

# *Pathways to Sustainable Travel* *w/ Biofuels & Carbon Trading*



# BioPure Food & Fuels

- BioPure Fuels is a project development company involved in oil seed crush, biodiesel, alcohol & 2<sup>nd</sup> gen. biofuel plants & food co-production
- Projects underway in Saskatchewan, Canada, Houston, TX and various locations in NE Brazil
- Work jointly with several non-profits to develop feedstock, solve sustainability issues, promote

## Facilities; Bio-Jet Fuel

- BioPure Fuels is currently negotiating to purchase a large chemical plant in Houston to make biodiesel (100 million gal. capacity, \$0.34/installed gal.)
- A chemical company partner is considering joint participation by adding an oil hydrotreating module that would produce 50 mil gal. bio-jet fuel
- Advantages include feedstock optionality, links to petroleum and major ship port pipelines, etc.

# Houston Biodiesel

Houston Biodiesel Module (100 mil. gal)



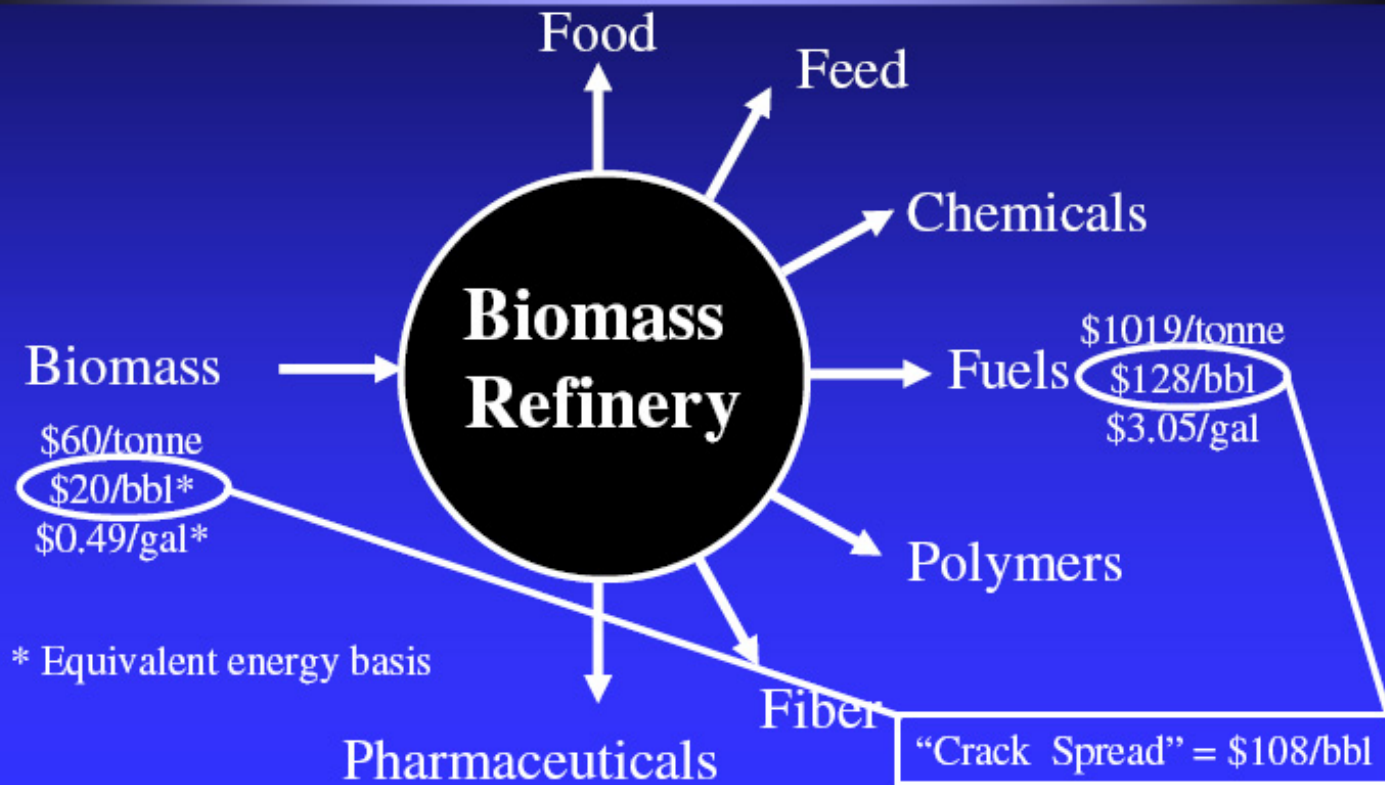
# Biofuel from Biomass

- BioPure Fuels negotiating with Terrabon to jointly develop biofuel facility from MSW in Houston plant
- Facility would convert mixed organic MSW to bio-gasoline with a ketone chemical pathway. Main advantage is low feedstock cost (get paid tipping fee)
- Potential to change pathway to carboxilates and develop method to convert carboxilates to jet fuel (not developed yet)

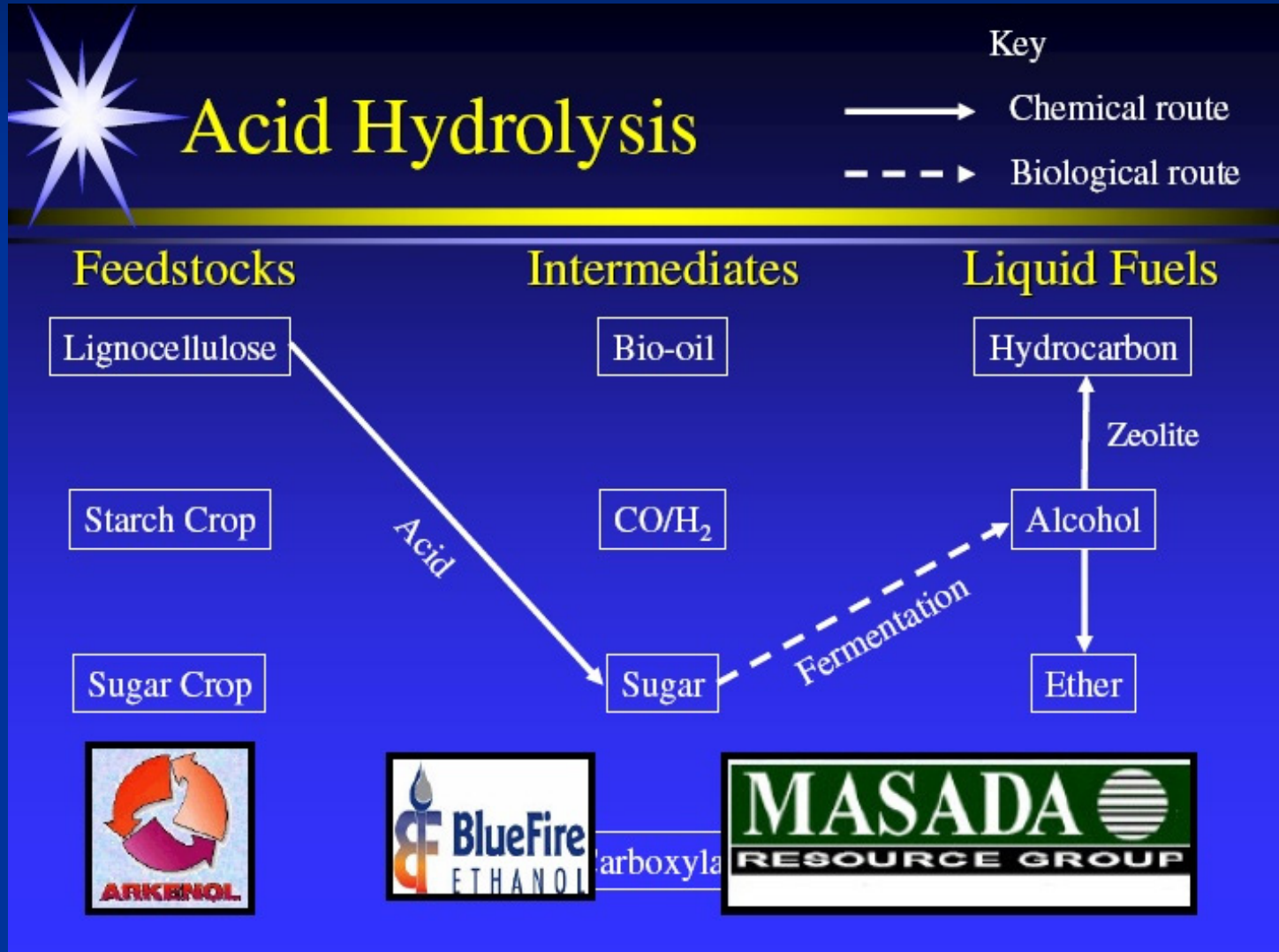
# Biofuel from Biomass



## Biomass Refinery



# Acid Hydrolysis



# Pyrolysis



## Fast Pyrolysis

Key



### Feedstocks

### Intermediates

### Liquid Fuels



Starch Crop

CO/H<sub>2</sub>

Alcohol

Sugar Crop

Sugar

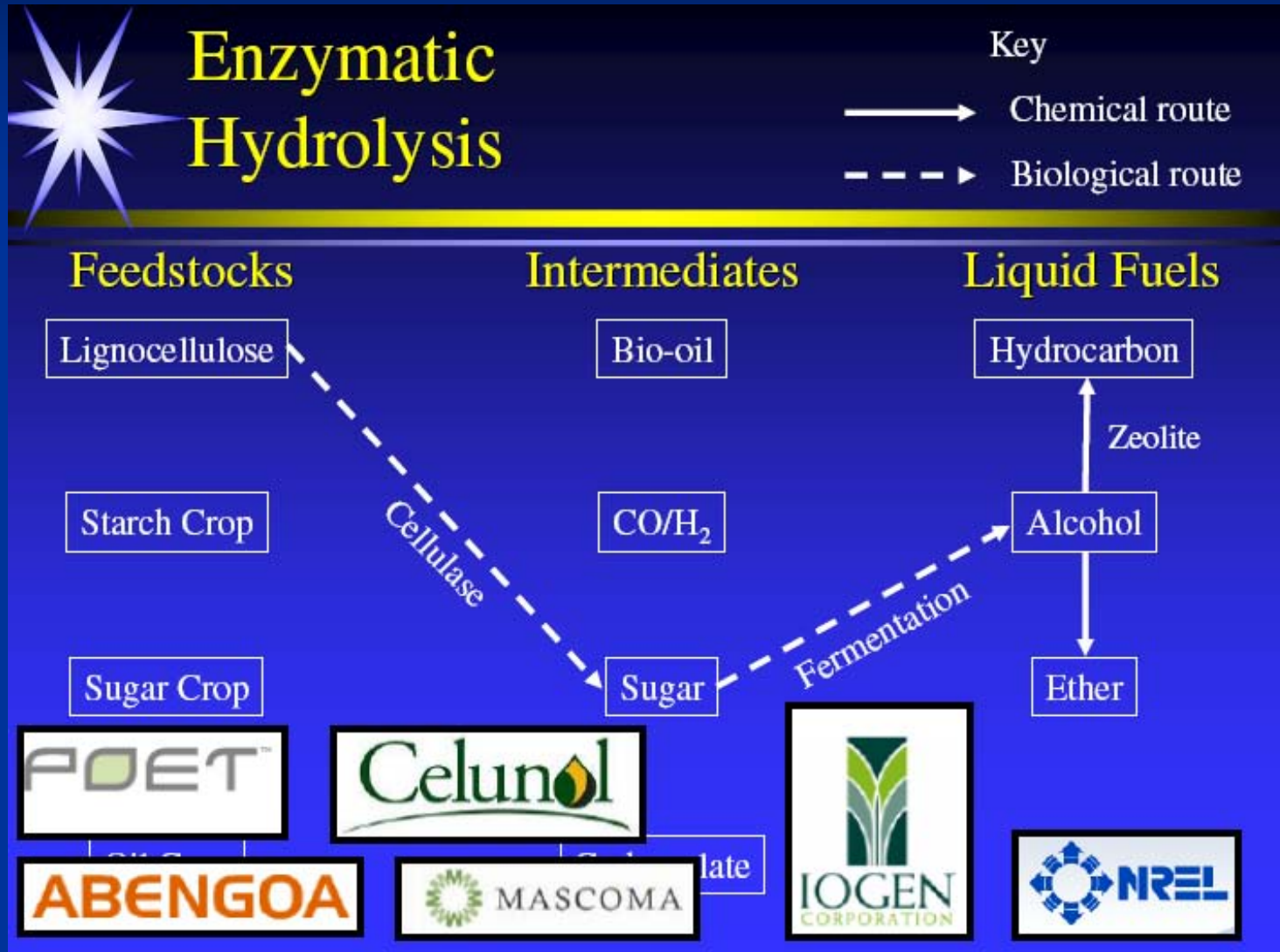
Ether

IOWA STATE UNIVERSITY





# Enzymatic Hydrolysis



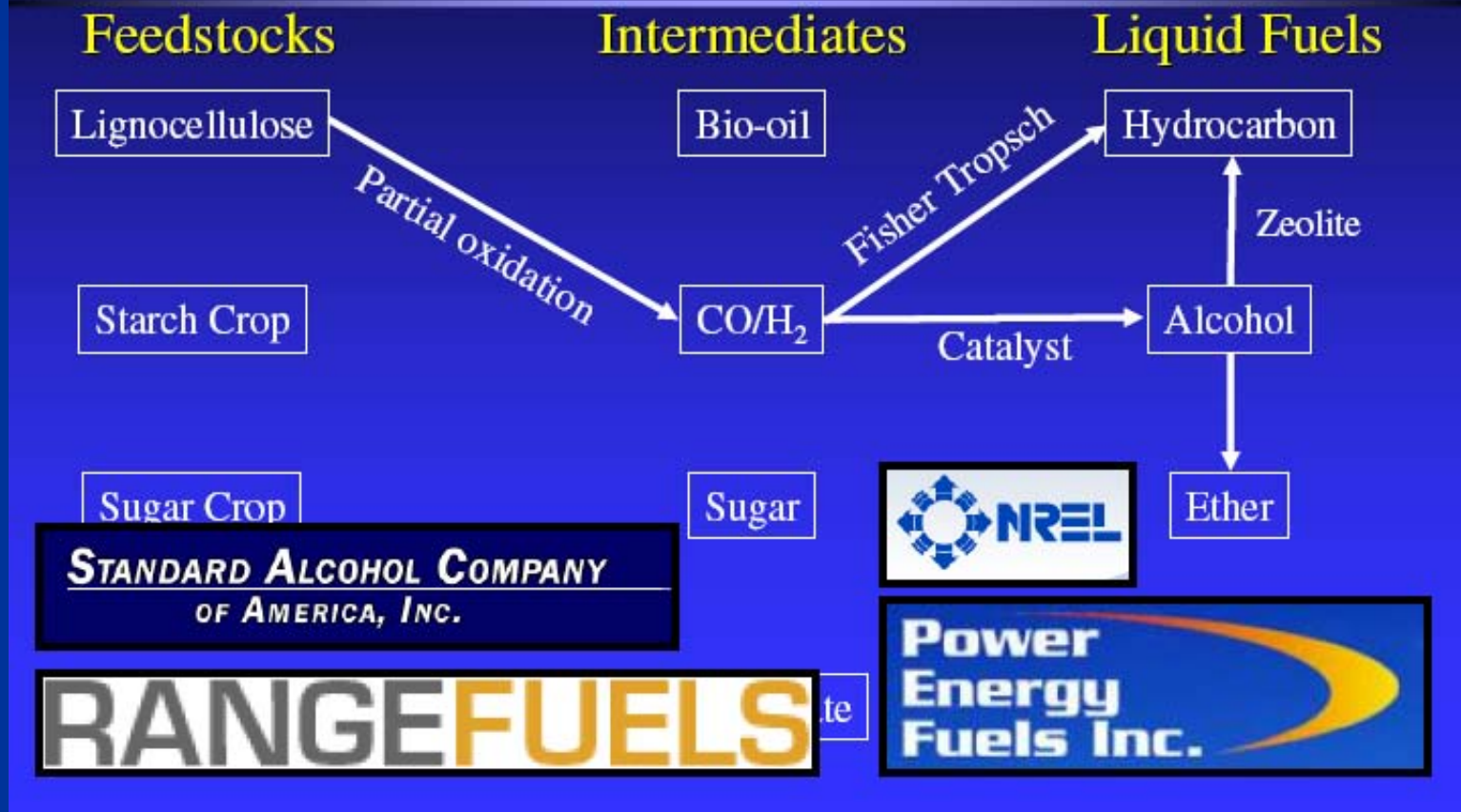
# Gasification



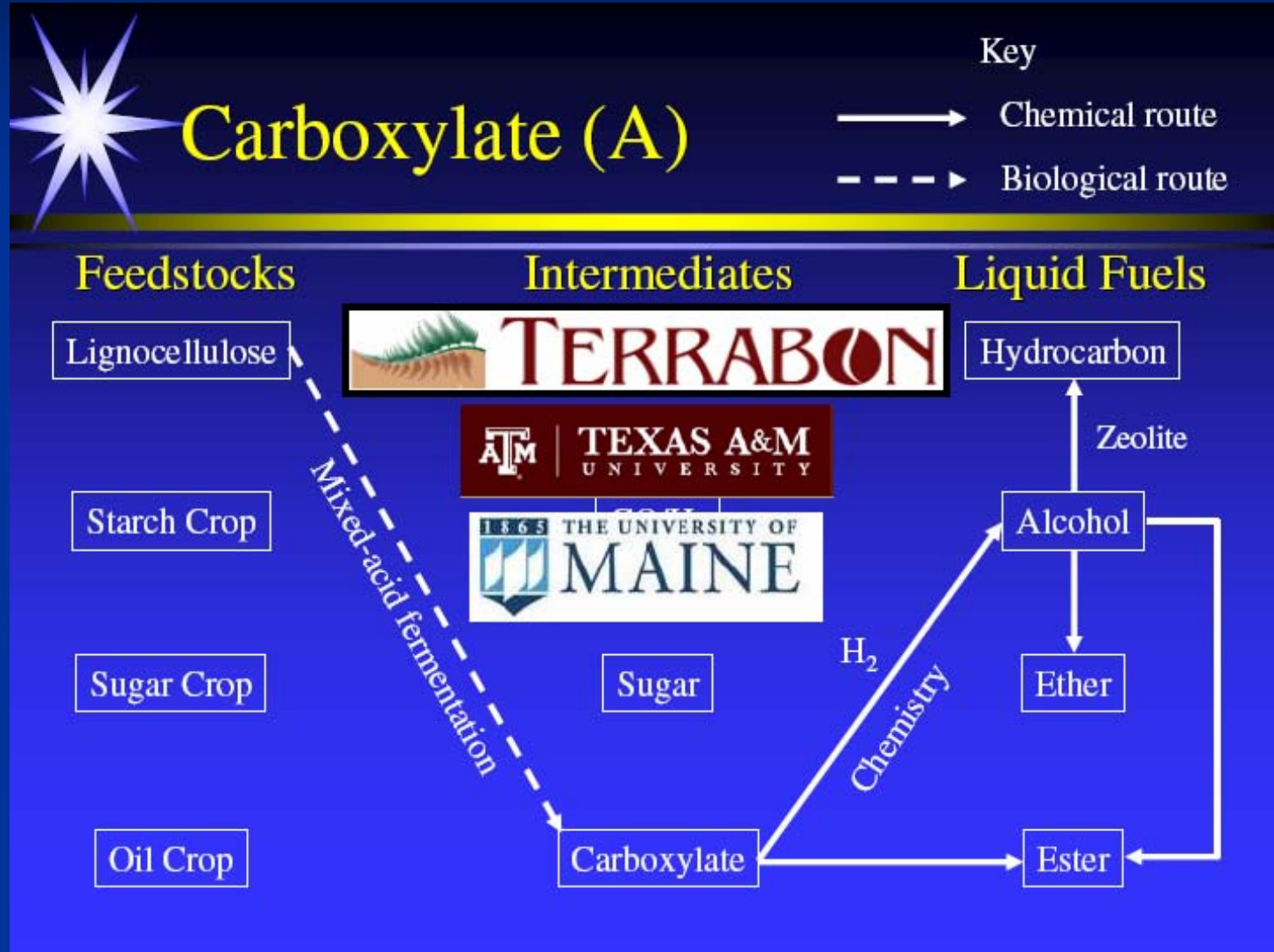
## Gasification

Key

- Chemical route
- - - > Biological route



# Carboxylate



# High Yield, Easy Catalyst



## Comparison of Three Platforms

	High Yield	Easy Catalyst
Thermochemical		
Sugar	×	
Carboxylate	×	×

Worth further investigation

# Carboxylate = More Fuel



## Summary

Theoretical Yield (gal/ton)

Ethanol

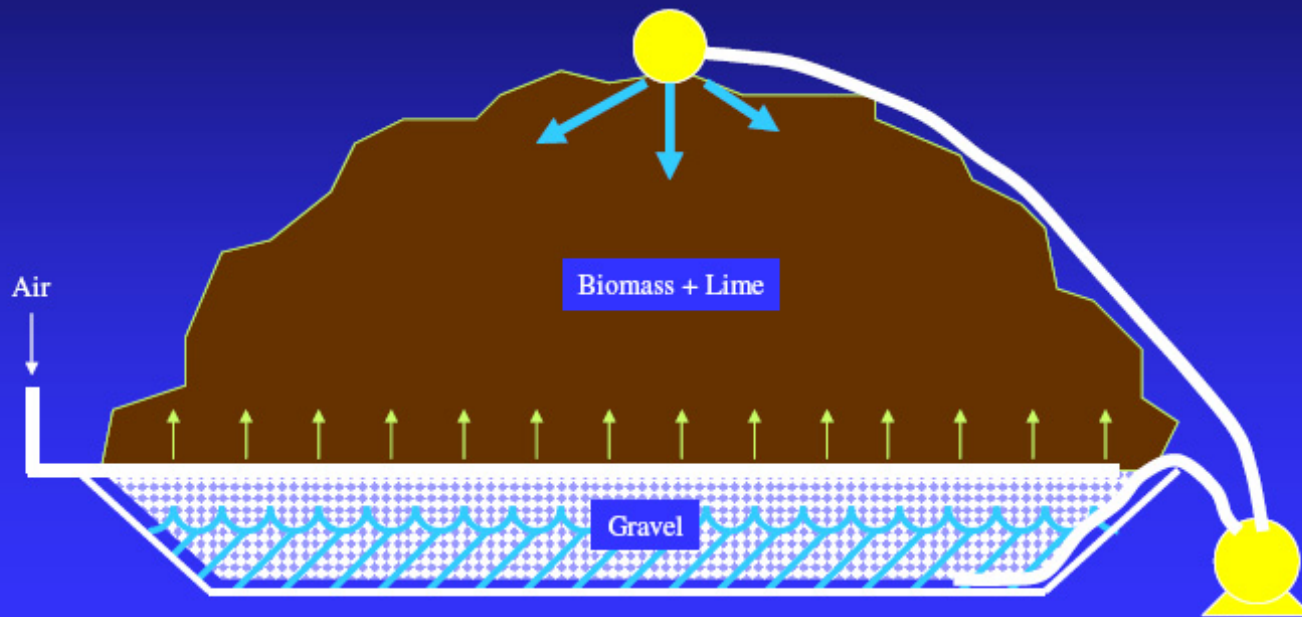
Hydrocarbon

Thermochemical	145	95.8
Sugar	175	115
Carboxylate	175	115

# Lime Treat, Liquid Removal



## Advanced Lime Treatment



# Flexibility is the Key

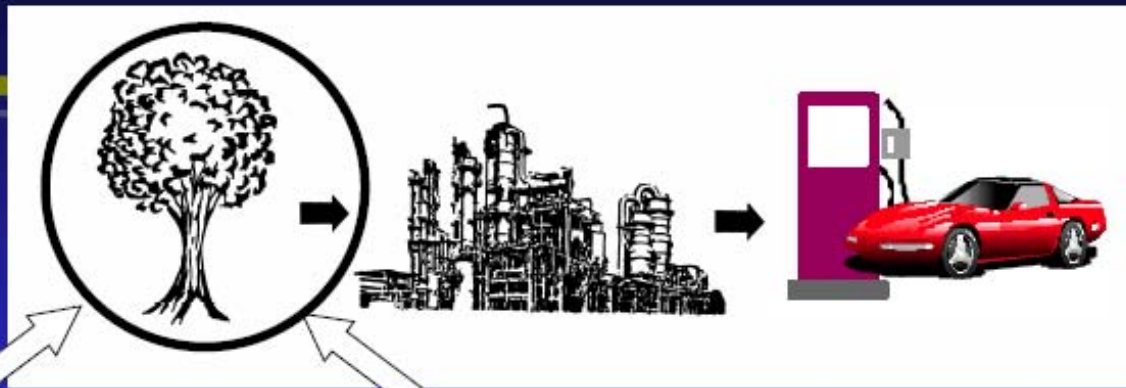


## MixAlco Advantages

- Can use wet feedstocks
- Wide range of feedstocks
- Energy efficient
- No genetically modified organisms
- Many products
- Distributed processing

# Feedstock Flexibility is the Key

## MixAlco Feedstocks



- trees
- grass
- **agricultural residues**
- energy crops
- animal manure
- sewage sludge
- municipal solid waste



# Feedstock

## Availability, Cost & Sustainability

- Feedstock represents 85% of a biofuel plant operating cost and its biggest risk factor
- Locating plant capacity near large resource base for feedstock is critical to developing a sustainable supply of renewable jet fuel
- Examples used in demonstrations so far have been oils (camelina, algae, jatropha, babacu)

# Materials for New Fuels / Chemicals

## SUGAR CANE



## OLEO DE PYROLYSIS



## ACIDO DE CARBOXILATE



# Algae & Co2 Sequestration

- Algae requires CO<sub>2</sub> and fertilizer to grow quickly. Both be supplied from refinery emission streams in fairly pure forms. Needs lots of light, heat
- Locating algae ponds near refineries offers chance to improve carbon numbers of refined fuels since CO<sub>2</sub> from refinery is sequestered
- Allows for sale of low carbon fuels by refinery and increases growth rates of algae

# *Co2 Sequestration w/ Algae Ponds*



## *Camelina Oil*

- Camelina is an oil seed similar to canola with better sustainability due to lower nitrogen, low pesticide, herbicide. Good cold flow properties
- BioPure Fuels 50% partner on developing a 1.2 million ton crush plant in Saskatchewan to crush both canola and camelina oil
- Touted as non-food oil, which is not going to be true when GRAS certification obtained in 2010

# Camelina



## *Babacu Oil*

- Babacu oil was used in test run by Virgin in a “biodiesel” fuel run between Paris & Amsterdam
- Large resource based of existing babacu trees (10 mil. hectares) but oil content low (7%) so a parallel market for biomass needed (pellets, etc.)
- BioPure Fuels working on automated processing equipment to separate oil seeds, produce pellets

# Oil & Carbon for Biofuel/Biomass



**Babacu**



## *Jatropha Oil*

- Many investments now occurring in Jatropha because good biodiesel oil but little experience in high volume cultivation & efficient oil extraction
- Jatropha when grown on marginal lands will result in marginal yields or require irrigation. Meal is toxic and costs to detoxify. Yield less 1 ton/hect.
- Cautious comparison w/ other oil seed tree options

# *Jatropha Curcas*



# Moringa Oil

- Moringa Oliveira is similar tree to Jotropha with optimum yields by year 4 = 2 tons oil/ha
- Can grow on marginal land, resistant to drought. Main advantage is edible meal, high value from leaves as extract to enhance yield, animal feed, herb Values as feed to cattle or herb greater than oil
- Experience base in India and Philippines, we are planning some Moringa in Brazil project

# Moringa Olifeira



# Macauba Oil

- Macauba is native Latin American oil palm tree with very high yield of fruit and oil (4-5 tons oil per ha)
- Meal is edible and height of tree and amount of palm fronds is limited allowing for intercropping
- Testing by Biodiesel Brasil suggests it is the best tropical oil in terms of cetane, cold flow, other

# Best Trees for Oil Production



Macauba

## Palm Oil; Good, Bad & ??

- GOOD: Palm oil is the highest yield source of oil for edible and biodiesel production (4-5 tons/ha) with highly developed industry (35% of all global oil)
- BAD: Indonesia is using excuse of job creation from palm plantations to justify forest destruction because of corruption of govt., value of timber to developers
- ????: Palm industry is claiming that new breeds of palm will achieve 10 times the yield of current trees (this would dramatically change importance of palm)

# Palm Oil





# Large Volume Feedstock Options

- Sustainable BioBrazil (NGO we work with) just got 1 million hectares of agricultural land from state of Maranhao, Brazil for biofuel feedstock development
- We plan to plant 1/2 mil. hectares oil seed trees and 1/2 million hectares of sugar cane. Output:
  - 4 tons oil/ha (macauba) = 2 mil. metric tons oil
  - 70 tons biomass/ha (sugar cane) = 35 mil. tons cane alcohol @15% = 5 mmt; bagasse @ 30% = 10 mmt

# Sustainability = High Yields/Hectare



Macauba

4-5 tons of oil



Sugar Cane

76 tons of biomass

# Ag. Waste and MSW Sources

- BioPure Oil project in Canada plans to make biofuel from flax straw burned in fields. Resource is 800,000 tons, 5 times as much wheat & barley
- MSW resource base is large. Potential to produce 6 billion gallons of biofuel from MSW in USA. Politics of permits and waste access complex
- Key is defining waste resource that has a negative value and can be delivered to plant at low cost

# Growth: Food & Fuel

- Expansion of biofuel crops offers chance to grow both food & fuel on same acres and greatly expand output of meal, beans & other food. Some crops fix nitrogen & reduce need for nitrogen fertilizer
- MA 1 mil. hectare project will include food production on 1/2 mil. hectares and local and export of food in large quantities. Provides opportunity to show world that both food & fuel can be grown on same land sustainably

# Land Use Change

- Major issue affecting carbon benefits if miscalculated  
Considered in biofuels but not other fuels
- Important to look at realistically where you can grow biofuels profitably and then get minimal impact from land use change through use of all biomass and from fixing nitrogen with coplanting & rotation
- Indirect land use change best dealt with through carbon trading system to preserve wild jungles, forest

# Co2 Credits to Stop Deforestation

- Primary issue related to land use change is deforestation from indirect land use change. Scientific link is weak but impact is large if true
- Airlines face requirement for entry into EU ETS in 2011. Alternative is to propose international carbon credit program & include oil seed tree planting and avoided deforestation to earn credits  
= future biofuel feedstock, travel/tourism value

# Invitation to Policy Roundtable

- Urban Bio-Alliance helping to organize major biofuels, Co2 trading conference and policy roundtable in Palmas Tocantins, Brazil Oct. '09 with participation by all Amazon states, US states & invitation to airline & maritime industry, China
- Proposal to link sale of carbon credits for entire Amazon (120 billion tons) to parallel effort to expand biofuel feedstock in agricultural areas and open up markets globally for biofuels. Combined strategy leads to complete solution for airlines

# Don't Forget Efficiency

- Most important strategy airlines will use to meet carbon targets is efficiency reductions
- Biofuels introduction offers opportunity to evaluate use of fuel additives that improve fuel combustion efficiency. Know of one company working with additive we like that is getting 5% fuel savings at treat rate of 2.5 cents/gallon



# Contact Information

## BioPure Fuels

**Texas:** 17815 Kings Park, #553 Houston TX 77058

1 303 895 0249 1 281 984 7225

**Brazil:** Rua Virgilio Domingues 328, Apt. 302 Sao Luis, MA

[billwason@biopurefuels.com](mailto:billwason@biopurefuels.com)

[Willy\\_wason@yahoo.com](mailto:Willy_wason@yahoo.com)

[www.biopurefuels.com](http://www.biopurefuels.com)

[www.urbanbioalliance.org](http://www.urbanbioalliance.org)

[www.sustainablebiobrazil.com](http://www.sustainablebiobrazil.com)