BIOENERGY

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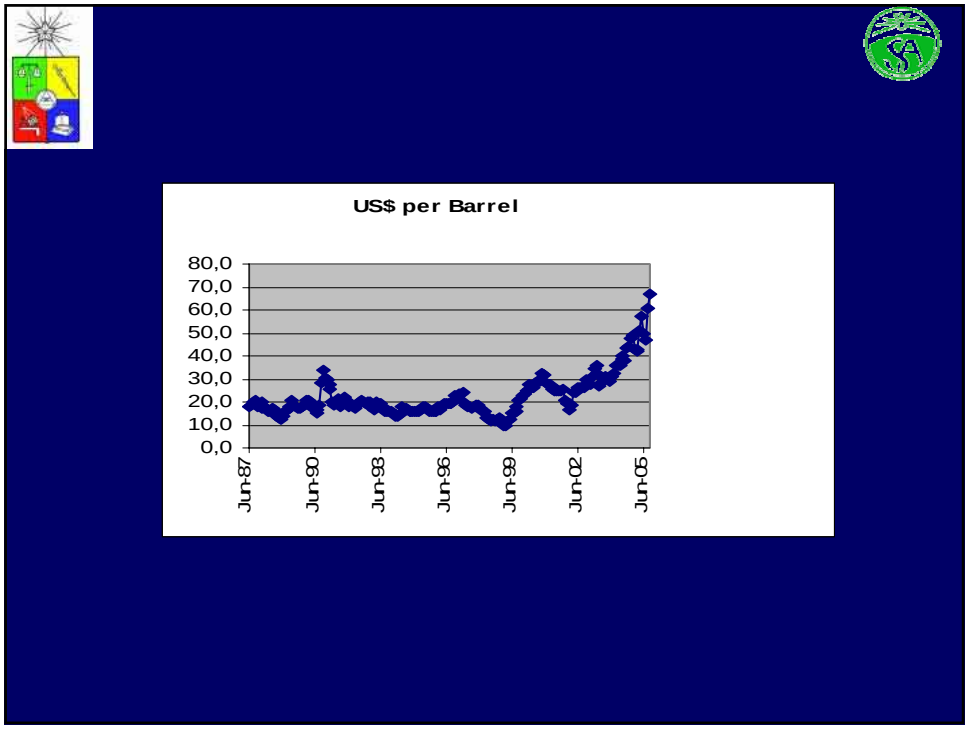
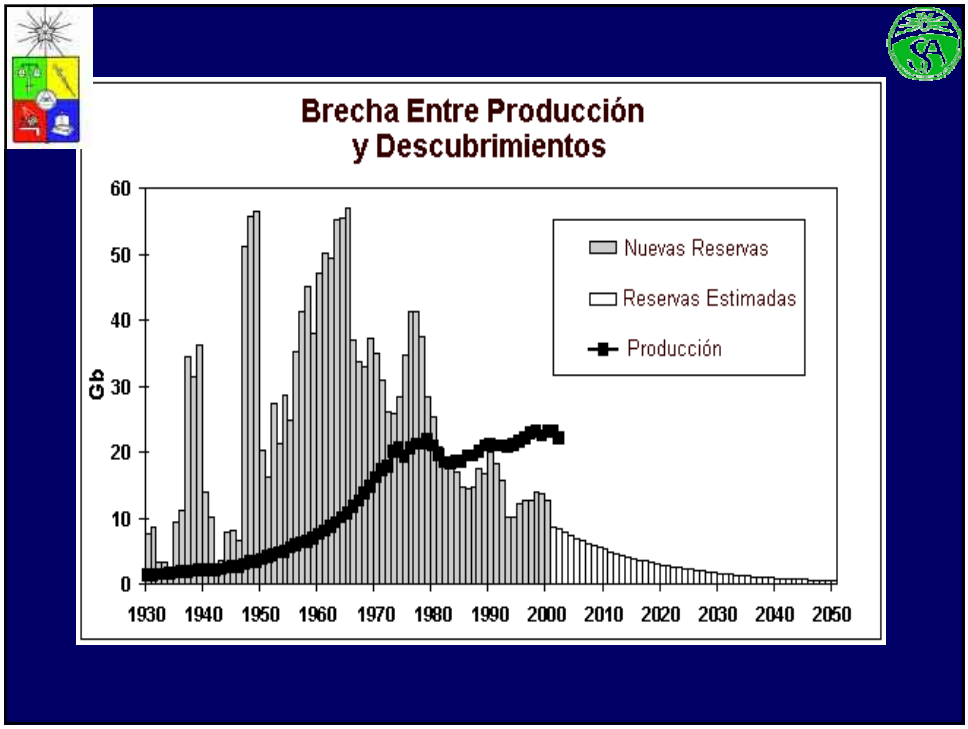
•i.e. decrease in fossil fuel availability is of major concern globally.

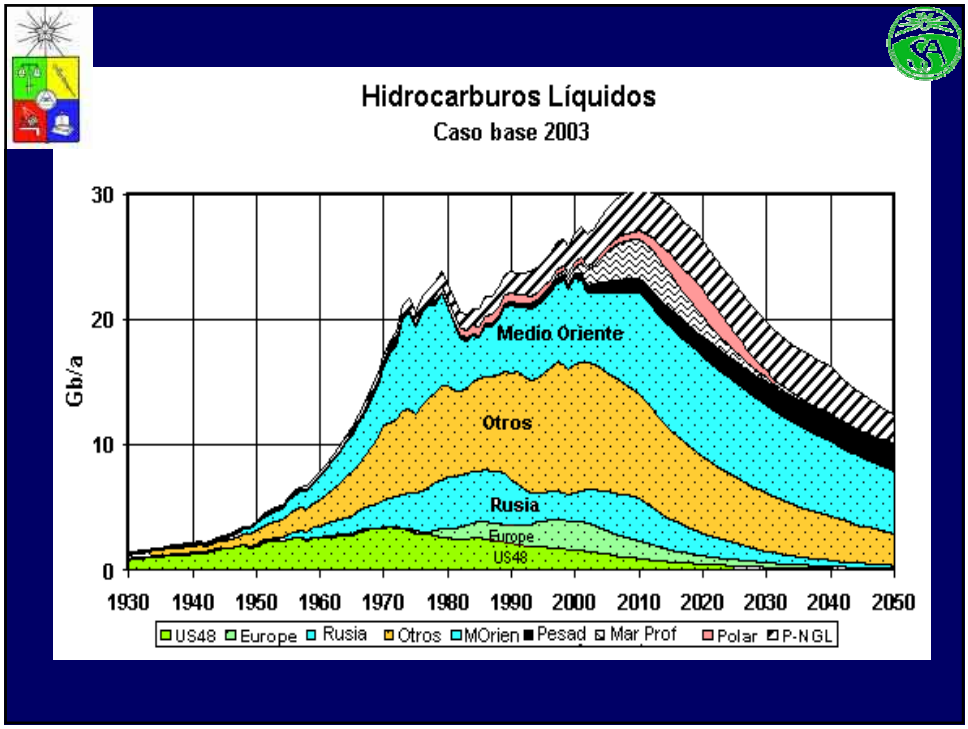
•Fossil fuel oil is the world main source of energy, accounting for 35,3 % of world energy use. In 2004 the world demand of fossil fuel oil was 82,4 millions barrels per day. The production was 83,1 mbd. The major production comes from the Persian Gulf region.

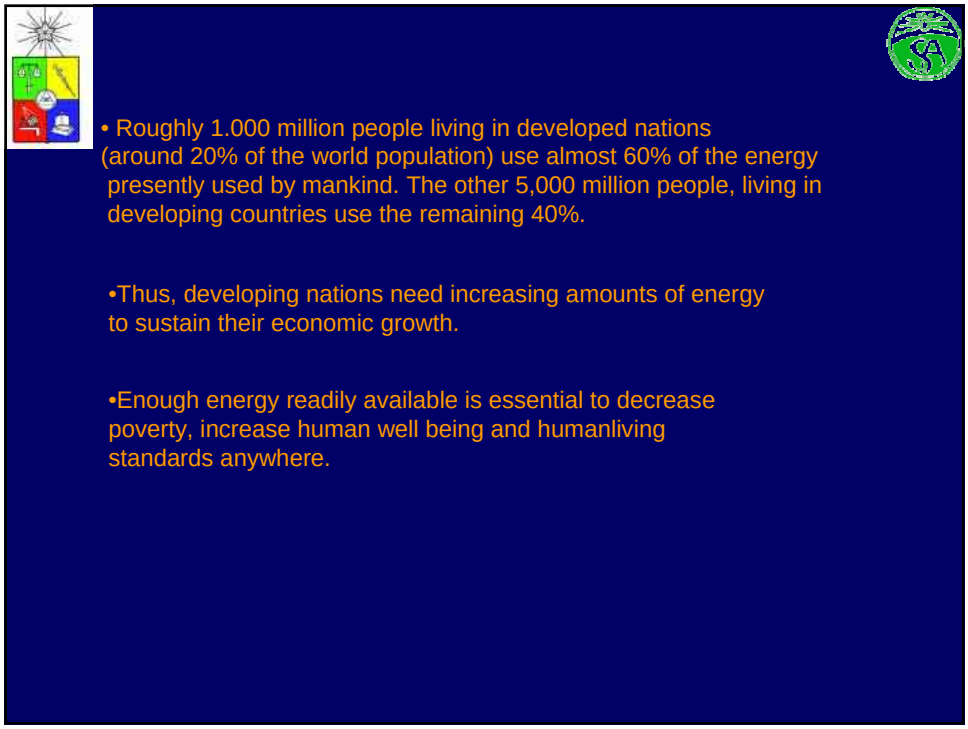
•About 20 % of fossil oil derivatives correspond to gasoline which is used in 550 – 600 million vehícles , an important contamination source for the atmosphere.

•The fuel oil crisis of 1973/74 , 1979/80, 1990/91 and the most recent (year 2001/2) have increased oil prices worldwide. The US dependence of foreign oil is 56 %, la UE depends in a 50% and China in a 32 %.


US$ per Barrel
80,0
70,0
60,0
50,0
40,0
30,0
20,0
10,0
0,0
Jun-87
Jun-90
Jun-93
Jun-96
Jun-99
Jun-02
Jun-05


Brecha Entre Producción
y Descubrimientos
Gb
60
50
40
30
20
10
0
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
2030
2040
2050
Nuevas Reservas
Reservas Estimadas
Producción





• Roughly 1.000 million people living in developed nations (around 20% of the world population) use almost 60% of the energy presently used by mankind. The other 5,000 million people, living in developing countries use the remaining 40%.

•Thus, developing nations need increasing amounts of energy to sustain their economic growth.

•Enough energy readily available is essential to decrease poverty, increase human well being and humanliving standards anywhere.

Chile has very limited resources of Hidrocarbons. Further, the possibility of permanently obtaining this type of products from neighboring nations is unsure and limited.

Chile imports most of its fuel and gas.

The energy dependence of the country will increase in the future affecting its stability and development. Therefore exploring alternative sources of energy is mandatory.

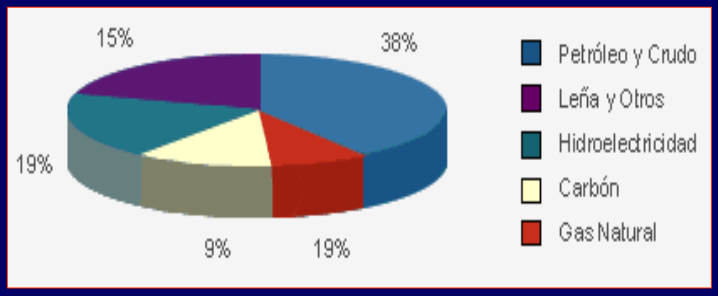
Worldwide oil production will start to decline soon. The total world extraction of hidrocarbons (including natural gas) is expected to start decreasing by 2015.

From 1980 onwards new fossil fuel dicovery is lagging behind fossil fuel production.
From 1940 trough 1980 the discovery of new oil sources was always ahead of fossil fuel extraction. During the last 23 years, however, this has not been the case. The new sources are becoming marginal and of high extraction cost.

The data show that in the last 60 years mankind has used up one half of the total oil reserves of the planet (which took millios of years to form).

The natural gas is in a similar situation. Three years ago the gas price in the US was US$ 2 / 1000 cubic feet. It was US$ 3.0 last year and today it is almost US$ 6.5 / 1000 cubic feet. It is almost three times the price it had in the year 2000.

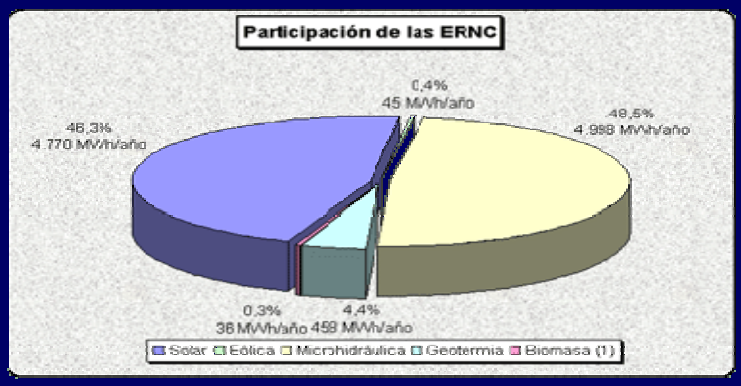
Primary Energy Consumption in Chile



Non Renewable Sources	
Oil	38%
Gas	19%
Coal	9%
Total	**66%**

Renewable Sources	
Hidroelectricity	15%
Solar, Biomass and others	19%
Total	**44%**

Renewable energy sources in Chile



•Fossil fuels represent 42 % of the energy use in Chile, being the major source of liquid fuels.

•Chile imports more than 90 % of its fossil fuels.

•70 % of crude oil is bought in South America and 29% in Africa.

•Chile uses 3.418.500 liters of gasoline per day.

•If the mean price per oil barrel is between US$ 50 a 60 ; the cost of imports will be higher than US $ 4 mil millones .

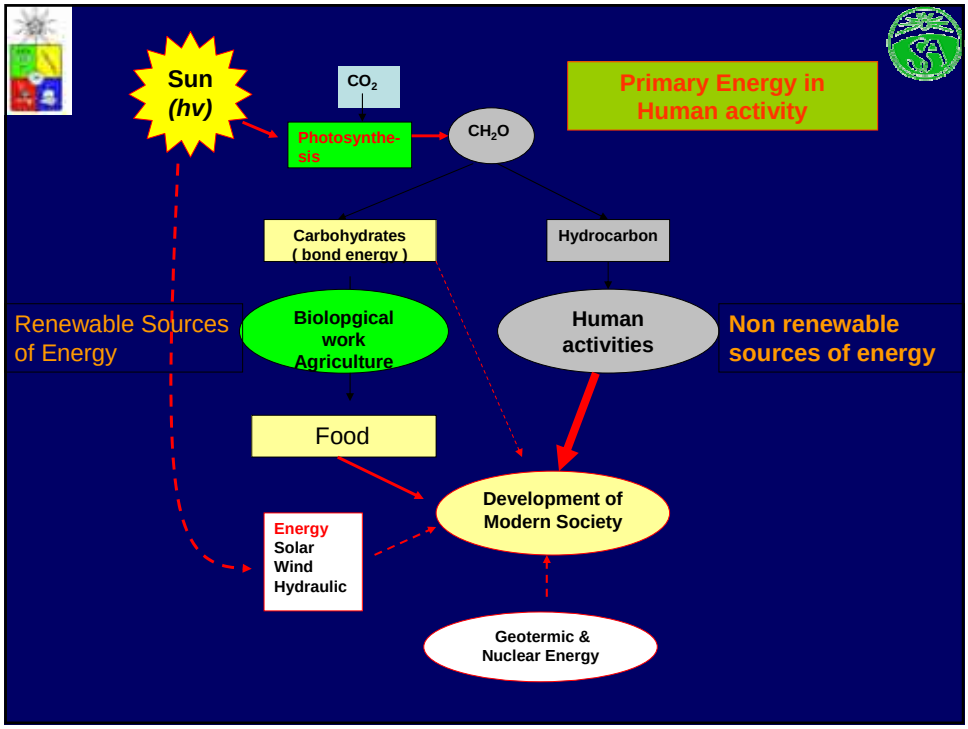
•The tip of the iceberg are oil prices. The major problem is the atmospheric contamination brought about by oil burning.The major emissions come from mobile sources, which are responsable for 93,7 % of the CO and 81% of NOx in the Metropolitan Region, RM.

The decrease in fossil fuel availability and associated increased fuel cost, along with the climatic change brought about by human activities are forcing to seriouly look into renewable energy sources.

Among them, BIOENERGY,is of special interest since it is a renewable source of liquid fuel which is cleaner than the presently used fossil fuel.

BIOENERGY also provides a way of stregthening annual crops classed as commodities, such as maize, wheat , sugar beet, canola and probably others; as well as a use for annual crop residues. Chile has excellent growing conditions for these crops but international prices care low.

BIOENERGY provides an alternative use of of forests, forest residues as well as plantations.



BIOENERGY PRODUCTS

ETHANOL

BIODIESEL

BIOGAS

- Bioethanol as a gasoline substitute.
- In Brasil bioethanol is being used as a liquid fuel since 1979.
- At present there are more than 25 million vehicles that use pure ethanol or in mixture.
- Bioethanol is considered a clean fuel by the US legislation since 1990 because it reduces CO emissions (Clean Air Act).
- In a comparative study of 9 biofuels, the EU considers Bioethanol and Biodiesel as the best products.

In Brasil, ethanol is obtained from sugar cane, in the US from maize , in the EU countries such as Germany from cereals and sugar beet.

- Brasil made mandatory starting 1979 that the gasoline had to contain 20 – 25 % anhidrous ethanol. The ethanol price was around 60% that of gasoline.

- Brasil is the major ethanol producer in the world. It produces approximately 95 million of barrels / year.

The main environmental advantage of ethanol as a fuel is that it reduces CO emissions by 30 %, as well as nitrous oxide and hidrocarbons emissions. It does not contain S, Pb and particles.

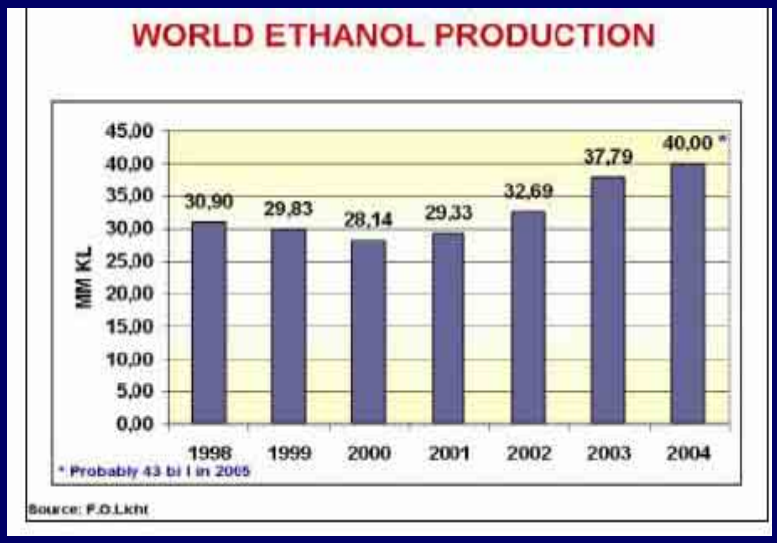
CONTAMINANT EMISSIONS (g / km)

Contaminants	Gasoline	Ethanol
CO	50,3	21,1
HC	4,7	1,2
NOx	1,3	1,0

CONTAMINANT EMISSIONS (g / km)

Contaminant	Gasoline + Ethanol	Ethanol
CO	16,3	9,3
HC	2,3	1,8
NOx	1,7	1,6

Bioethanol and biodiesel are considered to be first order renewable energy alternatives. They are being used as aditives in many countries such as US, Sweden, Japan, India, China , Canada , Australia, Thailand, Perú and in some EU countries such as Germany.



BIOETHANOL

Maize : 250 Gallons / Acre

Sugar Beet : 100 Gallons / Acre

Sugar Cane : 1200 Gallons / Acre

Mandioca : 1500 Gallons / Acre

Chicoria : 1500 Gallons/Acre

Crop area needed to replace gasdline by ethanol

CROP	Percentage ethanol replacement %	Land area ha
Sugar beet	1,5	6,923
	5	22,590
	10	45,180
	25	112,952
	100	451,808
Maize	5	75,000
	10	150,000
	25	375,000
Potatoes	10	125,000
Grapes	10	150,00
Wheat	10	136,364

PCK/2005

Ethanol in Chile

COMPARATIVE PRICES

Ethanol (from maize)	**US$**
- Production cost (liter)	$ 0.48
- 159 liters / barrel	$ 77.43

Gasoline

- Oil price (Gulf) / barrel	$ 66.00
- Transport to Chile	$ 6.50
- Oil to gasoline	$ 25.10
- Gasoline cost ex-refinery (barrel)	$ 97.60

Proposed use:

Use ethanol as an additive to gasoline.

- Annual gasoline consumption;
  3.500.000 m3

- Ethanol replacement per volume;
  10%

- Ethanol demand.
  350.000 m3

Effect in Agriculture:

-Tons of maize required.

750.000

-Hectars of maize crop

62.500

SUMMING UP

1897. The internal combustion engine was invented by Nikolas Otto.

1908. **Henry Ford** "The fuel of the future will come from agricultural products" In 1908, the first Ford T model was equipped with a hand regulated carburator which could be switched to gasoline or alcohol use.

1973. OPEP increased the oil price by a factor of 4. The oil importing coutries were badly hurt and started research on the use of bioethanol obtained by fermentation as an oxigenated additive.

1975. Brazil starts the Proalcohol Project.Presently Brazil is leading the use and production of bioethanol. 48 % of their cars use pure bioethanol

1980. Bioethanol is considered as an alternative fuel in many countries

1981. The increase of oil prices, the projected decrease in fossil fuel availability and the growing concern about the environment increases the need to research new oxigen additives that would decrease the magnitude of negative gas emissions.

1997 The US is consuming 1,300 million galons of bioethanol as an additive to the gasoline which have4 7 to 10 % de ethanol.The US ethanol consumption by 2010 is estimated between 10,000 and 11,000 million gal / year.

1997 The EU establishes Energy for the Future, indicating that energy from renewable sources must be 12 % of the total energy consumed

In the future 30% of the world consumption of fossil oil will be replaced by biomass derivatives. (*Biomass Research and Development TAC, USA)*

EU long-term alternative fuels target of 20% substitution by 2020.

Ethanol Production 2004

Country	Million Gallons
Brazil	3,989
United States	3,535
China	964
India	462
France	219
Russia	198
South Africa	110
United Kingdom	106
Saudi Arabia	79
Spain	79
Thailand	74
Germany	71
Ukraine	66
Canada	61
Poland	53
Indonesia	44

1997.- The Kioto Protocol on Climate Change establishes that the signing countries will have to reduce their net emission of CO_2. It is considered that the use of bioethanol will be essential to achieve the goal in the near future.

The replacement of 1 liter of gasoline by one liter of de bioethanol reduces the accumulation of CO_2 in the atmosphere by 70 %.

ETHANOL

95% of biocarburants consumption

E-5
E-10
E-85
E-95

BIOETHANOL

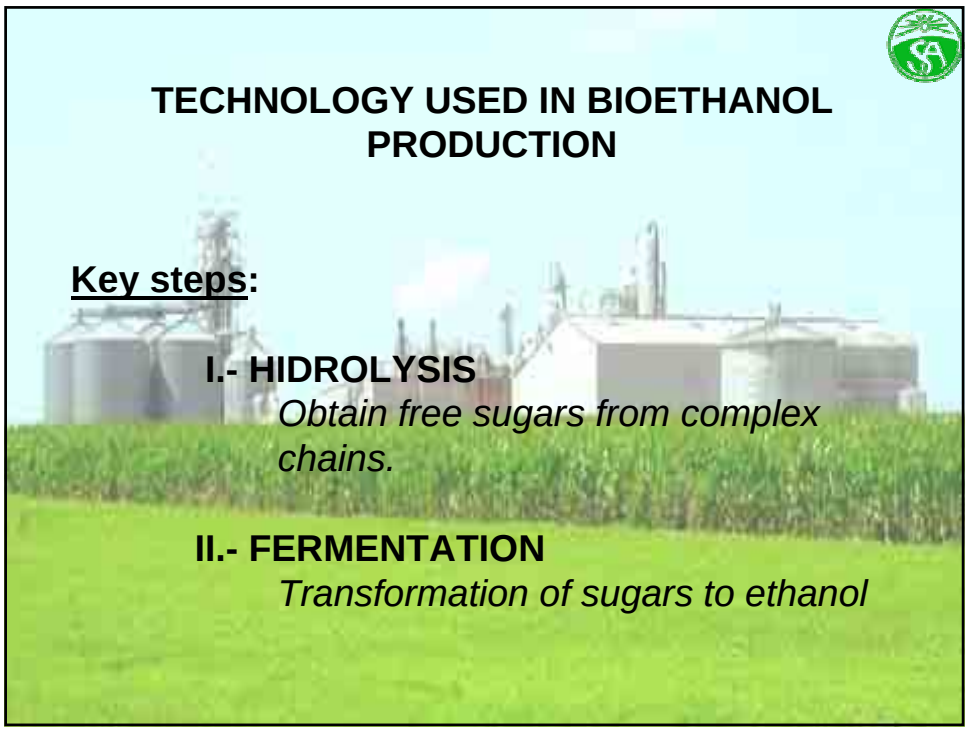
E85G : 85% ethanol+ 15% gasoline

E15D : 15% ethanol + 85% diesel

BIOREFINERY

Pre-processing	Final Process
Intermediaries	***Final Products***
Sugars	▪ Ethanol
Lipids	▪ Biodiesel
Lignin	▪ Biopolimers
Ash	▪ Chemical Products
Proteins	

Materials used for bioethanol production


TECHNOLOGY USED IN BIOETHANOL PRODUCTION
Key steps:
I.- HIDROLYSIS
Obtain free sugars from complex chains.
II.- FERMENTATION
Transformation of sugars to ethanol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