ZeaChem:
An entirely new approach to cellulosic ethanol

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National Ethanol Conference

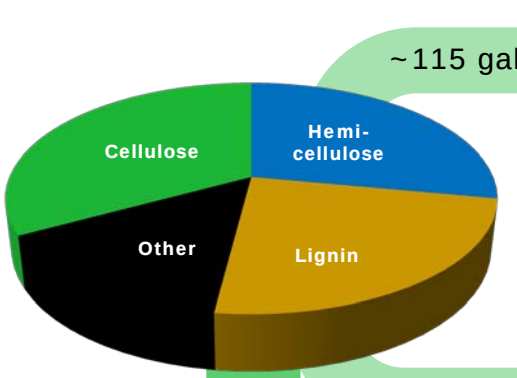
February 24, 2009

ZeaChem Overview

- "Third-generation" cellulosic biorefining company based in Lakewood, CO; R&D lab and pilot plant in Menlo Park, CA
- Hybrid process offers highest yield, highest efficiency and lowest fossil carbon footprint of any known biorefining process
  - Production of biofuels, including ethanol, and chemicals
  - Utilizing proven technology and naturally occurring organisms
- Experienced management team with backgrounds in petroleum (Koch), fermentation (Coors, NatureWorks) & chemical industries (Dow)
- Begin construction in 2009 of first plant, product in 2010
- Financing: $40MM raised to date

ZeaChem's Yield Advantage

- Currently two known paths to produce ethanol



~115 gal/BDT → Biochemical: Enzymes

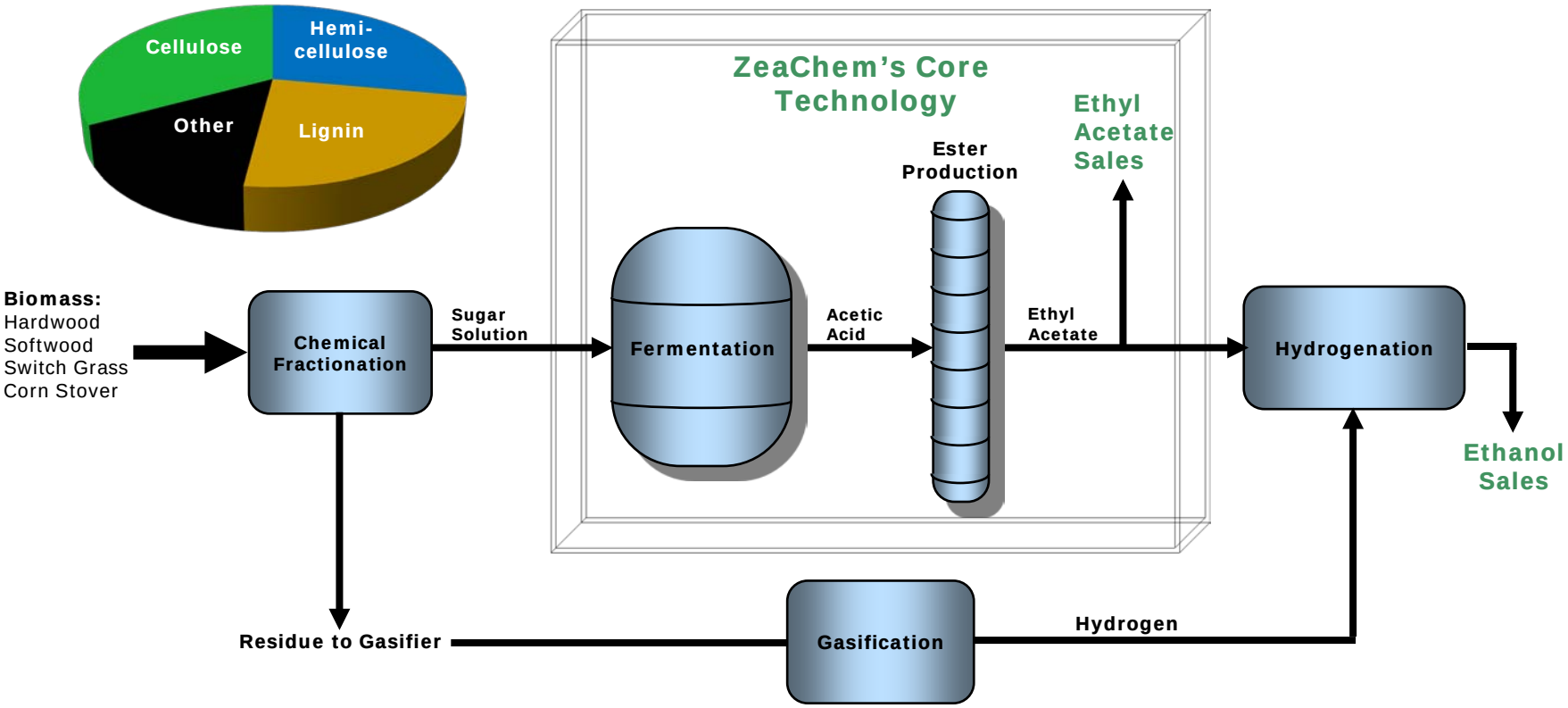
~115 gal/BDT → Thermochemical: Gasification

~160 gal/BDT

ZeaChem leapfrogs both approaches – 'Prius' hybrid

BDT = Bone Dry Ton
Yield is highest theoretical maximum

ZeaChem Process



Highest theoretical yield (160 gal/BDT)
Lowest net CO_2 footprint

Acetogen Advantages

- Naturally occurring acetogen
  - Found in termites, ruminants, waste water treatment
- Produces no CO_2 emissions during fermentation
  - Retain all the carbon in the feedstock
- Converts all C_5 and C_6 sugars into acetic acid – “The Terminator”
- Tolerates all breakdown products of biomass

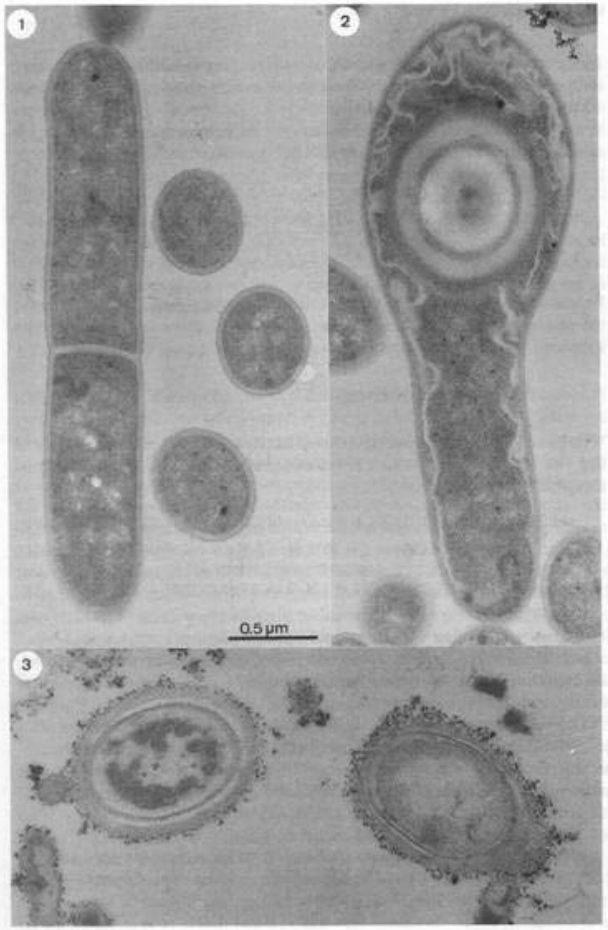


Figure 1.2. Thin sections of chemolithoautotrophically cultivated *Clostridium thermoaceticum*. Panel 1: vegetative cell; panel 2: sporulated cell; panel 3: spore.

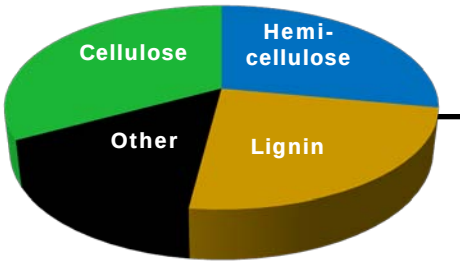
Feedstock Strategy

- ZeaChem process is feedstock agnostic
  - Hardwood, softwood, switchgrass, corn stover, etc.
  - Dedicated sustainable energy crops
  - Geographic diversity, “Grow where we go”
- Contract with GreenWood Resources
  - Supply hybrid poplar feedstock
- Benefits
  - Efficient harvesting
  - Low cost
  - “Store on the stump”

GREENWOOD RESOURCES

Potential Product Portfolio

Two Fundamental Alternatives
- Change organism
- Change downstream chemistry



Cellulosic Biomass Composition

ZeaChem's Technology

C3 Chain
- ❑ Lactic Acid
  - Propylene Glycol
  - Acrylic Acid & Esters
- ❑ Propionic Acid
  - Propylene
  - Methacrylic Acid & Esters

Current Platform

C2 Chain
- ❑ Acetic Acid
- ❑ Ethyl Acetate
- ❑ Ethanol
- ❑ Ethylene
- ❑ Ethylene Glycol

C4 Chain
- ❑ Butanol

C6 Chain
- ❑ Hexanol
- ❑ Hexene

Solving the "Food vs. Fuel" Debate with Efficiency

	Farm Yield	Factory Yield	Auto Eff.	**Land Prod.**
1st Generation - Corn Ethanol	150 Bu/ac/yr	2.7 Gal/bu	14 Mile/gal EtOH	**5,670** Mile/ac/yr
2nd Generation Cellulosic - (bio or thermo only)	7.5 BDT/ac/yr	90 Gal/BDT	14 Mile/gal EtOH	**9,450** Mile/ac/yr
3rd Generation Cellulosic – ZeaChem Process	15 BDT/ac/yr	135 Gal/BDT	14 Mile/gal EtOH	**28,350** Mile/ac/yr
3rd Generation Cellulosic + Auto Efficiency	15 BDT/ac/yr	135 Gal/BDT	25 Mile/gal EtOH	**50,625** Mile/ac/yr

Biorefinery Deployment

- 1st Plant
  - Engineering currently underway – CH2M HILL
  - Begin construction in 2009
  - Run wide variety of biomass feedstocks
  - Goal: Prove integration of known processes

- Next Steps
  - Scale up to commercial plant from 1st plant

ZeaChem Financing and Costs

- ZeaChem $40MM financing to date
  - Series A raised $6MM
    - Mohr Davidow Ventures (MDV) and Firelake Capital
  - Series B raised $34MM
    - Co-led by Globespan Capital Partners and PrairieGold Venture Partners
    - Follow-on from MDV and Firelake Capital
    - Investment by Valero Energy Corporation, largest US petroleum refiner

- Highest efficiency cellulosic ethanol producer
  - Operating cost <$1.00/gallon
  - Capital cost < $3.00/gallon

ZeaChem Summary

- “Third-generation,” hybrid cellulosic technology offers 40% yield advantage
- Using proven industry processes and technologies, naturally occurring acetogen
- Production of cellulosic biofuels and chemicals
- Dedicated sustainable energy crops
- Begin construction of first plant in 2009, engineering underway