

CORN BIO-REFINERIES (DRY)



- 11% of US production, 7% world
- 1.6 billion gallons of ethanol per year
- 27 production Biorefineries in Eastern and Western Corn Belts

- Raw starch hydrolysis (no-cook) process
- Industry-leading gallons per bushel
- Proprietary low-temperature enzymes
- Total Water Recovery system
- 2.6 gal water per gallon ethanol

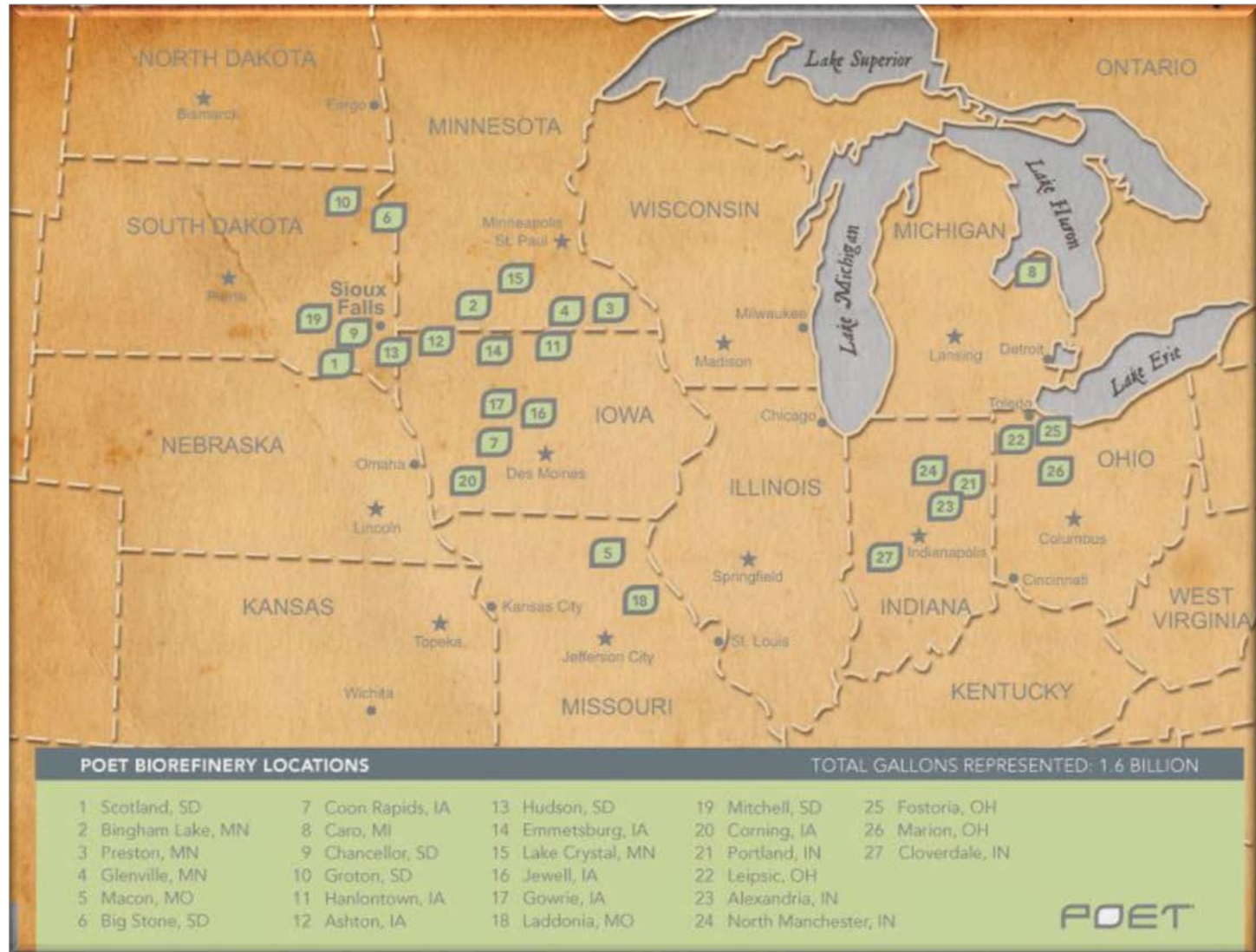


- 550 million pounds
- Distillers corn oil
- Biodiesel production, feed and potential food grade oil

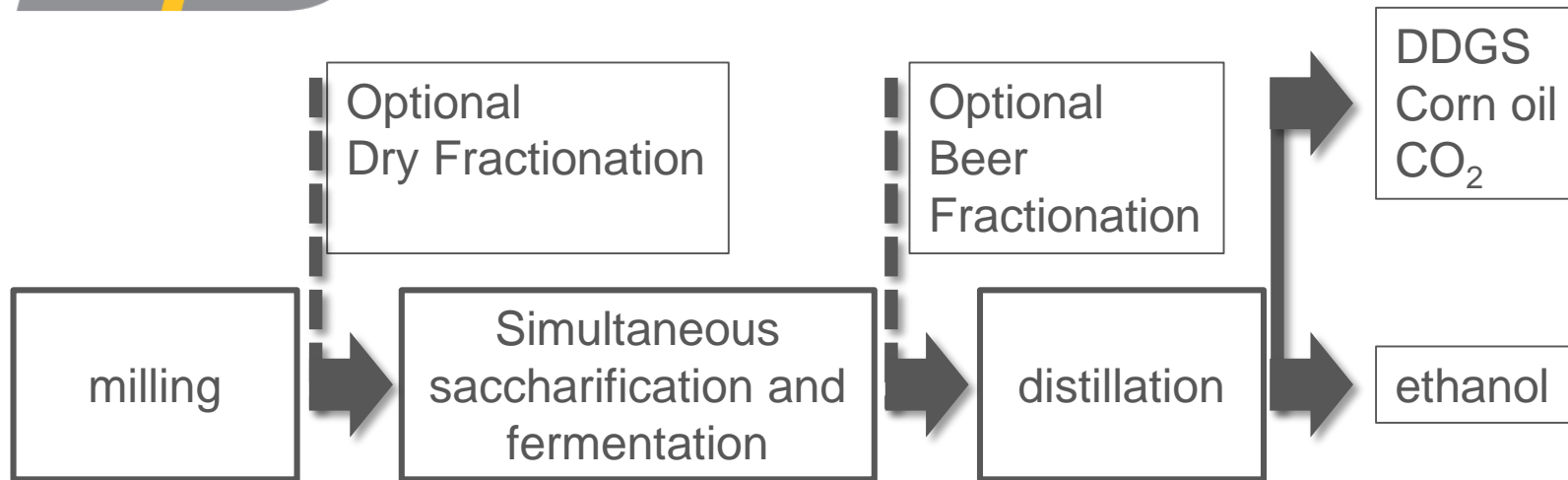
- 9 billion pounds
- POET Heat-Free Process maintains nutritional integrity
- Poultry, cattle, dairy



POET BIOREFINERIES



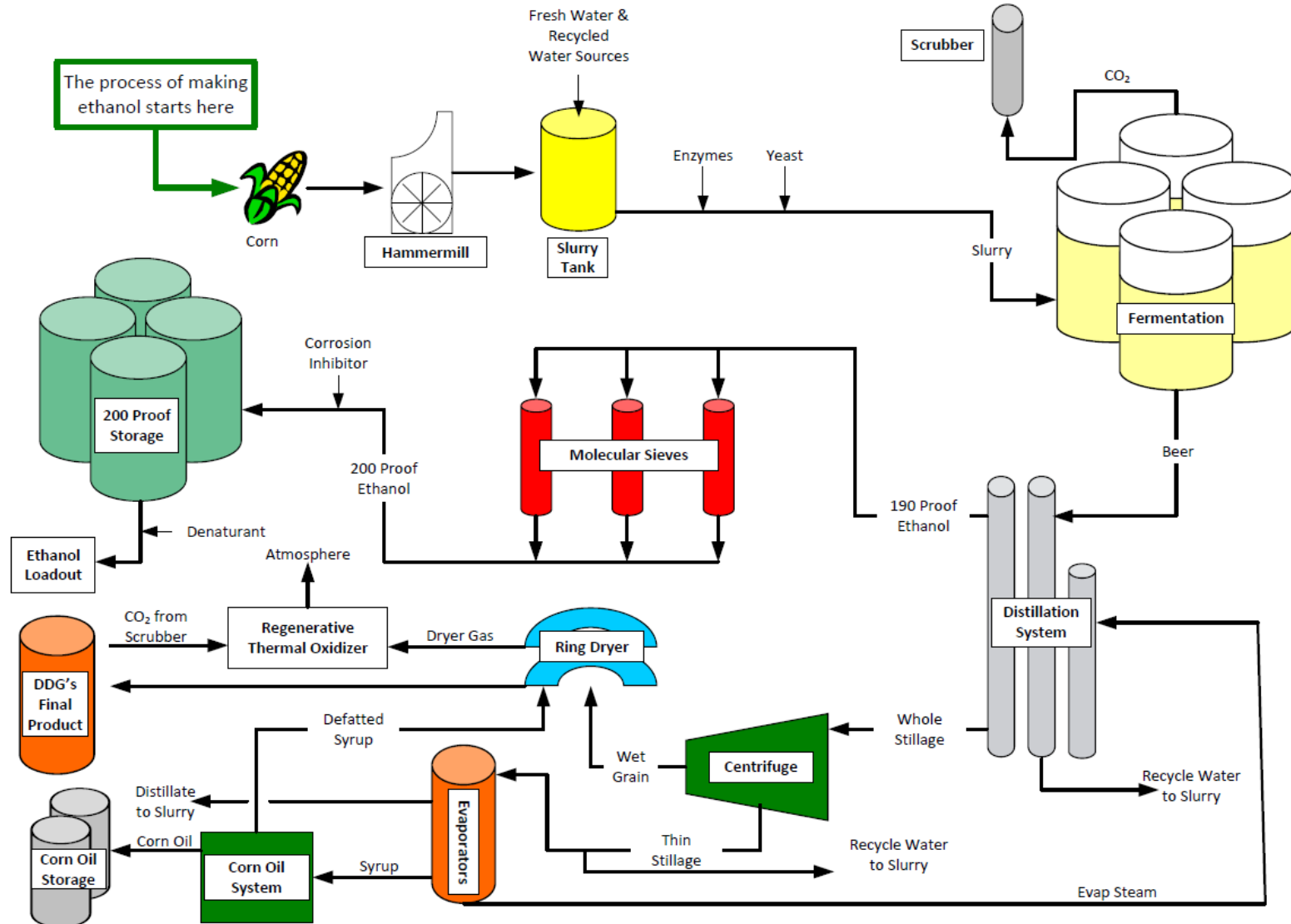
BPX PLATFORM



BPX

- Low temperature raw starch hydrolysis
- Proprietary α - and glucoamylase
- Controlled starch hydrolysis

UNIT OPERATIONS



- Topics
 - + Corn, Enzymes, Yeast
 - + POET dry-grind ethanol bio-refineries
 - + Research at POET (dry-grind process)
 - + Future trends in corn ethanol

PROCESS OPTIMIZATION

POET
research



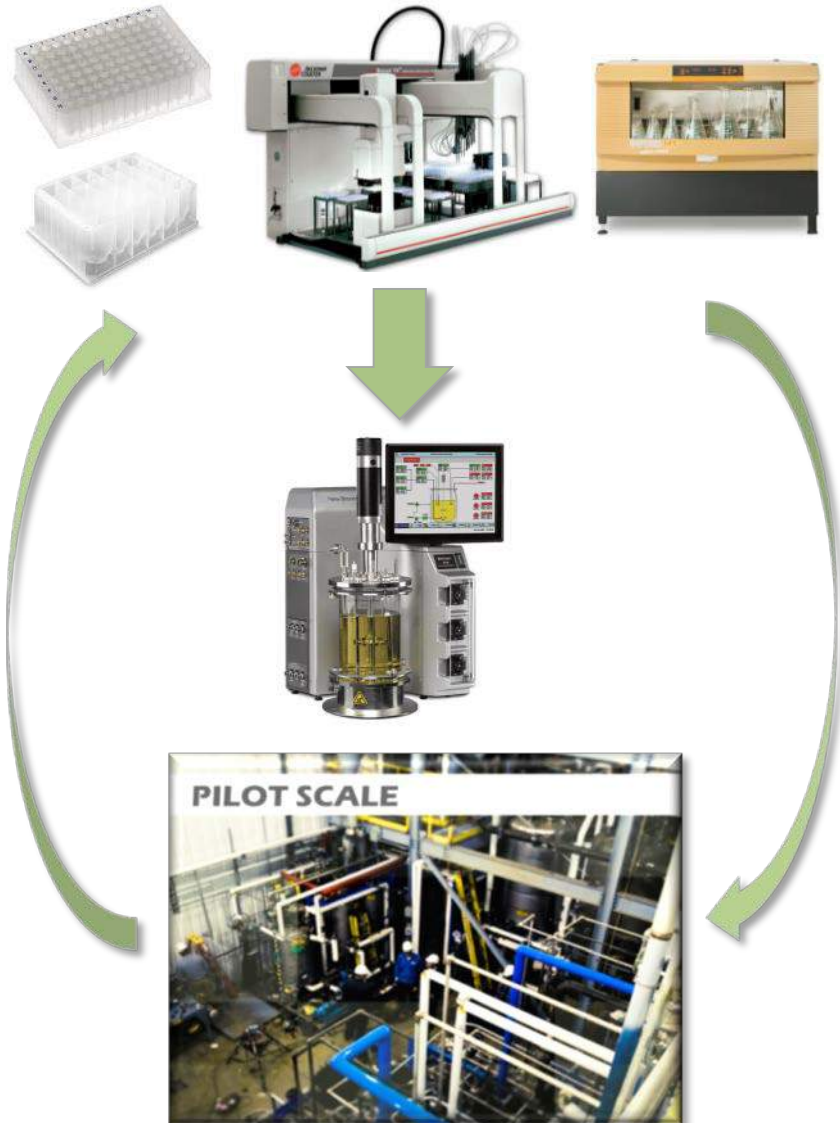
POET
RESEARCH CENTER



POET
biorefining



LABORATORY RESEARCH



HTS Laboratory Research

- mL to L scale (1000 ×)
- 10-20 × increased throughput

Enables

- 8 variable modeling
- Large DoE
- Accelerates technology roll-out

Predictive

- Pilot/Biorefinery data/economics
- Identifies most interactions

PILOT RESEARCH



Pilot scale

- 20,000 gal pilot fermentation

Enables

- Biorefinery effects
 - Recycle
 - Plant atmosphere
 - Operators vs. Scientists

Predictive

- Biorefinery data/economics
- Identifies problems early

Biorefinery Research

- 550,000-770,000 gal, to 1,000,000
- Dedicated PRI Deployment resource
- POET Plant Management involvement
- Sophisticated data acquisition

Enables

- Biorefinery process modeling

Economic Value Determined



POET[®]
biorefining

- Topics
 - + Corn, Enzymes, Yeast
 - + POET dry-grind ethanol bio-refineries
 - + Research at POET (dry-grind process)
 - + **Future trends in corn ethanol**

CORN ETHANOL IN THE USA

RFS2 Mandates for Conventional Renewable Fuels and Advanced Biofuels

(Billions of Gallons)



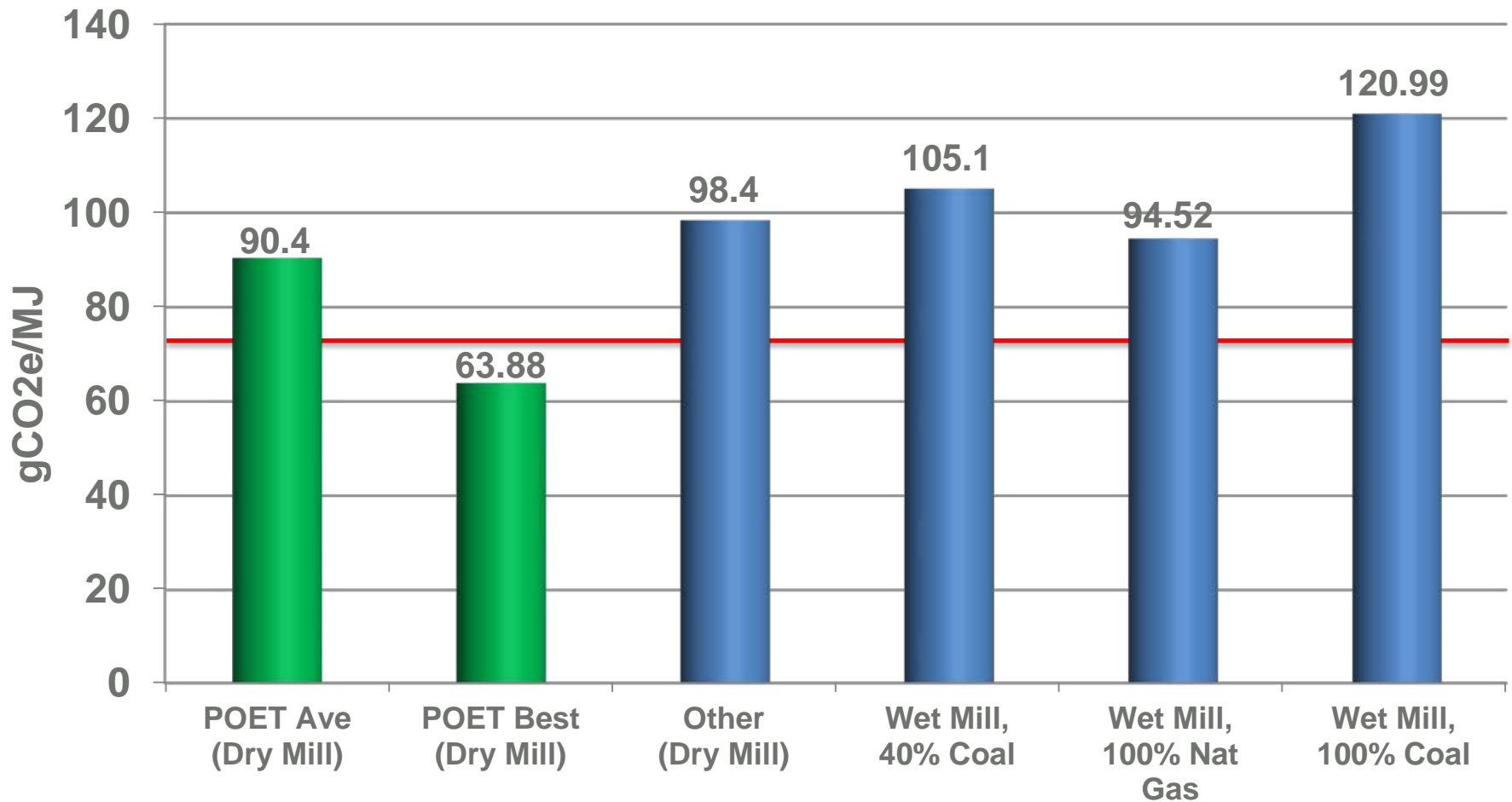
Source: Environmental Protection Agency, Energy Independence and Security Act of 2007

POET - CHANCELLOR

- 120 MM gal facility
- 2.88 gal/bu for corn
 - + California Air Resources Board (CARB) assumes 2.72 gal/bu
 - + Reduces farming emissions (per MJ ethanol)
- Gas from Sioux Falls Regional Sanitary Landfill
 - + Dedicated pipeline, credit for methane emission avoidance
- Solid fuel boiler
 - + Waste wood
- Carbon Intensity of 63.88 gCO_{2e}/MJ
 - + CARB assumes 97.56 gCO_{2e}/MJ



CI VALUES



CARB average sugarcane ethanol plant CI score is 73.40 gCO₂e/MJ

CBP, LOW GLYCEROL YEAST



TRANSFERM[®] TRANSFERM[®] Yield+

<i>PLANT</i>	<i>GA REDUCTION</i>	<i>GLYCEROL REDUCTION</i>	<i>YIELD BOOST (ETHANOL/SOLIDS)</i>	<i>NUMBER OF FERMENTATIONS</i>
Pilot	-30%	-30%	+4.1%	5
Plant 1	-40%	-23%	+2.9%	67
Plant 2	-35%	-30%	+4.8%	15
Plant 3	-50%	-43%	+3.1%	14
Plant 4	-30%	-28%	+2.7%	3
Summary	-30% to -50%	-23% to -43%	+2.7% to +4.8%	104

TRANSFERM Yield+ demonstrated a 2.7% to 4.8% increase in ethanol yield compared to conventional yeast (over 100 fermentations).

ALTERNATIVE PRODUCTS- ISOBUTANOL



Luverne, Minnesota
22 MGPY ethanol
18 MGPY butanol
ICM is EPC provider



Highwater Ethanol, LLC in
Lamberton, Minnesota
50 MGPY ethanol
FAGEN is EPC provider



CELLULOSIC FROM FIBER



Adding Cellulosic Ethanol (ACE) project in Galva, Iowa
35 MGPY starch, 2 MGPY cellulosic

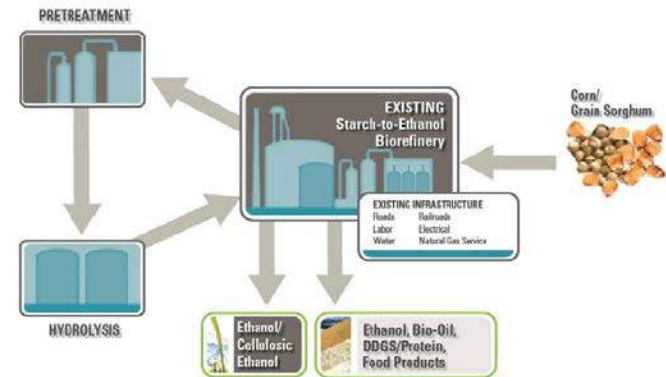


the **energy** of innovation™



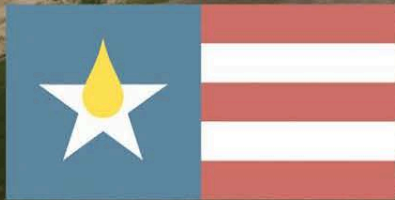
Edeniq

Generation 1.5: Integrated Cellulose at Existing Facilities



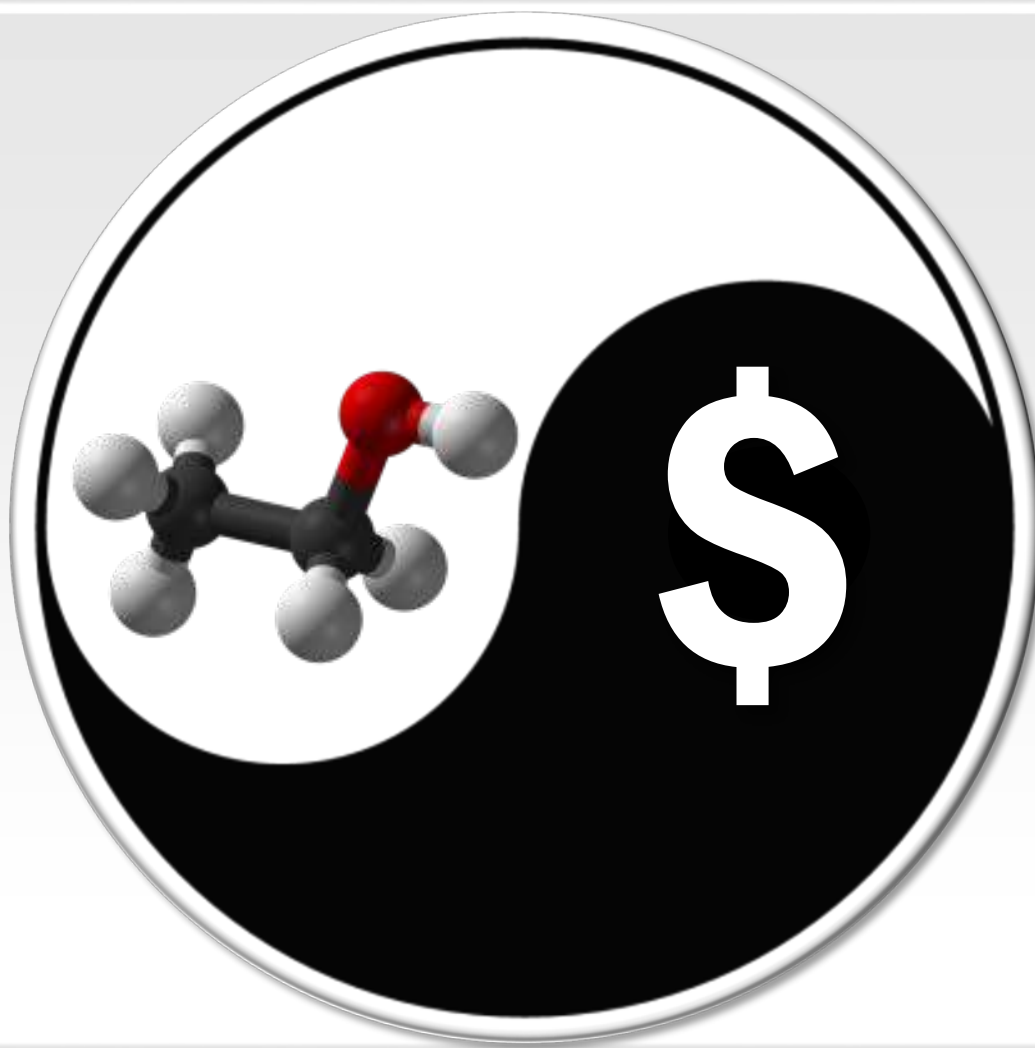
PATHWAY™ Platform, 3-6% increase, pilot scale

CELLULOSIC CO-LOCATION



Project LIBERTY

TECHNOLOGY ADOPTION



- BEST COLLABORATORS IN VALUE CHAIN
- CONTINUOUS PROCESS IMPROVEMENT
- ITERATIVE BETWEEN LAB AND PILOT
 - + DESIGN OF EXPERIMENT TO ENSURE STATISTICAL RELEVANCE
 - + STRONG MASS CLOSURE
- MATHEMATICAL AND ECONOMIC MODELING
- RAPID ROLL-OUT

THANK YOU!
