

# Green Power+™ -Low cost sugar platform



Theodora Retsina, President & CEO  
American Process Inc.  
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# American Process Inc.

<b>Founded</b>	<b>1994</b>
<b>Headquarters</b>	<b>Atlanta Georgia</b>
<b>Employees</b>	<b>31 employees</b>
<b>Origins</b>	<b>Consulting Energy Pulp &amp; Paper (400 studies, 250 mills) Project engineering, Project Execution</b>
<b>Experience</b>	<b>Fractionation of biomass, Wood Chemistry, Process engineering</b>

**Position in Value Chain**

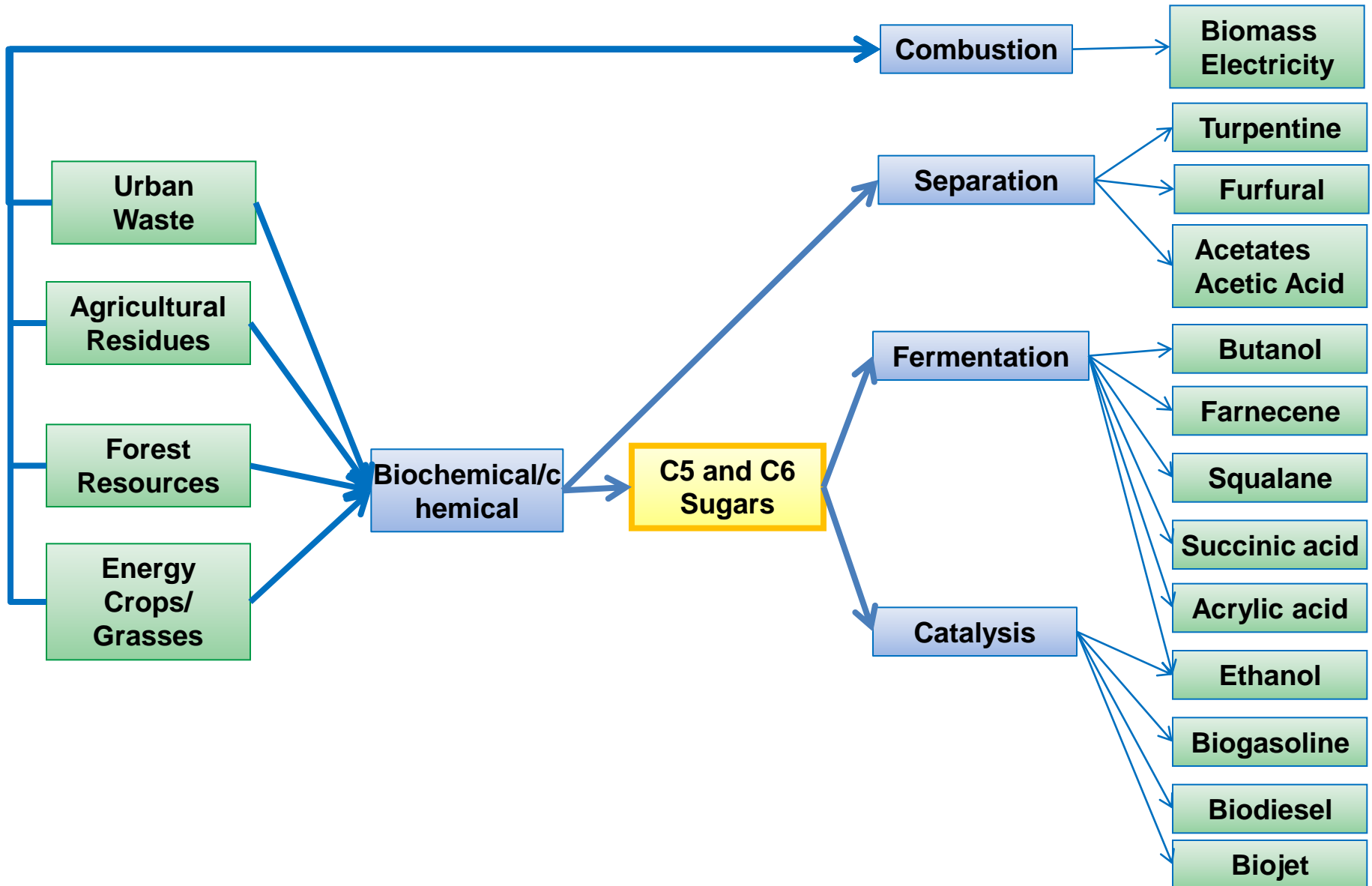


**Sugar activities**      **Extensive lab / pilot scale facilities (since 2006)**

**Design and construction of first of a kind cellulosic thanol/butanol Green Power+™(Alpena, Michigan).**

**Design and construction of the AVAP™ plant Georgia**

# Sugar is the new Crude™



# American Process Inc.

## Mission

1. Development and commercialization of technologies for production of low cost fermentable lignocellulosic sugars

2. Low cost low risk path to market by leveraging existing assets i.e. integration and retrofit of existing plants

Two proprietary conversion technologies



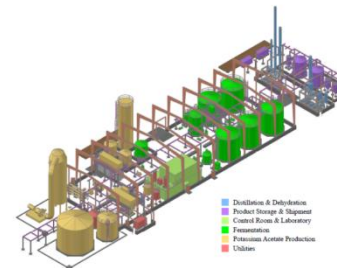
**AVAP™**

**Whole biomass conversion to sugars**

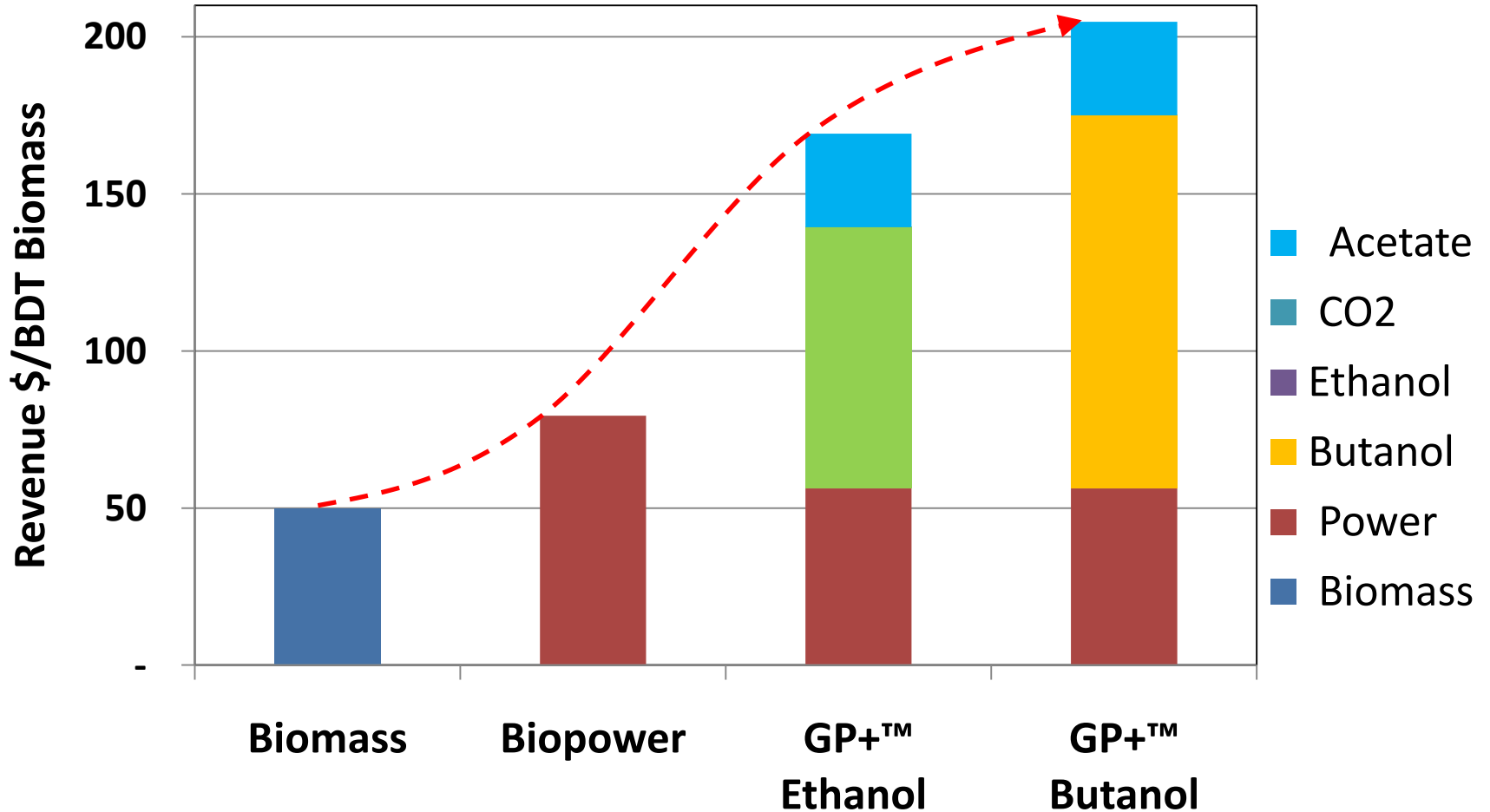


**Green Power+™**

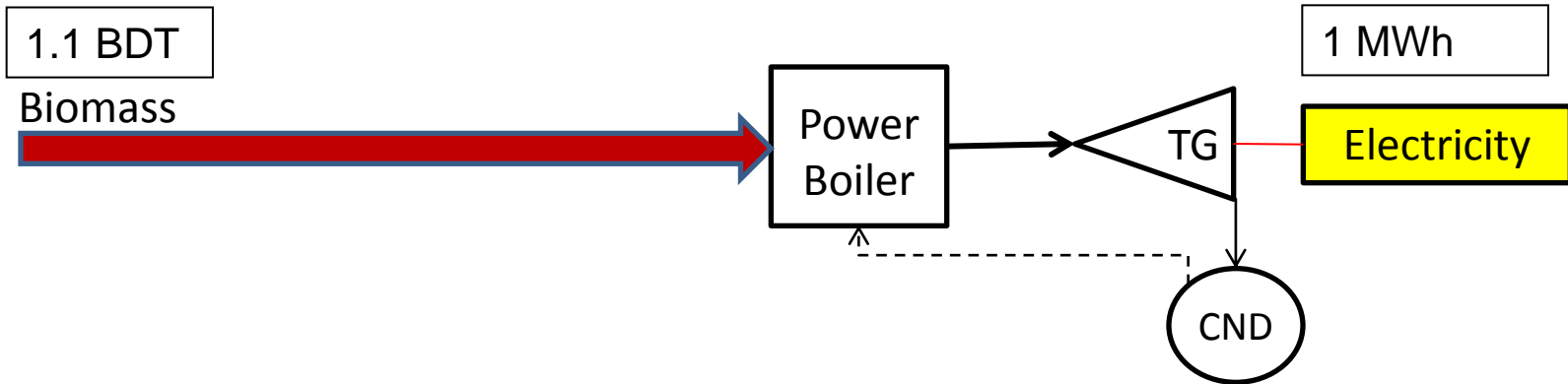
**Selective hemicelluloses conversion to sugars**



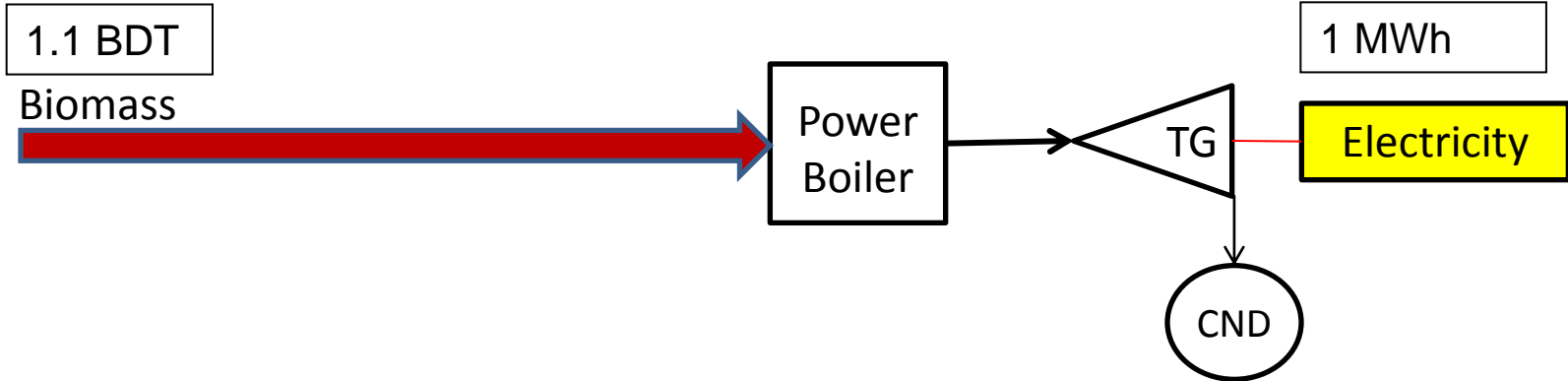
# GP+™ - Maximizing value from biomass



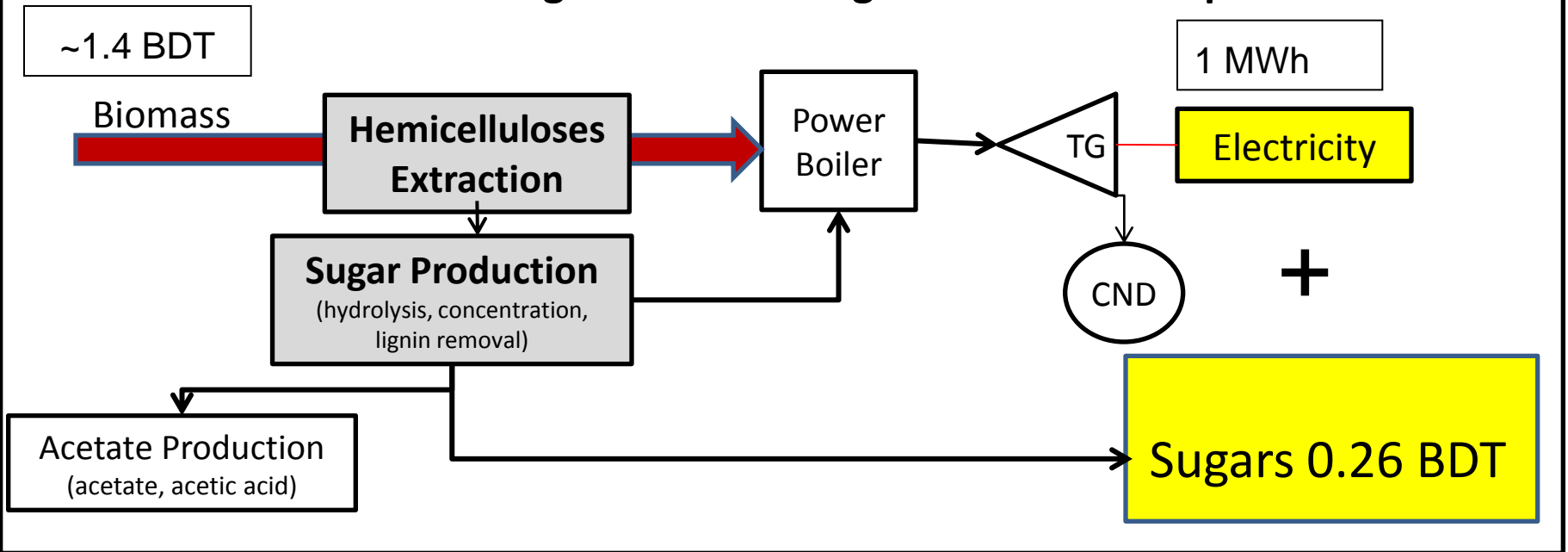
## Conventional biomass power generation



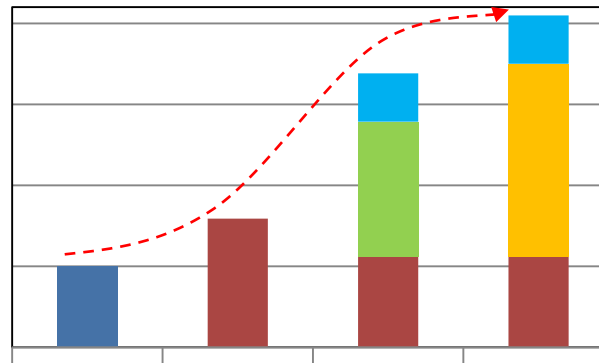
## Conventional biomass power generation



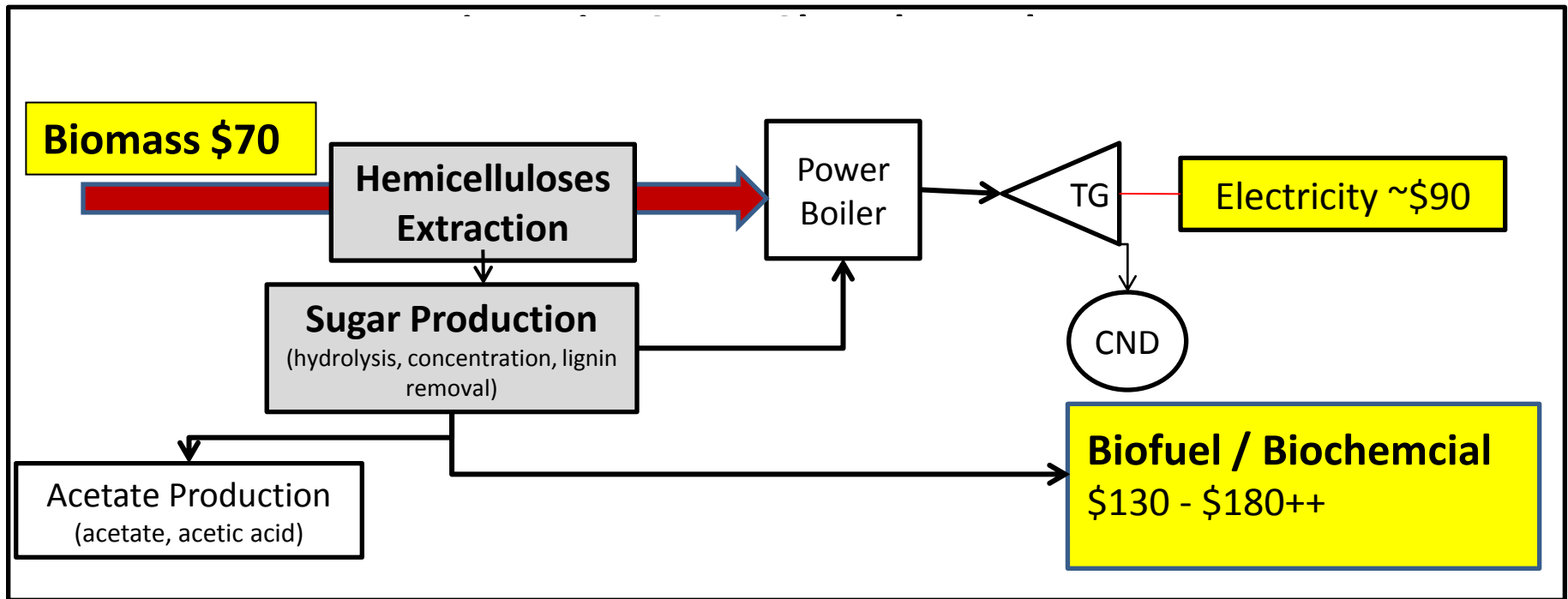
## Green Power+™ generation of sugars with biomass power



# GP+™ increases value from biomass products



- Acetate
- Ethanol
- Butanol
- Power
- Biomass

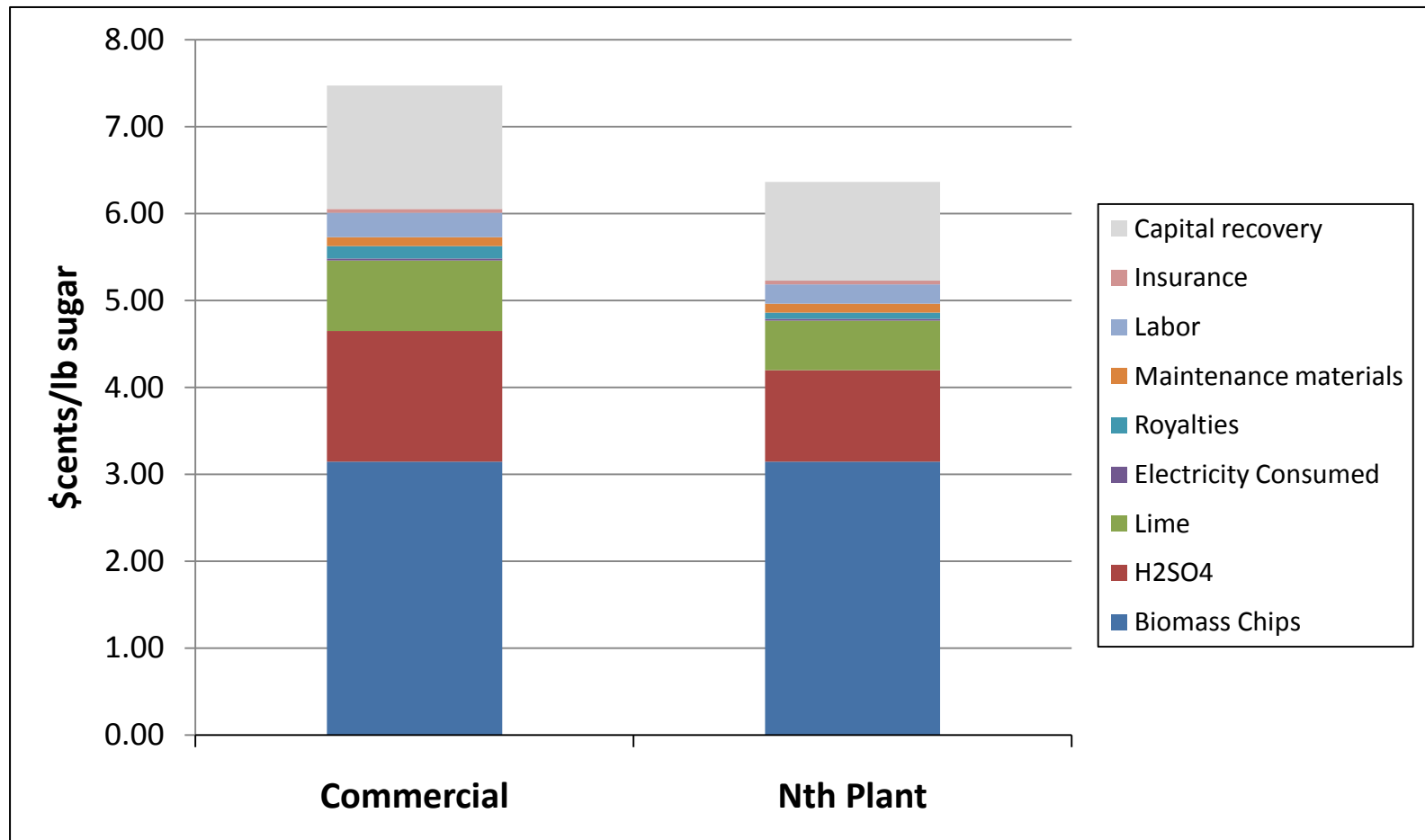




# Green Power+™ Advantages

- **Low cost source of fermentable lignocellulosic sugars**
  - Mass integration results in near theoretical yield to end bioproducts
    - Lignin, non fermented and byproduct are returned to the boiler
  - Energy integration with host biomass power plant
  - Proprietary process technology
    - maximizes sugar yield,
    - minimizes inhibitor formation
- **Low financial risk**
  - Financially viable at 6 – 10 million GPY ethanol
- **High IRR**
- **Low CAPEX**
- **Minimal technology risk**
  - Proven unit operations

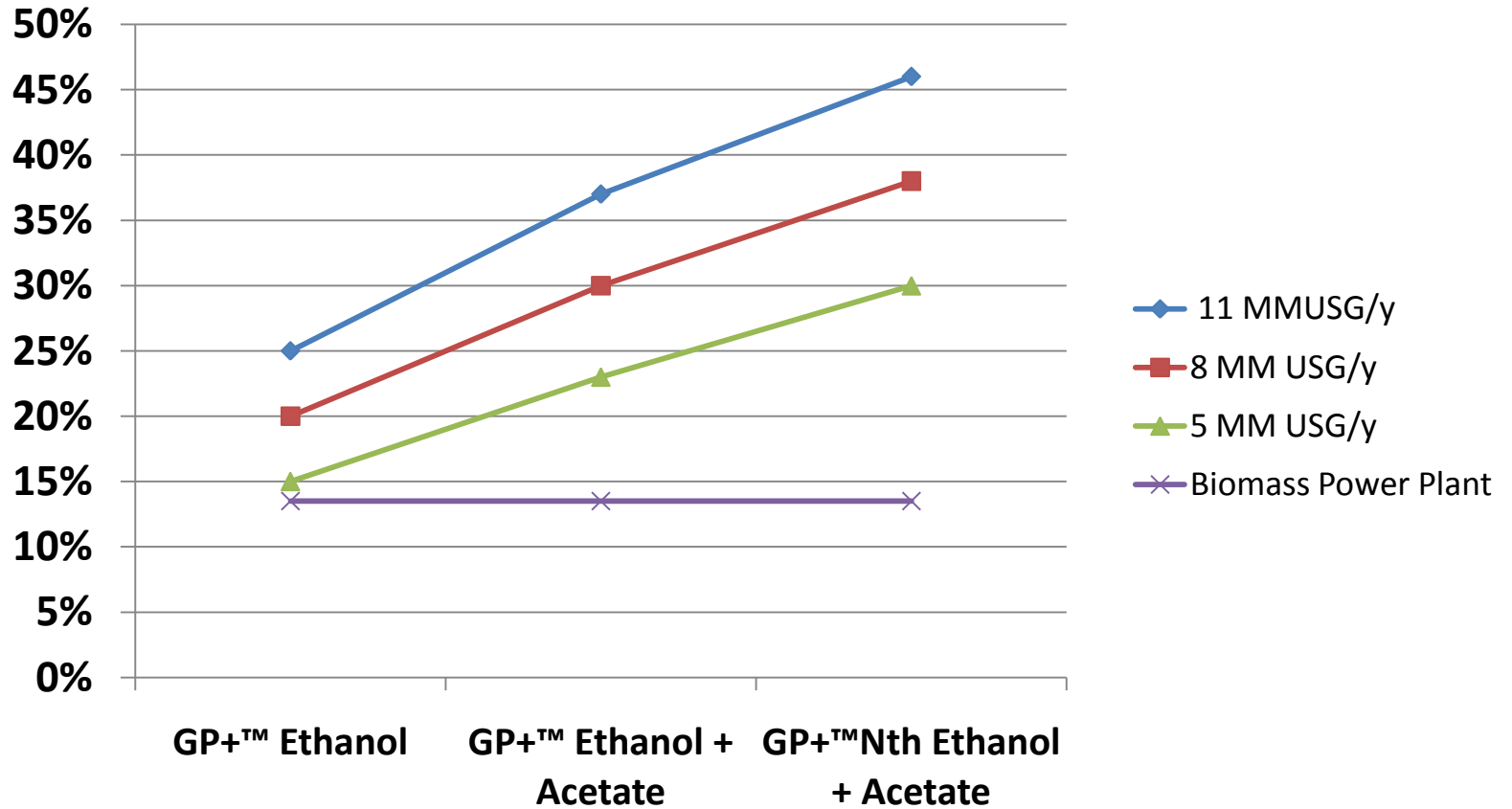
# GP+™ Fully loaded sugar cost at \$60/BDT



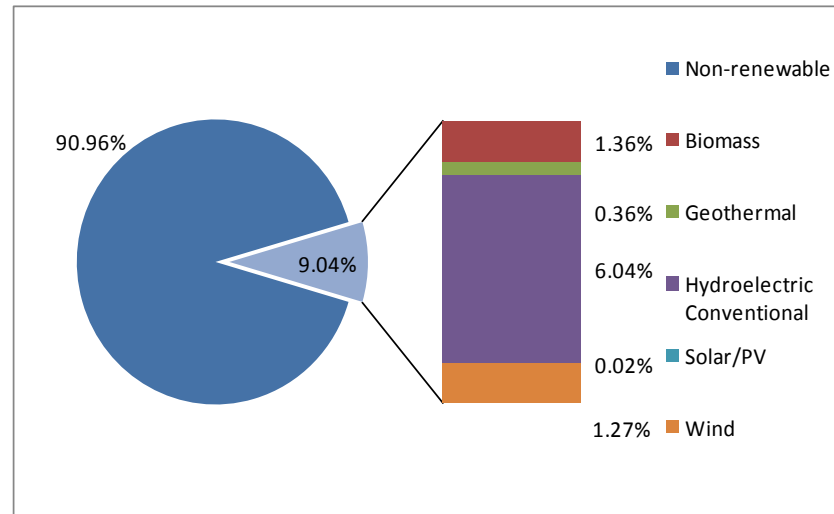
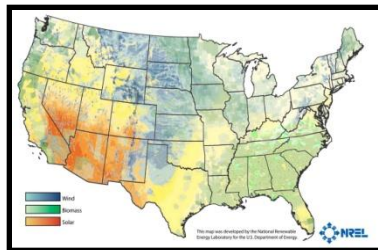
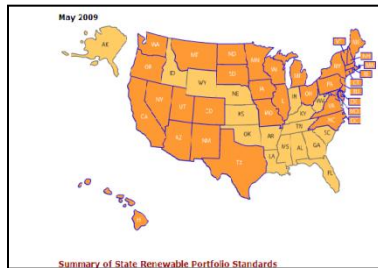
Cost of sugars in \$60/BDT biomass = \$c 3.0/lb

**Before any processing**

# Green Power+™ Unleveraged IRR at \$60/BDT



# Market size – USA 20+ MMT sugar /y



<u>Year</u>	<u>Biomass Electricity</u>	<u>% of USA Total</u>	<u>Sugar Potential</u>	<u>Ethanol potential</u>
	GW	%	Million T/y	Billion USG/y
USA 2008	6.7	1.36%	9 - 14	1.1 - 1.8
USA Forecast 2030	<u>18</u>	3.60%	23 - 38	3 - 4.5

# Feedstocks



- Sugar cane bagasse
- Hardwood chips
- Hardwood bark
- Softwood chips
- Softwood bark
- Corn cobs
- Switch grass
- Urban waste
- Mixed forest residue

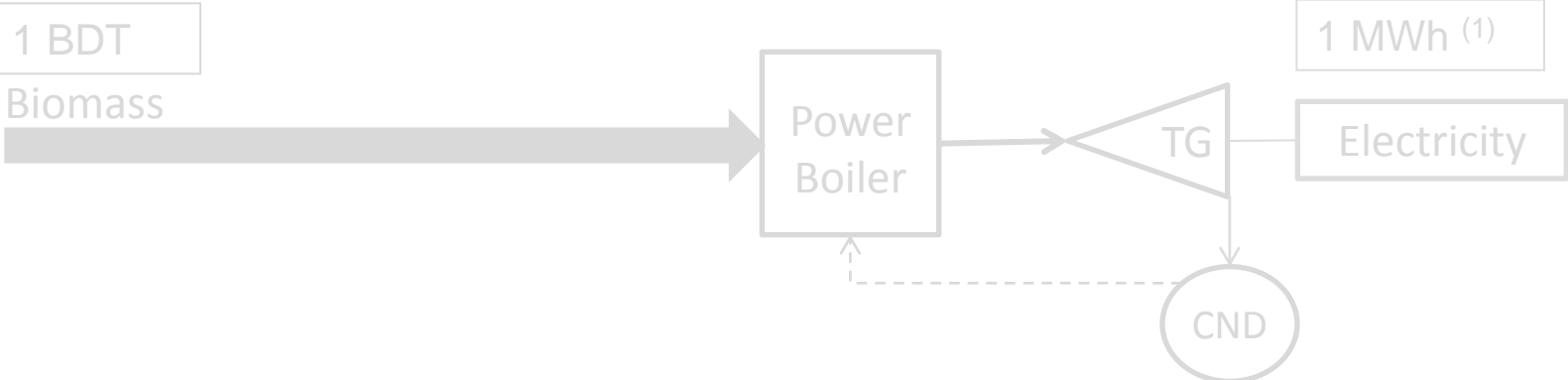


# Commercialization Step 1

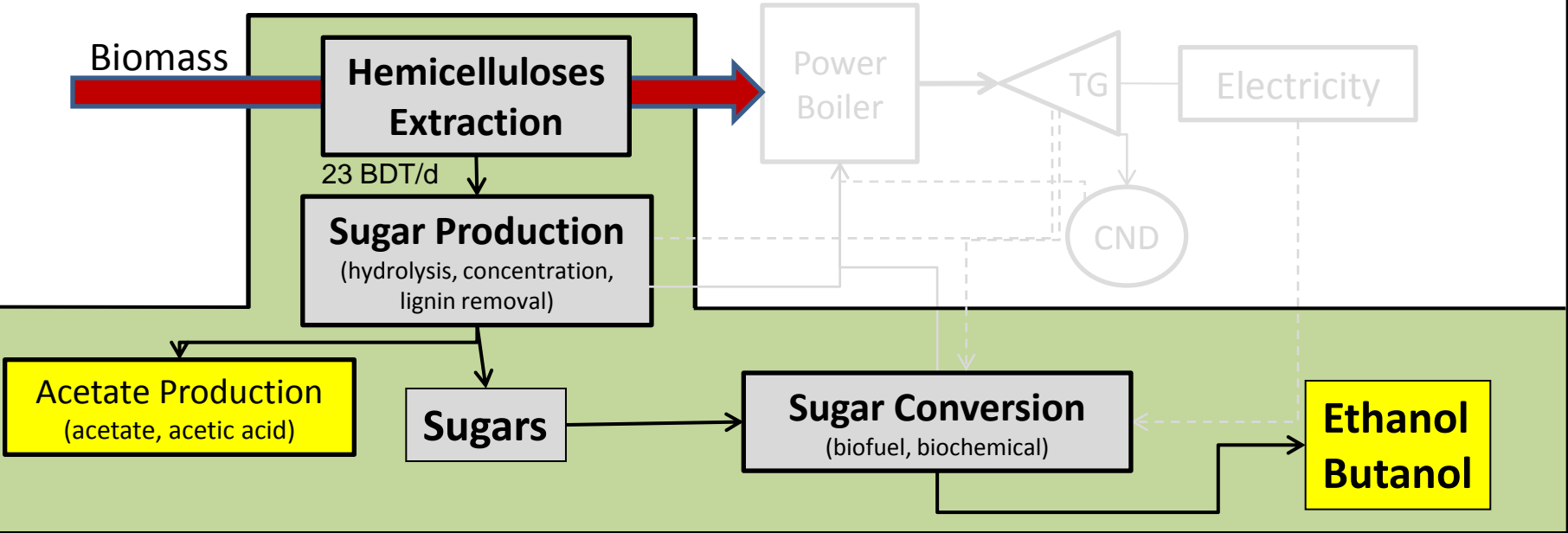
## The Alpena Project

1. Demonstration of Green Power+™
  - Confirmation of process economics
2. Platform for testing of downstream sugar conversion technologies
  - Ethanol, Butanol, Acetate, other....

# Conventional biomass power generation



# Green Power+™ Demonstration at the Alpena Biorefinery





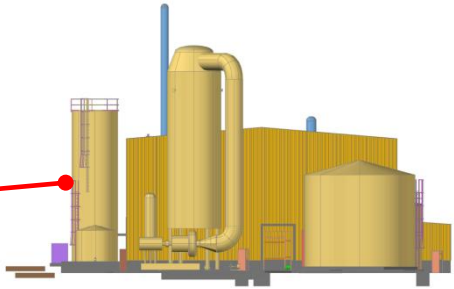
# The Alpena Biorefinery

- 23 BDT/d of hemicelluloses hot water hydrolyzate exists in Decorative Panels Int. plant.
- Currently going to Waste Water Plant. In December 2011 - the hydrolyzate will be the Alpena Biorefinery feedstock.
- Alpena, Michigan

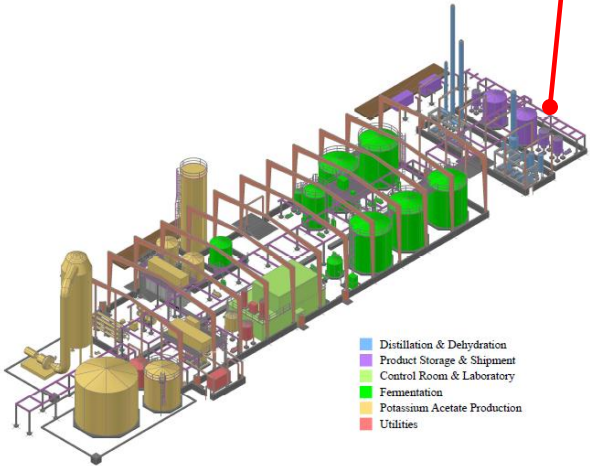




# Alpena Biorefinery



23 BDT/d of hemicellulose feedstock



- Distillation & Dehydration
- Product Storage & Shipment
- Control Room & Laboratory
- Fermentation
- Potassium Acetate Production
- Utilities

# Participants /Stakeholders

## Partners

- Decorative Panels International Inc.: Hemicelluloses feedstock
- Cobalt Technologies Inc.: Butanol production & Green Power+™  
Butanol joint marketing
- Michigan Technological University: Screening of microorganisms
- Green Tech America: Purdue-Ho Yeast

## Financing

- American Process Inc.
- Dept. of Energy – Integrated Biorefinery Grant - \$18MM
- State of Michigan – MEDC - \$4MM grant
- City of Alpena – Property Tax Free Zone

## Project Management

- Engineering: American Process Inc.
- Construction: DeVere Construction
- Start-up & Commissioning: American Process Inc.
- Operations: APER (subsidiary of American Process Inc.)

# Project Timeline

<b>2007</b>	Conceptual Development
<b>1/2008</b>	Initial Agreements
<b>8/2008</b>	Feasibility Study – Grant Applications
<b>2009</b>	Basic Engineering
<b>2010</b>	Detailed Engineering & Procurement
<b>2/2011</b>	Construction start
<b>11/2011</b>	Commissioning and Start-up

# Project Summary

- 2011 7000 T /y of fermentable **lignocellulosic sugars**
- 2012 lignocellulosic sugars →
  - ~900,000 USG/y of cellulosic **ethanol**
  - + ~700,000 USG/y of potassium **acetate**
- 2012 lignocellulosic sugars → ~500,000 USG/y of **butanol**  
(Cobalt Technologies / American Process Inc joint demonstration)
- 2012.... After the demonstration period the biorefinery will remain a viable commercial, **on-going operation**
- Expansion, **other feedstocks and /bio-products**

# Thank you

*Follow our progress at [www.alpenabiorefinery.com](http://www.alpenabiorefinery.com)*



*More news on sugar platforms [www.americanprocess.com](http://www.americanprocess.com)*