



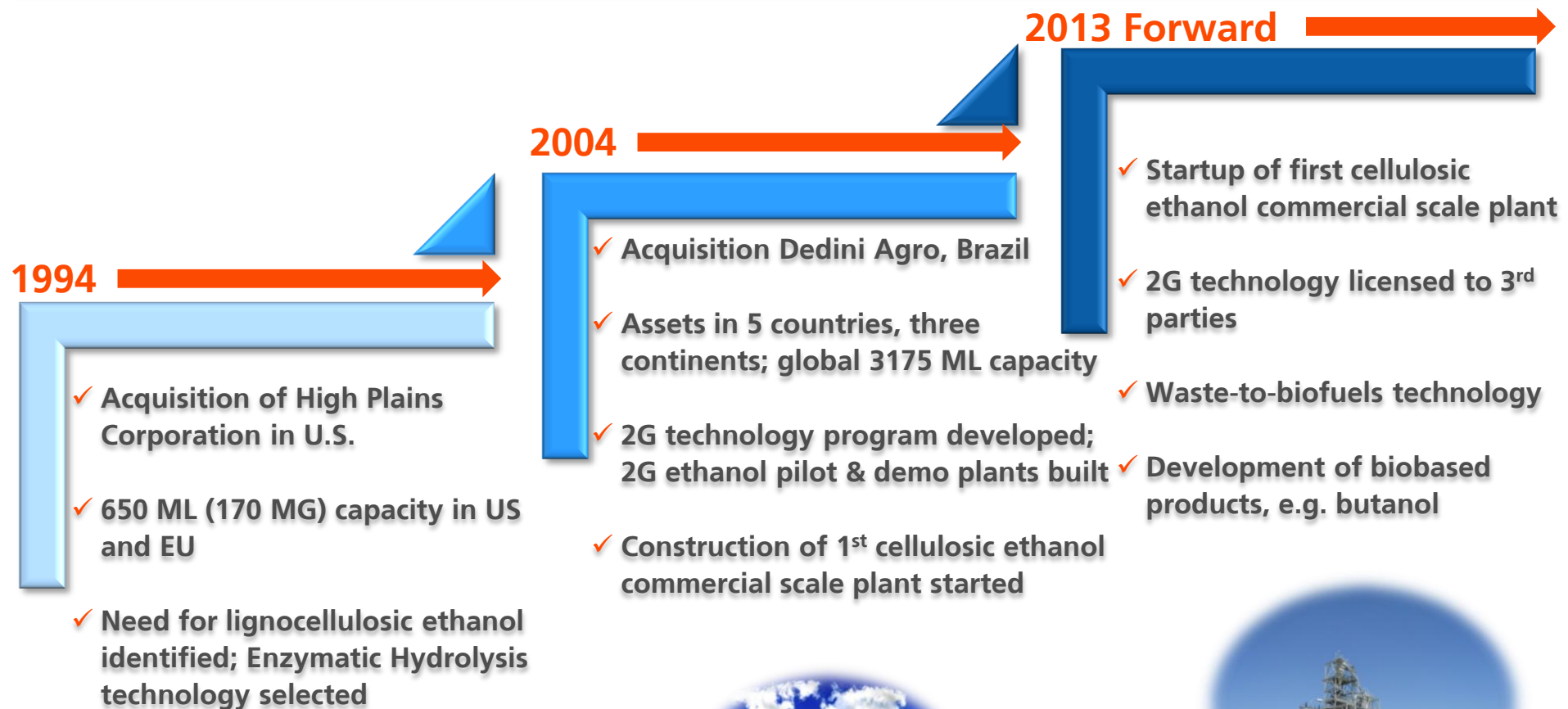
Integrated Biorefineries

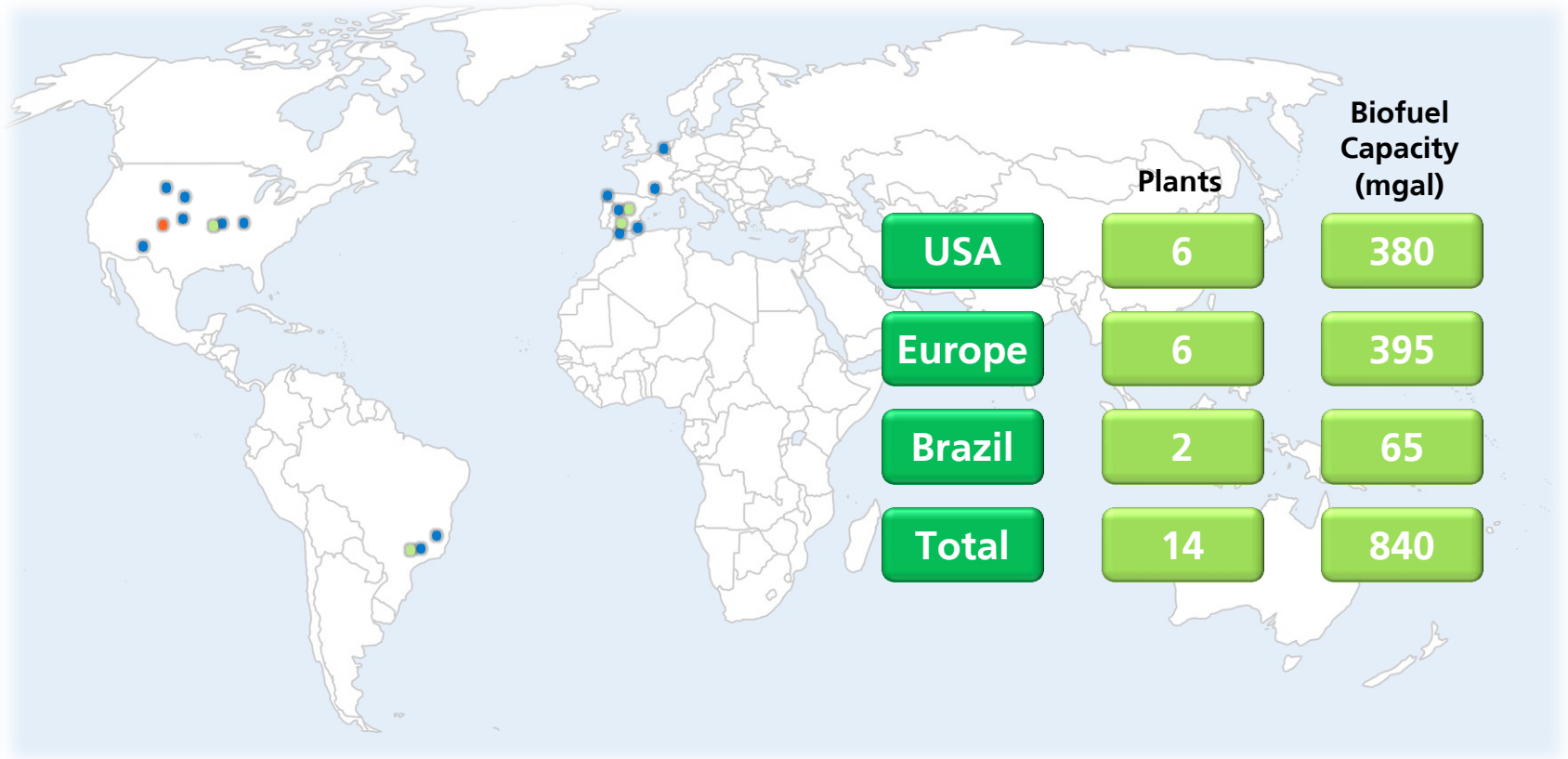
How the Advanced Bioindustry is Reshaping American Energy




Gerson Santos

Abengoa Bioenergy

Washington, DC





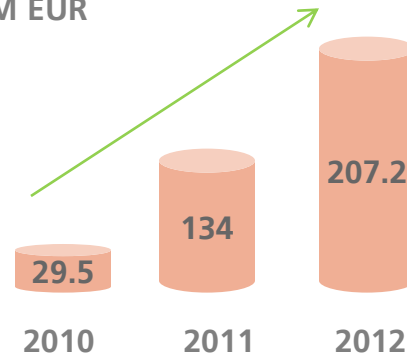
-  Biofuel plant
-  2nd Generation plant under construction
-  Offices

The number one producer in Europe and the fifth largest in the US

The global biotech ethanol company

Technology investment

MM EUR

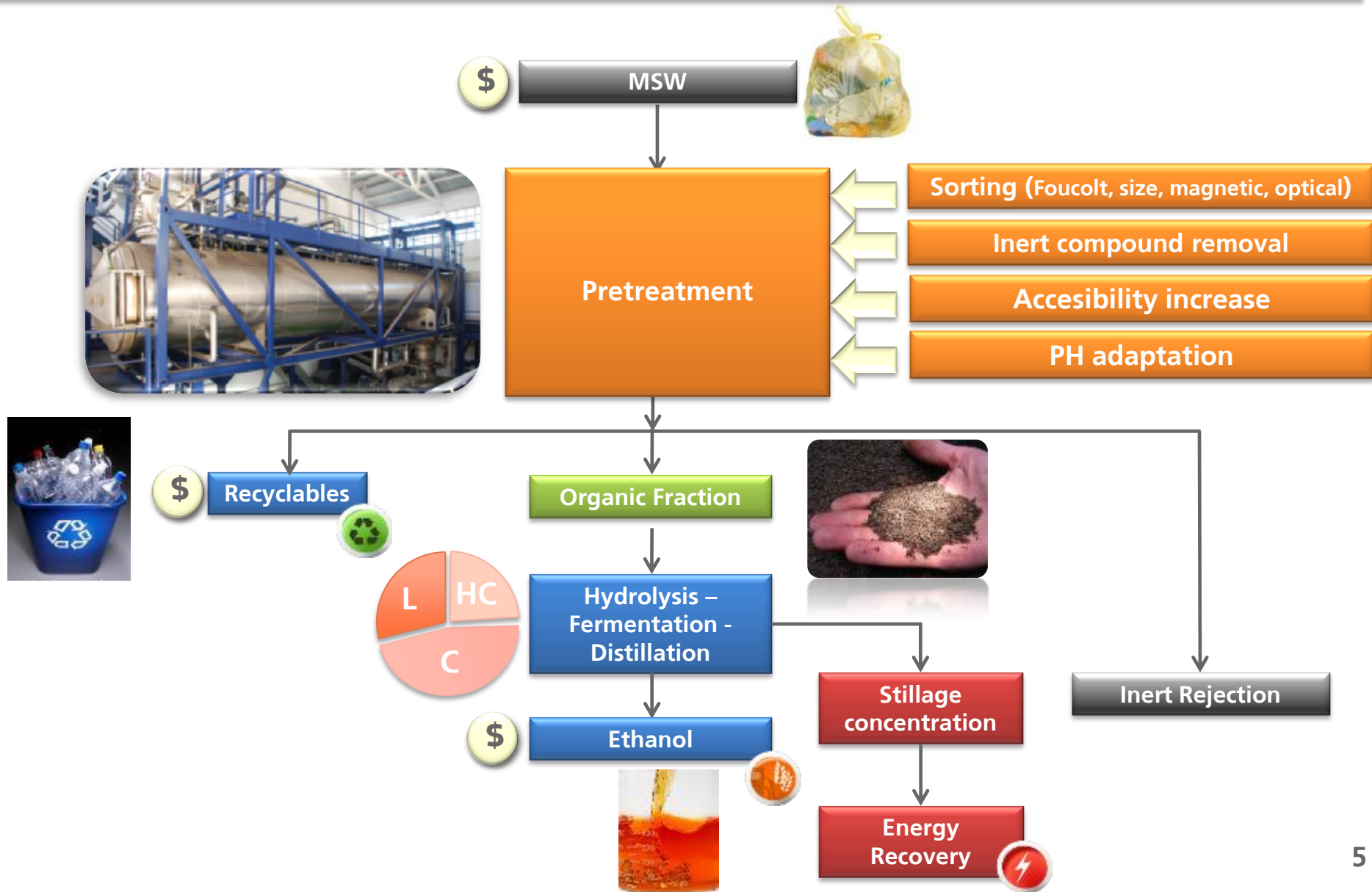


Main programs

- ✓ Enzymatic Hydrolysis
- ✓ W2B
- ✓ Bioproducts by fermentation
- ✓ Bioproducts by catalysis
- ✓ Enzyme development

Collaborations with DOE & EU

- ✓ DOE financing validates 2G technology
- ✓ DOE supports the EH technology development
- ✓ EU supports the development of Abengoa's technology programs



W2B Project – Demonstration plant

W2B Demonstration plant **has initiated operations;**
Grand opening done in **June 2013**

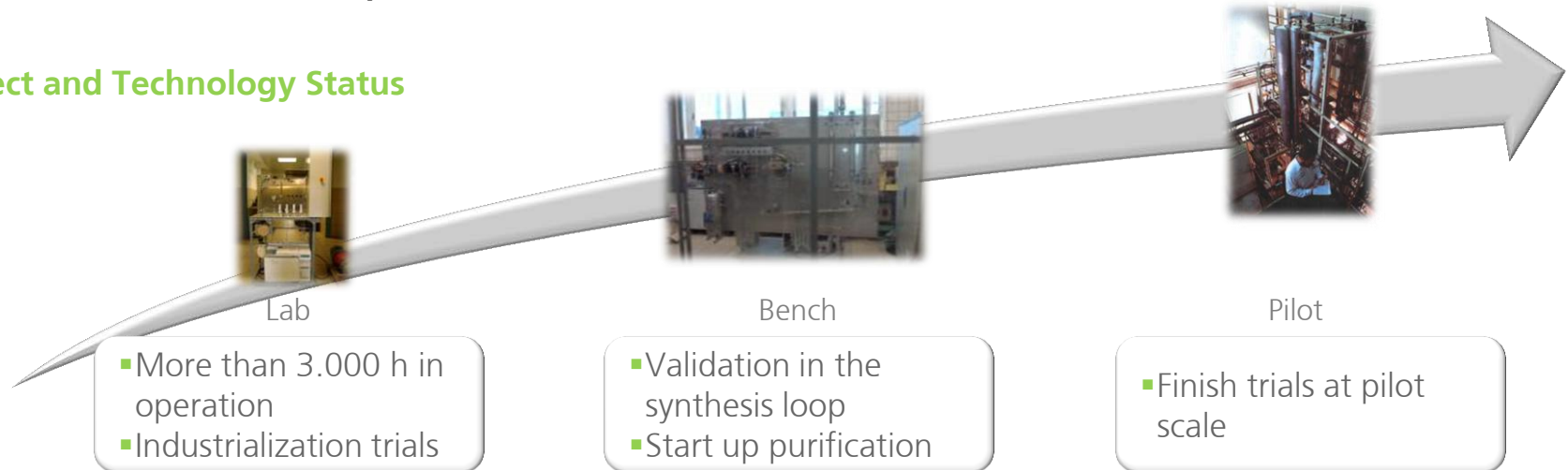


Butanol Project

Project Objective

- ❖ Develop a process to produce butanol from ethanol at a competitive cost with the fossil route to start the commercial production in 2015

Project and Technology Status



- ❖ **Engineering:** process concept defined
- ❖ **Permitting:** air permit application already submitted for 4 US plants
- ❖ **Commercial development:** contact with potential customers

IP

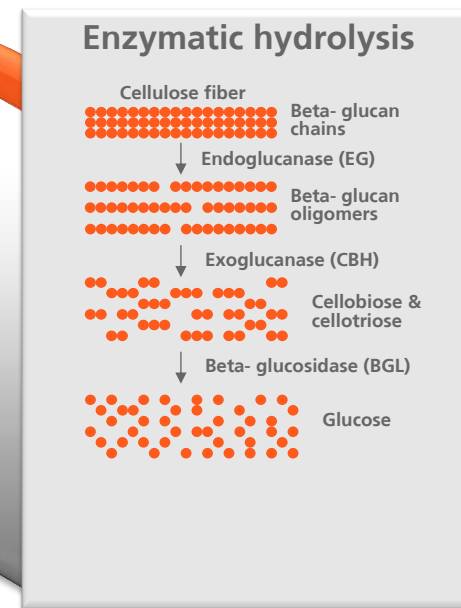
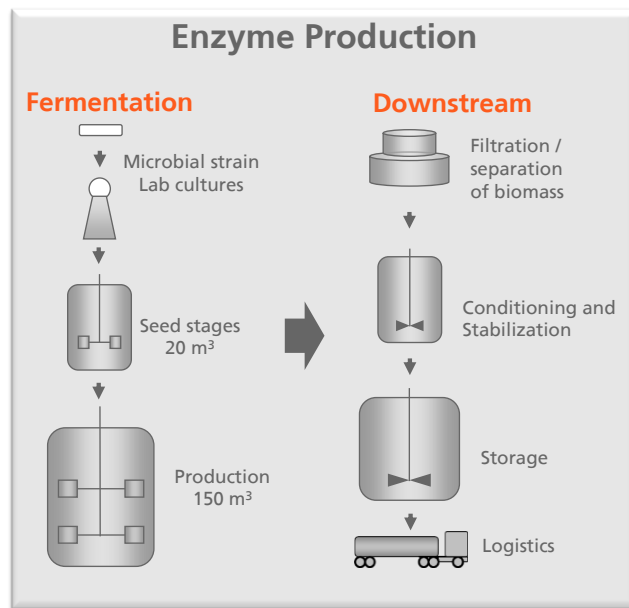
- ❖ Two patents filed covering several catalyst compositions and the production method

Enzyme Project – Overview

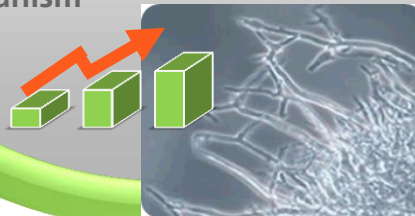
Economical goal for feasibility
"reduction of enzyme cost contribution to 2G ethanol cost"

How?
Reducing enzyme cost
Reducing enzyme dosage

Two main areas of R&D
Enzyme performance
Enzyme production



Enzyme improvement via genetic modification of producing organism



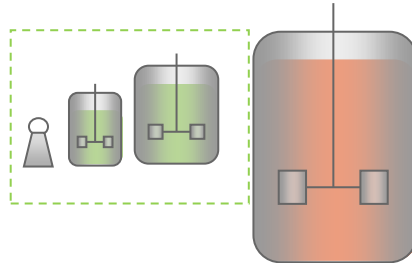
C5 Project – Overview and Status

- ❖ Propagation targets achieved
- ❖ Finalizing procedures to adjust raw material cost and the operability
- ❖ Toll manufacturing to produce dry or cream yeast to:

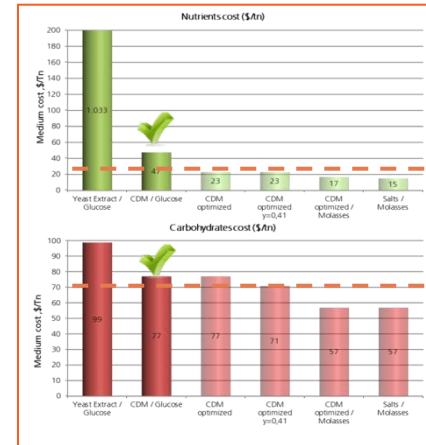
- simplify propagation steps
- minimize internal risk
- increase shelf life

Propagation

1. Increase yeast production
2. Scale down ABBK conditions



Cost reduction



Sugar conversion

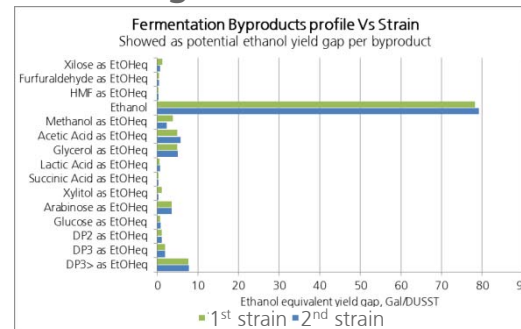
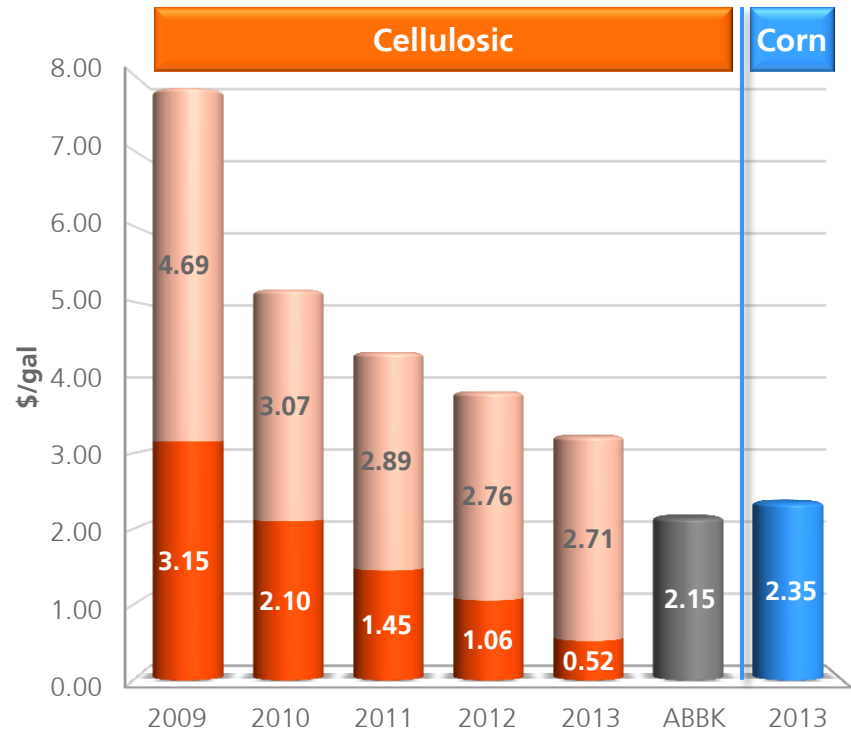
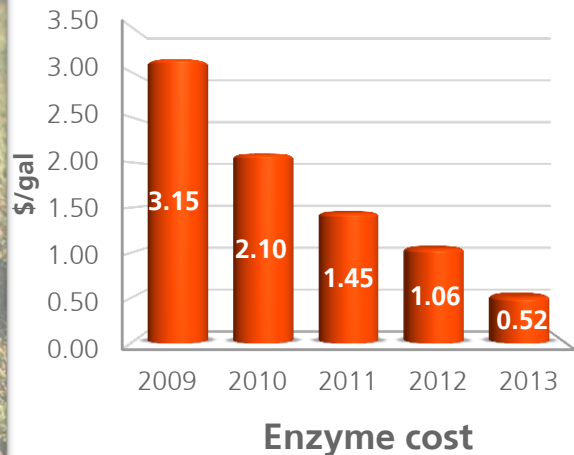
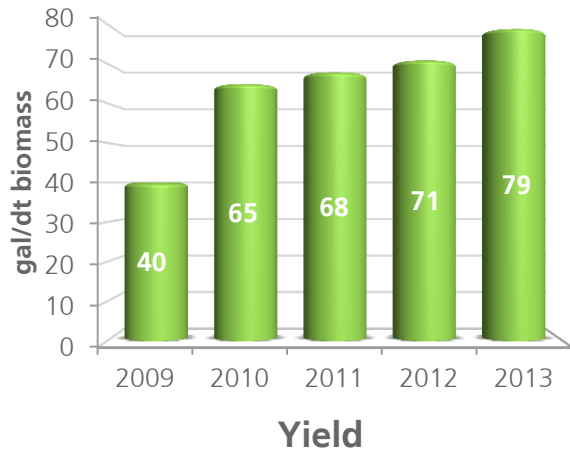


Figure – Fermentation byproducts profile comparison for tested strains

Item	2012	Current status
Fermentation conversion	90%	✓
Fermentation conditions	ABBK	✓
Propagation replications	50g/l; 35x	✓
Propagation procedures	Optimal	✓
SOTA protocol for C6&C5	70 gal/DUSST	✓
Close contract manufacturing		✓
Complete tech transfer to toller		Pending

EH – Production Costs Improvement

Our 2G biomass to ethanol technology is **competitive** with the 1G one





**Pilot Plant
York 2007**



**Demo Plant
Salamanca 2009**



**Commercial scale
Hugoton 2014**

- ✓ **First-of-its-kind commercial-scale facility**
- ✓ **Proprietary enzymatic hydrolysis**
- ✓ **Financing of USD 132 MM through DOE loan guarantee**
- ✓ **Awarded USD 97 MM grant from DOE**

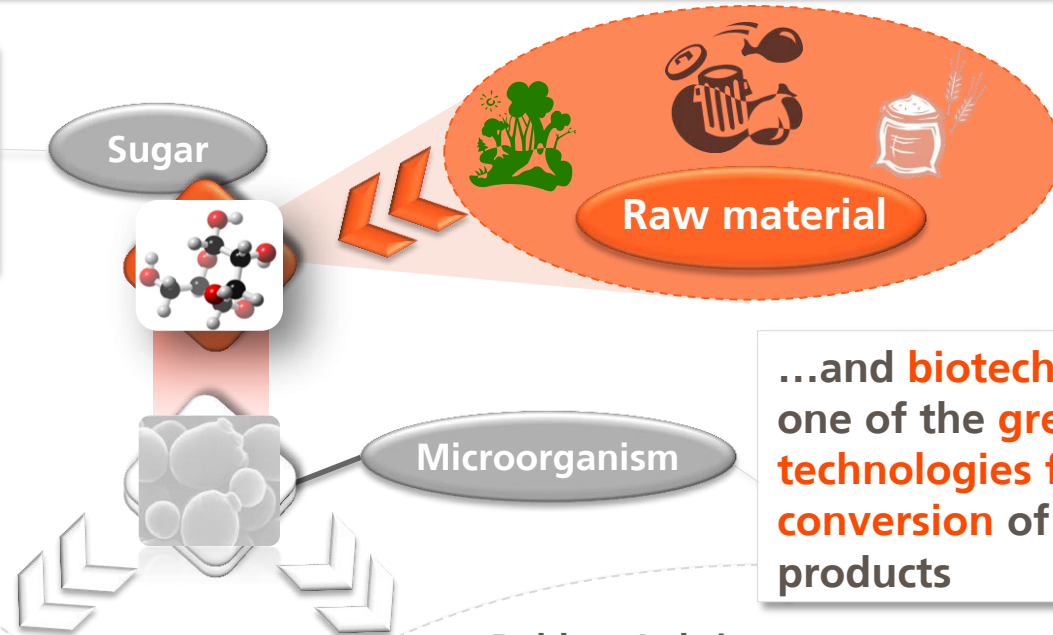
Snapshot

- **Capacity: 25 MGPY, 21 MW**
- **Location: Hugoton, KS**
- **Site: 400-acre parcel**
- **Feedstock: Corn stover, wheat straw**
- **Estimated start: Cogen Q3 2013
EH Q1 2014**
- **Biomass: ~330,000 d tons per year**



Abengoa's 1st commercial-scale biomass-to-ethanol plant in the USA

Abengoa Bioenergy envisions **sugar** as a **platform** for biobased compounds....






...and **biotechnology** as a one of the **greatest technologies** for **conversion** of sugars to products




Gasoline
349 BGY



Jet Fuel
94 BGY


Diesel
484 BGY

 Rubber, Lubricants
& Additives 8 BGY
 Surfactants

Polyesters/Xylene/Styrene 27BGY
PMMA 739 BGY

 Organic Acids
 Poly-Propylenes 32 BGY

Exceptional platform

Only truly global biotech platform

Diversified and differentiated product mix

Unique risk mitigating attributes for each asset

Serving large, established and growing markets

Superior technology with significant growth prospects

Leader in second generation (2G) biotech

Ability to target new growth industries

Platform to capture growth opportunities globally

Best in class strategy and execution

Strong financial performance

Robust risk management systems

Experienced leadership and operations expertise