



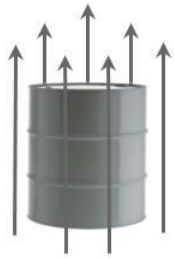
## EESI Cellulosic Ethanol Technology Update

October 6, 2014

Chris Standlee – Executive Vice President  
Abengoa Bioenergy

# ABENGOA

...We need alternatives to oil



Energy security

Climate change



Energy prices  
and sources  
outside of  
our control

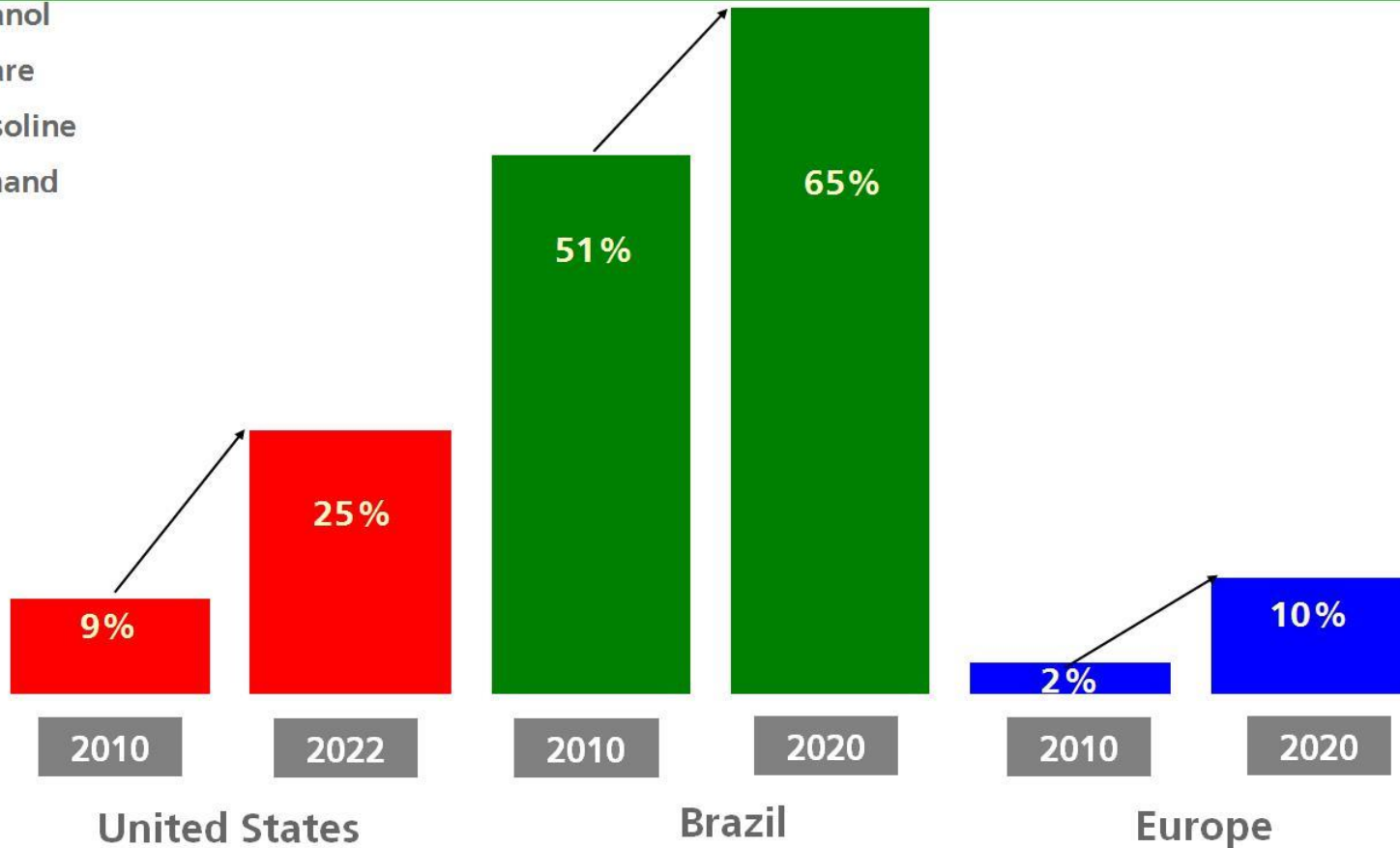


Middle Eastern conflicts,  
Resource nationalism &  
global competition for  
resources



Only viable alternative in commercial use

Ethanol  
share  
of gasoline  
demand





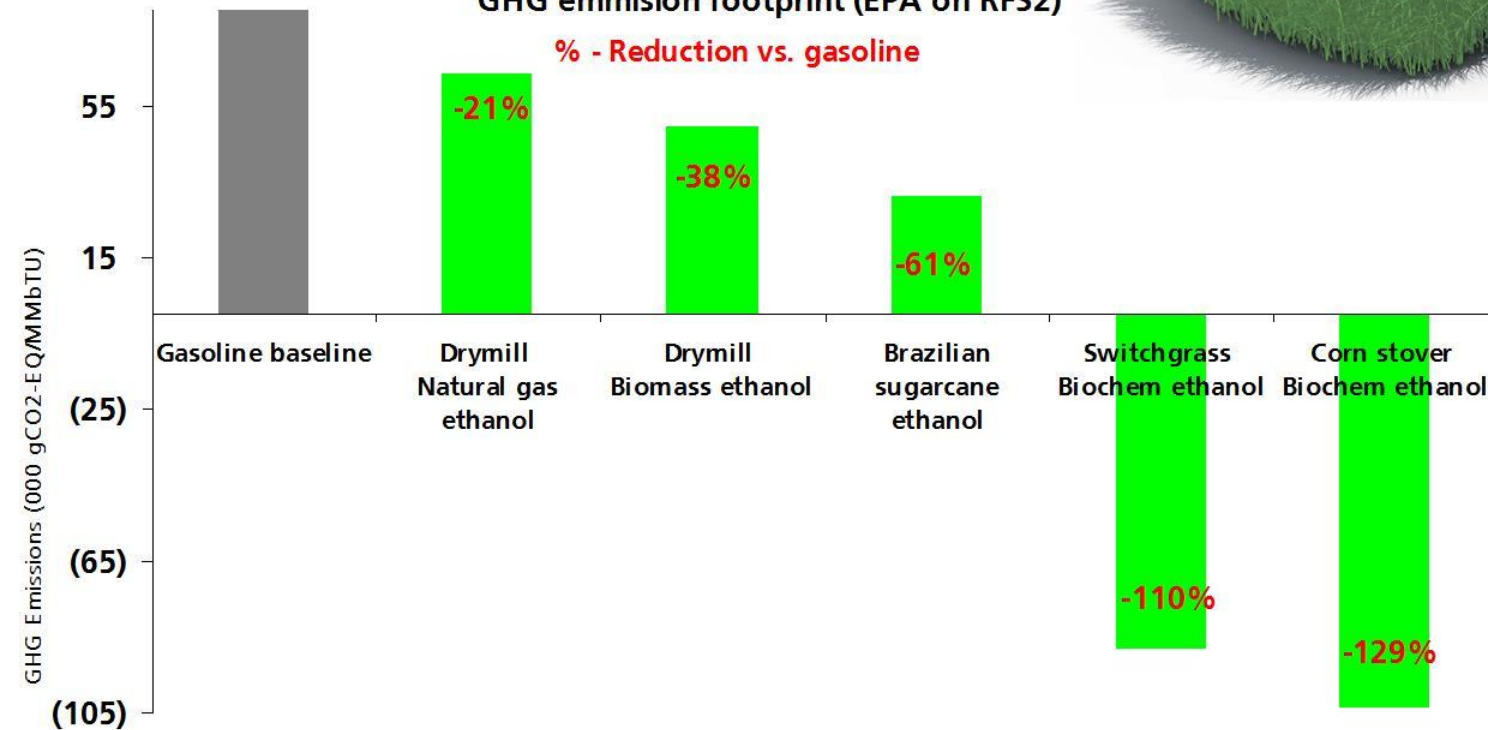
Ethanol is greener than gasoline

Corn ethanol: From -21% to -38%  
Sugar cane ethanol: -61%  
Cellulosic ethanol: From -110% to -129%



GHG emission footprint (EPA on RFS2)

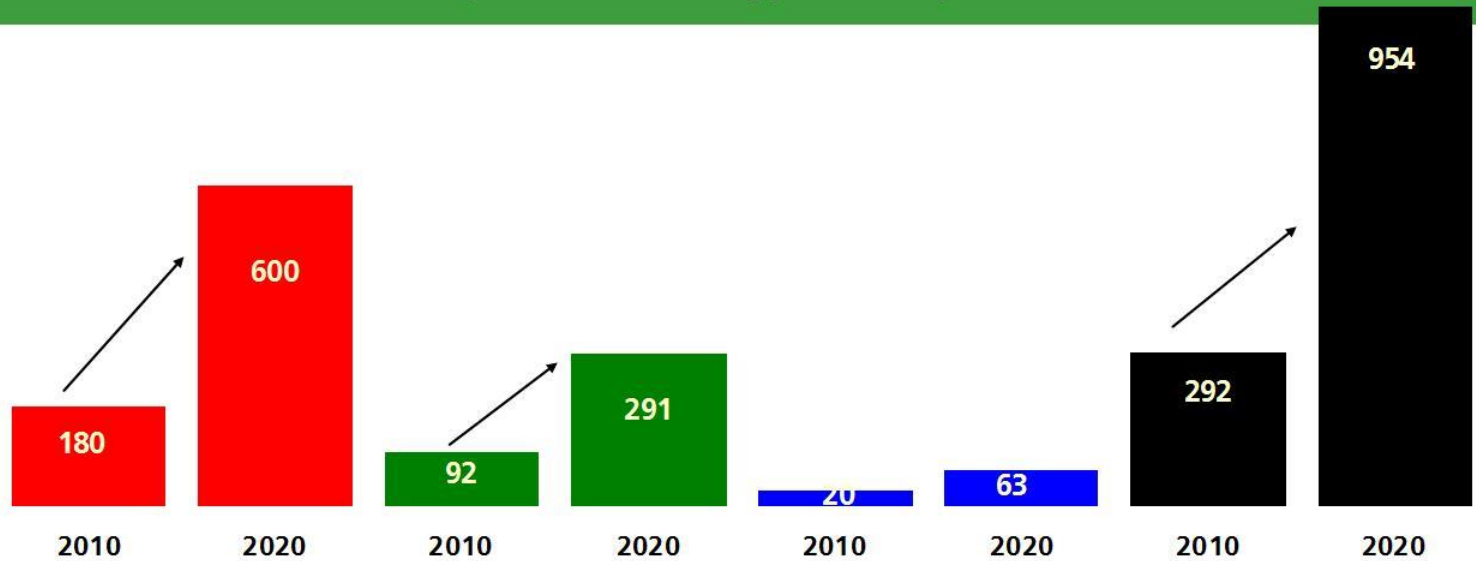
% - Reduction vs. gasoline



Data based on regulation of Environmental Protection Agency (EPA) on February 2010

### Ethanol provides energy security

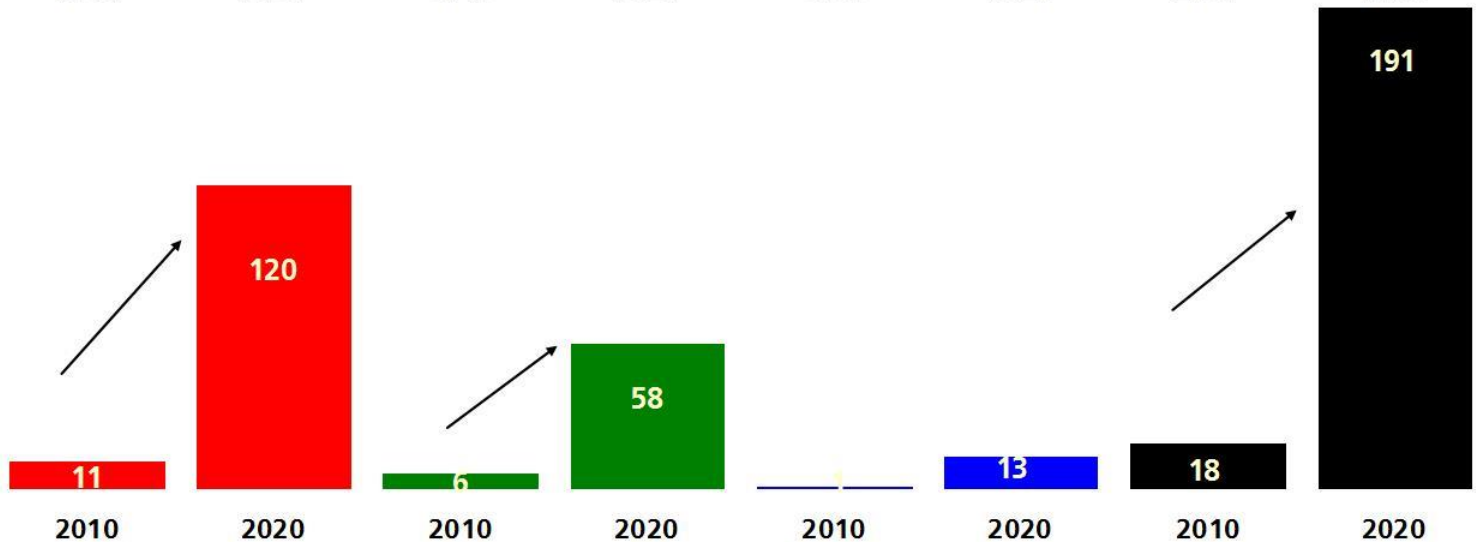
Annual global  
Crude oil displaced  
(MM BBL)



B \$

2009 (60 \$/bbl)

2020 (200 \$/bbl)

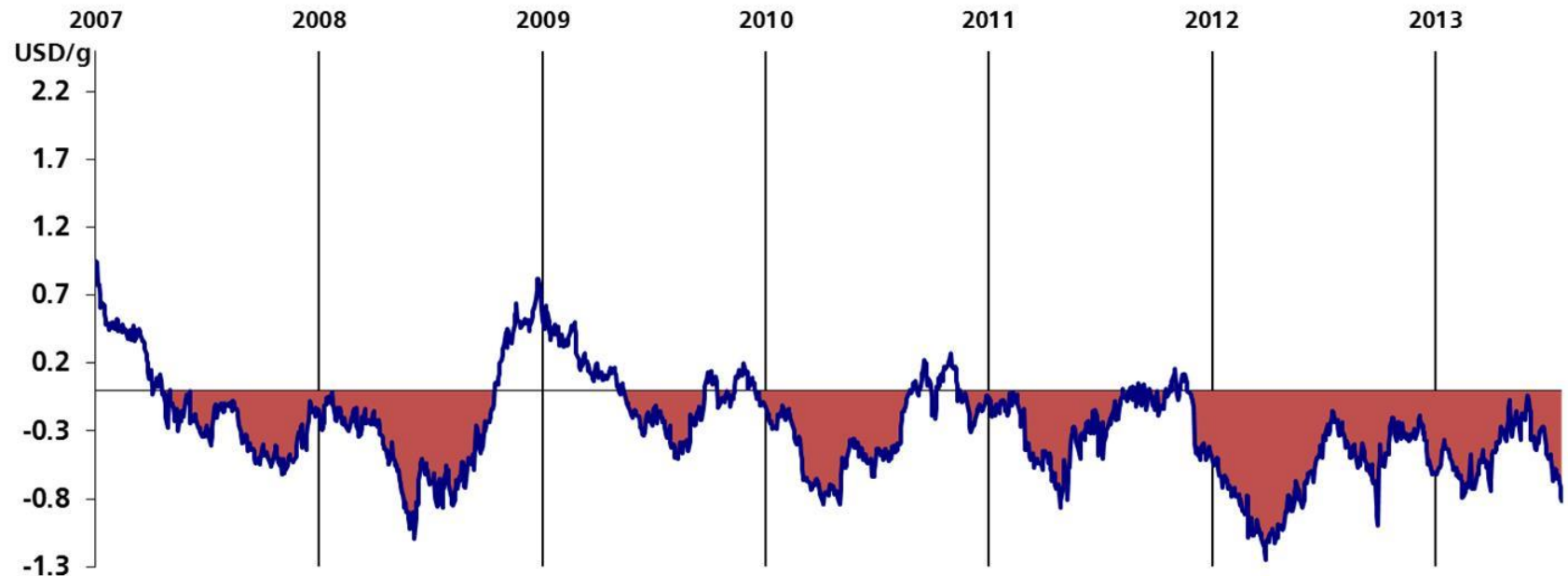


### Ethanol is cheaper than gasoline

Ethanol price compared to gasoline Price (2007-13)

Ethanol use saved .27c per gallon on US gas prices  
Gasoline price would have been 17% higher from 2000 through 2011

US Ethanol Price - Gasoline Price



Abengoa focuses its growth on creating new technologies that contribute to sustainable development...



- Generating energy from renewable sources
- Converting biomass into biofuels and producing drinking water from sea water
- Creating environmentally-friendly infrastructures
- Promoting new development and innovation horizons

To achieve this, Abengoa...



- ✓ Invests in research, development and innovation (R&D+i)
- ✓ Expands the technologies with the greatest potential
- ✓ Develops the necessary talent, attracting and retaining the best professionals (nearly 26,000 employees)
- ✓ Dedicates economic and human resources to promote social action policies that contribute to social and human progress

Abengoa's commitment to sustainable development is a priority in all its activities. We try to reduce the impact of our activities with the support of an integrated management system



**Technology is our engine for growth, providing innovative solutions in order to continue to create value and maintain our leadership position**

R&D and technology in numbers:

€426 M invested in R&D in 2013

261 patent applications, of which 106 have already been granted

Team of 781 people dedicated to R&D and innovation, lead by Abengoa Research



W2B demo plant (Salamanca)

**Products with a high technological component that are close to market...**

## Butanol

- **Technology** for producing n-butanol from biomass
- **Flexible process** that enables the production of ethanol or butanol depending on market conditions
- Enables existing 1G facilities to be used

## Waste to biofuels

- **Technology** for converting MSW into biofuels
- Demonstration plant in operation at our facilities in Salamanca

**...we continue to work on new options for the future**

Hydrogen

Energy Crops



### Hugoton project highlights

- Capacity: 25 MGPY ethanol from biomass
- Electricity capacity: 21-MW electr. power.
- Location: Hugoton, Kansas
- Site: 400-acre parcel
- Feedstock: Corn stover, switch grass
- Start-up: October 2014
- Biomass: ~300,000 dt per year contracted fix price for 10yrs
- Objective is to build first-of-its-kind commercial-scale enzymatic hydrolysis conversion of biomass to ethanol to operate at 2.00-2.30 \$/gal cost by 2015
- DOE awards validate our technology
- Positive economic impacts including \$17 MM feedstock purchases; 1000 construction jobs and 76 permanent jobs; \$5 MM annual payroll
- Facility will validate Abengoa as a fully integrated, one-stop provider of advanced biotechnology services



1st of its kind commercial-scale biomass to ethanol plant





















PM 3:38 JAN/30/2014

Hugoton - Site Looking South





## Hugoton Operational in October 2014

- ✓ Cogen plant commissioned at end of 2013, 800 MWh produced
- ✓ Process validation complete at pilot scale
- ✓ JV with Powerstock executed, already harvesting biomass
- ✓ 70,000 dry tons already stored at Hugoton



### Substantial technological improvements

Enzyme cost (\$/gal)



Yeast Cost (\$/gal)



Yield (gal/dt biomass)







Demonstration plant in Salamanca (Spain), which can process 25.000 t of MSW and produce up to a capacity of 1,5 ML of bioethanol.



## Abengoa's next 2G project is announced for Brazil



- 2G hybrid project announced for San Luiz, Brazil
- Co-located with existing Abengoa plant in Pirassununga

**The future of alternative energy in the US depends on consistent support – both in legislation and regulation**

**Protect and support the RFS**

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## Questions

