid waste to ethanol
- Genahol broke ground at the Columbus, OH solid waste facility 10/02 and will be the first large scale solid waste operation
- Genahol also has been fully permitted for the Phoenix, AZ plant
- Other Projects: North Carolina/Texas/CA

GENAHOL INCORPORATED

Columbus, OH Site



It Starts With Strategic Partners

WTE Waste To Energy

Feedstock Processor
Solid Waste

GENAHOL INCORPORATED

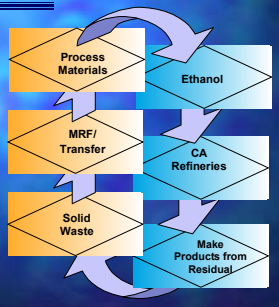
Ethanol Producer
Patented Position

Solid Waste Industry

HIGHER COSTS

The Industry Needs to Move in a Different Direction

Waste to Energy
Material Reduction Facility



Increasing the diversion rate efficiency of the California Waste Stream

From the Solid Waste Stream ....

C&D Material

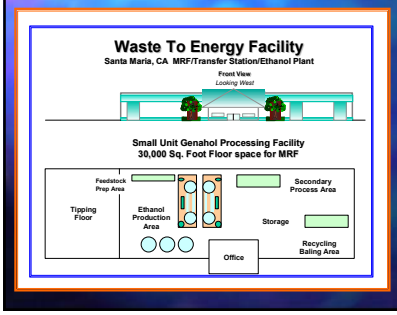
Green Waste

28% of California's Waste Stream

Mixed Paper

Ag Waste

Genahol, Inc.
Small Unit Facility



ADVANTAGES

* 25-100 tons per day
* Produces 75 gals/ton
* Plant capacity
  625,000 gal/yr
  2,500,000 gal/yr
* Profitable
* Expandable
* Logistics to Terminals

WTE Waste To Energy

Transform Waste into A Marketable Product

Genahol, Inc.'s BEI Process of converting cellulose-containing solid waste into ethanol

From the Solid Waste Stream ....

The Feedstock for Making Ethanol To CA Refineries ....

To CA Refineries ....

- Small (1 million gals./yr) plants to large (14-38 million gals./yr) located close to refinery terminals at existing & new MRF's
- Diversified source of supply - a true renewable energy source
- Eliminate expensive transportation costs

California Terminal Locations

Scattered where industrial/ population centers are located same as solid waste streams

95 Total Terminals in California

Genahol

Small Unit & Large Unit Facilities

Located at existing MRF's

Solve Logistical Problems

WTE - Shipley

California Projects

- Waste To Energy Plant - Small Unit - Santa Barbara County - 100 tons/day - this year
- 2nd Round RFI - one of three companies approved for conversion process for a Large California County waste stream - Large Facilty 750 tons/day - contract award this year
- Pre-Qualify permitting in 3 Counties

WTE - Shipley

Contact Information

Greg Shipley

INTEGRATED WASTE SYSTEMS, INC.

1599 W. Betteravia Road

POB 8990

Santa Maria, CA 93456

Toll Free: 866-471-8816

805-739-1898

805-739-9197 - fax

gregshipley@ralcco.com - email

WTE - Shipley

HFTA

A Technology Development and Licensing Firm
offering

Dilute Nitric Acid Biomass Hydrolysis

Lee M. MacLean
President

2424 Covey Way
Livermore CA, 94550

Phone: 925-292-5260
Fax: 925-292-5262
e-mail: lmmaclean@attbi.com

HFTA - Dilute Nitric Acid Hydrolysis

Patented Process for the recovery of Sugar from Lignocellulosic material utilizing Dilute (<0.2 wt.%) Nitric Acid

- Recovers – 85-90% of Sugars in Hemicellulose (First Stage)
  – 40-50% of Sugars in Cellulose (Second Stage)
  - 55-60 gallons ethanol/BDT (mixed softwood feedstock)
- High Throughput –Residence times of 5 –10 minutes in each reactor stage
- Benign Acid Neutralization –Ammonia, produces ammonium nitrate (highly soluble nutrient for fermentation)
- Clean Lignin By-product –No sulfur contamination
- Standard Materials of Construction –Stainless steels are satisfactory
- Process suitable either as a single-stage pretreatment for enzymatic hydrolysis or for two-stage total hydrolysis

Biomass Ethanol Status

California Ethanol Workshop
Developing Ethanol's Role in California's Energy, Economic & Environmental Future
Sacramento, CA
April 14, 2003

Short-term Strategy & Goal

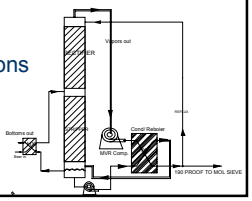
- Niche Cellulose Streams
  - Mill pulp sludges & Wastepaper fiber
  - Wood/green waste & Forest residue
- Consortium Building
  - Science & Engineering
  - Design & Construction
  - Host Partners & Fuel Distribution
- Demonstrate our Process Technology
  - 500 Gallons Per Day Bioreactor
  - Validate & Scale-up

Universal Entech, LLC

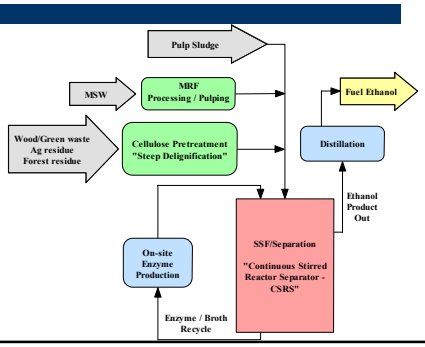
- Lead Project Developer
- Organic Resource Management Company
- Proprietary processing & recovery technology
  - Low energy cost
  - Quality / High yield
- Solids handling and processing experience
- Project development experience
- Licensed Enzymatic Hydrolysis Technology

Bio-Process Innovation, Inc.

- Leading Ethanol Technology Development firm
- Patented biochemical and processing technologies
  - Low energy cost distillation
  - Continuous process systems
- Plant Start up & Operations Experience



'Low Value Cellulose' Strategy



Integrated dry-MRF Technology

- Designed for "Fiber" Recovery
  - Patent Pending Technology
- Shortened Process Train
  - Less Capital Costs
- Less Energy & Labor
  - Improved O&M Costs
- Enables Further Recycling
  - Expandable & Customized

Converting Light Fraction Fluff

Mixed MSW

Recover 25 - 40%
Wastepaper fiber

Value-added Material Recovery

- *Ferrous*
- *Aluminum*
- *Plastics*

Pre-commercial Timeline

Design & engineering of R&D Pilot Plant	May 2003
Host site selection process	Sept 2003
Permitting & construction of Pilot	1st Qtr 2004
Operation & validation	2004 - 2005
Pre-commercial demonstration (1 – 2 mmgpy level)	2005 - 2006

500-gpd R&D Pilot Plant

Biomass Ethanol Development

Contact:
Universal Entech, LLC
5501 N. 7th Ave, PMB 233
Phoenix, Arizona 85013
(602) 268-8849
dmusgrove@earthlink.net

Case Studies on
Lignocellulosic Feedstocks
and
Technological Developments and Options
for Ethanol Production

Presented to
California Ethanol Workshop, Sacramento, California

Presented by
Fran Ferraro - Merrick & Company

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Example Lignocellulosic Feedstocks for Conversion to Ethanol

- Barky Wood Residues
- MSW - Paper Rich Trash and Green Waste
- Corn Stover

Project Evaluations

- Feed Material
- Project Location
- Project Markets
- Process Technologies
- Economic Feasibility

Feed Materials

- Cellulose Content
- Moisture Level
- Contaminants

Project Location

- State and Local Incentives
- Locations of Feed Sources
- Locations of Product Markets

Project Markets

- Ethanol or Mixed Alcohols
- Electricity
- Other

Process Technologies

- Hydrolysis and Fermentation
  - Acid and Enzymatic Hydrolysis
- Gasification and Conversion
  - Fermentative and Catalytic Conversion
- Technology Readiness

Economic Feasibility

- Capital Costs
- Operating Costs
- IRR
- Risks
- Financing

Economic Feasibility

- A biomass-to-ethanol plant can be economically attractive
  - Low cost Feedstock
  - Suitable project location
  - Appropriate project markets
  - Available process technology

Contact Info

Francis (Fran) Ferraro
Senior Technical Specialist

Merrick & Company
2450 South Peoria Street
Aurora, CO 80014-5472

Phone: (303) 751-0741
Fax: (303) 368-1299
E-mail: fran.ferraro@merrick.com
www.merrick.com

Steps to Commercialization

The Future is Uncertain

Hard Realities (George Simons)

- $35 billion State deficit
- Huge benefits associated with ethanol
- Why rain on the parade?
- MTBE phase out created demand for ethanol—high stakes, benefits need to be realized
- Hear all the time about breakthroughs, but not ensured, situation won't tolerate failures
- Perceptions:
  - MTBE=great opportunity for ethanol
  - Cellulosic ethanol cheaper than sugar/starch
  - Phase out of MTBE was not done to create market for ethanol
  - Ethanol production will be economically driven
  - Available resources do not support 3-4 billion gallons
  - Midwest relatively cheap source of ethanol
  - Cellulosic ethanol $1/gallon more expensive
- No commercially available technologies for cellulosic ethanol
- Don't expect single step breakthroughs
  - Don't take things from the bench scale directly to commercial processes
- Cellulosic based processes will take longer than anticipated, development costs much higher, how do we come up with the money?
- Need deliberate pathways to ensure success in California

Technology Options (Jim McMillan)

- NREL trying to develop high quality data for scale-up
- Need to look at biomass resource itself
- Concentrated acid processes are working (Arkenol, Masada, Russian facilities)
- Good progress being made in reducing costs of enzymes
- Thermo-biochemical least studied system, gasification costs and gas quality may be limiting
- Challenges:
  - Processing solids
  - Understanding chemistry
  - Chicken-egg on co-products (need materials for research)

History (Loyd Forrest)

- To date none of proposed projects has been commercialized
- What are deal killing issues?
  - Cost of feedstock (Economically and environmentally viable)
  - Siting of facility (logistics)
  - Technology (economically efficient?)
  - Market (long term purchase agreement as basis for financing)
  - Development team (95% of expertise needed for business deal)
- Need to provide ethanol from biomass at price less than corn ethanol
- What is longevity?
- Does technology work in practice?
- Complex job to build industrial plant with off-the-shelf technology
- Complex job to build industrial plant with new technology
- Greater risk demands greater margin
- Don't assume you can sell product at current market price
- Close to commercialization (biodiesel, cellulosic ethanol, biomass to hydrogen)
- Only technology in our short time frame (3 years) is gasification
- Biogas not Syngas (sorry Loyd--biogas is still digester gas)

Forestry Supply (Doug Wickizer)

- Reduce costs and losses from damaging fires
- Need for fuels reduction
- Options
  - Burning (not acceptable)
  - Composting
  - Energy production
- Difficulties implementing fuels reduction (air quality, structural damage risk)
- Large public benefits in finding uses for this material
- Barriers:
  - Technological
  - Institutional
- Driving Green—fleet markets for fuel
- Dispersed Generation—smaller facilities (Washington Ridge)
- Bioenergy or Ashes?
- Don't forget co-benefits that add benefits for public

Developers

- Bob Walker:
  - 30% rate of return to accommodate risk
- Michael Fatigati:
  - Success in working within existing framework (e.g. solid waste)
  - California not friendly for project development – issues (time and money will deal with those). More active role for State.
- Gene Jackson:
  - Ecalene, process can handle dirty synthesis gas.
- Don Brelsford:
  - Reverse interstage transfer. Commercial validation ready to start. See Don for a license.
- Greg Shipley:
  - Has already seen Don. Garbage in, ethanol out. Problems: trucking costs, labor costs, disposal costs, producing ethanol is solution to problems.
  - Utilize MRF infrastructure.
  - Suggestion: Single point permitting, coordinated policy.
- Laszlo Paszner:
  - Need co-product revenues. Cannot pay for feedstock on ethanol alone. Cannot make ethanol without subsidy. Need jobs.
- Lee MacLean:
  - Nitric acid is not sulfuric acid. Materials advantages, especially stainless steels.
- Daniel Musgrove:
  - Progressive scale-up is very important.

Case Studies (Fran Ferraro)

- State incentives justify small projects
- Obvious advantages where feedstocks already collected
- Lenders not necessarily familiar with products/stability of market
- No one has totally integrated pilot gasification system (might this also be said of more conventional routes?)
- Financing depends on reliability/feedstock guarantees

Theoretical California Biomass

- Solar energy = 2 MWh/m^2- year
- 1 % efficiency (agriculture)
- 16 tons/acre-year
- 100 million acres
- 160,000 MWe
- 112 billion gallons of ethanol
- Water?

Commercialization

Merriam-Webster DICTIONARY

Atlas | Reverse Dictionary | Rhyming Dictionary | Dictionary | Thesaurus | Unabridged Dictionary

Main Entry: **com·mer·cial·ize**
Pronunciation: kə-'mər-shə-ˌlīz
Function: *transitive verb*
Inflected Form(s): **-ized**; **-iz·ing**
Date: 1830
1 a : to manage on a business basis for profit **b :** to develop commerce in
2 : to exploit for profit <*commercialize* Christmas>
3 : to debase in quality for more profit
- **com·mer·cial·i·za·tion** /-ˌmər-sh(ə-)lə-'zA-shən/ *noun*

Commercialization

- Why are we here talking about "steps" to commercialization?
- There are a number of general models for commercializing technology
- Underlying sense of questioning why the technology is not already commercial

Needs/Incentives

- What needs does the industry have in commercializing the technology?
  - Continued research and development
  - Technology demonstration
  - Public/Government support
- What incentives can/should the State provide?

Needs

- Does California need ethanol?
- Does California need 1 billion gallons of ethanol?
- Does California need cellulosic ethanol?
- Does California ethanol need to come from California?
- Does California need a renewable fuels standard (RFS)?
- What policy does California need?
- What does the industry need?

Why fuel ethanol?

- Renewable, yes, with environmental and social (as fuel) advantages, but,
- Primary driving force for development is a liquid fueled transportation sector evolved from the ready availability of petroleum.
- Ethanol may be a transition fuel for the near to intermediate term, possibly longer if serving as energy storage (fuel cells).
- Sustained longer term use as a chemical intermediate.

Markets

- Replacement of MTBE gives ethanol a substantial market in California, but is it a necessary market?
  - Code does allow for oxygenates other than ethanol if no adverse impacts are demonstrated
  - non-oxygenated RFG?
- Transition to renewable fuels can also provide substantial ethanol market but other fuels also compete.
- High volumetric energy content and easy storage will remain major competitive advantages of liquid fuels.
- Ethanol will come under increasing competition from other fuels and propulsion technologies, including Hydrogen and Electricity, both capable of being produced from renewable resources.
- Continuing pressure to reduce production costs for the fuels market.

Why ethanol from cellulosics?

- Large resource with potentially improved economics and energy balance
  - 1 billion gallons from approximately 15 million tons of biomass, equivalent to estimated currently available annually in state from total of 65 million tons.
- Requires a more aggressive approach than for sugar and starch
- Elegant fundamental research
- Processes seemingly still in proof-of-concept stage
- Where is the technology?

Where is the technology?

"The conversion of cellulose to ethanol is not, at this point, rocket science."

David Morris, Institute for Local Self-Reliance

"...the world's most commercially advanced enzymatic process for making ethanol from biomass (bioethanol)."

Iogen Corporation Corporate Info
http://www.iogen.ca/2100.html

"Both units of the facility, the material recycling facility and the ethanol production plant, employ "proven" technologies with existing commercial operations. In fact, about 400 Material Recycling Facilities (MRF's) are currently operating in the United States, and more than 1.5 billion gallons of ethanol was produced in 1996."

Masada FAQ
http://www.ci.middletown.ny.us/cityhall/dpw/pmfaq.htm

Energy Grails?

- Tar-free gasifier
- Low-cost PV
- Effective hydrogen storage (is ethanol it?)
- Safe disposal/transformation of nuclear waste
- Fusion
- Sustainable carbon sequestration
- Paperless office
- US adoption of SI units and an end to the MMBtu
- Exergy (2nd Law) based energy policies
- Cellulosic ethanol?

What incentives from the State?

- What responsibility does the State have for developing and demonstrating technology?
- Should the State encourage/dictate fuel/energy types and strategies or simply set the standards for protecting human health and welfare and the environment, leaving the industry to develop within that context?

Needs Driven Approach

- Identify needs and seek solutions.
- Weighted on potential industry capability to address perceived needs of State while simultaneously satisfying shorter term needs of industry for development funding.
- May become resource, process, or technology driven rather than result focused
  - e.g., Renewable Portfolio Standard
    Renewable Fuels Standard
    AB 939/AB 2770 definitions affecting conversion options
    Commodity specific credits/taxes

Incentives Driven Approach

- Provide incentives consistent with social value to (needs of) the State.
- Economic incentives for actual benefits generated.
- State has no particular role in technology.
- Industry proves technology for the purposes of obtaining financing and access to markets.
- Economic incentives intended for a sufficient period to justify commercial investment.
- Appropriate incentive mechanisms based on results
  - e.g., production/producer credits based on perceived environmental/social benefits.
- Economic subsidies should inherently decrease as industry need declines
  - e.g. production/producer credits paid from carbon taxes if environmental issues predominate.

Remaining Steps to Achieving Commercial Biomass-to-Ethanol Process Technology

- Deliver on the promise
- Demonstrate the technology
  - Technical
  - Economic
  - Financial
  - Social
  - Environmental

Steps to Commercialization

- What is State policy?
- What are industry needs?
- Determine role, if any, of government in supporting development.
  - Support fundamental research.
  - Motivate through regulation/incentives aimed at public/industry goals.
  - Can provide markets as appropriate to meet State goals (e.g. fleet fueling provisions).
- Education and Training to meet current and future personnel demands.
- For public support and financing, credible and independently verifiable information is critical.
  - demonstration to confirm technology and develop credible cost estimates for scale-up.

Remaining Steps to Achieving Commercial Biomass-to-Ethanol Process Technology

- Clear policies and well-informed legislation
- Well-defined needs
- Public education
- Collaborative infrastructure development planning
- Continued government and industry support of basic research
- Successful industry demonstration of integrated technology backed up by commercial financing
- Equitable production incentives to meet public objectives

Motivation?

- Remain optimistic, there is hope.
- Cooperative efforts are key.
- Research is unpredictable, serendipity happens (or not).
- Avoid adversarial models, maintain flexibility in approach, keep focus on important elements, freely disclose and learn from failures, there is success in learning.
- If something better comes along, that's good.

You get what you pay for?

One who knows, does not speak.

One who speaks, does not know.

…the Lao Tsu (Tao Te Ching)…

Or perhaps this translation?

One who knows, does not brag.

One who brags, does not know.

…the Laozi (Daodejing)…

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