

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?
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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 Prioed 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
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Facilitation Approach: The group 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.

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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