STATUS, CHALLENGES & OPPORTUNITIES FOR RENEWABLE ENERGY PROJECTS ON KAUAI

Kauai Renewable Energy Conference

Kauai Marriott Resort & Beach Club

September 8, 2008

E. Alan Kennett
President, Gay & Robinson, Inc.

Alan Kennett & Gay & Robinson

- President and CEO of Gay & Robinson, Inc.
- Gay & Robinson, Inc. is a 7,500 acre sugar cane plantation and sugar mill located on the island of Kauai, Hawaii
- G&R is one of only two remaining sugar operations in Hawaii, the other is HC&S on Maui.
- G&R currently produces approximately 50,000 tons of raw sugar per annum.
- Highest yielding sugar plantation in sugar per acre, over 7 tons per acre per year
- Sugar production shipped to C&H refinery in Crockett, CA for refining.

New Energy Partnership

- Gay & Robinson, Inc. partnering with Pacific West Energy LLC
- New Company: Gay & Robinson Ag-Energy LLC
- Build 15 million gallon per year Sugar to Ethanol Plant
- Install a large Biomass/Biofuel, Used Oil boiler
- Install a 20 Megawatt (MW) condensing unit
- Replace a 4 MW back pressure unit with a 10 MW unit
- Build a 5 MW Solar Energy Plant
- Supply up to 90,000,000 KWH to the utility

Energy Projects

- Install a methane recovery system to handle distillery slops.
- Permit the large boiler to burn glycerin, a byproduct of the Biodiesel refinery.
- Plan to sequester CO_2 from fermentation plant in the production of algae to produce biofuels.
- Install the first steam reformation/catalytic conversion demonstration plant. Bagasse to Ethanol (Clear Fuels/Pearson Technology)
- Install a Municipal Waste to Steam plant if successful bidder on County of Kauai MSW Project.

Market Conditions Concerns

- Fuel price increases:
  2006 Diesel Price $2.85/gal 2008 Diesel Price $5.05/gal
- Fertilizer price increases over 100% in 2008
- Herbicide price increases over 100% in 2008
- Medical cost increase of 41% in last 2 years
- Steel parts up 40%
- New boiler price up 25% in the last year
- Ethanol price into Hawaii $2.80/gallon
- Manning – 175 additional employees

Acreage Expansion

- Add 7,500 acres of cane land for total of 15,000 acres.
- Convert roughly 7,000 acres to 1 year cane from historic 2 year cane.
- Harvest 1 year cane green and recover all fiber.
- Discuss with land owners to further increase cane land.

Large Landowners Continue to Look into Energy Crops

- Sugar cane offers largest potential.
- Requires lots of water: 1 ton water/ pound sugar production.
- Jatropha requires 30-50 inches/acre/year
- Sugar cane uses 90 inches/acre/year

Selected Tree Crops for Oilseed

Table 2 Potential production of selected tree crops for oilseed

Crop	Oil content	lbs. oil ac^{-1}	US gallons ac^{-1}	Years to production
Oil Palm	kernel 50%, fruit 40-70%	5346#	760#	3 to 10#
Kukui	45-65%	2672*	380*	6 to 10
Avocado	10-30%	1980	282	1 to 3
Coconut	60-80%	2018	287	5 to 10
Jatropha	43-59%	2106†	300†	2 to 3
Neem	33-45%	1161‡	165‡	10
Pittosporum	1.3 ml $fruit^{-1}$	880*	125*	8 to 10?
Copaifera	500 ml $tree^{-1}$ yr^{-1}	55§	8§	10+?
Pongamia	27-36%	3037¶	432¶	4 to 8^

Data taken from Journey to Forever, 2006, except where noted below.

Data taken from Wahid et al., 2004.

* Data taken from Duke, 1983.

† Data taken from Gaydou, et al. 1982.

‡ Estimated 40 trees ac^{-1} @ 33% oil content, with 88 lbs seed $tree^{-1}$

§ Assume 60 trees ac^{-1} with 500 ml $tree^{-1}$ yr^{-1}. Data taken from Plowden, 2003.

¶ Data taken from Duke, 1983. Assume 40 trees ac^{-1} @ 27% oil content, with 40 lbs seed $tree^{-1}$

^ May take as little as 3 years if grafting is method of propagation, and up to 10 years by seed.

Row Crops for Oilseed

Table 3 Potential production of herbaceous row crops for oilseed compared to algae

Crop	Oil content	lbs. oil ac^{-1}	US gallons ac^{-1}	Years to production#
Soybean	18-20%	335	48	0.35
Flax	35-40%	359	51	0.30
Rape	37-50%	893	127	0.33
Sunflower	25-45%	714	102	0.4
Peanut	40-55%	795	113	0.4
Euphorbia lathyris	40-48%	2300†	315†	<1
Castor bean	40-50%	1958	278	<1
Algae*	10-85%	~280,000‡	40,000‡	<1

* Algae would be grown in large raceway ponds along coastal areas.

Plantings can be established and harvested within a 4-8 month period for these crops. *Euphorbia lathyris* has an unknown time of implementation, but it would not be greater than one year. Algae would need only weeks to begin oil production.

Data taken from Journey to Forever, 2006, except:

† Taken from Duke, 1983.

‡ Taken from Hamilton, 2006.

Advantages of Jatropha:

- ***Jatropha Curcas*** **is resistant to drought and can be planted even in desert climates. It thrives on any type of soil, grows almost anywhere – in sandy, gravelly and saline soils.**
- **Jatropha has no insect pests, it is not browsed by cattle or sheep.**
- **Jatropha Curcas can survive long periods of drought. Propagation is easy and growing needs minimal input or management.**
- ***Jatropha Curcas*** **growth is rapid; forms a thick live hedge after only a month's planting.**
- **Jatropha starts yielding from the second year onwards and continues for 40 years. The Meal after extraction is an excellent organic manure. *Jatropha Curcas* quickly establishes itself and will produce seeds round the year if irrigated. Other than extracting *biodiesel* from Jatropha Curcas plant, the leaf and the bark are used for various other industrial and pharmaceutical uses.**
- **Approximately 31 to 37% of oil is extracted from the Jatropha Curcas seed.**

Jatropha

Rows of Jatropha trees

Nut cluster and split nuts from Jatropha tree

Algae Ponds at Cyanotech, Big Island, Hawaii

BioKing: Assembling Algae Tube Panel

Simgae™ – Low Cost Algae Production System
Diversified Energy Corp.

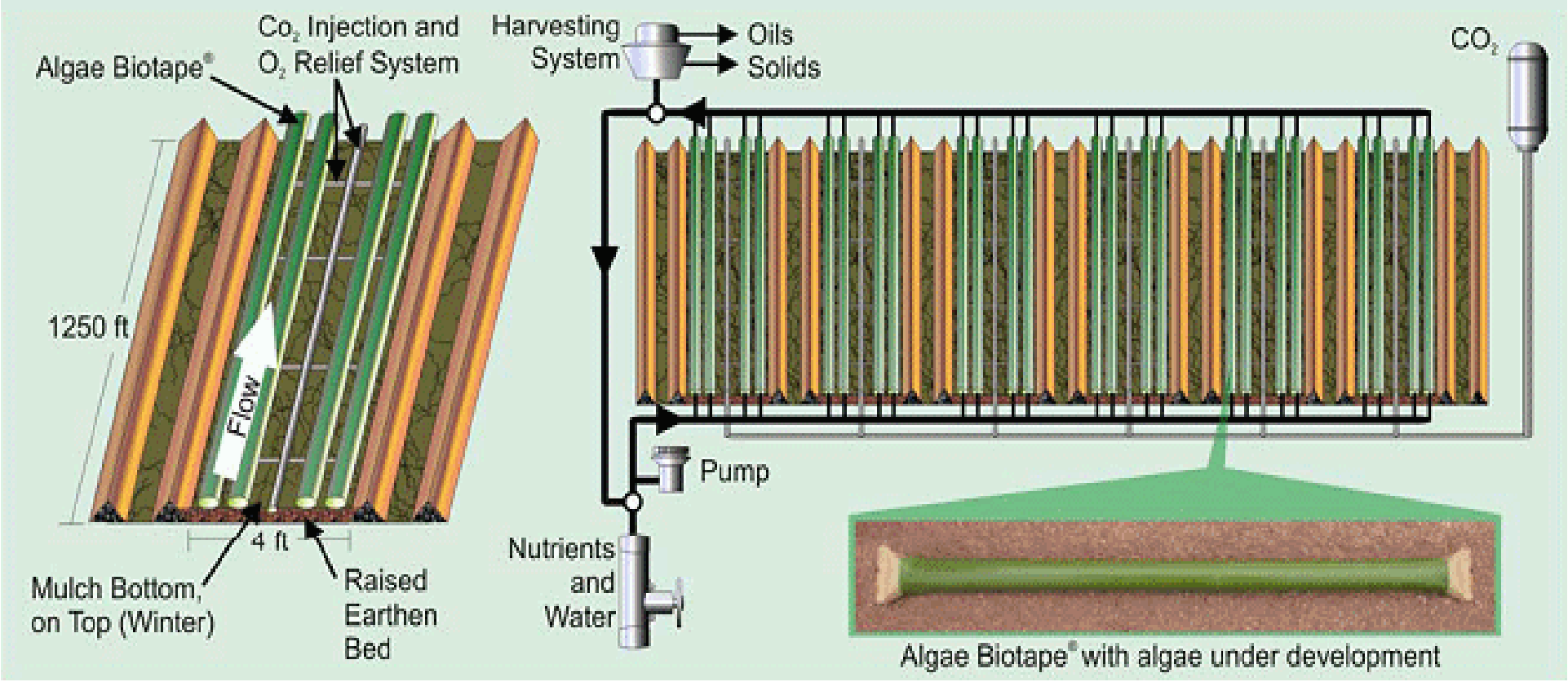


Figure 1. Single Simgae Bed (Left) 1 Acre Notional Farm (right)

New Opportunities with Algae

Sugar has new and exciting opportunities beyond Sweeteners and Ethanol

Sugar can be converted into OIL

- ***Sugarcane is currently used as a feedstock for multiple products***
  - *Sugar*
  - *Ethanol*
  - *Electricity*
- ***Sugarcane can also be used as a feedstock to produce other products***
  - *Diesel and Jet Fuels*
  - *Food Oils*
  - *Surfactants and other "green" chemicals*
  - *High Value Animal Feeds*
  - *Other*

- ***These other products are made using standard industrial fermentation techniques***
  - *Utilize a different microorganism other than yeast*
- ***Solazyme has developed a technology which can expand sugarcane's product portfolio today***

Solazyme uses algae instead of yeast

Algae can make oil without sunlight

- **Feed the algae SUGARS**
- **Similar to feeding a yeast fermentation**
- **Solazyme grows algae heterotrophically (in the dark)**

Algae oil is a near term, scalable, oil production opportunity

- **Oil can be sold as a fuel product, or a high value food oil**

Algae can produce fuels that meet current specifications

- **Including a premium biodiesel, renewable diesel and renewable jet**

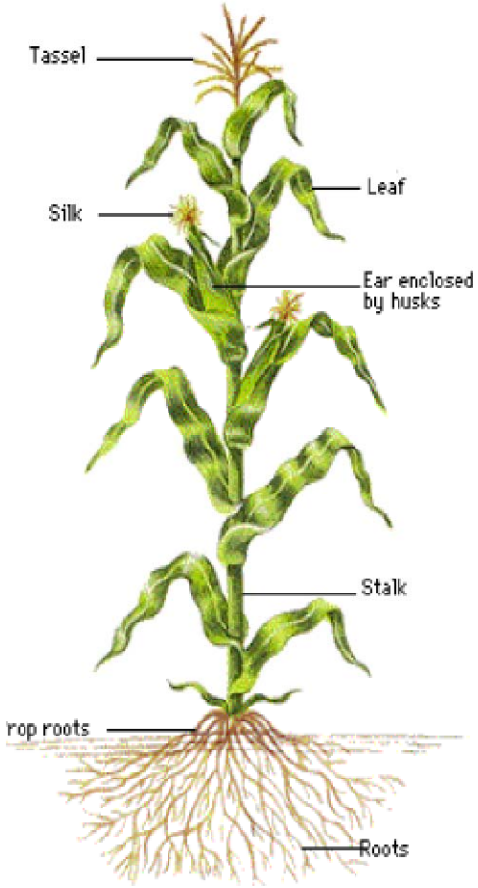
Diesel and jet fuels made with algae technology are clean, sustainable, and have a low carbon foot print

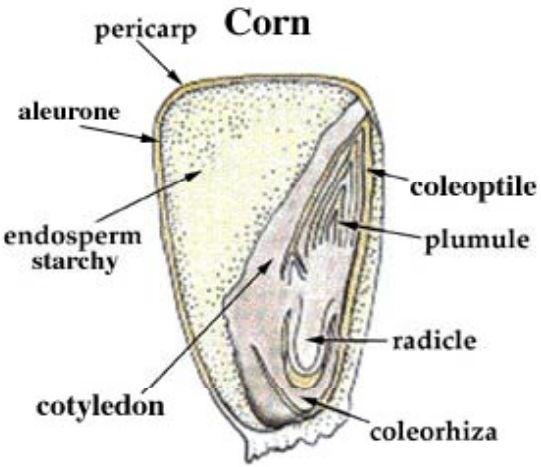
Solazyme's technology utilizes standard processes for fermentation and oil extraction, and will expand sugars product portfolio. This process can be performed at scale today

solazyme's algal biofuels

- ***Solazyme is the only microbial biofuel company that has manufactured an oil based fuel:***
  - *at commercial manufacturing scale*
  - *that meets any fuel standard (Meets: ASTM D6751, EN 14214, ASTM D975 and U.S. military specifications)*
  - *that has been road tested at 100% (or any %) blend*
  - *for thousands of miles in unmodified engines*

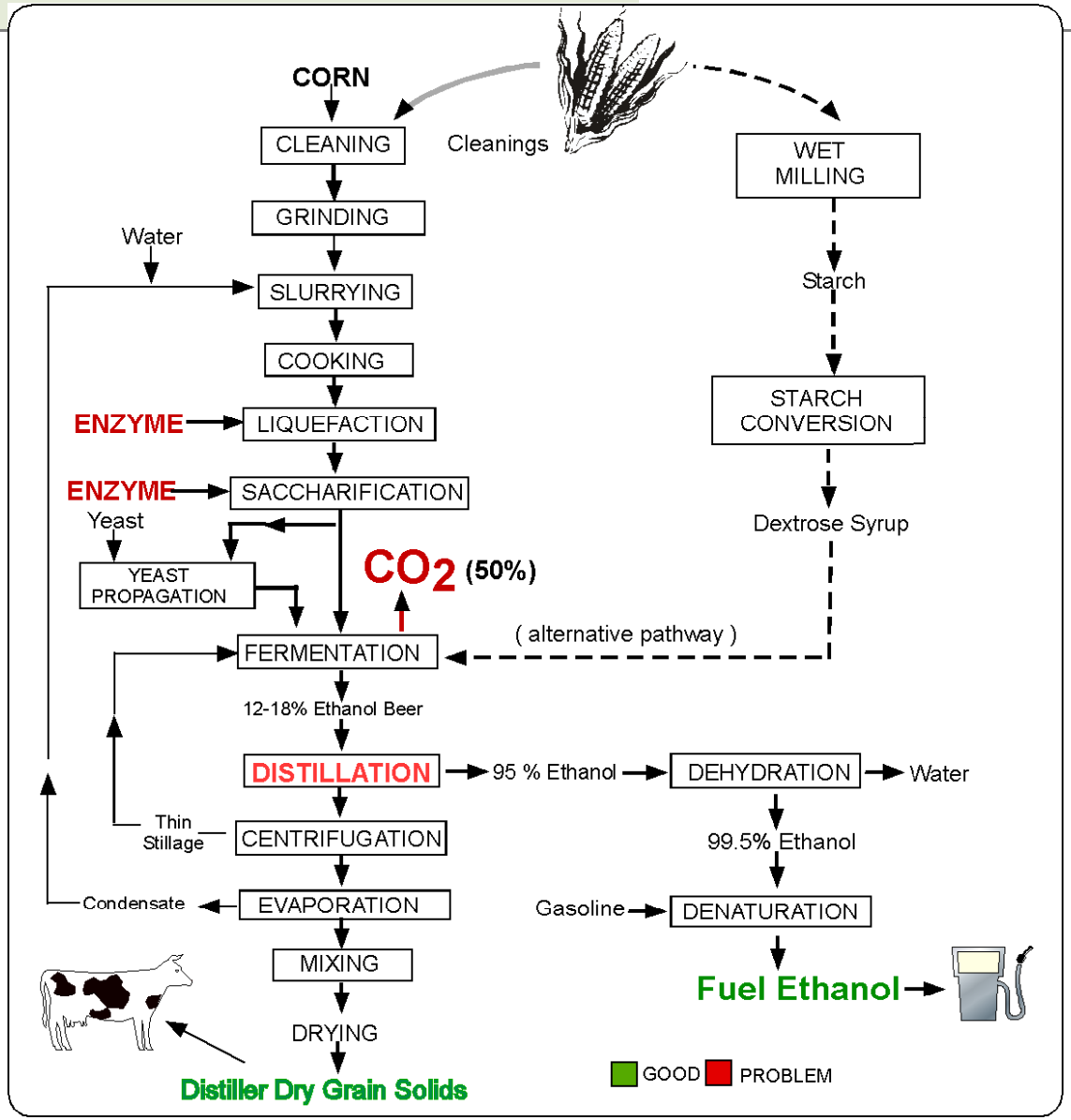
CORN-ETHANOL ISSUES





Only the endosperm starch is used to produce ethanol

CORN ETHANOL



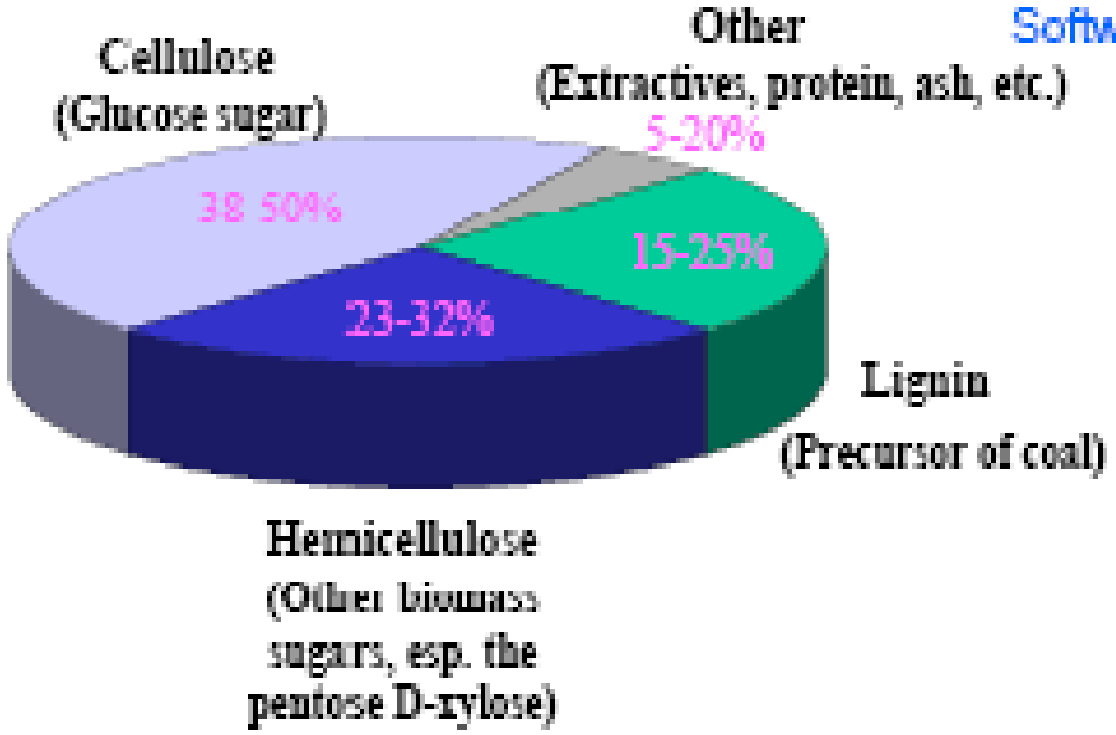
Lignocellulosic Biomass

Corn Stover

Bagasse

Hardwood

Softwood

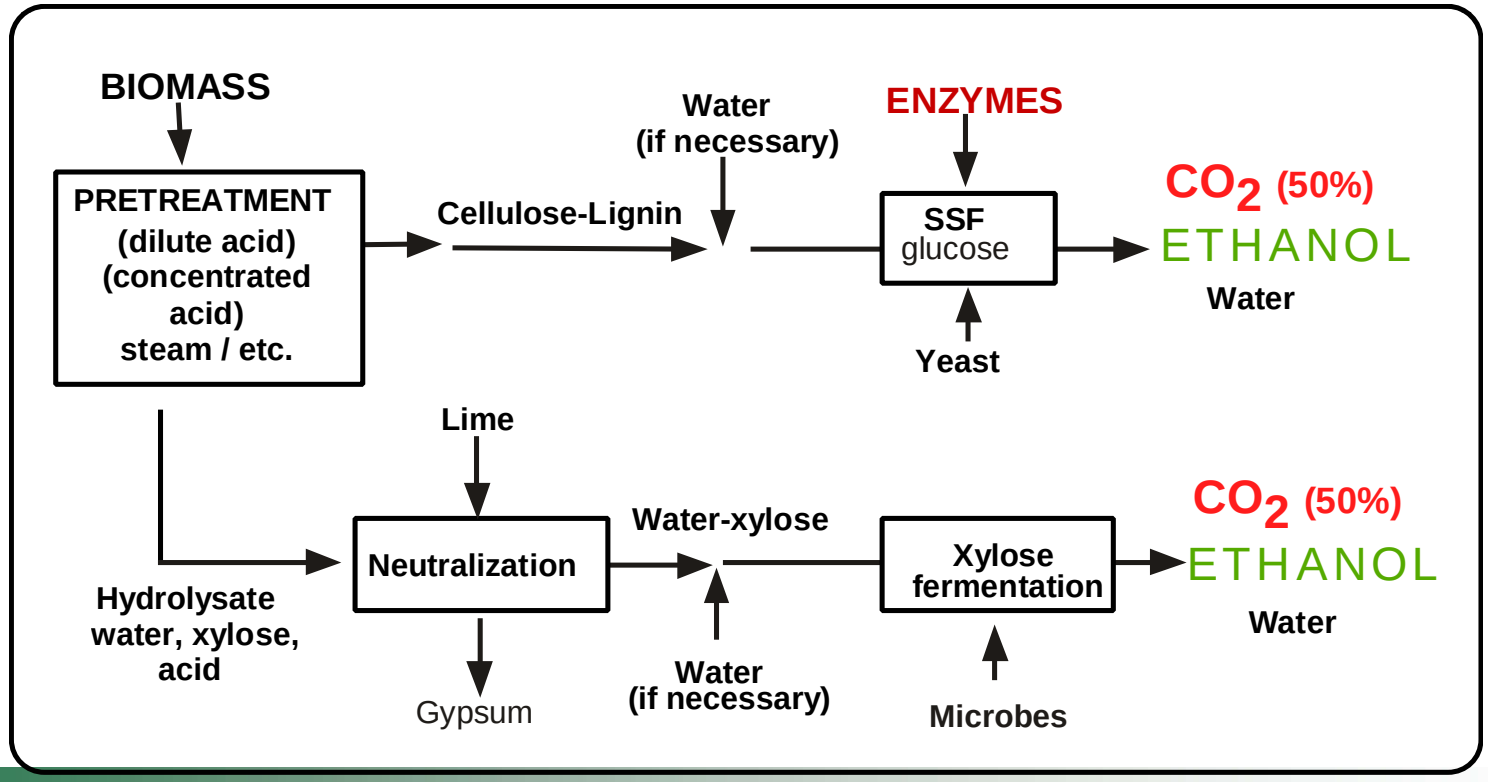


Saccharification- Fermentation Technology

Enzymatic Simultaneous Saccharification and Fermentation (SSF) of the cellulose fraction of pretreated biomass

Pretreatment of biomass with acids enzymes to release sugars for fermentation

COMPANIES: Mascoma, Blue Fire (Arkenol), POTET (Broin) Abengoa, Iogen



GASIFICATION –

Microbial Conversion

Alico (BRI)

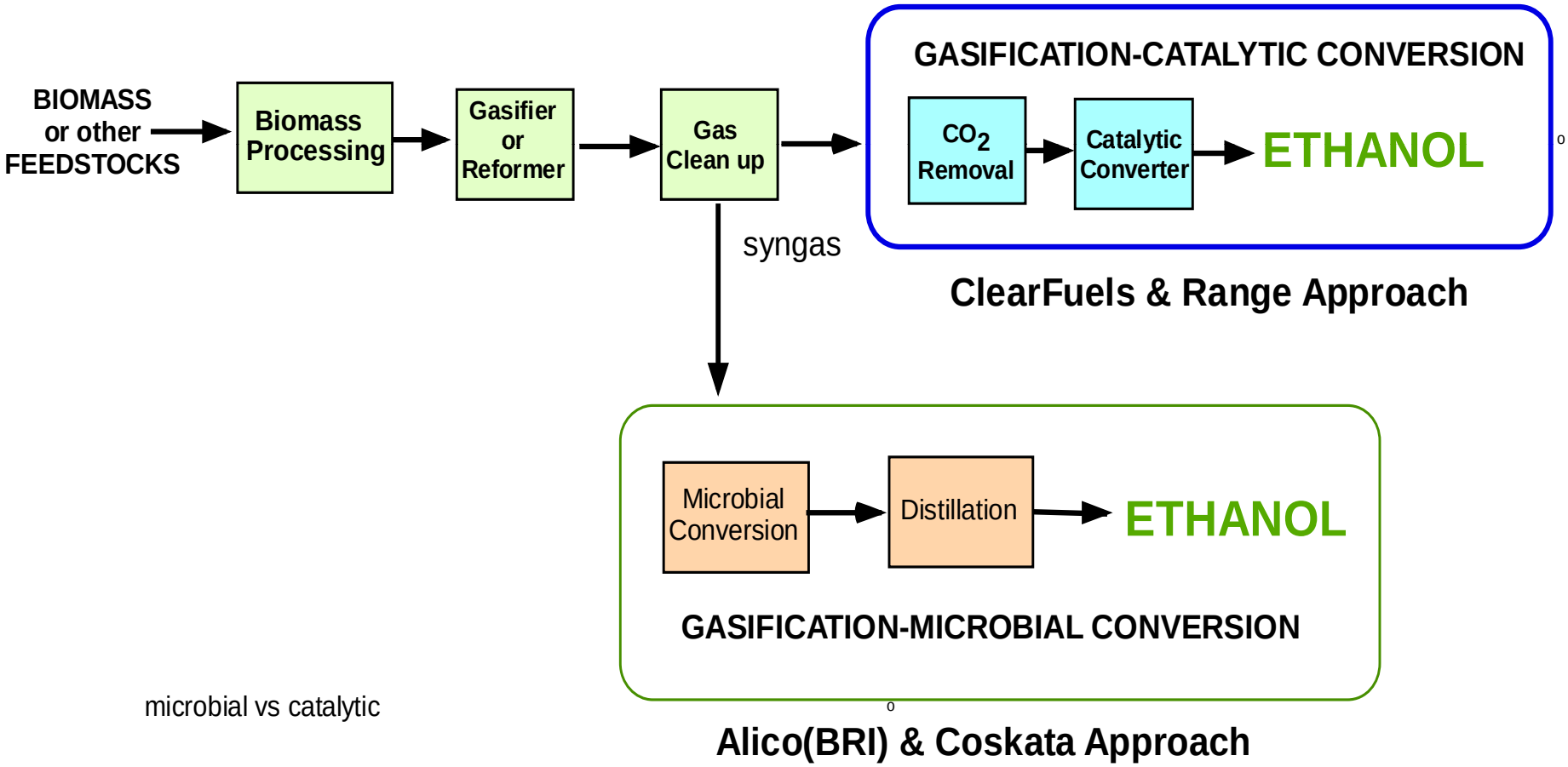
Coskata

Catalytic Conversion

Range Fuels

ClearFuels

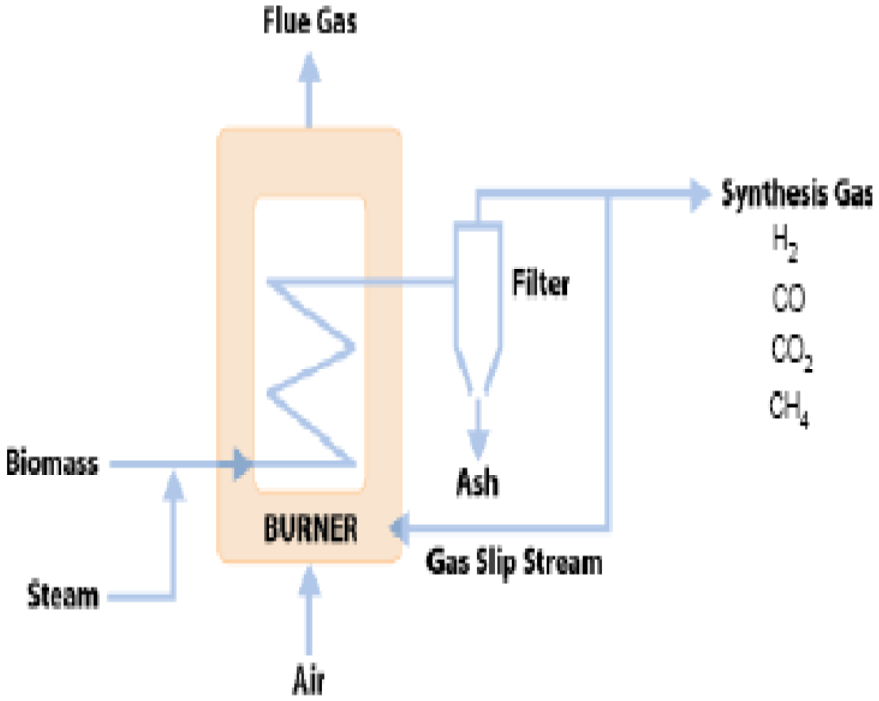
MICROBIAL vs CATALYTIC SYNGAS CONVERSION

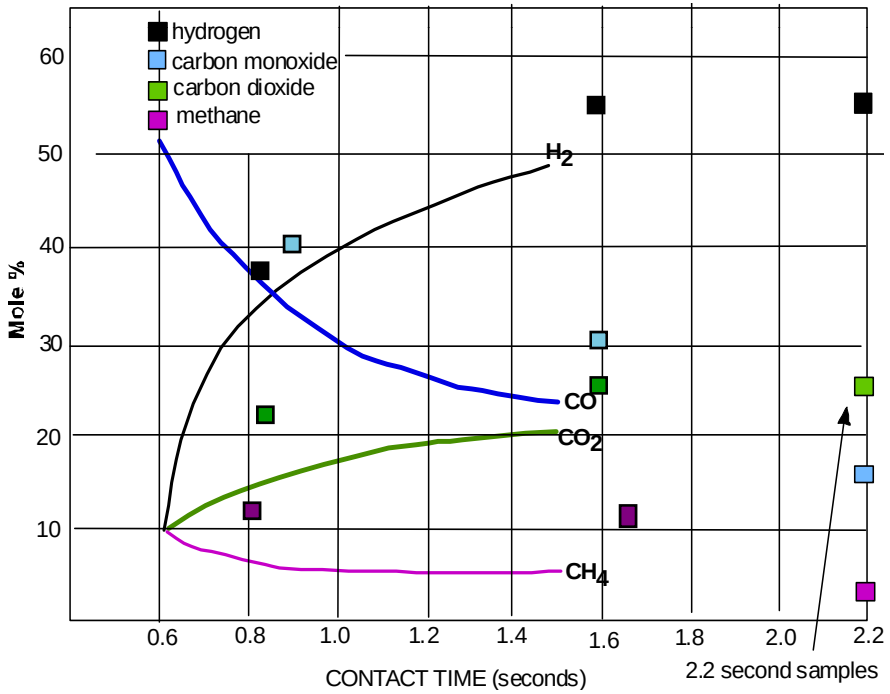


microbial vs catalytic

ClearFuels Novel Proprietary Reformer Design

Can use wide variation of cellulosic feedstocks
Controllable H:CO syngas ratio output
Very low tar syngas
Can produce multiple renewable energy products

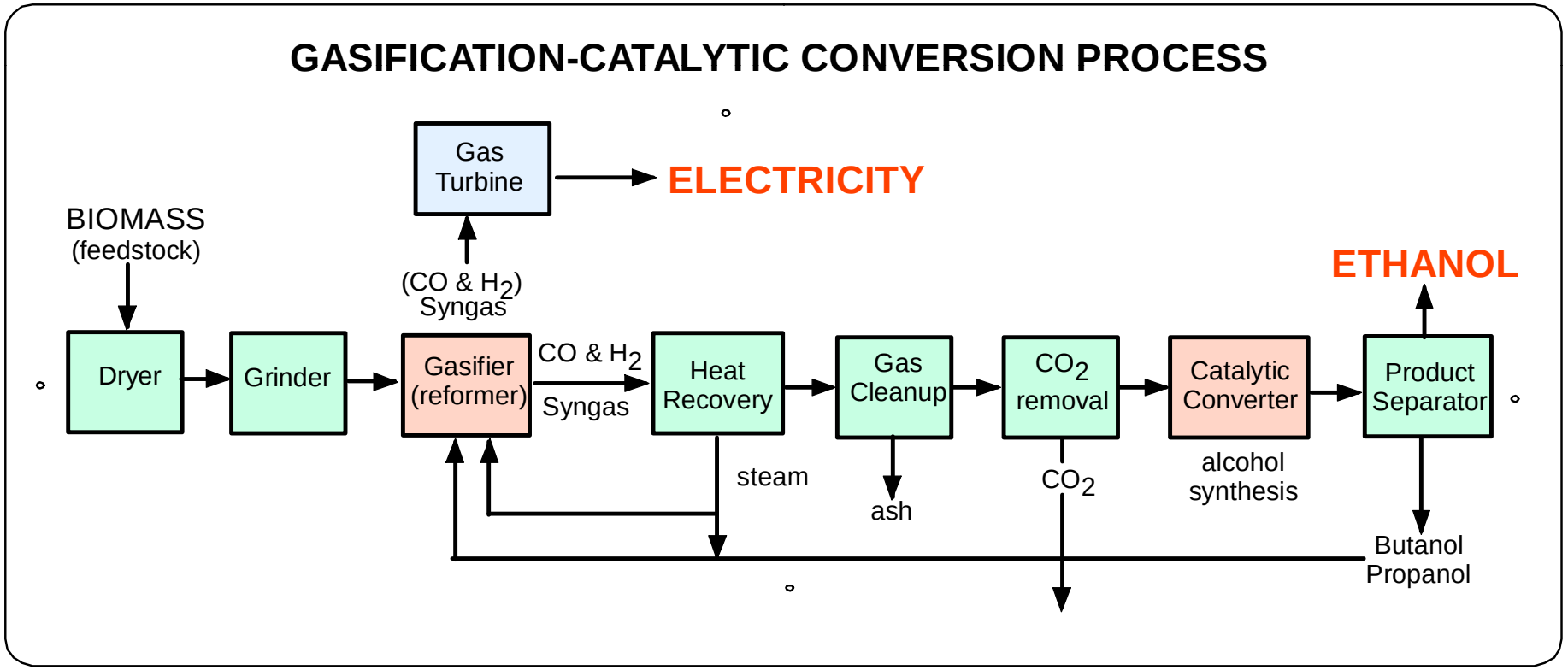




ClearFuels Technology inc.

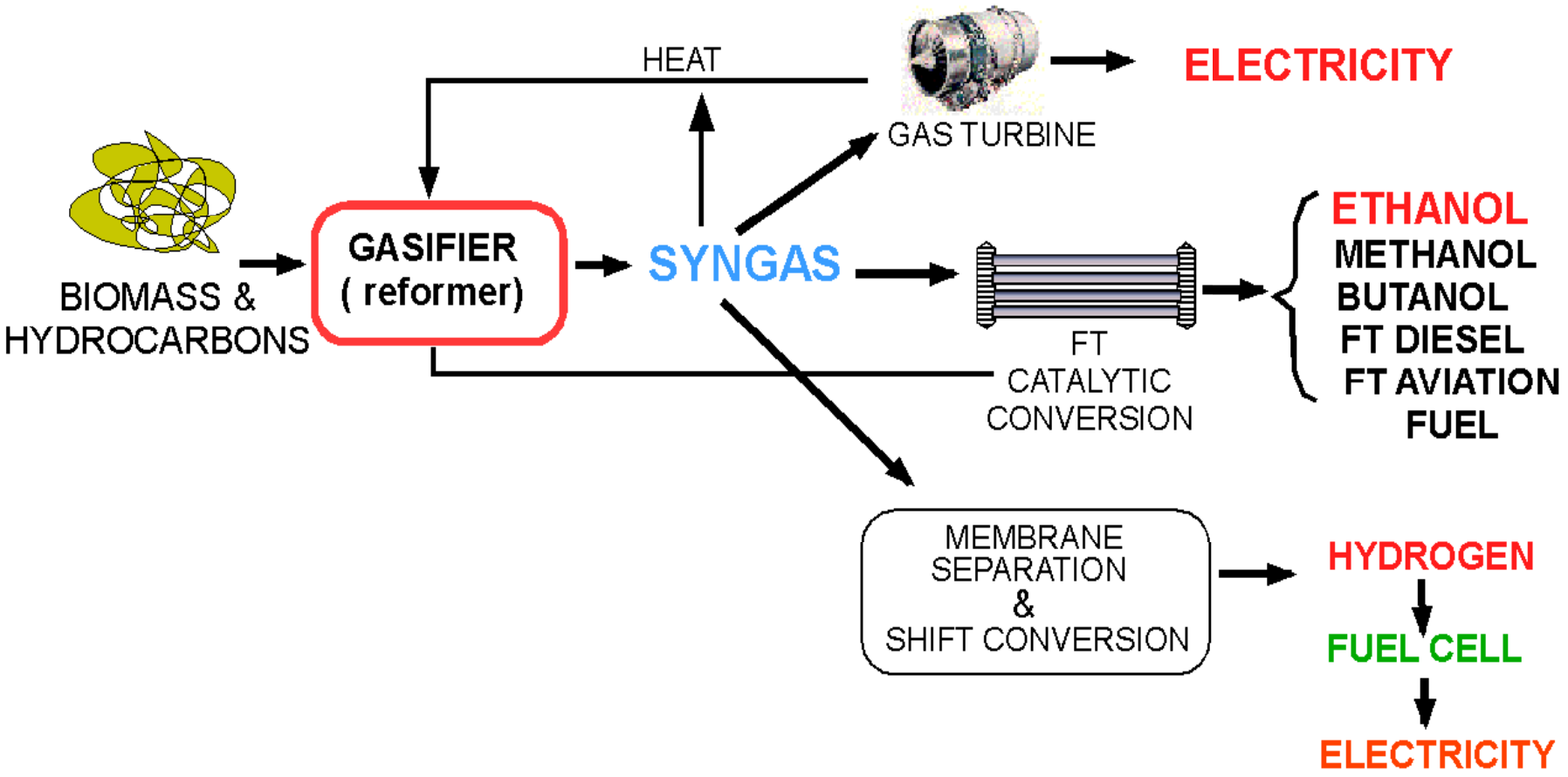
The technology consists of three primary steps:

- ***Biomass preparation:*** drying and grinding of biomass for the gasifier
- ***Gasification/reformation*****:** biomass feedstock is gasified by steam reformation The PTI process allows tight control of resultant syngas mixture.
- ***Gas-to-Liquids Conversion*****:** syngas (CO and H_2 mix) is transformed, via a series of catalyzed reactions into ethanol.



Pearson Biomasss

CF BIOMASS GASIFICATION OPTIONS

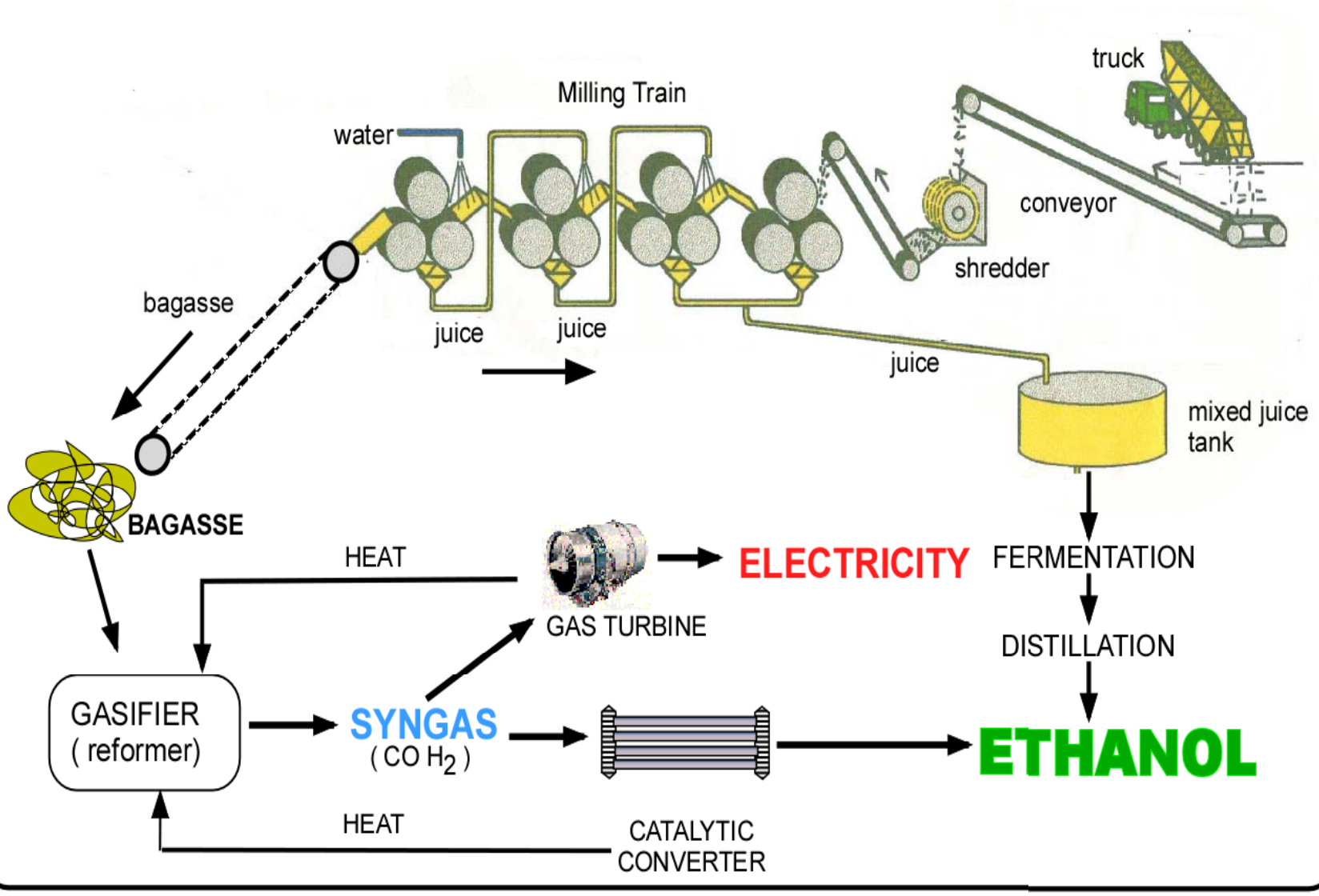


TECHNOLOGY COMPARISON

Feedstock	Cellulose	Hemicellulose	Lignin
BAGASSE	38%	27%	20%

Bagase				
Amount (lbs)	2,000			
Cellulose %	**38%**		**Hemicelluloe %**	**27%**
Amount (lbs)	760		Amount in lbs	540
Glucose Content (%)	95%		Fermentable Sugars content (%)	80%
Glucose available lbs)	722		Sugar content (lbs)	432
Ethanol from Glucose ferment (%)	45%		Fermentable sugars released (%)	80%
Ethanol from Glucose ferment (lbs)	**324.9**		Fermentable sugars (lbs)	345.6
Ethanol (lbs/gal)	6.58		Ethanol from hemicellulose ferment (%)	50%
Ethanol / ton glucose (gal)	**49.38**		Ethanol from hemiellulose lbs	**172.8**
CO2 from glucose (lbs)	324.9		Ethanol from hemicellulose gallons	**26**
Ethanol fron Cellulose and Hemicellulose (Gallons/ ton)	**75.64**			
SSF Ethanio yield / ton bagasse (gal)	75.64			
Total Ethanol yield / ton bagasse (lbs)	497.7			
Total Ethanol - Yield/ ton bagasse (%)	**25%**			
CF Reformation Catalytic Conversion				
CF Ethanol Gallons / ton	**120**			
Ethanol (lbs/gal)	6.58			
Ethanol Produced/ ton bagasse (lbs)	789.6			
Ethanol - Yield/ ton bagasse (%)	**39%**			

Integrated Sugar Crop Ethanol Production Business



KAUAI
HAWAII INTEGRATED SUGAR ENERGY PRODUCTS