



# **BIOREFINERY OPTIMIZATION WORKSHOP**

**U.S. Department of Energy,  
Bioenergy Technologies Office**

**October 5–6, 2016 • Chicago, Illinois**

**Theodora Retsina  
CEO**



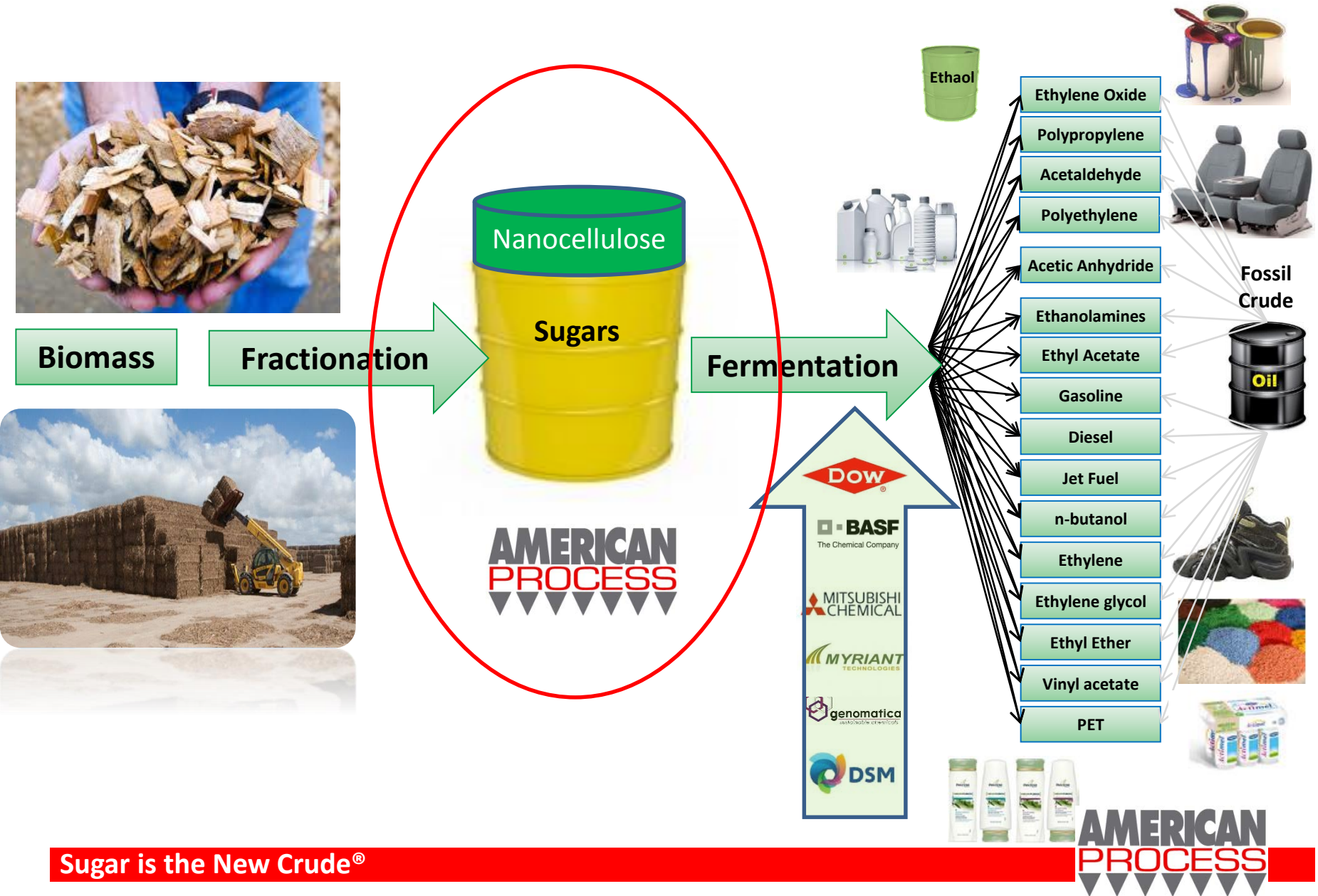
# Our History



- 1995 – 2005 Engineering services in biomass industries
- 2006 – 2010 Development of technologies lab/pilot
- 2011 – 2014 Pilot / Demonstration
- 2015 Commercialization



# Sugar is the New Crude®



## **AVAP®- Bulk sugar production & conversion – TRL 7**

- ❑ Clean sugars from cellulose & hemicelluloses
- ❑ Feedstocks: Softwood, hardwood, ag residues

## **BioPlus™ – Nanocellulose production TRL 7**

- ❑ Pre commercial plant for market development
- ❑ Hydrophilic and Hydrophobic NanoCrystals and NanoFibrils

## **GreenPower+® Technologies - Simple process to alcohols TRL 8**

- ❑ Low cost alternative for bolt on or standalone production
- Patent portfolio 37 granted ~250 pending
- All key patents granted USA – and at TCP progressing worldwide



# Lab tests – 2009



Fractionation



Autohydrolysis



Lignin precipitation



Chemical Recovery



Fermentation



Testing

## Pilot tests - 2010





# GP+ Alpena Biorefinery



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

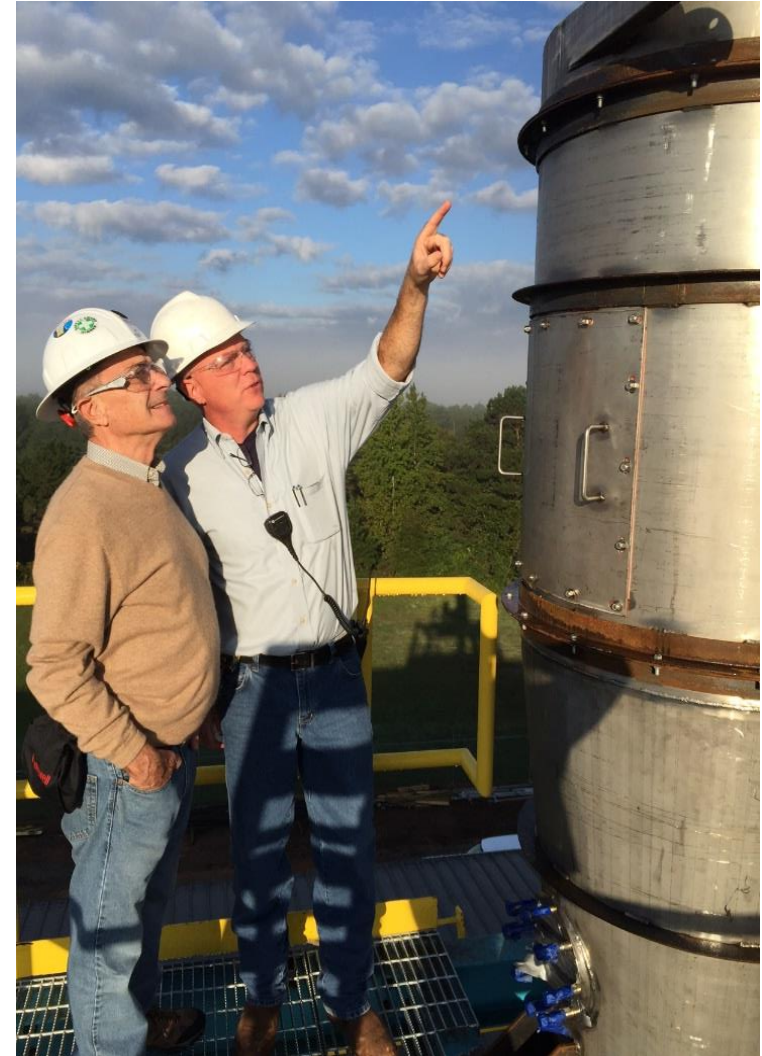
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US DOE

Alpena Biorefinery - First Ethanol Shipment



# 2014 - 2015 - GP3+ Cellulosic Ethanol Demonstration Plant







**Pre-commercial Integrated demos of our 3 technologies**

**AVAP – GP3+ - Nanocellulose**

**3.5 BDT/d feedstock - over 8000 hours operation**

**Next Step – Scaling to 50 bd t/d**





# First Steps to Commercialization 2014, 2015, 2016

## Alpena GreenPower+ First Pre-commercial Biorefinery Nov 2013



## Norampac Cabano GreenBox+ commercial plant June 2016



## First AVAP commercial license for clean C6 production for chemicals - sold! 2014



## First sale of commercial nanocellulose quantities - Thomaston plant April 2015





# The necessary ingredients

- Vision – why are we doing this?
- Steady governmental policies
- Technology team
  - Not only a science team
  - Driven – inspired - committed – with technical integrity!
  - Agile
- Enough financing
- Leadership – this is not for the faint at heart!
  - Decision making ability
- Networking – Supply chain alliances
- Understanding biomass
  - **“sisu” – irrational perseverance**

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Continued Operations	Continuous improvement	Think that we are there <b>Fail to allow for startup curve</b>

# Reducing CAPEX & OPEX

- CAPEX
  - Retrofit existing industrial facility
  - Right size
  - Process Yield
- OPEX
  - Logistics
  - Energy integration
  - Process Yield
  - Co-product



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