

American Process - Alpena Biorefinery

Lessons Learned:



Theodora Retsina
CEO



Sugar is the New Crude®

American Process Company History

1995 - 2010

- Conducted over 400 projects, in USA, Canada, Brazil, Europe, Australia
- In more than 150 forest industry plants
- Performed O&M services



1999 – 2010

- Designed EPC and operated power cogeneration facilities “across the fence”
- Designed projects for mill shutdown installations



2005 – 2012

- Invested in biorefinery R&D – Over 48 patents pending, 7 allowed
- Two technologies AVAP and Green Power+
- Built two demonstration cellulosic ethanol plants in GA and Mi USA
- Recipient of DOE and Michigan State grants



2013

- Partnership with GranBio
- Expansion and partnerships worldwide



API Experience

- Over 80 man-years experience in design and operation of ethanol plants
- Design and built large Greenfield projects in pulp and paper and ethanol fields
- Design and startup “first of kind” processes in pulp and paper and ethanol field
- API personnel have over 2,000,000 man-hours of project experience
- API personnel have over \$2 billion of project implementation experience
- API personnel have over 500,000 man-hours of operating and mill startup experience

We have been building, analyzing, starting up biomass plants for 20 years

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1st Commercial woody cellulosic ethanol in USA

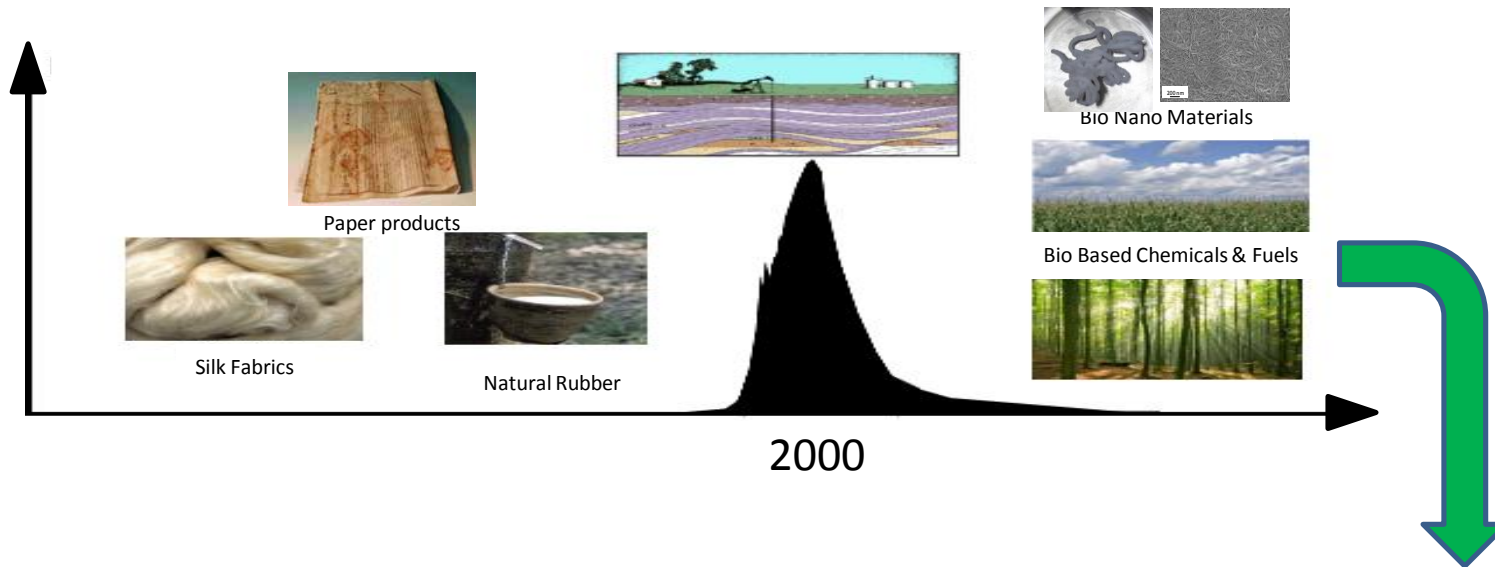
Nov 2013

THANK YOU
City of Alpena
Devere
Georgia Tech
GranBio
MEDC
Michigan Forest Council
Michigan Tech
Nancy Ho
NMTC (RDP CCML WF
State of Michigan
Tenaska
US DOE

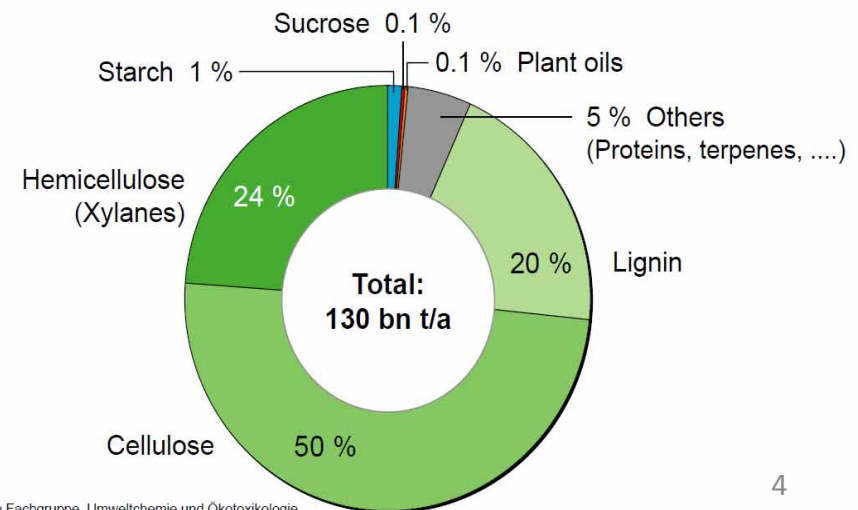
Alpena Biorefinery - First Ethanol Shipment



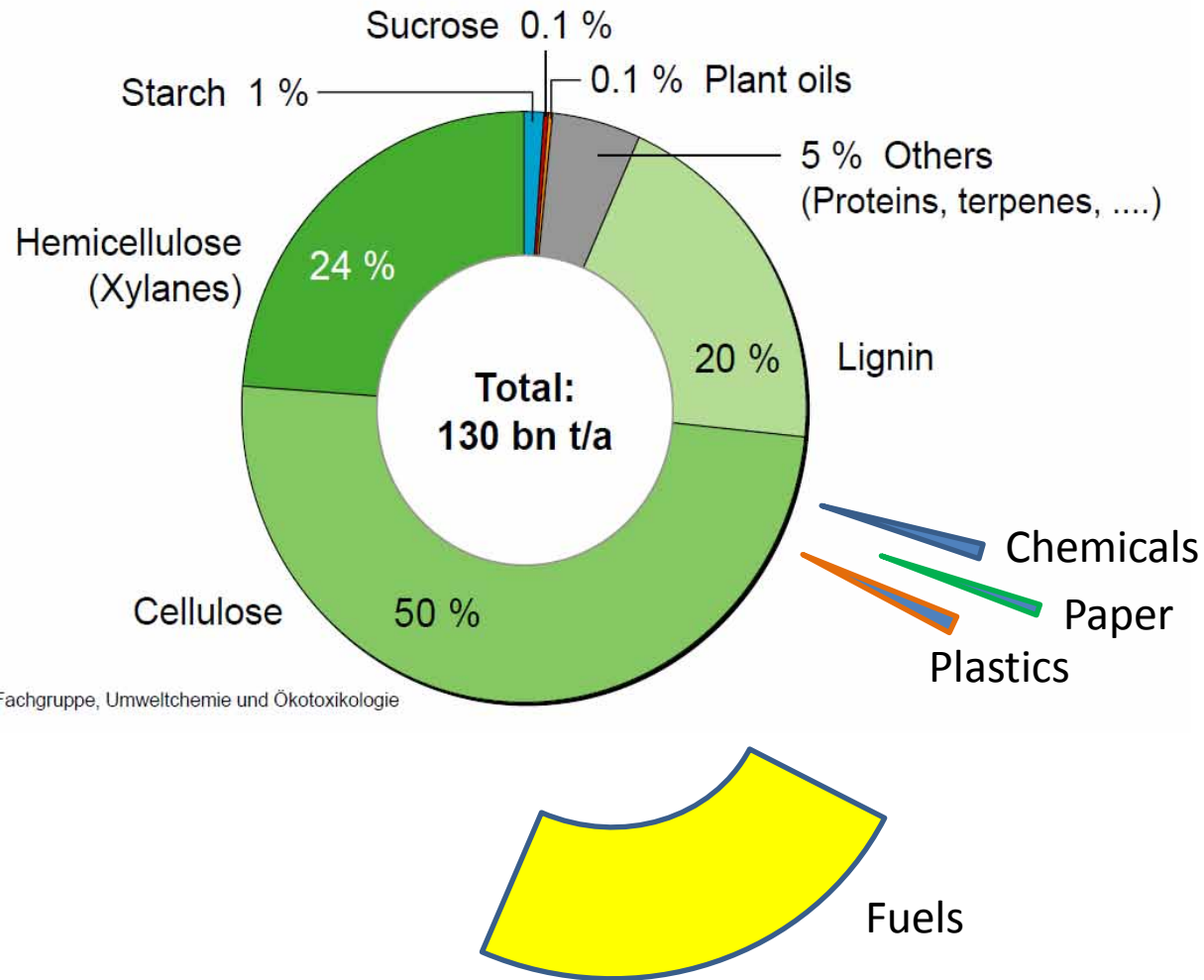
Shift to Bio-Based Economy – “Sugar is the new crude”[®]



- Most of the world’s history is based on renewables
- Fossil fuel is a finite resource, with negative environmental impact
- It allowed economic growth which enabled advance research and development of renewable chemicals and advanced renewable materials
- In the renewable economy cellulosic sugar is the new fungible feedstock



Shift to Bio-Based Economy – “Sugar is the new crude”[®]



Source: GDCh Fachgruppe, Umweltchemie und Ökotoxikologie

Sugar is the New Crude[®]

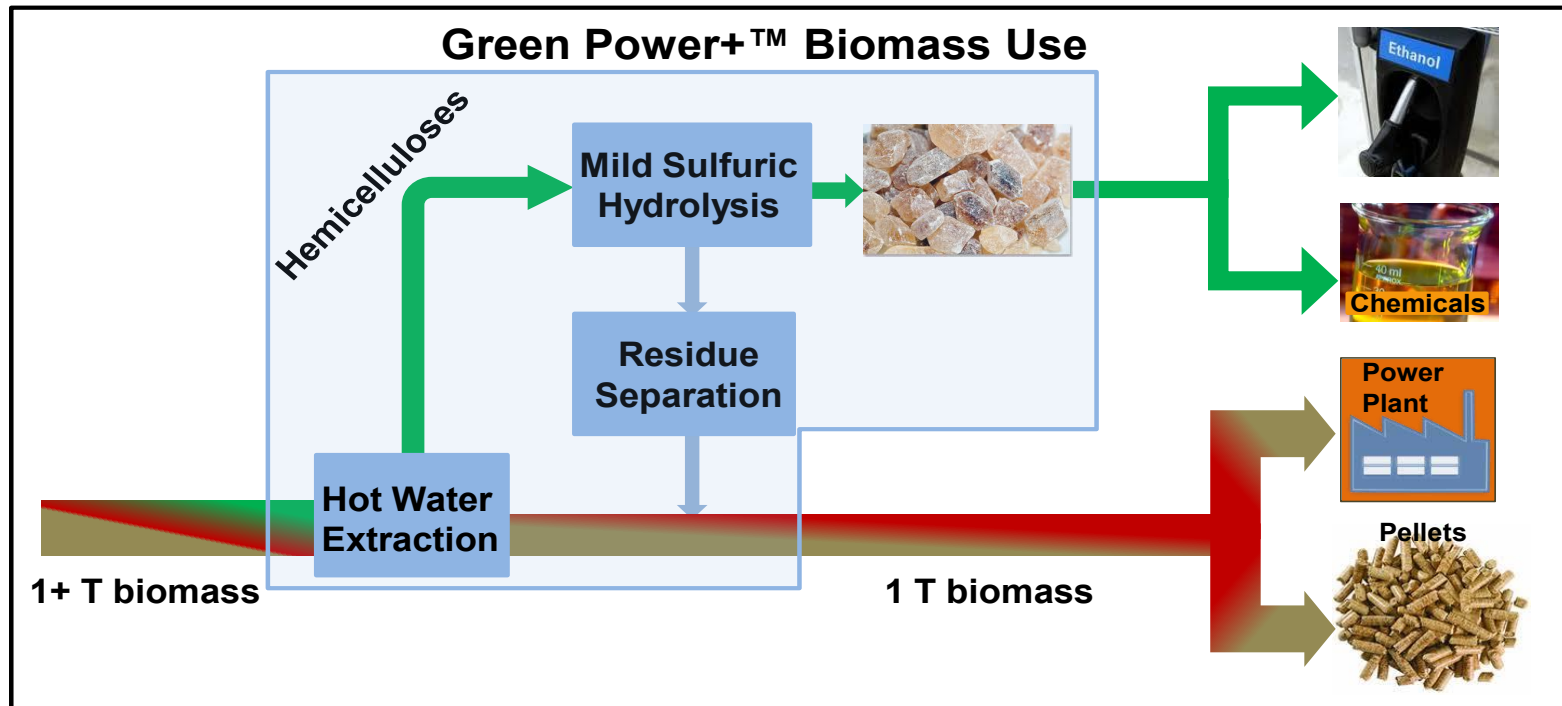
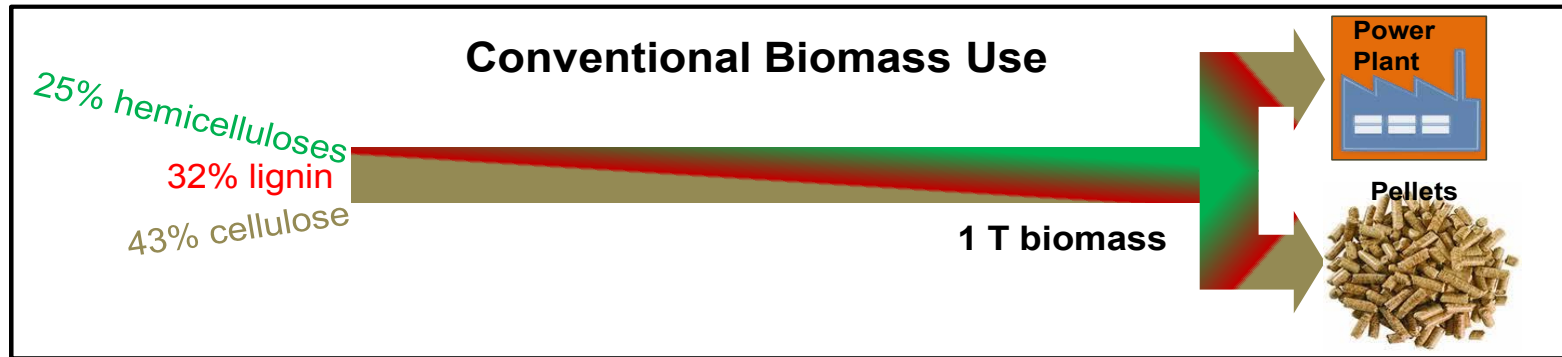
AMERICAN
PROCESS

How is Excess Biomass used today?

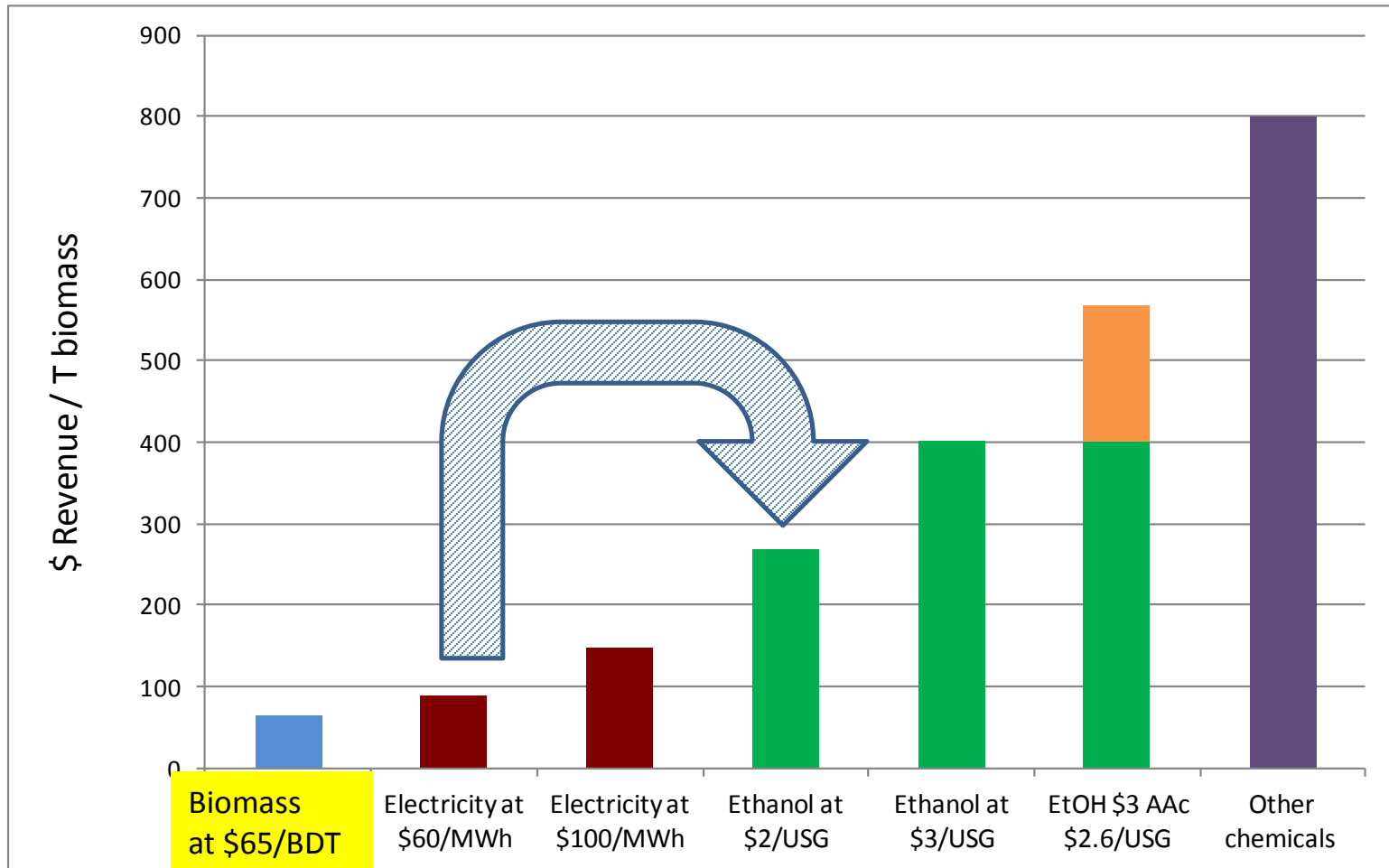
- In pulp and ethanol mills it is burned to generate steam and electricity.



Green Power+ Biomass Use

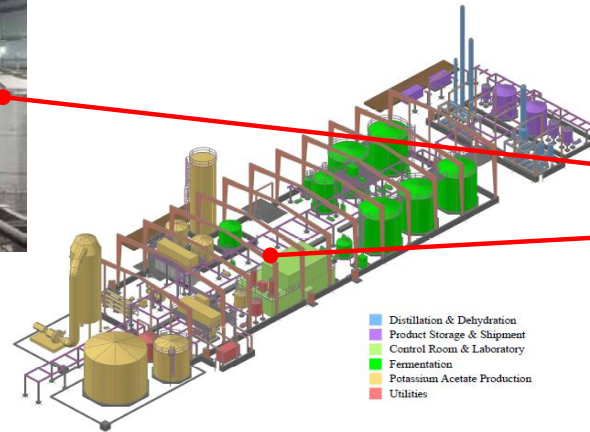


Green Power+ Value Proposition



Alpena Biorefinery – Green Power+ Demo

www.alpenabiorefinery.com

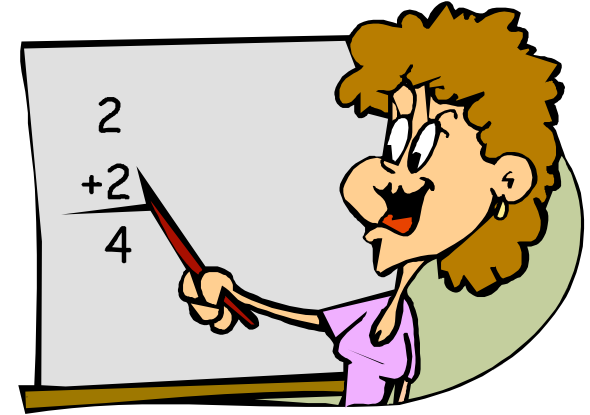


- Adjacent to hardboard plant which extracts the hemicelluloses from forest residue
 - Feedstock secured and cost advantaged
 - No need to build utilities
 - Leverage infrastructure
 - 24 BDT/day feedstock delivered to Biorefinery

Sugar is the New Crude®

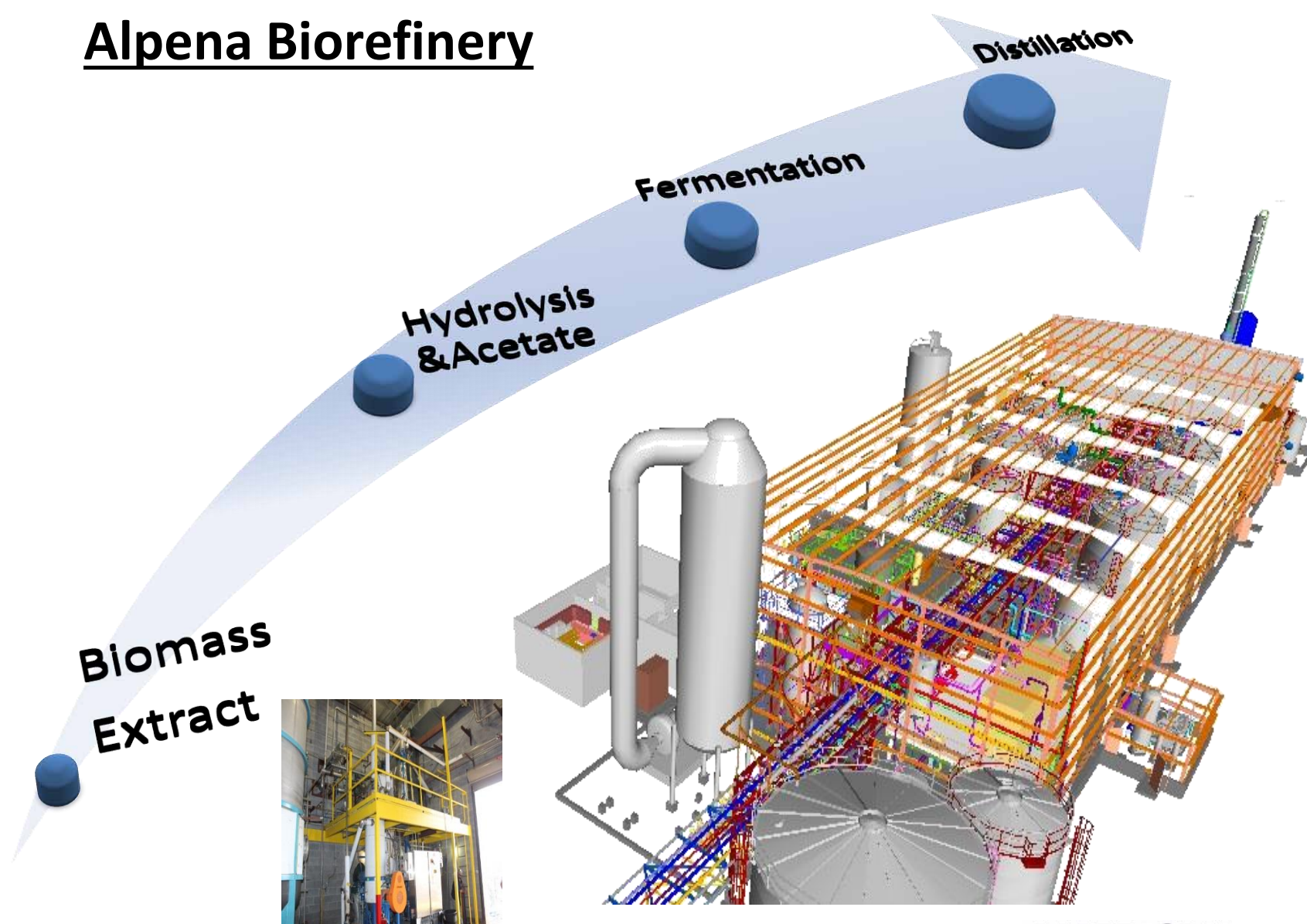
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Lessons Learned



- Leverage existing “across the fence” infrastructure to mitigate:
 - First of a kind risks
 - Small scale of “first of a kind”

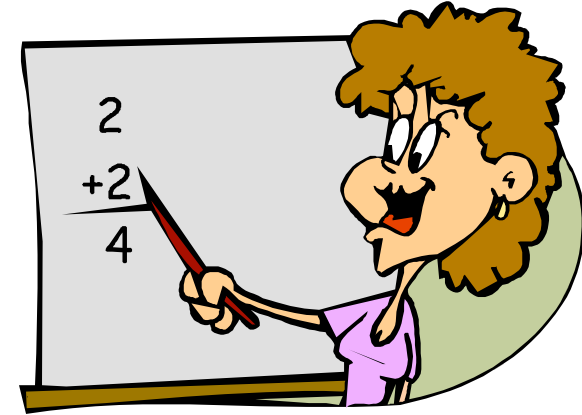
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Lessons Learned



- Engineering time and cost $\propto \sim 2$
- Construction... more....\$.
- By nature of these projects.. “scope cannot be frozen”
- Cost – contingency planning is needed

April 2011

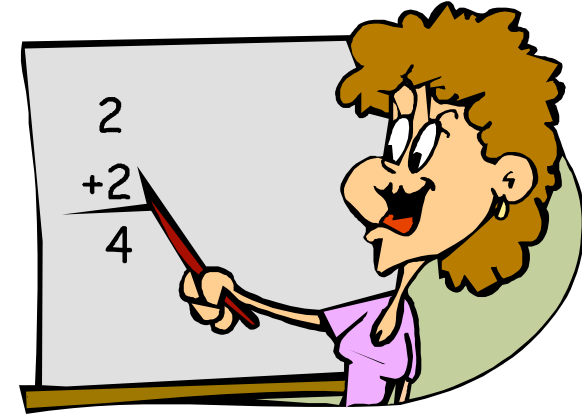
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Green Power+ Commercial Demonstration Plant

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Lessons Learned



- Financial Risk of “first of a kind” – very high
- This would not have been possible without
 - COEE Michigan Grant
 - DOE Integrated Biorefinery Grant
 - Alpena Property Tax Free Zone
 - GranBio investment
 - API Investment

March 2012

Alpena Biorefinery

Recognized by EPA one of the first five biorefineries to produce cellulosic ethanol in 2012

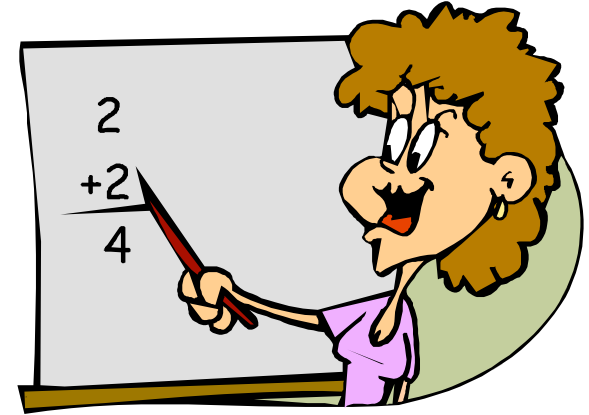
April 2012

Alpena Biorefinery - Fermentors

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Lessons Learned



- Startup curve
 - Nobody could have prepared us for such a slow startup curve
 - Rebuild – solve scale up issues – DOE assistance
 - Startup – slow startup curve
 - Milestone achieved – started shipments of ethanol
 - Second wave of debottlenecking – 6 months

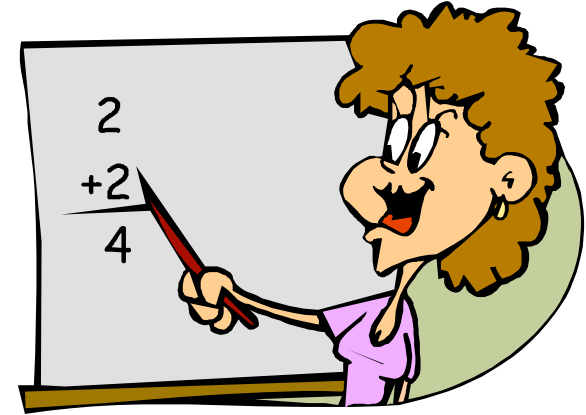
July 2013

Alpena Biorefinery Ethanol Distillation Columns Successful Startup

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Lessons Learned



- A continuous team thread is needed from R&D to startup to operations
 - R&D scale up from pilot to Demo
 - Choice of equipment / configurations
 - NOBODY REALY KNOWS! THIS IS NEW!

Sept 2013



September 15 made 196 Proof (98%) and ~200 Proof (anhydrous) cellulosic ethanol from wood biomass

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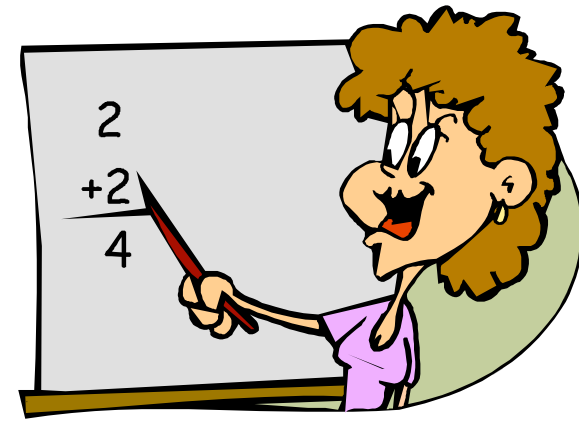
First Cellulosic Ethanol Production

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Lessons Learned

- Location, location, location!
 - Logistics
 - Feedstock
 - Product
 - Supplies / chemicals
 - Personnel
 - Environmental
 - Soil bearing capacity



Nov 2013



Alpena Biorefinery - CONFIDENTIAL MATERIAL - First Ethanol Shipment

Lessons Learned



- It takes a village, a town - the whole world!
 - No company in the space has all the necessary parts
 - It is worse for smaller companies
 - Chain supply must be secured
 - There must be project management with knowledge of chain supply
 - Forest management and certification, feedstock gathering and procuring, E, P, C, sugar processing, permitting, safety, environmental, GMOs, new equipment, operator training, product certification, product sales, logistics

April 2014

04.18.14



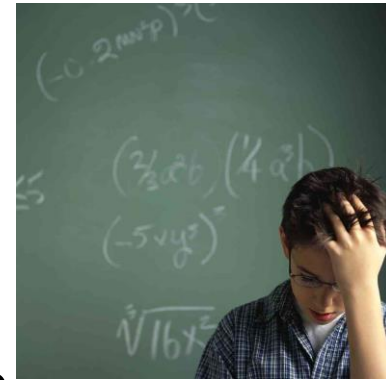
GREAT LAKES
PETROLEUM
CORPORATION

Alpena Biorefinery First Cellulosic Ethanol Shipment

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Lessons Learning...



- What is the right scale for a first of a kind?
- Small
 - Does not solve demonstration and scale up needs
 - Smaller CAPEX and OPEX makes impact of “unpredictable events” smaller
 - Has no commercial life after demonstration
- Large
 - Impact of cost overruns and schedule delays can be crippling
 - Once startup is survived – has independent commercial life.

Overview – Lessons Learned

Scope	Technology Readiness
Cost	Technical
Schedule	Validation
Risk Management	Go/no go decisions
Risk Mitigation	Milestones
Regulatory	Review
Programmatic	FOA development
NEPA	Merit Review
	Committee
Financial	Selection
Planning	Award Negotiation
Project Management	Active Project Management
Project Team	Award Closeout
Project Execution	



Most Important ! Keep going

- Many obstacles
- Environmental permit issues, capex escalation, IP entanglement, loss of personnel, loss of financing, changes in legislation, uncertainty in markets, uncertainty in fossil fuels prices, failures of others may trip you



Thank you

City of Alpena
Devere
Georgia Tech
GranBio
MEDC
Michigan Forest Council
Michigan Tech
Nancy Ho
NMTC (RDP CCML WF)
State of Michigan
Tenaska
US DOE

