Inbicon Biomass Refinery
Cellulosic Ethanol Technology Platforms
Growth and Sustainability through Biomass Refining, CHP

Technology Review – July 2012

Inbicon Biomass Refinery™
Building a path to The New Ethanol ™

$100MM+ investment in technology and a demonstration refinery

- Ongoing optimization, reduction in capital and operating costs = reduced risk
- Quality assurance for commercial development world-wide
- Proven integration with Coal Power Generation

100 tons/day production facility in Kalundborg, Denmark

Cellulosic Ethanol available for Danish drivers, now

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Inbicon Biomass Refinery
Meeting Outline

DONG Energy – Inbicon Profile

Feedstock Supply

Technology and Scale Up

Sugar Platform

Engineering and Project Execution

Project Development Pathway

Denmark's largest energy company

- Traditional Oil & Gas Company in transition to Renewables
- Reduce CO2/kWh to 15 percent of current levels by 2040
- $10 Billion Revenues in 2010, 5000 employees

Inbicon A/S Facts

The headwaters of Cellulosic Ethanol…

- Formed in 2003 to develop **Biomass Refining Technology**
- 85 employees, experienced North American team
- DONG Energy R&D since mid-1990's
- Headquarters, R&D, Pilot plant in Skærbæk, DK at local power station
- Demonstration plant in Kalundborg at 4 MT/Hr -
  5 mmly cellulosic ethanol production - startup in 2009

Cellulosic ethanol *available now in Denmark at 98 fuel stations*

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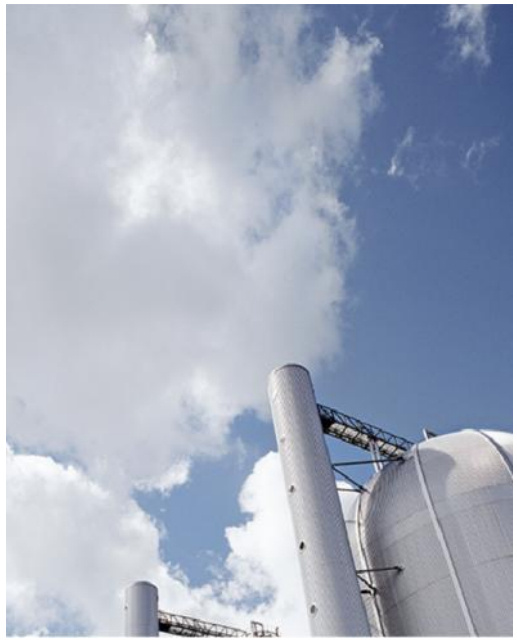
Denmark
Consistent, Long-term Renewable Energy Policy

30+ years of focused policy after the 1973 Arab oil embargo catapulted Denmark ahead in the use of renewable energy, from 99% import dependent to complete independence

- Widespread use of wind, MSW and renewable energy technologies
- Northern Europe leader in wind, biomass
- Net exporter of energy - oil, gas, and power



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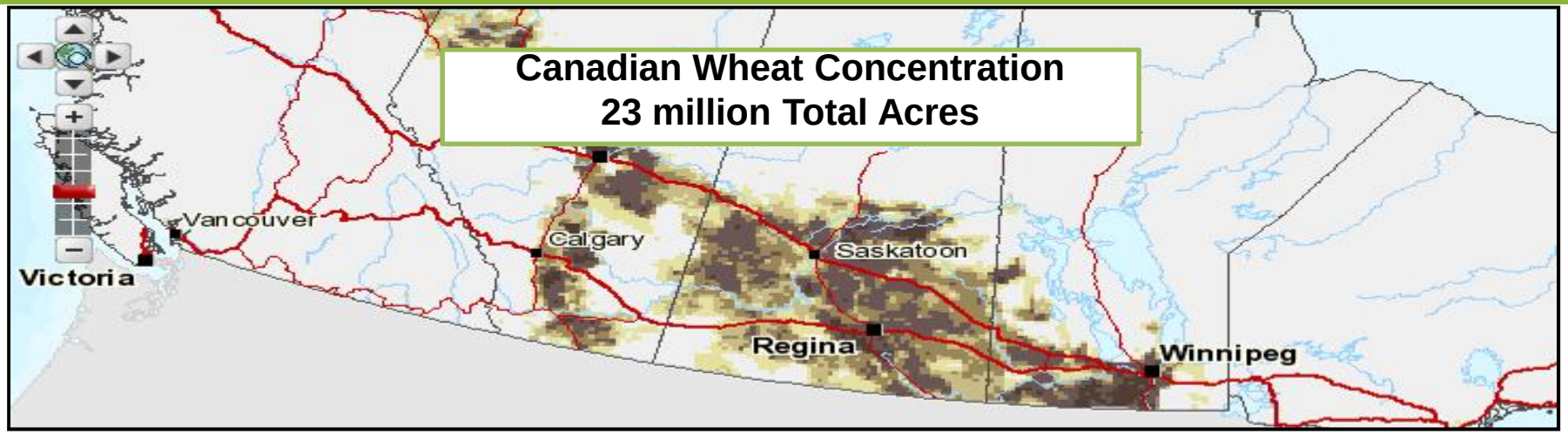
Inbicon – DONG Energy

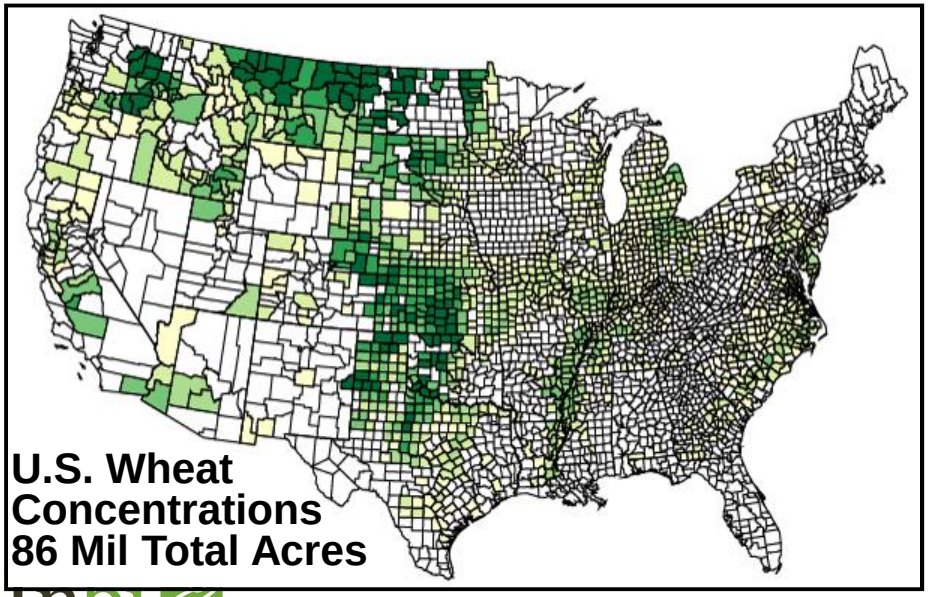
20+ Years Biomass Experience in Combined Heat & Power

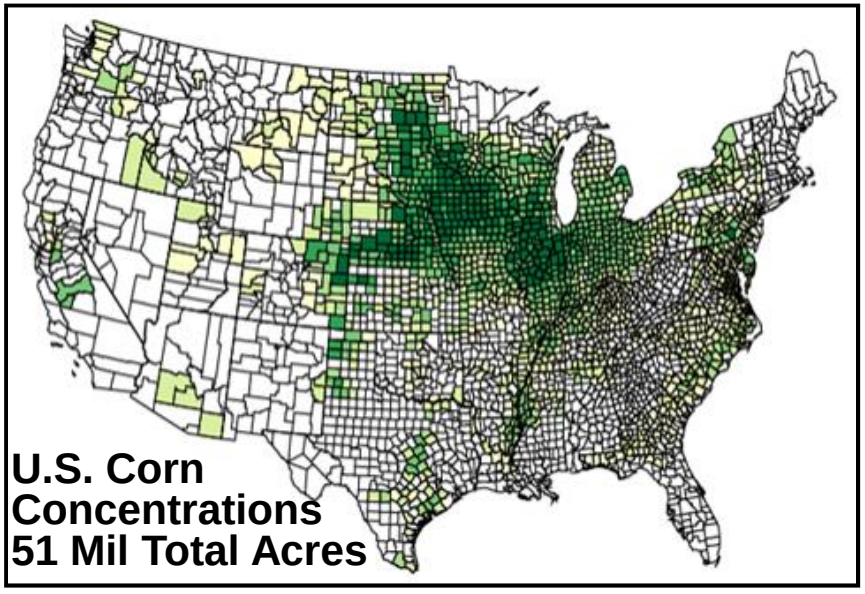
DONG Energy – Commercial operations, logistical experience. Proven biomass collection and handling systems

The Avedøre Power Station - 810 Megawatts of electricity and 915 MJ/s of heat. At maximum production, 25 tonnes of straw are fired per hour, corresponding to 50 straw bales of 500 kg each, the largest biomass to power plant in the world.

Biomass Supply: Over 163 million acres of crop-residues exist. Purpose grown crops increase potential.







Corn Stover Feedstock Development
North American Harvest Trials

Gathering feedstock for The New Ethanol takes new farm machinery, like this New Holland harvester and cornrower used for our biomass tests done in Indiana, USA Fall 2011.

Indiana Harvesting Trials
Custom Harvesters, Supply Models

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Feedstock Trials and Validation

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Purpose Grown Energy Crops

- Perennials
  - Switchgrass, Miscanthus
- Annuals
  - High biomass sorghum, sorghum sudan
- Grow well on under-utilized lands
- High yield/acre = shorter transport, fewer acres

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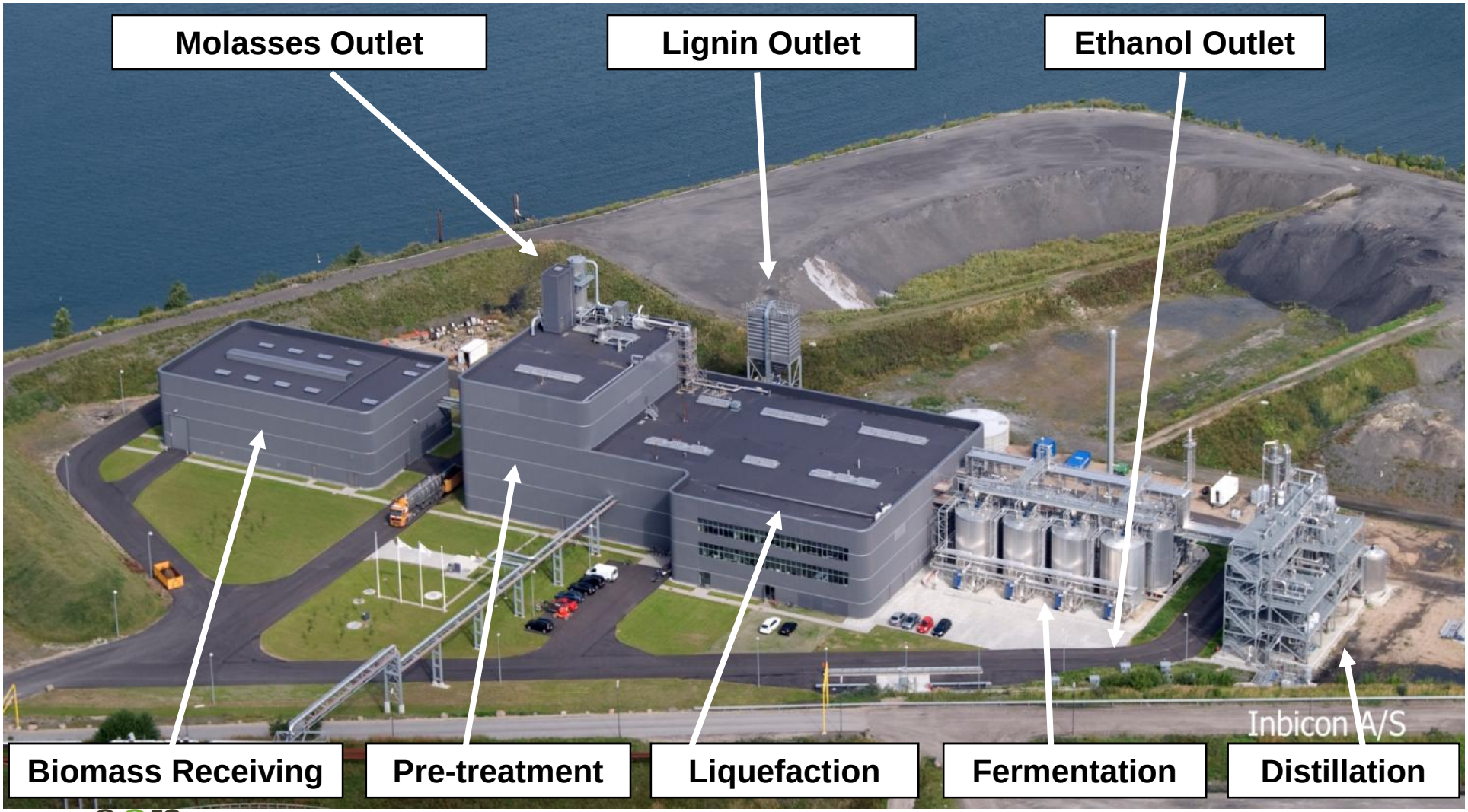
Inbicon Biomass Refinery
Technology



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Inbicon Biomass Refinery™
Historical Scaling Progression

Advantages of Inbicon's enzymatic process.

- Process Guarantees
- Proven at Pilot and Demonstration Scale
- Proven Integration with other energy-producing processes
- Economical route to cellulosic ethanol

Late 1990's

LABORATORY

<10 kg

2003

PILOT PLANT

2.4 MT/d*

2005

PILOT PLANT

24 MT/d*

2009

DEMONSTRATION

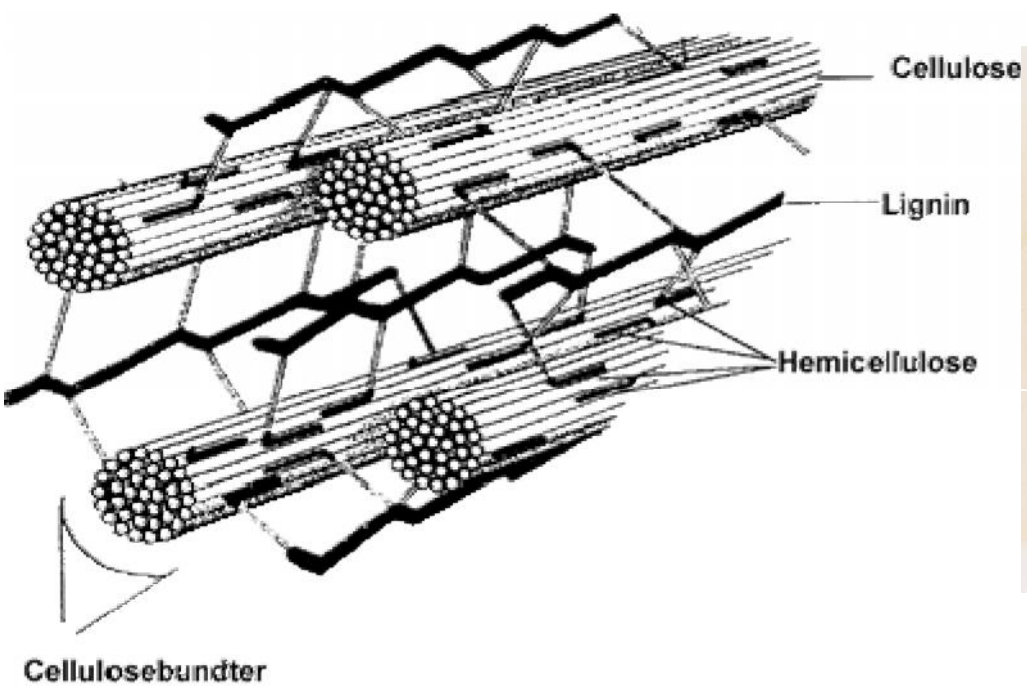
100 MT/d*

COMMERCIAL

1,200 MT/d*

Focus on Pretreatment

Simplifies downstream processes, diversifies business



Hemicellulose	Cellulose	Lignin
C5-sukre	C6-sukre	
20-25%	30-40%	15-20%

- ✓ Optimal use of biomass
- ✓ Unlocks three primary biomass components
- ✓ Synergy with other industries
- ✓ Avoids technical hurdles, high CAPEX

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Enzymatic Hydrolysis

Liquefaction of pretreated biomass at ~ 30% solids

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Inbicon Biomass Refinery™
Pretreatment & Enzymatic Reactor

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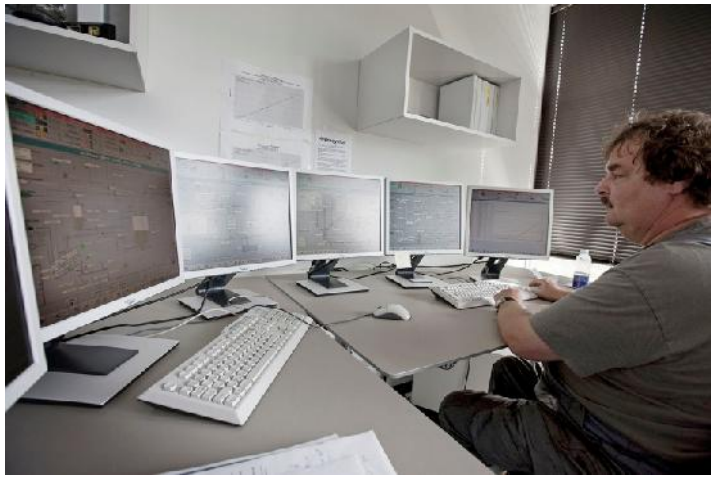
Fermentation & Distillation



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Inbicon Biomass Refinery™
Optimal Use of Biomass, Maximizing Value

Farm residues (straw, stover)
Energy crops, bagasse

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Ethanol

85% reduction of CO2 emission

Bio-based chemicals

Biogas / Power

C5 molasses

C5 conversion to Ethanol

Animal Feed

Lignin biofuel

Renewable solid fuel, replaces coal in power and heat generation

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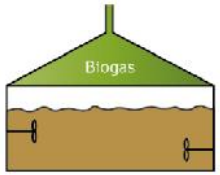
Energy integrated solutions

Ethanol 7.0 t/h

Ethanol

Wheat Straw
50 t/h
(at 86 % dm)

C5 molasses



C5 molasses used for biogas production

Power

The Lignin and biogas are used in power plant for both production of steam for the INB plant and electricy for own consumption. A surplus of Green electricity can be sold to the grid :

27 MWe

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Inbicon Biomass Refinery
Products – Clean Lignin

- Produce Steam, Power, CHP
- Reduced Slagging/Corrosion
- Low in Salts and Maintenance
- High Coal Displacement Levels
- Proven Emissions and GHG reduction
- RPS price incentives, renewable power targets

Inbicon Biomass Refinery
50 ton/hr commercial scale facility

Requires **450,000 tons/yr** stover, straw, or energy crop

•**50 MT/hr** plant design produces*:

28 mmgy cellulosic ethanol from C6/C5 combined sugars

152,000 ton/yr lignin solid biofuel

Or

20 mmgy cellulosic ethanol from C6 sugars

200,000 tons/year C5 molasses

152,000 tons/yr lignin solid biofuel

* Feedstock composition dependent

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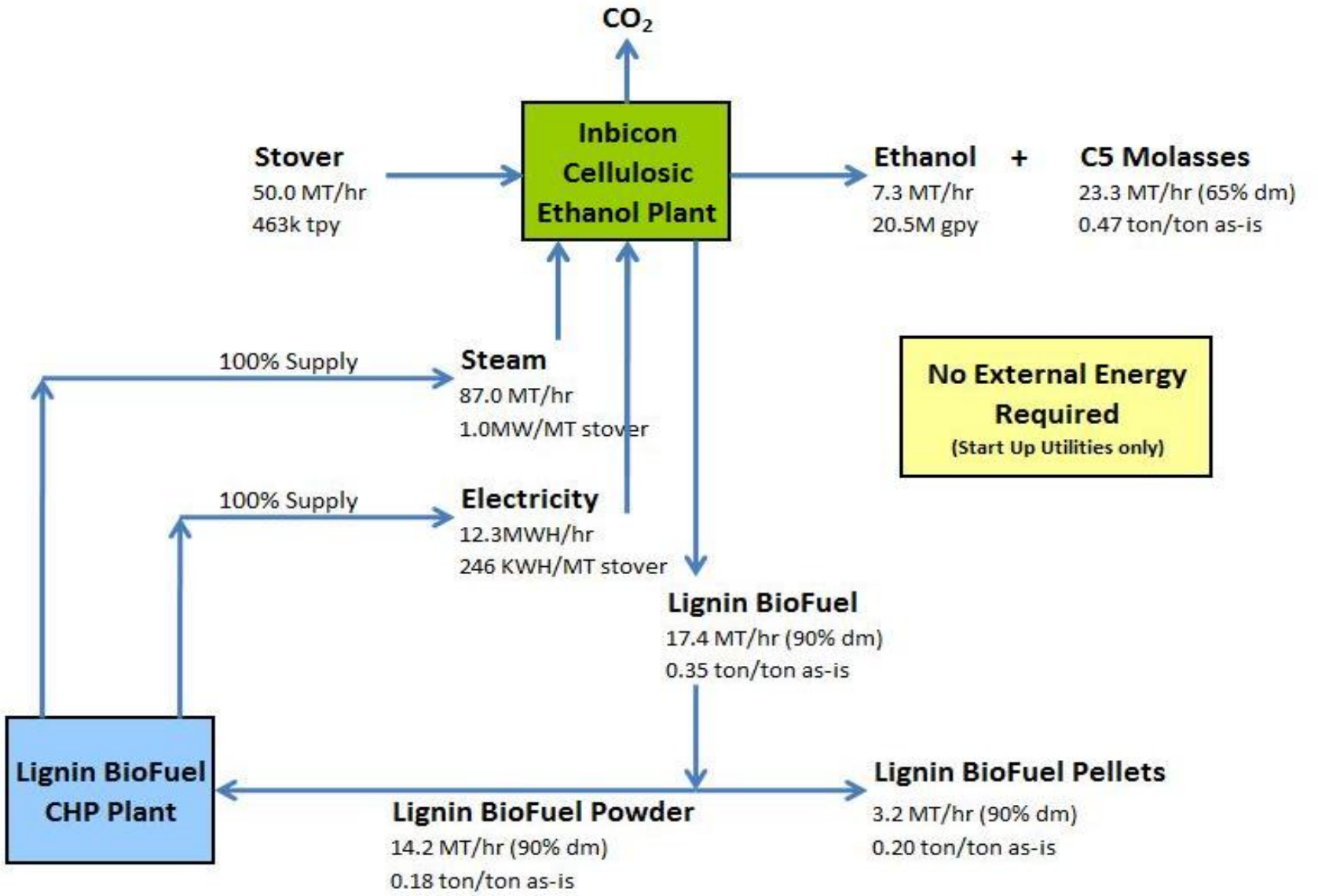
Inbicon Biomass Refinery
Competitively advantaged, commercially scalable, today

Inbicon advantages
- Simple Hydrothermal Pretreatment and Enzymatic
- Cleanest Co-products for Power and Heat
- Denmark is Center of advances in Enzymes
- Less Intensive Metallurgy Requirements – CAPEX reduction
- Core Technology utilized for Fuel, Feed, Power, Chemicals

Compared with Acid /Base Hydrolysis
- Acid/Base hydrolysis is more chemical intensive
- Residues in co-products
- Requires more expensive metallurgy

Compared with Thermo-chemical
- Thermo-chemical is much more expensive to build
- Scaling issues have not been overcome

Inbicon Biomass Refinery™ - Integration Examples
50 MT/hr stover ethanol plant with lignin CHP



Inbicon Biomass Refinery™
Why Integrate with Grain Ethanol Operations?

- Enhanced Margins and Asset Value
- Gallons for RFS2 – Ethanol Industry Growth
- Same Farmers supply Feedstock – More Value
- Skills and Staff, Know-How
- Heat and Power for both Grain and Biomass plants
- Compliance - RFS2, CARB/LCFS, EU regulations, DoD

Corn Ethanol Integration

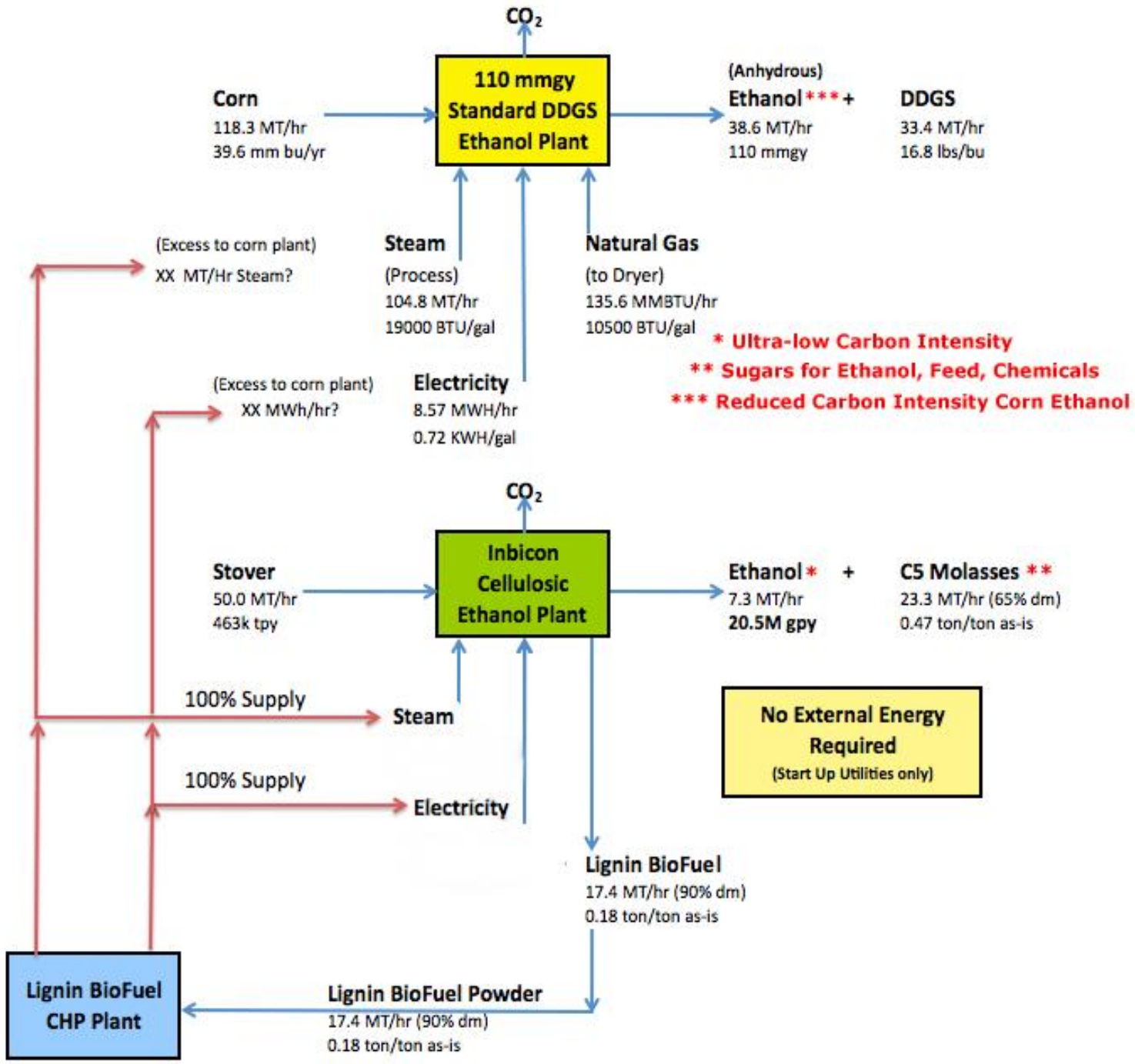
Inbicon 50MT/Hr Stover Refinery

Lignin CHP (Combined Heat and Power)

110mmgy Corn EtOH Plant +DDGS

Requires no new grain acres

$20-$30 million In value for area farming

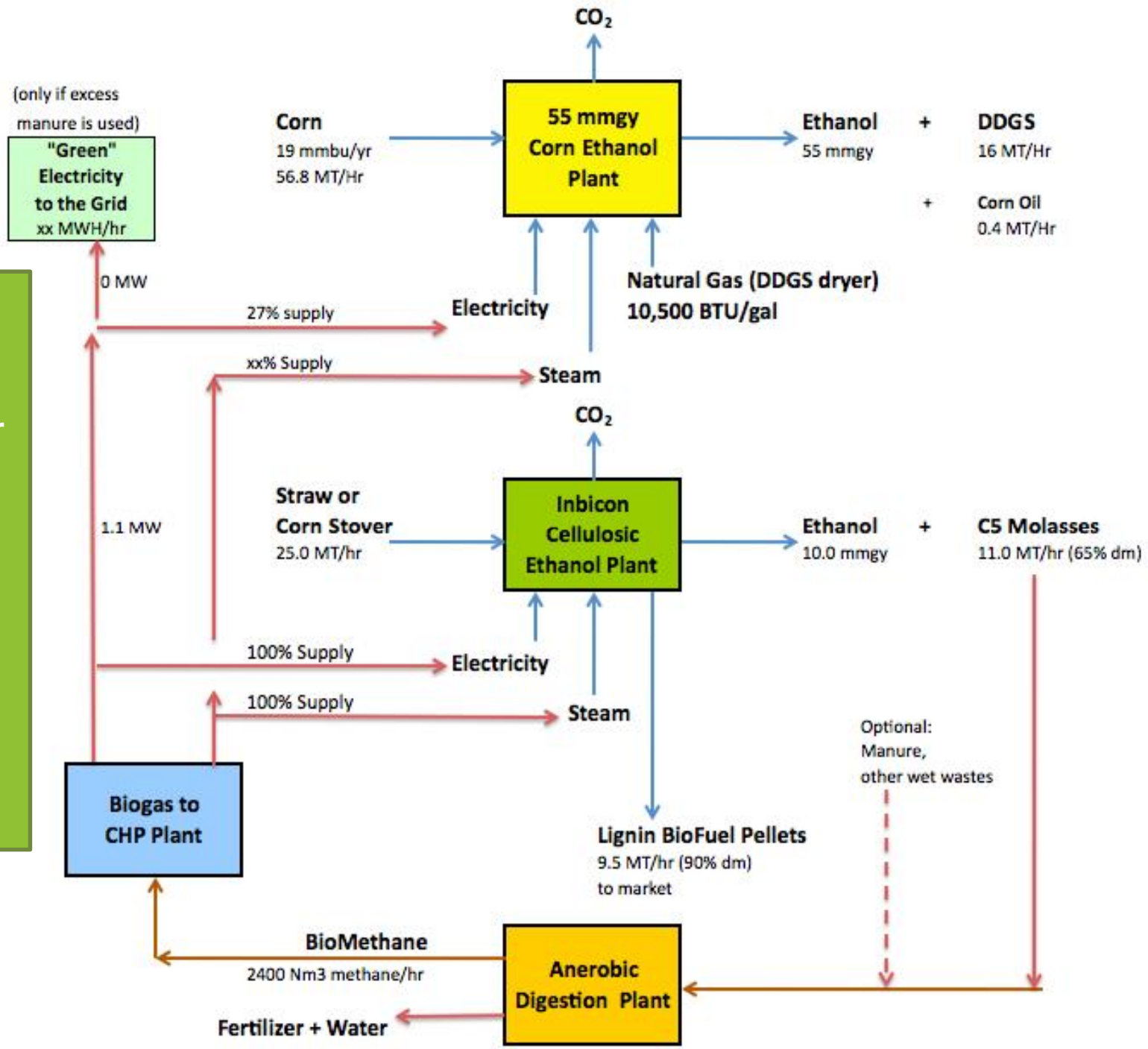


55Mgpy Corn ethanol

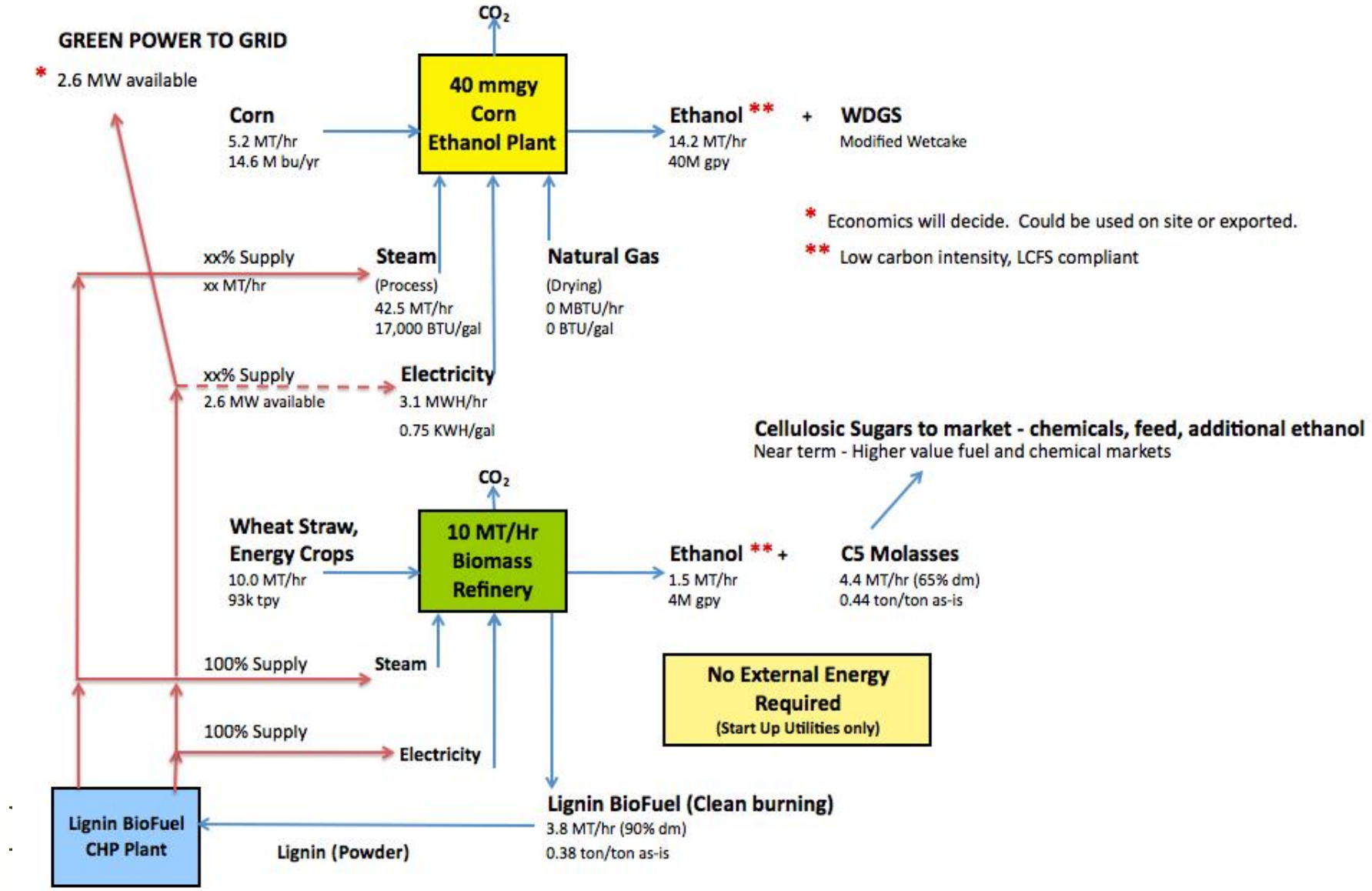
25 MT/hr stover

Lignin to coal power market

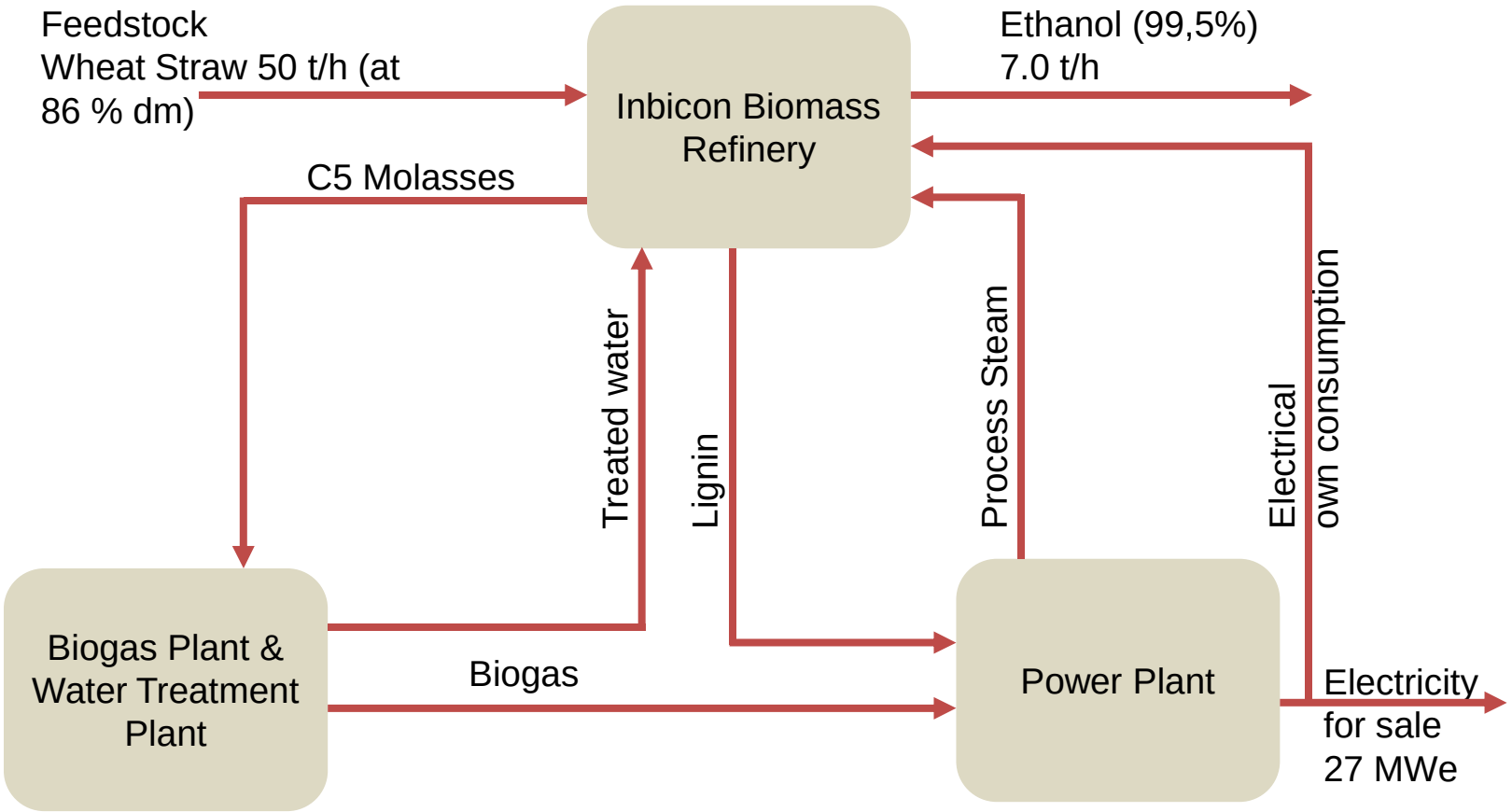
Integration with Anaerobic Digestion & Biogas CHP plant



Inbicon Biomass Refinery™ Co-Location Projects
Integrated, Diversified Platform Example

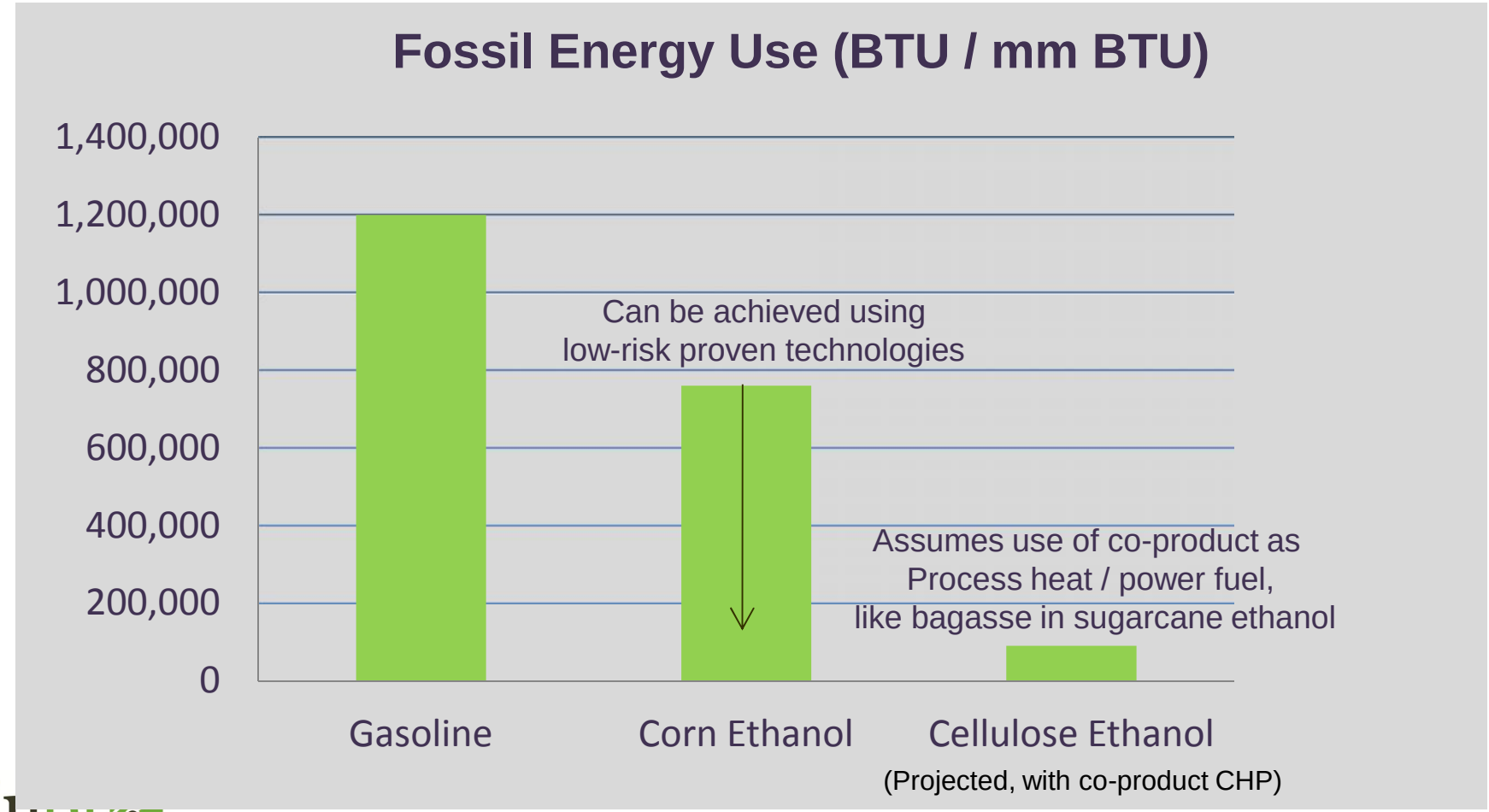


Inbicon Biomass Refinery
Integrated solution with Power Production

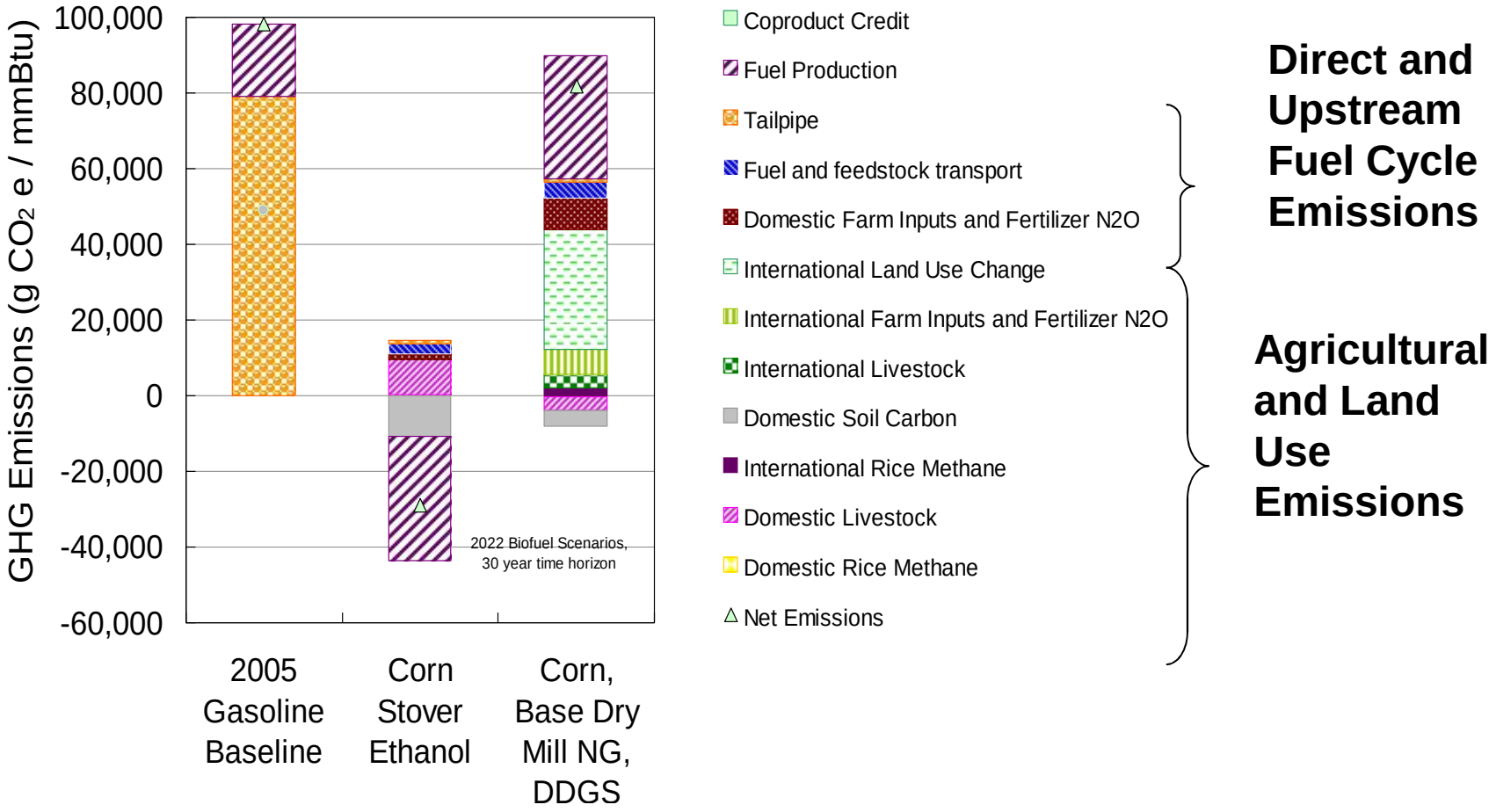


Biomass Refinery Platform
N.A. cellulosic and grain ethanol vs. Brazilian sugarcane

Use of Co-Products for process heat and power



Inbicon Biomass Refinery™
Surpassing the EPA's RFS2 Compliance Standards



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LifeCycle Associates, LLC

Biomass Refining and Cellulosic Ethanol

What is required for first movers?

PROJECT RISK ASSESSMENT and MARKET CERTAINTY

Feedstock Supply

Technology and Scale Up

Policy and Legislative Certainty

Project Execution

Economics – CAPEX and OPEX

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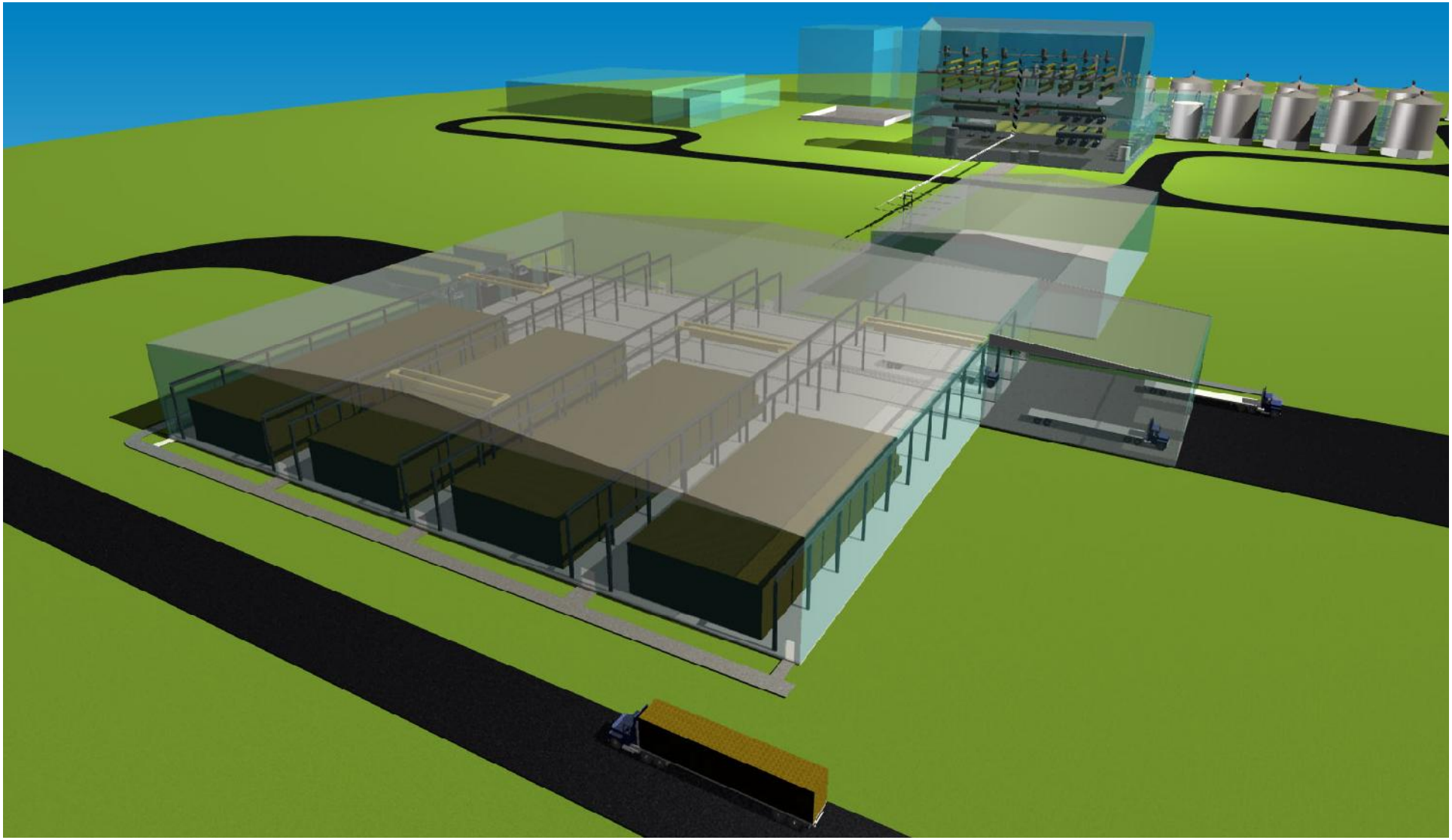
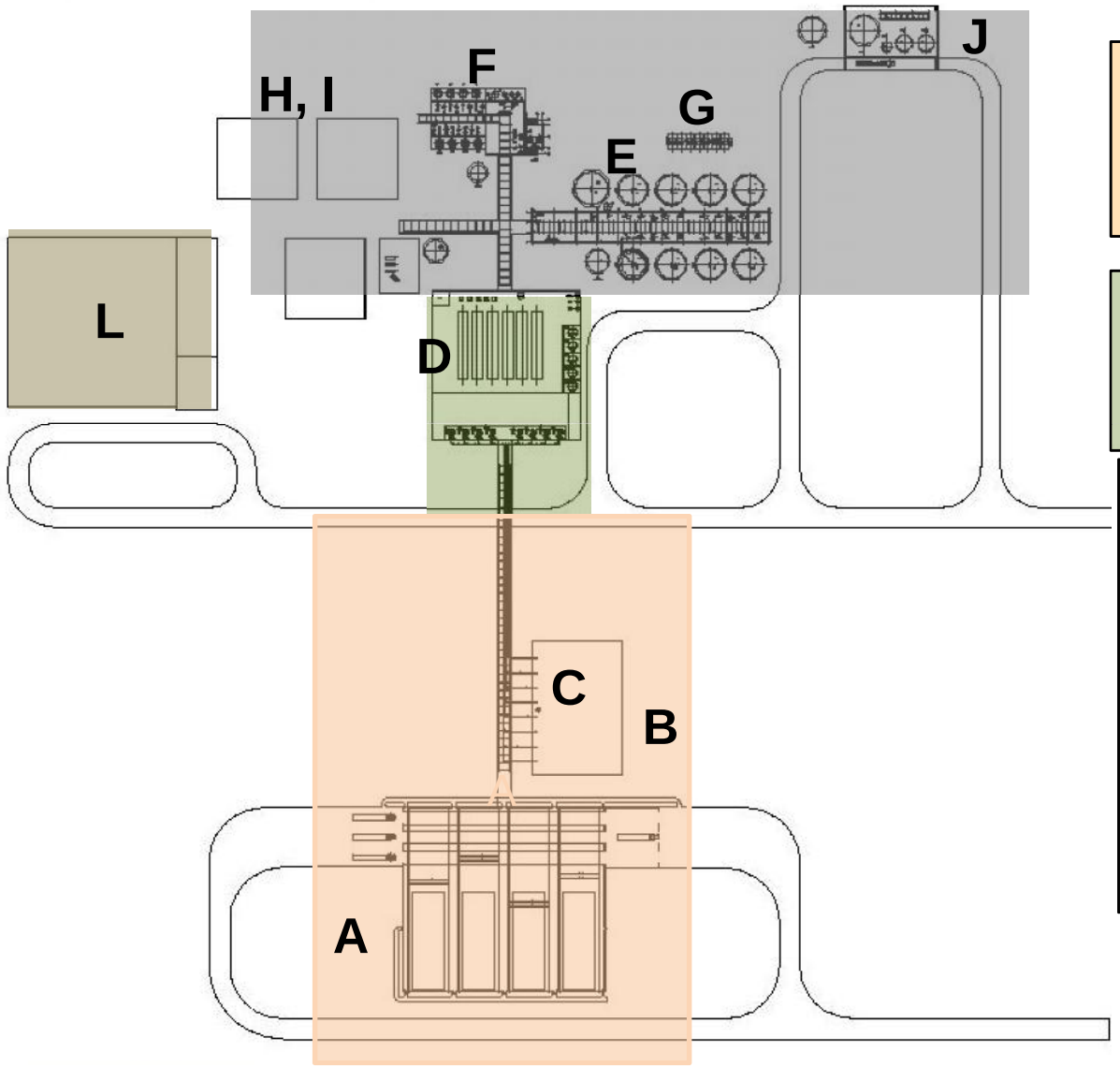
Leifmark

Inbicon Project Execution

50 MT/Hr – 20 mmgy Commercial Plant + sugars, lignin



Inbicon Biomass Refinery
Project Execution Battery Limits



A. Soft Biomass Storage
B. Soft Biomass Preparation

DONG Energy Know-How

C. Soft Biomass Pretreatment
D. Soft Biomass Conversion

Inbicon Proprietary Technology

A. Fermentation
B. DD&E
C. Centrifuge Building
D. Lignin Pad
E. Dryers
F. Cooling Towers
G. Ethanol Storage

Established Ethanol Process Technologies

H. Co-Gen Facility

CHP Known and Established Technologies

Inbicon Biomass Refinery Platform
Technology and Scale Up – Project Execution Teams

Equipment Supplier Agreements

Companies with decades of experience, at scale

Pulp and Paper

North American Engineering Partners

Pöyry Engineering, Harris Group, APS

EPC Alliances

World's largest EPC – project in FEED phase

EPC alliances with Engineering Partners

US and Canadian EPC companies

Engineering work completed for other projects

Equipment Drawings

M&E Balances, P&ID's, Deliverables

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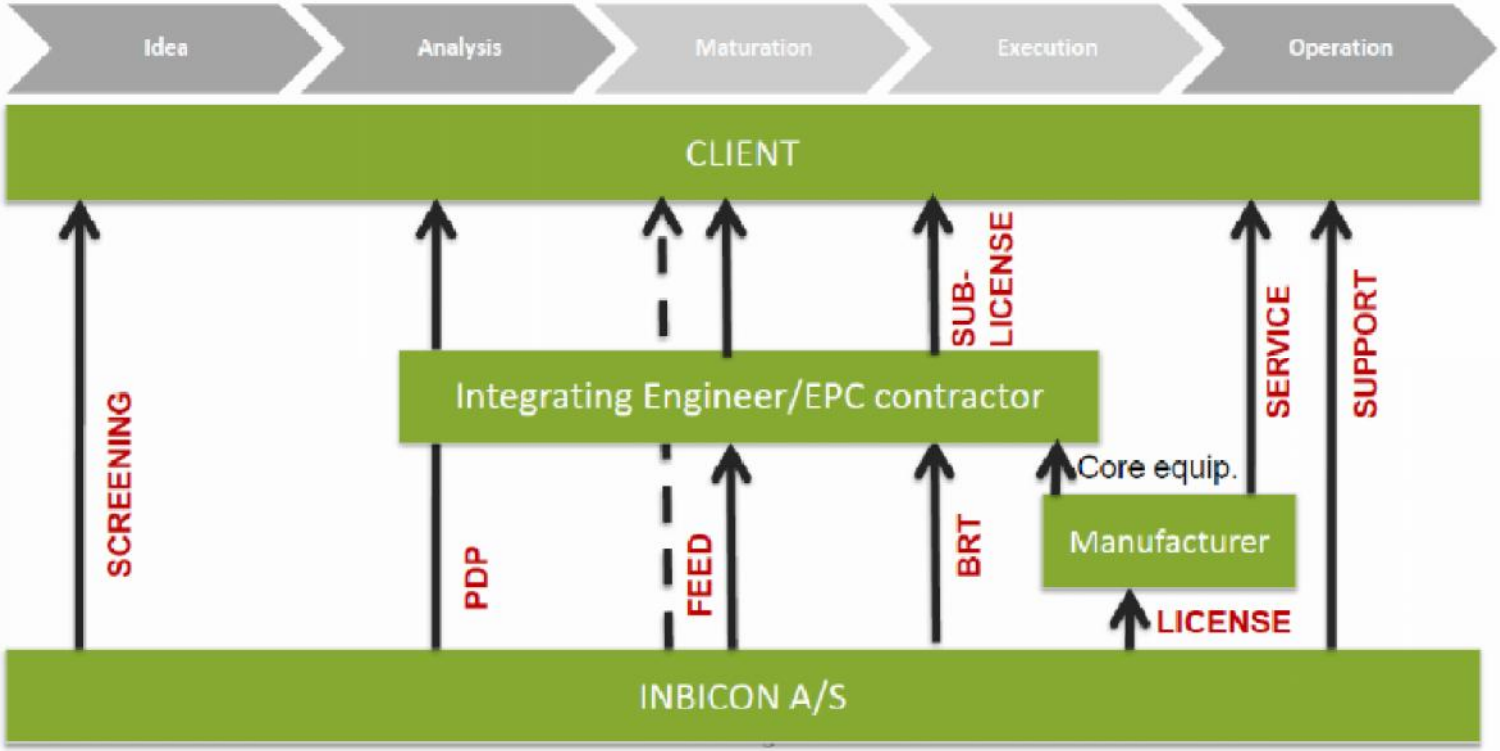
Inbicon Biomass Refinery
Project Development and Contracts

Contract set-up, main topics

- Technology Sales Product Portfolio - During The Project Model (example: Inbicon)



The objective of the **screening** is to analyze the technical end economic factors for the further development of a Inbicon Biomass Refinery Technology plant.

The results from the screening include the following:

- Biomass description
- Product description
- General mass and energy balance
- General economy.

Screening of a specific biomass is free
The following steps will trigger a contract:
PDP=Proces Description Package
FEED=Front End Engineering and Design
BRT=Biomass Refinery Technology

License = License Contract
Service = Service Management Contract
Support = Operational Support (Production Royalty)

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YOUR BIOMASS REFINERY
RESULTS FROM THE SCREENING

Standard Platform
Feed Stock: Corn Stover
Date: 09-08-2011

SCREENING
The objective of the screening is to make an initial evaluation of the output from Inbicon's Biomass Refinery Technology plant.
The screening is based on data given by the Client.

RESULTS FROM THE SCREENING
The results of the screening are illustrated on this page.

DISCLAIMER
Please note that any data presented in this document are subject to uncerntainties, and Inbicon cannot be held responsible for the validity of the data.

BIOMASS DESCRIPTION

Water fraction	14%
Cellulose fraction	39.1% of dm
Hemi-cellulose fraction	28.4% of dm
Lignin fraction	19.9% of dm
Ash fraction	7.9% of dm
Other solids fraction	4.7% of dm

INPUT FIGURES

Biomass price	70 $/dry mt
Enzyme cost	0.6 $/gallon
Electricity selling price	85 $/MWh
Molasses selling price	70 $/mt
Average operator cost	60,000 $/year
Operating hours	7000 h/year
Investment	$220 MM

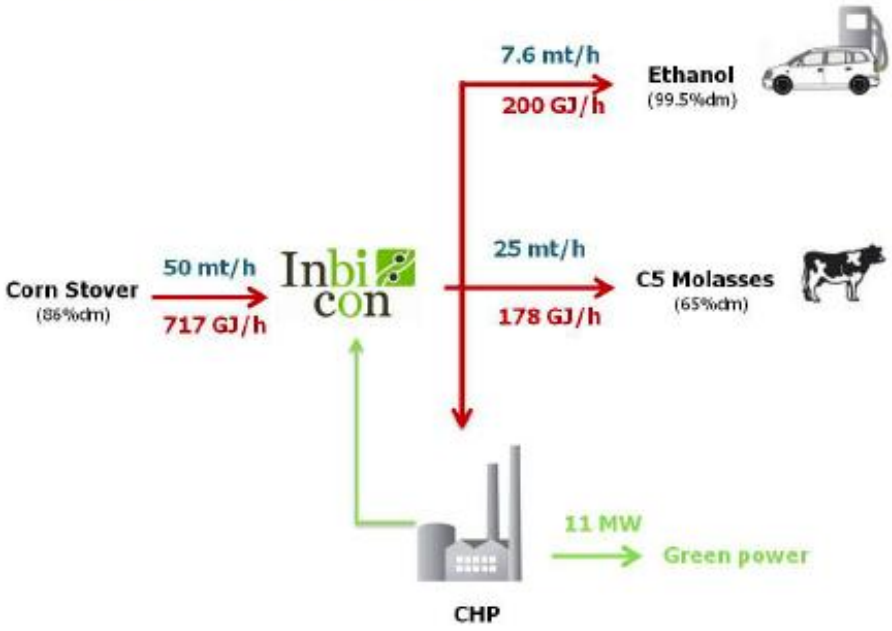
PRODUCT DESCRIPTION
Ethanol
Complies to EC norm: *EN15376:2007*

C5 molasses
Dry matter: 65%
Sugar content: 50% of dm
Appearance: Black syrup

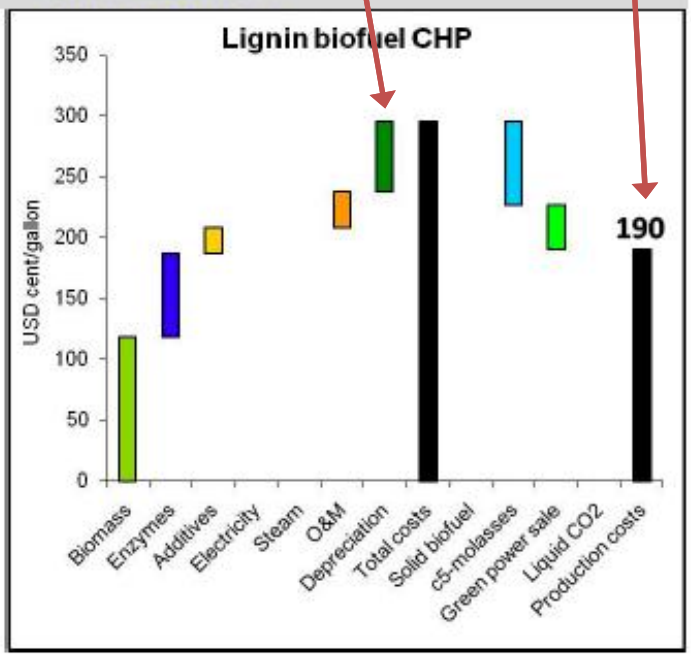
CAPEX 20 Yr Straight Line

No RIN's. Tax Credits, Premiums

GENERAL MASS AND ENERGY BALANCES



GENERAL ECONOMY



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