

Case Studies

Emerging Technologies in Wood Biomass Use

Bill Cook, MSU Extension





Case Studies—Emerging Technologies in Woody Biomass Use

Laurentian Energy – *heat/electricity*

Mascoma Corp. – *ethanol, fermentation*

ABRI portable systems – *portable plant*

Flambeau Papers – *energy, ethanol*

Fuels for Schools – *rural development*

Torrefaction – *process technology*

Dynamotive – *commercial bio-oil*

Messersmith – *combustion systems*

USFS Grant – *biomass research*



Case Studies—Emerging Technologies in Woody Biomass Use

Laurentian Energy Authority

Produce electricity and heat, 35 mW

Utilize woody biomass for fuel

Meet State mandates (25x25)

Two NE Minnesota towns

Replace obsolete coal-fired plant

Rural economic development

Case Studies-Emerging Technologies in Woody Biomass Use





Case Studies—Emerging Technologies in Woody Biomass Use

\$52.6 million construction project

\$5 million wood yard

\$4.5 million first stage Tree Farm

(650 acres + 40 acre nursery)

\$21.5 million long-term Tree Farm

(~50,000 acres, third-party)

10.2 cents/kwh sale to Xcel Energy

20 year contract length

Operational 31 December 2006



Case Studies—Emerging Technologies in Woody Biomass Use

\$1.2 billion local value over 20 years

Cease use of fossil fuels

Maintain logger infrastructure

70 existing jobs, 100 new jobs

Avoid \$40 million in env. controls

Avoid steam conversion costs

Predictable & reliable steam rates

Environmental / CO₂ benefits

Closed vs. Open Loop wood supply

Closed: SRIC plantations

Open: forest harvest

Mandate is 50% closed loop supply

Avg. ~280,000 bone dry tons/year
(~210,000 cords/year)



Case Studies—Emerging Technologies in Woody Biomass Use

Partners

State mandated biomass energy

Legislative support

Pricing from Xcel Energies

(required 110 mW bio-based)

Co-op with Public Utilities Comm.

Hibbing & Virginia utilities

Greenwood Resources, NRRI,

USDA Forest Service



Case Studies—Emerging Technologies in Woody Biomass Use

Forestry Impacts

Maintain logging infrastructure

Forest Mngt. Systems Co-op

Produce 225,000 tons/year

Wood yard - 30-60 day inventory

Utilize more woody biomass

Tree farm began 2004, hyb. poplar

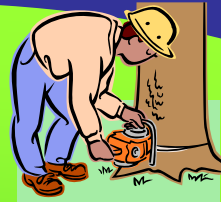
Eventually 50,000 acres

Forestry Extension outreach

Case Studies—Emerging Technologies in Woody Biomass Use

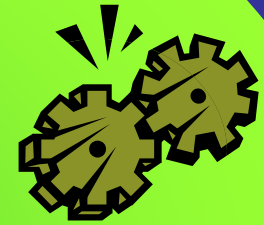


Investment



Supply

Legislation Mandate



Engineering

Fiber Farms 

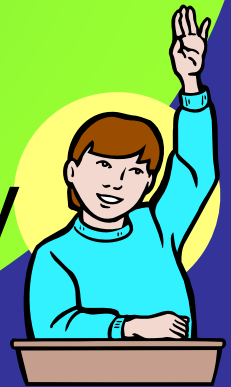


Public Support



Partners

Opportunity





Case Studies—Emerging Technologies in Woody Biomass Use

Laurentian Energy – *heat/electricity*

Mascoma Corp. – *ethanol, fermentation*

ABRI portable systems – *portable plant*

Flambeau Papers – *energy, ethanol*

Fuels for Schools – *rural development*

Torrefaction – *process technology*

Dynamotive – *commercial bio-oil*

Messersmith – *combustion systems*

USFS Grant – *biomass research*



Case Studies—Emerging Technologies in Woody Biomass Use

Mascoma Corporation

Commercial Ethanol Production

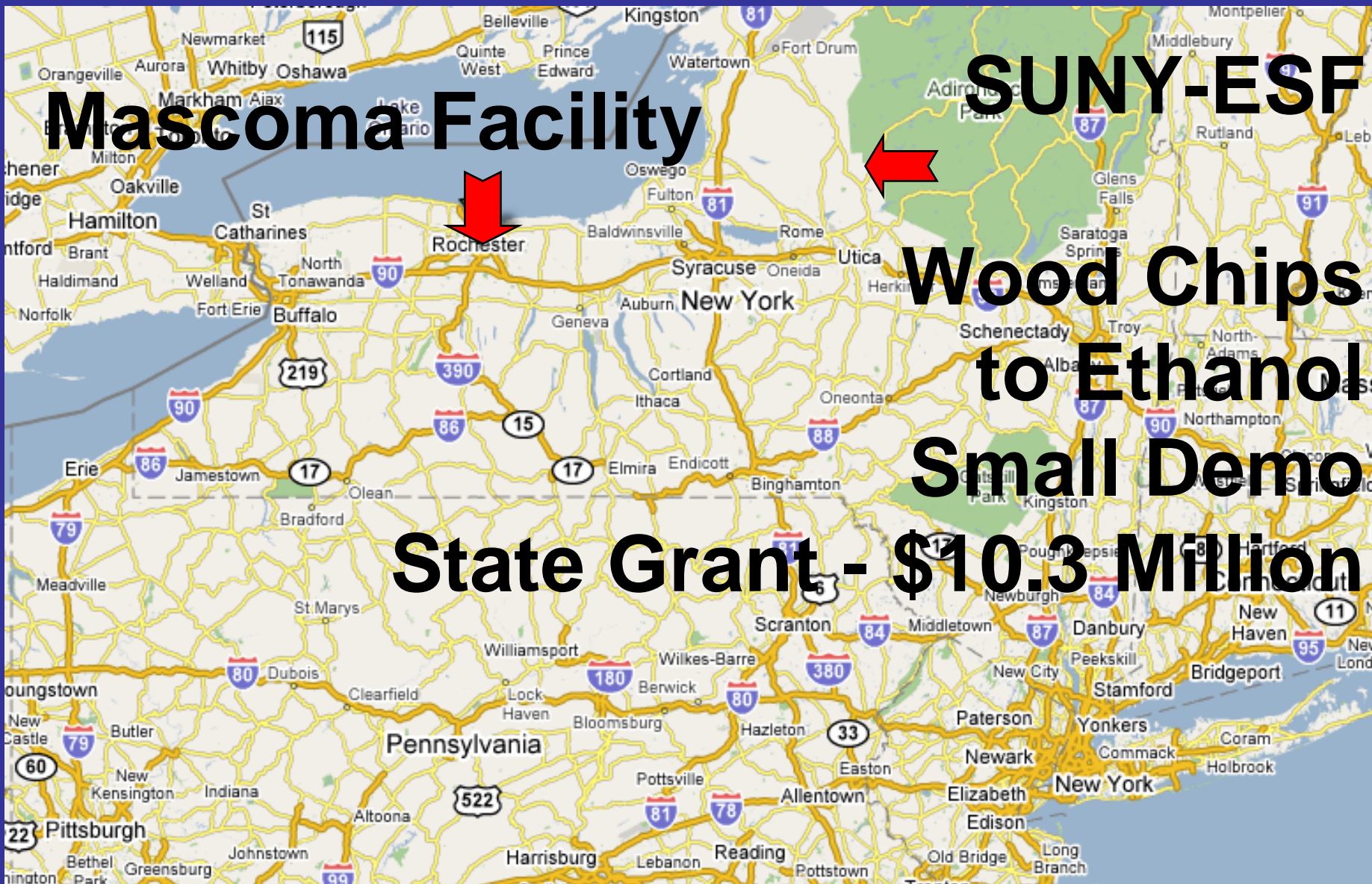
Cellulosic Biomass Feedstock

Enzymatic hydrolysis-Fermentation

1/2 to 2 Million Gallons/Year (*small*)

One of ~Dozen Companies

(keen on wood chips)





Case Studies—Emerging Technologies in Woody Biomass Use

Innovative mix of - - -

Technology & Research

Private & Government Funding

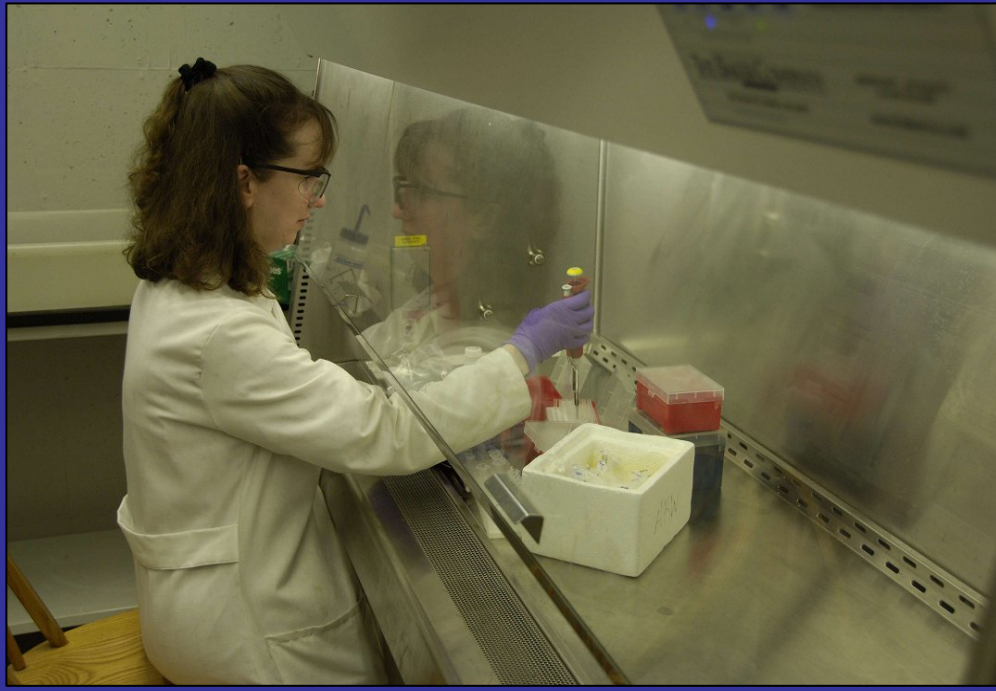
Corporate Mergers & Agreements

“Biorefinery” concept (a version)

Should be on-line in 2007

At Least \$50 Million Invested

Case Studies—Emerging Technologies in Woody Biomass Use



Bacterial
engineering.
Ethanol from
cellulosic material.
Gene modification.



Case Studies—Emerging Technologies in Woody Biomass Use

Fermentor sampling (or bioreactor).
New engineered bacterium grown on cellulosic feedstocks.





Case Studies—Emerging Technologies in Woody Biomass Use

2006 DOE Big Grants - **\$385 Million**
(Biorefinery Projects)

Abengoa, **\$76 million**, Kansas

ALICO, **\$33 million**, Florida

BlueFire Ethanol, **\$40 million**, California

Broin (now Poet), **\$80 million**, S. Dakota

logen, **\$80 million**, Virginia

Range Fuels, **\$76 million**, Colorado

**Plus \$774 million in
private venture capital in 2006!**



Case Studies—Emerging Technologies in Woody Biomass Use

Laurentian Energy – *heat/electricity*

Mascoma Corp. – *ethanol, fermentation*

ABRI portable systems – *portable plant*

Flambeau Papers – *energy, ethanol*

Fuels for Schools – *rural development*

Torrefaction – *process technology*

Dynamotive – *commercial bio-oil*

Messersmith – *combustion systems*

USFS Grant – *biomass research*



Case Studies—Emerging Technologies in Woody Biomass Use

Advanced Biorefinery, Inc. (ABRI)

Ottawa, Ontario

Portable dryer and pyrolysis units

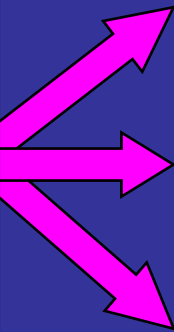
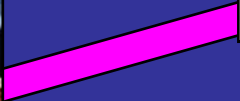
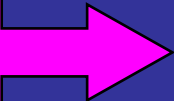
Produce bio-oil in the field

Current testing on-going

Unit purchased by OMNR

Case Studies—Emerging Technologies in Woody Biomass Use

Wood



Gases – *powers unit*

Bio-oils – *marketable*

Carbon – *marketable*



Case Studies—Emerging Technologies in Woody Biomass Use

Laurentian Energy – *heat/electricity*

Mascoma Corp. – *ethanol, fermentation*

ABRI portable systems – *portable plant*

Flambeau Papers – *energy, ethanol*

Fuels for Schools – *rural development*

Torrefaction – *process technology*

Dynamotive – *commercial bio-oil*

Messersmith – *combustion systems*

USFS Grant – *biomass research*



Case Studies—Emerging Technologies in Woody Biomass Use

Flambeau River Papers

Park Falls, Wisconsin

Johnson Timber bought Smart Papers

Economically troubled mill—energy costs

400 tons paper, 3 paper machines

150 tons/day hardwood sulfite pulp

80-100 tons post-consumer recycled

300 employees



Case Studies—Emerging Technologies in Woody Biomass Use

Replace natural gas boilers
with biomass gasifier

First energy independent,
integrated mill in N.A.

First U.S. pulp mill to produce ethanol

Up to 18 million gallons ethanol

Thermochemical process

Reduce CO² emissions 140,000 tons





Case Studies—Emerging Technologies in Woody Biomass Use

Laurentian Energy – *heat/electricity*

Mascoma Corp. – *ethanol, fermentation*

ABRI portable systems – *portable plant*

Flambeau Papers – *energy, ethanol*

Fuels for Schools – *rural development*

Torrefaction – *process technology*

Dynamotive – *commercial bio-oil*

Messersmith – *combustion systems*

USFS Grant – *biomass research*



Case Studies—Emerging Technologies in Woody Biomass Use

Fuels for Schools

Heat schools with wood (chips/pellets)

Reduce school operating costs

Help schools with assessments

Wood market – esp. rural schools

Active in the PNW

The technology is not new but the effort to implement the technology and assist schools is new.



Case Studies—Emerging Technologies in Woody Biomass Use

Technical assistance
Money for assessments
Grants for construction
Eligibility requirements

USDA Forest Service
State Foresters
Area Schools & Contractors



Basic Process from the PNW

1. Pre-assessment form
2. Prelim. engineering assessment
3. Contractor report-costs/savings

Various levels of technical assistance, funding, and fund sourcing are available.



Case Studies—Emerging Technologies in Woody Biomass Use

Laurentian Energy – *heat/electricity*

Mascoma Corp. – *ethanol, fermentation*

ABRI portable systems – *portable plant*

Flambeau Papers – *energy, ethanol*

Fuels for Schools – *rural development*

Torrefaction – *process technology*

Dynamotive – *commercial bio-oil*

Messersmith – *combustion systems*

USFS Grant – *biomass research*



Case Studies—Emerging Technologies in Woody Biomass Use

Torrefaction

A form of pyrolysis
(160-245° C and O₂-free)
Alters molecular structure
Concentrates energy
Hydrophobic product
Reduces weight



Case Studies—Emerging Technologies in Woody Biomass Use

Applications

Wood fuel pellet treatment

Lighter, more energy-rich, waterproof
Save on storage, shipping, packaging

Non-chemical wood preservative for
lumber (*MEC, Servicom*), with
dimensionally stable properties

Challenge

Ovens are not yet engineered to torrefy wood chips and similar sized woody material.





Case Studies—Emerging Technologies in Woody Biomass Use

Laurentian Energy – *heat/electricity*

Mascoma Corp. – *ethanol, fermentation*

ABRI portable systems – *portable plant*

Flambeau Papers – *energy, ethanol*

Fuels for Schools – *rural development*

Torrefaction – *process technology*

Dynamotive – *commercial bio-oil*

Messersmith – *combustion systems*

USFS Grant – *biomass research*



Guelph

West Lorne

Dynamotive – April 2007

Gu
Be
Fu
10+
200



07
lay

upgraded to commercial in 2007

West Lorne Plant

Fast pyrolysis - cogen
Produce electricity & heat
Small – 2.5 mW
Sell at ~11 cents/kW





Case Studies—Emerging Technologies in Woody Biomass Use

Laurentian Energy – *heat/electricity*

Mascoma Corp. – *ethanol, fermentation*

ABRI portable systems – *portable plant*

Flambeau Papers – *energy, ethanol*

Fuels for Schools – *rural development*

Torrefaction – *process technology*

Dynamotive – *commercial bio-oil*

Messersmith – *combustion systems*

USFS Grant – *biomass research*



Messersmith Biomass Combustion Systems (short DVD) Field Site with Larry Klope





Case Studies—Emerging Technologies in Woody Biomass Use



Case Studies—Emerging Technologies in Woody Biomass Use

USFS Bioenergy Grant Project Superior National Forest (Don Howlett & a remote connection)



Case Studies—Emerging Technologies in Woody Biomass Use