

# POET BIOREFINING LADDONIA AND MACON

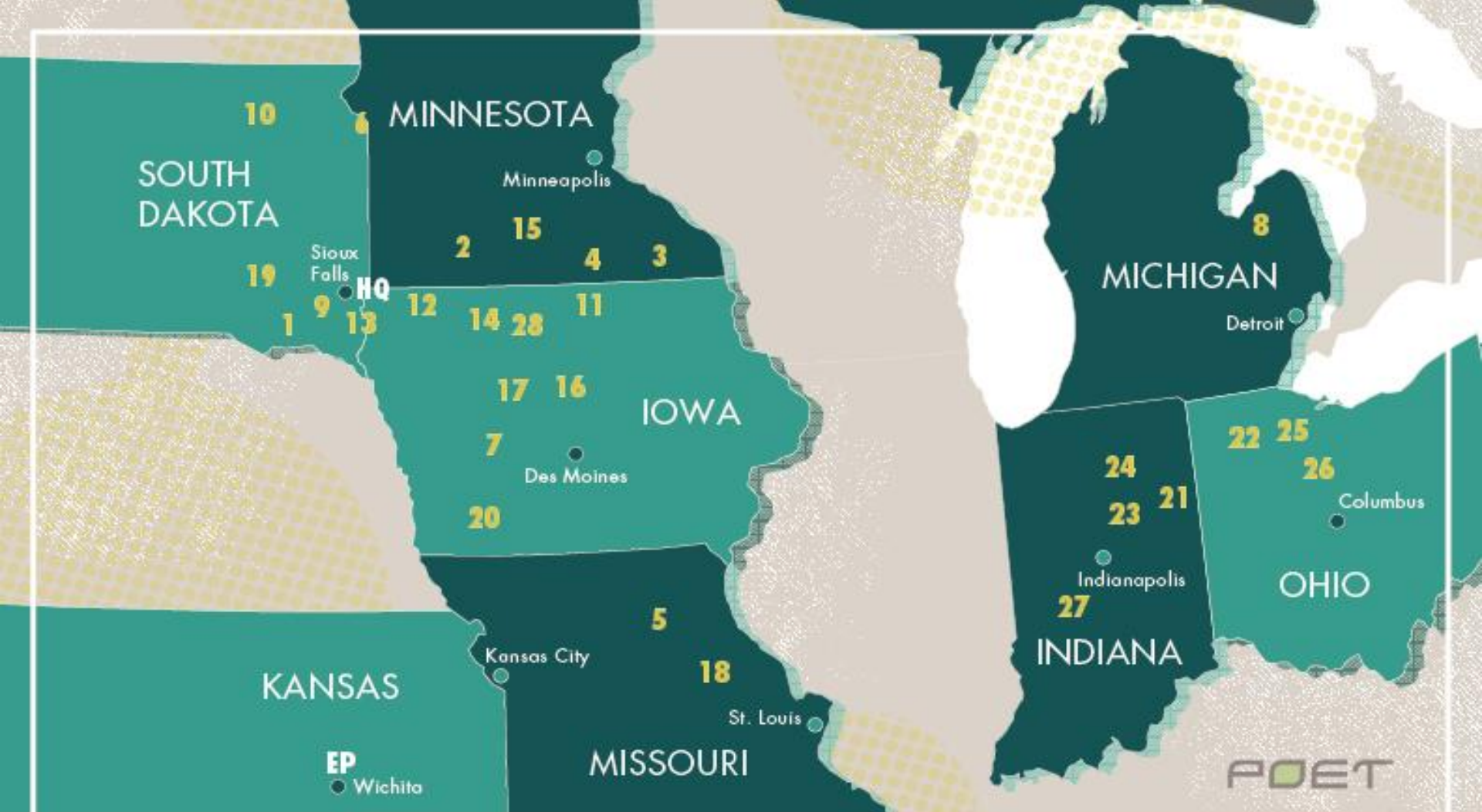
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Steve Murphy – GM

AEE Tour Group

4/9/2019



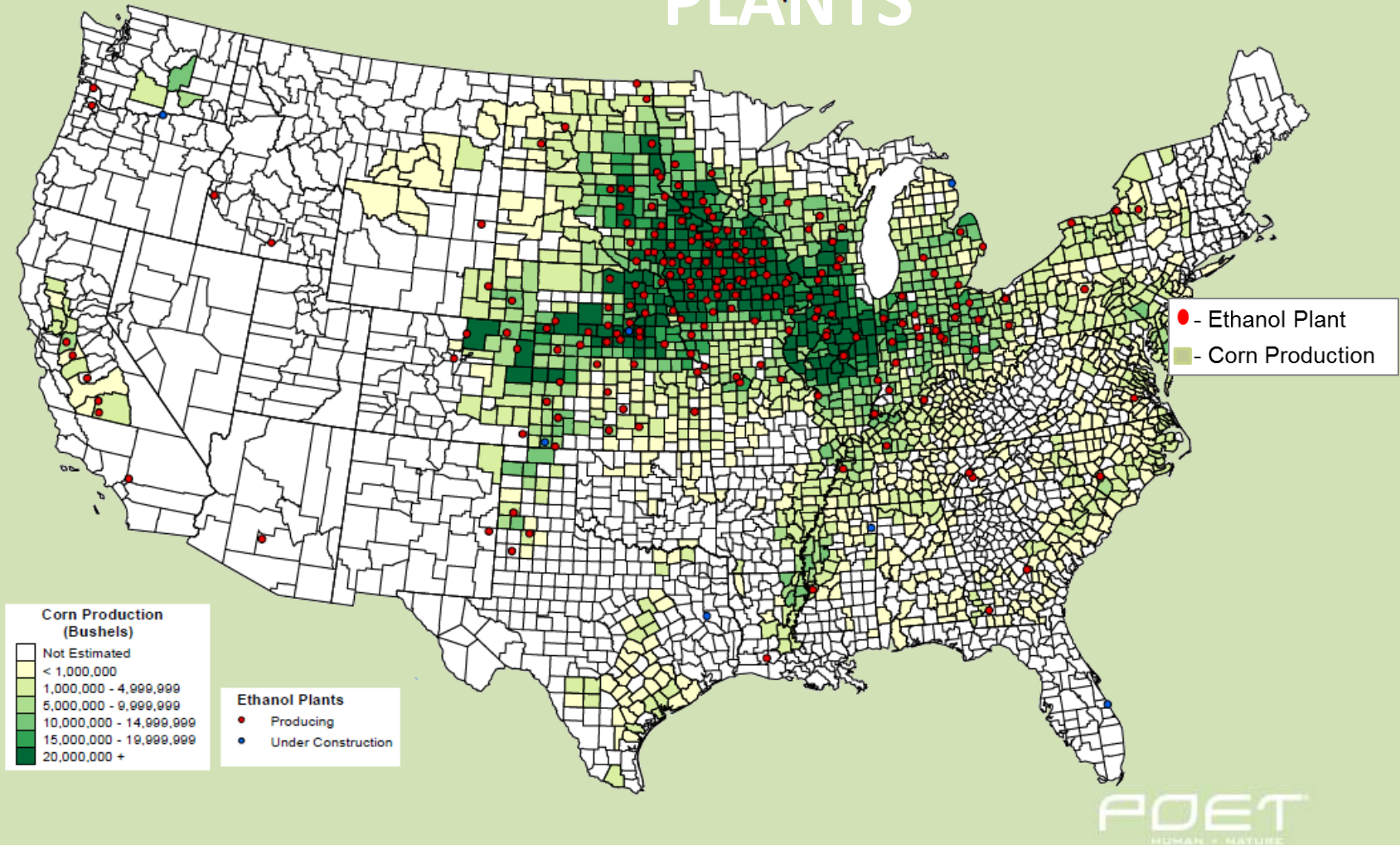


#### POET BIOREFINERY LOCATIONS

1 Scotland, SD	7 Coon Rapids, IA	13 Hudson, SD	19 Mitchell, SD	25 Fostoria, OH
2 Bingham Lake, MN	8 Caro, MI	14 Emmetsburg, IA	20 Corning, IA	26 Marion, OH
3 Preston, MN	9 Chancellor, SD	15 Lake Crystal, MN	21 Portland, IN	27 Cloverdale, IN
4 Glenville, MN	10 Groton, SD	16 Jewell, IA	22 Leipsic, OH	28 Project LIBERTY
5 Macon, MO	11 Hanlontown, IA	17 Gowrie, IA	23 Alexandria, IN	HQ Headquarters - Sioux Falls, SD
6 Big Stone, SD	12 Ashton, IA	18 Laddonia, MO	24 North Manchester, IN	EP Ethanol Products - Wichita, KS

TOTAL GALLONS REPRESENTED: 1.7 BILLION

# US CORN PRODUCTION & ETHANOL PLANTS

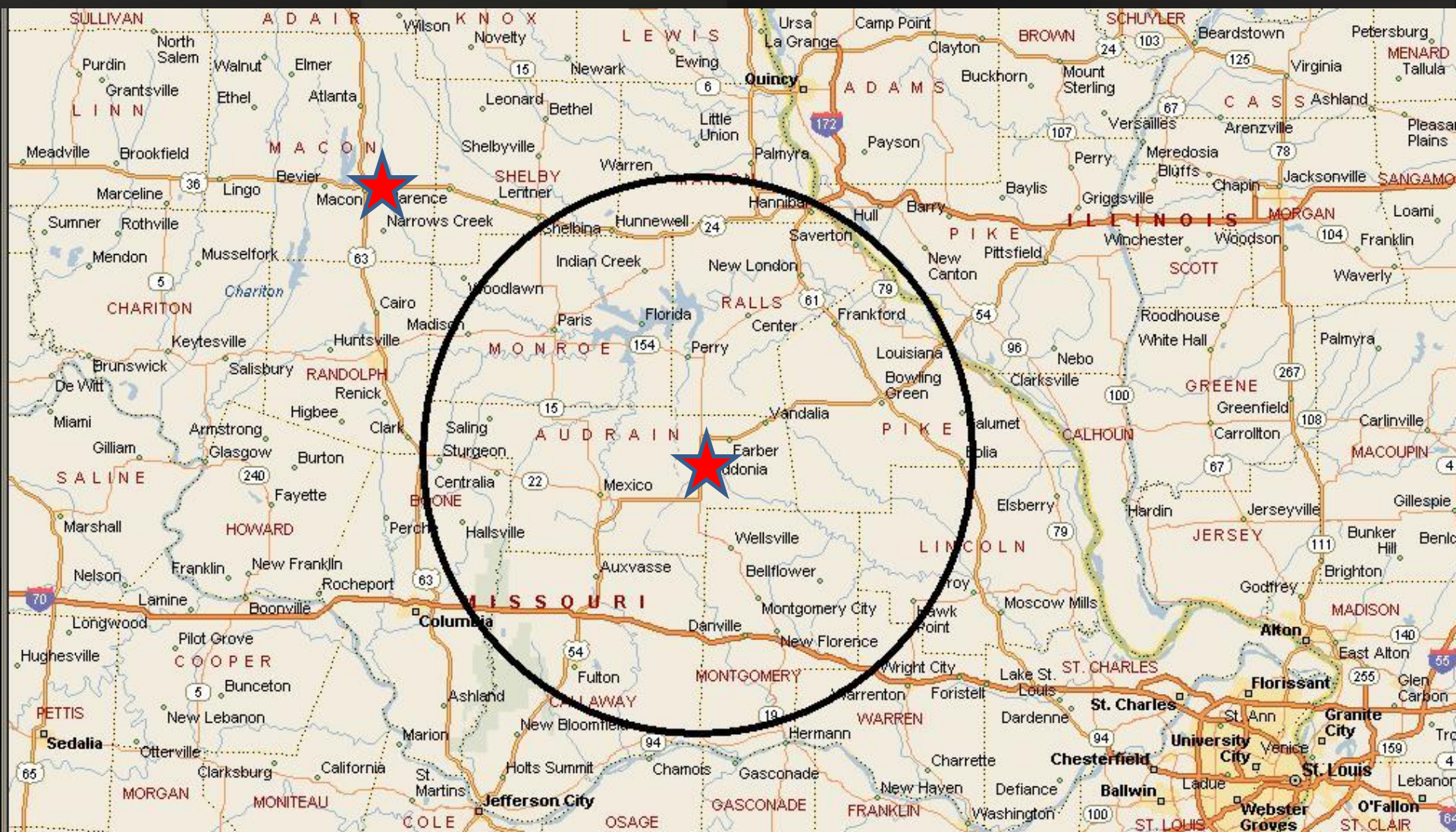








# CORN DRAW AREA



# LADDONIA PRODUCTION - 2018

65+ MGPY of ethanol annually

- Over 2 gallons/second

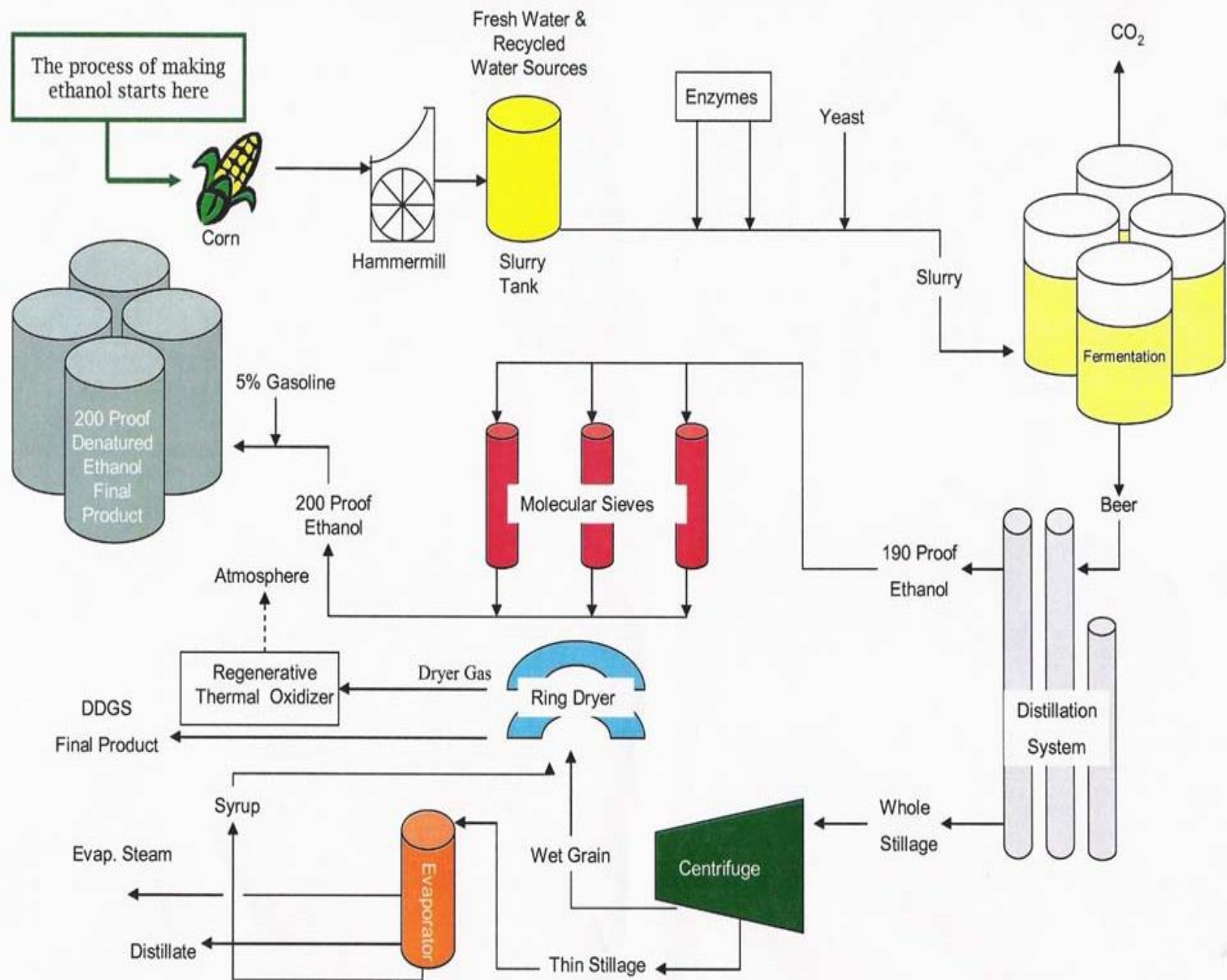
20+ M bushels of Corn

\$80MM dollars of corn ground in 2018

- Produce over 150,000 tons of DDGS/year
- Wetcake
- Corn oil – started December 2011
  - Animal feed (poultry), biodiesel, asphalt
- Liquefied CO2 – started March 2013
  - Food and beverage grade
- Electricity – 15MW
- Up next – cellulosic ethanol
  - Stover and corn kernel fiber



# Ethanol Production – Block Flow Diagram



# ETHANOL FACTS AND MYTHS

## Ethanol Myth – Ethanol needs and receives government subsidies to survive

- VEETC Blenders credit was allowed to expire on January 1, 2012 (went to oil industry anyway)
- Tariff on imported ethanol (Brazilian sugar cane) also expired on 1/1/2012
- Small Producer Tax Credit expired 1/1/2012
- All ethanol subsidies ended after 2011 and farm subsidies have been reduced
  - Only RFS with RVO gallons remains
    - However oil tax subsidies still remain
  - MO state producer credit also expired



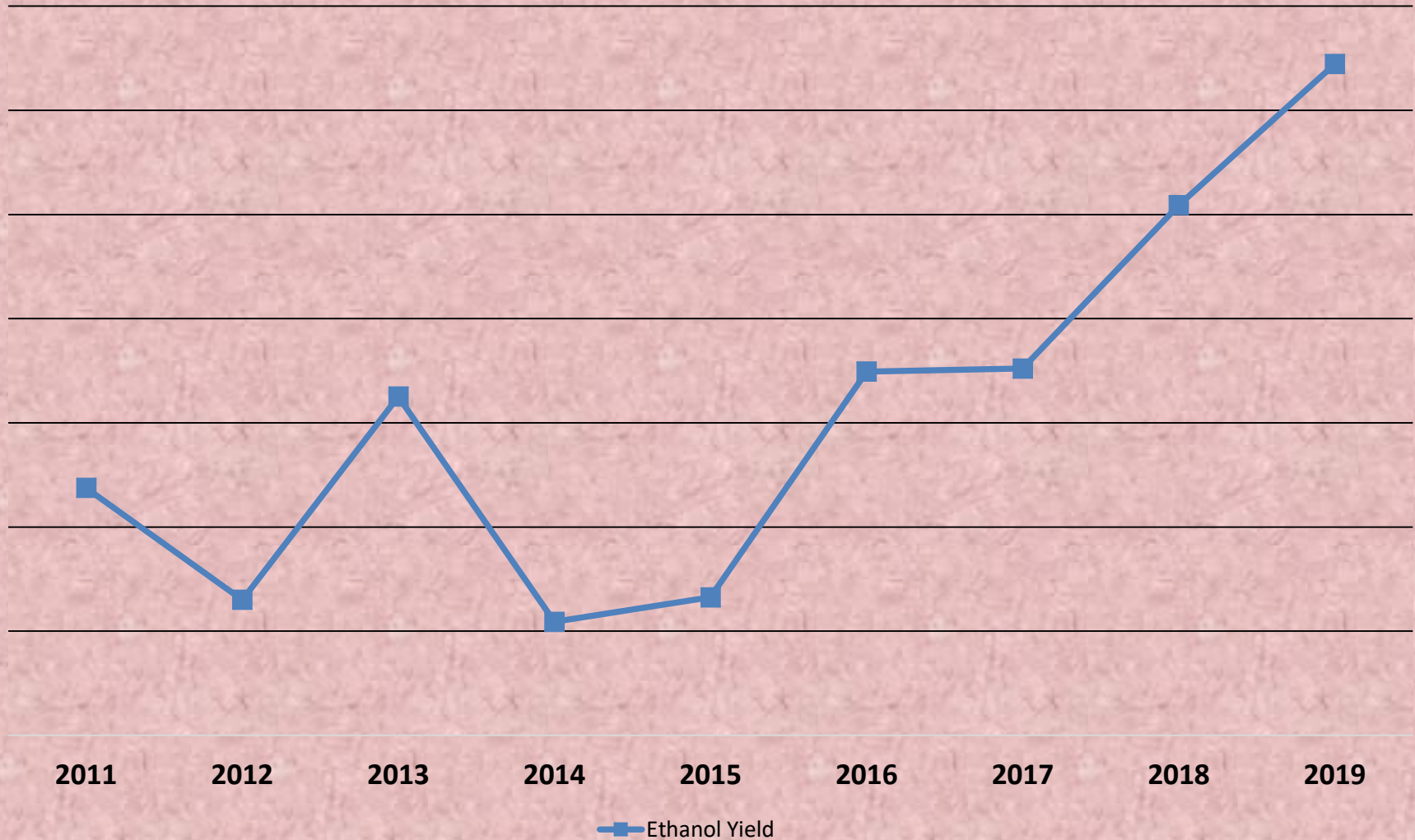
# ETHANOL FACTS AND MYTHS

Ethanol Myth - It takes more energy to produce a gallon of ethanol than it generates

- This statement does not include co-products values like DDGS (dried distillers grains)
- Some studies also include some questionable assumptions
- Data or studies referenced are often old and obsolete
- **USDA calculated between 2.1x to 4.0x energy benefit using 2015 data, and this ratio has increased further**  
GPS farming, higher yields (more bu/acre), process optimization (more gallons/bu), enzymes/BPX, yeast development, combined heat and power, etc.

# POET BIOREFINING – LADDONIA

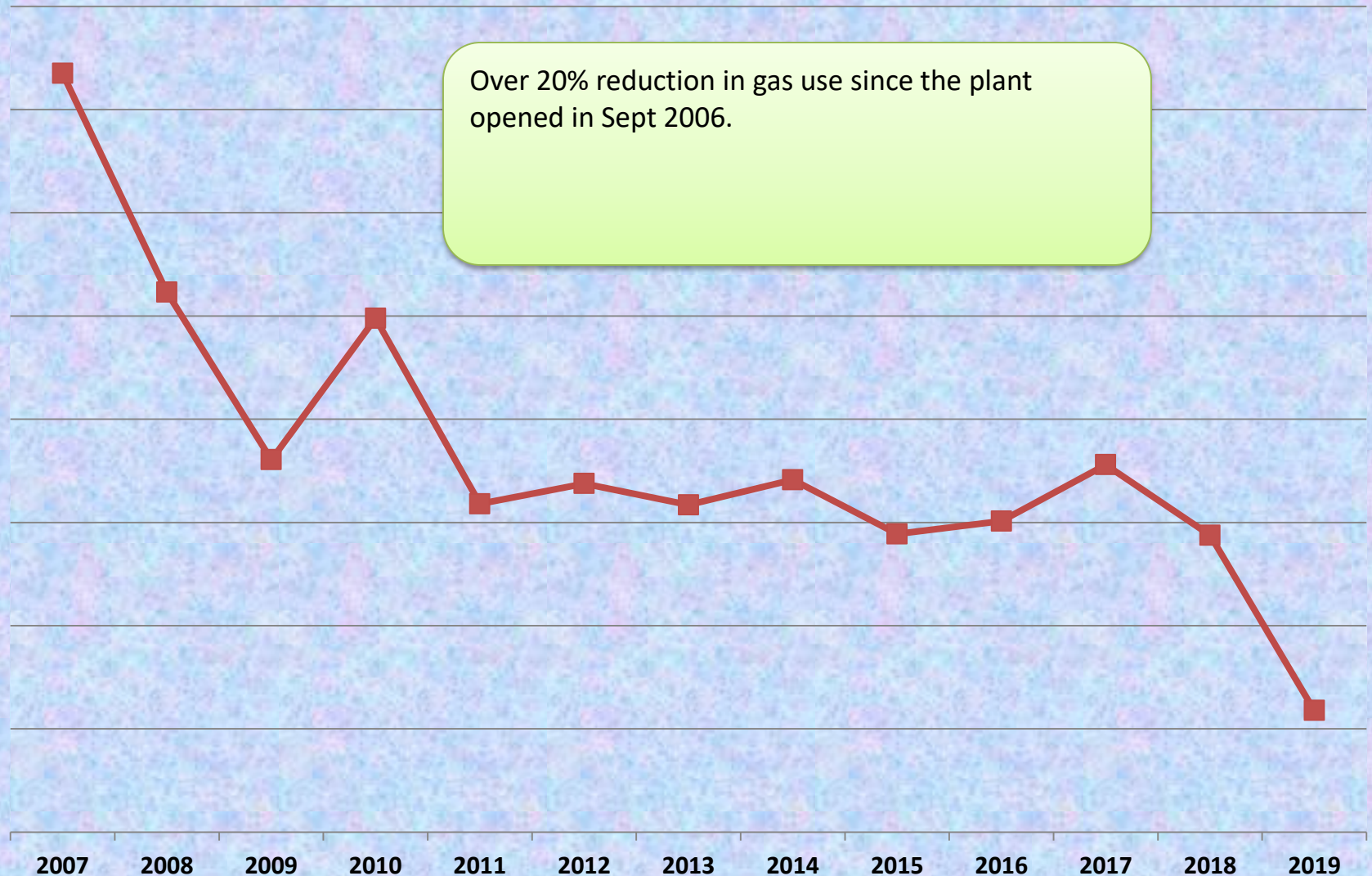
## LAD Ethanol Yield (gallons/bu)



# POET BIOREFINING – LADDONIA

## Natural Gas Use – BTU/Gallon

Over 20% reduction in gas use since the plant opened in Sept 2006.

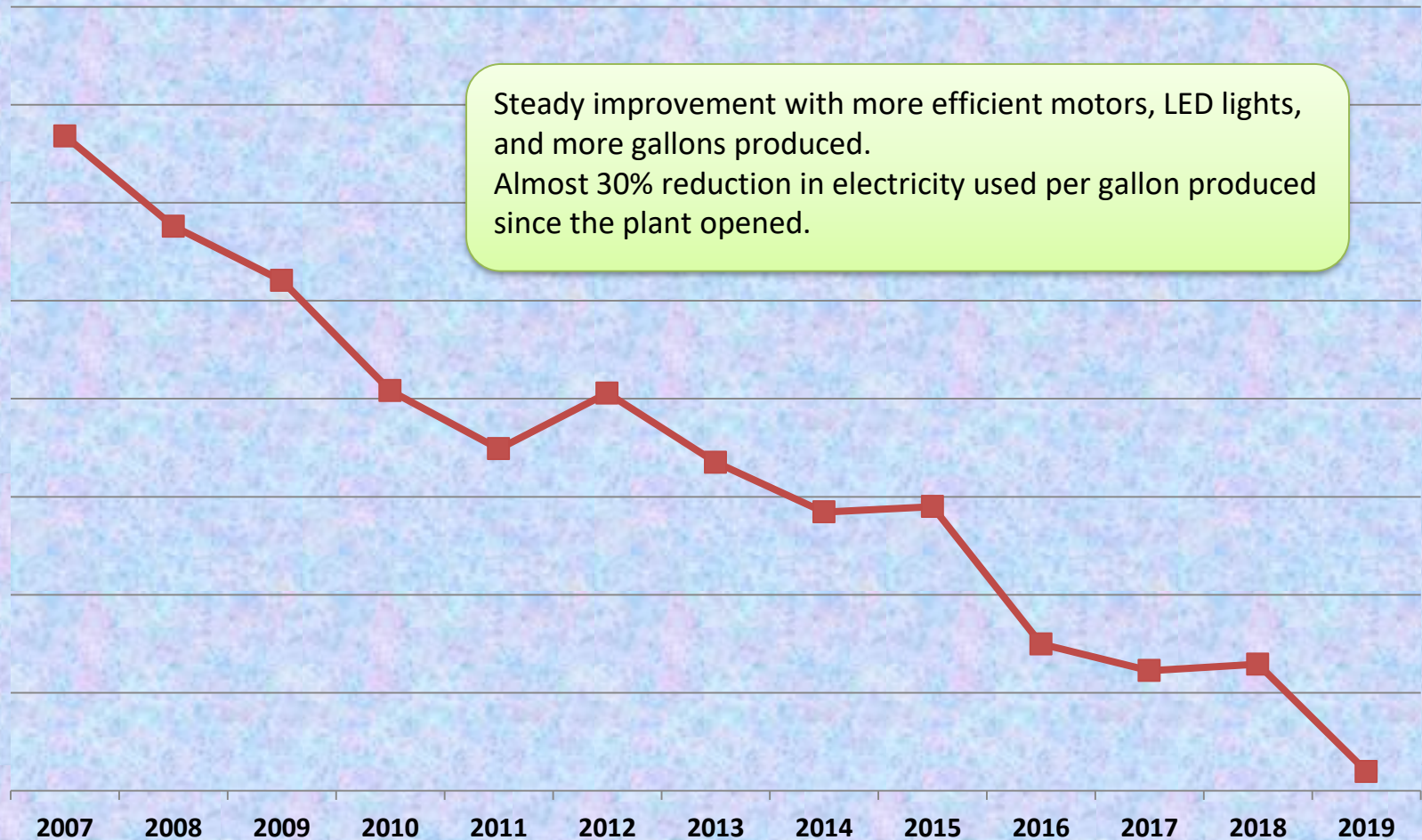




# POET BIOREFINING – LADDONIA

## Electricity - KWH/Gallon

Steady improvement with more efficient motors, LED lights, and more gallons produced.  
Almost 30% reduction in electricity used per gallon produced since the plant opened.



# ETHANOL GHG VALUE

- USDA just released a study in April 2019 that shows a 43% GHG reduction using ethanol vs. gasoline when all inputs are considered.
- Includes “land use change” penalties, but with more accurate data based on what has actually happened vs. models.
- USDA estimates ethanol will be 47% lower on GHG emissions compared to gasoline based on current trends in 3 years

# CHP OPPORTUNITY

- POET – Laddonia has a 15MW CHP unit
- POET – Macon has a 10MW CHP unit
- CHP could be repeated throughout the USA with more ethanol / electric generation partnerships
- There are over 200 ethanol refineries in the USA
- Natural gas pipelines already exist to service the ethanol plants
- Cost for the natural gas consumed is shared between the utility and the ethanol plant
  - A very cost effective way to reduce GHG and other emissions for both electricity and transportation



# CHP OPPORTUNITY

- There is over 15 Billion gallons of ethanol production capacity in the USA primarily in the corn belt
- At a conservative 2MW of electricity for every 10 million gallons of ethanol production, 3,000MW of potential CHP
- Coal power plants are still common in the corn belt
- Ethanol plants run 24/7 unlike wind and solar and are ideal for baseload power
- Distributed generating capacity at 200+ ethanol plants could provide redundancy and energy security from power interruptions to the grid

# INDUSTRY CHALLENGES

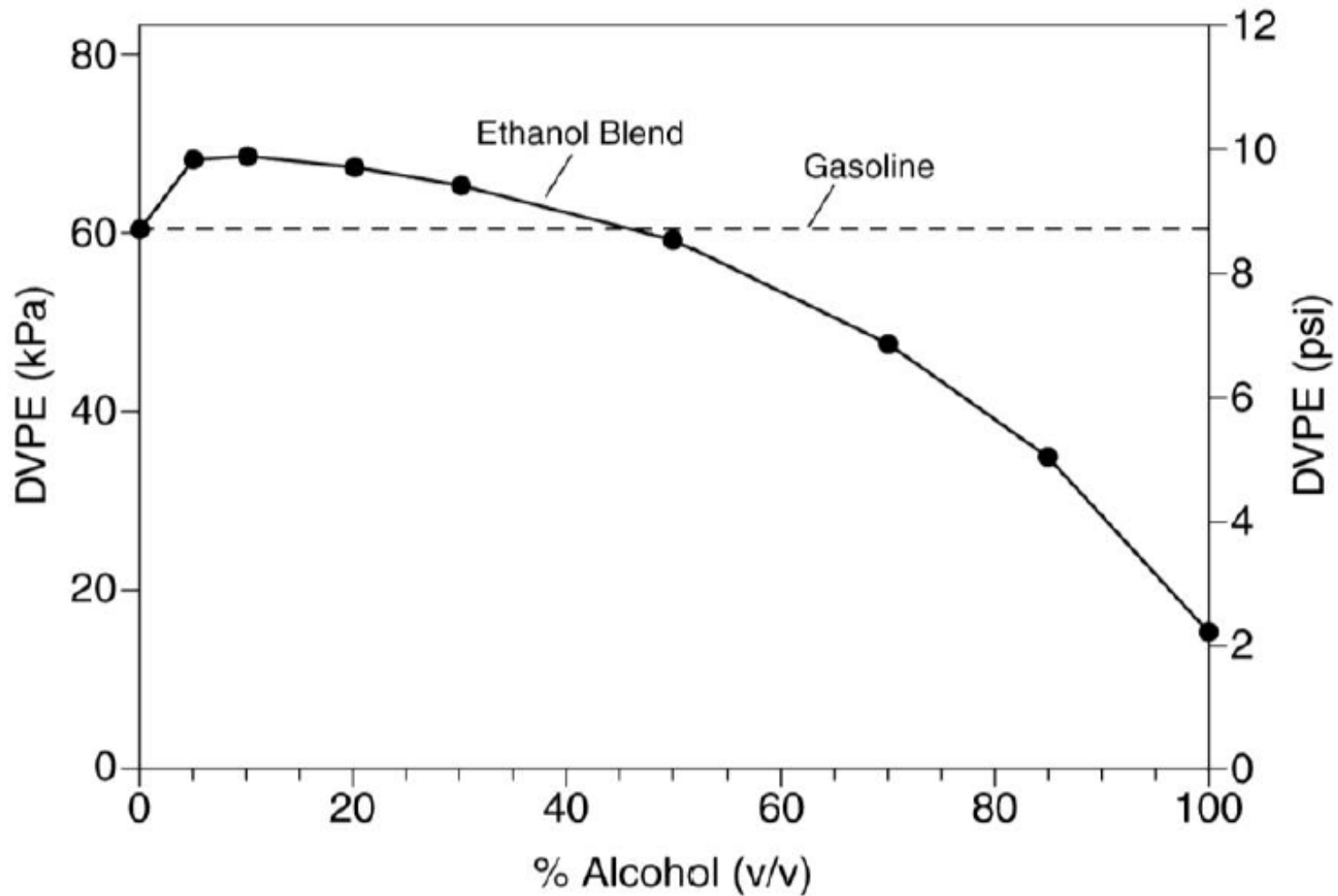
- 10% Blend Wall – E15 and flex pumps
  - US Market uses 10% ethanol in 98% of gasoline

Renewable Fuel Standard allows up to 15B gallons of corn ethanol to be used annually. This is often referred to as the “ethanol mandate”.

Small refinery waivers the last few years have eroded ethanol demand.

**10% maximum ethanol = 90% minimum mandate for oil**
  - There is NOT a national 10% ethanol mandate, ethanol is just the most economical renewable fuel
    - Biodiesel, biogas, renewable electric, etc. also satisfy the RFS
  - E15 (Unleaded88) at nearly 2,000 retailers now
    - EPA has approved E15 for vehicles 2001 and newer
  - **E15 is an option, NOT a mandate**
  - Ethanol industry can compete on value and if given market access to consumers
  - NASCAR runs on E15

# RVP

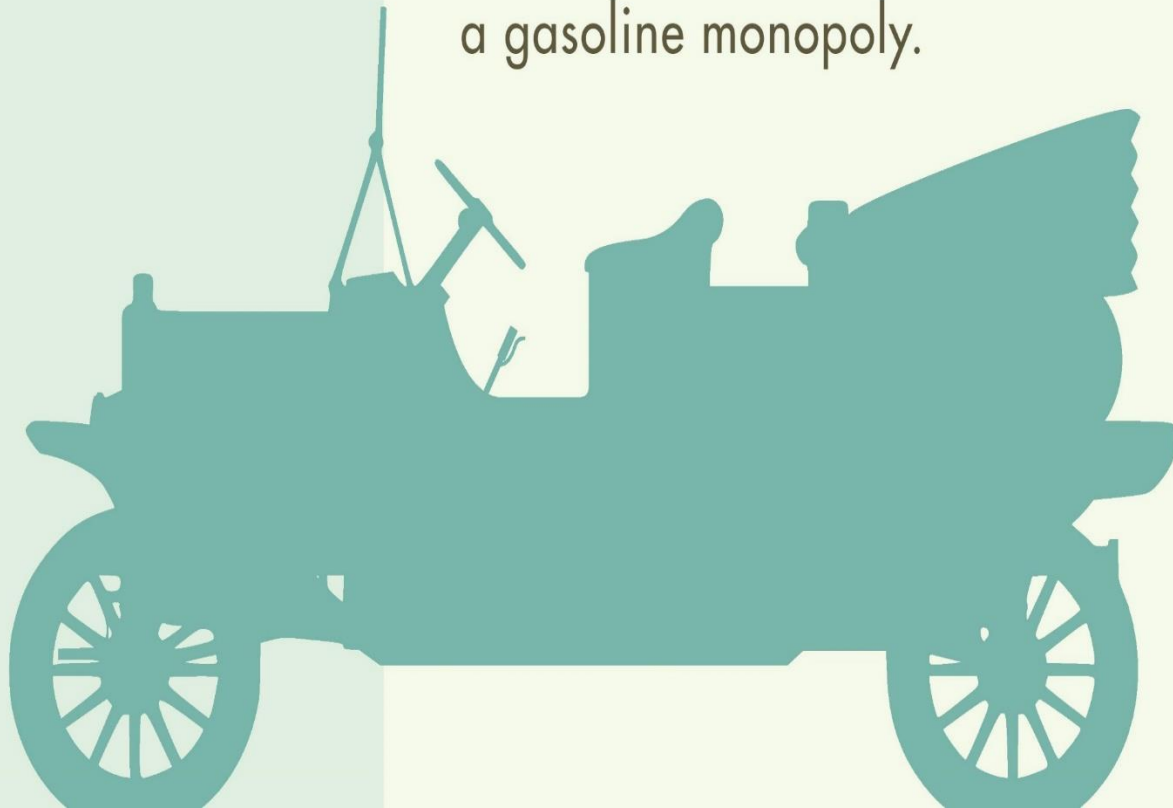


**Figure 1. Effect of ethanol blending on vapor pressure of gasoline.**



# ETHANOL IS NOT NEW

**DURING THE 1930s**, more than 2,000 service stations in the Midwest sold ethanol made from corn. Ethanol Prohibition changed that by creating a gasoline monopoly.



# BREATHE EASIER

## HEALTH IMPACT

Gasoline contains toxic chemicals that cause many human health and environmental issues. Adding ethanol to our gasoline reduces the amount of toxins that are in our fuels.

**ETHANOL IS A BIOFUEL  
THAT HAS UP TO  
90% LESS  
GHG EMISSIONS  
THAN GASOLINE**

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**ETHANOL**



**GASOLINE**

**SOME FUELS ARE  
CLEANER THAN OTHERS**

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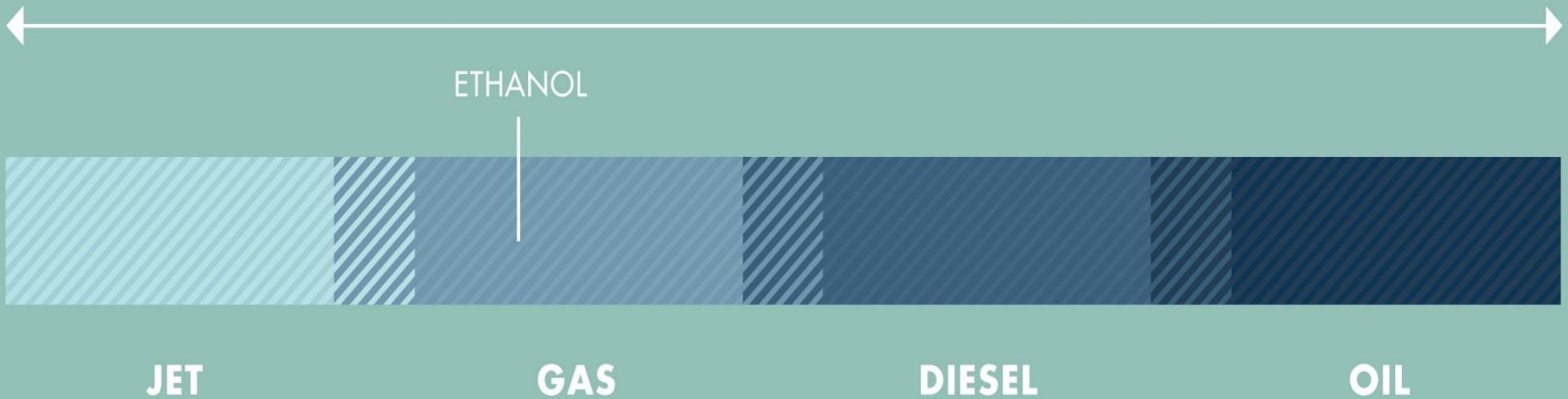
BENZENE, TOLUENE, XYLENE, HEXADIENE, DIMETHYLHEXENE,  
NONENE, OCTANE, DECALIN, 1,3-PENTADIENE, TETRAFLUO-  
ROETHANE, TRIMETHYLCYCLOHEXANE, ETHYLIDENEBIS-BEN-  
ZENE, TRIMETHYLNAPHTHALENE, DIMETHYLCYCLOHEXANE,  
ISOBENZOFURANDIONE, PENTADIENE, DINOTRONAPHTHA-  
LENE, DIMETHYLPHENANTHRENE, HOPANE, BUTANE,  
ISOBUTENE, METHYLFLUORENE, BENZOFURAN, DIMETH-  
YL-1-HEXENE, TRIMETHYLHEXANE, DINITROPHENOL, ETHYL-  
CYCLOPENTANE, TRIMETHYLTRIDECANE, DINITROFLUORENE,  
ETHYLBUTENE, HEXANONE, METHYL-PHENYL-PROPENE,  
ETHYLOCTANE, ETHYLHEPTANE, ABIETIC ACID, ACETIC ACID,  
ACETOPHENONE, AMMONIA, AZELAIC ACID, STERANE,  
TERPANE, CIS-DECALIN, CIS-PINONIC ACID, DECANAL, DECA-  
NOIC ACID, DECYLCYCLOHEXANE, DIETHAYL PHTHALATE,  
ETHYL DODECANE, DOCOSANE, ELAIDIC ACID, ETHYL  
METHYL BENZENE, CARBON TETRACHLORIDE, CERIUM,

ETHYL HEXANOL, EUGENOL, FLUORIDE, FORMIC ACID,  
FURFURAL, GLUTARIC ACID, GUAACOL, HENICOSANE,  
HEPTANAL, HEPTANEDIOIC ACID, HEPTYLCYCLOHEXANE,  
HEXADECANOIC ACID, HEXADECANE, HEXANOIC ACID,  
ICOSANE, INNDANONE, ISOAMYL BENZENE, ISOEUGENOL,  
LAURIC ACID, LIMONENE, MALEIC ACID, MALONIC ACID,  
METHYL CHLORIDE, METHY DODECANE, OCTANAL, OCTANE-  
DIOIC ACID, OCTYLCYCLOHEXANNE, OLEIC ACID, CRESOL,  
PENTACHLOROPHENOL, PENTYLCYCLOHEXANE, PERINAPH-  
THENONE, PHOSPHATES, PHTHALIC ACID, PHYTANE, PICOLINIC  
ACID, PINACOLIN, PRISTINE, PROPYLTOLUENE, SITOSTANE  
SITOSTEROL, STEARIC ACID, SYRINGOL

# FUEL MATRIX

**LIGHTEST**  
MOST VOLATILE

**HEAVIEST**  
LEAST VOLATILE





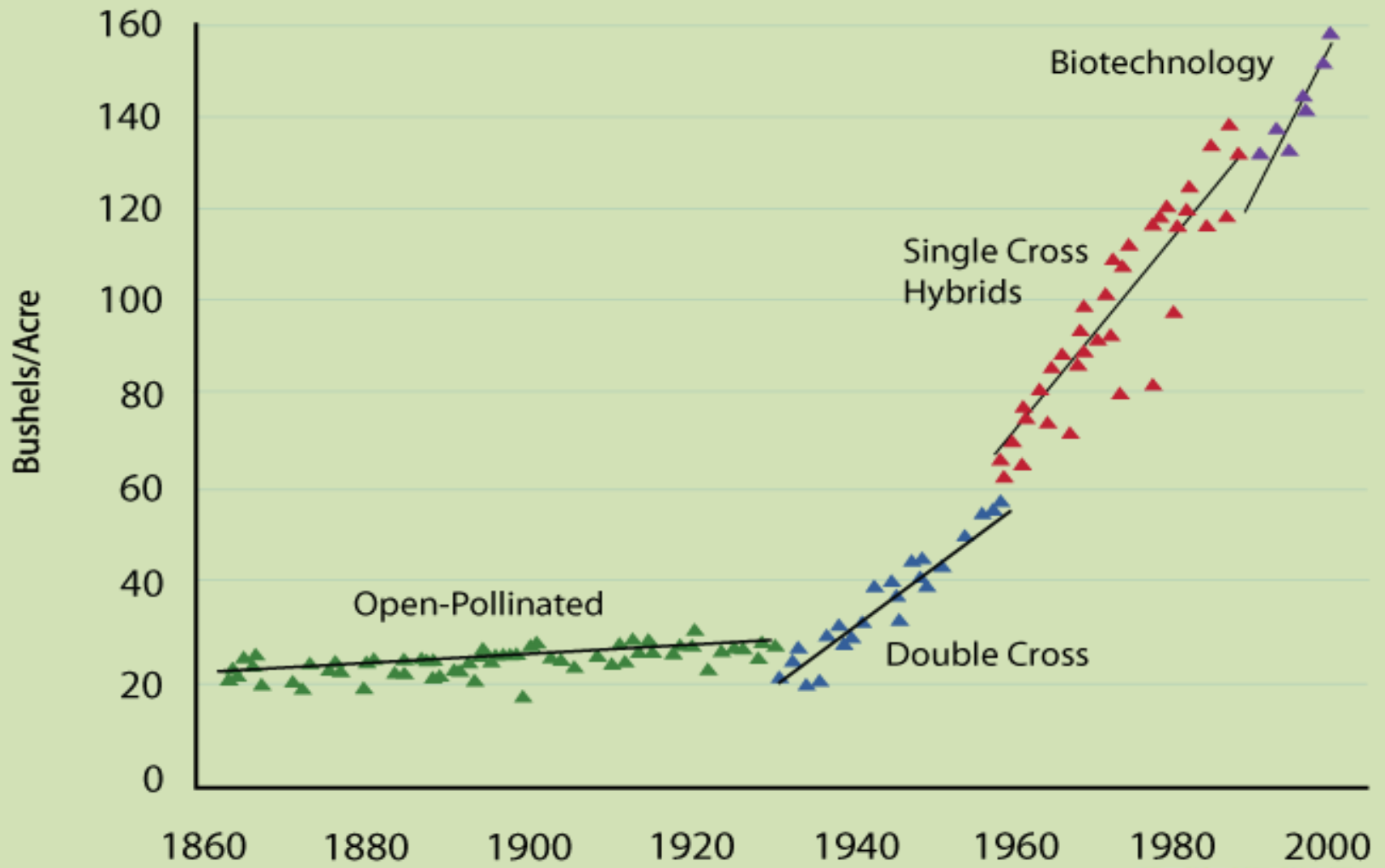
# ETHANOL FACTS

- Ethanol does have ~30% lower BTU content than gasoline
  - But it is also 113 octane (126 octane impact when blended)
- Blended with lower 84 octane gasoline (RBOB)
- Current flex fuel engines are designed to **tolerate** ethanol, not **optimized** to use it
- Auto industry is moving to smaller, higher compression, engines that are ideal for higher octane and ethanol
  - Many owners manuals recommend higher than 87 octane now
- Higher ethanol blends like E30 would improve air quality (particularly in cities), engine performance, and reduce CO2 emissions

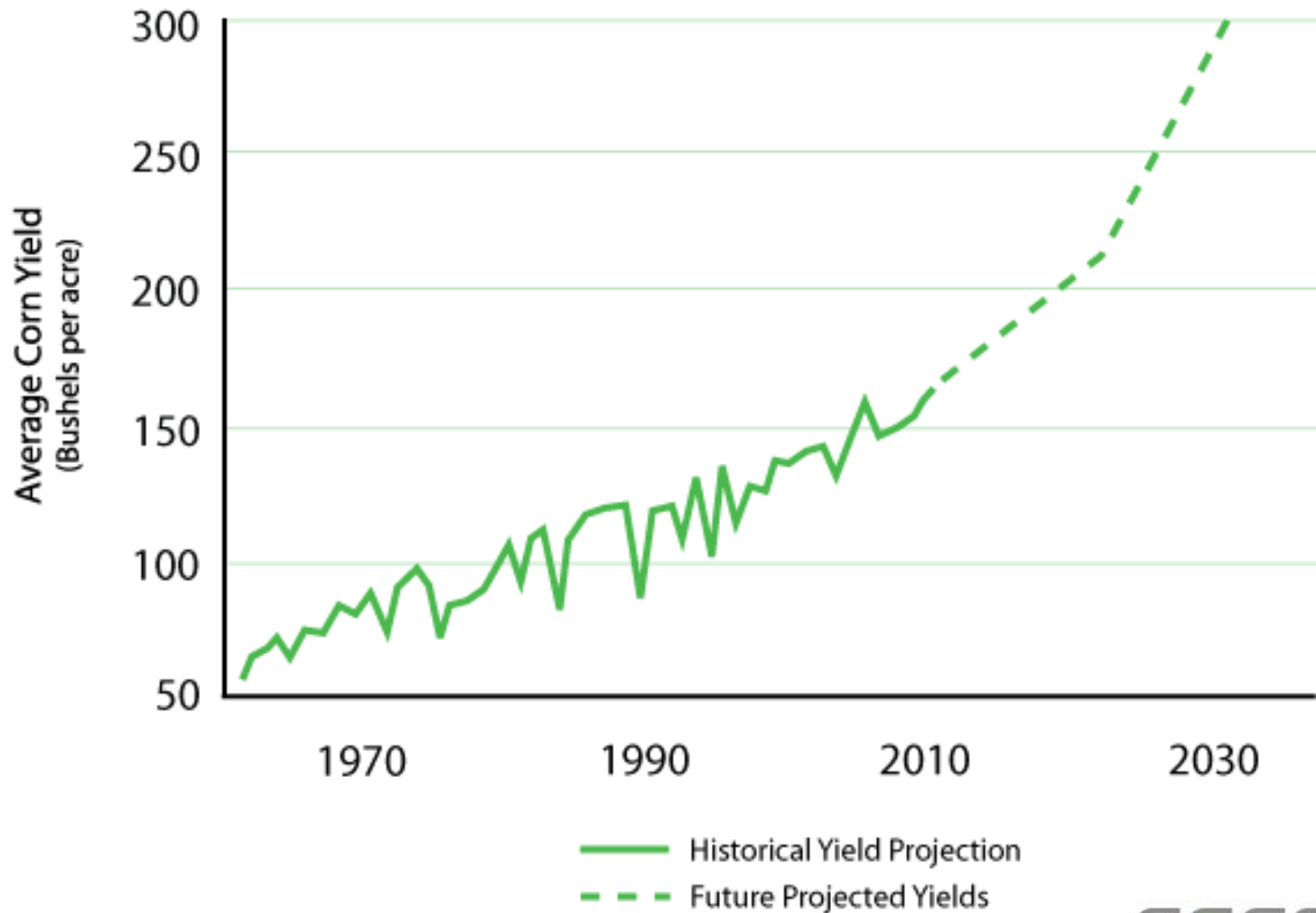
# ETHANOL FACTS

- Engines have evolved, but our fuel has not changed for decades – 87 octane is still the USA standard
- Ethanol has reduced/eliminated farm subsidies
  - Direct payments to farmers have been eliminated
- Monsanto/Bayer and other seed companies expect 300 bushels of corn/acre in a few years
  - Where will all the corn be used in the future?
  - Will we pay farmers to leave land idle (CRP)?
  - What happens to land values, farm income, and local tax revenues without ethanol helping boost the rural economy?

# U.S. CORN YIELDS



# U.S. Corn Yields





# HISTORY OF CORN PRODUCTION

Then	Now	Tomorrow
<b>1970</b>	<b>2011</b>	<b>2030</b>
<b>86<sub>(1)</sub></b> bu/acre	<b>172<sub>(1)</sub></b> bu/acre	<b>300<sub>(2)</sub></b> bu/acre
<b>2.2</b> tons of residue	<b>4.3</b> tons of residue	<b>7.5</b> tons of residue
<b>18,000</b> planting population	<b>32,000-38,000</b> planting population	<b>50,000</b> planting populations
<b>1.2</b> tons left after harvest	<b>4.3</b> tons left after harvest	<b>7.5</b> tons left after harvest
Plowing	reduced tillage	what do we do with the trash?
Picking corn in the ear	combining	combining
Cobs and husks removed	residue management problem	bigger residue management problem
<b>40"</b> rows	<b>30"</b> rows	<b>12"-20"</b> rows



There is **358%** more residue left in the field today than in 1970.

# ETHANOL FACTS

- Corn prices and ethanol prices near multiyear lows
- Ethanol displaces carcinogens like benzene/toluene
- Ethanol does not displace gasoline, it really displaces the high octane portion of gasoline to lower per gallon fuel costs (BTX @ \$4+/gal vs. ethanol @ \$1.35/gal)
- Ethanol is the lowest cost and cleanest way to create premium high octane fuel
- Oxygenate for better combustion (less particulate)
  - Carbon dioxide is not the only air pollutant to worry about
  - The recent Volkswagen diesel issue is a reminder of this
- Biodegradable – “no beaches ever closed due to ethanol spills”

# MACON BREAK TIME STATION



# BENEFITS OF ETHANOL



**ENGINE  
HEALTH**



**THE ENVIRONMENT**



**HUMAN  
HEALTH**



**VALUE TO THE  
CONSUMER**



**NATIONAL  
SECURITY**



**THE ECONOMY**



**AGRICULTURE**

