Production of Sustainable and Economical Biofuels and Bio-based Chemicals

Carrie Atiyeh

Director of Public Affairs

ZeaChem Overview

ZeaChem: Who We Are

Biorefiner with Demonstrated Success

- Produce advanced biofuels and bio-based chemicals

- Advantages:
  - Feedstock agnostic
  - Dedicated / Sustainable energy crops
  - Novel integration of known processes and natural organism
  - 40% yield advantage
  - Diverse product portfolio addresses multiple $billion opportunities

- Compete with lowest cost alternative
  - Must be economical vs. oil to succeed

Key Organizations

Investors and Sponsors

MOHR DAVIDOW

prairiegold venture partners

VALERO

ecotrust

FIRELAKE CAPITAL MANAGEMENT

GLOBESPAN CAPITAL PARTNERS

P&G

CEI COASTAL ENTERPRISES INC.

Western Technology Investment
www.westerntech.com

DEPARTMENT OF ENERGY · UNITED STATES OF AMERICA

OREGON DEPARTMENT OF ENERGY

business oregon where business grows

Key Participants

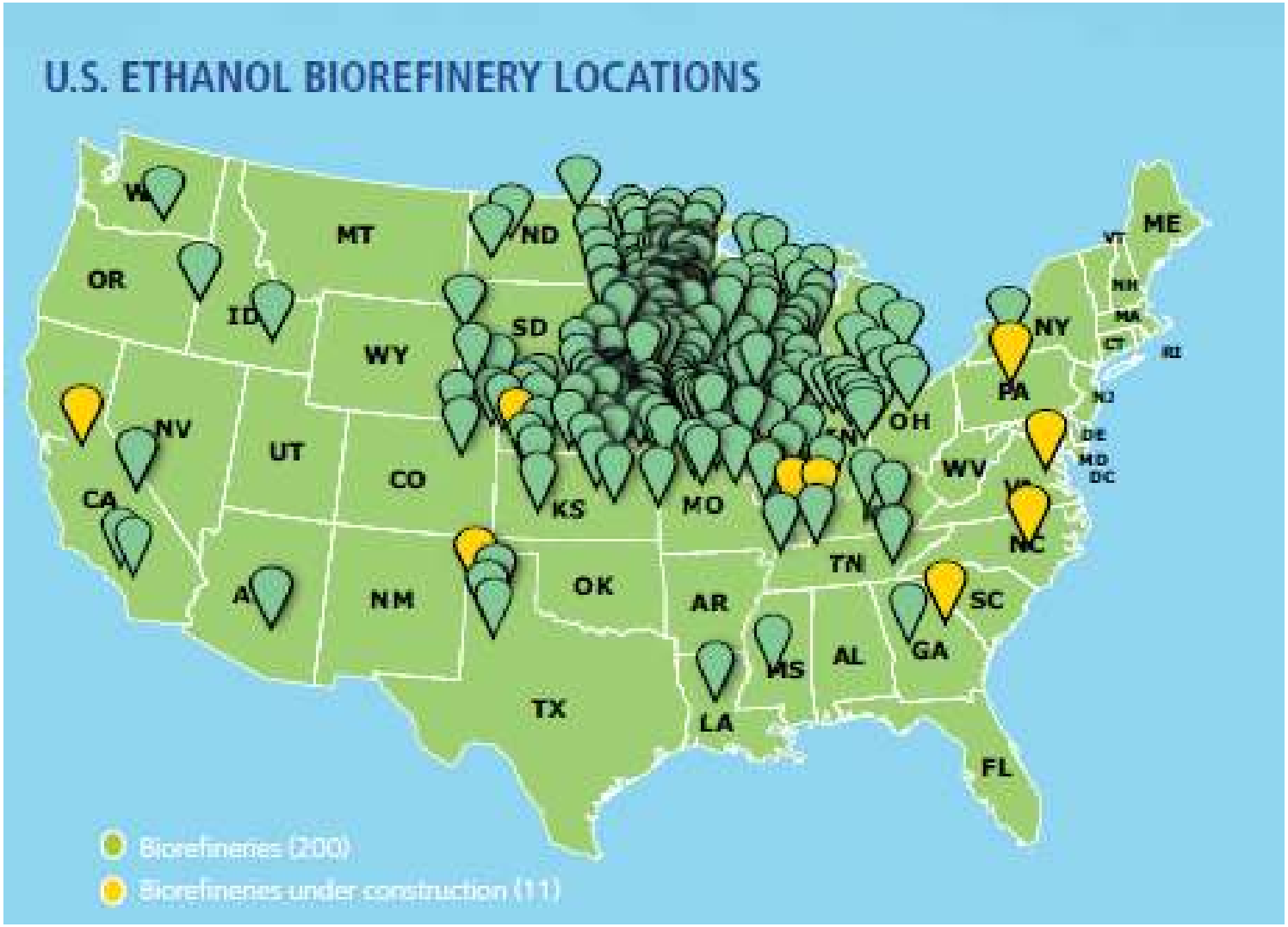
POM PORT OF MORROW

GREENWOOD RESOURCES

Burns & McDonnell SINCE 1898 ®

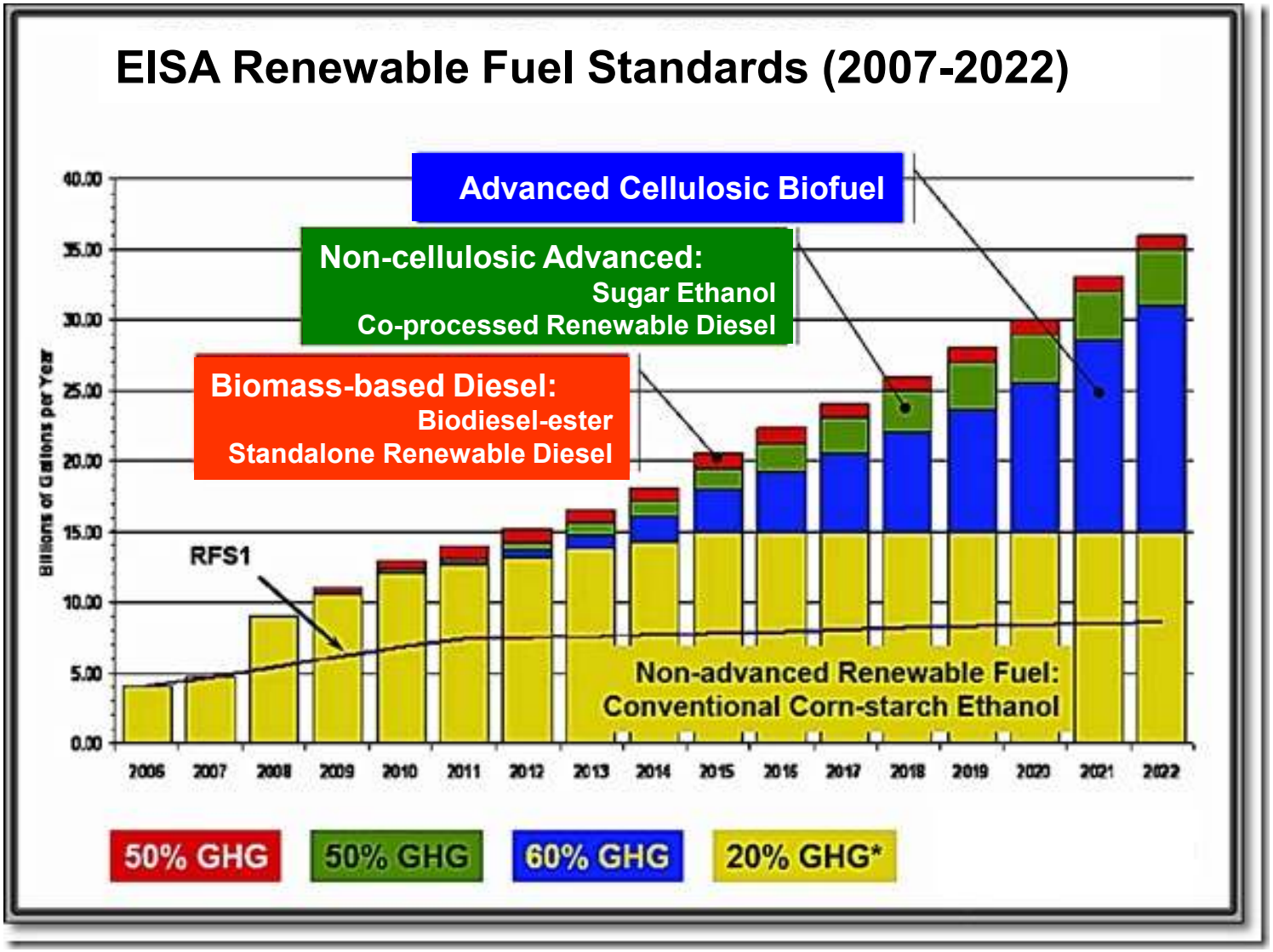
Introduction to Ethanol

Ethanol Today



Source: RFA

Meeting the Renewable Fuels Standard (RFS)

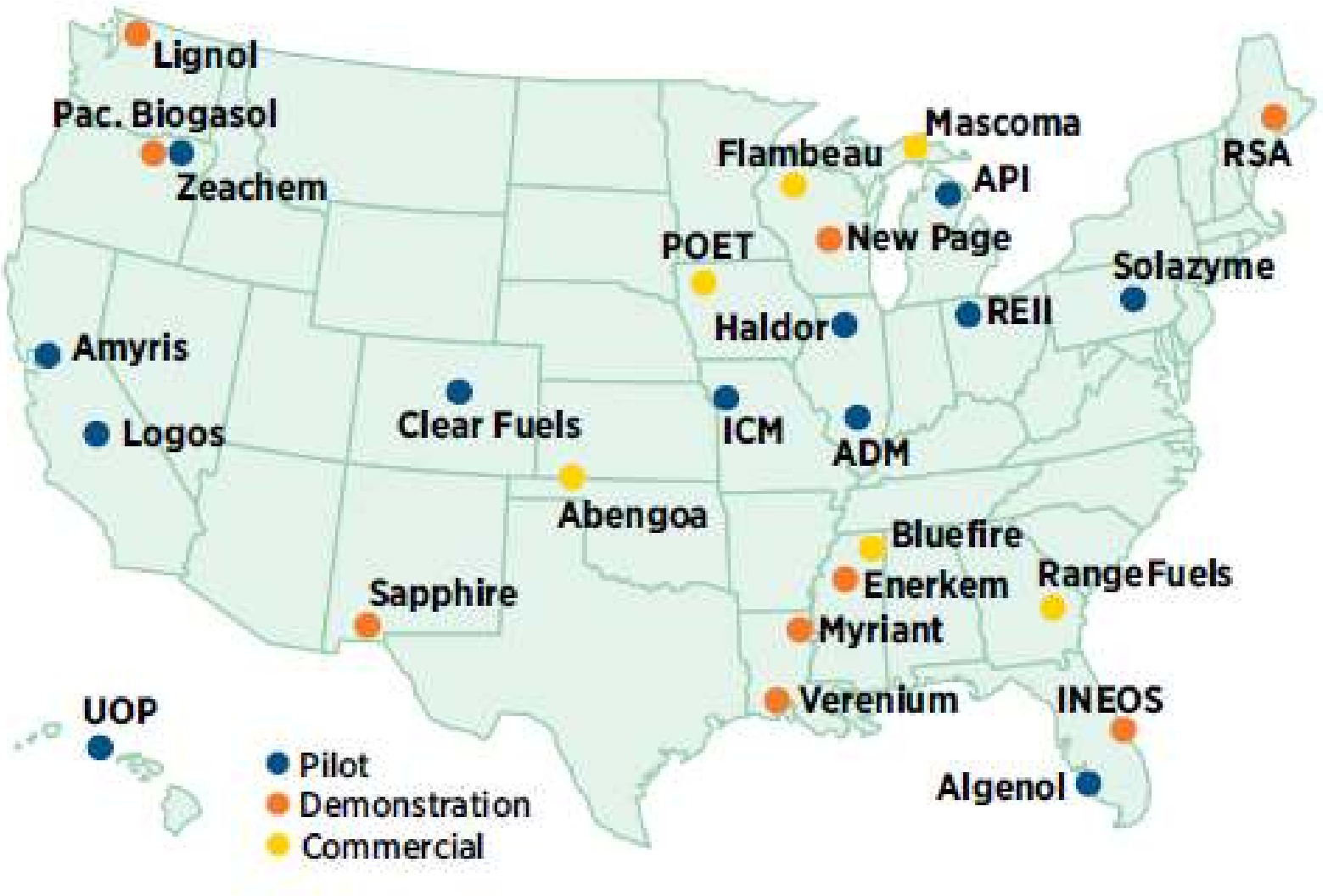


ZeaChem

Meeting the Renewable Fuels Standard (RFS)

- ZeaChem aims to produce 20% of total advanced cellulosic biofuel requirement (3.2B gals)
- Compete with oil at $50/barrel
- <$1/gal cellulosic ethanol produced

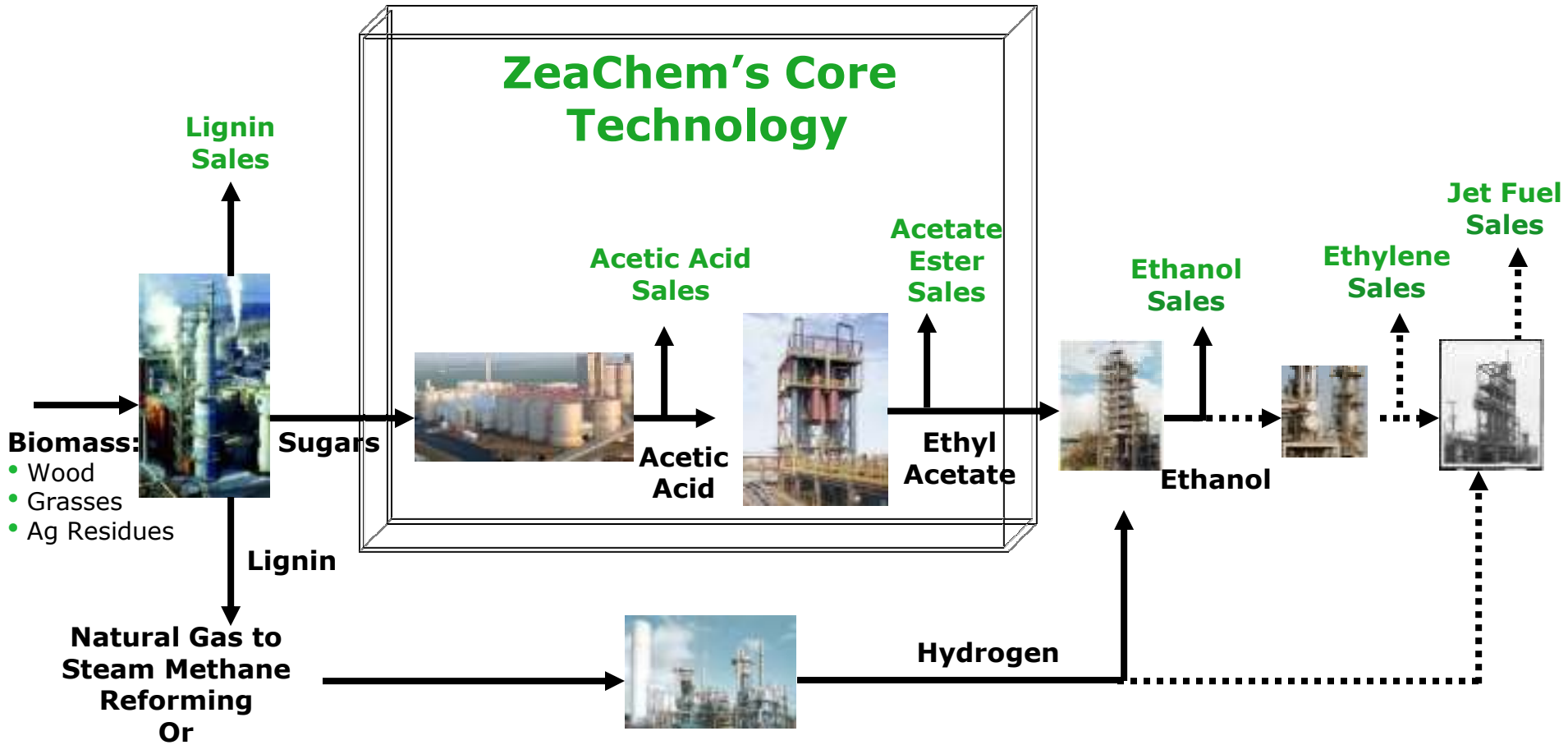
The Future of Advanced Biofuels



Source: US DOE Biomass Program

ZeaChem's Technology and Products

ZeaChem C2 Platform

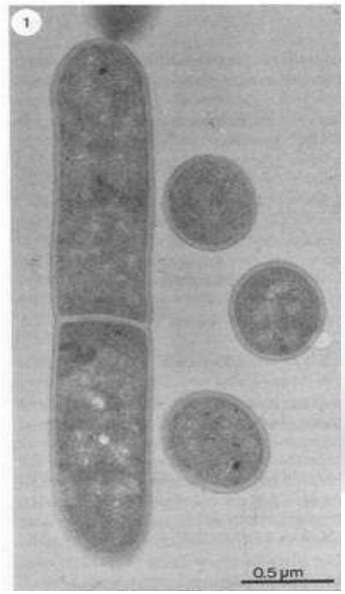


Known processes integrated in a novel way with a naturally occurring organism

Using Mother Nature's Bug

- Naturally occurring bacteria
- Produces no CO_2 during fermentation
- Converts nearly 100% of carbon
- Eats mixed sugars from cellulosic feedstocks
- Achieves 40% higher yield

"Nature's Proven and Most Efficient Biomass Conversion Path"

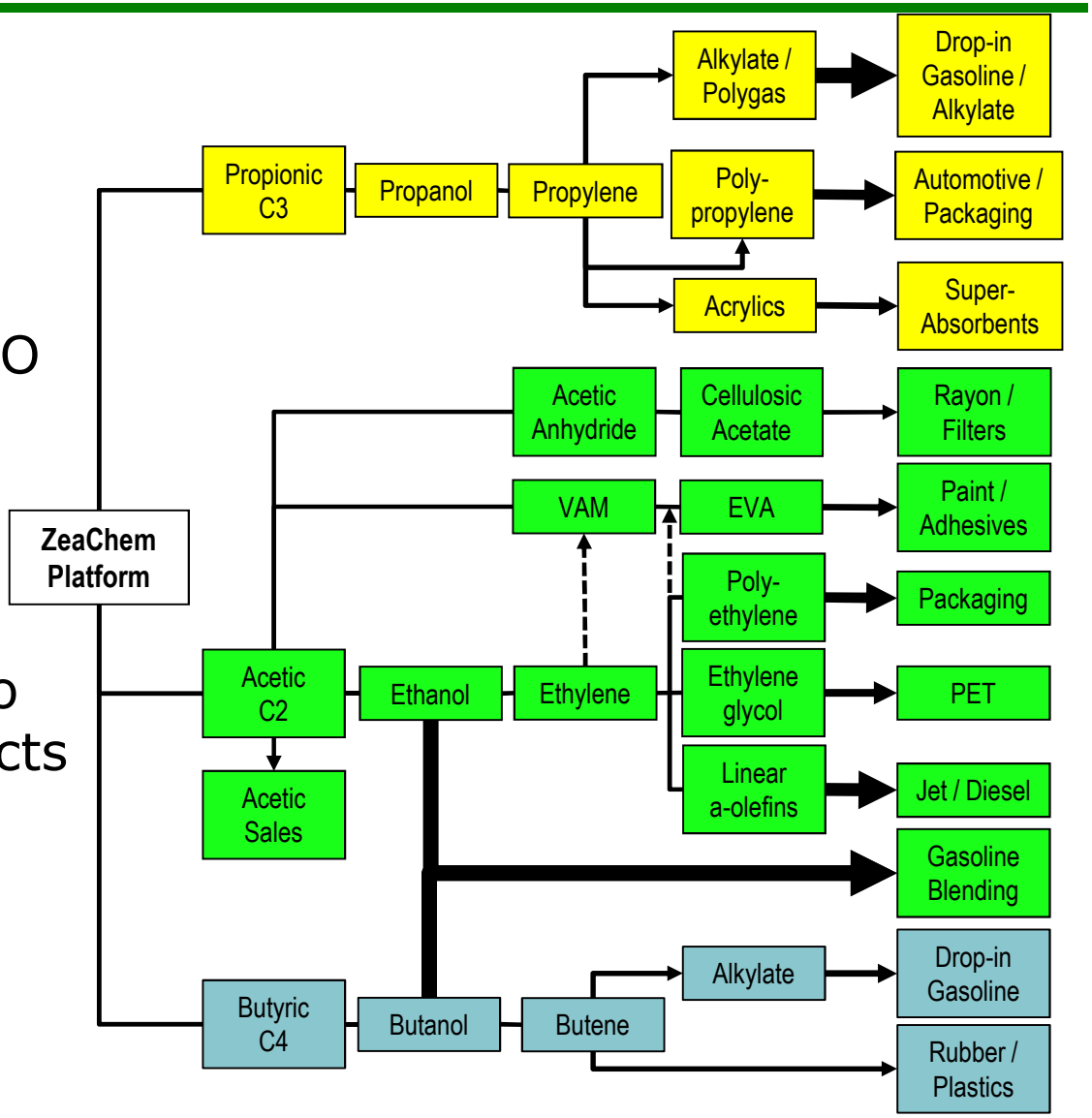


Acetogen
Bacteria: Moorella thermoacetica

Termite
Acetogen is naturally occurring organism. Found in the digestive tract of termites, among others

Multiple Petroleum Replacements

- Potential markets >$1 Trillion
- Customers will make NO adjustments to use ZeaChem's products
- Use same equipment and change organism to produce multiple products
- Diverse product lowers risk



Example Chemical Products and Markets

Product	Global Market Size	End Product Uses
C2 Products		
Acetic Acid	$3.6B	Paints, coatings and solvents
Ethyl Acetate	$1.6B	Paints and adhesives
Ethanol	$46B	Gasoline blending
Ethylene	$179B	Plastic bottles and bags
Ethylene Glycol	$15.6B	Antifreeze, precursor to polymers
C3 Products		
Propylene Glycol	$1.4B	Detergents, antifreeze and solvents
Propylene	$108.6B	Caps, toys, and housewares
Acrylic Acid & Esters	$4B	Detergents, antifreeze and solvents
Methacrylic Acid & Esters	$5.1B	Surface coatings and inpregnation resins
C4 Products		
Butanol	$1.4B	Fuel, artificial flavorant, perfume

Feedstock

Primary Feedstock – Woody Biomass

GREENWOOD RESOURCES

Forest Stewardship Council United States FSC

Sustainability

Economics

Environment

- **High Yield / High Density (10-12 BDT/Acre/Year)**
- **Low Price Volatility / LT Contract**
- **Resource Availability (Exists today)**
- **Ability to Aggregate Additional Land**
- **Working (JIT) Harvesting Method**
- **Non-GMO Short Cycle Perennial**
- **28,000 planted acres within 10 mile radius of 1st Biorefinery**

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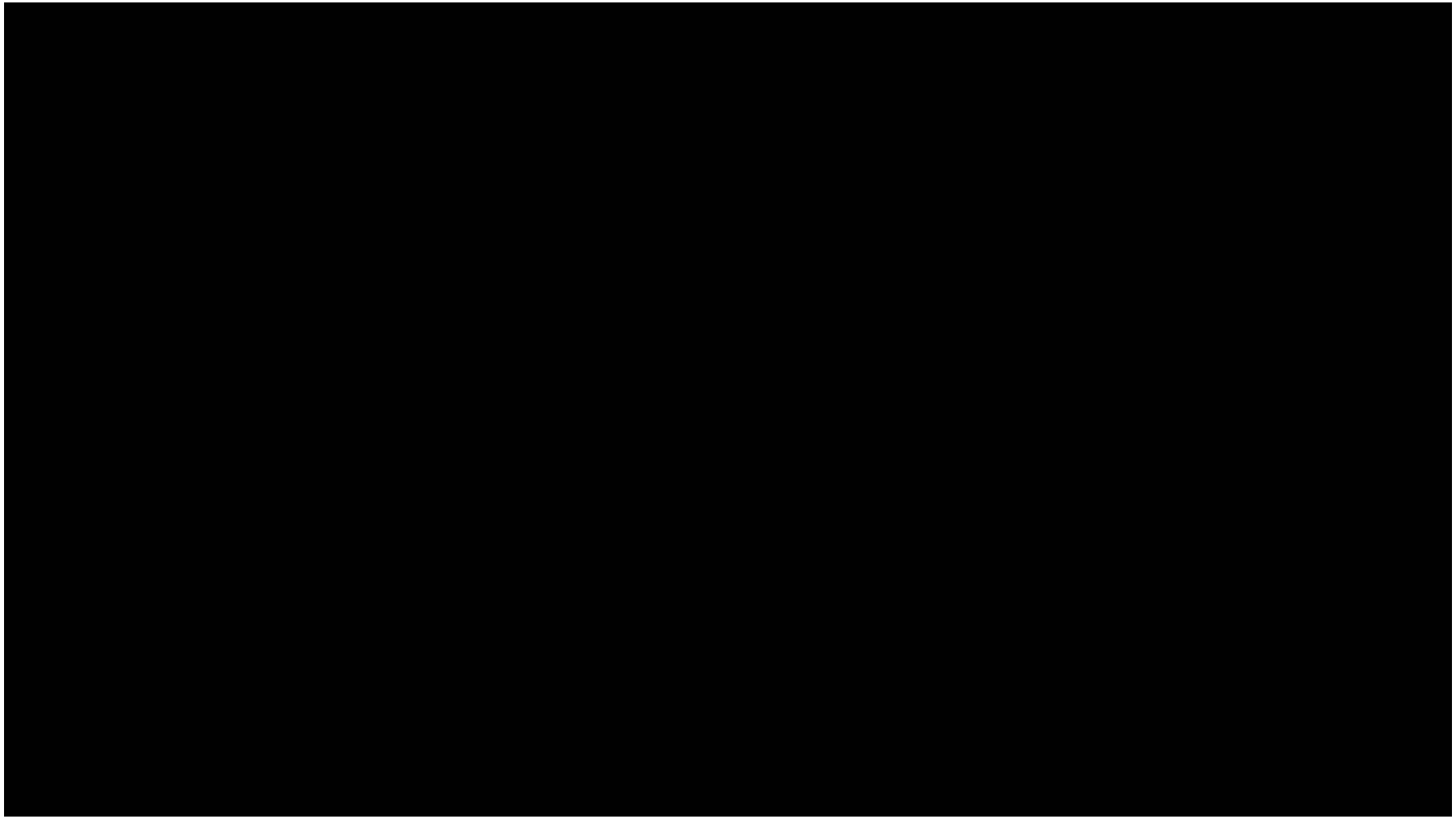
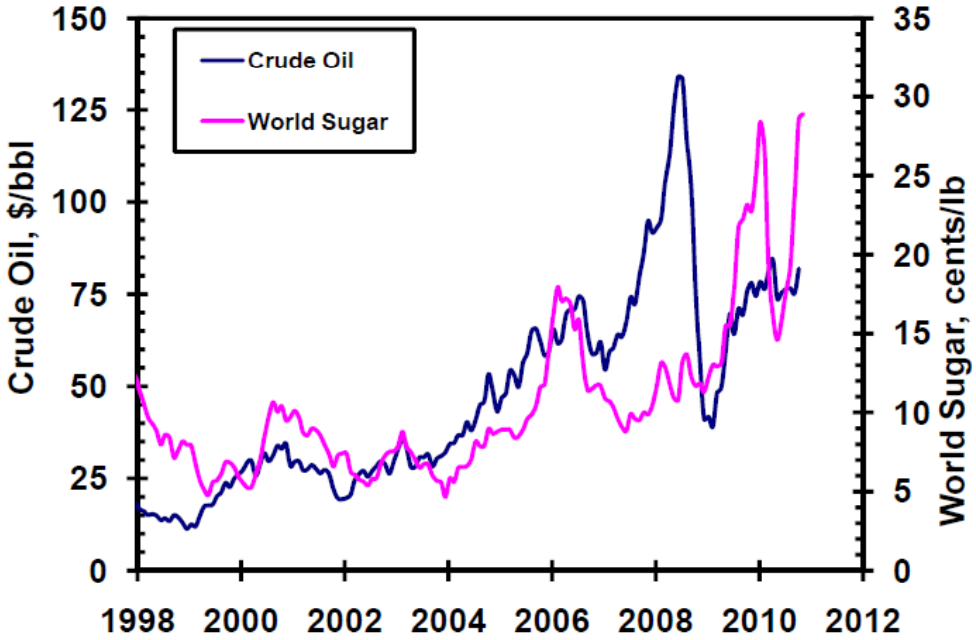
Poplar Tree Harvesting

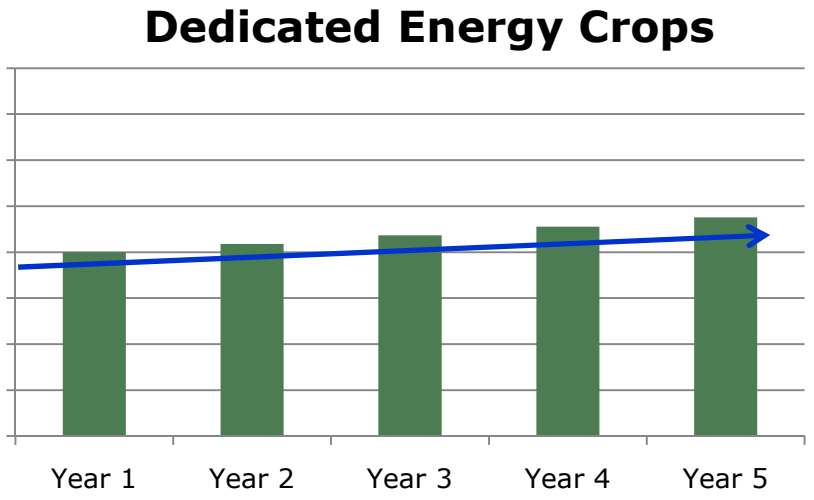
Poplar Tree Harvesting



Economic Benefits of Dedicated Energy Crops

- Feedstock price volatility causes difficulty for chemicals industry to absorb
- Long-term, fixed price contracts for dedicated energy crops offers valuable price stability



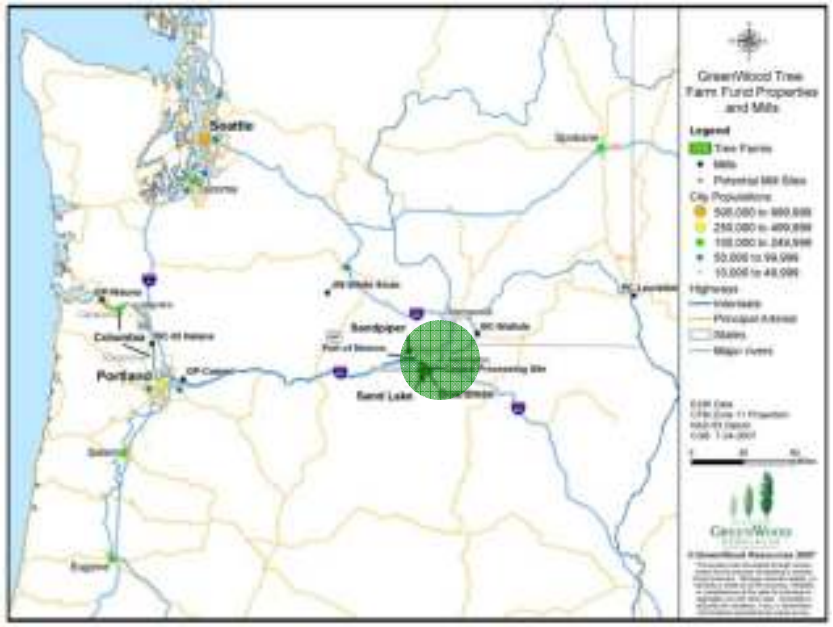


Supplemental Feedstock – Agricultural Residues

- **Consistent Yields / Low Density (1-3 BDT/Acre/Year)**
- **Medium Price Volatility / MT Contract**
- **Resource Availability (Exists today)**
- **Ability to Aggregate Additional Land**
- **Single or Multiple Pass Harvesting Methods**
- **Non-GMO Annual**
- **200,000 planted acres within 40 mile radius of 1st Biorefinery**

Biorefinery Deployment

Boardman, Oregon



- Advantages of location
  - Access to feedstock: woody biomass + ag residues
  - Transportation: barge, mainline rail, interstate
  - Port of Morrow Industrial Park: power, gas, water, sewer, permitting
  - Market access: fuel distribution for western region and Pacific
  - State support: local community, ODOE, Biz Oregon

Demonstration Biorefinery

- **Overview**
  - Scale: 10 BDT/d, 250,000 GPY
  - Direct jobs: 75 construction, 25+ operations
- **Progress to date**
  - Guaranteed Maximum Price Contract
  - >55% complete
  - Long-term feedstock supply and product off-take agreements in place
- **Next steps**
  - Begin operations 2011
  - Cellulosic ethanol in early 2012
  - Optimize process, sell products

1st Commercial Biorefinery

- **Overview**
  - Scale: 650 BDT/d, 25MM GPY
  - Direct jobs: 275 construction jobs, 65 operations
- **Progress to date**
  - Applying for USDA loan guarantee (Sec. 9003)
  - Long-term feedstock supply and product off-take agreements in place
- **Next steps**
  - Secure USDA loan guarantee
  - Commercial operation 2014
  - Regional leader for RFS2 advanced biofuels

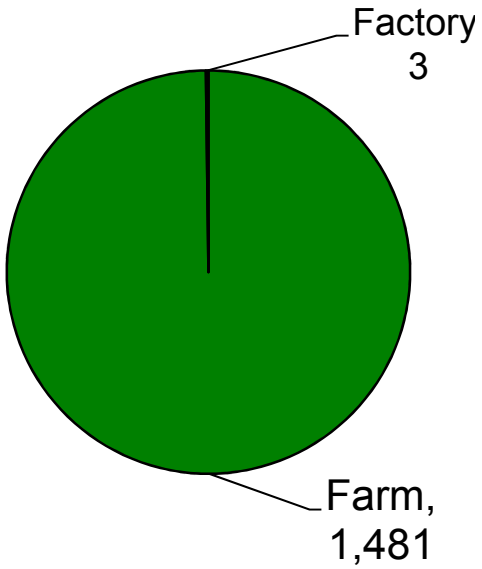
Sustainability

Carbon Advantage

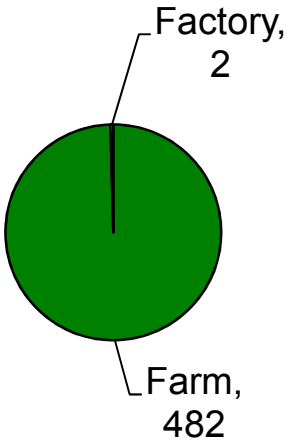
Fuel Technology	GHG % Reduction from Gasoline
Gasoline	0%
Corn Ethanol	21-24%
Cellulosic Ethanol w/Stover	86-89%
ZeaChem w/Energy Farm	94-98%

Water Use

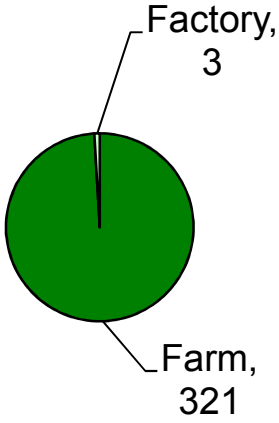
Corn Ethanol
1,484 gal H2O/gal EtOH



Other Cellulosic
484 gal H2O/gal EtOH

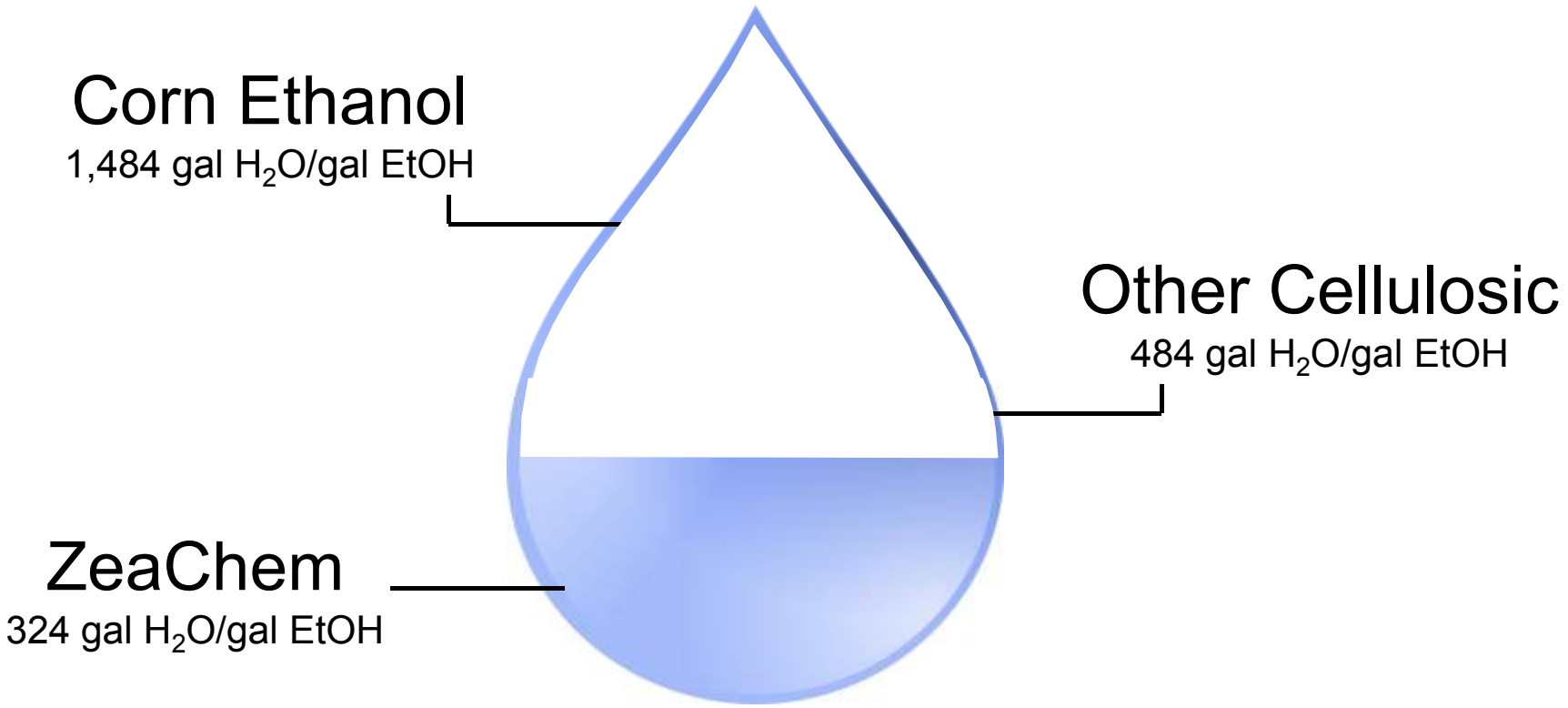


ZeaChem
324 gal H2O/gal EtOH



Approximately an 80% reduction in water demand vs. corn ethanol and 35% reduction vs. other cellulosic processes

Water Use



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ZeaChem Summary

- **Hybrid technology = High yield**
  - Drives economics and environmental performance
  - Product flexibility: biofuels and bio-based chemicals
- **Relentless focus on risk reduction across value chain**
  - Feedstock
  - Technology
  - Product platforms
  - Off-take
  - Financing
- **Executing C_2 platform at demo plant scale**
  - Will scale to commercial facilities
  - Beginning work on next product platform

Thank You

Carrie Atiyeh
Director, Public Affairs

(303) 248-7778
catiyeh@zeachem.com