Wisconsin Biorefining Development Initiative

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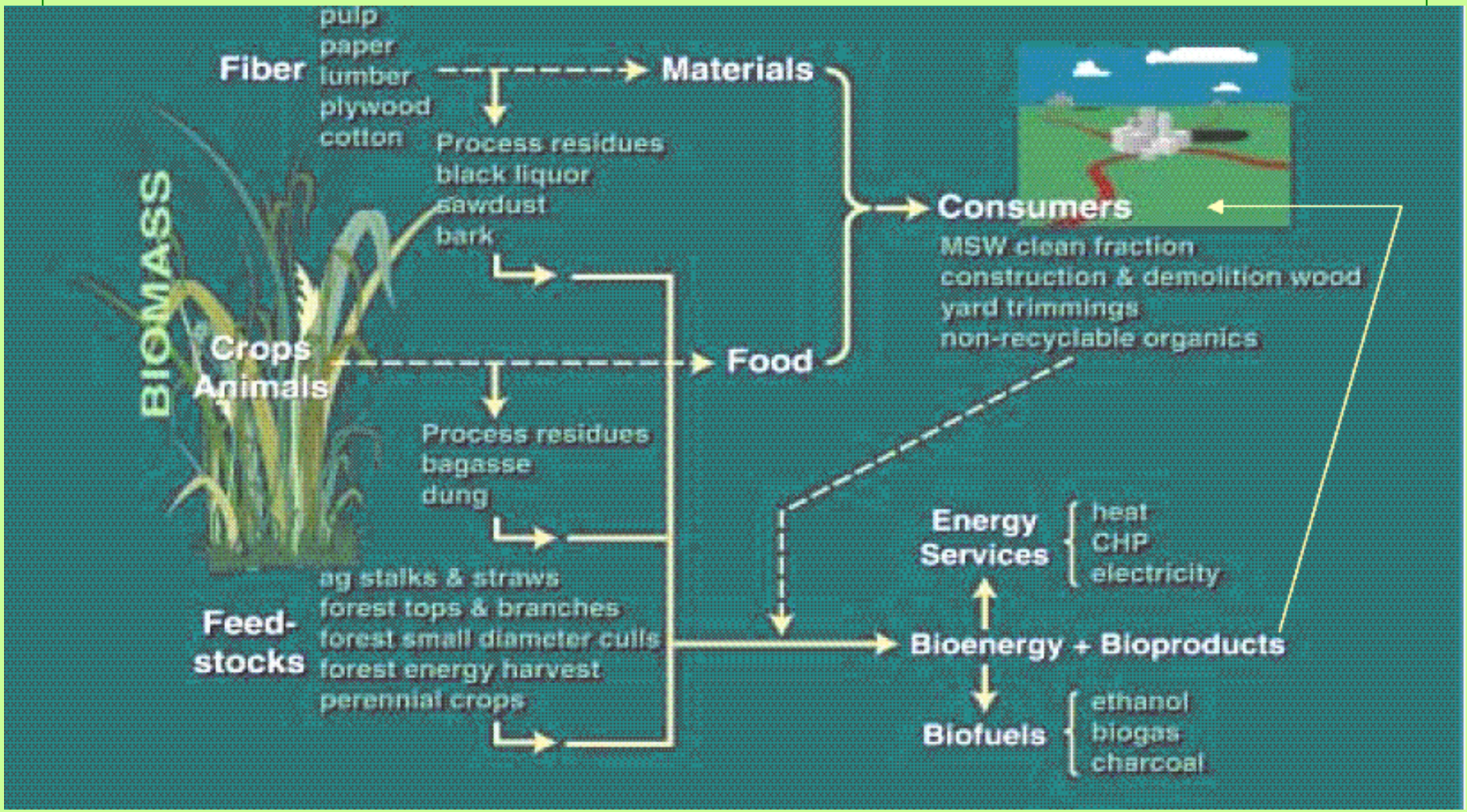
What is Biorefining?

- “Biorefining is similar in concept to the petroleum refining industry, except that local, renewable biomass materials are the feedstocks rather than crude oil.”

- *Try* to utilize existing waste streams of current Value Chains

General Concept Diagram



Schutt, Biorefining Videoconfernce, June 17, 2004

Benefits of Biorefining

- Less dependence on petroleum
- Reduce waste streams
- Create new jobs & businesses
- Boost rural economies
  - Utilize *local* biomass resources

WI Roadmap Development Milestones

- Funding to create the roadmap
- R&D to discover WI's biorefining potential
- Symposium in June 17, 2004 to present findings & generate interest
- Promote to extension executives to promote further biorefining developments

Federal Biorefining Investments

- U.S. DOE
  - >$80 million granted since 2001
- U.S.D.A.
  - Farm Bill 9006
- WI biorefining initiative funded by the U.S. Department of Energy
- Energy Division of the Wisconsin Dept. of Administration
  - Preston Schutt wrote the grant

People Involved in Drafting the Initiative

Center for Technology Transfer
Project Advisor: Masood Akhtar

Energy Center of Wisconsin
Technical researchers: Kevin Grabner, Sean Weitner
Research and editing: Melanie Lord
Web site: Andrea Minniear
Videoconference: Kate Anderson, Jaime Barbian, Brenda Jessen
Oversight: Karen Meadows

University of Wisconsin
Technical researchers: Douglas Reinemann, Patrick Walsh, Jennifer Hermans, Stephanie Larsen
Project Reviewers: Thomas Jeffries, William Kenealy, James Converse, Brian Holmes

We Didn't "Invent the Wheel"

Utilized existing resources

- "Industrial Bioproducts: Today and Tomorrow"
  - July 2003
  - A national roadmap
- Iowa's biorefining roadmap
  - Bioconference, March 7-8, 2004
  - Useful as a template for our own state
  - Different bio-sources than WI
- Professionals in the field, Experts from the university

Consider Biosources of WI

Breweries

Dairies

Grains & crops

Meat processing

Pulp & paper, solid wood industry

WI's "Biorefining Roadmap"

- Available at http://wisbiorefine.org/
- Website organization:
  - Industry sectors: breweries, dairies, grains & crops, meat products, pulp & paper, solid wood industry
  - Comprehensive list of major feedstocks generated in WI
  - Applicable biorefining technologies
  - Possible biorefined products

"This Web site is a tool to help industry, agriculture, technology developers, and business supporters in Wisconsin pursue biorefining opportunities."

Example Biosource: Spent Hops

DESCRIPTION:Hops are added to malt extract, which is then boiled to release the hops' oils and resins. The extract is then clarified and filtered, leaving spent hops, or trub. Spent hops represent a small fraction of a brewery's **spent grains**, and are sometimes mixed with them and sold to farmers as a livestock feed called brewers grains

CLASSIFICATION
Plant-based proteins, **Lignocellulose**

SOURCE INDUSTRY
Breweries

ANNUAL VOLUME GENERATED IN WISCONSIN
24,500 barrels (based on 8.57 million barrels beer at an estimated 1 barrel trub/350 barrels beer)

Example Biosource: Spent Hops (cont.)

CURRENT APPLICATIONS

Fertilizer/mulch, animal consumption (feed supplement)

COST

No cost or marginal revenue if added to brewers grains or given away; otherwise, standard disposal costs

APPLICABLE BIOREFINING PROCESSES

Anaerobic digestion, **biomass gasification**, **combustion**, **fast pyrolysis**, **fermentation of lignocellulosic biomass**, **thermochemical liquefaction**

Topics Provided for Biorefining Processes

- Feedstock classification
  - Physical description of required feedstock
- Feedstock examples
  - Includes links to feedstock PDF
- Feedstock Restrictions
  - Provides suggestions for optimum production
- Process Description
  - Explains the chemical/physical changes to obtain bioproducts from biosources

Topics Provided for Biorefining Processes (cont.)

- Primary biobased products
  - Describes product yield volume
  - Includes link to the product
- Process byproducts
  - Lists “waste streams” of the bioprocessing
    - Considers steam, CO_2, ash
  - Describes possible uses for (usable) byproducts

Topics Provided for Biorefining Processes (cont.)

- Major equipment
  - Outlines equipment required for entire process, including pre-treatments
- Energy Required
  - Unit of energy/volume product, or,
  - Efficiency of the process
- Capital & operation cost
- Commercialization status & suppliers

Topics Provided for Bioproducts

- Description of the product
- Bioprocesses it's derived from
- Market for the product
  - Current (2004) value
  - Potential market possibilities

June 17, 2004 VIDEO Conference

- Most speakers broadcast via internet
  - Their video ran alongside the slides on two separate screens
  - DVD's of presentations are available
- Took place in two separate rooms
  - Food and Agribusiness
  - Forest Products

Conference Agenda

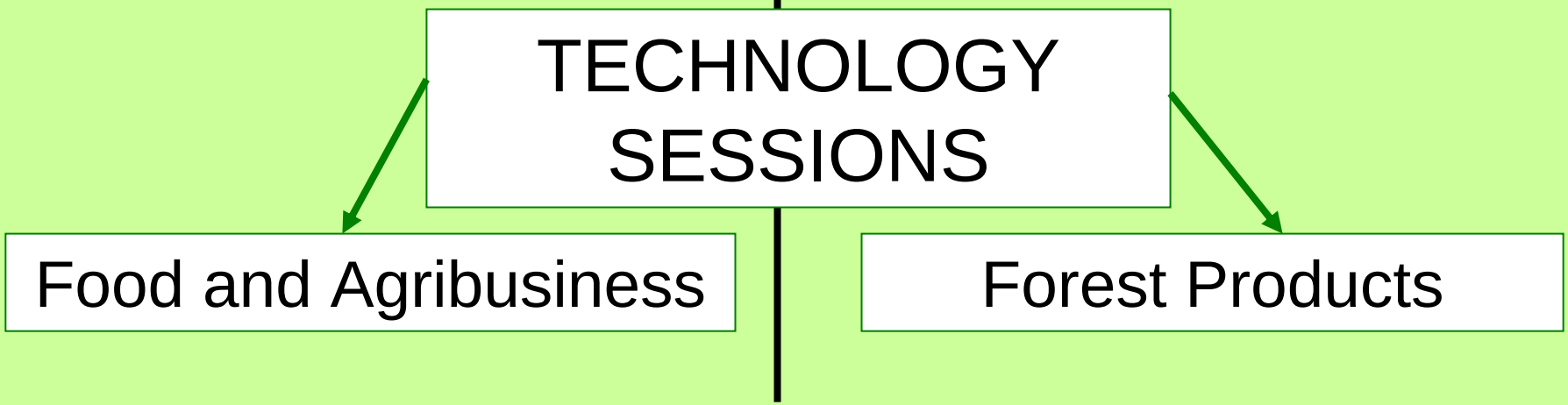
Introduction:

What is Biorefining?

Preston Schutt, WI Dept. of Administration

Minnesota Perspective

Roger Ruan, Center for Biorefining, Univ. of MN



Food & Agribusiness

- Enzymes and fermentation for commercial scale biorefining
- H-production from sugars, waste streams, and biomass crops using liquid phase reforming
- Commercial technology for converting food processing wastes to biodiesel and value added products
- Biorefining opportunities for the dairy industry

Forest Products

- The forest biorefinery-a partial view
- Commercially available technology for black liquor gasification
- Hydrogen from biomass pyrolysis: Integrated co-productsandservices
- Ethanol production from biomass

Mark R. Etzel's *Biorefining Opportunities for the Dairy Industry*

- Interesting comparison of biorefining to the petroleum industry
  - "Revenues from generating multiple pure products are greater than revenues from generating one pure product and an impure product."
  - "Shifting between products day-to-day matches output to changing consumer demands and market values"

Mark R. Etzel's *Biorefining Opportunities for the Dairy Industry*

•Ion exchange and microfiltration to separate proteins and sugars from milk. Sees major opportunity for milk-derived sugar substitutes

Compound	GI	Sweetness	Calories (kcal/g)
Lactose	46	20	4
Glucose	100	75	4
Galactose	23	35	4
Lactulose	0	55	0
Lactitol	6	40	2.0
Tagatose	3	92	1.5

Other Milk Biorefining Opportunities?

Lactose (recovered from cheese whey)

↓ catalytic hydrolysis

High-value polyol chemicals

Battelle Pacific Northwest Division, 2001

Lactic acid bacteria (LAB)

↓ natural fermentation

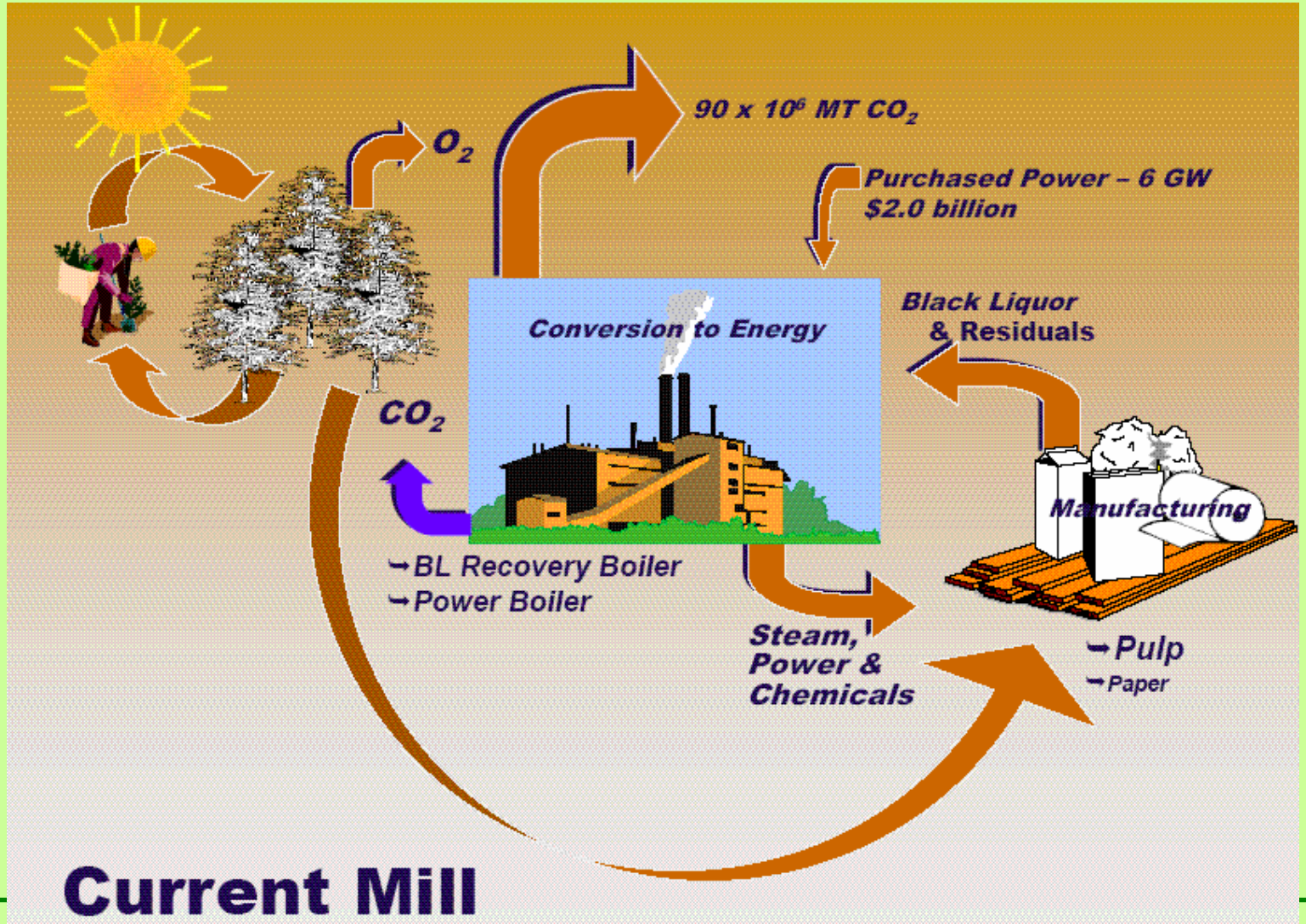
Exopolysaccharides (EPS)-or-biopolymers

P.Ruas-Madiedo et al. International Dairy Journal 12 (2002) 163-171

B.A. Thorp's *The Forest Biorefinery*

- **"Traditional tree growing and liberation of fibers while inefficiently burning spent liquors becomes the old technology."**
- **"In its place is forest stewardship and the processing of wood in a way to extract fiber, fuel, chemicals, and power streams that are valued by society and the marketplace."**

B.A. Thorp's *The Forest Biorefinery*



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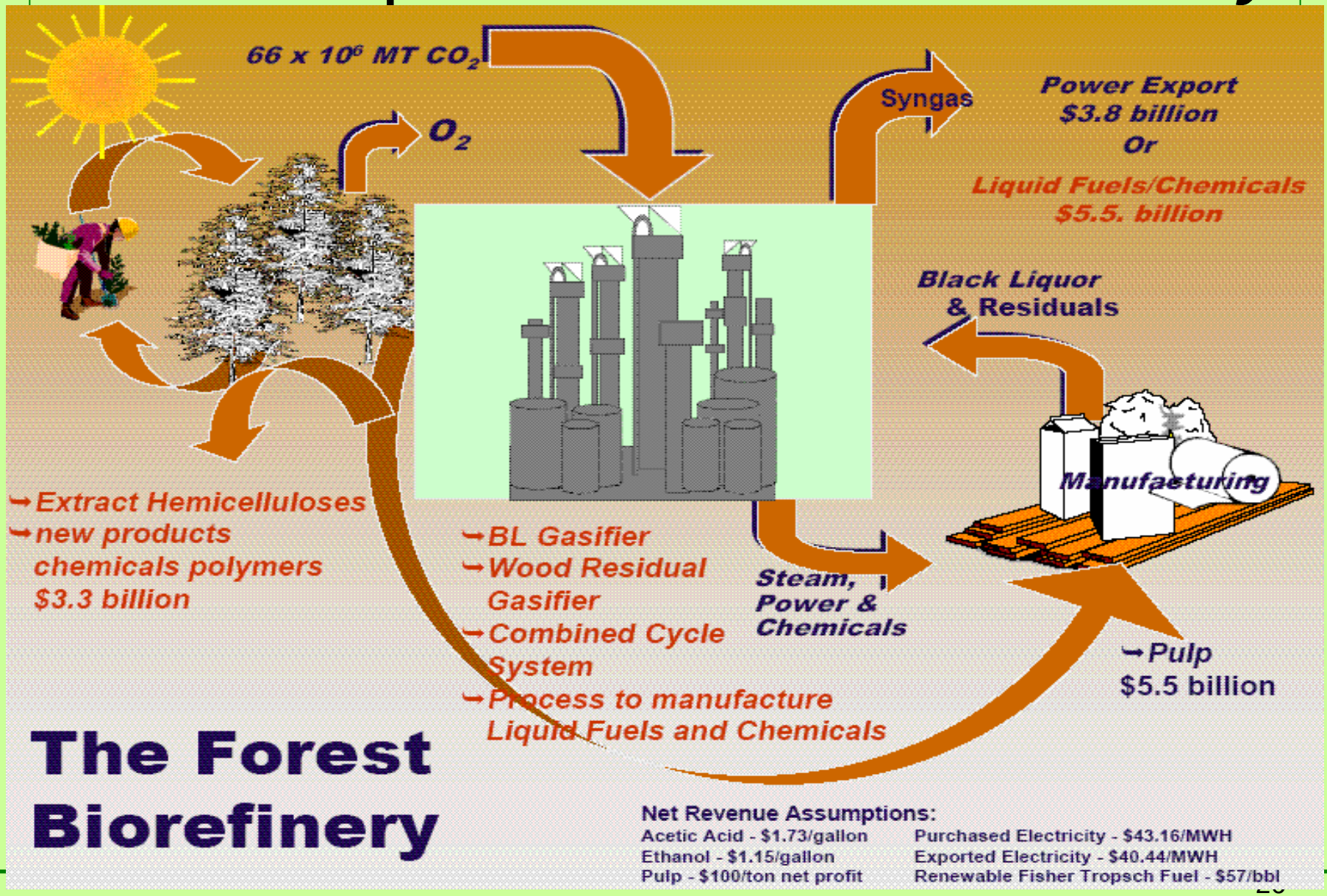

Attendees' Review of Videoconference

1/3 of the attendees were from WI, a select group of industry leaders

- Interested in learning how to get biorefining started from a local level
- Would also like to learn more about applicable biorefining processes

Meeting the Needs of Interested Parties

- Proposed scope of work (Preston Schutt, Department of Admin. Energy Division)
  - 'Train the trainer program' delivered to UW-extension executives
    - 6 districts of 72 counties
  - ½ Day workshop targeted at UW-extension and industry leaders who may have missed the videoconference
    - New speakers
  - Continue to update www.wisbiorefine.org

Other Biorefining Resources

- Book: Biorenewable Resources, Robert C. Brown
- Bioeconomy update www.valuechains.org
- BIOWA Development Association http://biowa.us/
- Center for Biorefining http://biorefining.waaha.net/

Thank You!