Responses to participant questions
AAEA Extension section webinar
April 20, 2011.

Format: There were many chat questions asked during the webinar. Time did not allow for responses to all the questions. The presenters graciously agreed to respond here to the additional questions. Questions that were answered during the webinar were omitted from this list. The answers are identified with the presenter's name in bold.

3. Wisner: Will Francis' presentation including references cited be available to participants?

Dr. Francis Epplin: For cellulosic ethanol see:
Kazi, F.K., J.A. Fortman, R.P. Anex, D.D. Hsu, A. Aden, A. Dutta, and G. Kothandaraman. "Techno-economic comparison of process technologies for biochemical ethanol production from corn stover." Fuel 89(2010):S20-S28.

For "drop-in" fuel see:
Wright, M.M., D.E. Daugaard, J.A. Satriob and R.C. Brown. "Techno-economic Comparison of Biomass-to-Biofuels Pathways." Fuel 89-1(2010): S2-S10.

16. Horace: topic: Where is the 1 billion tons of biomass coming from. Can the source be totally domestic or will it have to be global? If global what does that do for the security portion of EISA?

Dr. Cole Gustafson – Just after the seminar, the International Energy Agency forecast that 3 billion tons are needed globally. Therefore the U.S. must compete with other demands internationally. While 1 billion tons may be produced domestically, it is doubtful that it is all economically or technically available.

Dr. Francis Epplin: There have been several studies to determine potential sources and costs of delivering biomass to fulfill the 16 billion gallons/year cellulosic biofuel mandate. The map I showed was based on a report prepared by the USEPA. "U.S. Environmental Protection Agency. 2010. Renewable Fuel Standard Program (RFS2) Regulatory Impact Analysis."

Table 1.8-13. on page 275 includes: Cellulosic Feedstocks Assumed to Meet EISA in 2022

Feedstock	Volume (Ethanol equivalent Bgal)
Agricultural Residues	9.1
Corn Stover	7.8
Sugarcane Bagasse	1.2
Sweet Sorghum Pulp	0.1
Forestry Biomass	3.8
Urban Waste	2.2
Dedicated Energy Crops (Switchgrass)	0.9

Total 16.0
Based on their assumptions only a small proportion of the biomass would come from dedicated energy crops.

For another study with different findings see:
http://www.agpolicy.org/ppap/REPORT%2025x25.pdf

Perlack et al. (2005) anticipate that 55 million acres of U.S. cropland, idle cropland, and cropland pasture could be seeded to a dedicated perennial energy crops with little economic consequences for food and fiber production.

Perlack, R.D., L.L. Wright, A.F. Turhollow, R.L. Graham, B.J. Stokes, and D.C. Erbach. 2005. Biomass as Feedstock for a Bioenergy and Bioproducts Industry: The Technical Feasibility of a Billion-Ton Annual Supply. Washington DC: U.S. Department of Agriculture, U.S. Department of Energy.

17. Keiser: I would be interested in a detail discussion on the merits of millet as an energy crop.

Dr. Cole Gustafson – I have not followed this as the crop is not widespread in the northern plains.

Dr. Francis Epplin: The only study that I have been involved with that included millet was with foxtail millet as a double cropped hay crop in a rotation with wheat. As I recall adding the millet resulted in not much more than breakeven.
Decker, J., F. Epplin, D. Morley, and T. Peeper. Economics of five wheat production systems with no-till and conventional tillage. Agronomy Journal 101-2(2009):364-372.

18. Brummel: Topic: Basis implications for wheat markets

Dr. Cole Gustafson - Economic theory suggests that additional demand for a co-product will enhance the entire value of the crop leading to a positive acreage response and greater production.

19. Ferris: Biodiesel

Dr. Francis Epplin: Potential biodiesel and renewable diesel feedstocks include:
Vegetable oil (form oil seeds such as soybeans, canola, camelina, pennycress)
Corn oil from ethanol production
Rendered animal fats and greases
Algae oil or other advanced sources

20. Brummel: What kind of by-products are possible from a stover facility, and are there any values attached to these by-products?

Dr. Cole Gustafson - As my slide from Inbicon showed, the products are biopellets which are essentially lignin and animal feed which are the C5 sugars that are not commercially fermented with available technology.

Dr. Francis Epplin: It depends on the conversion system.

22. Wisner: Cole Do you see conversion of crop residues to ethanol as being able to compete with direct use of the material in electric power plants?

Dr. Cole Gustafson - Use of biomass for co-firing in electrical plants is a low value use for the resource. Biomass has more value in conversion to biofuels and other high value chemicals. As the industry develops, residual co-products will be co-fired as my Inbicon slide shows.

Dr. Francis Epplin: We have evaluated switchgrass relative to coal. See:

Aravindhakshan, S., F. Epplin, and C.M. Taliaferro. Economics of switchgrass and miscanthus relative to coal as feedstock for generating electricity. Biomass and Bioenergy 34(2010):1375-1383.

The short answer is that it is cheaper to burn coal to produce electricity. More formally "..In the absence of government intervention such as requiring biomass use or instituting a carbon tax, biomass is not an economically competitive feedstock for electricity generation in the region studied…"

For a study of corn stover specific to Iowa see:

English BC, Short C, Heady EO. The economic feasibility of crop residues as auxiliary fuel in coal-fired power plants. American Journal of Agricultural Economics 1981;63(4):636-44.

24. Keiser: Would an energy crop be a better rotational crop for corn/soy beans that wheat?

Dr. Cole Gustafson – As demand for all energy crops expands, producers will have an opportunity to incorporate them into all rotations. Each will have unique agronomic implications.

Dr. Francis Epplin: For current market conditions throughout most of the Corn Belt it is difficult for wheat to compete economically.

26. Sam: Q: Might non-dwarf wheat varieties ever come back as the stover becomes more valuable?

Dr. Cole Gustafson – Yes, our team has commented on that. It all depends if the producer is provided an economic incentive to raise a riskier variety and one that requires more time/effort to process.

27. Kelly: Monsanto mentioned the equipment that they are evaluating for the ADM / Monsanto Sustainable Corn Stove Harvest Research Project .Are any of these being evaluated for the Spiritwood project?

Balers used in 2010:

1 New Holland BB9080
2 Case IH RB564
3 John Deere 567/568

Grinders evaluated:

1 Peterson-Pacific Horizontal Grinder - Model 6700B, 1000HP
2. Vermeer Tub Grinder - Model TG5000, 540HP
3. Haybuster Tub Grinder - Model 1150, 595HP
4. Rotochopper Horizontal Grinder - Model B66, 765HP

Dr. Cole Gustafson – We are familiar with these equipment. The balers under consideration are actually higher capacity and produce denser bales to reduce transportation costs. I don't see local grinding as it is very high cost. Each additional machine operation adds to total biomass cost and reduces it's competitiveness.

28. Heinkel: Aren't most combines "rotary" these days?

Dr. Cole Gustafson - In our region they are about 50/50, but market share is increasing.

29. Kelly: Primeboard® Inc. is a particleboard manufacturer. Any direct knowledge gained from their handling of the wheat straw?

Dr. Cole Gustafson – Yes, we have been in contact with producers and the contractor. The prices and rates quoted were from them.

31. Brummel: How accepting are producers to allow traffic in their fields, is $15 dollars enough to incentivize producers?

Dr. Cole Gustafson - $15 is incenting producers who supply Primeboard. Compaction is an increasing concern among producers. Large scale biomass processing equipment will be required to economically collect and process, but machinery at the scale has greater impact on soil.

Dr. Francis Epplin: Excellent question. Reminded me of a quote from a farmer published in the Omaha World-Herald in 2007:
"Our main concern is $4 / bu corn (worth $750 to $800 an acre)," Johnson (a corn producer) said. "$30 / acre for biomass is a minor concern for our operation."

Source: Bill Hord, 27 March 2007, Omaha World-Herald

32. Ferris: In central Iowa, to feed a 50 million gallon corn ethanol plant requires about 50 hopper bottom semi-trailers from a maximum of 12 to 15 miles daily if have of the available corn is involve. For a similar sized corn stover plant, 150 semi-trailers per day from as far as 35 miles would be required. Have the implications of the transportation been fully researched?

Dr. Cole Gustafson – We considered 1) Logistics to ensure the timing of trucks hauling can be accommodated at plant delivery and 2) We also discerned the impact on rural road infrastructure by noting which roads were capable of handling increased traffic and what increased traffic implied for damage and earlier replacement.

Dr. Francis Epplin: We have attempted to model the field to fuel chain with switchgrass as the feedstock. The corn-ethanol model is not a good model for switchgrass to biofuel. The models suggest that production characteristics and harvest cost economies for perennial grass production for use as a dedicated energy crop would result in a system that more nearly resembles the structure of U.S. timber production rather than the atomistic system that we observe for U.S. grain and oilseed production. If the low-cost feedstock is a perennial, such as switchgrass, with a long stand life and a wide harvest window such as switchgrass, market forces could be expected to drive the structure toward vertical integration. For a mature industry, feedstock production, harvest, and transportation may be centrally managed and coordinated.

The length of the harvest window matters a great deal. Many of our timber firms harvest throughout the year and deliver logs daily for processing. In Oklahoma, switchgrass could be harvested from July through March – over nine months.

The harvest window for corn stover in much of the corn belt would be relatively narrow. This requires a substantially greater investment in harvest machines and in storage to provide for a flow of material to a biorefinery throughout the year.

We have not fully researched the consequences on roads and bridges.

33. Deering: Is the nutrient and soil conservation value of corn stover and other crop residues being fully accounted for?

Dr. Cole Gustafson – Several studies including ours and those in corn belt are evaluating not only lost fertility value but also impacts on soil health and organic matter. The last point is a bit of contention as my last slide and comments described impending conflict with USDA/NRCS.

34. Pennington: You mentioned the study by Kazi et al about cost per gallon to produce cellulosic ethanol - were these fermentation processes? What is the current cost per gallon for pyrolysis?

Dr. Cole Gustafson – I defer to Francis.

Dr. Francis Epplin: For cellulosic ethanol (biochemical and thermochemical) see: Kazi, F.K., J.A. Fortman, R.P. Anex, D.D. Hsu, A. Aden, A. Dutta, and G. Kothandaraman. "Techno-economic comparison of process technologies for biochemical ethanol production from corn stover." Fuel 89(2010):S20-S28.

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Wright et al. (2010) evaluated fast pyrolysis of cellulosic biomass to bio-oil and upgrading of the bio-oil to naphtha and diesel range fuels. They estimate production cost of $2.11 per gallon of gasoline equivalent for the nth plant.

35. Wisner: Can the biomass feedstock be stored outside without problems?

Dr. Cole Gustafson – There are going to be losses when stored outside. Our system utilizes elevated platforms, drainage, and covered tarps. Other studies assume no cover and just expect to loose the top layer of material.

Dr. Francis Epplin: This is one of the reasons why the length of the harvest window is important to the economics.

The group at the U. of Tenn has evaluated storage losses:
http://ageconsearch.umn.edu/bitstream/56518/2/Larson%20et%20al.%20SAEA%202010%20Submitted%20Paper%201-15-10.pdf

36. Horace: Would it be better to burn the biomass for Electric power generation or to make biofuels?

Dr. Cole Gustafson, co-firing biomass to produce electricity is a low value use of biomass. It is usually only viable when a utility is mandated to produce a certain level of renewable energy. Biofuels and other high value chemicals offer greater economic potential.

Dr. Francis Epplin: We have evaluated switchgrass relative to coal. See:

Aravindhakshan, S., F. Epplin, and C.M. Taliaferro. Economics of switchgrass and miscanthus relative to coal as feedstock for generating electricity. Biomass and Bioenergy 34(2010):1375-1383.

The short answer is that it is cheaper to burn coal to produce electricity. More formally "..In the absence of government intervention such as requiring biomass use or

instituting a carbon tax, biomass is not an economically competitive feedstock for electricity generation in the region studied…"

This corn stover study from 30 years ago is still relevant :

English BC, Short C, Heady EO. The economic feasibility of crop residues as auxiliary fuel in coal-fired power plants. American Journal of Agricultural Economics 1981;63(4):636-44.

Public policy is more interested in finding alternatives to crude oil (since some of it is imported) than in finding alternatives to coal.

37. Sanders: are estimates of water use still about 4-6 gal/gal of ethanol?

Dr. Cole Gustafson – the efficiency of ethanol plants continue to improve. Recent studies show that new firms can produce ethanol with only 3 gal. of water. Our energy beet project assumes to produce biofuel with only 1 gal. of water.

Dr. Francis Epplin: Water requirements for the cellulosic feedstock processes are expected to differ depending on the conversion system. I don't have a range on the estimates.

38. Pennington: Will DOE or USDA start shifting R&D dollars toward this infrastructure problem?

Dr. Cole Gustafson – The both have invested considerable funding already to develop a biofuel infrastructure in our nation.

Dr. Francis Epplin: USDOE in partnership with USDA have, and are funding a Biomass Research and Development Initiative. That includes "…Feedstocks Development – Research, development and demonstration activities regarding feedstocks and feedstock logistics (including harvest, handling, transport, preprocessing, and storage) relevant to production of raw materials for conversion to biofuels, bioenergy, and biobased products…."

39. Horace: Is there enough marginal land to grow enough biomass to significantly affect the energy demand?

Dr. Cole Gustafson – My view is that if biomass becomes profitable, the most productive regions of our country will raise it – just as is the case with other commodities.

Dr. Francis Epplin: Perlack et al. (2005) anticipate that 55 million acres of U.S. cropland, idle cropland, and cropland pasture could be seeded to a dedicated perennial energy crops with little economic consequences for food and fiber production. Similarly, English et al. (2006) conclude that with some economic incentives, switchgrass could be established on more than 100 million U.S. acres.

Perlack, R.D., L.L. Wright, A.F. Turhollow, R.L. Graham, B.J. Stokes, and D.C. Erbach. 2005. Biomass as Feedstock for a Bioenergy and Bioproducts Industry: The Technical Feasibility of a Billion-Ton Annual Supply. Washington DC: U.S. Department of Agriculture, U.S. Department of Energy.

English, B.C., D.G. De La Torre Ugarte, K. Jensen, C. Hellwinckel, J. Menard, B. Wilson, R. Roberts, and M. Walsh. 2006. "25% Renewable Energy for the United States by 2025: Agricultural and Economic Impacts." Department of Agricultural Economics, University of Tennessee.

40. Sam: Any carbon base can theoretically be converted to a bio-diesel as I understand from the NBB 41.

41. Keiser: Would Millet be a good energy crop for fast Pyrolysis and production of Diesel fuel?

Dr. Cole Gustafson – I am not familiar with millet.

42. Pennington: What is biomass based diesel? Produced from canola or soybean oil?

Dr. Cole Gustafson - Biomass or renewable diesel differs from biodiesel in that it originates from a biomass feedstock instead of an oil crop. One of the most popular sources at present is corn oil obtained from new ethanol plants that have invested in fractionation.

Dr. Francis Epplin: Potential biodiesel and renewable diesel feedstocks include:
Vegetable oil (from oil seeds such as soybeans, canola, camelina, pennycress)
Corn oil from ethanol production
Rendered animal fats and greases
Algae oil or other advanced sources