Integrated Corn Cellulose Biorefinery

Biomass Research and Development
Technical Advisory Committee
Johnston, IA
May 21, 2008

Mark D. Stowers, Ph.D.
Vice President, Research and Development
POET
mark.stowers@poetenergy.com
www.poetenergy.com

Project LIBERTY

- Converting Emmetsburg, IA plant to an integrated biorefinery
- Over $200 million capital investment
  - Awarded DOE grant up to $80 million
- Will produce 125 million gallons of ethanol
  - 25 million from cellulosic feedstock
- Cellulosic feedstocks are cobs and corn fiber
- Multiple synergies with corn and cellulose model

Project LIBERTY

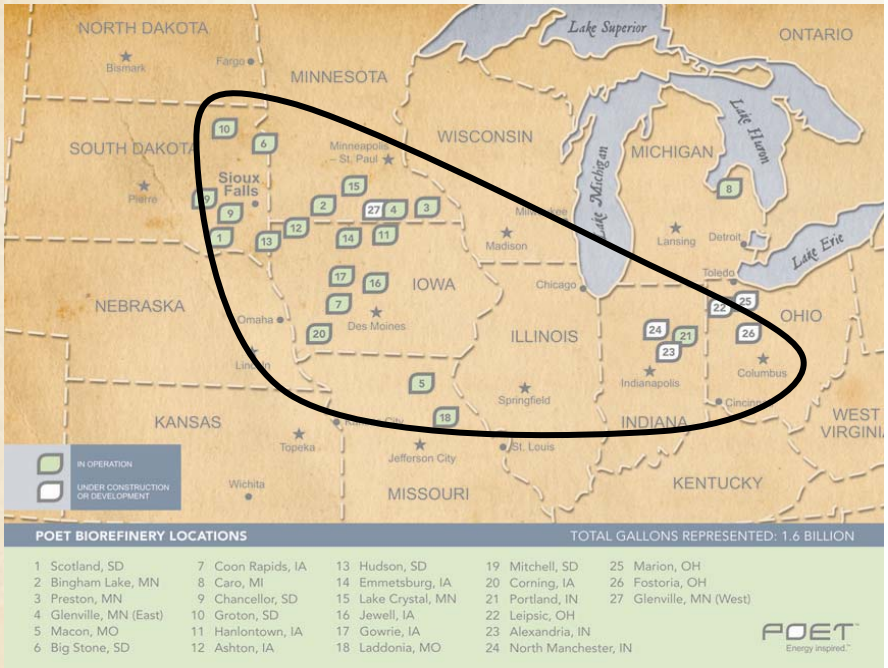
- Expansion to 100 million capacity
- Corn Fractionation
- Solid Fuel Boiler
- Anaerobic Digestion
- Cellulosic Ethanol Plant

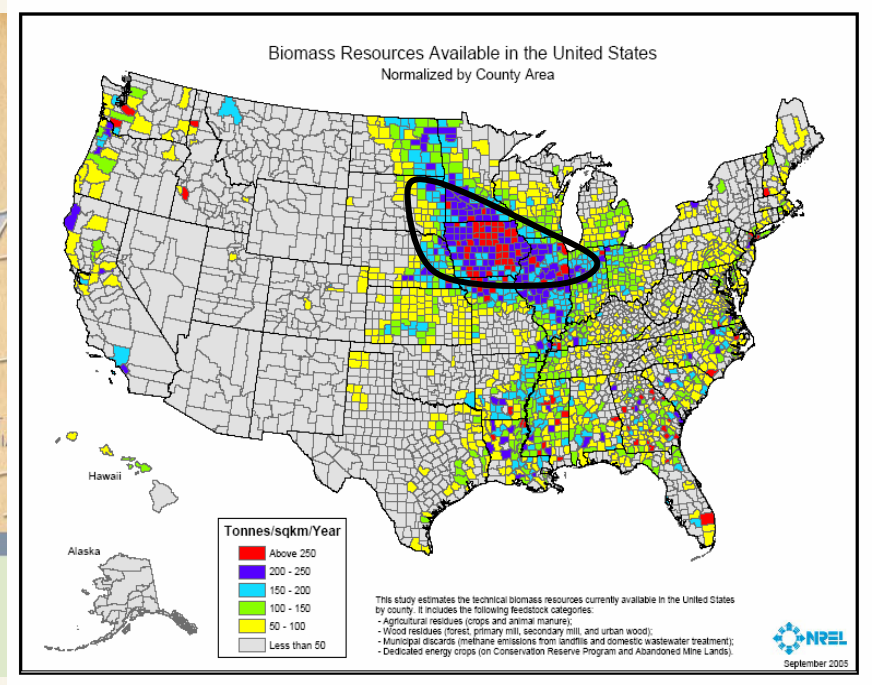
Research and Development

- Feedstock Collection, Storage and Processing
- Process Development and Optimization
- Scale Up
- Construction

Cellulosic Ethanol: Starts with Corn

Corn and Cellulose





Why Cobs?

- Abundant supply
- Low level of nutrients
- More carbohydrate
- More than 2X the density of corn stalks
- Collectible
- Sustainable
- Potential high yield
- Existing market

The Challenge

- Small scale business today
- Limited farm machinery available
- Not much experience with cob storage
- A lot to learn about how to process
- How do we engage farmers, OEMs and systems suppliers to meet our goals?

Collaborators

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Energy inspired.™

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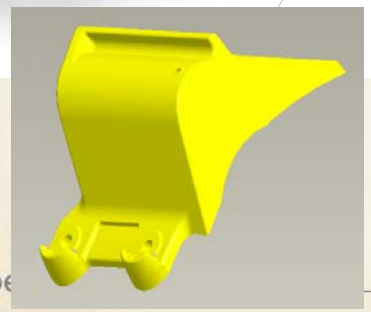
Cob Field Days 2007

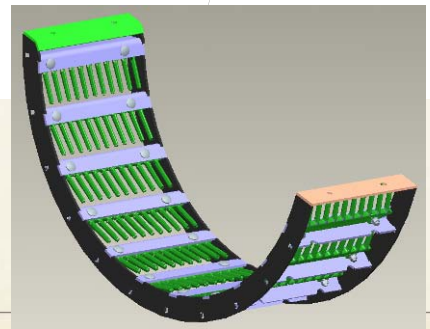
Grain Harvest 2007 – Hurley, SD

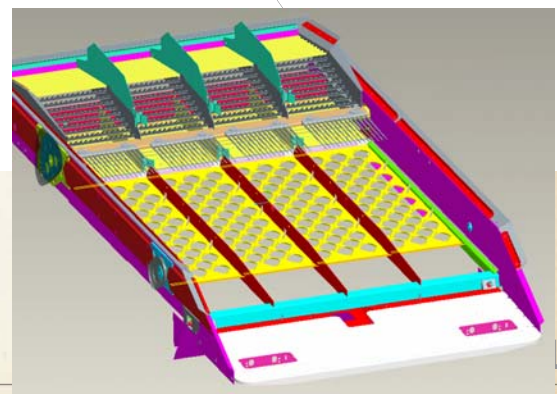
Grain Harvest 2007 – Hurley, SD

First Generation: Corn Cob Mix

Field Test ’07 - CCM Package







Co-mingled Corn Grain and Cobs (CCM)

The corn & cob mixture is unloaded into common hopper bottom trailers & hauled to the farm, plant or separation area.

Storage Options

CCM can either be separated in the field or hauled to a pile for further processing.

Separation Options

The Corn & Cob mix can be separated at the field, farm or plant.

The “Cob Caddy”

Cob Caddy Dump to “Cob Cart”

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Things Work

Prototype Biomass Harvester

Source: S. Birrell, Iowa State University

Prototype Biomass Harvester

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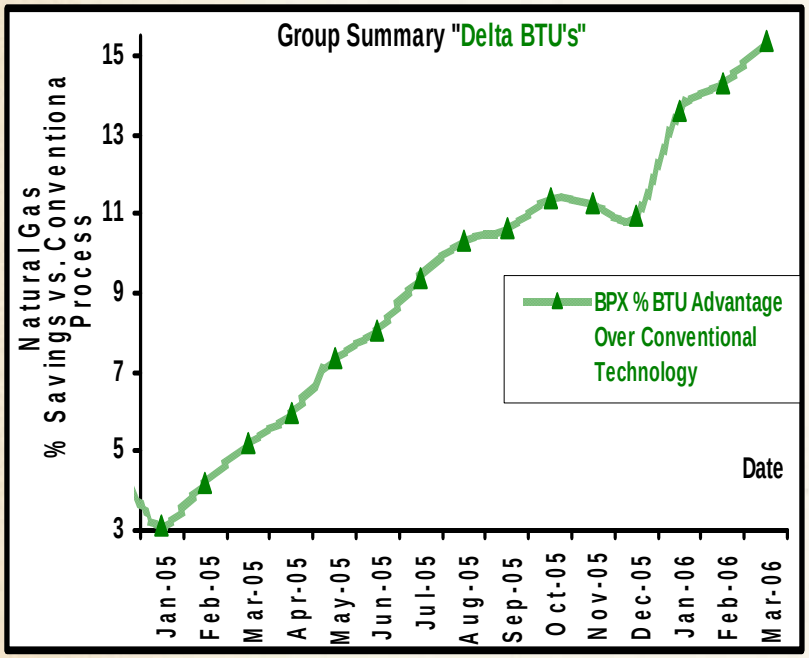
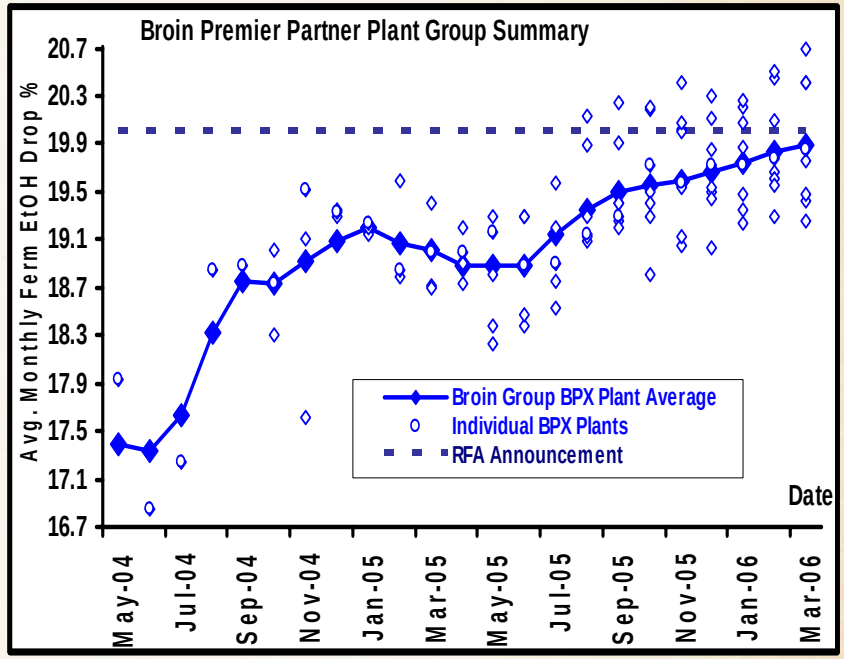
Enabling Technologies

- Corn Fractionation
- Raw Starch Hydrolysis
- Feedstock Collection
- Process Strategies
- Alternative Energy

POET Research Center
Scotland, South Dakota

BPX™





Raw starch hydrolysis process without the need for cooking

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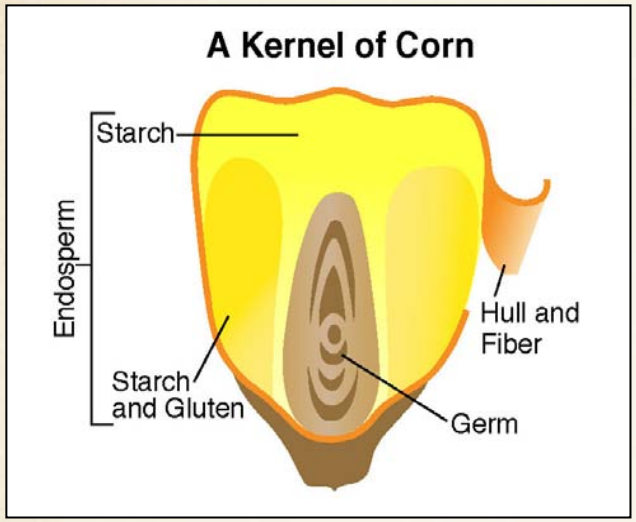

Dry corn fractionation producing endosperm, fiber and germ

Dakota Gold HP
Distillers Grains
Nutrient Profile

Dakota Gold MARKETING
Enhanced Nutrition Distillers Products
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DAKOTA GOLD HP™
Dried Distillers Grains

PROTEIN, FAT, ENERGY, FIBER

ITEM	VALUE[1,2]	ITEM	VALUE[1,2]
Dry Matter, %	92.2	NE_L, Mcal/cwt[3]	103
Crude Protein, %	43.0	NE_M, Mcal/cwt[3]	100
Crude Fat, %	4.3	NE_G, Mcal/cwt[3]	68
TDN, %	89.2	ADF, %	8.6
ME – Swine, Kcal/lb[3]	1842	NDF, %	18.1
ME – Poultry, Kcal/lb[3]	1328	Ash, %	2.1

AMINO ACIDS, %

ITEM	VALUE[1,2]	ITEM	VALUE[1,2]
Alanine	3.89	Lysine	1.43
Arginine	1.30	Methionine	1.21
Aspartic Acid	3.17	Phenylalanine	2.22
Cystine	1.60	Proline	4.14
Glutamic Acid	8.35	Serine	2.27
Glycine	1.59	Threonine	1.64
Histidine	1.40	Tryptophan	0.50
Hydroxyproline	0.13	Tyrosine	1.94
Isoleucine	1.64	Valine	2.31
Leucine	5.52		

MINERALS

ITEM	VALUE[1,2]	ITEM	VALUE[1,2]
Calcium, %	0.02	Sulfur, %	0.82
Phosphorus, %	0.50	Copper, ppm	5
Sodium, %	0.13	Iron, ppm	61
Potassium, %	0.38	Manganese, ppm	7
Magnesium, %	0.13	Zinc, ppm	72

1 All Values: Dry Matter Basis.

2 Average of approximately 10 New Crop '05-'06 samples sent to Midwest Laboratories, Omaha, Nebraska.

3 All energy values determined experimentally assume following values for corn: NE_L = 91; NE_M = 99; NE_G = 65; ME – S = 1750; ME – P = 1770.

2006-2

DGRA Dakota Gold Research Association

FOR MORE INFORMATION, CONTACT US AT
888.327.8799 • 605.332.2200 • 605.332.2266 (fax)
contactus@dakotagoldmarketing.com

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Enhanced Nutrition Distillers Products

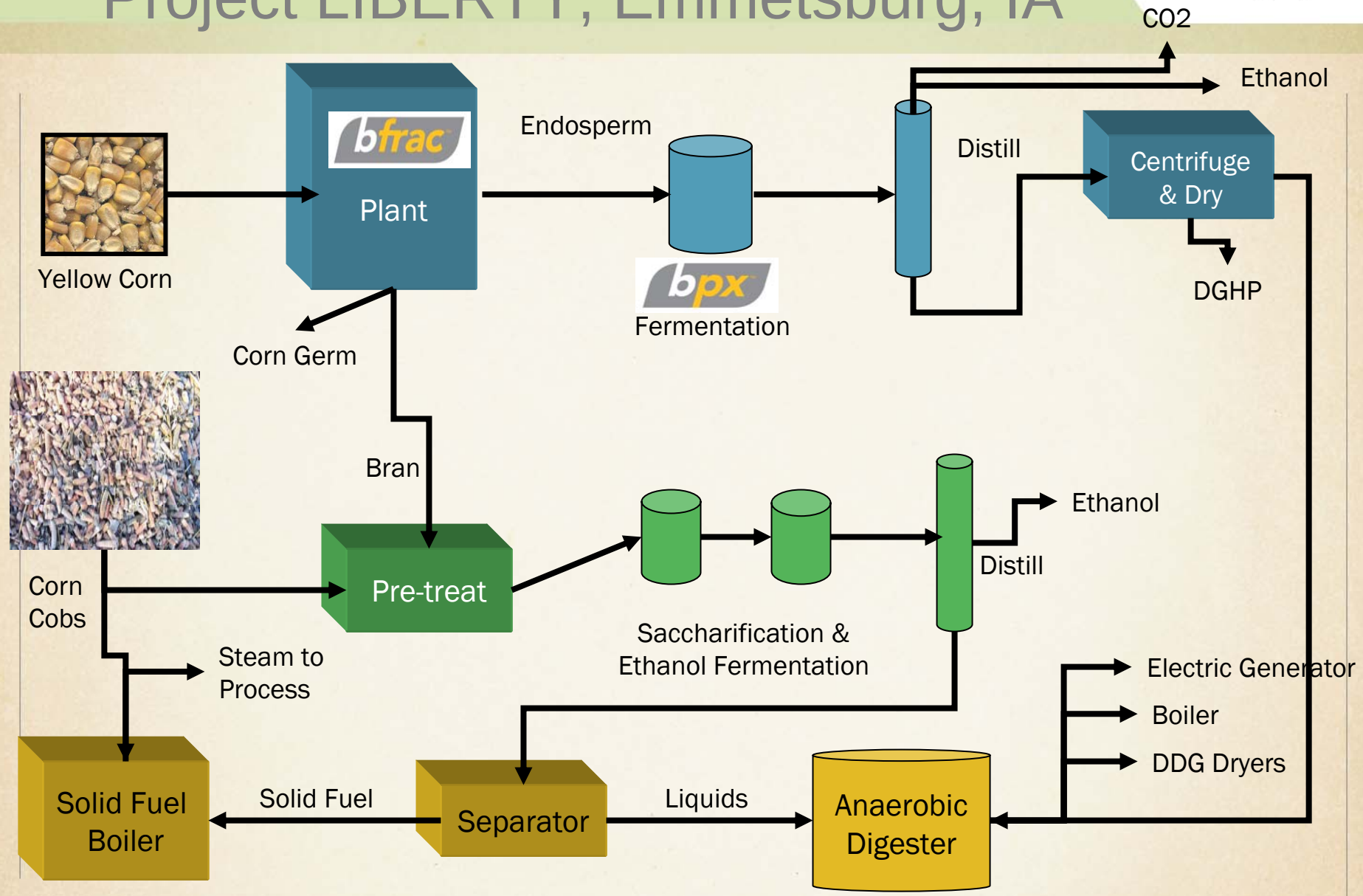
Cellulosic Ethanol Technologies

- Pretreatment
  - Acid, Alkaline, Temperature, Oxidation
  - Solubilize lignin and hydrolyze cellulose and/or hemicellulose
- Saccharification
  - Cellulose and hemicellulose hydrolysis
- Fermentation
  - Separate C6 and C5 fermentations
  - Mixed sugar fermentations

Alternative Energy

- Lignin incineration and steam generation
- Biogas and process water production

Project LIBERTY, Emmetsburg, IA



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Timeline

Feb 2007
POET selected to receive up to $80 million for Project LIBERTY

Oct 2007
POET and DOE sign agreement for first phase

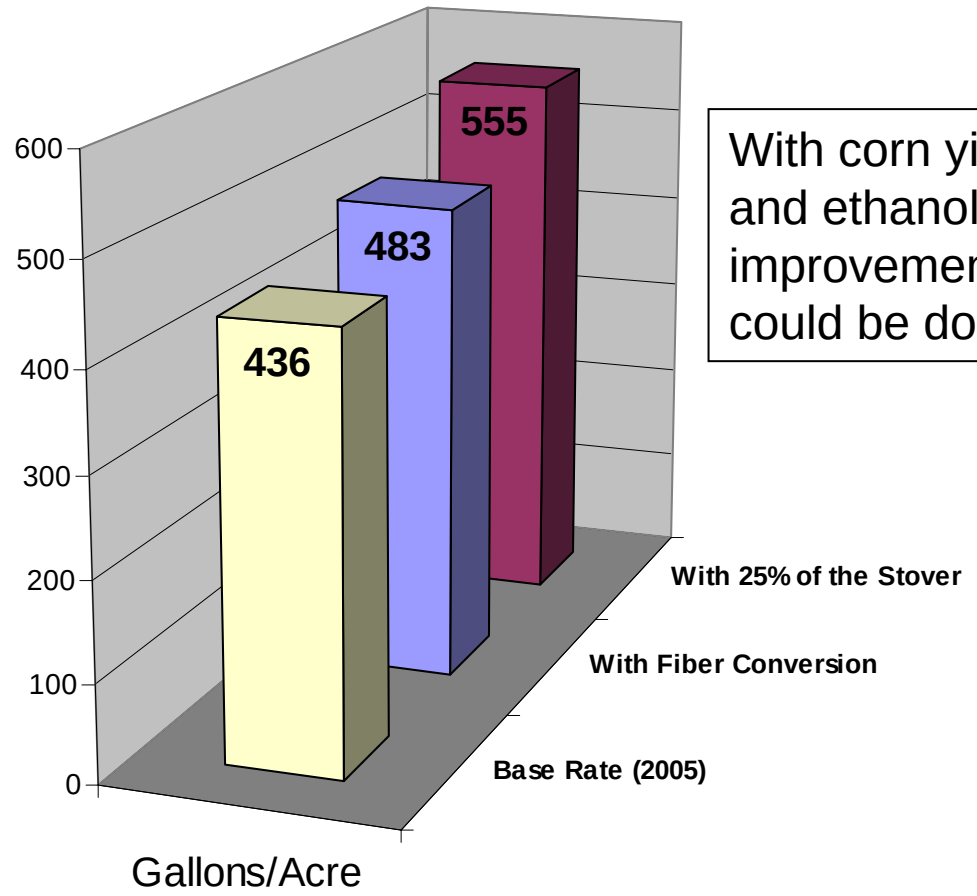
2009 (anticipated)
signing of second phase agreement

Phase 1
2007 to 2009
Design, engineering, environmental analysis, biomass collection and others

Phase 2 (anticipated)
2009 to 2011
Construction

Start Up
2011
(anticipated)

Improved Ethanol Efficiency



With corn yield increases and ethanol process improvements, these levels could be double by 2030.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