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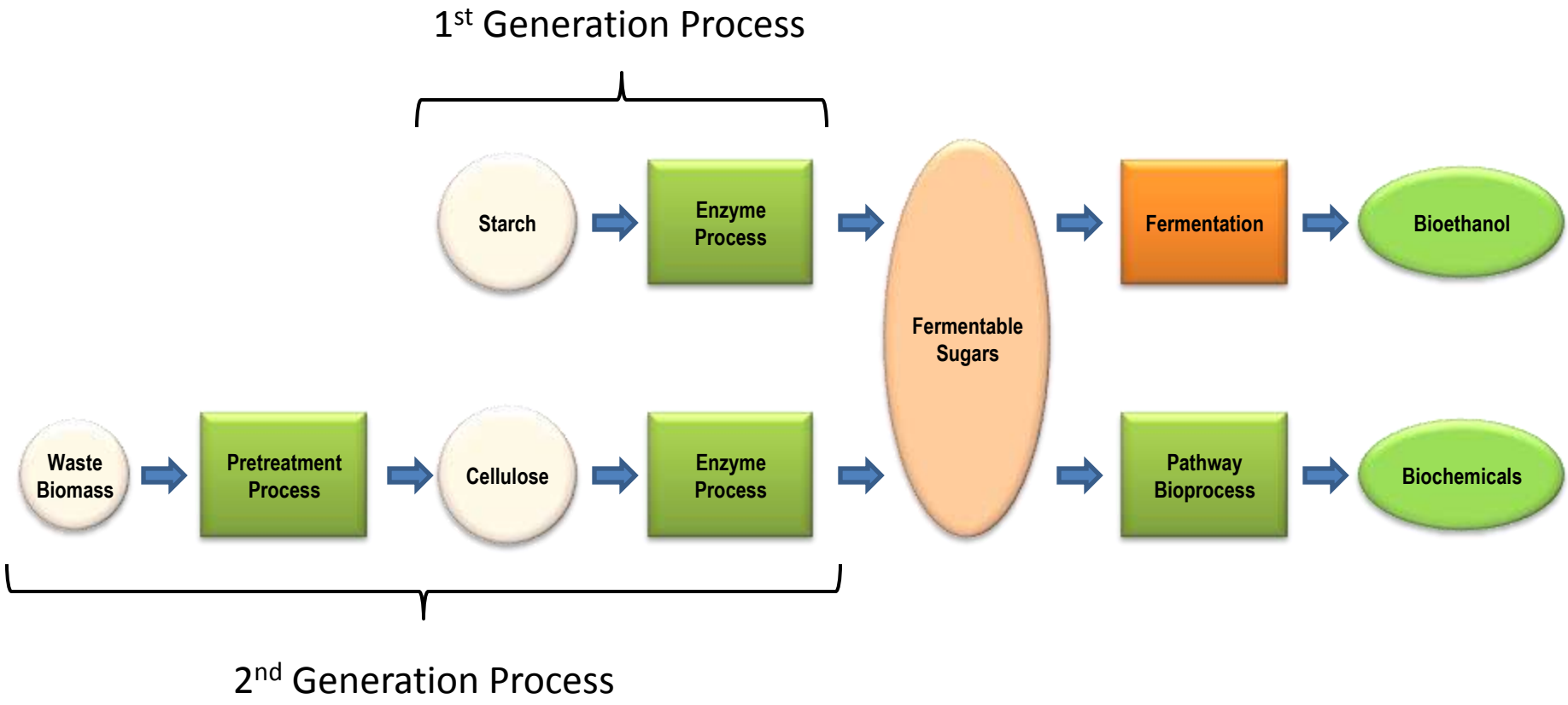
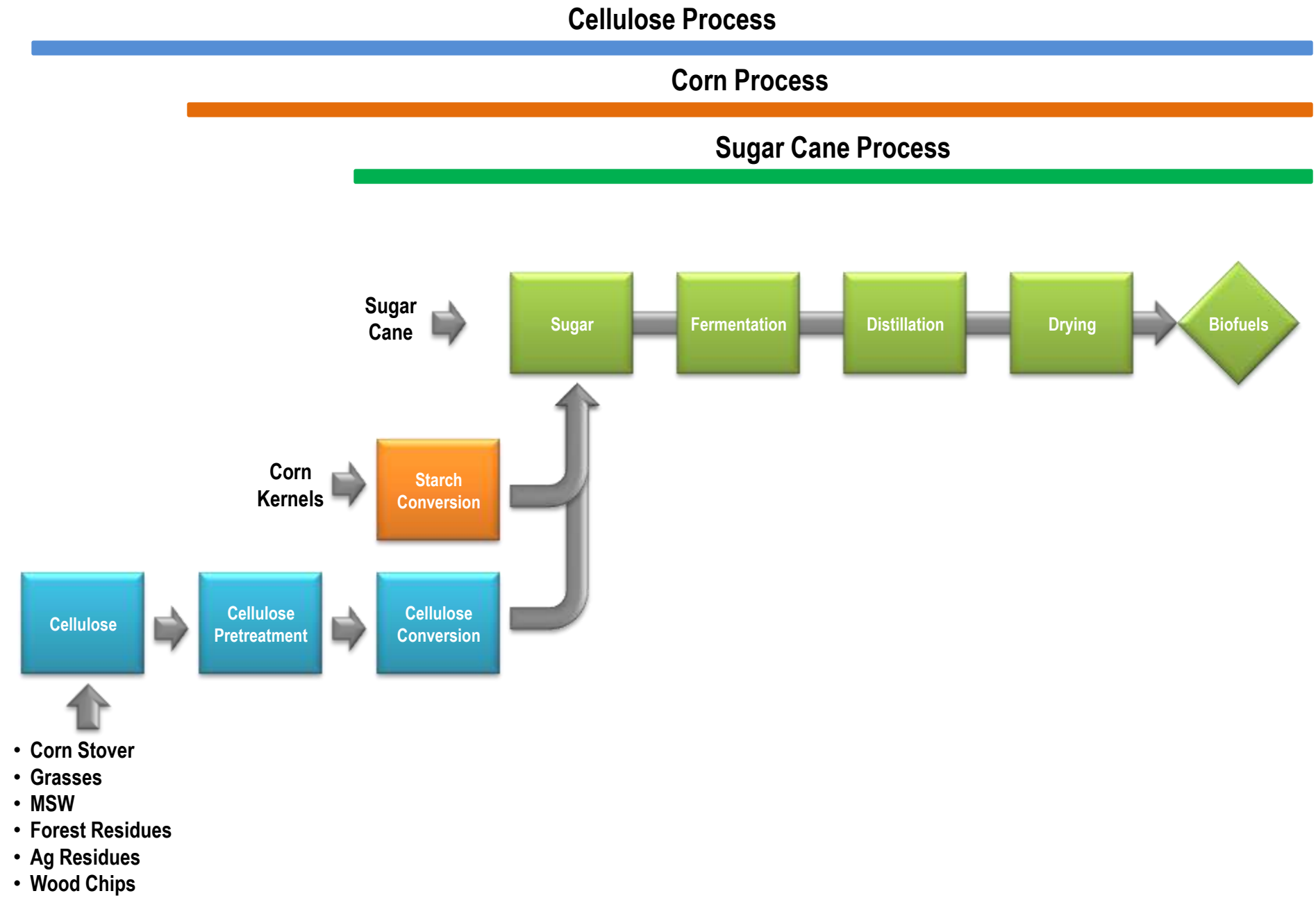
Sugar platform and beyond

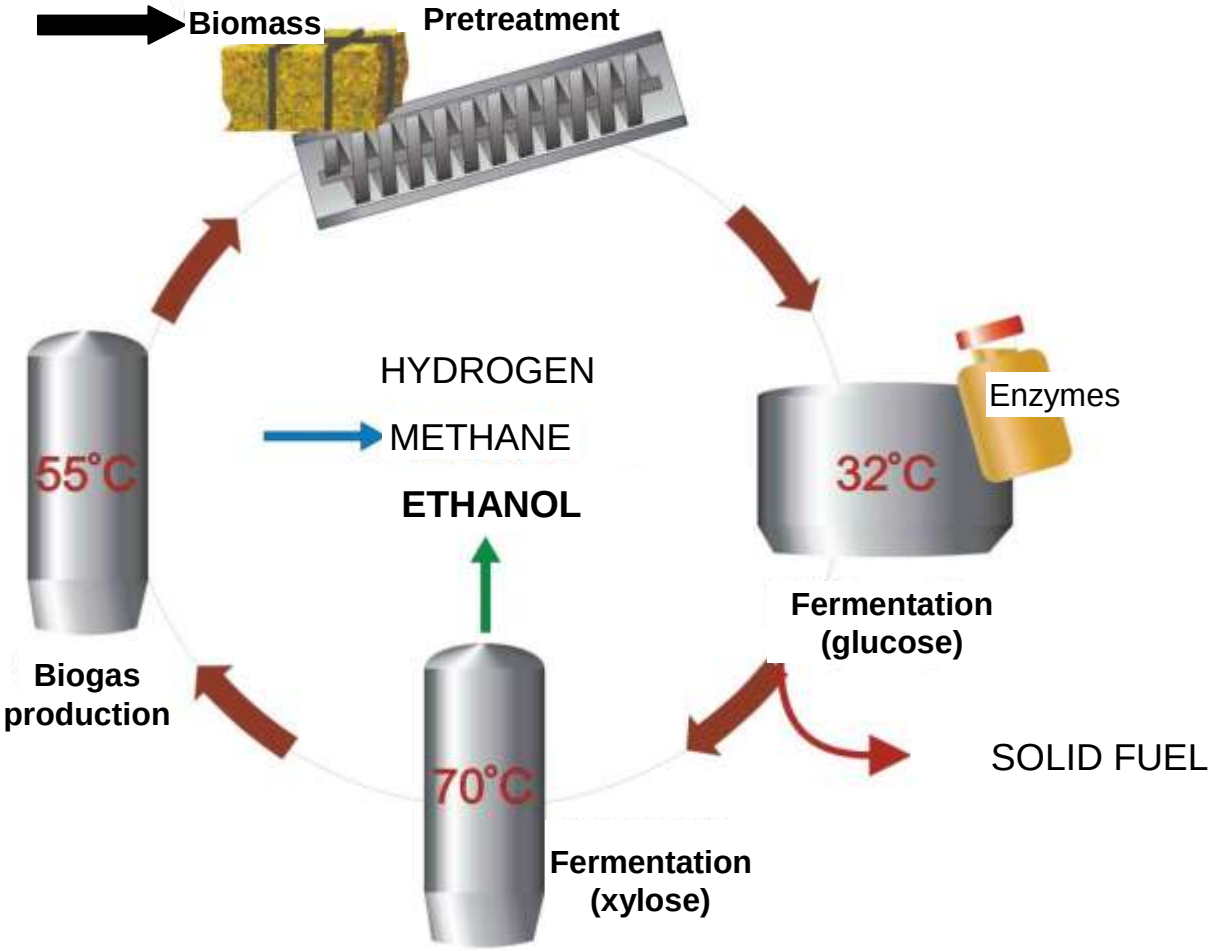
"Concepts for producing advanced biofuels and bioproducts"

Birgitte K. Ahring, WSU

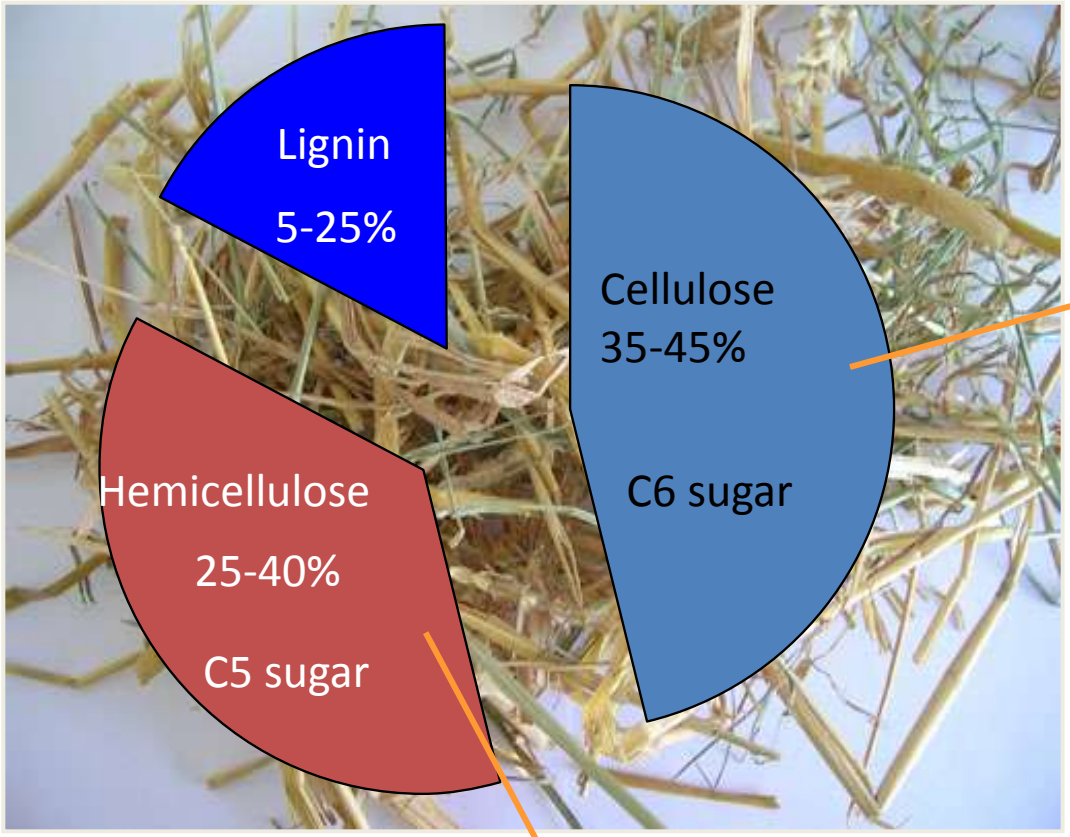

1st Generation Process
Starch
Enzyme Process
Fermentable Sugars
Fermentation
Bioethanol
Waste Biomass
Pretreatment Process
Cellulose
Enzyme Process
Pathway Bioprocess
Biochemicals
2nd Generation Process


Cellulose Process
Corn Process
Sugar Cane Process
Sugar Cane
Sugar
Fermentation
Distillation
Drying
Biofuels
Corn Kernels
Starch Conversion
Cellulose
Cellulose Pretreatment
Cellulose Conversion
• Corn Stover
• Grasses
• MSW
• Forest Residues
• Ag Residues
• Wood Chips

BioGasol's Concept

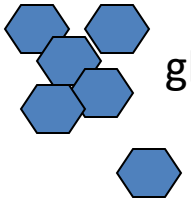


Straw, wood, etc..



Klinke et al., 2000

xylose, arabinose, galactose, mannose, glucose.

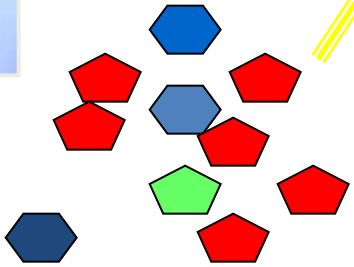


glucose

Yeast / BG1

Ethanol

BG1



Lignocellulosic biomasses

Tested with success in the laboratory

Wheat straw

1 tonnes wheat straw

300-320 liters of ethanol

Coffee Husks

Corn Stover

Rice Straw

Willow

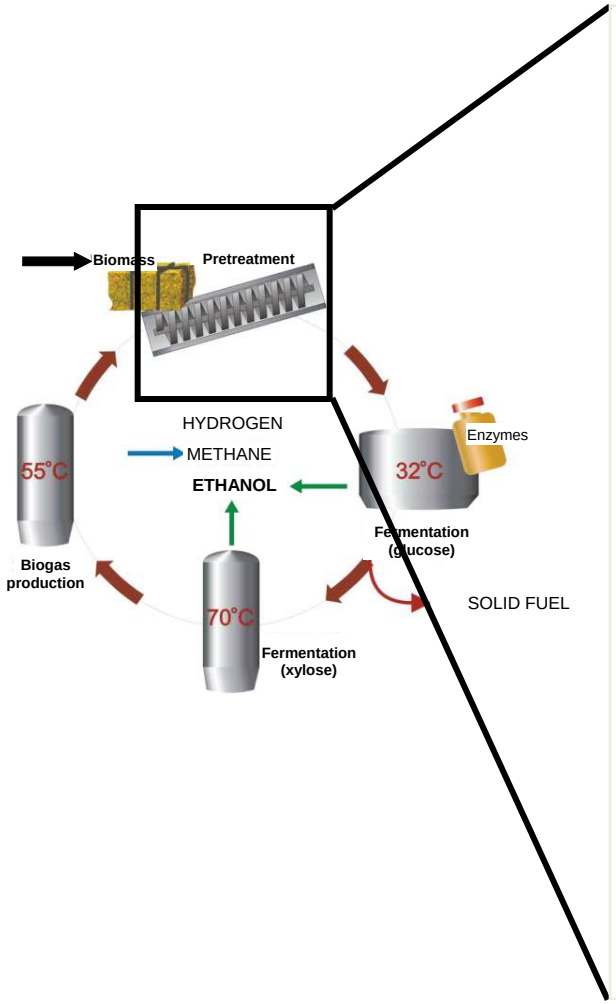
Eucalyptus Wood

Sugarcane Bagasse

Pilot plant under construction

Pilot plant

Pretreatment-wet oxidation
BioGasol proprietary technology



Biomass is macerated

Biomass cut in small pieces to increase surface area and ease handling

Wet oxidation

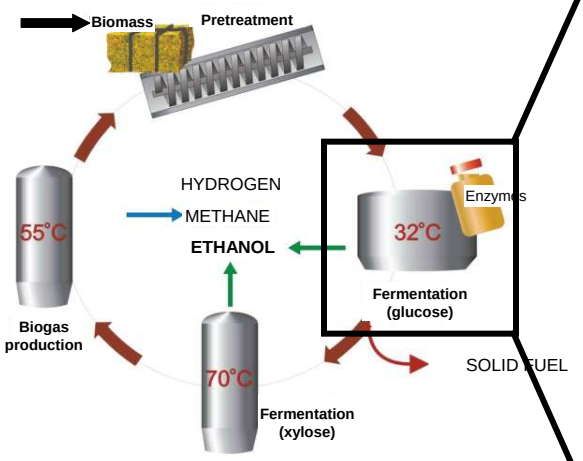
Temperature: 160-180°C (12 to 20 bar)

Additions: Oxygen & Water

Exothermic process

Heat will be produced

Enzymatic treatment and glucose fermentation



Hydrolysate cooled

No detoxification required

Enzymes added

Commercial enzyme mixture: Cellulases & β-glucosidases

Mesophilic fermentation

Saccharomyces cerevisiae

C6 fermentation

Yield: 0.45 – 0.48 g ethanol / g C6 sugar
Productivity: 1 - 2 g ethanol / l / h

Pretreated straw 20% DW

Enzymatic hydrolyzed straw 1.5 hours

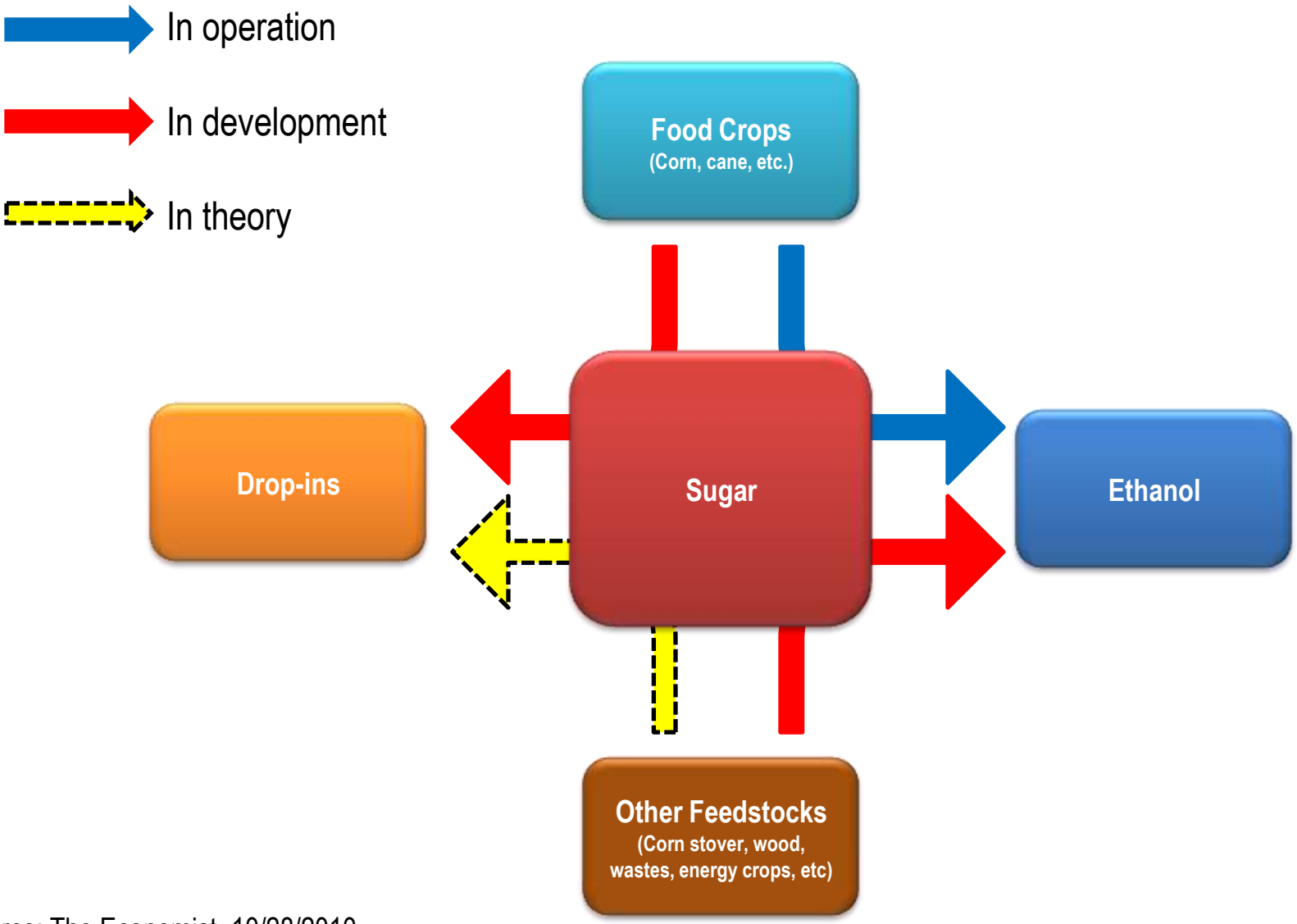
After SSF 48 hours

The aviation problem

- Energy density
- Freezing point
- Sulfur and particle generating content
- Availability
- Prize

Different quality Fuels

Ways of making biomass into fuels

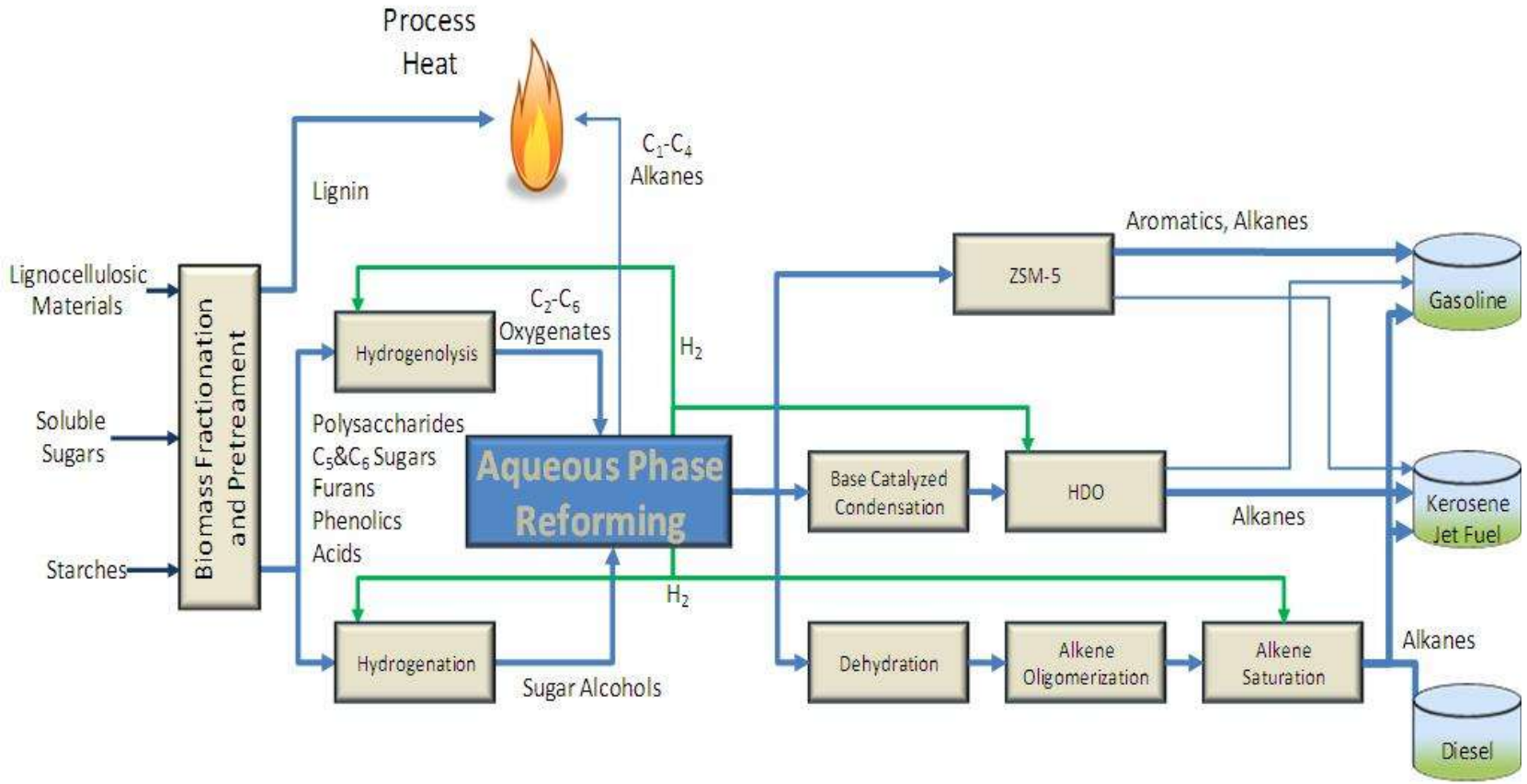


Source: The Economist, 10/28/2010

NABC
National Advanced Biofuels Consortium

Biofuels for Advancing America

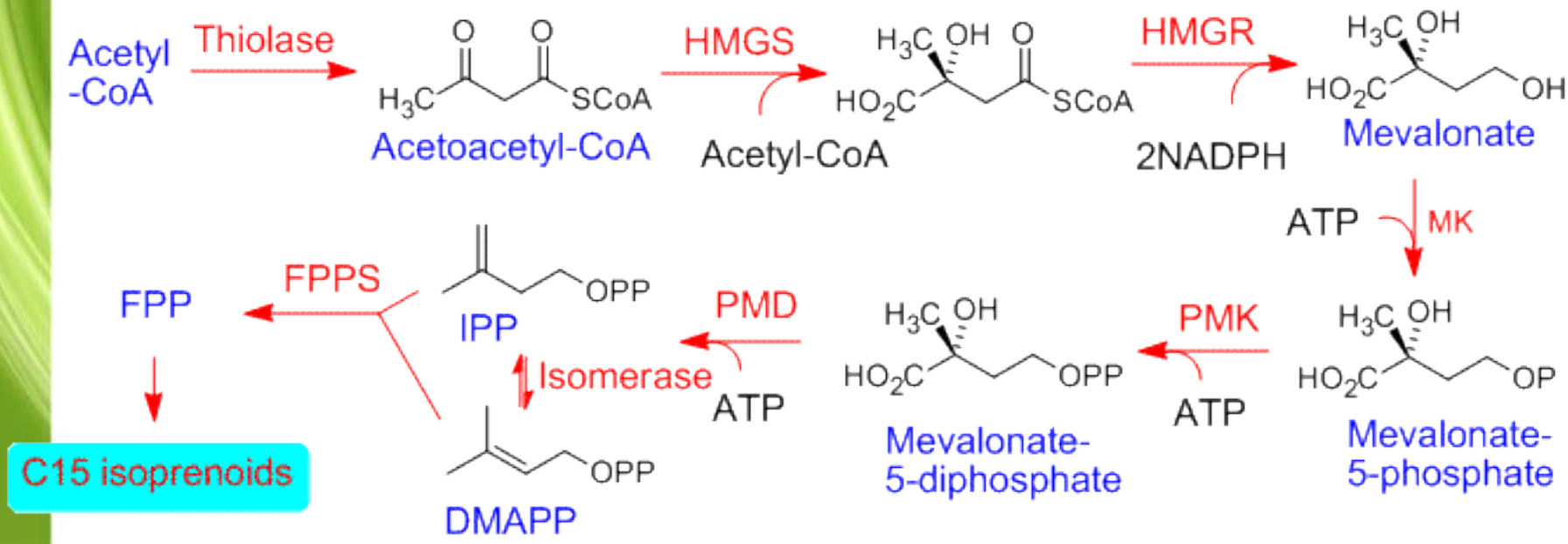
Catalysis of Sugars



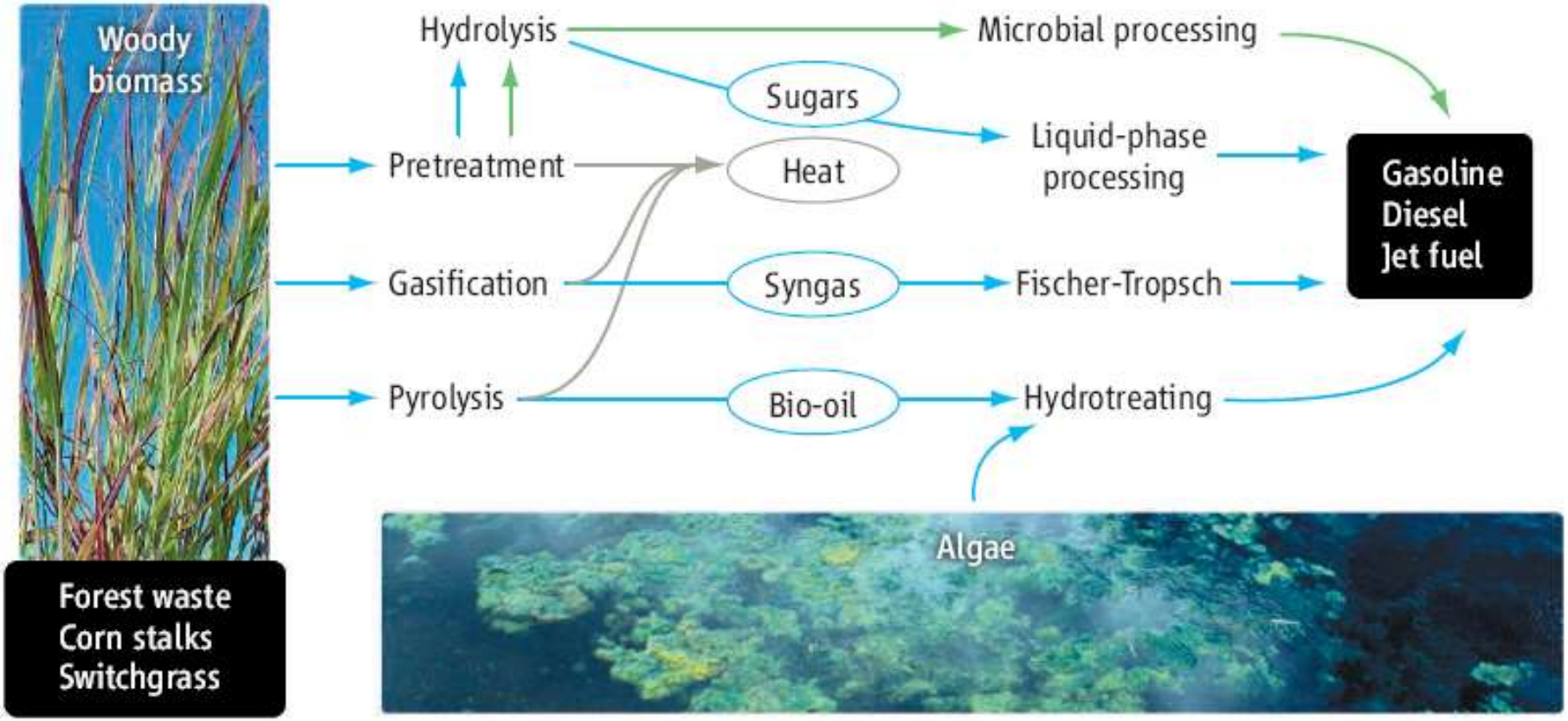
BIOFORMING PROCESS

Fermentation of Sugars

- The fermentation technology builds on isoprenoids. The primary (5-carbon) building block is isopentenyl pyrophosphate (IPP).
- Will be looking at organism development for C5 sugar utilization and biomass hydrolysate compatibility.



Mevalonate pathway for diesel fermentation intermediate production (Amyris)


Woody biomass
Forest waste
Corn stalks
Switchgrass
Hydrolysis
Microbial processing
Sugars
Liquid-phase processing
Pretreatment
Heat
Gasification
Syngas
Fischer-Tropsch
Gasoline
Diesel
Jet fuel
Pyrolysis
Bio-oil
Hydrotreating
Algae

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Full biomass utilization & feedstock flexibility

Integrated biorefinery process concept maximizes the utilisation of the biomass resource

(i.e., converting the biomass available into a number of high energy products). We call it the:

"the carbon slaughterhouse "

Wheat Straw

Miscanthus

Corn Stover

Rice Straw

Paper and Food Waste

Solid Waste

The Integrated Biorefinery concept can use many different types of biomass materials

Equipment for the pilot testing of the BioCat* process