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Bio Energy and Bio Fuels: Make it Happen

Other Woody Biomass to Energy Technologies

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In partnership with
USDA Forest Service Region 5



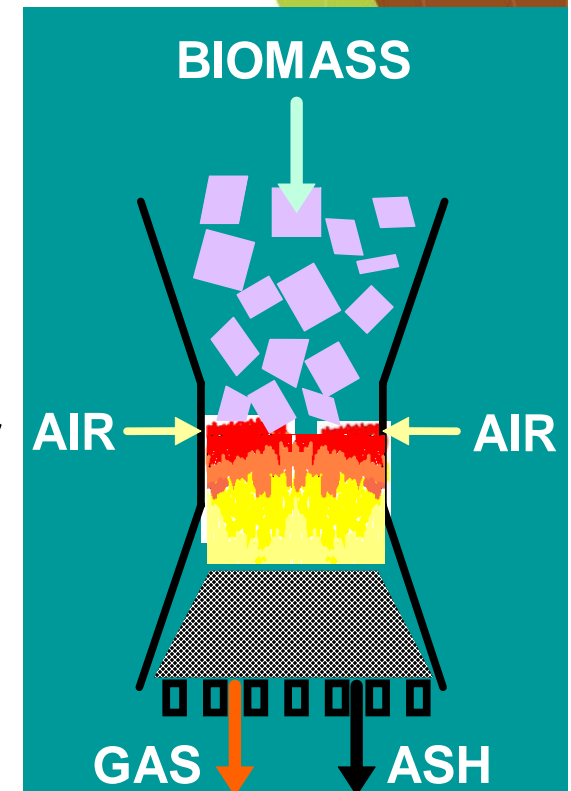
Overview

- ★ Emerging technologies:
 - ★ Pyrolysis
 - ★ Gasification
 - ★ Liquid fuels
- ★ Densified fuels (pellets etc)
- ★ Market conditions
- ★ California project approaches (*making it happen*):
 - ★ *Go big*
 - ★ *Go micro*
 - ★ *Go re-deployable*
 - ★ *Go local*
 - ★ *Go high value*



Gasification

- ★ Biomass used to produce fuel gas (typically downdraft gasifier)
- ★ Fuel gas (producer gas) burnt in engine or turbine to generate electricity
- ★ Smaller scale
- ★ Could apply to off-grid areas
- ★ Potential to make liquid fuels or other chemicals



Fluidyne Pacific Class



Gasifier flare



<http://ucanr.org/WoodyBiomass>

Gasification summary

- ★ Costs \$5,000-10,000/kWh installed (may make sense for off-grid areas)
- ★ Operations and maintenance (who will do this?)
- ★ Fuel specification (can be restrictive)
- ★ Reliability



Pyrolysis

- ★ Pyrolysis is thermal decomposition occurring in the absence of oxygen
- ★ It is the first step of combustion and gasification
- ★ Some other terms:
 - ★ Biochar
 - ★ Fast pyrolysis
 - ★ Torrefaction
 - ★ Torrification
 - ★ Destructive distillation
 - ★ Airless drying



Slow pyrolysis – carbonization

- ★ Proven technology (1000+ years)
- ★ Charcoal production
- ★ Flexible feedstock specification
- ★ Equipment available for large and small scale production
- ★ AQ issues
- ★ Works in the woods!



Fast pyrolysis

- ★ An emerging technology
- ★ Few commercial installations
- ★ 10+ vendor companies (eg, Dynamotive, Ensyn, ABRI, ROI)
- ★ Tight feedstock specification (clean, $1/16$ - $1/8$ ", <10% moisture)
- ★ Energy balance



Fast pyrolysis



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Pyrolysis outputs



1. Liquid (bio-oil - C, H, O and others)
2. Char
3. Gas

Vary depending upon process conditions (residence time and temperature)...

Mode	Conditions	Liquid	Char	Gas
Fast pyrolysis	moderate temperature, short residence time particularly vapour	75%	12%	13%
Carbonisation (slow pyrolysis)	low temperature, very long residence time	30%	35%	35%
Gasification	high temperature, long residence times	5%	10%	85%

Source: PyNe

Lignocellulosic ethanol

- ★ Multiple technological approaches
- ★ Significant DoE investment in projects
- ★ Government (state and federal) push for this technology
- ★ No commercial scale facilities yet
- ★ Facilities likely to be large (1000 BDT/day)
- ★ Prices likely to be ~\$50/BDT for feedstock
- ★ 3-6 years from commercialization?



Keep an open mind and ask:

- ★ Is the technology commercially deployed (proven)?
- ★ What is the feedstock specification?
- ★ What are the markets for the output products?
- ★ Do the economics work?
- ★ Is the process a net energy user?
- ★ Permitting requirements?
- ★ Do not rely on technology vendors for balanced information



Densified Wood Products



- ★ *Fire logs*
 - ★ Wood (Presto logs, briquettes, pucks etc)
- ★ *Pellets*
 - ★ Domestic
 - ★ Commercial/dirty
- ★ *Bricks*



General market situation

- ★ Global installed capacity: ~20m tons
- ★ US capacity: ~4.1m tons (69 mills)
- ★ Raw material shortages
- ★ Slow stove sales – low gas and oil prices, economy
- ★ Recent price reductions in domestic pellets
- ★ Growing market for co-firing with coal (international and domestic)
- ★ Tough market at present but potential for future growth



Reminder: Typical US Pellet Mill



Example: 40,000 ton/yr pellet facility

- 100 BDT/day sawmill residues
- Pay up to \$50/BDT
- \$5.5-\$7m build cost
- 24/7 operation
- 3-5 acre site
- May also make fire logs
- 30-35 jobs



Densified fuels in California

- ★ Anecdotal evidence suggests a large residential market for densified fuels exists
- ★ Almost no in state manufacturing capacity
- ★ 18 National Forests (20m acres)
 - ★ Link to forest health projects?



Why no manufacturing capacity?

- ★ Less sawmill residuals
 - ★ 27 primary wood processing facilities closed from Jan 2000-June 2009*
- ★ Sawmill residuals are in demand by other markets:
 - ★ Biomass power (~32 power plants)
 - ★ Landscape amendments
 - ★ Animal bedding
- ★ Other markets can often pay above \$50/BDT for residuals
- ★ Other non-traditional feedstock sources require a different approach to business



*Source: California Forestry Association

<http://ucanr.org/WoodyBiomass>

Barriers for new projects

1. Feedstock availability and price
2. Scale (drying capacity)
3. Seasonal markets (cash flow)
4. Quality control
5. Developing a market for a new brand/product
6. Overcapacity
7. Commodity product = price volatility



Approaches

- ★ Use alternative feedstocks
- ★ Use different approaches to drying feedstock
- ★ Develop non-seasonal markets
- ★ Produce a product that competes with cordwood
- ★ Partner with an existing densified fuel manufacturer
 - ★ Technical expertise
 - ★ Market access
- ★ Manage costs - leverage existing assets
- ★ Serve local markets – reduce transport costs
- ★ Grow production capacity gradually with market growth



Project Approaches

- ★ *Go big*
- ★ *Go micro*
- ★ *Go re-deployable*
- ★ *Go local*
- ★ *Go high value*



<http://ucanr.org/WoodyBiomass>

Go big

Enligna, Port of Sacramento

- ★ 184,000 BDT pellet mill for export market
- ★ 5.8 MWe cogeneration facility
- ★ Raw material:
 - ★ Construction and demolition (hog fuel)
 - ★ Forest: bole material (chipped or ground including bark)
 - ★ Slash subject to specification
 - ★ Agricultural waste
 - ★ Arboricultural waste

ENLIGNA.



<http://ucanr.org/WoodyBiomass>

Go big – Enligna Approach

- ★ Start with export market (Europe/Asia) – long term supply contracts
- ★ Leverage existing port facilities
- ★ Develop local markets for:
 - ★ Domestic pellets
 - ★ Commercial pellets - supplying institutional boilers (BioEnergy Solutions)
- ★ 360° sourcing radius
- ★ Diversified feedstocks to manage supply risk



Go micro

Red Rooster Fuels, Humboldt County

- ★ 2,000 tons/yr pellets
- ★ Raw material:
 - ★ Small diameter trees (Douglas fir)
 - ★ Tops (Douglas fir)



Go micro – Approach

- ★ Capitalized pellet mill, debarkers and chippers
- ★ Existing firewood producer
- ★ Husband and wife team
- ★ Local markets (stoves and animal bedding)
- ★ Bagged or bulk delivery



Go micro – Status

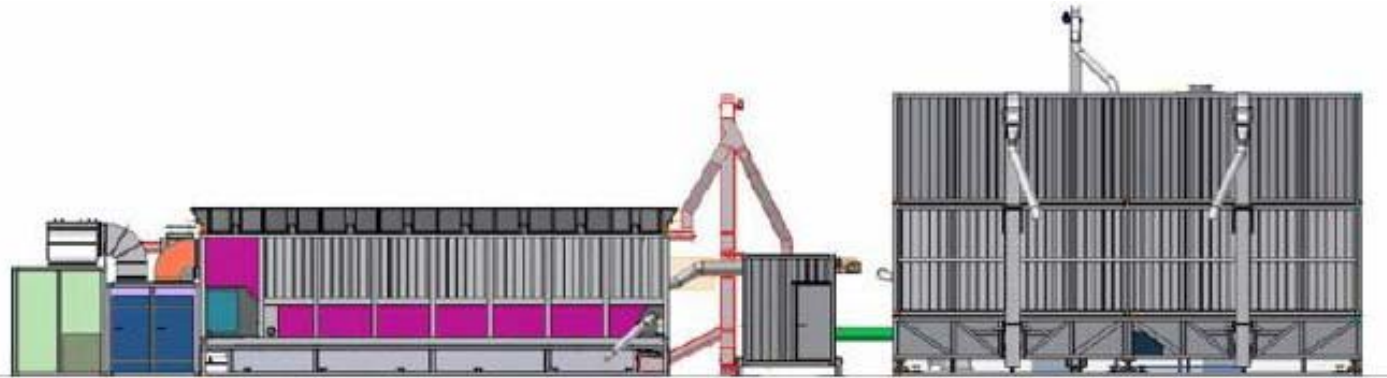
- ★ Pellets well received
- ★ Demand outstrips supply
- ★ Manufacture pellets to order (no inventory held)
- ★ Streamlining system to produce 10 ton batches



Go re-deployable

Woodwork, Trinity County

- ★ 10,000 tons/yr pellets
- ★ Raw material:
 - ★ Small diameter trees
 - ★ Tops



Source: BioJoule

Go re-deployable - Approach

- ★ Rapidly re-deployable BioJoule (UK) unit
- ★ Move equipment to site near forest management operation
- ★ Relocate when work is complete
- ★ Partnership with existing pellet manufacturer to sell product
- ★ Bed dryer
- ★ Small scale CHP sized to heat load
- ★ Automated – few staff required



Go re-deployable - Status

- ★ Early stages
- ★ Pilot equipment being proved in UK
- ★ ORC based CHP under development
- ★ Subject to funding



Source: BioJoule

<http://ucanr.org/WoodyBiomass>

Go local

Bear Mountain Forest Products, Sonora

- ★ 18,000 tons/yr brick mill in Sonora
- ★ Raw material:
 - ★ Forest chips



Source: BMFP



Bear Mountain Forest Products

<http://ucanr.org/WoodyBiomass>

Go local – BMFP Approach



- ★ Make a product that competes with cordwood
- ★ Uses forest waste
- ★ Forest health benefits a selling point
- ★ Use of a novel bed drying system
- ★ Build on existing brand
- ★ Develop local commercial markets



Go local – BMFP Status

- ★ USDA Forest Service Woody Biomass Utilization Grant secured
- ★ Staged approach
- ★ Negotiations with partners (raw material supply and site)
- ★ Initial sales through Costco and others – supply from Oregon mill
- ★ Locate equipment in 2010
- ★ Start supplying California product to market late 2010



Source: BMFP

Go high value

Goodwood Products, Watsonville

- ★ 3,000 tons/yr fire logs
- ★ Raw material:
 - ★ Forest residues
 - ★ Arboricultural waste
 - ★ Mill residues



Go high value – Goodwood Approach

- ★ Produce a desirable easy to use high value fire log
 - ★ Existing stoves/fires
 - ★ “Campfire in a box”
- ★ Niche marketing based on environmental benefits



Go high value – Goodwood Status

- ★ Demand outstrips supply
- ★ Possible partnership with another company to assist growth



<http://ucanr.org/WoodyBiomass>

Conclusions

- ★ Densified fuels are proven production technologies serving existing markets
- ★ Significant interest in densified fuels
- ★ A diverse range of project proposals moving forward
- ★ Attempts to utilize forest residues and other feedstocks
- ★ Diverse range of products
- ★ Trend towards smaller projects targeting local markets
- ★ Project finance is challenging



“Woody Biomass Utilization Opportunities”

Friday, February 12, 11:00am-12noon Room 125



Topics:

Woody biomass utilization basics

Project trends in California

Funding opportunities

Thank you

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<http://ucanr.org/WoodyBiomass>

Help with:

- ★ Grants
- ★ Technology
- ★ Markets
- ★ Networks
- ★ Healthy skepticism

