

Agricultural Residues Pathway Session Summary Meeting Minutes for Day 1

Day 1 – August 1st, 2006

Participants:

Georg Anderl	Fred Gerdeman	Raphael Katzen	Valerie Reed
Glen Austin	Ralph Groschen	Kevin Kenney	Gerson Santos Leon
Marco Baez	Kevin Gray	Fumiak Kobayashi	Rajat Sen
Jacqueline Boras	Michael Himmel	Gregory Luli	Lyle Stephens
Joseph Bozell	Maurice Hladick	Liz Marshall	Carol Werner
Amy Ehlers	Larry Holy	Jonathan Mielenz	Wallace Wilhelm
Richard Elander	Kevin Hurst	Amy Miranda	Doreen Willams
Mark Emptage	John Jechura	Thomas Nelson	Charles Wyman
Gene Fynboh	Jason Jerke	Leslie Pezzullo	

Purpose of the Meeting: Gain key industry stakeholder input into developing a strategic plan that supports the President's Advanced Energy Initiative goals related to biomass.

Purpose of Day 1 Breakout Session: Assist in identifying the research and policy requirements between 2007 and 2012 for achieving cost competitive biofuels.”

Session Deliverables:

- Priority direction for the pathway
- Reasonable plan of action to how we will reach success
- Realistic timeline for achieving success

One major outcome will be the development of an R&D plan and future budget requests around the activities and barriers discussed at this workshop. In order to develop these documents, OBP needs the following input from industry:

- Identify risk reduction needs;
- Determine the probability of the Agricultural Residues pathway achieving the 2012 goal;
- Determine the amount of resources needed to achieve the goal;
- Identify major interim targets;

Question: Do biofuels derived from agricultural residues need to be cost competitive with gasoline or starch based Ethanol to see market penetration?

Methodology: The moderator posed the question to the participants and asked for a show of hands as to which current product biofuels derived from agricultural residues will need to be cost competitive with for market entry (e.g., gasoline or starch ethanol). After an initial vote the floor was open for discussion and after a short period of discussion a revote was called.

The result of first vote was 19-11 for gasoline and starch ethanol respectively, the revote was for gasoline, ethanol and both or neither was 12-16-2.

Key Points:

- Policies can drive the cellulosic ethanol industries entrance into the transportation fuels market, but the industry has to be able to compete long term, ultimately for sustainability cellulosic ethanol must be competitive with gasoline.
- Cost and price goals are important, but the industry will achieve the goals and be cost-competitive, whether the competitor is gasoline or starch based ethanol. Drivers are the key for industry acceptance.
- The net price of the biofuel that has ethanol as a component (whether it be as an oxygenate or E85) must be equal to gasoline.
- The initial facilities that are built will be based on current technology, with little to no room for R&D advancements over the next few years. The second generation plants being built in the 2012-2015 timeframe will likely be planned around any major processing improvements.

Resulting Discussion:

- John Jechura: Cost-competitive depends on the timeframe you are referring to, I believe that for market penetration cellulosic ethanol needs to be cost similar with starch ethanol, but ultimately both need to be competitive with gasoline.
- Kevin Gray: Starch ethanol is growing but the production volume is capped at ~ 12-15 B gallons and at that point cellulosic ethanol will need to be competitive with gasoline.
- Valerie Reed: Can cellulosic ethanol break into the market before the cap on starch ethanol is reached?
- Kevin Gray: If it's cost competitive with the future selling price for ethanol.
- Unknown: But isn't the selling price of ethanol driven by barrel of oil?
- Ralph Katzen: The cost is largely dependant on feedstock costs and the logistical issues that drive those costs up (i.e., transportation costs, seasonal crops). Corn as a feedstock has an advantage in that it can be shipped anywhere, whereas the real problem is how to transport the feedstock.
- Charles Wyman: Cost competitive is elusive, what cost are we basing the comparison on, operating cost or capital cost? Cellulosic ethanol has cheaper operating costs, but high capital costs; whereas, starch ethanol is fairly low risk.
 - Cost competitiveness is harder for cellulosic in the short term.
- Gene Fynboh: If the only driver was society, ethanol probably couldn't compete, but one doesn't have to follow other. Policies can and will act as a market pull.
- Lyle Stephen: Ultimately you have to look at how external policies will affect the cost paid at the pump. Policies geared towards limiting the import of oil would affect the cost of both gasoline and ethanol at the pump. (e.g., a tax on oil imports)
 - In a direct BTU/dollar comparison ethanol is not competitive with gasoline, but policies that "dislike" gasoline (i.e. an additional tax on gasoline or on oil imports) have the potential to balance the comparison, helping to promote the use of ethanol.

- Raphael Katzen: A portion of the funding that is being spent on protecting the oil supply should be redirected to weaning the nation from oil and developing renewable fuels.
- Gerson Santos-Leon: Industry drivers, i.e., carbon savings and energy security, will drive the growth of the ethanol industry NOT the price and cost of ethanol.
 - If/when there is a demand for the fuel, the industry will focus on delivering it in a cost-competitive fashion on a long-term basis.
 - This all comes down to policy – the policies implemented will enhance the growth of industry.
- Glen Austin: Other factors may influence the emergence of ethanol in the market, but ultimately the existing market is driving the industry and that market is currently oil based.
 - Consumers won't act until the conflict is right in their face, prices are rising, but there is little reaction as of yet.
 - The establishment of a market will need to be policy driven (i.e., premiums).
- Glen Austin: suggested that there should be a category for “not competitive with anything”, meaning that external drivers would create a market pull; therefore, it would not be necessary to initially produce cost-competitive ethanol.
- Ralph Groschen: We have to discuss net cost. Ethanol needs to compete with gasoline, regardless of the feed.
- John Jechura: We need to be careful to distinguish the difference between industrial production cost and end consumer ~~prices~~ ~~costs~~.
 - Wally Wilhelm: Currently the price comparison is on cost per gallon, but we need to work towards shifting towards cost per mile driven. To do so, consumer education and understanding of engine efficiency need to be addressed.
- Charles Wyman: the industry needs to be cost competitive to get financiers to invest, but the drivers will improve the competitiveness. If government will help in investment of plants – reduce cap cost, then dynamic will change.
 - Someone has to be given incentive – given that scenario cost-competitive will depend on short/long competitiveness
- Valerie Reed: Should ethanol ~~being~~ ~~targeting~~ the oxygenate market or gasoline market (i.e., blend vs. fuel), where an initial blend requirement could be a nationwide mandated blend of 10% in all gallons?
 - Gene Fynboh: We are producing energy not withstanding what fuel you are talking about. The cost of starch ethanol is a function of the cost of corn and at the current price and production level it's the competition, but soon it will start to drive corn prices up.
 - Co-products could benefit the economics.
 - Joe Bozell: The real question is how to get ethanol in the fleet. We have to get the consumer to pick up the handle and consumers will be put off if the price at the pump is 6 – 15 cents higher than the alternative.
 - Drivers will have to enable the consumer to purchase ethanol, but it won't happen until the consumer cost is reduced.

- John Jechura: Consumers are not always driven by lower costs, if there is an additional value based on what they are going to buy there is precedence (bottled water), but fuel is tough.
- Maurice Hladick: the first two or three plants will not be competitive with starch based ethanol. Public sector shares risk on first two plants with the objective of reducing the production cost to match starch ethanol. Focus on \$1./gallon ethanol
- Kevin Kenny: To get cellulosic ethanol into the market, it seems based on the discussion that the production cost will need to be competitive with starch ethanol in the near term, then we have to be competitive with and then ultimately gasoline.
 - Georg Anderl: If the price of oil drops, ethanol wouldn't be competitive, so you must be (with or without policy) competitive in the market place at a cost for oil.
- Gerson Santos-Leon: Basically the initial facility constructions will be based on current technology and what the industry is doing now, and will likely not be competitive with anything. Differentiation – technology or in ground; planning to be competitive in long-term, not in the short term
 - With the help of incentives, the net wholesale cost of cellulosic ethanol needs to be similar to cost of starch ethanol.
- Ralph Groschen: The \$1.07 cost target is unrealistic and will not help offset the investment, the cost will be based on whatever the market says ethanol is worth or whatever cost the terminal refinery will buy it.

Question: How do you define cost competitive?

Methodology: Each participant was asked to write his/her answer on an index card. All of the answers were stated aloud, posted, and recorded. There was little further discussion. The group was not asked to come to consensus on these questions.

Key Points:

- Competitive by 2012 can mean many things, but for this group there were two major categories of thought; cellulosic ethanol must be produced at a cost competitive with the future value of starch ethanol (some participants stated that this would be at the pilot scale), OR 2012 price of gasoline with crude at \$45/barrel of oil* (some participants felt that the Btu equivalence needs to be taken into account).
 - * - \$45/bbl is the current EIA projection for crude in 2012.
- The group should use 2006 dollars.
- Parameters
 - Production cost level
 - EBITA or EBIT (earning before interest tax with depreciation and amortization)
 - Pilot – cost-competitive scale should be at pilot scale

Resulting Discussion:

- Maurice Hladick: Iogen will have a facility in operation by 2009 and by 2012 they hope to have 3 facilities and at that time hope to be competitive with gasoline from \$30-35/barrel of crude.
- Gene Fynboh: If you set on feasibility high for the 1st facility, you may be disappointed; the cellulosic ethanol industry will have to mature as the starch ethanol industry while facilities are up and running (learning curve).
 - Charles Wyman: Some of the advance R&D can be done in the labs and academia to be implemented in 2nd or 3rd generation cellulosic ethanol facilities, but the 1st generation plant will be build using the technology available today (with the aid of policy or company innovation).
- Kevin Kenny: This is all feedstock based, if you project forward in R&D needed, you have to have some basis for the feedstock, etc.
- Gerson Santos-Leon: Is this going to be applied feedstock specific --- maybe fiber and residues are extremely alike.
- Valerie Reed: When can those particular feeds hit a cost that gets us into the market?
 - Can that be sustainable across the country, so you can look at multiple feeds in a single facility?
- Gerson Santos-Leon: When you look at feedstock right now; we are looking at cost of over \$50 at plan gate, \$30 is out of the question.

Question: What is the cost at which biofuels derived from agricultural residues must be produced to be cost competitive with gasoline or starch based ethanol? Your answer can be a dollar amount per gallon or a percentage of gasoline production costs.

Methodology: Each participant was asked to write his/her answer on an index card. All of the answers were stated aloud, posted, and recorded. There was little further discussion. The group was not asked to come to consensus on these questions.

Results:

Dollar/gallon

- 1.10 – 1.25
- 1.25 – 1.50
- 1.51 – 1.76
- 1.50/gallon (timeline – 2012)
- 1.00/gallon with \$0.52 tax incentive
- 1.50 – 2.00
- \$1.75/gal

- Cost from agricultural residue by 2012 \$2.00/gallon including fixed charges and feedstock delivered at \$50/dryton. Competitive with gasoline (not starch-based ethanol).
- \$ 1.35-1.60/gallon @ 2012 vs. Starch.
- \$ 1.50/gallon.
- Competitive with starch on cash cost basis.

Competitive with starch ethanol

- At a cost that blenders will use it interchangeably with starch based ethanol.
 - Cost equivalent to cost of starch ethanol including capital charge (annualized) for both.
 - The net cost of biomass ethanol should be equivalent to the net cost of starch ethanol to compete.
 - By 2012 the current production costs are not material. Policy alone will drive the activity. However, the projection must be for agricultural residue ethanol to compete with all other ethanol in the market-place at the time your plant comes on line or into full production.
 - 120% of the cost of starch ethanol.
 - Equal to the cost of starch ethanol
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- It needs to be price competitive on a pilot scale with starch ethanol.
 - 100% cost of starch ethanol at pilot scale.

Competitive with Gasoline

- Equivalent on BTU basis to crude @ \$ 45.00/bbl.
 - Equivalent to the energy content of \$ 45.00/bbl crude. **The ethanol must be cost competitive on a BTU basis for the gasoline that is produced from \$45/bbl crude oil (Clarification from John Jechura).**
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- Must be competitive with 2012 crude (\$45/bbl) taking into account return on capital.
 - Final consumer price should be cost competitive to 100% gasoline base.
 - Cost of ethanol production = Cost of gasoline production @ \$45/bbl (needs policy to establish floor).
 - Basis
 - Semi-works level (24/7 demonstrate technology robustness and economics. Have full design to deploy.)
 - Ind. Depreciation.
 - 15% cost of capital.

Cost Target

- Comparable to \$45-50 barrel oil. Policy in existence will allow “costs” to be more and still be cost competitive – also, value of co-products can help “cost” equation.
 - They must be produced at whatever cost makes it ~~cost makes it~~ competitive (at a commercial scale, and with any government subsidies (blended credit, etc.) taken into account) with EIA’s projected cost of oil. If blender’s credit expires or is reduced in 2010, that cost will have to be lower.
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- Tied to crude at \$45 per barrel
 - 52 cents tax remains
 - Somewhat equal to \$1.00 per gallon
 - By 2012 must move quickly with commercialization
 - Two components

- Cellulosic ethanol needs to be cost competitive with starch ethanol in order to attract Investors/Bankers to build the plant.
- Cellulosic ethanol needs to be competitive with gasoline on the market for consumers to buy depending on whether we are talking about E85 or E10.
 - Overall production cost needs to be \$1.51/gal

Additional comments after Workshop concluded

- Ralph Groschen: From a policy point of view, assuming a goal of commercializing cellulose to ethanol production, it may be counter productive to establish \$1.07 per gallon or any threshold price to guide development of the industry. First of all, prices of crude oil and gasoline have been and continue to be extremely volatile. As soon as a document is published with a hard and fast threshold price, it will be obsolete as soon as the market shifts up or down. Secondly, the first time a successful new plant design is built the cost of that plant is likely to be much higher than for subsequent plants that can benefit from lessons learned and the track record that proves the model can work. Assuming that there are many people waiting to invest in the second successful cellulose to ethanol plant, we should recognize that the most difficult successful plant to build is the first. If the most promising plant design proposal is based on a cost of production of \$1.17 it might be discounted or shunned by investors because the DOE has established a \$1.07 per gallon threshold.

Question: What are the biofuels that offer the greatest potential for being produced cost competitively from Agricultural Residues?

Methodology: Each participant was asked to state the fuel he or she believed offered the greatest potential for being produced cost competitively. The answers were posted, summarized and recorded. There was little further discussion. The group was not asked to come to consensus on these questions.

Results:

- Ethanol – 28
- Biodiesel – 2
- Syngas to Methanol – 1
- Butanol – 1
- Mixed Alcohols – 2

Question: What are the agricultural residues and routes for producing that biofuel cost competitively and what in what timeframe can these biofuels be produced cost competitively?

Methodology: The participants were divided into four 5-6 member groups. Each group was given a poster-sized pathway diagram and was asked to review the stages of the pathway (i.e. feedstock production, conversion processes, outputs, etc.) and to identify the agricultural residues and routes for producing that biofuel cost competitively.

A representative of each group presented their group’s results to the entire breakout session. The group reviewed all of the results and agreed upon a route through the pathway which became the focus for the remainder of the day 1. The general route was presented in the day 1 report-out session.

Group Assignments and Results:

Blue Group

Participants:

Ralph Groschen

Maurice Hladick

Lyle Stephens

Raphael Katzen

Mike Himmel

Valerie Reed

Chosen Route:

- Two feedstock categories:
 - 2D feedstocks (wheat straw/hulls – slightly easier preprocessing)
 - 3D residues (stover, etc)
- Followed the outlined pathway stages

	Harvesting	Storage	Transport	Pre-processing	Pre-treatment	Conversion (Bio & Thermo)	Products
2D feedstocks	Wet & dry concerns	Wet & dry concerns	Weight and density		Near-term: thermo processing Long-term: thermo/bio	SSCF (separate 5 & 6 carbon sugars OR gasification with thermo-bio route to ethanol)	<ul style="list-style-type: none"> • Ethanol • Value-Added Products • Heat & Power
3D residues	Feedstock cleanliness (wet & dry concerns)	Wet storage		Recalcitrant material			

Question: What was the driver for the statement “co-products are essential”?

Answer: Economics

Question: Will this be realistic in the 2012 timeframe, or would it be seen as another risk?

Answer: Yes, heat and power specifically could be potential near-term co-products, and adding additional co-products could increase the facility’s long-term sustainability.

Comment: The caveats used were based on following the biochemical route; but some of them are moot if you utilize thermochemical processing.

Red Group

Participants:

Georg Ander

Glen Austin

Kevin Hurst

Joe Bozell

Mark Emptage

Rick Elander

Amy Miranda

Chosen Route:

- Feedstocks will differ based on regionality
 - Corn stover: is the most abundant feed, but has many wet/dry issues including storage, transport, etc
 - Corn fiber: would be Secondary – corn fiber from (wet/dry mills)
 - Wheat straw possible – rice straw volume too small
- Ethanol & power should be the 1st priority
 - Co-products should be the 2nd priority
 - NOTE: this group believed that there would be no co-products in the near-term facilities (2012) and that the waste/residue streams would go to power.
- The pathway diagram is accurate for the 2030 timeframe
 - Feedstock flexibility will be key in the long-term (non-dedicated feed facilities)

Yellow Group

Participants:

Marco Baez

Jason Jerke

Fred Gerdeman

Greg Luli

John Jechura

Gene Fynboh

Chosen Route:

- Feedstocks
 - For a 100 MM ~~mm~~ gal/year facility, we need a high yield/acre feedstock = corn stover
 - Removing 100 MM ~~mm~~ gal/year caveat brings the following feedstocks into the picture: bagasse, wheat straw, fiber from wet/dry
- Timeline
 - Near-Term Opportunity: corn fiber and bagasse
 - Mid-Term Opportunity: wheat straw
 - Long-Term Opportunity: corn stover
- The facility path to producing ethanol could/would dictate the conversion technology utilized
 - Add-on process(es) may follow the thermochemical conversion route through gasification.
 - Greenfield facilities will most likely follow the biochemical conversion route, utilizing combustion of lignin and other wastes to satisfy heat and power requirements.

Green Group

Participants:

Larry J. Holy

Gerson Santos-Lean

Leslie Pezzullo

Carol Werner

Charles Wyman

Doreen Williams

Wally Wilhelm

Kevin Kenney

Chosen Route:

For 1st plant consideration:

- Regional niche market Agricultural Residues (focused on wheat straw)

- Inter-Mountain Market: Wheat straw
- Deep South: Bagasse
- Midwest: Corn stover (Dry)
- Routes: Biochemical w/ lignin to heat and power in the near-term
 - Long-term: co-location or incorporation of alternative renewables as power source/feed
- Fuel: Ethanol
- Timeframe: 2009 with production 2010.

Group Discussion:

- Key Similarities:
 - Biochemical processing route through pretreatment, enzymatic hydrolysis and fermentation; with gasification to power
 - Feedstocks will be regional, with the first plants utilizing niche opportunities (i.e., bagasse, wheat straw); with the long-term sustainable feedstock being corn stover.
 - Technology barriers are more long term. In order to get to plants in the 2012 timeframe you need to use current technologies (with the exceptions of enzymes, feedstocks, storage, transportation).
- Gasification of lignin could potential produce additional ethanol, but not necessarily practical in the 2012 timeframe.
 - Kevin Gray: Bagasse and rice straw have high silicone content, which would hamper conversion.
 - John Jechura: Flexible feedstock facilities are more difficult to consider, especially on the commercial scale.
- Gerson Santos Leon: Processing choices will have to be site specific, but “our” concept is co-location and hybrid facilities with gasification to power, looking at the long-term possibility of producing additional ethanol. Gasification of both lignin waste residues and/or redirection of a portion of the biomass.
 - Charles Wyman/Wally Wilhelm: Direct gasification of biomass to syngas to ethanol would be logical if you want to maximize the ethanol production, you realistically the industry will want to balance the economics.
- Valerie Reed: Looking at 5 year timeframe: continuum of putting new technologies in the grounds; what are the barriers that we should be overcoming to be implemented in 2010 or 2012 to be operating in 2012 or 2014, etc; so the next facilities and their next facilities will be better.
- Larry Holy: The industry needs to try to remove the timeline barriers to entry; removing constraints of the feedstocks: wheat straw; bagasse; fiber and then learn on fly from there for corn stover, etc.

Question: What are the major barriers that need to be overcome in each phase of the route(s) identified?

Methodology: The smaller groups were reconvened and asked to their answers on index cards. Each response was read aloud, and posted on the wall under the appropriate stage of the priority

pathway. After all responses were posted and discussed, each participant was given 6 dots, and asked to place one dot on each barrier they identified as a priority (multiple dots could not be placed on one barrier by the same person). Priority barriers for each stage were presented in the day 1 report-out session.

See “Pathway Barriers” tab on the attached spreadsheet for index card responses, organized by priority votes.

Day 2 – August 2nd, 2006

Participants:

Georg Anderl	Fred Gerdeman	Kevin Kenney	Gerson Santos Leon
Glen Austin	Ralph Groschen	Fumiak Kobayashi	Rajat Sen
Marco Baez	Kevin Gray	Gregory Luli	Lyle Stephens
Jacqueline Boras	Michael Himmel	Liz Marshall	Carol Werner
Joseph Bozell	Maurice Hladick	Jonathan Mielenz	Wallace Wilhelm
Amy Ehlers	Larry Holy	Amy Miranda	Doreen Willams
Richard Elander	John Jechura	Thomas Nelson	Charles Wyman
Mark Emptage	Jason Jerke	Leslie Pezzullo	
Gene Fynboh	Raphael Katzen	Valerie Reed	

Opening Discussion: The group reviewed the progress made on day 1 and further discussed the concept of cost-competitiveness and the priority route through the agricultural residues pathway.

Methodology: The DOE co-chair reviewed the biochemical route through the agricultural residue pathway with the group. The group's discussion was recorded below.

Key Points:

- This group believed feedstock logistics are essential to reducing the production cost of cellulosic ethanol.
- DOE needs to carefully consider their definition of cost competitiveness. When DOE states that cellulosic ethanol will not be ready or cost competitive until 2012, investors and financiers are get wary of involvement with the current industry.

Resulting Discussion:

Pathways:

- General Comment: We open the discussion with description of chosen route through Ag residue pathway.
 - Wally Wilhelm: Is there any kind of point of no return? At some point can't we look at the pathway chosen and correct mistakes?
 - Valery Reed: We can make changes as necessary.
 - Gerson Santos Leon: We have neglected to discuss the alternative pathways with thermo processes.
 - Gerson Santos Leon: Through alternative pathways we may be able to mitigate risk.
- General Comment: We should be able to look at alternative pathway to help meet our goal (i.e., biomass gasification).
 - Carbohydrates ----to---- Ethanol
 - Lignin ----to---- Power and Diesel
 - General Comment: We need to continue to pursue R&D in all areas because they could all, conceivably, be in the first facility.

- Valery Reed: Do we envision the 2012 demo plant to be route specific or look at both options equally?
- Charles Wyman: In the 2012 timeframe there will most likely be few R&D advancements that can be put into the first generations of cellulosic ethanol facilities.
- Georg Anderl: In the 2012 facility we will be using traditional boilers for power, utilizing combustion not gasification.
- Ralph Groschen: Fluidized boilers are a possibility.
- Gerson Santos Leon: In the pathway:
 - 2010-2012, demo with existing technologies.
 - 2012-2015, technology with current R&D.
 - 2015-2020, third generation facility will include advanced technology.
 - 2020-2030, long term, with highest return of interest.
- Valerie Reed: Focus our group on what we can build in 2012 for 2015

Collecting and Harvesting:

- General Comment: Logistics is a significant issue being ignored but serious to technology deployment.
- Gerson Santos Leon: Feedstock cost is almost a moot point and currently \$50/dry ton.
 - With additional processing cost at the processing-throat.
- Kevin Kenney: To demo the 2012 technology we only need 10% of the available feedstock at \$10 payment for the farmer.
 - There is room after 2012 for feedstock R&D because issues are long term.
- Wally Wilhelm: (This is an additional comment provided after workshop concluded) The production and harvest systems must not increase erosion or reduce soil carbon.

Production:

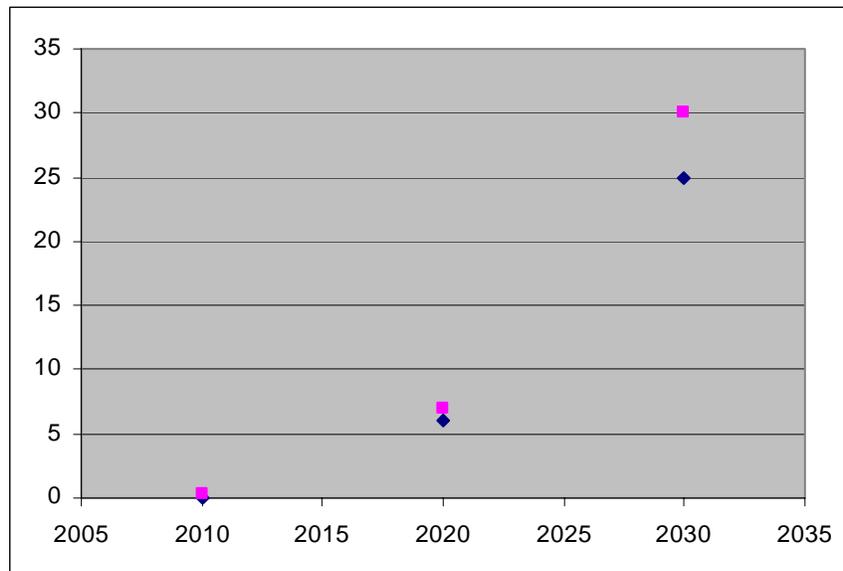
- Gregory Luli: DOE needs to carefully consider their definition of cost competitiveness. When DOE states that cellulosic ethanol will not be ready or cost competitive until 2012, investors and financiers are get wary of involvement with the current industry.
- Gregory Luli/Gerson Santos Leon: Current niche opportunities are attempting to inspire the growth of the cellulosic ethanol industry.
 - Larry Holy: How do we get to industry to build, therefore jumpstarting the industry to grow to 60 billion gallons?
- Valerie Reed: Niche opportunities are trying to get funding and are cost competitive, but lack long term viability.
- Larry Holy: What is DOE's starting point for funding? Is it the 932 solicitation?
 - Valerie Reed: No, it is beyond that. 932 is a continuation of the current R&D and the selected projects will get us to the 2012 goal and beyond.
- Gregory Luli: Why couldn't the goal be to have 10 facilities operating by 2012 (with a volume sub goal of 250 million gallons)?
- Charles Wyman: Cost competitive is dangerous terminology for the existing industry to get funding for the first plants (the niche opportunities).
- Valerie Reed: Should DOE request and gear funds towards the RFS? At what expense to R&D?

- Gerson Santos Leon: The first opportunities will be policy driven and DOE is encouraging that with the following three options:
 1. 932 solicitation
 2. Loan guarantees
 3. Subsidy for 1 billion gallons of cellulosic ethanol
 - These three will get us to the 250 million gallon by 2012.
 - In the interim the following process improvements can be made to benefit the facilities:
 1. Feed logistics
 2. Enzymes
 3. Fermentative organisms (yeast)
 - Three to five years to develop these technologies and have them in the ground by 2012.
 - Then you have to work on additional barriers and R&D for long term needs.

Question: What is your estimate of the contribution that this pathway could make in meeting the 30% goal? (What volume of biofuels can be produced from Agricultural Residues by 2030?)

Methodology: The group was polled to determine what the potential production of the cellulosic ethanol industry in 2010, 2020 and 2030.

Results:



Question (Continued from Day 1): What are the major barriers that need to be overcome in each phase of the route(s) identified to reach the 2030 goal?

Methodology: The smaller groups were reconvened and asked to their answers on index cards. Each response was read aloud, and posted on the wall under the appropriate stage of the priority pathway. Priority barriers for each stage were presented in the day 2 report-out session.

Results:

See “Pathway Barriers” tab on the attached spreadsheet for index card responses.

Discussion:

- Currently there is not an established biomass market, which is a potential issue for deployment.
 - The biomass market, or lack thereof, affects the machinery and equipment manufacturers, etc)
 - A market needs to be establishing for new biobased products.
- Charles Wyman: wild card is what is going to happen with oil – assume EIA \$45/barrel of oil
- Lyle Stephens: Many of the long term barriers and R&D needs need to be addressed now, in order to have enough people participating and the necessary feedstock availability to support the 2030 goal.
 - Jason Jerke – dependent on location – improved agricultural res rate
- Kevin Kenney: Improved agricultural residue yields and higher residue removed rates -
 - You need to achieve high yield of residues (without higher ethanol yields you can't get to the goal.)
 - This is necessary to reach the 2030 goal, but you need to start it now
- Richard Elander: There is the need to integrate processing steps.
 - The work starts earlier – this is a barrier not only for cost, but for volumetric long term.
- Gerson Santos Leon: Early deployment of energy crops – to achieve the high targets, we need to focus on the early deployment of energy crops to compliment the agricultural res production.
 - deployment- 2010
- Gerson Santos Leon: Enzymes in plants- 2030
- Gregory Luli: Water processing needs.
 - Need to be concerned about by 2020 for 2030
- Liz Marshal: Breeding for increased residue yield and lowing input requirements
 - Now for 2030
- Georg Anderl: Increase Residue Supply so you have the large biomass residues
 - High densities will be more responsible
- Carol Werner: Improve the efficiency of the first generation facilities
 - Begin looking at this in 2010
- Kevin Gray: Address potential facility construction limits
- Gerson Santos Leon: Increase the size of the facilities for better economy of scales (primarily feedstocks) look at 2020.
 - Other: cost of steel and concrete
- Joseph Bozell: Incorporation of products/ integrated biorefinery (2015)
- Joseph Bozell: Gasification- Optimize ethanol and co-products development from biomass gasification.

- Land and water use and allocation (people, crops, manufacturing, recreation and nature) – look at now for 2030
 - Central to BTS and how the cellulosic ethanol industry would impact land use
 - Jason Jerke: Farming culture economics – we need (slow changing culture) PR campaign needs to start now.
 - Lyle Stephens: Development of infrastructure and improve storage and transport technology, increasing the feedstock collection area (2012-2015)
 - Marco Baez: Biological pretreatment – efficiencies and rational design in saccharification (2015-2030)
 - Charles Wyman: Increase yields between the two from pretreatment and enzymatic hydrolysis (2012-2015)
 - Larry Holly: The demographics of farmer demographics – who is going to be there to start at the farm gate ---- revitalization of the farms (based on costs)
 - Gene Fynboh: you have to share the value of the feedstocks if you are going to get them. If it's profitable the farmers will be there.
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Question: What policies would you recommend to help achieve the goals of the biofuels initiative with Agricultural Residues?

Methodology: Each participant was asked to write his/her answer on an index card. All of the comments were stated aloud, posted, and recorded. There was little further discussion. The group was not asked to come to consensus on these questions.

Results:

Risk Mitigation

- Michael Himmel: Education on the real and perceived issues pertaining to genetically modified organisms.
- Wallace Wilhelm: Risk mitigation for the 1st facilities
 - Charles Wyman: 50/50 cost share for capital costs in the first 5 facilities
 - Gene Fynboh: Producer payments – it built (10 cents a gallon for first x gallons, over a set period) – alternative to 50/50 capital share

Carbon Tax

- Ralph Groschen: Carbon/gas tax with the revenue going to spur R&D of biofuels
 - Mark Emptage: Cellulosic specific subsidies
 - John Jechura – We need to make sure that we aren't pitting cellulosic ethanol against starch ethanol.
 - Carol Werner – could be Cellulosic new which the starch ethanol industry is mature. The new industry realistically needs more help than the existing industry
- Kevin Gray: Carbon credits – benefit of the biofuels
- Fumiak Kobayashi: Policy that activates the competition within industries; accelerate development and/or diversity

Encourage Market

- Kevin Gray: increasing the RFS (provides a market pull) – for blending, etc
 - Jason Jerke – issue stands with volatility at 20% and forces engineering of vehicle systems, etc.
- Gerson Santos Leon: E85 is great, but we should be considering 20-30 % vehicles
 - Incremental mandates on a function of 10%
 - EPA certify 20% ethanol
- Gregory Luli: Incentives for consumers (create market pull)

Broaden 932 and Loan Guarantees

- Gregory Luli: Broaden 932 (acceptance criteria)
 - Should not necessary be the processing; they do have to be able put in the capital
- Carol Werner: expanded (size and time) RFS

Ag Policies

- Liz Marshal: Incentives for processes with the lowest environmental impacts. (no till or new tillage practices, etc)
- Kevin Kenney: These agricultural policies need to be consistent with residue demand/use. --- (CRP)
- Jason Jerke: Need to continue to support both the 10-15 billion gallons from corn and future cellulosic ethanol production.
- Carol Werner: Incentive payments to growers who are incorporating sustainability practices
- Carol Werner: Continuity of policy, constant changes destroy the industries ability for long-term planning
- Carol Werner: Incentivize local equity; just don't replace big oil with big corn
- Amy Ehlers: Incentivize regional feedstocks/pretreatments; wide variety of competition

Sliding Tax Credit

- Gene Fynboh: Sliding scale on vehicle tax credit (if you are at 45-50/barrel, as the price goes up need less of a credit) that fades away to as you increase your production and near the volumetric goal
 - Valerie Reed: Change the meaning of the sliding tax credit to cover the externalities – used to incentivize the industry

Set Oil Floor at \$45/barrel

- Georg Anderl: Set oil floor at \$45/barrel (tax the imports, catch it before it gets to the oil companies) – concept: industry would be guaranteed that if oil went under a certain point the consumer wouldn't be held for the increases.

Increased Funding

- Joseph Bozell: Stable and reliable funding for the identified R&D
- Joseph Bozell: Stronger inter department relations – cooperation
- Lyle Stephens: Legislation and appropriation to stimulate industry (no earmarks)
- Glen Austin: Training (centers of excellence???)

Vehicles

- Jonathan Mielenz: federal tax credit for renewable/hybrid vehicles (including plug-ins) -- incentives market
 - Georg Anderl: if the engines are designed correct, fuel Btu neutral engines
 - Optimize engines for use
 - Larry Holly: Arizona would be a perfect state study on what not to do.
 - Jason Jerke: along with FFV, the E85 infrastructure needs to be enhanced (or just developed)
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Question: What is the federal role in overcoming the barriers and meeting the goals of the biofuels initiative?

Methodology: There was open discussion on what role the federal government was in enable the cellulosic ethanol industry to meet the biofuels initiative targets. The individual comments were recorded, but the group was not asked to come to consensus on this question.

Discussion Results:

- Carol Werner: The provisions in EPAct05 need to implemented and funded.
 - Carol Werner: The federal procurement process needs to utilize biofuels and bioproducts.
 - Carol Werner: National interconnections language; get credit for using renewables.
 - Charles Wyman: You are trying to overtake commodity products on the market, on a thin budget.
 - Ralph Groschen: Increase funding of basic and applied research; emphasizing a larger budget.
 - Wallace Wilhelm: new dollars; increase budgets and request
 - Joseph Bozell: In industry, it is traditional to have 4-10% of net sales applied directly to R&D, which is ~ 50B/year for the petroleum refiners. The R&D funding for the cellulosic ethanol industry must be increased in order to compete with the traditional energy markets.
 - The group decided a reasonable yearly R&D budget would be ~ 5B/year.
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Question: Identify any synergies that the Ag Residue pathway has with other breakout session pathways? What are the potential conflicts that may exist between pathways which may inhibit their ability to meet the program's target?

Methodology: here was open discussion on what role the federal government was in enable the cellulosic ethanol industry to meet the biofuels initiative targets. The individual comments were recorded, but the group was not asked to come to consensus on this question.

Discussion Results:

- Herbaceous in all areas (i.e. feedstock supply, conversion, output, etc.)
- Early deployment of energy crops

- Corn Wet & Dry Mill in that fiber could be used in the mills