Bio-ethanol production

from sugar- and starch, cellulose containing feedstock

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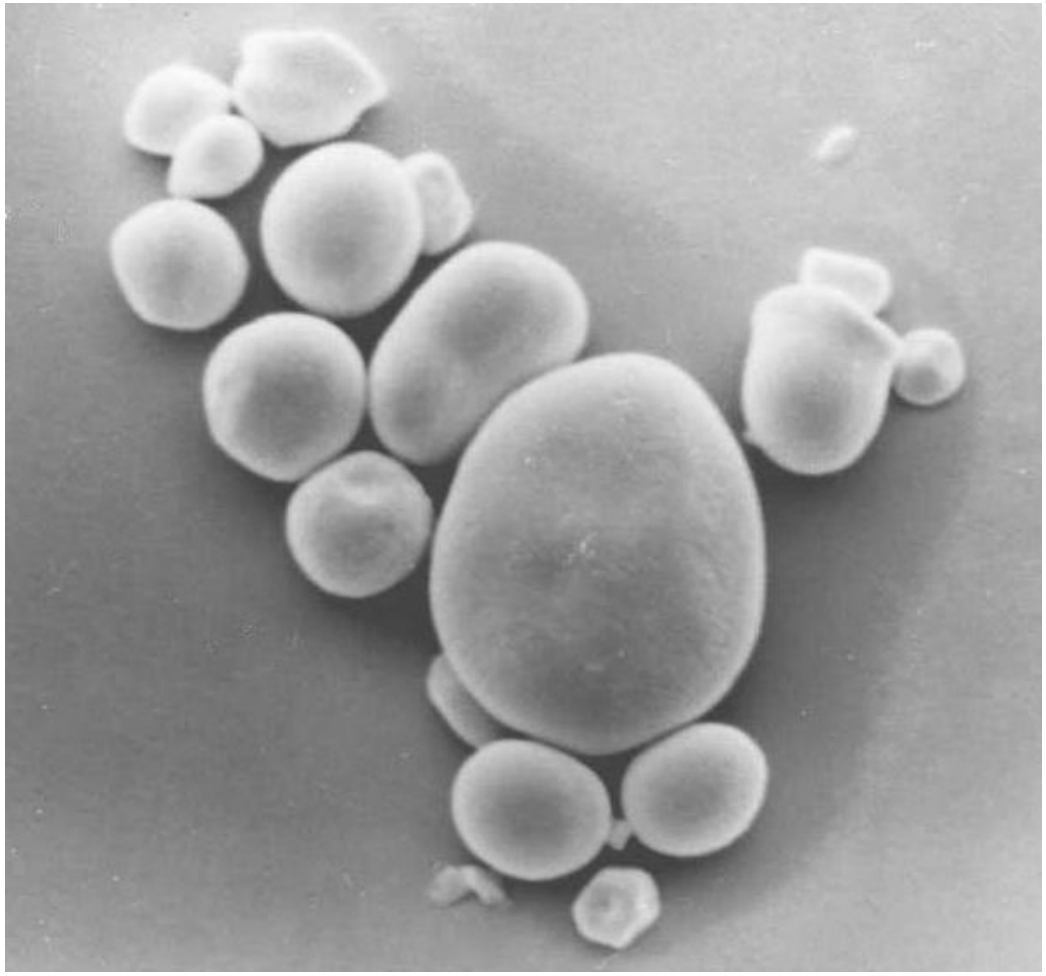
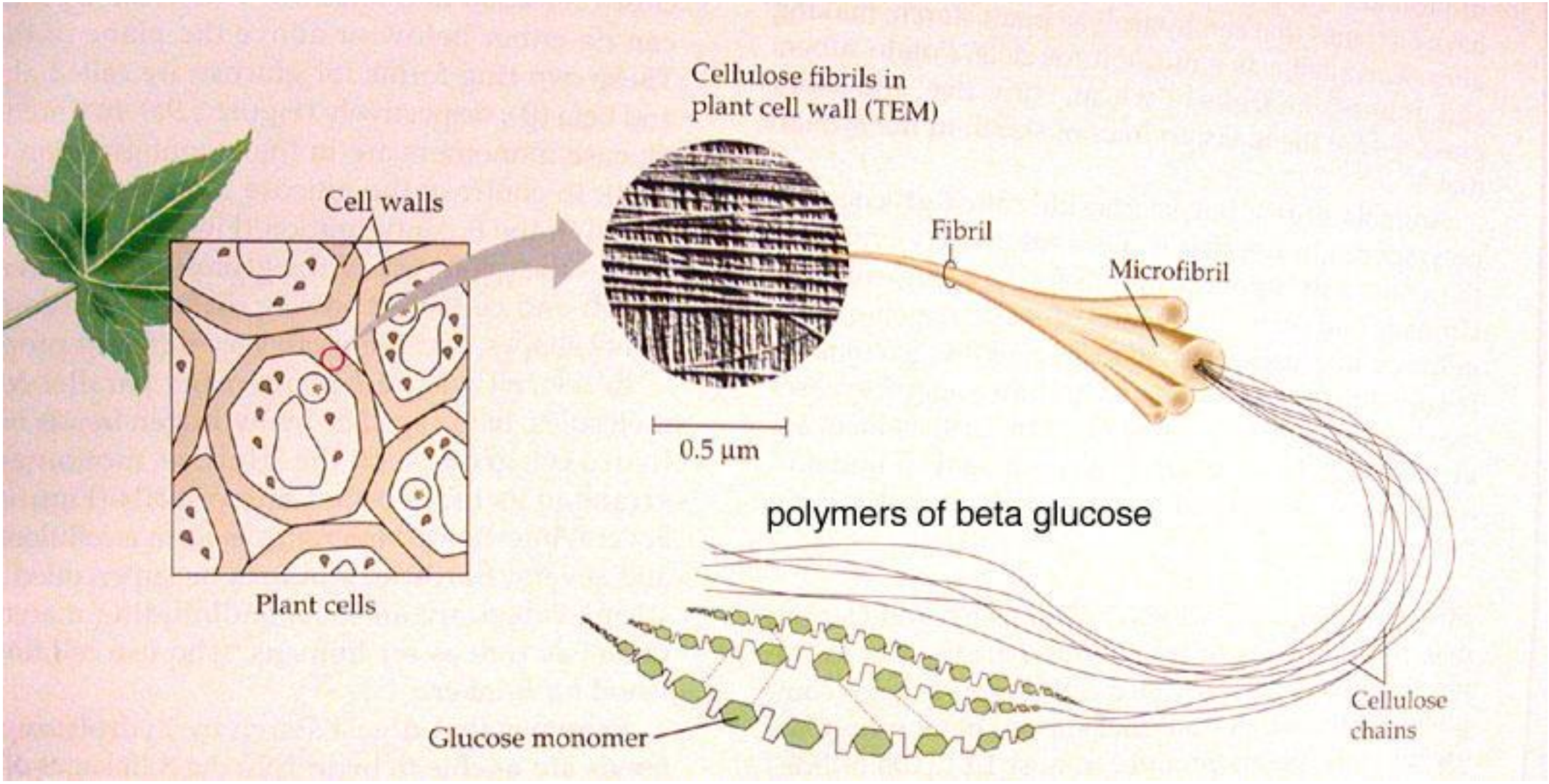
Feedstock: types

- Sugar
- Starch
- Cellulose



(starch granules)

Feedstock types



Feedstock: examples

- Sugar cane
- Corn
- Cassava
- Sugar palm
- Sugar beet
- Sweet Sorghum
- Sweet potato
- Bananas
- Coffee residues
- Wood

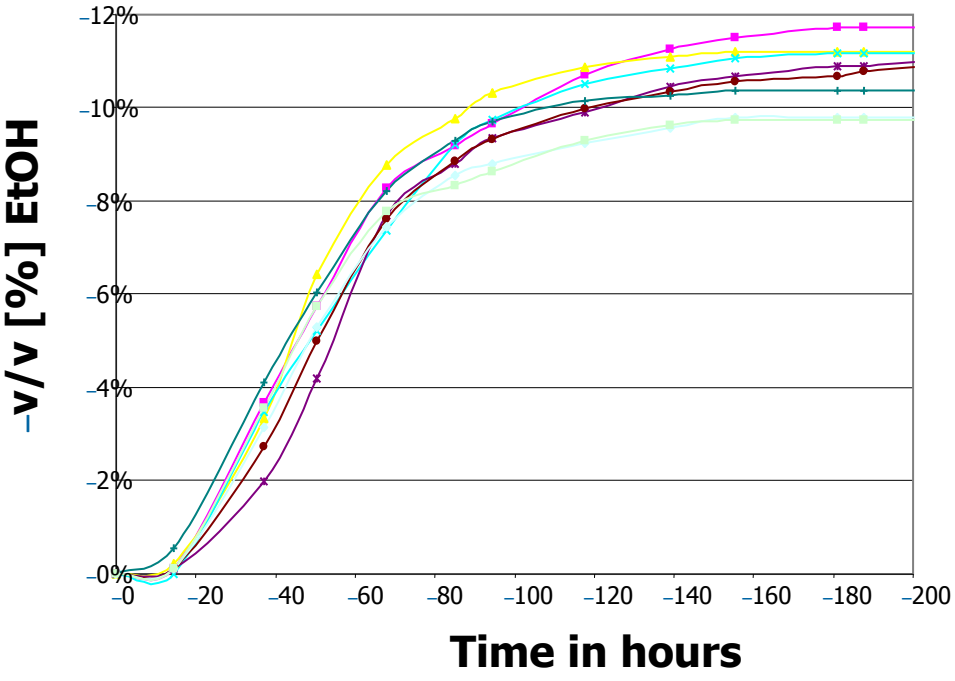
Production potentials

1 kg of sucrose → 0,52 liters of ethanol (≈12,6 MJ)

Feedstock	Yield	Ethanol yield
Sugar palm	20 ton sucrose /ha/year	≈ 10000 liters/ ha/ year
Cassava	25 - 60 ton/ha per year	≈ 3750 - 6000 liters/ha/ year
Sugar cane	40 -75 ton raw sugar cane/ha/yr	≈ 2800 - 5250 liters/ ha/ year
Sweet sorghum		≈ 2500 –4000 liters / ha/ year
Sugar beet	60 ton/ha/year	≈ 5700 liters/ha/year
Corn	5 ton/ha/year	≈ 2050 liters/ha/year
Wheat	4 ton/ha/year	≈ 1560 liters/ha/year

Cassava

- 25 ton/ha per year
- 150 liter etanol/ton
- 3.750 lts etanol/ha por year



Evaluation of efficiency of bioethanol production from different cassava varieties

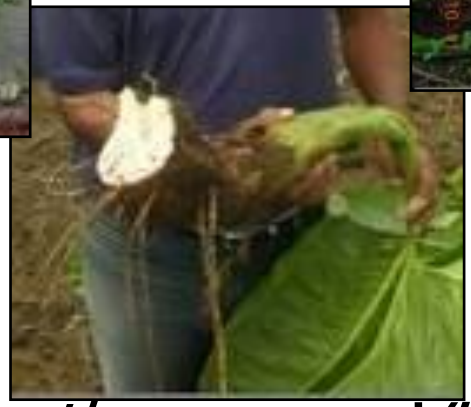
Sweet sorghum

Sugar beet

2500-5700 liter/ha/ year

Sweet potato ethanol

other root crops



- 45 ton/ha per year
- 150 liter ethanol/ton
- 6750 lts etanol/ha per year

Xanthosoma y *Violaceum*

Banana

- No need for mechanisation
- 50 kg/plant
- 67 ton/ha per year
- 3.350-7.000 liter ethanol/ha per year

Ethanol production

- (Hydrolisis)
- Fermentation
- Distillation
- Drying

Hydrolisis

- The cellulose molecules are composed of long chains of sugar molecules. In the hydrolysis process, these chains are broken down to free the sugar, before it is fermented for alcohol production.

- There are two major cellulose hydrolysis (cellulolysis) processes: a chemical reaction using acids, or an enzymatic reaction.

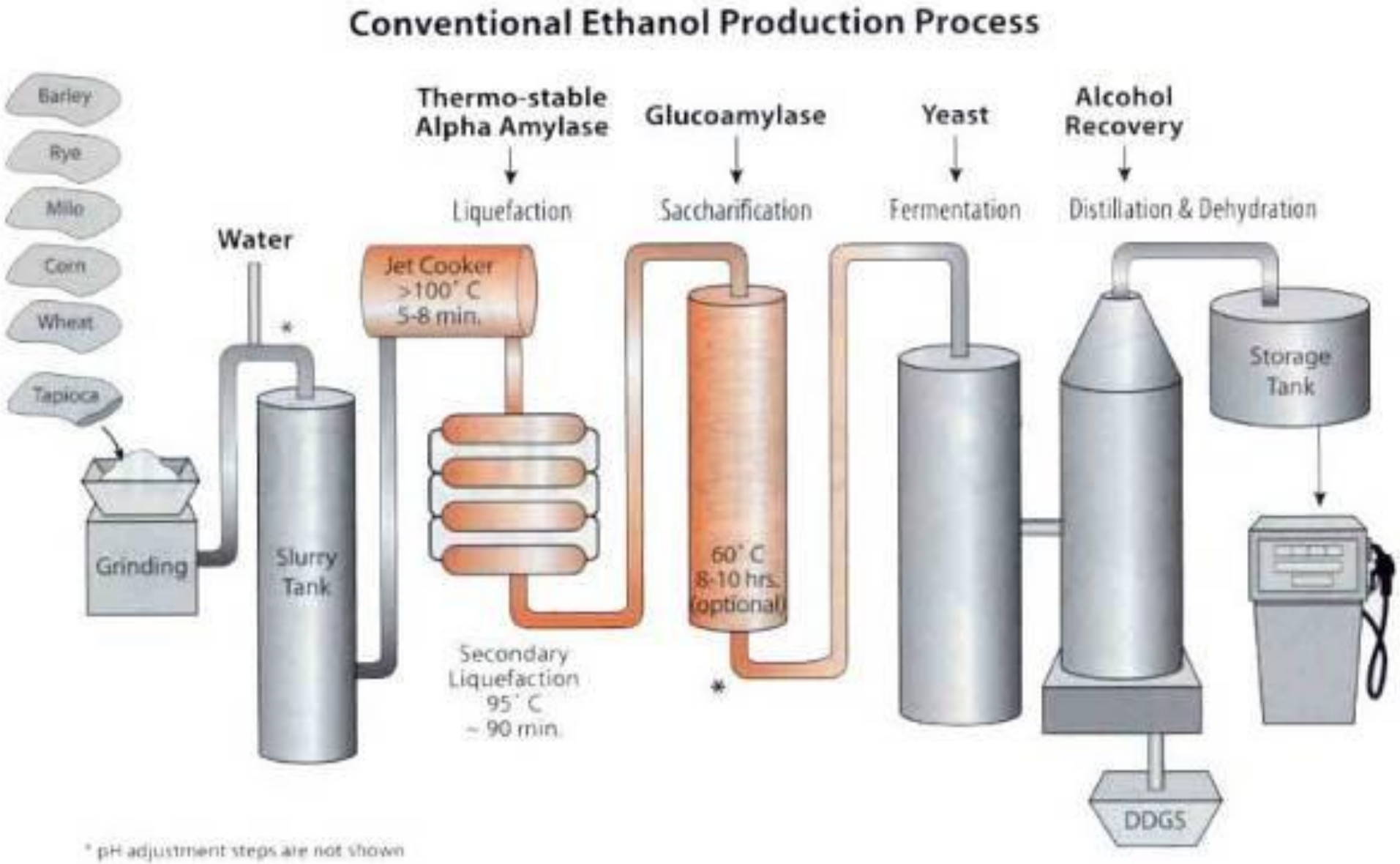
Fermentation

- The chemical equation below summarizes the fermentation of glucose, whose chemical formula is $C_6H_{12}O_6$.

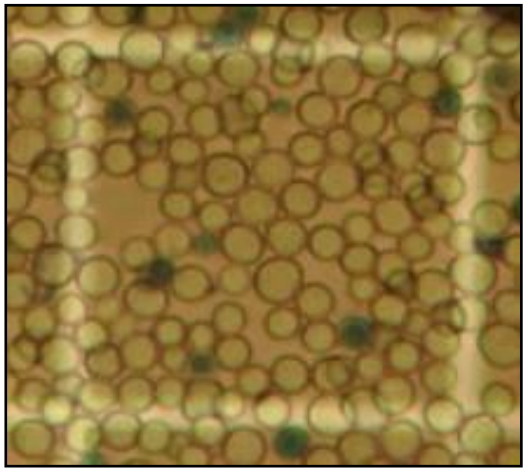
- One glucose molecule is converted into two ethanol molecules and two carbon dioxide molecules:

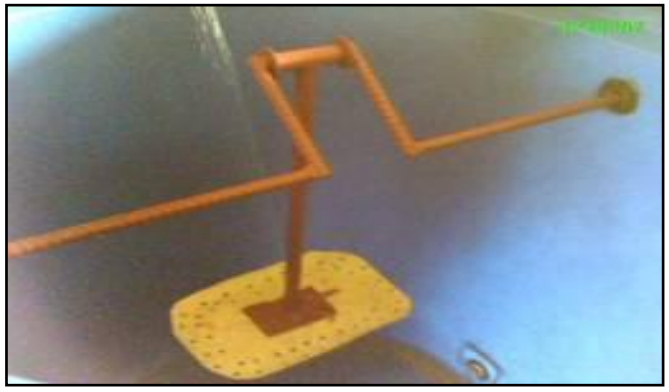
- $C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$

Fermentation



Fermentation: Colombia





Distillation & Ethanol drying

Distillation of 1000 liter of 10 v/v [%] produces about 100 liter of ethanol in the following forms*:

Liters production	Vol [%]	Liters pure EtOH
75,5	50	37,7
37,7	70	26,4
37,7	95	35,8
	total	100

(*based on field data John Loke)

Uses for ethanol

Hydrous ethanol

- Engine fuel

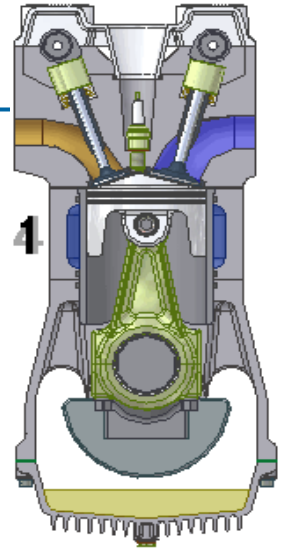
(flextek → > 60 vol %)

- Cooking stoves
- Gelfuels

Anhydrous ethanol

- Blends with gasoline (e.g. E85)
- Blends with diesel
- Direct use in cars
- Stoves

Flextek



–东风汽车公司*

65 % ethanol
&
35% water

*Dongfeng Motor Corporation (China)

Small scale bioethanol production

Rural communities

↓

Consortium of bio-ethanol producers

↓

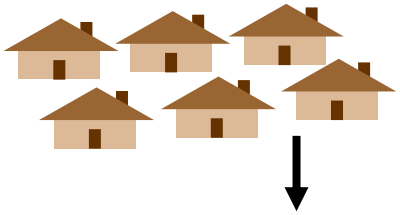
Total land for energy crops
Up to 100 ha.

↓

Micro plants:1.000 – 2.000 liters/day (50%-99,5%)

↓

Central plant for anhydrous ethanol (99,5%)



Composición del fruto del café
Coffee Cherry

COOPEDOTA

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SANTA MARÍA

FACT

Innovative technology to enable rural entrepreneurs to access markets for bio-energy

Thank you for your attention.

Questions?

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