the energy of innovation™

Alternative Energy: The Energy of Innovation in Biofuels

Presented by: Greg Krissek, *Director, Government Affairs*

Kansas Economic Policy Conference

October 22, 2009

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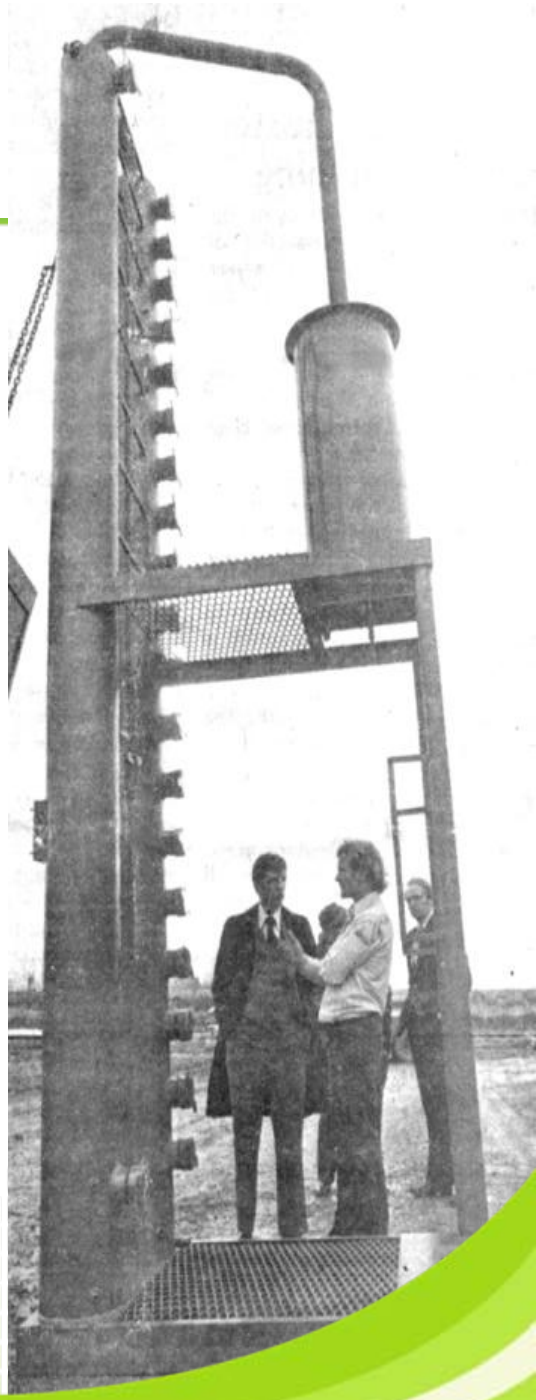
Presentation Outline

- Current Outlook for the Biofuels Industry?
- Grain Ethanol and Co-Products – More Food, Less Carbon
- Next Generation Ethanol & Biofuels
- Biomass Gasification Potential
- Q&A

ICM History

- Founded in 1995; History Dating to the 1970's
- Based in Colwich, KS with 300 Employees
- Design, Construction, and Support of Ethanol Plants; Manufacturing of Equipment
- R&D, Engineering, Energy, Controls, and Environmental
- 102 US ethanol plant customers – technology responsible for over 6.6 billion gallons of annual capacity



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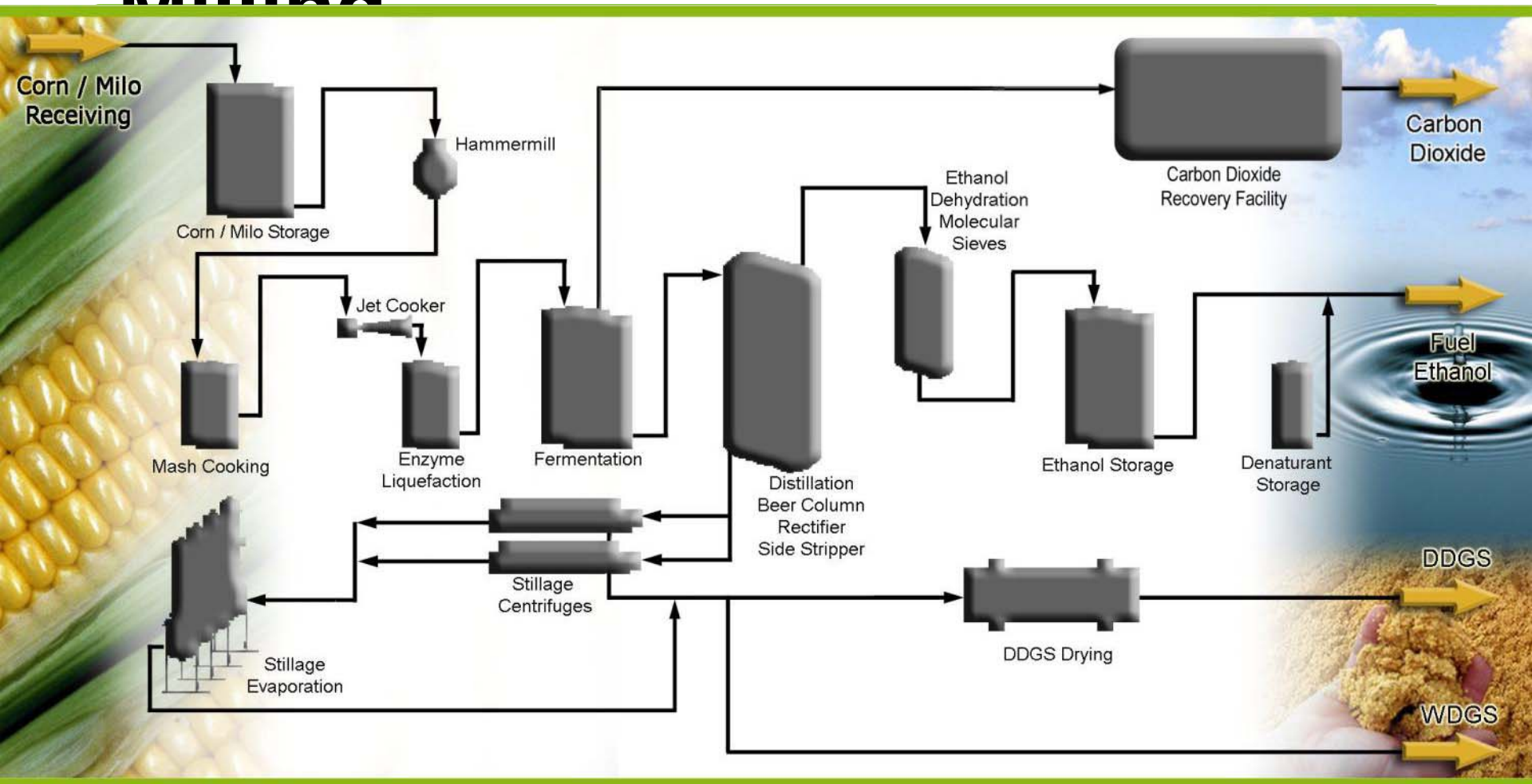
Ethanol Production from Dry Milling



Feedstock in, ethanol and DGS out

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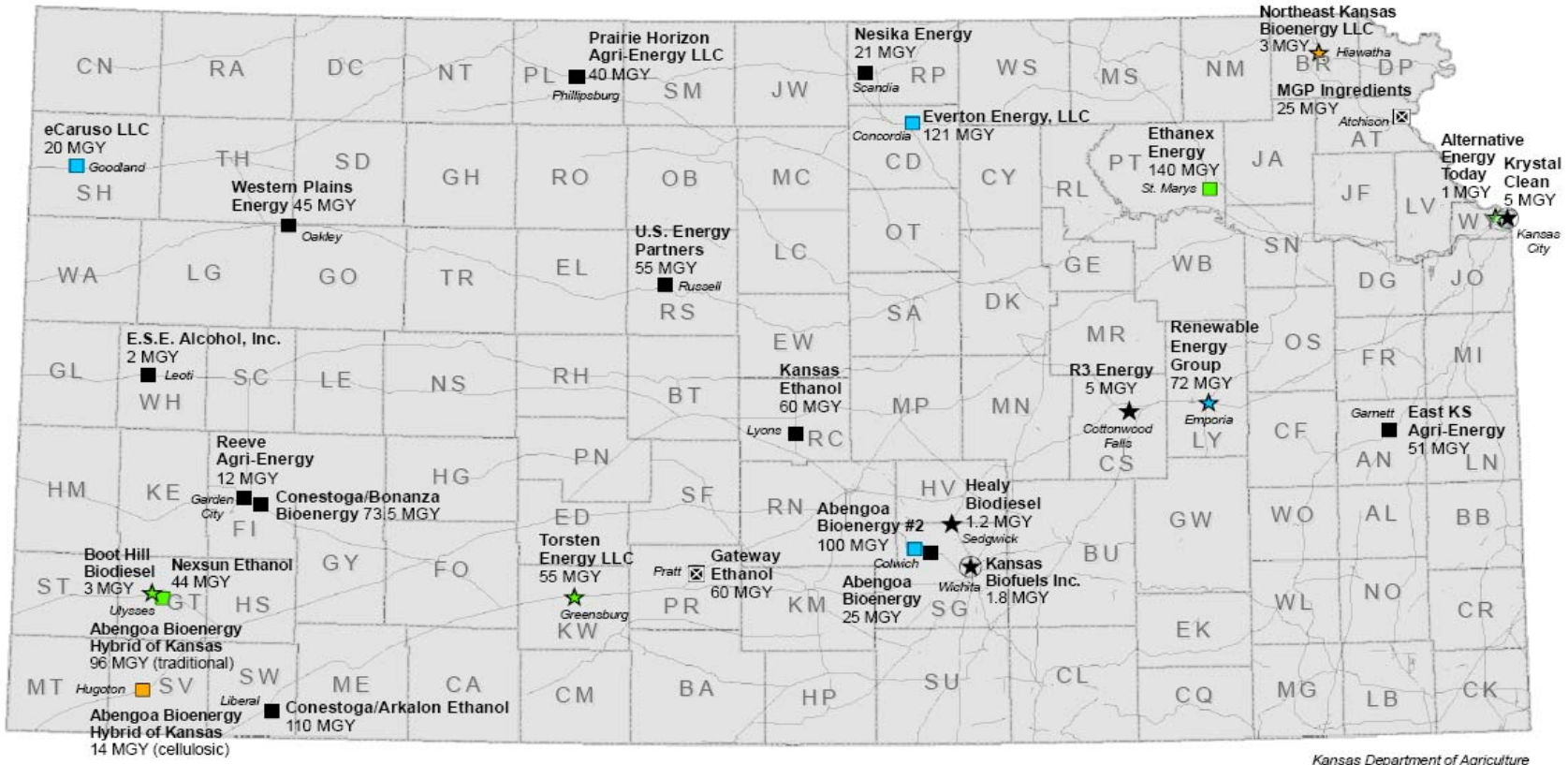
Grain-Based Fermentation

- Maize based (corn kernel)
  - ~95% of US industry ferments corn kernels
  - Other potentials
    - **Grain sorghum (milo)**
    - **Small grains (wheat, barley, rye, triticale)**
- "Typical" new dry grind plant today
  - Ethanol: 2.8 gal/bushel corn
    - 96 gallons per dry ton
  - DDGS: 18 lbs/bushel corn
  - CO2 capture where economics allow
  - > 98%+ up time
  - Emissions below 100 tpy
    - **(NOx, VOC, PM, CO, SOx)**
  - Higher focus on DDG quality
- Fuel ethanol produced exclusively by fermentation
  - Plant consumption per gallon ethanol
    - **30,000 BTU**
    - **0.75 kW electrical input**
    - **3 to 4 gallons water**
      - **Majority of water needed for cooling**

Ethanol and Biodiesel Plant Activity in Kansas
August 2009



Kansas Department of Agriculture
Administrative Services, GIS
August 10, 2009

KANSAS
as big as you think℠

MGY = Millions of gallons per year of permitted capacity. Capacities courtesy of Kansas Department of Health and Environment and the Kansas Department of Revenue.

* Permitted and Permit Pending codes refer to KDHE Bureau of Air and Radiation – Air Construction permits.

Ethanol Plants

- Existing: 11 plants, 494.5 MGY
- Under Construction: 3 plants, 241 MGY
- Permitted*: 2 plants, 184 MGY
- Permit Pending*: 1 plant, 110 MGY
- Idle: 2 plants, 85 MGY

Biodiesel Plants

- Existing: 2 plants, 6.2 MGY
- Under Construction: 1 plant, 72 MGY
- Permitted*: 3 plants, 59 MGY
- Permit Pending*: 1 plant, 3 MGY
- Idle: 2 plants, 6.8 MGY

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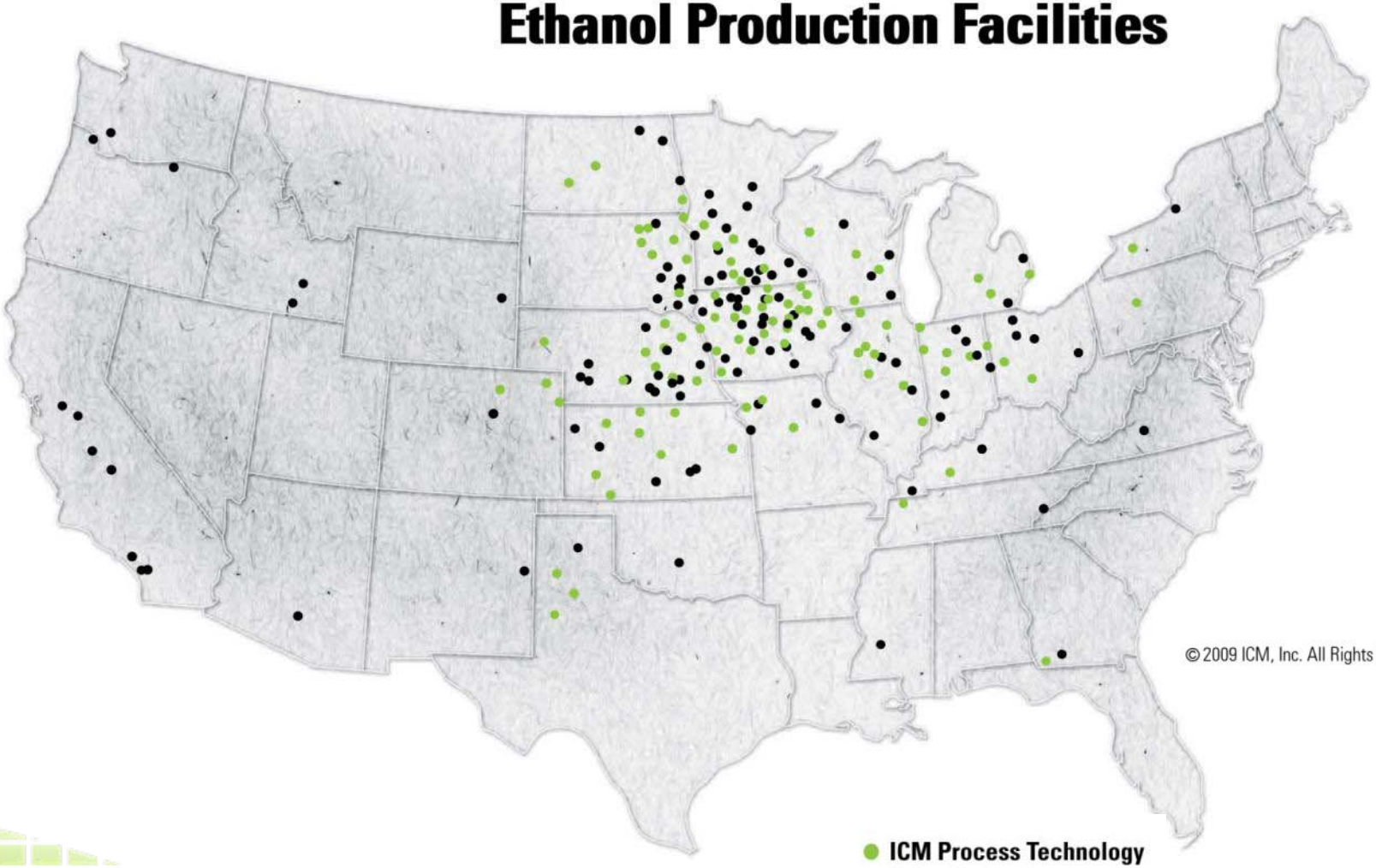
United States

Ethanol Production Facilities



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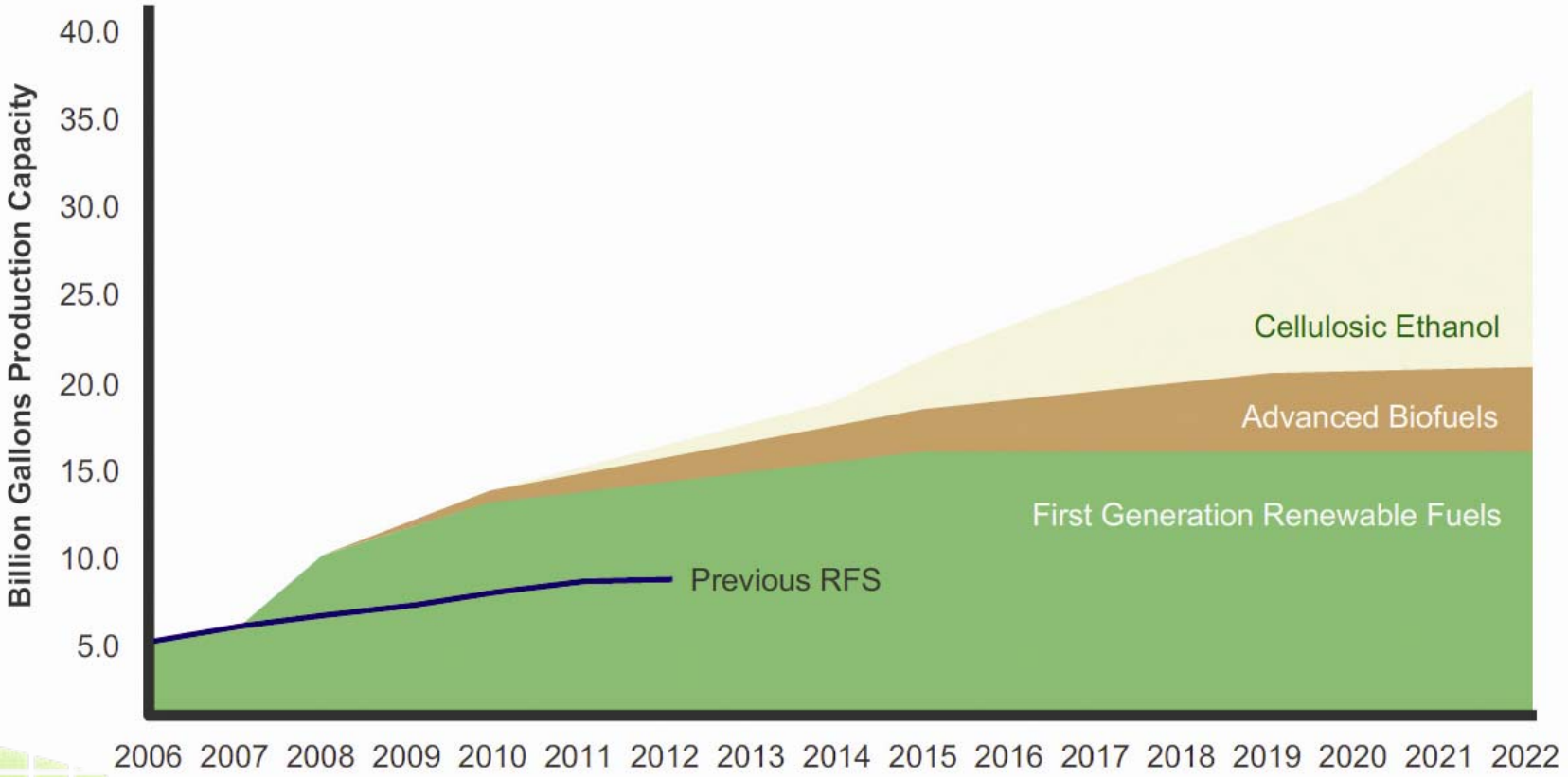
Renewable Fuel Standard

2007 RFS with Advanced Biofuel Carve Outs



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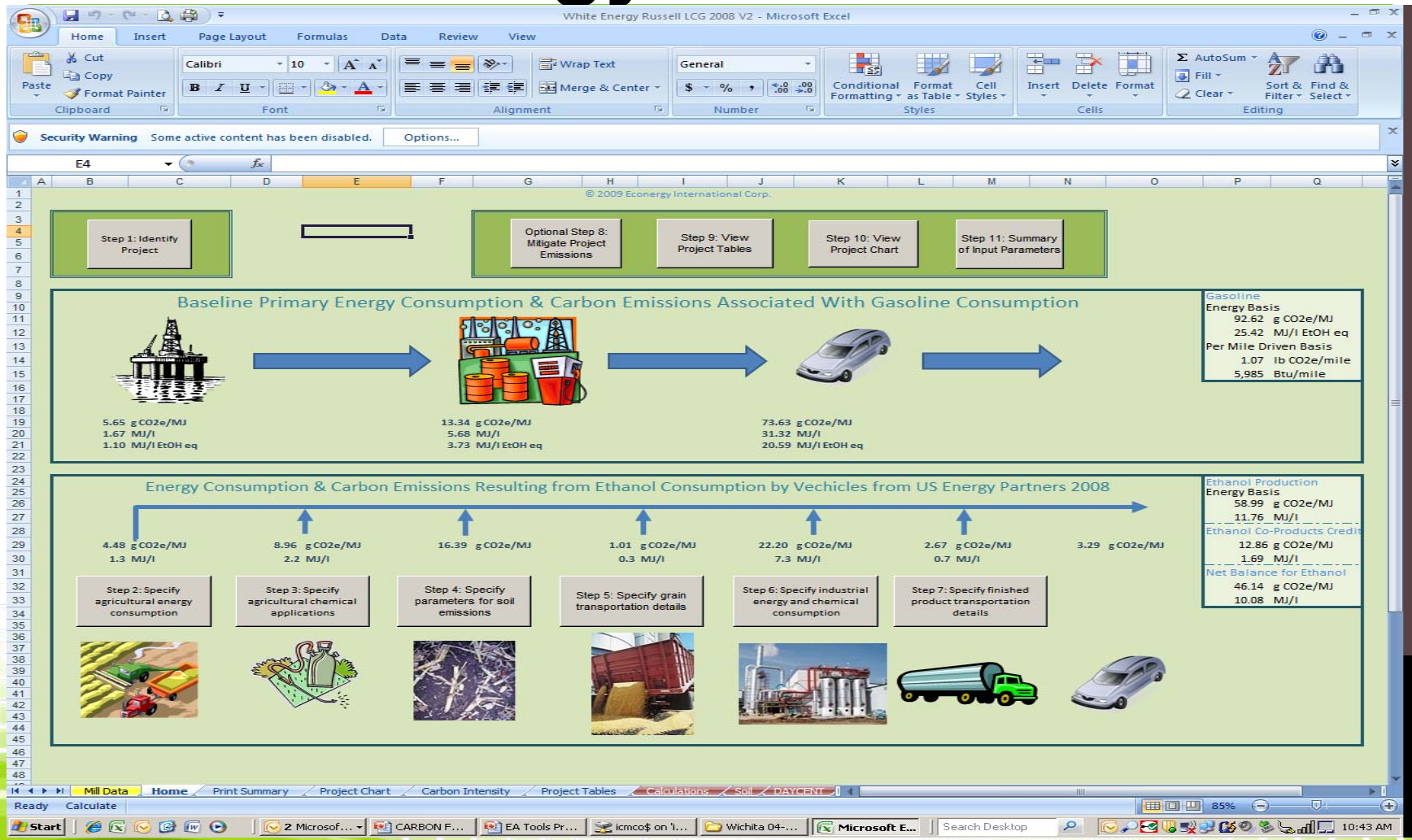
ICM/Econergy Carbon Model



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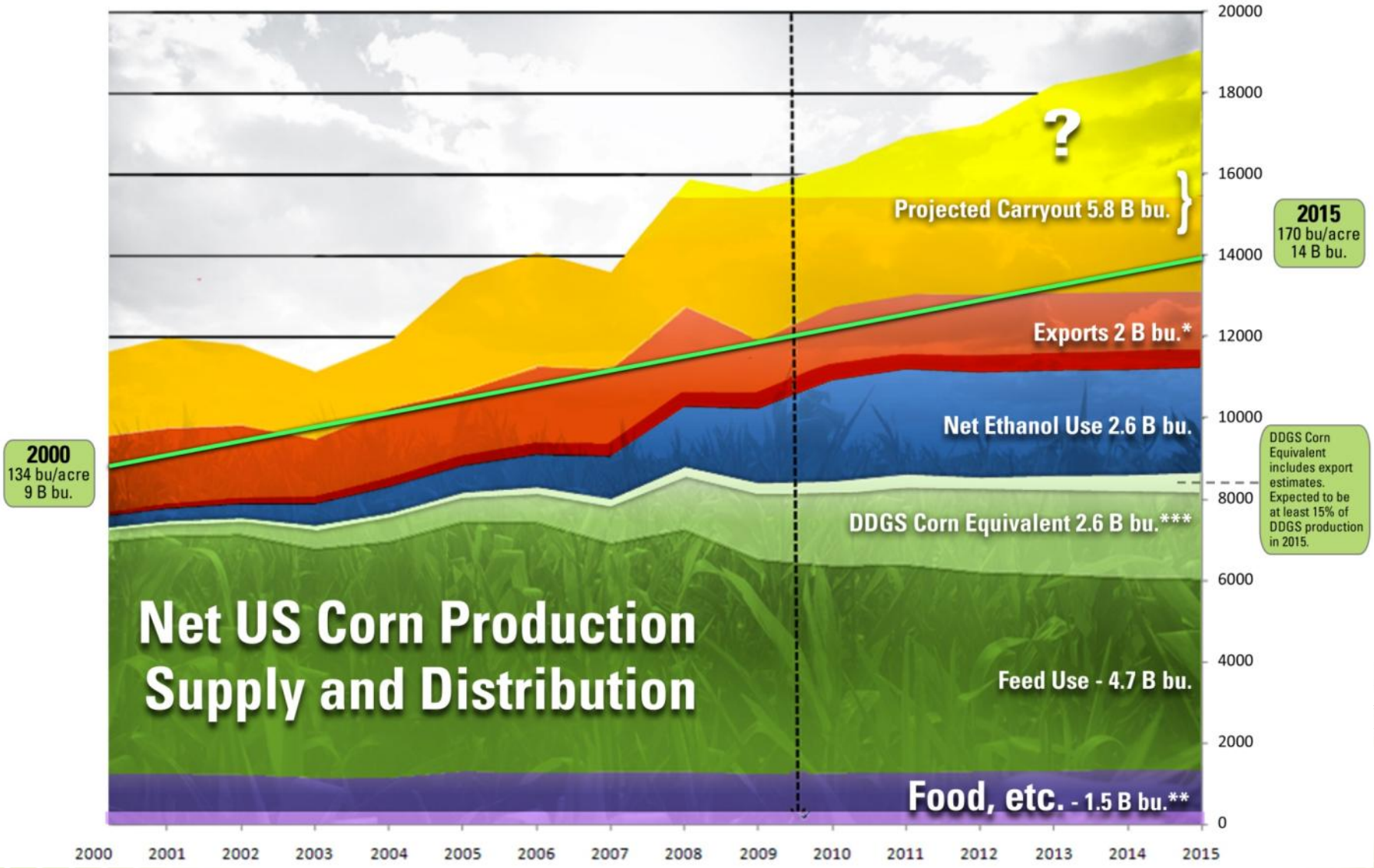

* ≈200 M bu (10%) of "Exports" represents food corn.

** ≈300 M bu (20%) of "Food, etc." represents chemicals and other non-food or feed uses.

*** Corn and corn equivalent better illustrates the U.S. feed demand for meat products.

Sources: ICM data from USDA and Dr. Terry Klopfenstein, Univ. Nebraska, et al.

Giving Consumers Choices with Blender Pumps and FFVs

- Blender Pumps Potential Contribution to State Economic Growth
- e.g.– **KS** >1 billion annual gasoline consumption

  E30 uses 300+ million gallons of ethanol replacing imported oil

  Replacing gasoline with E30 gallons stimulates the local economy (with a multiplier 3x to 7x) and leads to …… **A significant economic impact of billions of dollars – would this be good for your state?**

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Future Paths - Volumes for Conversion

Amounts of feedstock's to produce 10 mL ethanol

<u>Moisture Content</u>

Corn 15%

Fiber 46%

DDG 64%

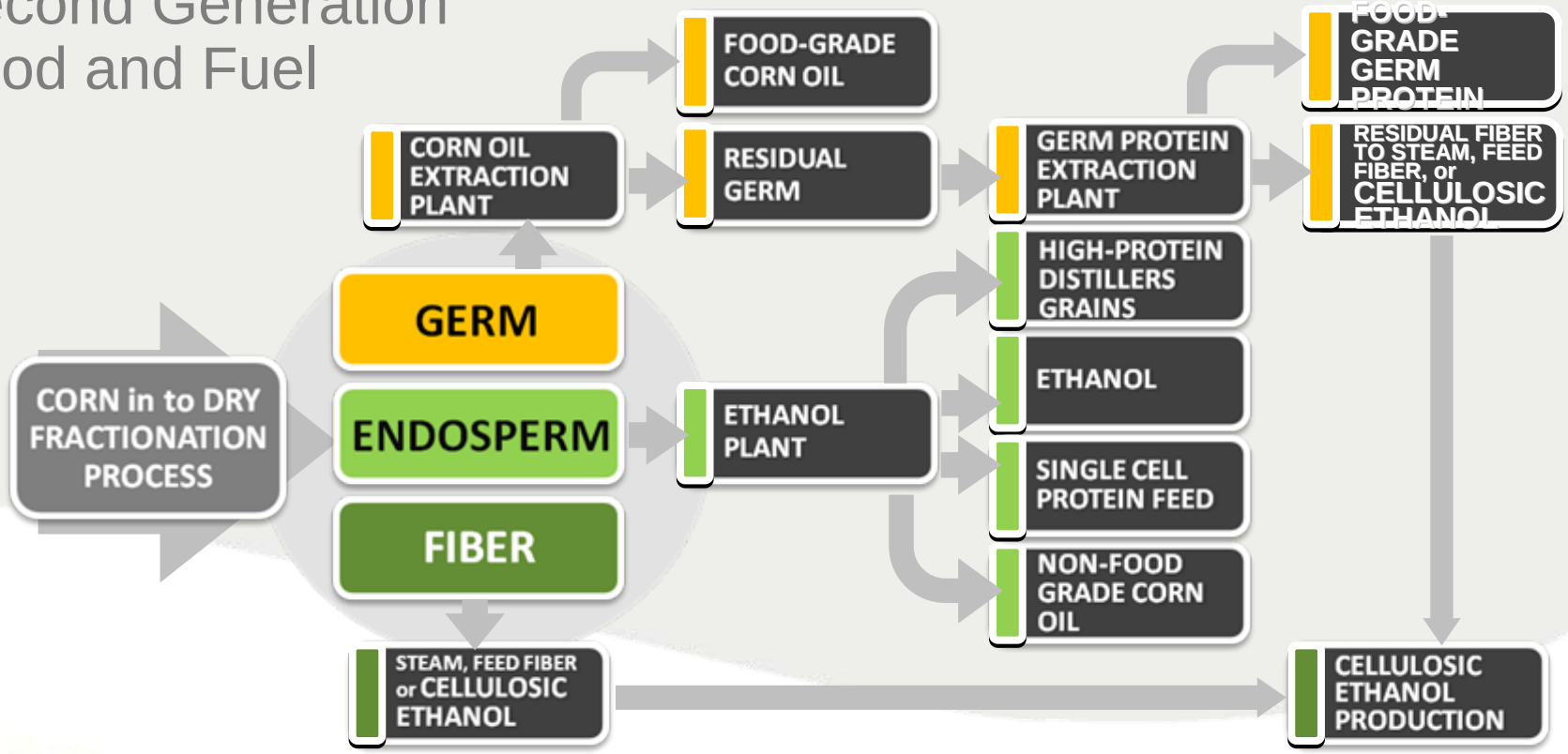
Stover 5%

NCERC, 2006

One Future Path - Dry Fractionation

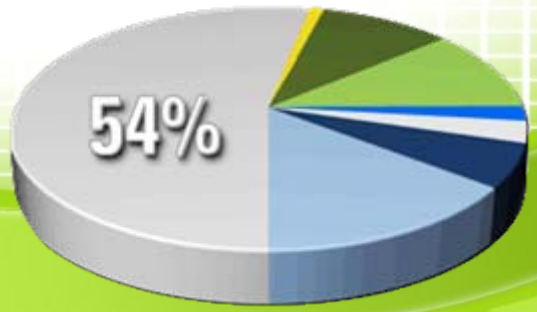
TKO - Total Kernel Optimization

Second Generation Food and Fuel



Standard Plant Ethanol Revenue

TKO Plant Ethanol Revenue



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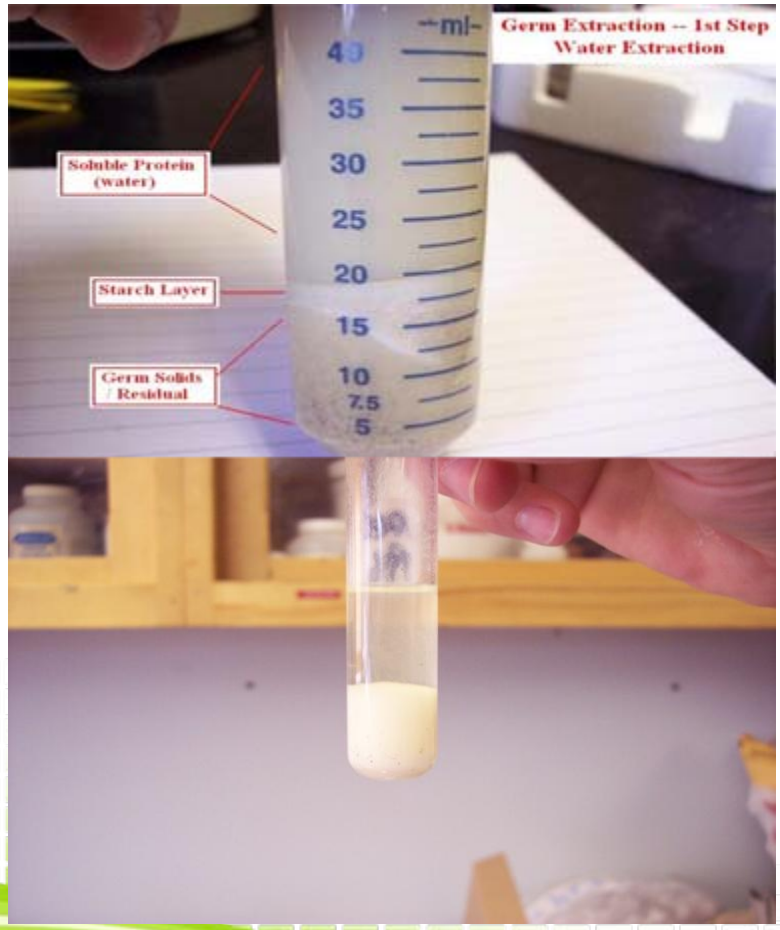
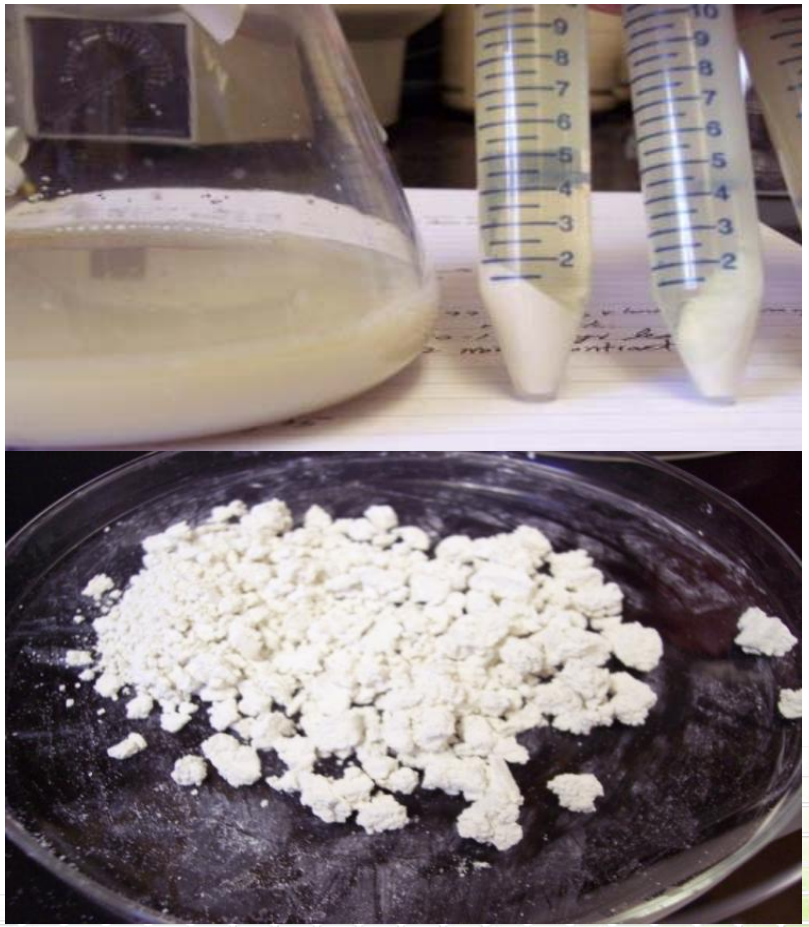
Dry Fractionation Ethanol Plant

- Food-grade Corn Oil
- Food-grade Protein
- Food-grade Snack Grits & Flour
- High-protein Distillers' Grains
- Single-cell Protein for Feed
- Bran for Dietary Fiber
- …Ethanol

Germ Protein



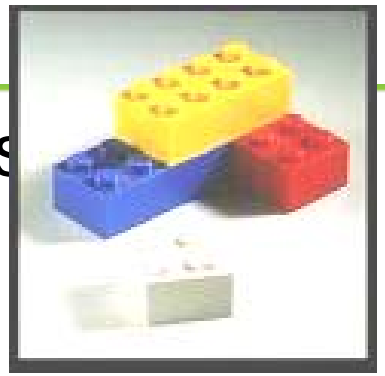


Cellulose-to-Ethanol Process

- Commercially relevant process developed
  - Laboratory work “complete”
    - Pretreatment proven
    - Enzymes tested
    - Initial yeast developed
  - Pilot plant underway
    - 1st phase installation complete
    - 2nd phase equipment designed
- Process metrics
  - Corn fiber, stover, switchgrass…
  - No fossil fuels
  - 80+ gallons per ton
  - 160+ lbs SCP per ton

Pilot Floor

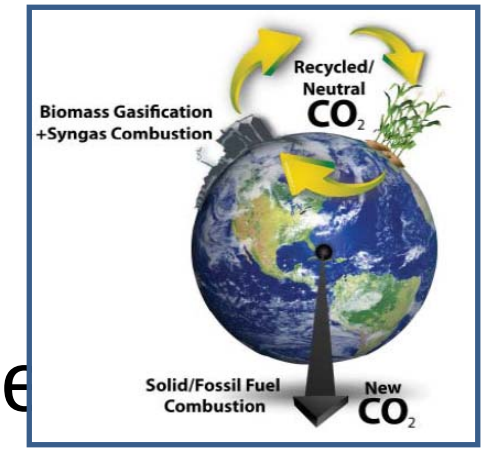
Gasification 101



- Convert Materials Directly to ‘Syngas’
  - Carbon Monoxide
  - Hydrogen
- Versatility Across Feedstocks – Beyond Coal & Wood
  - Ag Residue Can Cause ‘Slag’ in Heat of Combustion
  - Gasification Separates Combustion & Ash to Avoid Slagging
- Critical Eduction of Emerging Technology
  - **Combustion** ← Steam ← Power
  - **Gasification** ← Steam ← Power ← Syngas ← Biochar ← Transportation Fuels ← Synthesis Chemicals ← Hydrogen ← Fuel Cells ← Energy Crops ← Biomass Collection Technology

Combined Heat & Power (CHP)

- Renewable Biomass Displaces Fossil Fuels
  - Natural Gas Heat & Steam
  - Coal-Derived Electricity
- ACORE & EPA Express the Nee
  - ACORE Requests 100 GW by 2025
  - EPA CHP Partnership Suggests ‘Best’ Applications
    - Dry Mill Ethanol Production
    - Hotels and Casinos
    - Municipal Water Treatment Facilities



C-H-O C Biochar

Gasification

- Terra Preta – “Black Earth”
  - Synthesized by Amending w/ Bioch
  - Soil Retains Moisture
  - Enhanced Benefit from Fertilizers
  - Increased Biomass & Food Yield
- UNCCD Proposed Language for Copenhagen
- IBI Models “1 Wedge” Carbon Mitigation by 2054

www.biochar.org

www.biochar-international.org

Pilot Gasifier – 150TPD

Harvey County, Kansas

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THANK YOU!!!

QUESTIONS?

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