USDA Biofuels Meeting Report

State:	Vermont
FSA State Director:	Robert G. Paquin
RD State Director:	Molly Lambert
NRCS State Conservationist:	Vicky Drew
FS Representative	Chris Casey, Sylvaculturalist, Green Mountain National Forest

Date of Meeting:	October 20, 2010
Location of Meeting:	Vermont State House
City, State, Zip:	Montpelier, VT 05602

Number of Attendees:	49

Executive Summary

Attendees wanted to make sure that all appropriate biomass energy potential was included in our national effort to reduce greenhouse gases and our dependence on imported oil. In the Northeast, transportation and liquid biofuels are not where the greatest potential is to be found. Rather the displacement of home heating oil by biomass holds vast potential—the Northeast consumes over 80 per cent of the nation's heating fuel oil. There was almost unanimous support for a regional approach to bio-energy issues taking regional differences and opportunities into consideration, including regional equity in grant funding which would then be reviewed by a regional board.

Attendees also felt it was important not to pit liquid and solid biomass against one another, or transportation against stationary such as school or home heating. The goal is the same—to reduce our nation's greenhouse emissions and dependence on foreign oil. There is a role for biofuel in the Northeast—on farm, in fleets for example, but it must be placed in perspective.

Note: We grouped the questions into four categories: Production, Markets, Government Role and Sustainability. Attachments: agenda, the discussion questions, attendee comment summary, attendee list and some additional submitted comments/amplified remarks including a letter to the Secretary signed by nearly 200 Northeast businesses, organizations and individuals.

AGENDA

USDA/Vermont 25 X 25 Alliance Biofuels Forum

October 20, 2010 Montpelier, Vermont

2:00PM—Welcome and Introductions: Netaka White, VSJF* & Vermont 25 X 25 Alliance

2:10PM—Secretary Tom Vilsack Video Message

2:15PM—USDA Biofuels Draft Plan Presentation with Power Point: Bob Paquin, USDA/FSA

2:30PM—Facilitated Discussion/Production: Bob Paquin, USDA/FSA

2:50PM—Facilitated Discussion/Markets: Netaka White, VSJF & Vermont 25 X 25 Alliance

3:10PM—Facilitated Discussion/Government Role: Vicky Drew, USDA/NRCS

3:30PM—Facilitated Discussion/Sustainability: Susan Allen, Renewable Energy-Vermont

3:50PM—Wrap-up: Netaka White and Bob Paquin

4:00PM—Adjourn

*Vermont Sustainable Jobs Fund

Please Note

Additional comments and recommendations are welcome and may be submitted to USDA through the end of October in writing via mail, fax or e-mail to: USDA/FSA, 356 Mountain View Drive, Suite 104, Colchester, VT 05446: fax: (802) 660-0953: or e-mail: robert.paquin@vt.usda.gov.

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Suggested Discussion Questions for USDA/25 X 25 Biofuels Forum

Production

Are there potential sources of regional feedstock that could contribute to expanded biofuels production?

Are there further opportunities for expanding production capacity that should be considered?

What are your views of the estimated land use needed or available in Vermont for biofuels?

What are the key conditions that you need to be assured exist or issues that need to be addressed before you would grow biomass for biofuels, or continue to invest time and resources into developing a biofuels sector in Vermont?

Markets

Are there ways to harness current local infrastructure such as biodiesel blending, storage or distribution?

What are the top issues or concerns which might deter you from considering growing biofuels crops or investing time and resources into developing a biofuels sector in Vermont?

Who has experiences with flexible fuel vehicles (FFVs)? Why did you purchase an FFV? Do you use biofuels higher than E10? Why, or why not?

What are your views of the projection of corn-starch ethanol contributing 15 billion gallons of the nearly 140 billion gallon U.S. fuel demand by 2022?

As a consumer, what are your expectations of biofuels such as performance, access and price? Are there differences in biofuels you would be willing to accept in order to switch from standard fuels?

What do Vermont and our region offer in meeting biofuels goals? What are the barriers or challenges we face in our state/region to meeting biofuels goals?

Government Role

How can State or Federal government agencies partner with the private sector to expand the demand for and use of biofuels? Would such a plan push the private sector to meet the increased supply needs?

In what ways can the government help to expedite biofuels infrastructure or other improvements in the private sector?

Are there innovative state-based programs or incentives that have worked and that the Federal government should consider implementing nationwide?

Sustainability

What are your expectations around biofuels production and environmental sustainability? What is your definition of "sustainability" as it relates to expanded production and use of biofuels?

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MEETING NOTES PRODUCTION	
Andrea Colnes, Biomass Energy Resource Center (BERC)	Liquid biofuels potential not highest in New England; need to include solid biofuels—greatest source of biomass and heating fuel—greatest use (NoEa uses 85% of total US fuel oil consumption)
Matt Cota, Vermont Fuel Dealers Association	Tremendous potential in biofuels for heating by blending with heating oil
Heather Darby, UVM Extension	Many people can only use liquid fuel. Cannot manage solid fuel. Great biofuel potential in VT--Can grow oil-seed crops, feed byproducts to livestock using farming systems
Steve Sinclair, VT Dept of Forest, Parks, & Recreation	Concerned about using logging residue- not suitable for ethanol production—wastes too much energy to convert—use it as is—solid biomass fuel
Ellen Kahler, Vermont Sustainable Jobs Fund	Oilseed crops can replace farm diesel use. Think multi-sources: Switchgrass (thermal), Industrial hemp (thermal) and algae is currently being produced to make biodiesel
Dan Scruton, VAAFM	Manure can be used in algae system
Scott Gordon, Green Technologies, Inc.	Infrastructure to conversion is the barrier in VT
Robert Foster, Foster Brothers Farm / Agri-Mark	Need to evaluate existing data on ability to use biofuels to meet energy targets to make sure data used in USDA report accurate
Dan Scruton, VAAFM	Need changes in federal rules on CRP and CREP land to allow biofuel to be harvested
Heather Darby, UVM Extension	Need to develop VT scale models, need Federal (USDA) funding
Roger Rainville, Borderview Farm	Biodiesel being produced on his farm for $1.70/gallon
Ellen Kahler, Vermont Sustainable Jobs Fund	Need to move from 1,000 to 10,000 acres of oilseeds to produce enough to reach goal
Dan Scruton, VAAFM	Idle acres that can be used (CRP)
Steve Graci, Nava Bioenergy	Cooperative efforts among farms to produce feedstock require USDA support Cooperative efforts among grower, manufacturer, & converter do as well.
Heather Darby, UVM Extension	Need infrastructure to create markets to stimulate production
MARKETS	
Matt Cota, Vermont Fuel Dealers Association	Legislation requiring percentage of biofuel used in fuels needed—20% a good target
Steve Graci, Nava Bioenergy	Use of waste oil for biodiesel in Vermont is happening now
Scott Gordon, Green Technologies, Inc.	Need to determine the number of biofuel facilities wanted/needed
Andrea Colnes, BERC	Markets and infrastructure needed to use solid biofuels
Ellen Kahler, Vermont Sustainable Jobs Fund	Need oilseed crushing facility and year round blending capacity
Matt Cota, Vermont Fuel Dealers Association	Need federal regulated percentage of biodiesel in fuel oil- 5%-20%
Tom Berry, Sen. Leahy	Need to maintain state focus on production and use
Roger Rainville, Borderview Farm	Investment needed on the farm isn't that large to produce fuel for the farm
Tanner Williamson	Williamson farm processes oilseeds and crops to produce biofuels
Matt Cota, Vermont Fuel Dealers Association	Uses biofuel in delivery trucks. Performance is good, there are no issues or downsides

Winston Sadoo, New tech Energy Systems, Inc.	Biofuel used by farmers, used in trucks and home. Company produces 800 gallon/day now, are currently expanding
Gina Campoli, VT Trans Agency	Uses biodiesel in truck fleet but had to cut back blend from 20% to 5% due to warranty issues. Supply shortage.
GOVERNMENT ROLE	
Andrea Colnes, BERC	For district energy systems to use solid biofuels, capital cost is an issue. Need grants up front and guaranteed loans.
Steve Graci, Nava Bioenergy	Matching grants aren't enough, it is hard to get match Use competitive process for grants Base grant funding on production goals
Scott Gordon, Green Technologies, Inc.	Zoning , permitting issues not established for biodiesel Set a template
Matt Cota, Vermont Fuel Dealers Association	Funding through tax on heating oil for R&D
Heather Darby, UVM Extension	Government needs to understand that VT is unique in biofuel development
Brian Woods, VTrans	Biofuels can help with the reduction of carbon content of fuels. Needs to be a Regional effort
Steve Graci, Nava Bioenergy	National educational campaign to counter stigmatization of biofuel use needed
Ellen Kahler, Vermont Sustainable Jobs Fund	Revamp 5 year energy plan based on regional specific issues, needs and potential
Tom McGrath, UVM Transportation Research Ctr	Studies looking at biodiesel blends and emissions are underway—more needed.
Paul Comey, GMCR	Lack of stability of fuels with ethanol Fuels are unstable and cause problems in marine industry
Tom Berry, Sen. Leahy	EPA should review these comments
Gina Campoli, Vtrans	Federal government should embrace regional solutions
SUSTAINABILITY	
Gina Campoli, VTrans	Carbon content in all fuels must be considered
Ellen Kahler, Vermont Sustainable Jobs Fund	Need to know greenhouse gas emissions balance in VT, specific to VT scale, systems, etc. Current research on too large a scale. See amplified remarks attached
Scott Gordon, Green Technologies, Inc.	Sustainability parameters change over time
Brian Woods, VTrans	Consider the full range of sustainability issues (air quality, water quality, food security, etc.)
Steve Sinclair, VT Dept of Forest, Parks, & Recreation	Woody biomass sustainability standards should be set by states Sustainability issues/standards need to be set by states
David Frank, Sunwood Biomass Company	Woody biomass has not been shown to be sustainable Look at addressing fuel oil
Jamey Fidel, VNRC - Biomass	Procurement standards for woody biomass needs to be consistent in region
Bob Foster, Foster Brothers Farm / Agri-Mark	USDA can be the repository of information related to biofuels (land use, food/fuel issues)
Scott Gordon, Green Technologies, Inc.	Ratio between population and resources See amplified remarks attached

BIOFUELS FORUM ATTENDEES			
	First	**Last**	**Organization**
	Sue	Allen	Renewable Energy/Vermont (REV)
	Tom	Berry	Staff/Senator Patrick Leahy
	Michele	Boomhower	Chittenden Cty Metropolitan Planning Org
	Gail	Busch	Algepower Inc.
	Chris	Callahan	Vermont Sustainable Jobs Fund (VSJF)
	Gina	Campoli	Vermont Agency of Transportation (VTrans)
	Chris	Casey	Green Mountain National Forest
	Jane	Clifford	Clifford Dairy Farm
	Tricia	Coates	Staff/Representative Peter Welch
	Andi	Colnes	Biomass Energy Resource Center (BERC)
	Paul	Comey	Green Mountain Coffee Roasters
	Peter	Condaxis	Ryegate Power
	Matt	Cota	Vermont Fuel Dealers Association
	Heather	Darby	UVM Extension
	Vicky	Drew	USDA
	Cheryl	Ducharme	USDA
	Jamey	Fidel	Vermont Natural Resources Council (VNRC)
	Jackie	Folsom	Vermont Farm Bureau
	Robert	Foster	Foster Brothers Farm / Agri-Mark Dairy Co-op
	David	Frank	Sunwood Biomass Company
	Scott	Gordon	Green Technologies, Inc.
	Stephen	Graci	Nava Bioenergy
	Jesse	Huffman	REV
	Larry	Johnson	Sugarmaker
	Ellen	Kahler	Vermont Sustainable Jobs Fund
	Sara	Kittell	Vermont State Legislature
	Bob	Kort	USDA/NRCS
	Kim	Locke	Carbon Harvest Energy
	Kelly	Lucci	Staff/Senator Bernard Sanders
	Allen	Matthews	Center for Sustainable Ag at UVM
	Tom	McGrath	UVM Transportation Research Center
	Kevin	Morehouse	USDA/ Rural Development
	Jenny	Nelson	Staff/Senator Bernard Sanders
	Don	Ostler	Green Mtn. Coffee Roasters
	Michael	Raker	Ag Energy Consultants
	Bob	Paquin	Vermont Farm Service Agency
	Bill	Peterson	Green Mountain National Forest
	Kim	Peterson	USDA/FSA
	Roger	Rainville	Borderview Farm
	Diane	Reynolds	State of VT Clean Energy Development Fund
	Winston	Sadoo	NewTech Energy Systems Ltd

	Dan	Scruton	VAAFM
	Steve	Sinclair	VT Dept of Forest, Parks & Recreation
	John	Thurgood	District Conservationist, NRCS
	Netaka	White	Vermont Sustainable Jobs Fund
	Bren	Whittaker	FSA State Committee
	Tanner	Williamson	State Line Farm
	Brian	Woods	VTrans
	Stephanie	Zehler	Agency of Agriculture

Vermont Sustainable Jobs Fund

Accelerating the Development of Vermont's Green Economy

Robert Paquin
State Executive Director
USDA Farm Service Agency
356 Mountain View Drive Suite 104
Colchester, VT 05446

Dear Bob

Thank you for the leadership you and your team provided yesterday, giving the Vermont bioenergy stakeholders an opportunity to highlight state and regional issues of importance. On behalf of the Vermont Sustainable Jobs Fund, I am submitting the following responses to the discussion questions. Not knowing exactly how you plan to format your report to Sec. Vilsack, I understand that some editing may be necessary. If that's the case, responses marked with an "**" are the most important items to include from this report

I enjoyed working with you and Kim on the forum, and thanks for involving me and the 25x'25 Alliance!

Sincerely,

Netaka

Netaka White, Bioenergy Programs Director

PRODUCTION

1. Are there potential sources of local feedstock that could contribute to expanded biofuels production?

   ****The following crops are being grown in increasing quantities** (industrial hemp being the exception):

   a. **Sunflower, canola, soy, camelina** – (for biodiesel),
   b. **Sweet sorghum** - (conventional ethanol),
   c. **Switchgrass** - as a dedicated biomass energy crop for thermal heating and (eventually) liquid fuel
   d. **Algae** - biodiesel and ethanol
   e. **Industrial hemp** - for thermal heating and liquid fuel (16 states, including Vermont, have enacted laws that establish low THC hemp as a valuable agricultural crop. But without a change in federal law, which would move regulation of hemp from the DEA to the USDA, there is still no commercial hemp production in the US)

2. Are there further opportunities for expanding production capacity that should be added?

VSJF and our project partners have been working to develop a model of ***Local Production for Local Use.* **Vermont's first priority with biofuel produced in the Vermont is to reduce the amount in state of fossil fuel consumption.**

Since 2005, the VSJF has committed ~$3.5M (from DoE grants) and focused a considerable amount of technical assistance on the *Vermont Biofuels Initiative:* **Oilseeds/biodiesel, cold climate algae, and grass energy, http://www.vsjf.org/projects/1/vermont-biofuels-initiative

- To reduce the state's dependency on fossil fuels,
- Help farms be more self sufficient (feed, soil amendments and energy)
- Help Vermont's rural economy.

For instance:

a. **Oilseeds-to-biodiesel: principally on-farm use**. A distributed fuel production model, ie., farmer/producer groups with individual farms growing crops and having them processed into meal and fuel at one of the farms.

VSJF research indicates 1 **or 2 facilities with 1-2 million gallons** per year (MGPY) of biodiesel production capacity from local oilseeds are feasible and sustainable. **These small-scale models as yet have not figured into DoE or USDA analysis of opportunities, and they need to!**

Over the next 10-12 years, **6 to 8 on-farm oilseed processing centers (250k to 500k GPY) and 1 or 2 larger facilities (1 MGPY) could produce 5-6 MGPY. This amount of biofuel is **enough to run Vermont's entire agricultural sector** *(without taking land out of food production).*

b. ****Algae-to-biofuels:** Current algae prototypes and R&D underway in Vermont indicate in state oil production potential of 30-50 MGPY by 2022.

c. ****Dedicated biomass energy crops, like switchgrass,** are now being grown successfully in Vermont. A variety of R&D and pilot projects are underway to determine the feasibility and the extent to which grasses can contribute to thermal heating demand and eventually cellulosic fuel production.

3. What are your views of the estimated land use needed or available in Vermont for biofuels?

a. ****Oilseeds, near term: Our 5-year goal is to provide infrastructure grants and TA to farms and entrepreneurs to grow and process ~10,000 acres of oilseed crops** (soy, sunflower, canola) in rotation with grains and grasses, to produce 750,000 gallons of biodiesel (and 12,500 tons of meal), this is ~12% of agricultural fuel demand.

b. **Oilseeds, Long term:** VSJF research examined potential land use changes for oilseed production = **by 2025, up to 90,000 acres per year (or 15% of available cropland)** could be put into oilseeds without taking land out of food production, and producing **5 to 6 MGPY** of biodiesel, plus meal as a feed or fertilizer

c. ****Algal oil:** projections indicate that 500 to 1000 acres of marginal land will be needed by 2025. (30-50 MGPY)

d. **Grass energy**: land use estimates have not been assessed.

4. What are the key conditions that you need to be assured exist or issues that need to be addressed before you'd grow biomass for biofuels, or continue to invest time and resources into developing a biofuels sector in Vermont?

a. **Increased (private and public sector) **investment in infrastructure** for growing and processing oilseed crops

b. ****On-going R&D** to reduce pest and weed pressures and increase crop yields using low-input management practices.

c. ****More commitment from State Government** to support energy crop production as a component of sustainable and diversified agriculture.

d. ****More public outreach** *focusing on the economic, environmental and societal benefits* of local and sustainable biofuels production (and use).

MARKETS

5. Are there ways to harness current local infrastructure such as biodiesel blending, storage or distribution?

   a. Year-round blending capacity is a must, *since most of the biodiesel sold in the state is blended with petrodiesel or heating oil.* Recent VSJF grants have helped to fund 2 biodiesel blending facilities - to go on-line in early 2011. **One more blending facility in Southern VT is needed.** These facilities are vital so **that:**

      i. Biodiesel produced in-state is used in state, and

      ii. B99 can be imported, blended and distributed to meet a variety of blend preferences, performance characteristics and price points for the end-user.

   b. ****An in-state oilseed crushing facility** would create a much-needed market "pull" for area growers. This facility should be located in Addison or Franklin county, and grow to have the capability of processing at least 50,000 tons (~50,000 acres) of seed.

   c. ****Biodiesel made from local feedstocks** (at the larger 1-2 MGPY facilities) would ideally be blended, distributed and used in state, instead of being exported.

6. What are the top issues or concerns you would want to avoid, or be protected against; and what might deter you from considering growing biofuels crops, or investing time and resources into developing a biofuels sector in Vermont?

   a. ****It is very important that Vermont farmers have access to in-state oilseed crushing and biodiesel production capabilities** *to avoid a scenario where we are exporting raw commodities to meet the national goals.*

7. Who has experiences with flexible fuel vehicles (FFVs)? Why did you purchase an FFV? Do you use biofuels higher than E10? Why, or why not?
   a. No comment

8. What are your views of the projection of corn-starch ethanol contributing 15 billion gallons of the nearly 140 billion gallon U.S. fuel demand, by 2022?

   a. VSJF has reviewed a number of independent studies regarding production and use of corn ethanol. **We feel overall that a corn-ethanol target of around 10% of total domestic fuel consumption is reasonable.** We have a few observations to make:

      i. EPA took an important step to include land use change in their biofuel life cycle assessments. Current analysis has shown that compared to gasoline, corn ethanol production and use can reduce GHG emissions and even though this fuel pathway

shows the least reduction of all biofuels**, Ethanol's contribution to GHG is a 20% improvement over gasoline.**

ii. Contrary to much media attention, **there is no consistent evidence that corn ethanol production has any significant impact on food supplies or prices.** (High energy costs, crop losses from bad weather and retail price gouging are the leading causes of volatile food prices).

9. What do Vermont and our region offer in meeting biofuels goals? What are the barriers or challenges we face in our state/region to meeting biofuels goals?

   a. **As noted above, we believe that Vermont has the technology and agricultural land potential to create between **25 million and 50 million gallons of biodiesel and an as-yet-to-be-determined amount of cellulosic ethanol from energy crops, by 2025.**

   b. **VSJF believes that **Vermont should not be developing its forest resources for liquid fuels** - but instead should be looking to the sustainable production and utilization of woody biomass to meet thermal or CHP demands

10. As a consumer, what are your expectations of biofuels as a fuel, such as performance, access, price? Are their differences in biofuels that you'd be willing to accept in order to switch from standard fuels?

   a. **We should not sacrifice performance, supply reliability or convenience to utilize biofuels.

   b. Biofuels can reduce GHG emissions and other pollutants, sometimes dramatically. This is well documented.

   c. As long as the true cost of fossil fuels is not reflected in the price we pay at the pump, and the petroleum industry continues to receive $billions$ in tax breaks, we should expect to pay slightly more for biofuels.

GOVERNMENT ROLE

11. How can the State or Federal government agencies partner with the private sector to expand the demand for biofuels? Would such a plan push the private sector to meet the increased supply needs?

   a. ****Develop and promote a series of regional energy plans that focus on the benefits and advantages of energy efficiency and renewables.** Evidence suggests the general public doesn't recognize the positive environmental, economic and energy security *advantage* of biofuels; instead the focus has been on narrow media representation of the negative aspects.

   b. **Federal government needs to **significantly increase the CAFE standards** to reduce overall demand for all forms of transportation energy, including biofuels.

   c. National transportation strategy should be placing more emphasis on **making electric vehicles efficient, convenient and affordable.**

12. In what ways can the government help to expedite biofuels infrastructure or other improvement in the private sector?

   a. **Develop a **wide spectrum regional energy plan** that addresses the unique regional energy demands, existing energy infrastructure, all bioenergy resources and processes. Then! adapt federal grants, programs and other strategies to enable adoption of the plan(s)

   b. ****Restore the federal biodiesel tax credit!** Make it retroactive

c. Then, move the federal tax credit **from a blender's credit to a producer's credit.**

13. Are there innovative state-based programs or incentives that have worked, and that the Federal government should consider copying nationwide?

    a. Public Service Announcements that promote the benefits of biofuels and bioenergy

SUSTAINABILITY

14. What are your expectations around biofuel production and environmental sustainability? What is your definition of 'sustainable' as it relates to expanded production and use of biofuels?

    a. **Biofuels can and should be produced using **methods that do not deplete or damage soil, water or air quality; that do not take away from critical food production** (i.e., high fructose corn syrup and its derivatives are not critical food supplies); **that sustain biodiversity and contribute to local economic prosperity etc, for generations.**

    b. **Meeting sustainability principles and guidelines, and incorporating them into best practices **is a process of continuous improvement. Producers should develop effective and efficient implementation, monitoring and evaluation plans.**

    c. **The public must be assured the **biofuels meet the minimum lifecycle GHG** thresholds established in the RFS2

    d. **As stated earlier, biofuels can reduce GHG emissions and other pollutants, sometimes dramatically. But to be eligible for the RFS2 mandate or benefit from federal incentives, **biofuel producers should be held accountable to a regulatory structure** that verifies their feedstock production sources and methods.

    e. **US biofuels policy should be in line with the **Roundtable on Sustainable Biofuels 3rd party verified** ("certified") protocol. Website available: http://www.bioenergywiki.net/Roundtable_on_Sustainable_Biofuels

Basic Biofuels Strategy(s) for the Northeast

Scott Gordon - GreenTech VT

Feedstocks

Starch/Sugar
e.g. corn, sugar beets, sorghum etc.

Oilseeds/Algae
Soy, canola, camelina, algae, etc.

Cellulose/Hemicellulose/lignin
Grass, wood, etc.

Other
Waste veg oils, waste food, MSW (municipal solid waste), trap grease, sewage sludge, manure etc.

Protein/Food
Food vs fuel - must be addressed at policy level even though food vs fuel argument is largely specious, the food & fuel message is not getting across loudly enough

Feedstock utilization

Starch/Sugar
Fermentation => ethanol + feed
ABE process => acetone + butanol + ethanol
Non Fermentative transformation => specialty products e.g. HF corn syrup, industrial feedstocks etc.

Oilseeds/Algae
Oil extraction => Transesterification => Biodiesel + Feed
Oil extraction => other processes => specialty chemicals/products (general point: high margin return for ag producers unlike fuels which are low margin, a blend of high and low margin activities is essential for boosting small scale production of fuels & ag products in general)

Cellulose/Hemicellulose/Lignin
a) Burn as fuel
b) Water gas shift (gasifier) => Syn gas => Fischer Tropsch => Synthetic Liquid fuels (e.g. green diesel, green Jet A, green JP8, etc.) + char + HEAT
c) Biofine process => Levulinic acid + char => add ethanol => Ethyl Levulinate (liquid fuel)
d) Delignification => Enzymatic Digest => Fermentation => Ethanol ("cellulosic ethanol")
e) Hemicellulose => see U Maine

Other
Bio oils => transesterification => biodiesel
Food/other wastes => anaerobic digestor => biogas => burn for energy
MSW => Fischer Tropsch => Syn Gas => Synthetic Liquid Fuels + char + HEAT
Ag wastes => Biofine, Fischer Tropsch, anaerobic digestor, thermolysis/pyrolysis/torrefaction => solid + liquid fuels + char + HEAT

NEEDS

Infrastructure, r&D on offtakes e.g. char, lignin, heat, sludge, etc., education, money, time, enthusiasm, cooperation, crude oil > $75 brl, market development, a good plan, good interlinks to food & energy & transportation webs, service, giddyup.