NW CERT Cellulosic Fuel and Product Industry Forum Summary:
Current Practices, Future Possibilities

Co-sponsored by: NW CERTs, NW RSDP, Pembina Trail and Giziibii RC&Ds, AURI

Wednesday, April 25th, 2007, 9:00 am –4:00 pm
Black Cat Sports Bar and Grill, Thief River Falls, MN

Note: The summary of this forum will soon be posted on the CERTs website http://www.cleanenergyresourceteams.org/northwest.html. Powerpoint presentations will be posted at http://www.cleanenergyresourceteams.org/presentations.html in the Northwest Section.

OVERVIEW

Big Picture Industry Potential – Brendan Jordan, Great Plains Institute
After CERTs Coordinator Lissa Pawlisch made introductions, Brendan Jordan of the Great Plains Institute's Cellulose Initiative http://www.gpisd.net/resource.html?Id=75 gave an overview of the ethanol and coming cellulosic fuel industry. He said that Minnesota is in the middle of the bio-belt and cellulosic fuels have the potential to bring benefits to areas that currently don't grow corn and soybeans. The Department of Energy projects 1.3 billion tons of biomass will be needed, and Minnesota has enormous potential with mill waste, wheat straws, beat bulbs and perennial energy crops that could all be used.

In 1996, the USDA approved 6 pilot projects to harvest CRP, but only one project really got going. The project harvested 7,000-8,000 tons/year which they then co-fired at a 5% mix in a coal-fired facility (and from which they've seen major reductions – 2x the biomass percentage - in NOX emissions). In comparison, Europe does larger scale co-gasification, with up to 30% biomass co-fired with coal. The Minnesota Renewable Electricity Standard may impact biomass power projects; it might not be the cheapest way to generate electricity, but it can be used for baseload power. Switch grass at $40/ton currently can't compete with coal, but it can with natural gas and is cheaper than oil.

Technology: Emerging biomass technologies include sugar platforms and thermochemical platforms.

- Sugar Platform is much the same as current ethanol technology and requires enzymes to break down the cellulosic materials into the requisite sugars.
- Thermochemical platforms include:
  - Pyrolysis – similar to gasification but at a lower temperature; can make a low-quality bio-oil not unlike fuel oil which can then be burned in a variety of applications.
  - Gasification – accepts all sorts of materials and gasifies them to make a syngas than can be transformed into a variety of products. In Minnesota, the Central Minnesota Ethanol Coop is using gasification and Central Valley Ethanol Coop is working on it.

To kick start the cellulosic fuel industry the Department of Energy has approved $385 million for six projects, all of which use various feedstocks and produce ethanol plus something else. These projects plan to utilize a variety of technologies to make ethanol. For many cellulosic ethanol

projects the challenge is how to assemble a feedstock; once assembled, facilities can install a new technology and use biomass for whatever they want.

Monoculture and Mixtures: Perennials have multiple environmental benefits, and people will need to decide between monocultures (switchgrass bred for energy, for example) and mixtures (multiple grasses that can be used for hunting but harvested outside of the hunting/nesting period). Brendan noted North Dakota and Iowa Farm bureaus are aggregating carbon credits to sell on the Chicago Climate Exchange http://www.chicagoclimatex.com/ and grasslands and forest lands can use this as another financial incentive to grow alternative crops.

Hurdles for biomass:
- Technology demonstration and commercialization
- Feedstock logistics: how to plant and manage the land, how to harvest, how to store and transfer plant material
- How to develop new crops
- Public perception

Scale issues: All biomass is local and it may make more sense to have small scale facilities, especially with gasification. When looking at enzymatic conversion, bigger may seem better as you'd want to process a lot of the same material.

Prime Opportunities: the low hanging fruit seems to be with easily accessible "waste" biomass and CRP and using these supplies at larger rural heat users.

Q&A:
- Wildlife connections? More robust integrative studies are needed, for example looking at species besides birds (like invertebrates and slugs).
- Residue harvesting? Lots of studies are underway to look at how much how much residue can/should be removed from the land; current DOE estimates are conservative
- Natural gas pipelines as a market outlet for biomass gasification? Not sure, some are looking at digesters to natural gas. The SW Minnesota effort is to do corn stover to syngas and then to natural gas.

POSSIBILITIES TODAY: CASE STUDIES

Small-Scale Gasifiers – Michael Sparby, Agricultural Utilization Research Institute (AURI)
After the break, Michael Sparby from the Agricultural Utilization Research Institute (AURI) http://www.auri.org/ quickly mentioned their Biomass Cost Comparison table for raw feed stocks that compares fuels according to their price/BTU. The target price to beat for a lot of projects is $9.07 natural gas (the average 5-year price for natural gas). The biomass benefit is that you can lock in long-term contracts that you can't with natural gas.

Then it was on to the Northern Excellence Seed Growers (Northern Excellence) Case Study (http://www.auri.org/news/ainjan06/wastenotfibers.htm). Michael pointed out that Minnesota is the third grass seed producing state in the nation (although it's quite a ways behind #s 1 and 2 (WA and OR). Northern Excellence is planning to acquire a gasification unit @ their Williams

Plant to supplant electrical needs. Each year they use about $45,000 for electricity. They tested a 100 kW unit to evaluate the moisture content, ash content and BTU/lb of their various grass seed screenings (blue grass screenings had a volume of gas better than anything else they've ever tested). They have enough bluegrass and ryegrass screenings to power the facility all year and right now they just dispose of those screenings—it's free feed stock.

To buy the system, a portable downdraft gasification unit from India, would require a $150,000 investment for the equipment and installation plus an additional $150,000 to work out any initial glitches and guarantee 24/7 operation. While it seems like the 8-year payback would make the investment a no-brainer, it would be the first project in the US, making a more risky investment and harder to get regular bank financing. For example, the Central Minnesota Ethanol Plant ran into problems with sand in with the wood creating glass, which hadn't been anticipated. Some of these things could happen with grass seed which is why they want an additional $150,000 to mitigate risk. First projects are always high risk; the added cost is a hurdle, but will make it better for all subsequent projects.

West River Dairy Case Study

West River Dairy wanted to look at resources from Stevens County to supply natural gas displacement for an industrial park to attract business. They looked at three areas: manure digestion (biogas), stover combustion (to electricity), and stover gasification (to biogas).

The most feasible option was for 6,000 cows to make 108,000 BTUs of biogas that would then be sent via pipeline to the industrial park. That system would cost $1.66 million and produce gas at a price of $10.59/mmBTU – higher than the 5-year natural gas average but lower than today's natural gas price. Stover combustion to electricity would have used 28% of stover produced in Stevens County and not feasible because of electricity selling price. Stover removal has a lot of variables that need to be worked out.

AURI hopes to do a user-friendly system online that farmers can enter their information. See Michael's slides for more specific cost-comparison data.

Q&A:

- Derek Crompton, UMN Extension, mentioned reading a recent article that predicted that middle to northern Minnesota was likely to see electricity go up by 60%. Will biomass be able to compete at that price? Going to electricity is the least efficient use of syngas. Replacing heat alternatives is more efficient and cost competitive, but higher electricity prices would make a variety of other options more economically viable.
- Will big ag users become energy exporters? The RES may drive some of that. The Little Falls digester plans to inject gas to natural gas for Xcel to use.

University of Minnesota Morris – Troy Goodnaugh, UMM Campus Sustainability Coordinator

UMM wants to be self sufficient in 2010 in electricity and heat, and the community wants to be a destination to learn about renewable energy, crops, soils, etc. This connection between the University and the community is critical – as Troy said, the key theme is partners working together. UMM received the Carter Partnership Award for University & Community Relations http://www.mccormack.umb.edu/carteraward/ .

Their project started with a wind turbine @ the West Central Research and Outreach Center that provides ½ of UMM's electricity and may expand. Now they are looking at wind to hydrogen to ammonia fertilizer and also using biomass gasification to get heat. In 2000 natural gas prices peaked and jumped from $5/mmBTU to $10/mmBTU, eating the entire UMM Facilities reserve budget in one winter. That fluctuation and the EIA futures which show natural gas prices on a roller coaster ride have led UMM to set a goal of offsetting 80% of UMM's natural gas needs.

To kick start their biomass project UMM contracted with UND's Energy and Environmental Research Center (EERC) to look @ available feedstock—found about 677,000 tons of biomass within 100 miles of Morris—Morris wants to use 9,000 tons, or about 9.000 bales.

The next step was test burns of corn stover to test BTU output and emissions. They conducted 2 test burns @ Coal-tech in Carter, IL. The first time around they used unprocessed corn stover and burned out their screws. The second time around they changed to 2-inch stover pieces and used a hydraulic ram to feed the stover instead of screws. That test worked. They've found that moisture is a problem and reduces energy "produced" by ½. BTU values in hand, they then brought in GE to do emissions testing and found HCl (which will need to be scrubbed).

Troy talked about converting woody crops to fuels and described that with gasification one converts the cellulose, hemicellulose and lignin of the woody crop to other usable products. At first you just break the bonds, pushing off the hydrogen so that you're left with an active carbon. Active carbons want to react—flow a bit of oxygen in it to get CO & H2 gases—once one has a gas anything this possible—ethanol, di-methyletter (DME is like propane). Another benefit is that one could potentially use any ash as a field spread.

UMM plans to have its plant operational by next spring (although they'll spend a year or two getting the whole heating system on line). It is sized to produce 16-25 MMBTU/hour (150 psi steam @ 15,000 lbs/hour). It has been hard to find a gasifier manufacturer with good price and good technology. Right now they've raised about $6,000,000 for the project from Minnesota Legislature & IREE. They have another $1,900,000 from USDA/DOE grant to look at wheat straw and other residues as well as to build a biomass toolbox that details heating value and emissions data for all of their test materials, standard operating procedures, and contracting information (all of which will be posted online). They hope their work will help others with emissions testing and data gathering on emissions.

Madelia Model – Linda Meschke, Rural Advantage

The Madelia Model uses the "3rd Crops" concept to come at the biomass question from a water quality perspective using higher level Best Management Practices. The project is working with a rural economic development concept that would have a centralized industrial park to process local agriculture products and be powered by renewable energy. The communities in the surrounding areas would help support the industrial park by consolidating & preprocessing local farm products.

Madelia (town of 2300) is working with their local utility and economic developer to be a national model and prove that within a 25 mile radius you can grow or capture enough biomass

to fuel a community. They believe that the community should decide what kind of development they want, and should consider multiple benefits—not just renewable energy but also water quality, wildlife and local ownership. Ownership could come not just from growers, but also consumer shares and some outsiders who like the model and could purchase "supporter" shares.

Their biomass inventory found:

- 1.9 million crop acres in Annual Tillage (all numbers are given by county, so this is a bit more than a 25-mile radius)
- 52,000 acres in CRP
- 151,000 acres in natural or conservation use
- Energy demand=39 trillion BTUs
- If 20% of environmental sensitive lands were converted from row crops (380,000 acres) into 10% long term perennials and 10% short term perennials (including grazing) it would really help water quality (they would target non-productive soils with perennials based on Crop Equivalency Ratings)

At this point Madelia is still assessing what crops they might grow (miscanthus is not native, but also isn't aggressive, NY is using willows and managing them to improve yields, etc.), when they'd need to be harvested (like after senescence, when plant nutrients have gone back to the roots) and other harvesting logistics.

PANEL DISCUSSION

Biomass Inventories

Keith Butcher, Center for Energy and the Environment – Keith is working on scenario building where you can evaluate biomass projects and feedstock options comparing apples to apples and plugging in your own numbers. Several key tools include BioPET, a software tool that one can download to perform cost comparisons. Another is listed as "Map Appendix" that shows Minnesota's biomass resources, ranging from crop residues to manures and wood, in billions of BTUs/county. You can see all of Keith's work thus far at: http://www.mncee.org/public_policy/renewable_energy/biomass/index.php.

Randy Hilliard, AURI – Randy discussed the wide-ranging opportunities available to utilize biomass including small-scale applications that require less biomass. Randy said that beyond ethanol, gasification and co-firing, pellet fuels were a rapidly evolving market ripe with opportunity. Other markets that biomass producers could target include livestock bedding and landscaping.

Trenton Haffley, University of Minnesota Crookston – Trenton is a student at UMC and has just begun work on a biomass fuelshed analysis for the Crookston area. He hopes to determine (like Madelia):

- BTUs available from biomass within 25 miles of Crookston
- whether or not that total number of BTUs is sufficient to support energy use in the area
- if more BTUs can be generated on marginal soil with grasses (based on soil quality analyses)

Water Availability – Bob Merritt, Minnesota DNR (http://www.dnr.state.mn.us/index.html)

Bob started by laying out the context within which the DNR assesses water usage priorities – first and foremost is domestic water usage; agriculture irrigation & processing of agriculture products is their 3rd priority. Water usage has increased dramatically since 1998, and the increases track gains in ethanol production (each gallon of ethanol takes 4-6 gallons of water).

Northwestern Minnesota is largely in the Lake Agassiz area which consists of soils from the Laurentian Ice Sheets (i.e., lots of clays and fines). Precipitation in northwest Minnesota is also low – it's a pretty dry area, almost semi-arid. These two factors combine to dictate the availability of water in the region. Agricultural facilities have two water resource options: surface water and groundwater. Surface water is controlled by precipitation and the NW is often in drought conditions. Groundwater levels change more slowly, but the quality of water in the northwest declines as you move west. Linear buried aquifers are not appropriate for industrial use as they draw down quickly. Bob suggested that water be primary criteria when thinking about a cellulosic project and advised that water consultants should be hired upfront. The DNR has one groundwater specialist to deal with the entire western part of the state.

Electric and Water Utilities – Arlo Rude, Thief River Falls Municipal Utility
Arlo suggested you contact the utility early and let them know when you want to start; also contact your township, city, county, etc. Local utilities will want to know:

- How big your facility will be and whether or not you plan to expand
- Where you want to locate
- What kind of service you want (thermal, electrical, 3-phase, 1-phase)
- If you plan to produce some of your own power (will require they make arrangements with their power suppliers and require that you obtain a switching mechanism from your utility).
- If there are light pollution issues
- How much water you want and your schedule for usage
- If you plant to use surface water or well water (require different levels of treatment)
- Whether or not you need fire protection (take bigger water lines)
- How much waste water you plan to discharge, what will be in your discharge, the temperature of your discharge, and when you plan to discharge (you may need frequent waste water testing; this varies by municipality. Some require weekly testing and are interested in heavy metals, phosphorus or mercury).

Permitting – Myrna Halbach, MPCA www.pca.state.mn.us/programs/ethanol.html
The MPCA's goal is to work with Minnesota and industry; indeed, the PCA Strategic Plan includes energy, ethanol and renewables. Their ethanol program goals include environmental protection, sustainable opportunities and process improvement. In all cases they hope to limit the environmental footprint of facilities by looking for sustainability opportunities that maximize environmental efficiencies, encourage thoughtful siting and build sustainable infrastructure – including looking for synergies between businesses to match the steam producers with the steam users.

The PCA process for permitting an ethanol plant should take 150 days; they want the process to move down towards 90 days as they realize this helps with financing. The PCA needs to set proper limits for contaminants and temperature and establish compliance rates up front; they don't want one project to give the entire industry a bad name. They may have a summit with all

the ethanol plants and the MPCA for cross-learning. There are now technology and facility improvements getting towards 1 gallon of water for one gallon of ethanol, down from 10/1. Gasification might help even further.

Funding and Research Assistance – Shawnn Balstad, Pembina Trail Resource Conservation & Development (RC&D) Council (http://www.mn.nrcs.usda.gov/partnerships/pembina/)
Each RC&D is locally driven. They take local project ideas with a 2 page proposal to request funding and then they work with applicants to go out and look for project funding. Councils can help with technical & planning assistance, grant writing, serving as fiscal agent, education, etc. RC&Ds want to fill the gaps and get more projects moving forward. Shawnn mentioned two biomass projects that RC&Ds have been involved in recently. One was the NW Minnesota UND EERC biomass testing study that they worked on with CERTs (see case study here: http://www.cleanenergyresourceteams.org/northwest/Gasifier-EERC.pdf), another is the Renewable Energy Clean Air Project (RECAP) project, a plasma torch project in International Falls (http://www.lrcd.org/energy/RECAP_Entire.pdf).

Question & Answer

- What about water in-water out for surface water? You need it most when it is least available. At ethanol plants they recycle and reuse water 4 or 5 times; that's great but then you end up concentrating the salts.
- Why not more local dams? 1) Safety; can break or blowout; 2) most fill up with silt; 3) fish issues/kills.
- Testing gasifier again? Contemplating doing so with aspen and willow. EERC is getting a new gasifier and PCA wants to partner with them for testing.
- Is there enough long-term funding to ensure long-term studies of sources of water in northwestern Minnesota? No, it is sporadic. Most studies are in Red River Valley, not north of Clay & Becker. In fact, they recently identified a new aquifer in Fargo-Moorhead area.
- Could municipal waste water be used as a source of water @ ethanol plants? Maybe for cooling water, but not for process water as ethanol comes into human contact.
- Erskine-Agassiz Energy— Status? Coal fired vs. natural gas fired? They are looking at coal, but coal is frowned on because of mercury emissions (and the existing total maximum daily load allowed for mercury). They are also looking at co-firing with a certain percentage of biomass. They may change the design to deal with water discharge and steel prices. Ash from coal could be used in roads.
- Water usage in ethanol? VeriSun plant is cutting its water usage down to three gallons of water/ one gallon of ethanol. With emerging technologies such as pyrolysis and gasification, less water may be required per gallon of ethanol.
- What are the financial incentives available?
  - Federal level: best targets are USDA Energy Title (9006) and the DOE
  - State level: this year the legislature is considering some incentives. Linda Limback @ the Dept of Commerce is a good resource and sends out periodic funding announcements (Linda.Limback@state.mn.us).
  - EP Overviews out of Canada sends out funding announcements (http://epoverviews.com/)

- Xcel Energy: Renewable Development Fund (http://www.xcelenergy.com/XLWEB/CDA/0,2914,1-1-1_4359_8118-801-5_406_657-0,00.html)
- Economic Development: USDA has infrastructure $.

- What about state forest lands, wetlands & other state property that could be harvested instead of converting agricultural acres from food to energy? There will be opportunities to use anything and everything as we move forward. We just need to make sure we do it in a sustainable way. Even with corn ethanol, still only using ½ of MN corn, but we should look to other cellulosic options.

BREAK OUTS

The following includes a few highlights about project ideas and research questions from the small group breakouts.

Wood project:
Use wood chips from plants near Bemidji and convert wood to gas through gasification or burn it in boilers to produce steam. A few possible outlets for the wood might be the Grand Rapids Power Plant or the new Erskine Ethanol Plant. The group wondered whether or not wood could be mixed with grasses to improve the over flow into the gasifier (thinking back to Troy's example). The group also discussed their desire to come up with a process that will not emit CO2.

Grass seed screenings in Williams:
- Opportunity for onsite gasification for electricity
- Might the screenings be more valuable in a biomass process somewhere else? Would they need to be densified for transport? We need to develop other biomass markets in the region.
- We may need to consider desification of multiple fuels to meet growing energy demands. May be able to gasify all fuels at a larger scale.

What is the energy and economic payback for onsite generation?
Compare this to transportation costs to move resources to an existing facility. Maybe use Erickson Mill as a concentration point.

Use perennial grasses and crop residues @ UM Crookston's new heating plant:
- AURI and other groups have inventory information of available material
- UMC has the heat energy requirements for campus
- Lots of crop residue is available in the immediate area
- Biomass from wetland areas could be utilized
- Biomass residue from industry (beet pulp) is readily available
- Native grasses in Glacial Ridge area may be available in the area close by.
- Could start to establish perennials in buffers/priority soil areas – think about needs around river flowing through Crookston.
- Grass supply from DOT mowing of rights of way?
- Lots of opportunities for partnerships with agencies, City EDA, farm groups, implement dealers, local industry, EERC and UMC, other community members