



Biorefining Forest Biomass

Working Biomass Group Meeting

Sacramento, CA Feb 18, 2014

Reliant BioFuels & Applied Biorefinery Sciences





Reliant BioFuels: Yuba City, CA

Applied Biorefinery Sciences: Syracuse, NY

Reliant BioFuels

- Paul Mann, PhD
- Phil Treanor






**Applied
Biorefinery
Sciences**
Syracuse, NY
("ABS")

Dr. Thomas E. Amidon, Prof
SUNY-ESF

Dr. Joel R. Howard, CEO
ABS, LLC

Mr. Christopher D. Wood, VP
Engineering
ABS, LLC



**Why should the
forest products industry
consider deploying
Biorefinery Technology?**

What is the need?

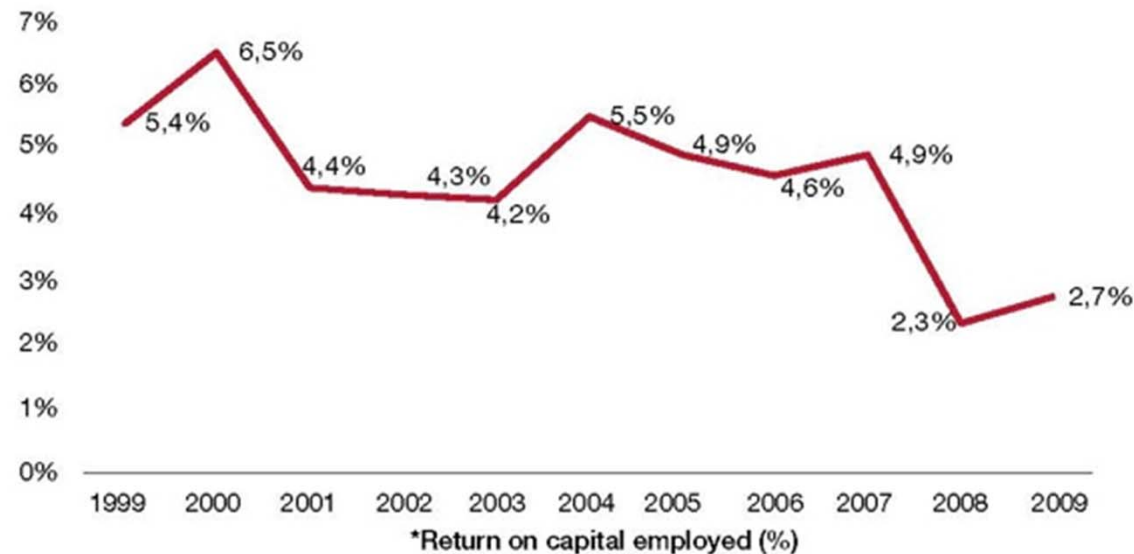
Where is the **Pain?**

According to PricewaterhouseCoopers' – Feb 2011 report

****Growing the Future: Exploring new values and new directions in the Forest, Paper & Packaging industry.**

Declining profits are the Pain

Figure 1: Industry Financial Performance: The Top 100 Forest, Paper & Packaging companies' ROCEs*



Source: PwC Global Forest, Paper & Packaging Industry Survey – 2010 Edition

**** www.pwc.com/fpp -- “Growing the Future”**

What is CALIFORNIA'S Pain

- Forest biomass buildup
- Catastrophic fires
- Degradation of watersheds
 - Siltation of streams
 - Loss of fisheries
 - Loss of wildlife
 - Loss of hydropower
 - Loss of jobs
 - Drinking water compromised
 - Loss of wildflowers/native flora



How will it work?

First we must define:
“What is a Biorefinery?”
(under the ABS model)



What is a “Biorefinery”?

The Applied Biorefinery Sciences Perspective

- **Refinery?** An industrial plant for purifying a crude substance
- **The diversity of products from, and economic strength of, a refinery is a function of:**
 - Feedstock chemical composition
 - Capital investment
 - Markets



What is a “Biorefinery”?

The Applied Biorefinery Sciences Perspective

- A sugar refinery is an example of a single product refinery



What is a “Biorefinery”?

- An oil refinery is a **multi-product** refinery
 - gasoline
 - diesel fuel
 - asphalt base
 - heating oil
 - kerosene
 - liquefied petroleum gas
 - chemicals



Anacortes, WA



Warren, PA

So, what is a “Biorefinery”?

- A “Biorefinery” under the ABS model is defined as:
 - an industrial plant where crude biomass is processed and refined into more useful products.



How can
ABS Process™
Biorefinery Technology (“BT”)

Capture value not currently realized?

**By generating an
increased or improved variety of products
per volume of wood**

“More jobs from the same tree”

Pat Curran

President

Seaway Timber Harvesting

Massena, NY, USA



ABS Process™ BT

starts with raw (crude) biomass
that is
cooked in water



SUNY ESF Hot Water Extraction vessel



Top



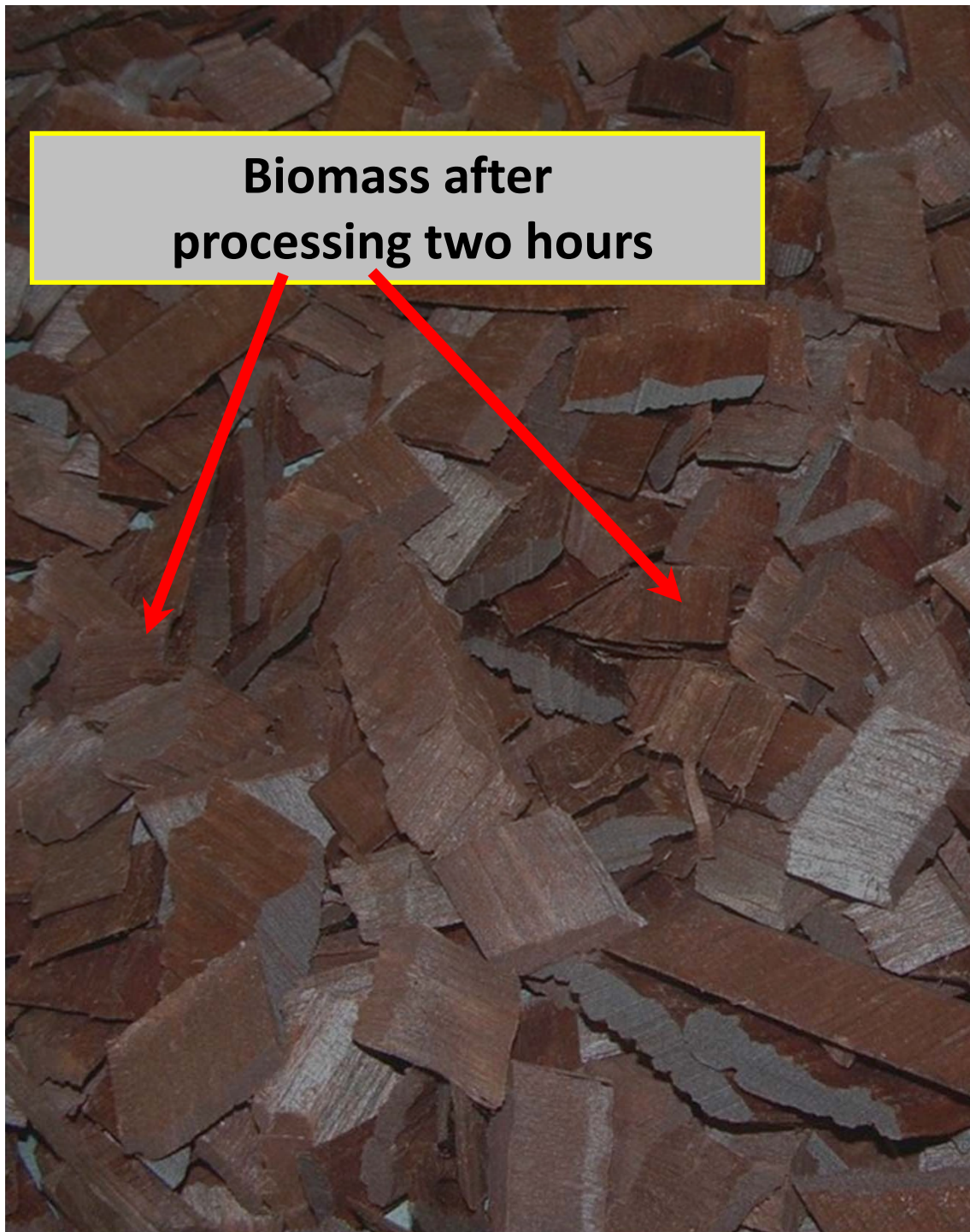
Bottom

Separation of products

After two hours:

- Remove wood/extract mixture from extractor
- Drain hemicellulose extract from wood

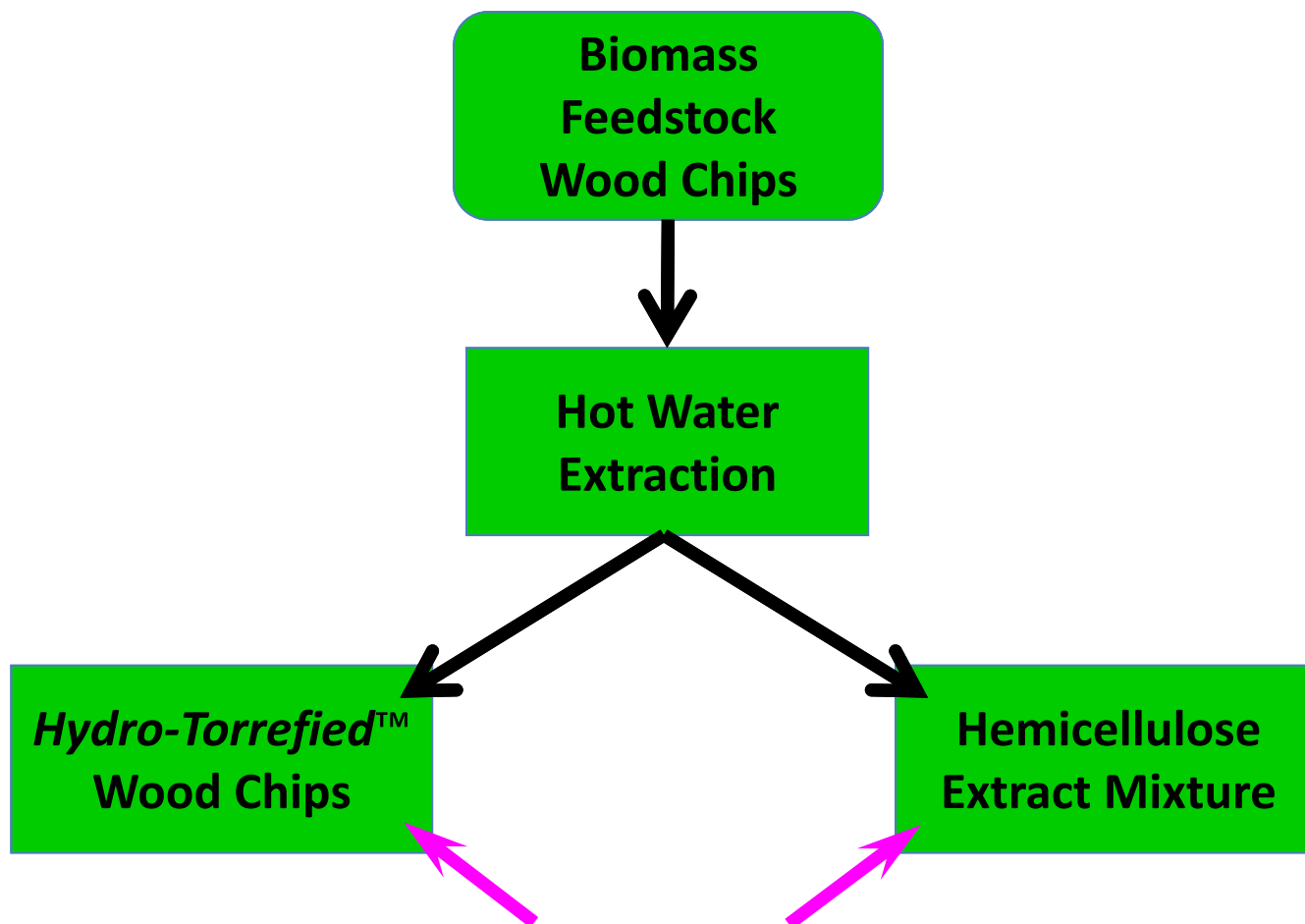
**Biomass after
processing two hours**



**Extract mixture
after processing**

Applied Biorefinery Sciences

Integrated Biorefinery – General Process Flow



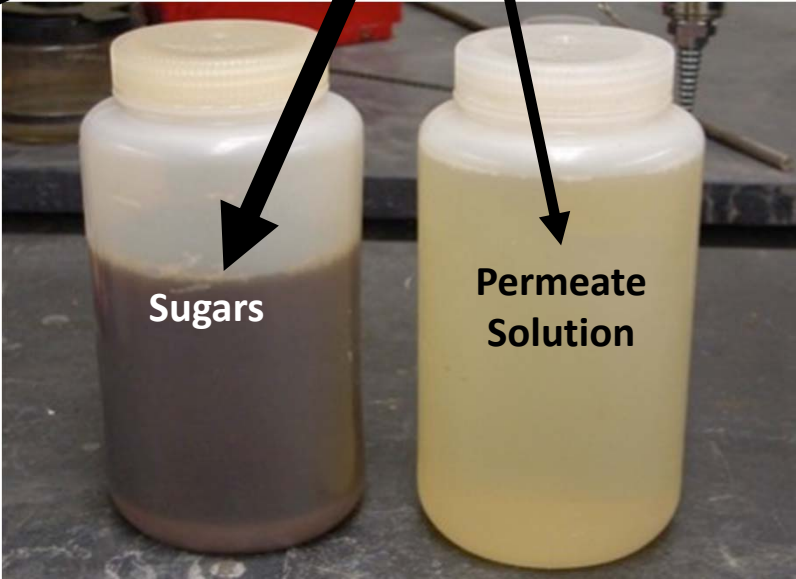
Yields two potential product streams instead of just one

Hemicellulose Product Recovery



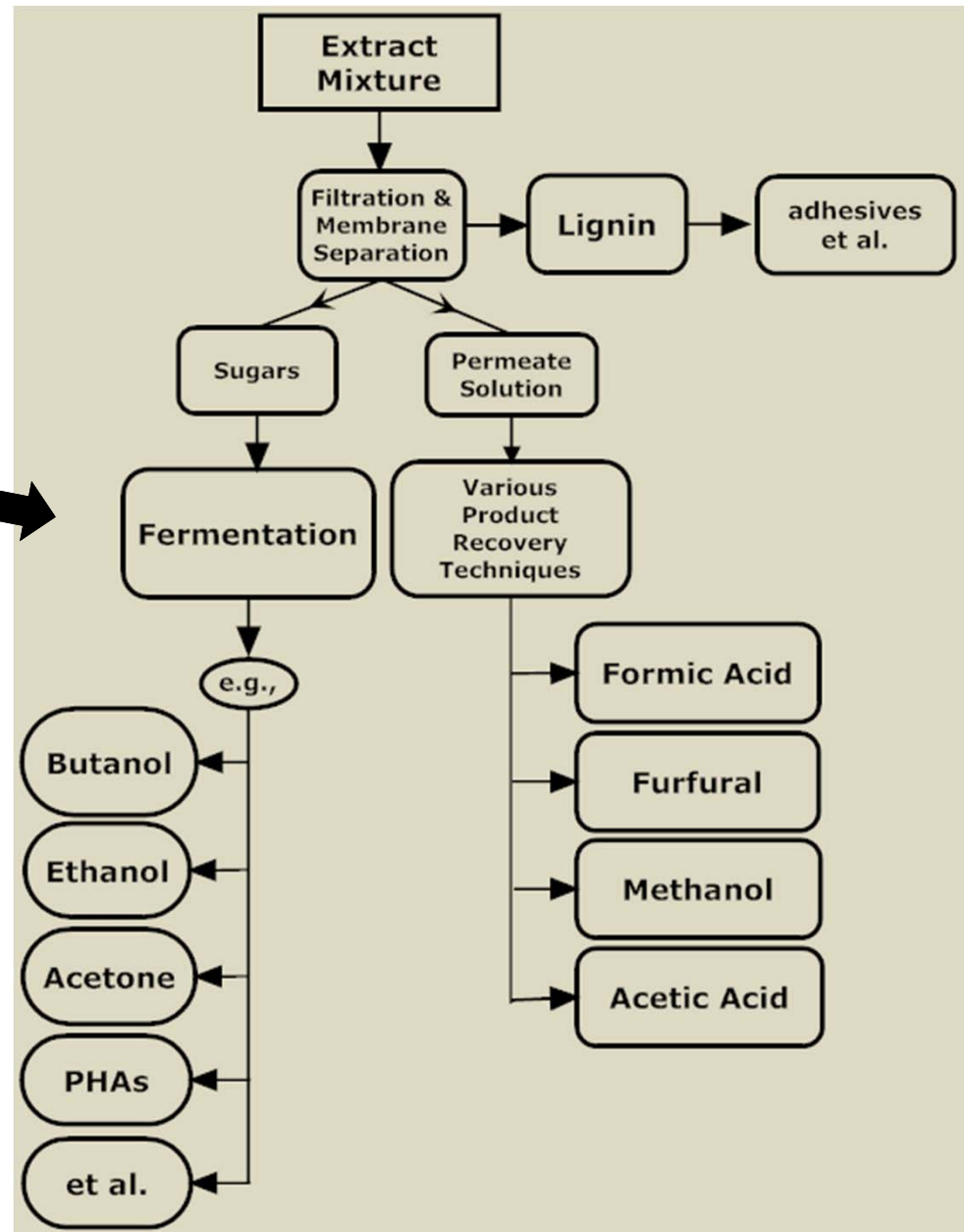
Hemicellulose Product Recovery

Using multiple methods and pathways,
separate extract mixture components
into

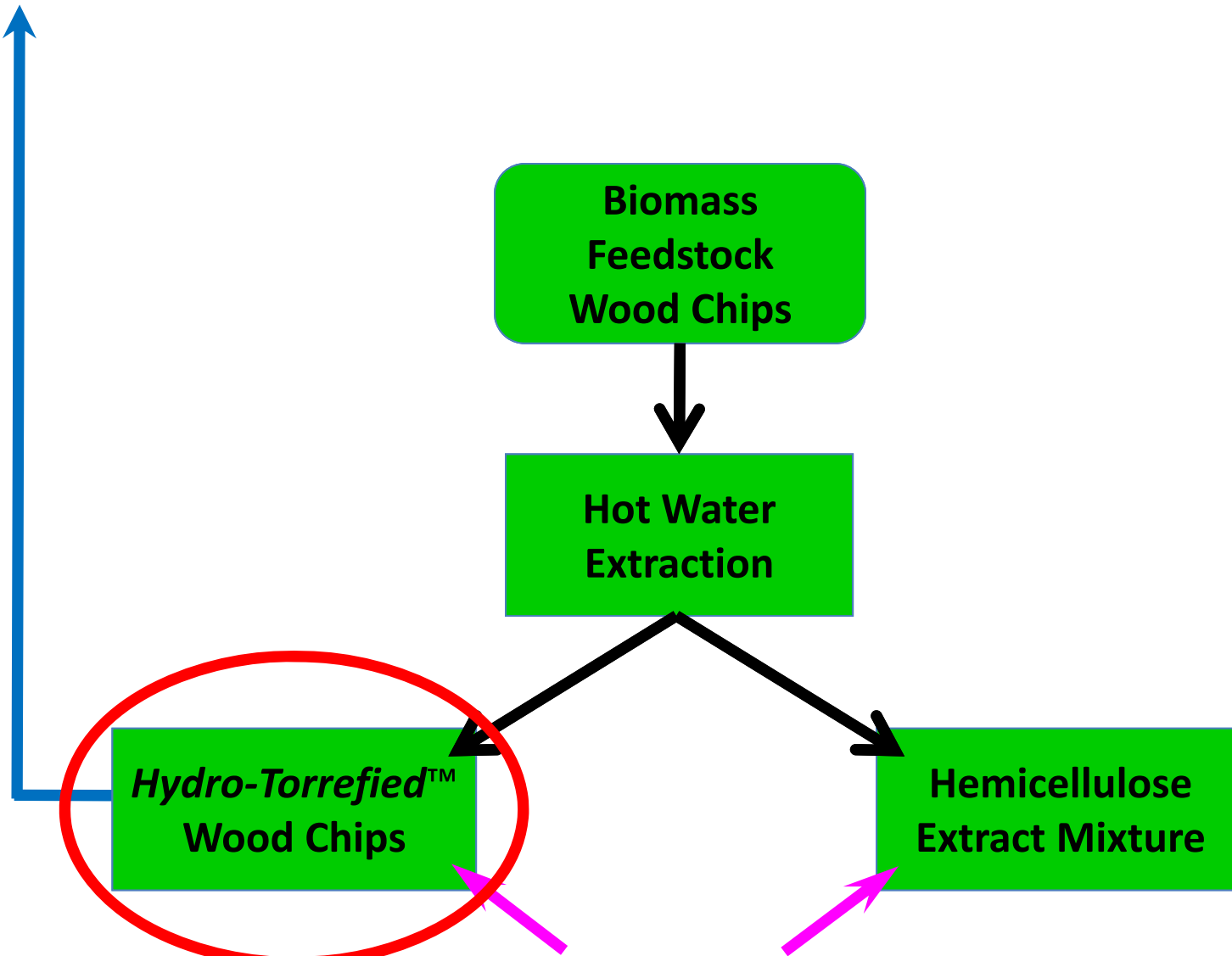


Hemicellulose Product Recovery

Potential
Hemicellulose
Related
Products



Hydro-Torrefied™ Wood Uses



Two potential product streams instead of just one

Hydro-Torrefied[™] Wood Uses

Raw Chips



***Hydro-Torrefied*[™] Chips**



*Hydro-Torrefied*TM Wood Uses

What has happened to the chips?



After extraction:

- darker color
- structure (cellulose & lignin) still intact
- same volume, **but**
- 20-23% less mass



Hydro-Torrefied[™] Wood Uses

After extraction:

- structural components (cellulose & lignin) remain intact, therefore
- chips are usable and improved for making:
 - **Fuel pellets**
 - **Reconstituted wood products**
 - **Pulp**
 - **And other products**



Hydro-Torrefied[™] Wood Uses

Hydro-Torrefied[™] fuel pellets

- **decreased chip bulk density** (due to hemicellulose extraction)
- **increased Btu content/lb**
- **reduced ash content/lb**
- **increased structural stability**
 - **higher % lignin** (less likely to break)
 - **decreased hydrophilicity** (less likely to absorb water)



Simplified Business Model



Nature's Biorefinery



Market potential

- **California has largest dairy herd in the country**
- **Cows & heifers – 2.7 million***
- **Potential demand for C-5 Sugars**
 - **If fed 1 lb/day per cow**
 - **1290 T/day**
 - **491,000 T/yr**

*NASS California Agricultural Statistics 2012

Hydro-Torrefied[™] Wood Uses

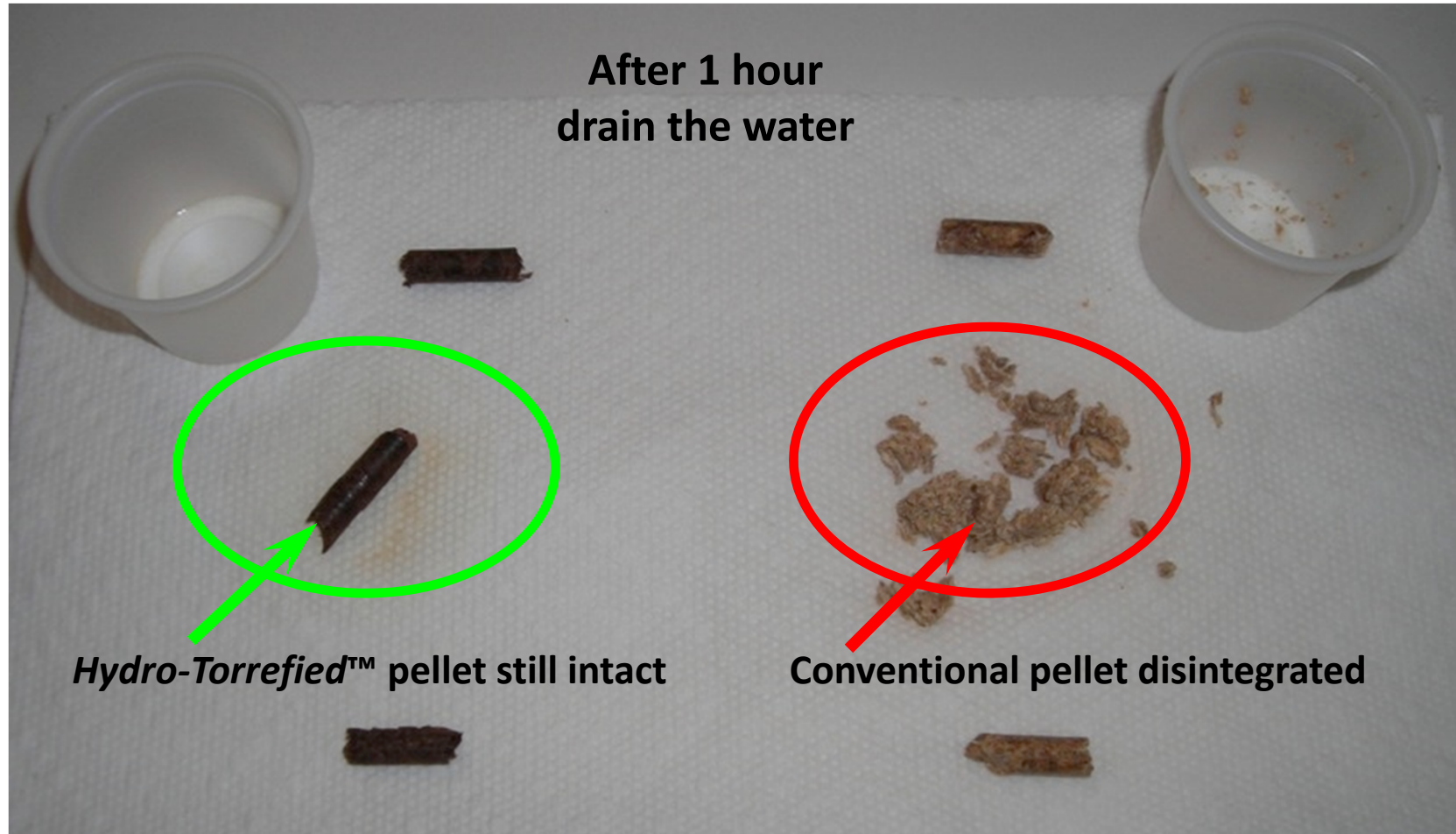
Hydro-Torrefied[™] fuel pellets

- increased structural stability
 - higher % lignin (less likely to break = fewer “nubs”)



***Hydro-Torrefied*[™]** **Wood Uses**

Submerge a *Hydro-Torrefied*[™] pellet & a conventional pellet in water



Potential Pellet Market

Ship to Pacific Rim* nations to:

Blend with coal

Improve air quality

Domestic Coal Burning Generators

Public entities such as Schools, etc.

Residential Pellet Stoves

*** Dr. Thomas Amidon met with Environmental / Energy liaison & China Coal Specialist at US Embassy in Beijing.**



Potential feedstocks

Forest biomass:

Thinnings

Slash piles

Fire salvage

Hardwoods/softwoods

Courtesy_Jeffrey Bellaire BLM, Redding, CA



Potential feedstocks

Agricultural by-products:

Almond shells

Peach pits

Prune pits?

Olive pits

Orchard pullouts

Testing California's ag byproducts

at

USDA Western Regional Lab at Albany, CA





Concluding Statements

ABS Process™

Biorefinery Technology

offers a complementary solution to:

Torrefaction

Pyrolysis

Slash pile burning

Land filling

Biomass power

to help solve

California's Forest Health Issues

Recommendation

**When developing policy to address
California's forest health issues,**

**Develop policy that is
results driven & technology neutral.**