DRAFT

Forest Biorefineries Breakout Session Day 1: Tuesday, August 1, 2006

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Paul Grabowski – Introduction

- There are 2 goals outlined, are they good goals?
  - To achieve $1.07 cellulosic ethanol by 2012
  - To achieve 60 billion gallons of ethanol (or 30 percent of 2004 ….
- How do we achieve them?
- Woody perennials, why are they a separate group, do we want to talk to those people? Are their goals and activities related to ours? At some point forest biorefineries are going to use them.
- We will be examining 4 forest biorefineries pathways in our session:
  - Pulp and Paper Mill Improvements Pathway
  - Forest Products Mill Improvements Pathway
  - Forest Residues Processing Pathway
  - Pulp and Paper Mill Repurposing Pathway

Group Discussion :

The following discussion took place as the participants asked questions to Paul Grabowski:

- Does wood-fired CHP fall in? 1million tons of fuel is already produced from it.
  - It doesn't fall in b/c we're trying to produce fungible fuels.
- Wood processing facility can be modified some way to make a liquid fuel.
  - Focus on developing technologies to produce fuels
- Are we restricted to forest residues or are we open to the broader spectrum?
  - As long as we can show its relevance. Boundaries are artificial, we are asking - where can we pull things that make sense?
- Group should also consider the bio part of it. A huge chunk of the cost is the growing, harvest, and delivery of it. Agree however woody group is looking at short rotation and that's different.
- You would grow something different if you know that the material is also going into making fuel.
  - Change in the way you manage.
- Feedstocks are something this group should look at. Where is this technology going as far as putting pressure on the forest?
- We hope discussion is not limited to ethanol.
  - It's not limited to ethanol as long as it's a fungible fuel.
- We're not precluding green field mills.
- Intent to hold feet to the fire, a plan for 2012.

11:00 a.m. Forest Resources Facilitated Session

Purpose: To identify research and policy requirements to achieve developed targets.

Group Discussion :

Facilitator, Roy Tiley, outlined the purpose and proposed agenda for the meeting. The following group discussion took place as participants questioned the agenda items and 4 pathways:

- Let a feedstock group coalesce and get it down to 4 working groups
- Quality is an issue
- Re-group Pulp and Paper Mill Improvements with Pulp and Paper Repurposing
- Add new group called Forest Feedstocks
- You would have to connect back to the mill discussion
- Changing management practices needs to be addressed.
- Are we laying down a premise that the billion ton study is not applicable to the mills we discuss here? Billion Ton Study only looked at things not currently being used. But potential is there to use wood that may or may not go in the existing timber or wood markets need to be looked at.

- 15 million tons of woody biomass that were going to plants that have been closed. Current production in North America is not going to increase?

- In US you can provide 2.5% of your current use from gasification of black liquor

Participants then answered the following agenda questions:

1. What biofuels can be generated by Forest Resources?
2. What is the cost at which each biofuel must be produced to be competitive with gasoline?
3. When will each biofuel from Forest Resources enter the market place?

Facilitation Approach: The group decided to discuss agenda questions as a whole. Facilitator, Roy Tiley recorded participant responses to questions on note cards and posted them onto the wall. Like responses were grouped.

The following items were posted and grouped:

What biofuels can be generated by Forest Resources?

Syngas-Gasification
- DME
- Methane
- Gasoline
- Methanol
- Diesel
- Mixed Alcohols
- Ethanol
- Jet Fuel

Direct Chemical
- Ethanol
- Gasoline
- Diesel

Bio
- Ethanol

Group Discussion :
The following items were discussed as question one was answered:
- If you waste heat you get 30-50% thermal efficiency issue
- If there is a plant next to you that you can capture this heat and use – 60 – 70%
- Integrate plant and use waste heat, you don't need to change processes to make more efficient
- Are we looking at a stand alone plant or an integrated plant?
- Do we want to address both? Can we integrate by 2012?
- All are inherently integrated
- Some of the diagrams show fermentation being nonintegrated
- There is a lot of activity going on in the fuel gasification route. It is economically more viable to co-gasify. You can put in bio-fuel routes
- Solely based on a biorefinery and note the fact that it can be more efficient if integrated
- Let's address these plants as stand-alone.
- What can we do – we should we do!
- Outside the U.S. a lot of things being done in gasifying coal and biomass, it is the quickest route
- Are the targets remaining 1.07? Is it competitive and practical?
- That's the point of this session, how do want to target what is considered competitive. Are there other costs?, are there other ways to measure it?

- How might the ethanol be used, with e-85, it has to be priced more on an energy basis, consumer might need incentive to use the fuel. You have to look at how to break into the market with the fuel
- It has to be cost-competitive with producing ethanol from corn.
- They know price is going up and down and they want to be competitive when the price is down.

- The real numbers are going to vary but 1.07 was derived as the price that is competitive with corn produced ethanol
- Typically don't include corporate overhead, distribution, plant production price, whether corn is subsidized or not.
- Should we discuss each fuel by itself? No time – let's look at groups
- Fuels that have a tax subsidy and do not have a tax subsidy
- Is it a fungible fuel?- DME is not

Group chose to continue discussion on the following 3 fuels:

- Ethanol
- Diesel-Jet fuel
- Gasoline

What is the cost at which each biofuel must be produced to be competitive with gasoline?

Group Discussion :
The following items were discussed after the question above was posed:
- We're going to get a range, pyrolysis and fermentation, one answer, by another process, different price.
- Or do you just pick the process that can get you to the $1.07?
- But what does everybody think? Is another number more likely?
- $1.07, only possible with 51 cent subsidy.
- If you include the cost of capital its more like 1.40 for ethanol
- 50 million dollar plant to produce $1 gallon, you have to add in the cost of the plant
- Should we measure the cost against gasoline. Whatever the cost of gasoline is, ethanol needs to be some percentage.
- You have to pick a value and choose the route to get to that number
- 1.07 includes the cost of the feedstock
- Go with the metric we've been handed and go with the route that gets us to it
- 1.07 is the end of plant cost you can reach by 2012

The following item was posted:

Ethanol – $1.07 in plant and does not include the cost of capitol, marketing, sales or distribution

Group Discussion :
The following items were discussed after the statement above was posted:
- $1.07 does include capital recovery, 10% return on investment, feedstock cost of $35/ ton, and a plant gate cost, done on project, 90gallon/ton for 2012
- Another caveat – we're using 2002 dollars
- $2.50 at the pump in 2012, correction for energy cost per BTU and marketing and distribution

The following items were posted, but the question was not answered for Gasoline or Diesel-Jet fuel

Gasoline-
Diesel-Jet fuel

When will each biofuel from Forest Resources enter the Market Place?

Group Discussion :
The following items were discussed after the question above was posed:

- $1.07 without subsidy
- 25 cents a gallon cost possible with a certain technology. Lab scale data, process has not been fully defined. Intervening in a pulp and paper mill. Chips make regular hemicellulose that gets destroyed anyway. How do you get hemicellulose out? Process not defined.

- 10% hemicellulose can be taken out. You have to get the process down.
- Of the processes this group understands and is scalable to current plants. Existing plants with existing process.
- 2 assumptions – 35$ a dry ton – more like 50$ a dry ton
- 90 gallons per ton of biomass, that's 10 gallons more than what we can do now.
- We're talking about extracting out resources that would be wasted anyway.
- All wood is not the same, you have oak, hickory, hard wood, soft wood, and you can't assume all wood can get you to that fuel.
- We're trying to frame what we can do by 2012.

12:00 p.m. Lunch

Participants spent the rest of the session answering the following agenda questions:

- For each process, what are the major barriers which need to be overcome?
- What are the key RD&D activities needed to overcome major barriers?
- What policies would you recommend to help achieve cost competitive biofuels from Forest Resources?
- What is the federal role in implementing key RD&D and policy activities?

Facilitation Approach:

The group decided to divide into teams along 4 conversion processes:

- Gasification
- Fermentation
- Pyrolysis
- Feedstock

Each team answered the agenda questions listed above on flipcharts. Each team was then given time to report their answers to the whole group and ask for inputs from the whole group. Roy Tiley recorded any additional group inputs onto the flipcharts.

The following was recorded on flipcharts:

For each process, what are the major barriers which need to be overcome?

- **Gasification**
  1) Feeder systems
  2) Gasifier availability/reliability
  3) Gas cleanups – tars, sulfur, …
  4) Matching scale to economy: size
  5) Business links – fuel resources->converter>product distribution
  6) Biomass vs. coal, oil, natural gas for GTL equipment, etc. – drawing talent
  7) Lack of demo plants

- **Fermentation**
  1) Simultaneous effective conversion of sugars
  2) Extraction of hemis
     - Maintain paper value
     - Concentration of hemi
     - Acetic acid
  3) Production of cheap sugars
     - Hydrolysis

- Gasification (fermentation)

- **Pyrolysis**
  1) pH of oil product
     - Environmental issues if you have a spill during transport
     - Refining equipment "protection" corrosive to metal
  2) Scale-distributed is "better"
     - For production of oil
     - Hydro treating & upgrading to reduce corrosivity
  3) Efficiency & Yield – amt. of py oil needs to be enhanced
     - Production
     - Lower Char production, less char, less gas, more oil
  4) Catalyst Stability & Robustness (specifically for Py-oil) no tech. in place for
     In early 80's no catalyst were involved, so now a fertile ground to apply R&D activities
  5) Catalytic Process for Upgrading or converting Py-oil
  6) Competing markets for biomass resources
  7) Permitting
  8) Stability- relates to polymerization of materials that make up py-oil, if char can be separated from oil, you can solve stability problem.
  9) Toxicity -Carcinogenic nature –
  10) Lack of fundability
  11) Water Environmental Issues

- **Feedstock**
  1) Growing – species management
     - Species differences – feedstock characteristics (yield, mc, specific gravity juvenile wood)
     - Ex- loblolly pine and how to manage differently
     - How much hardwood can be used
     - How much can we remove (nutrient removal)
     - Public vs. private land issues (tribal)
     - Time – (for 2012 its already there, for 2030, a fair amount is there)
     - Communication at all levels
     - Land ownership and current tax laws
  2) Harvest/Collection/Transportation
     - Fuel + iron costs
     - Regulatory and social expectations
     - politics
     - More efficient use of high impact harvest systems
     - Fuel efficiency
     - Trained work force (including biorefinery skills)
     - Not enough resources for R&D
  3) Economic
     - Leakage of the resource (pellet plants ship to EU) (electricity production plants) degraded potentially
     - Infrastructure (Roads, bridges, RR lack of)
     - Capital requirements
     - Trucks &Drivers
     - Production costs and site capital

What are the key RD&D activities needed to overcome major barriers?

- **Gasification**
  1) Feeders (solid biomass)
  2) High temperature materials (BLG)
  3) Optimized syngas conversion match to scale – better processes/catalysts
  4) Gas cleanup
     - Tar destruction/conversion

- CO2 removal
- Sulfur removal/recovery
- Alkali removal/recovery

5) Gasifier type
6) Blended fuels
7) Demonstration plants

- **Fermentation**
  1) Sugars conversion (Patent 5,000,000)
     Simultaneous C-5, C-6, Sequential
  2) Optimization of mixed C-6
  3) Upgrading of sugars
     a. Conc.
     b. Inhibitors
     c. Co-product (separation)
  4) Fermentation syngas
  5) Extract with Pulp Quality
  6) Eng. Studies on modifications
  7) Cellulose hydrolysis (could allow enzyme recycling)

- **Pyrolysis**
  1a) Institu process to raise Ph and lower O2 level – changing the way you process the oil to change the oil to molecules with less acidity
  1b) Institu process to change chemical composition
  2) Modular & Portable Systems – distributed better, move to source of biomass
     - Production
     - Upgrading
     - Economic Modeling to Optimize size of the small distributed units
     - Process Intensification- same output, smaller cheaper units
  3) Reactor Design and/or catalytic materials
     - Process design -
     - Feedstock sizing & Handling the smaller the biomass particles higher the energy yield, but you need energy to make particles smaller
     - Modeling
  4) Catalyst Process Development – Critical
  5) Char separation
  6) Integration Issues
  7) Optimization of Pyrolysis vs. upgrading

- **Feedstock**
  1) More Efficient Logging and wood production systems
  2) Define resource need (feedstock characteristics)
  3) Impact of increased harvest on site capital (synthesis of ongoing/existing site productivity work)
  4) Infrastructure Assessment
  5) Enzyme integration
  6) Ecosystem services & delivery & valuation (impacted by urbanization/fragmentation of landscape) value of forests in landscape
  7) Economic & Environmental analysis of product leakage & harvest transport systems – impact on existing industry and on the landscape/ecosystem/environment

What policies would you recommend to help achieve cost competitive biofuels from Forest Resources?

- **Gasification**
  1) Foster demonstration plants
     i) Multiple technologies
     ii) Appropriate Scale
  2) General renewable transportation fuels incentives (not ethanol only)

3) CO2 benefits/credits
4) Plant permitting (state role)
5) Continued R&D funding
6) Facilitate cooperation across Industries from well to wheel, woods to wheel
7) General displace oil incentive (not just transportation) (increase use of gasification)
8) Increase national interest visas for biofuel resources
9) Increase talent base/ engineers in biomass arena

- **Fermentation**
  1) Pilot Plants (Demo) 50 t/$ day
  2) Implement EPAct to section tax provisions – open loop biomass credit same as closed loop
  3) Production tax credit for 20-30 year period wet & dry (cellulose E+OH) (electricity)
  4) Competitive rail infrastructure
  5) Permitting issues (90 days)

- **Pyrolysis**
  1) All incentives currently for Ethanol must be applicable to Py-oil
  2) Long-term accessibility to resource -Stewardship contracts to operate on public land
  3) Transportation of oils DOT regulations
  4) EPA certification of fuels
  5) Water Needs

- **Feedstock**
  1) Worker education/training programs (state role)
  2) Income tax changes (integrated companies US land ownership companies)
  3) Complimentary farms and forestry policy development
  4) State property Taxes (Land Use)
  5) Careful targeting of incentives/subsidies to avoid perverse outcomes
  6) Transportation subsidies (western issue)
  7) Allocation of resources to transportation infrastructure (roads, bridges, railroads)
  8) Regulatory – more rapid/streamlined permitting
  9) More focused allocation of resource to biomass feedstock R&D needs
  10) $ necessary to implement program objectives

What is the federal role in implementing key RD&D and policy activities?

- **Gasification**
  1) Direct Support/Risk mitigation for demonstrations
  2) Protect private incentive for R&D (policy too!)
  3) Encourage vehicle, infrastructure, flexibility for 2030
  4) Fuel certification (avoid MTBE fiasco)
  5) Fed. Fleet incentives for biofuels
  6) All except permitting on policy list

- **Pyrolysis**
  1) Sustained Investment in R&D (15-20) yrs. in discretionary funding (solicitations, loan guarantee, R&D)
  2) Guarantee Price floor for biofuels – ex. Price per corn bush subsidy
  3) Mandate (RFS) 30x30 for U.S.
  4) Fully appropriate all authorized funds for programs

- **Fermentation**
  1) USDOE needs to ask in their POM for:
     a) Demo Dollars (Technology Validation)
     b) Pilot plants
     c) Early commercialization
     d) Tax Matters Beneficial
     e) Permitting Streamline

f) Drawdown oil R&D w/ increasing biomass R&D
g) Immediate (2012) EPAct 2011
h) Construction – Rail transportation competitiveness

- **Feedstocks**

1) Federal Roles
   a) Long-term fiber supply commitment (regionally important)
   b) Policy impacts analysis (market development)
   c) Coordinating research (or any)funding
   d) Making policy changes happen
   e) Implementing complementary farm +forest + policy
   f) Capital assistance?
   g) Communications

2) Private Sector Roles
   a) Contribute to policy impacts analysis
   b) Market development
   c) Is this economically feasible
   d) Making policy changes happen
   e) Systems development (putting pieces together so they work)
   f) Communications

DRAFT

Forest Biorefineries Day 2: Wednesday August 2, 2006

Group Discussion :

Participants began day 2 by raising the following items:

- Producing ethanol is not new – from 1920–2002 - 600 tons a day sulfite pulp mill, Georgia pacific used pulping liquor, took cellulose out, precipitated out the lignin by changing pH of solution and took what was left over from the red liquor, no cellulose or lignin, 10 million/gallons a year of ethanol was produced
- Do you have a process to reach out to other stakeholder groups? There are segments of the environmental community focused on agricultural and forestry.
- Once we develop a grander plan out of this meeting, if nothing else, some kind of stakeholder meeting can be arranged to get their opinions
- Environmentalists are concerned with global warming, you don't want to create problems as you try to solve problems
- Analysis addressing environmental issues are conducted by DOE
- One of the reasons we invited forest service is b/c they have a better connection with the communities involved in forestry than DOE does
- We need to do an environmental impact study, what kind of footprint do these activities leave
- One thing we are lacking is that while there is a definition of biomass in the farm bill and energy bill, there is no clear definition of cellulosic ethanol, a lot of people speaking cellulosic ethanol, but are talking about different things. It would be advantageous to congress and the general public to come up with a definition that everyone can live with and support. Lack of a definition may be a barrier. We don't have a good common understanding of what that is.
- Where would that definition come from? Is coming up with a definition a federal role, or private role?
- Coming up with a definition of cellulosic ethanol can be added to the breakout discussion agenda. This group can try to come to one definition with consensus.
- Don't agree with infrastructure group b/c they said the next feedstock is corn stover
- We lack a definition of biofuel, we should come up with both, definition of cellulosic ethanol and biofuels. There should be an even playing field, it should all get fair credit.
- At 2012, everyone is actually looking at 2030, nobody is seriously thinking about it being possible by 2012, but it is possible, you have facilities, resources whose environmental battles have already been fought over. 18 gasifiers running on woody substance today. Put focus on what does it take to do it in 2012? What does it take to replicate it by 2030?
- When a little federal money gets thrown out, its spent, and not followed up. Then the government comes back to it 10 years later, consistent funding is needed.
- What does your technology need to get your plants up and running by 2012?
- What needs to be done tomorrow, and the next year, to produce ethanol?
- Gasification technology is there, within 3 years, forest guys say they have the feedstock, but the infrastructure is not there. We are ready to do it today.

Discussion of items above resulted in changes to the proposed agenda. Participants spent the rest of the session answering the following agenda questions:

1. For each biofuel, what volume will be produced in 2012? At what cost of production? If zero in 2012 – when, how much, what cost?
2. How would you define Cellulosic Ethanol?
3. How would you define Bio-Fuel?
4. What are the 2030 RD&D needs?
5. What is the timeline for realizing the needs for 2012 and 2030?
6. What are the 2030 Policy Needs?
7. What synergies does Forest Resources have with other breakout sessions?
8. What conflicts does Forest Resources have with other breakout sessions?

Facilitation Approach: The group was divided into 4 teams - Pyrolysis, Fermentation, Feedstocks, and Gasification. Each team answered the question "For each biofuel, what volume will be produced in 2012? At what cost of production? If zero in 2012 – when, how much, what cost?" on flip charts. Each team was then given time to report their answers to the whole group and ask for inputs from the whole group. As each team reported their conclusions, Facilitator Roy Tiley, recorded the data on note cards and posted them on a sticky wall.

See attachment "day 2 sticky wall" for a listing of the items that were posted. The following data was recorded on the flipcharts of each team:

Pyrolysis

For each biofuel, what volume will be produced in 2012? At what cost of production? If zero in 2012 – when, how much, what cost?

Ethanol -

Gasoline – 25,000 bbl/day

Diesel - 25,000 bbl/day

1 ton = .75ton py-oil = 0.5 ton dry py-oil = 100 gallon/ton
d=1.25

2.5 bbl/ton
2 bbl fuel ton BM

10lb/gallon
1000lb x 1 g/10 lb
12.5 kton/day = 25,000 bbl/day

Commercial Demo by 2012
(less than or equal to 25,000)

Demo by 2012

Option 1

- Distr Py-oil production (=n)
- 12.5 kton/ day Biomass
  (12.5 k/n = biomass per py-oil)
  Based on Forest guys
- Refiner receiving 30,000 bbl/day py-oil (dry)
- Refinery producing 25,000 bbl/day fuel
- Dry = 75% Py-oil
  = 25% water
- N= 30 plants

Option 2

- Distribute Py-oil production

30,000 bbl/day ÷ N

- Distribute Py-oil production

25,000 bbl/day ÷ N

At = 400 dry ton/ day
N = 30 plants
$18/bbl py-oil

Fermentation

For each biofuel, what volume will be produced in 2012? At what cost of production? If zero in 2012 – when, how much, what cost?

150 million tons wood
Value Priored Pulping – 1.6 – 2.4 Billion Gallons of ethanol, full deployment, entire industry

10 Hemi Prior Comb/Gas - 100 million tons Power?
1.1 – 1.6 billion gallons of ethanol

Total Conversion of wood to ethanol - 15 million tons wood
100gallons/day
1.5 billion gallons

Total of 3 methods =4.8 billion gallons for 2030

2012

2-3 VPP mills x 1500 tons/day 10% ---------- Acetic Pulp
10 biomass to power plants x 1500 tons/day 10% ---------- Acetic Combined Heat and Power
1 Total conversion x 800 x 70/g/t ---------- CHP

100 million gallons per year by 2012
50% below the current market price of ethanol (50 cents or less)

- assuming you're well below saturation of the co-product markets
- assuming Modification of plants of existing plants, Supply chain, Infrastructure, Work Force, Collection, Permits

Feedstocks

For each biofuel, what volume will be produced in 2012? At what cost of production? If zero in 2012 – when, how much, what cost?

- Affordable, accessible supply and transport => location
- Use existing infrastructure (Southern US)
  - mills (many already on grid) 400-1000 trucks/day
  - pipelines ROW

- Use loblolly plantation thinnings
- Supply Available
- Support production/operational scale demo plant
- Production cost = $20/green ton
- How many tons & where do you want it?
- By 2012 – for 2030 would take R&D Policy and other work from day, flip charts

Gasification

For each biofuel, what volume will be produced in 2012? At what cost of production? If zero in 2012 – when, how much, what cost?

Volume
Prior Studies from BLG ---------- 7.billion Gallons Ethanol equivalent from converting black liquor
20 billion gallon Ethanol Equivalent
with forest potential – 70 billion gallon
Range – 7 – 20 billion

AF & PA

By 2012 – Demonstrations
-2 BLG =>
-2 Biomass => 75 M Gal/y of ethanol from 2 to 4 demonstrations

Cost

Production cost - $1.00 Ethanol Equivalent
DME
Fisher Tropes => $1.17 according Alterner study

$0.80 (2030)- $1.50 (2012) / gallon ethanol equivalent

Group Discussion

As each team reported their findings, the following items were discussed:

- There is a need for a liquid fuel production tax credit, not an investment tax credit, to happen in 2008 for this to be possible for 2012. There is a parody between open and closed loop
- A renewable fuel displacement credit is needed to help reduce demand on foreign oil
- The forest products industry needs to work on forest products stuff, it shouldn't compete with fully commercial corn production
- Today in the U.S. we use 13 million barrels a day of transportation fuel
    - 9 million – gasoline
    - 4 million – diesel
- 200 million gallons a day of transportation fuel is the goal DOE is talking about for 30 x 30 target
- 100 million gallons a year is what we see from this group
- We (forest products) are the closest to the market from the bare bone infrastructure
- Given the biomass it is important that you focus on energy efficiency, we have not seen any efficiency numbers
- What is the right choice? A mix of fuels.
- Increase efficiency of vehicles, public transportation, smart growth all needs to be considered to reach DOE goals
- Vehicle R&D is needed to make modifications to increase efficiency
- Models need to be carved out so that they are earmarked or congressionally directed for forest products demonstrations and should be geographically distributed
- Most of what we need for 2010 exists and is commercially available, the R&D is done, the jump that needs to be made is from R&D to demonstration
- Mixed sugars and Fermentation still needs to be developed and demonstrated
- To get to 2012 with finished technology, you have to use commercial pieces, but nobody has integrated them, evaluating systems integration needs to happen
- Chinese and Europeans investing in DME
- Quicker permitting is needed- NY state is working on, an efficient way to permit these things that are benefits to the environment and to the nation
- House passed refinery bill, now in senate
- EPA has to have the final say and needs to reach down and set the state standards
- EPA needs to be charged with getting this done
- You shouldn't have to spend millions in legal fees to get a permit
- Cooperative federalism is needed
- January 2012, a new administration will come in, one way or the other, there is going to be a sea change, and you need to get this done before then
- What are the gasifier materials you need? Can you do it without R&D?
- We came up with a bunch of technical barriers for gasification, we need continued R&D to overcome those barriers

Facilitation Approach: The group the broke out into the 4 teams - Pyrolysis, Fermentation, Feedstocks, and Gasification again. Each team answered the questions:

- How would you define Cellulosic Ethanol?
- How would you define Bio-Fuel?
- What are the 2030 RD&D needs?
- What is the timeline for realizing the needs for 2012 and 2030?
- What are the 2030 Policy Needs?

Each team was then given time to report their answers to the whole group and ask for inputs from the whole group. As each team reported their conclusions, Facilitator Roy Tiley, recorded the data on note cards and posted them on a sticky wall.

See attachment "day 2 sticky wall" for a listing of the items that were posted. The following data was recorded on the flipcharts of each team:

Pyrolysis

How would you define Cellulosic Ethanol?

Ethanol derived from the cellulosic and hemicellulosic components of biomass

How would you define Bio-Fuel?

Liquid and gaseous fuel made from a sustainable organic material

What are the 2030 R&D needs?

- Infrastructure (Piping) Development
- Determine Technology Platform to replicate
- Strategic analysis to tie human needs, resource validation, and existing infrastructure

Timeline

2012 - pH of oil product
- Environmental issues if you have a spill during transport
- Refining equipment "protection" corrosive to metal

2010 - Scale-distributed is "better"
- For production of oil
- Hydro treating & upgrading to reduce corrosivity

2009 - Efficiency & Yield – amt. of py oil needs to be enhanced
- Production
- Lower Char production, less char, less gas, more oil

2009 - Catalyst Stability & Robustness (specifically for Py-oil) no tech. in place for
In early 80's no catalyst were involved, so now a fertile ground to apply R&D activities

2009- Catalytic Process for Upgrading or converting Py-oil

2009 -Toxicity -Carcinogenic nature

Fermentation

How would you define Cellulosic Ethanol?

Ethanol from plant or trees biomass

How would you define Bio-Fuel?

Plants, trees, and animals, heat power or liquid fuels

What are the 2030 R&D needs?

Syngas fermentation process
- Organism
- Integration
- Economics

Improve (optimized) saccharification. Technology for cellulose (process intensification) (consolidated Bioprocess)
Improved pretreatment, hydrolysis, fermentation
Utilization of unproductive, fertile (farmland) for Biomass production

2030 Policy Needs?

Production Tax Credit of at least 20 years or floor price
Well designed policy environment for R&D, Production & Construction

Timeline

2008 - Sugars conversion (Patent 5,000,000),
Simultaneous C-5, C-6, Sequential
2008 - Optimization of mixed C-6
2008 - Upgrading of sugars - Conc.
2008 - Fermentation syngas
2010 - Extract with Pulp Quality

Feedstocks

How would you define Cellulosic Ethanol?
Ethanol made from any lingo-cellulosic material

How would you define Bio-Fuel?
*Any fuel from current plant and animal sources

Living matter – Botanical - Trees
Liquid incendiary-combustion- vehicles/motors

R&D Needs Timeline
2012 - More Efficient Logging and wood production systems
Now - Define resource need (feedstock characteristics)
2009 - Impact of increased harvest on site capital (synthesis of ongoing/existing site productivity work)
now – DOT's states and countries for data and feds - Infrastructure Assessment for pilots
2012 – infrastructure assessment for full deployment
ongoing - Enzyme integration
start now with periodic improvements - Ecosystem services & delivery & valuation (impacted by urbanization/fragmentation of landscape) value of forests in landscape
Start done by 2015 - Economic & Environmental analysis of product leakage & harvest transport systems – impact on existing industry and on the landscape/ecosystem/environment

Appropriate genotypes through breeding, cloning, biotechnology
Silviculture/mgmt systems for improved genotypes

Gasification

How would you define Cellulosic Ethanol?

Ethanol derived from the lignocellulosic portion of plant matter

How would you define Bio-Fuel?

Any fuel derived from any renewable biomass used for transportation.

What are the 2030 R&D needs?

Timeline: 2 yrs contracts for components
2-3 yrs for construction of Demo plant
1 yr for engineering
1.5 yrs for permitting
R&D immediate: gas cleanup (tars)
Feeder/fuel prep
Integration issues
Low cost oxygen

Long-term – ongoing issues

Facilitation Approach: The group reconvened at the U – shaped table. Each participant was given a few minutes to write their responses to the following two questions on different colored note cards:

- What synergies does Forest Resources have with other breakout sessions?
- What conflicts does Forest Resources have with other breakout sessions?

Facilitator Roy Tiley, collected the note cards and posted them on a sticky wall. Duplicate cards were not posted. The following data was posted on the sticky wall:

Conflicts

- Land Conflict w/Herbaceous and woody crop to grow saw-logs
- Infrastructure – lack of emphasis on trees/forests, too much focus on corn
- Agricultural Residues – ethanol/corn stover centric
- Saturation of Energy coproducts markets – corn, oils
- Produce hydrocarbon fuels on equal footing with ethanol
- Corn/Wet dry mill – policy protection from competition with CTL
- Competition for R&D dollars
- Environmental performance standards for renewable fuels
- Tree-biomass has existing harvested handling systems more cost effective & existing conversion facilities

Synergies

- Forest products industry leads the development of Lignocellulosic feedstocks (herbaceous or woody crops) (only need C-6, C-5 fermentation technology & have capital in place
- Agricultural & Herbaceous Energy- we can use some of them. Also, some common R&D needs
- Agricultural & Woody Energy- Fermentation Technology
- Simultaneous C5/C6 sugar fermentation
- Forest Biorefinery – Woody Perennials – Upgrade the generic quality of planting stock through tree breeding & biotechnology
- Feedstock Woody Energy Crops
- Need for Information/work force development
- Corn wet dry mills – Lignin => Py-oil => gasoline
  Cellulose => Ethanol

All in E85

- Certain policy needs – i.e. incentives/tax credits
- Woody Biomass Energy Crops can extend the forest biorefinery supply chain – woody short rotation crops-willow
- Gasification/Pyrolysis products fit into existing fuel delivery infrastructure
- Suitability of conversion technology to wide range of feeds/pathways
- Corn Wet Dry Mills – Bottom line metric consistent with policy and relevant economic metrics
- Need better rail transportation
- A level playing field for all suitable renewable fuels
- Water usage/consumption issues