West Central CERT Biomass Tour

Morris & Benson, MN
Thursday, October 16th, 2008

Attendees: Jacki Anderson, Jim Barbour, Bob Bonawitz, Duane Carrow, James Dontje, Jerry Gesch, Cheryl Glaeser, Richard Herbeck, Dawn Hegland, Cheryl Knoll, Pamela Lehmann, Phil Lord, Orville Moe, Randy Nelson, Steve Nelson, Amy Nelson, Lucas Olson, Dave Opsahl, Mike Resse, William Rois, Dorothy Rosemeier, Mary Ann Scharf, Dean Schmidt, Stan Simon, John Strand, Joel Tallaksen, Dan Tepfer, Becky West, Graden West, Steve Wagner, Travis Issendorf, Gary Hoffman, Chris Hettig, Lissa Pawlisch, Linda Kanne, Isaac Dontje Lindell, Pete Baalson, Mike Baalson, Joel Haskard

See pictures from the day here:
http://picasaweb.google.com/LissaPawlisch/WestCentralCERTUMMorrisBiomassVisit#

UM Morris Biomass Project
Joel Tallaksen of the University of Minnesota West Central Research and Outreach Center kicked off the day with an overview of the UM Morris Biomass project. (To learn more about the biomass gasifier, please visit http://renewables.morris.umn.edu/biomass/ and here for a video: http://www1.umn.edu/urelate/newsservice/Multimedia_Videos/morris_sustainability.htm). The goals of the biomass plant are to provide affordable, reliable energy to communities, stabilize fuel prices (or at least make them predictable), reduce reliance on foreign oil, and increase renewable community resources. The Morris Campus is a good model for a project like this because similar mechanisms can be used in communities such as district heating for a downtown area and hospitals.

The campus has historically spent around $900,000 a year on natural gas. When they realized they needed to invest more money to replace old equipment, the crossroads led to a shift in thought… what if we were to supply our own natural gas with a biomass alternative? Average natural gas prices have been on the rise for decades, and natural gas isn't a local resource – whereas biomass is. Biomass grows back every year, it can be clean burning (if you do it right), and it is produced locally throughout the country (although it takes different forms in different places) and could help keep those energy dollars local. Thus an idea was born! And NOW, the system is complete – although it still needs some tweaks.

Biomass is defined as a ***complex carbon molecules derived from a living organism.*** Examples include wheat straw, almond shells, turkey manure, newspaper, orange peels, wood chips, and oat hulls. At Morris they will primarily use corn stover, and they've found that within a 10-15 miles radius they can get 8,000 to 10,000 tons of corn stover per year, which is what they need (an earlier study found potential for upwards of 677,000 tons within 100 mile radius).

There are no other biomass energy plants of this scale in operation in the US. There are others world-wide, but they are much larger in scale. The main problem is there is no regional infrastructure for biomass supply and handling, transportation and storage are all difficult problems to solve.

What about the $?:
The total system cost about $900,000. Their current calculations look like this: $900,000 on natural gas - $500,000 on biomass = $400,000 savings… without the added costs. There will be other costs for processing and supply, but all that money for equipment, maintenance, harvest and supply will stay local. By using local farmers and truckers etc, the biomass facility puts $1 million back into the local economy.

Joel finished his talk with a key take-home message: Biomass = Community Energy. It is too bulky to move long distances, and therefore must be used near where it is produced. This benefits local communities because resources stay within the community.

The Gasifier
Joel Tallaksen and Jim Barbour gave tours explaining the biomass facility. The gasifier is capable of 18 million BTU per year and can supply 80% of peak demand (sized to 80% otherwise it would be too expensive). It is designed for agricultural biomass and other fuels and doesn't fully replace the current boiler because they need redundancy. The maximum biomass use is 36 tons/day (2-3 semi loads), and will connect to a chiller unit for AC in the summer. This spring they also plan to look at adding a steam turbine to produce electricity. The system is designed to run at high capacity – although it's not required to run at maximum all the time – and is more efficient and cleaner burning if it is not at max.

Gasification, in general, is an old (150 years) technology that had been used for coal and municipal solid waste. It's actually quite common in the wood processing industry as well. One of its benefits is that it can utilize a variety of fuels. Another benefit is that it's not actually "burning" and therefore doesn't result in the same emissions. For example, with stover, the gasification system can keep silica on the ash rather than glassing up the system. It can also keep more nutrients in the ash (which is helpful for potential re-application on fields).

The loading dock at the gasifier has 5 bays. They plug a trailer into a bay and have walking floors to move the material, and they can build a 3-5 day supply if needed.

They are looking for stover with less then 20% moisture content; more than 30% they have to reject because it is hard to store and uses a lot of additional energy to dry. Feeding the gasifier is tough with anything other than pellets because it is hard to manage. Stover shreds are hard to handle and they have to regulate the amount of air going in. Need smelting that seals with hydraulic ram. They are currently testing the ash and are hoping to take the ash back to farmers who are supplying stover because the ash maintains the phosphorus. They have both fly ash and ash from gasifier, so there are lots of opportunities for research on field usage and application. They also have installed a $600,000 emissions testing box: nitrous, carbon monoxide, sulfur dioxide, etc. gas after passes boiler goes through a wet scrubber. They would like to reuse water they pump from basements instead of treated city water.

> **UM-Morris hopes that with their biomass powered turbine and wind turbine (early next year) they should be able to reach full electricity capacity with renewable energy.**

Feedstocks
Next stop was the West Central Research & Outreach Center to see feedstocks being grown just next to the turbine (check out the pictures linked on the first page)! It also gave the tour the chance to see the two main storage piles of stover and wood chips in the distance.

They currently have on-site supplies to cover 6-8% of their annual needs, and have trial plots of perennial grasses, rye, prairie grass, switchgrass, big blue stem, reed canary (invasive grass), sorghum, alfalfa and beans. Right now prairie grasses can't compete economically- but with cap-and-trade, carbon tax, or combined systems there may be opportunities.

Production per acre also varies with different feedstocks and much research is underway to evaluate how much material could be generated per acre of land. Dean Schmidt referenced one such study from the NRCS on big blue stem as an example: http://plant-materials.nrcs.usda.gov/NDPMC/pubs/ndpmcpu08BBBiom.pdf.

Joel also discussed the continuum of cropping systems (say corn and beans) to alternative agricultural systems (like poplar or switchgrass) to conservation systems (like native prairie grasses). Which type of system you use depends upon your goals, but getting folks to convert to alternative ag systems or conservation systems may take different economic incentives and programs, as right now it takes at least three years to establish these alternative crops – and that means you won't be able to harvest and recoup your costs right away. The recent Farm Bill provisions provide some opportunities to alternative cropping systems.

See two summaries of the Farm Bill:
http://www.usda.gov/documents/FB08_Pub_Mtg_Renew_Energy_Factsheet.pdf
http://www.farmenergy.org/newsitem.php?item_id=443

Actual Farm Bill language (thanks to Stan Simon and Tom Meium for the link) here:
http://agriculture.house.gov/inside/Legislation/110/FB/Conf/CRlang.pdf.

Beyer Laundromat and Car Wash
After the feedstock presentation, the tour met Jessica Beyer at the Beyer Laundromat & Carwash to see how they are using wood waste to heat the building, 3 car wash bays and water for Laundromat (they need supplemental heat for the dryers). Jessica and her husband, Craig, bought the business about 4 years ago, and 2 years ago – when natural gas prices increased – they moved their home wood boiler to their business where they thought it would make a bigger impact on their energy costs. It did! They went from spending $1,000-$1,500/month for natural gas in winter of 2006 to around $300/month in winter of 2007.

The wood boiler is an Aquatherm (http://www.aqua-therm.com/) and has been modified to include a gasification unit that can help minimize smoke out of the stack – which had bothered their neighbors in the summer. The Beyer's got the gasifier at cost from Aquatherm because it's the first of its kind. Beyond helping with emissions, they gasifier has also cut their wood use in half.

The system can use any wood except Elm (because of Dutch Elm). Whole logs and chunks can be fed into the system, and the wood from Craig's tree trimming service would have

gone to waste if it was not used in the gasifier. They keep the water temperature at 180 degrees and have an automatic system that can control temperature and firing.

Bus Discussion – Business Opportunities and Potential Biomass Challenges

- Aggregators – folks who can collect materials, process them and deliver them to facilities. This is a major logistics task in addition to the technical pieces.
- Densification/Processors – to work directly with growers or with aggregators to get supplies ready for transport
- Some challenges include: getting the right equipment for the job, although more tools are being developed and sourcing where the biomass will come from.

Another opportunity for growers is the Productive Conservation on Working Lands incentive, that Dean Schmidt mentioned, that can pay up to $150/acre per year, and still has need for 500 acres across Minnesota. To find out more, visit: http://www.threeriversrcd.org/pcwl%20pages/pcwl_home.htm or contact Joe Domeier 507-345-7418 ext. 127; jadomeier@threeriversrcd.org.

Chippewa Valley Ethanol Company – CVEC

At 1 pm the tour pulled into CVEC and was greeted by General Manager Bill Lee. The plant produces 47 million gallons/year, and is now working with Frontline BioEnergy out of Iowa: http://www.frontlinebioenergy.com/ (see pictures of the CVEC project being built) to pilot a biomass system that they hope can be used to convert any natural gas-using facility to a biomass one. Minnesota-based Fagen Inc. http://www.fageninc.com/ will be the exclusive builder with Frontline.

Right now CVEC is using exclusively wood because they are more comfortable with wood emissions (as is MPCA) and there is a more readily available supply – although their permit allows for test burns of agricultural residues, and they are in the process of demonstrating emissions and system performances. They currently use approximately 70 tons/day, but want approximately 270-280 tons/ day to replace 90% of their natural gas usage. The gasification system is separate from the ethanol system itself and this will allow CVEC to run their facility off of the least expensive fuel – be it biomass or natural gas – which is critical with fluctuating natural gas prices between $6.50-$14.00/dekatherm and wood at around $5/dekatherm.

The gasifier is a fluidized bed system that can handle a more varied feedstock stream. Right now they are looking closely at using only corn cobs or cobs and stalks. Cob is appealing because:

a) cob keeps $ in the coop (pay existing corn growers/coop members for the biomass),
b) there are new systems being tested to separate cob before it hits the ground. On October 15th they tested the Vermeer CCX770 pull-behind cob harvester, and will do further testing throughout the fall http://www.mncorn.org/index.php?option=com_content&view=article&id=141:corncobstoenergy&catid=1:daily-stories&Itemid=85.
c) cob can be stored
d) cob has 1/3rd the ash of stover
e) cob doesn't have much value as biomass on the field in cobs (not possible with stalks).

CVECs Phased-In Gasification Plan:

- Phase I: Build the Pilot Unit and work out any kinks.
- Phase II: Clean gas – clean up the ash and tar to get to a cleaner syngas. Phase II will begin once the Iowa gas clean up pilot is a proven system.
- Phase III: Implement commercial scale gasifier – they hope to replace 90% of their natural gas usage. CVEC must get through all the hurdles of Phase II before marketing the system to other facilities – it could also be used for paper, steel, food, ethanol and bricks.

How it Works:
The wood is unloaded using walking floor trailer which also makes a seal around the truck to control for dust. There is plenty of space for truck movement. They then store the wood in a silo and then slowly and steadily feed it into the gasifier. The system handles densified biomass and wood chips well. It has self cleaning magnetic belts to pull out nails and metal.

They pump air into the fluidized bed – the fluidized bed mixes the wood chips with sand (that has a good thermal value and stabilizes the process). They use natural gas to pre-heat the gasifier up to 800-900 degrees F. Once @ that temp, they put in wood to start increasing the temperature and turn off the natural gas entirely when it hits 1500 degrees. Then they just keep on pushing in wood but keep air pressure at the same level to keep things from burning (which is bad) and instead they get gasification – which happens at lower temperatures and therefore avoid burning the silica (which causes glassing and clinkers) and works more efficiently. They pump the gas produced from the gasifier around the plant to standard boilers which provide the process heat.

They pneumatically move out char-ash which is sometimes put back on soil (but the agronomic value is uncertain at this time and being studied). The char ash is very fine and dusty; it flows like water and they are trying to make a depressurized pocket to keep from dusting all over – and are looking at pelletizing it for little brickets which could then be stored. Right now 20 trucks of wood come in per week and one truck of ash is produced.

To read a Star Tribune article about the CVEC biomass gasification project, visit http://www.startribune.com/business/22942999.html.

A few people had questions about other companies that were working on cellulosic ethanol. Our research assistant, Malia Caruso, found these helpful resources: http://earth2tech.com/2008/06/03/12-companies-racing-to-build-cellulosic-ethanol-plants-in-the-us/; http://www1.eere.energy.gov/biomass/past_solicitations.htmll and http://www.energy.gov/news/5903.htm.

Bus Discussion – Return Trip
On the return to Morris, Mike Reese with the West Central Research & Outreach Center (WCROC) http://wcroc.cfans.umn.edu/Renewable_Energy2.html spoke about the potential of hybrid energy systems. He used the example of hybrid corn that takes the best traits of two parents and related that to renewable energy systems that can combine to make good effective systems. With wind, for example, much of the energy is stranded away from the load. WCROC is looking at using wind power to make ammonia and hydrogen for fertilizer, peaking power and transportation fuels. They hope to start the ammonia project in the spring.

He mentioned that at the national ammonia conference two weeks ago Toyota & Caterpillar were both looking at ammonia as an energy carrier for hydrogen because it has good density.

Bob Bonawitz presented about the Citizens Energy Policy http://energyparadox.org/ which is organizing around creating a national policy for an energy mix that is reliable, environmentally friendly and economical. They are recruiting 12 board members from issues areas including solar, wind, coal, gas, nuclear and oil.

Engineer Stan Simon updated the tour about the energy efficiency upgrades and biomass heating system that they are planning for the Murdock School Building (built in1908 with an addition in 1952). They received a $350,000 grant from DEED and are looking to install a biomass heating system that can use wood chips with up to 50% moisture and it is relatively inexpensive; they are working to develop the biomass industry with 45 miles of school of the school.

We arrived back in Morris and adjourned @ 2:45.