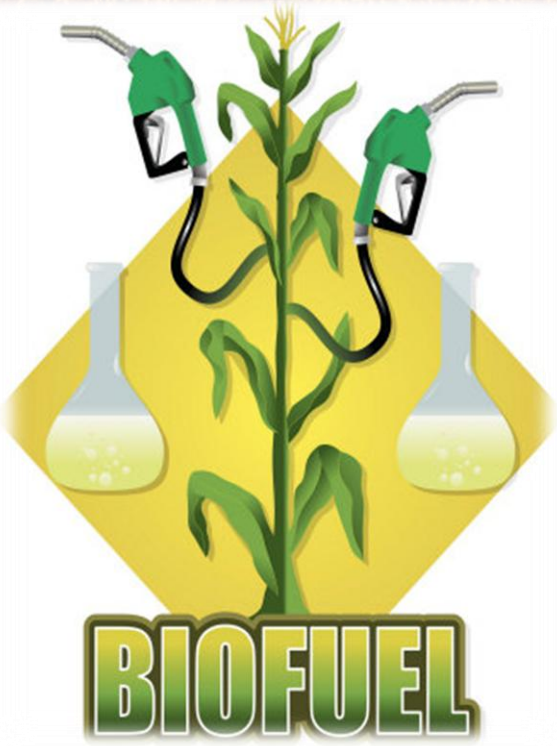
Institute of Natural Resources
Department of Fuel Engineering and Chemical Cybernetics

Biofuels: raw materials, production, types

Lecturer: Kirgina Maria Vladimirovna
assistant teacher

• Plan

- What is biofuels and bioenergy?
- Raw materials for biofuels
- Types of biofuels
- Ethanol and Biodiesel
- Second-generation biofuels



What is biofuels and bioenergy?

Bioenergy is energy derived from biofuels.

Biofuels are fuels produced directly or indirectly from organic material – biomass – including plant materials and animal waste.

Biofuels – renewable energy source!

• Demand for biofuels

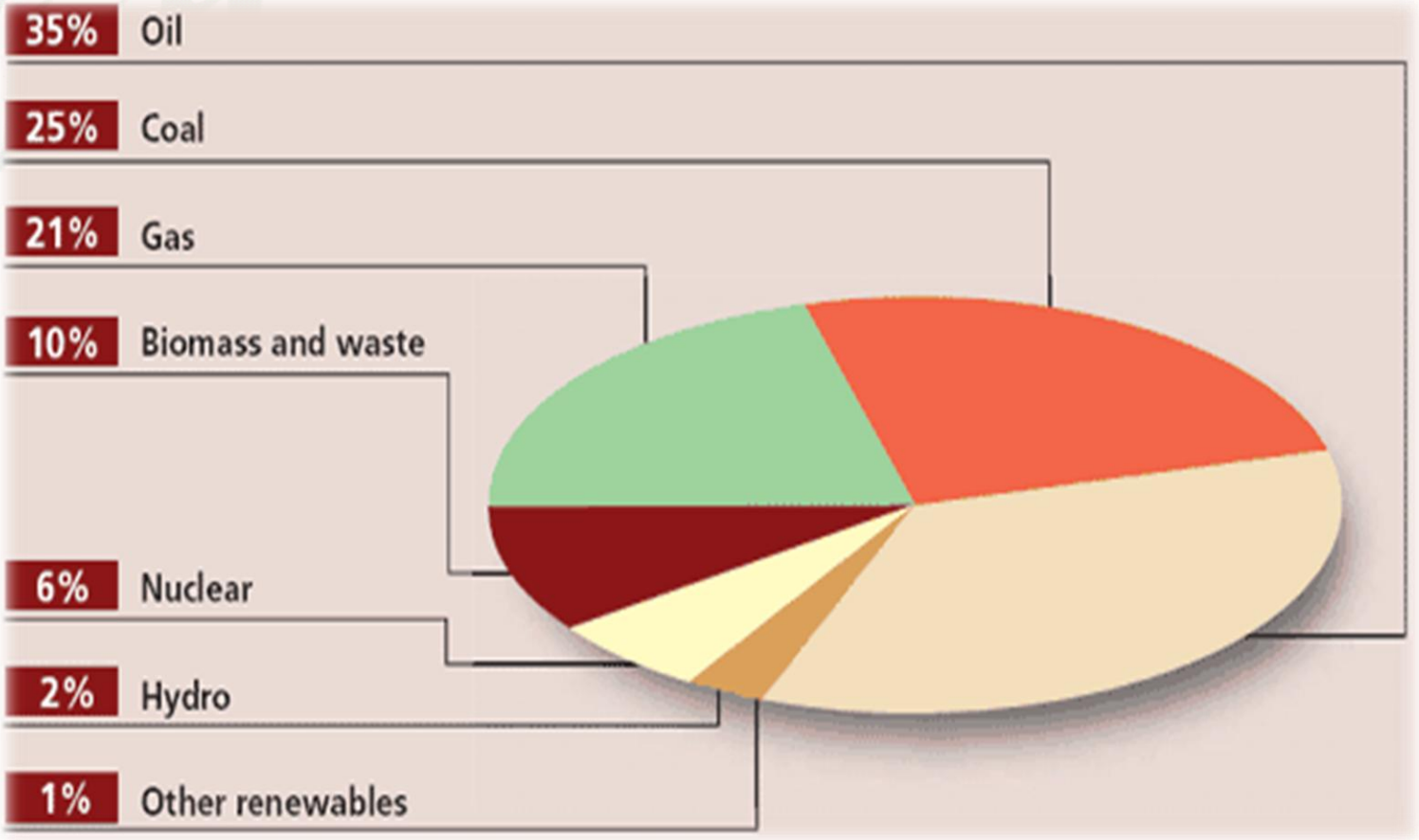


Figure 1. World primary energy demand by source, 2005

• Uses of biomass

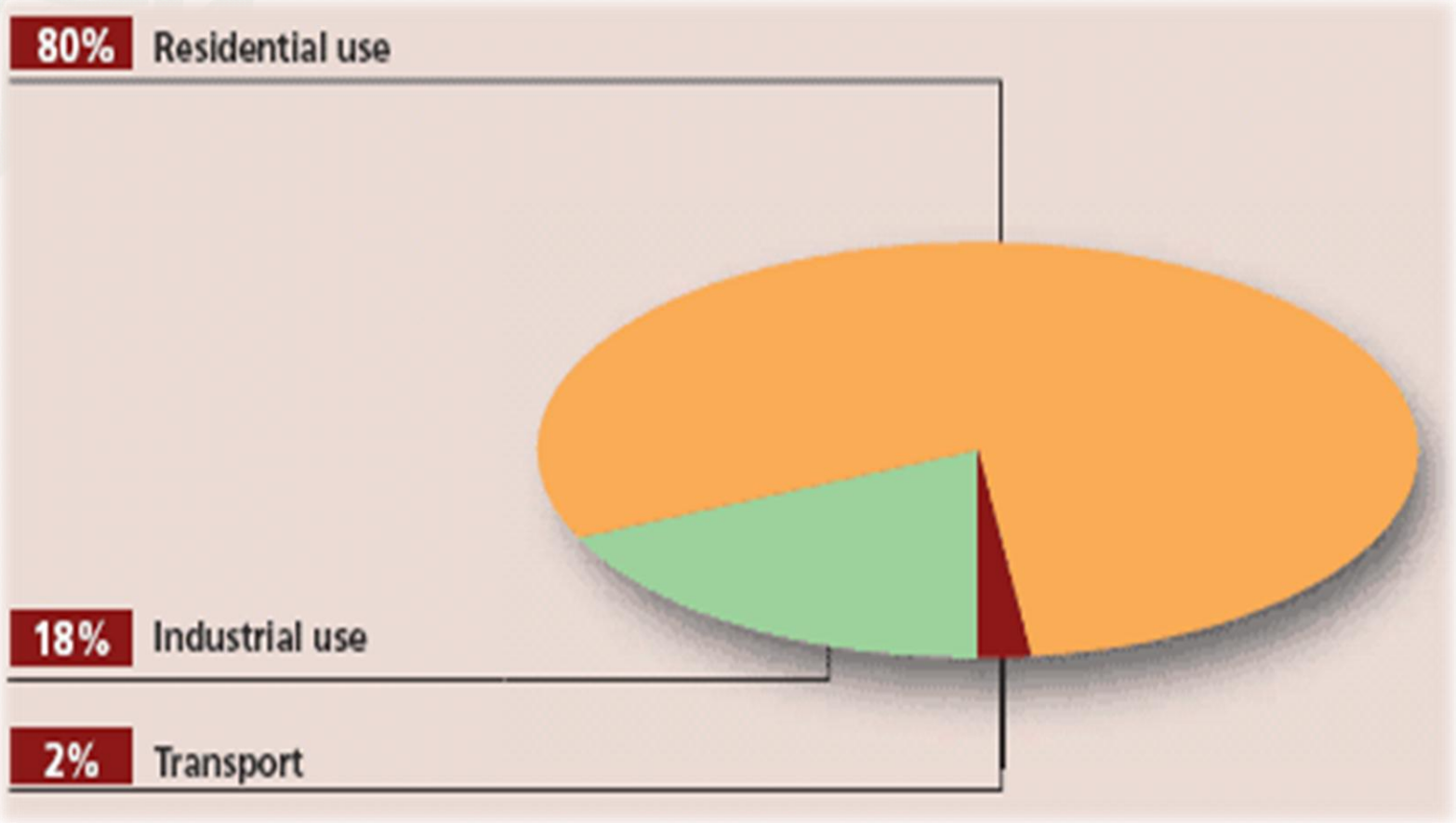


Figure 2. Uses of biomass for energy

Raw materials for biofuels

Biofuels may be derived from:

Wood

Crops

Forestry, agricultural or fishery products

- ✓ Conventional food plants;
- ✓ Special energy crops.

Waste

- ✓ Municipal wastes;
- ✓ Agro-industry, food industry and food service by-products and wastes.

Types of biofuels

Solid

- ✓ Fuelwood;
- ✓ Charcoal;
- ✓ Wood pellets.

Liquid

- ✓ Ethanol;
- ✓ Biodiesel;
- ✓ Pyrolysis oils.

Bio Diesel

Gaseous

- ✓ Biogas.

Biogas

Types of biofuels

Primary biofuels

organic materials are used in an unprocessed form

- ✓ Fuelwood;
- ✓ Wood chips and pellets.

used for heating, cooking or electricity production

Secondary biofuels

result from processing of biomass

- ✓ Ethanol;
- ✓ Biodiesel.

used in vehicles and industrial processes

Liquid biofuels for transport

Liquid biofuels for transport cover 1% of total transport fuel consumption and 0.2-0.3% of total energy consumption worldwide.

The most widely used liquid biofuels for transport are:

Ethanol

Biodiesel

Ethanol

Ethanol is a type of alcohol that can be produced using any feedstock containing significant amounts of sugar or starch.

Feedstock:

- ✓ **sugar cane;**
- ✓ **sugar beet;**
- ✓ **maize;**
- ✓ **wheat.**

<u>Sugar</u> can be directly fermented to alcohol.

<u>Starch</u> first needs to be converted to sugar.

Ethanol

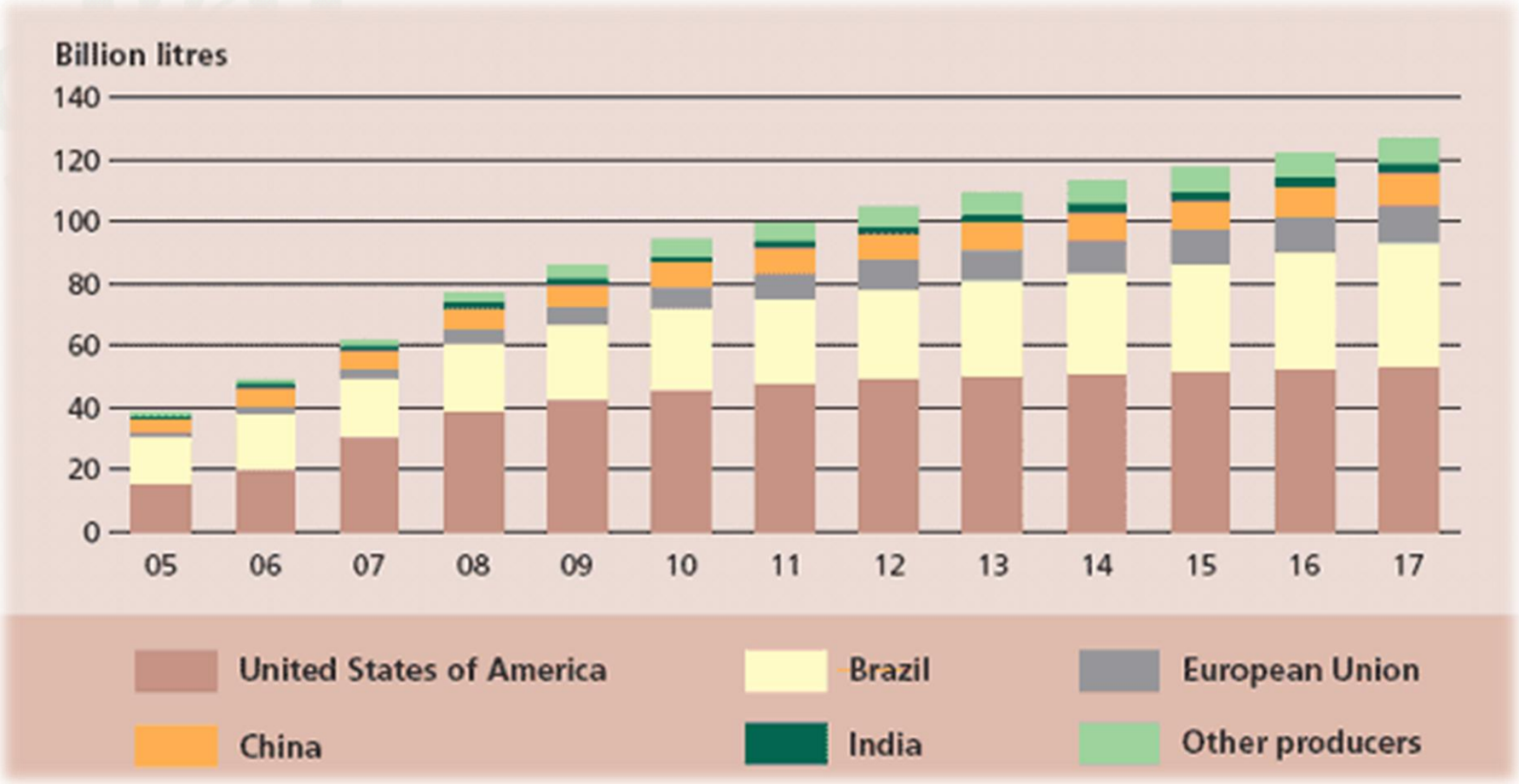


Figure 3. Major ethanol producers, with projections to 2017

Ethanol

Ethanol can be blended with petrol or burned in pure form in slightly modified spark-ignition engines.

Ethanol mixed with petrol:

- ✓ improves the combustion performance;
- ✓ lowers the emissions of carbon monoxide and sulphur oxide.

A litre of ethanol contains 2/3 of the energy provided by a litre of petrol.

Biodiesel

Biodiesel is produced by combining vegetable oil or animal fat with an alcohol.

Can be derived from

- ✓ **rapeseed oil;**
- ✓ **soybean oil;**
- ✓ **palm oil;**
- ✓ **coconut oil;**
- ✓ **jatropha oil.**

Biodiesel display a greater variety of physical properties than ethanol.

• Biodiesel

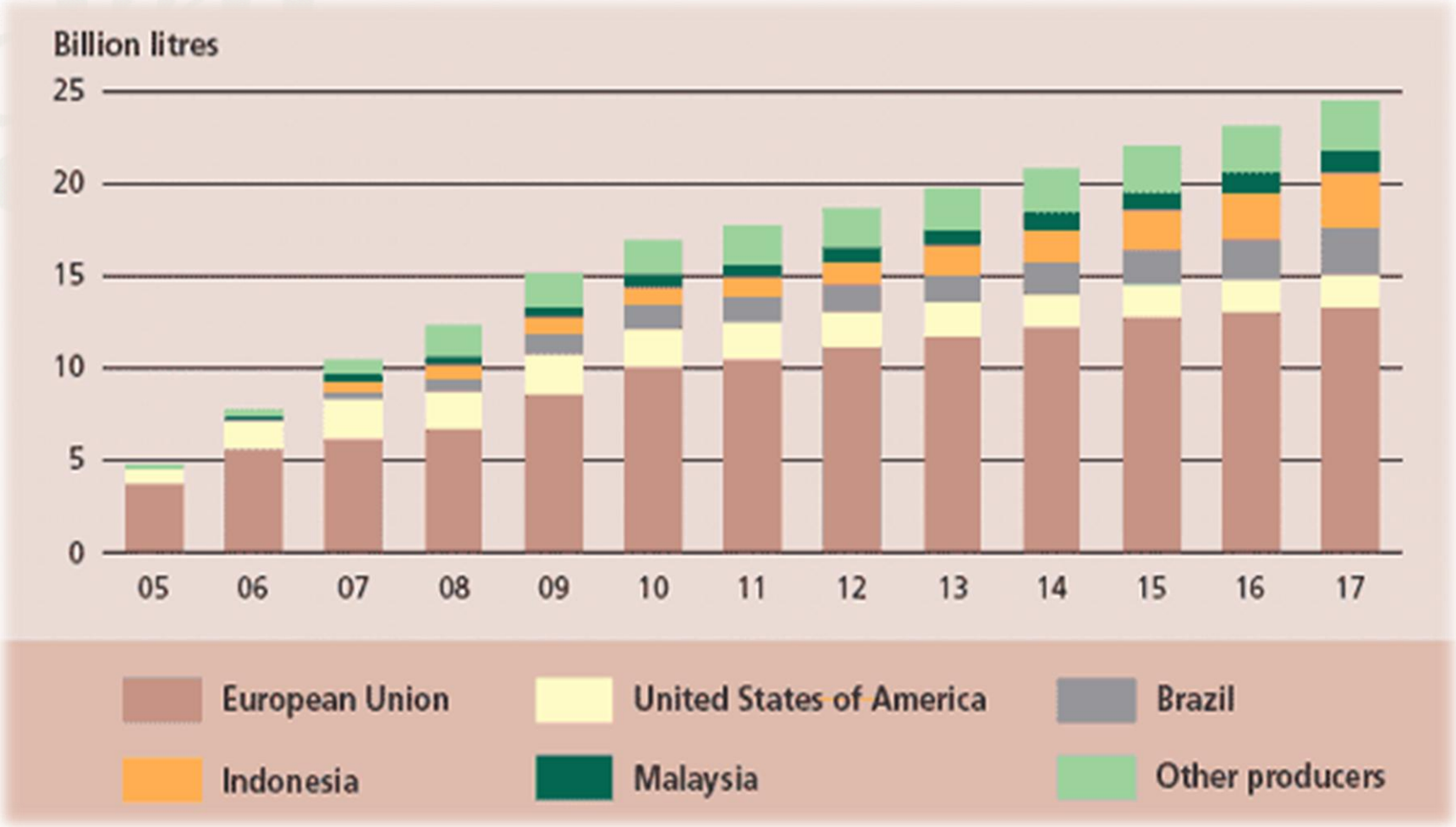


Figure 4. Major biodiesel producers, with projections to 2017

• Biodiesel

Biodiesel can be blended with traditional diesel fuel or burned in its pure form in compression ignition engines.

Biodiesel energy content is 88 to 95% less than that of diesel.

Diesel engines can also run on **vegetable oils** and **animal fats:**

- ✓ used cooking oils from restaurants;
- ✓ fat from meat processing industries.

Second-generation biofuels

Ethanol and biodiesel are **first-generation biofuels**.

Most plant matter is composed of:

- ✓ **cellulose,**
- ✓ **hemicellulose,**
- ✓ **lignin.**

second-generation biofuel technologies able to convert these components to liquid fuels

Expansion of volume and variety of sources that could be used for biofuel production.

Potential cellulosic sources include:

- ✓ **municipal waste;**
- ✓ **waste products from agriculture, forestry, processing industry;**
- ✓ **new energy crops such as fast growing trees and grasses.**

Second-generation biofuels

The conversion of cellulose to ethanol involves two steps:

1. **The cellulosic and hemicellulosic components of the plant material are broken down into sugars**

2. **Sugars are fermented to obtain ethanol**

Lignin cannot be converted to ethanol, but it can provide the necessary energy for the conversion process.

Gasification is a technique that converts solid biomass into a fuel gas.

Gasifiers operate by heating biomass to high temperatures in a low-oxygen environment releasing an energy-rich gas.

Gas can be burned to generate electricity.

Biofuel production costs

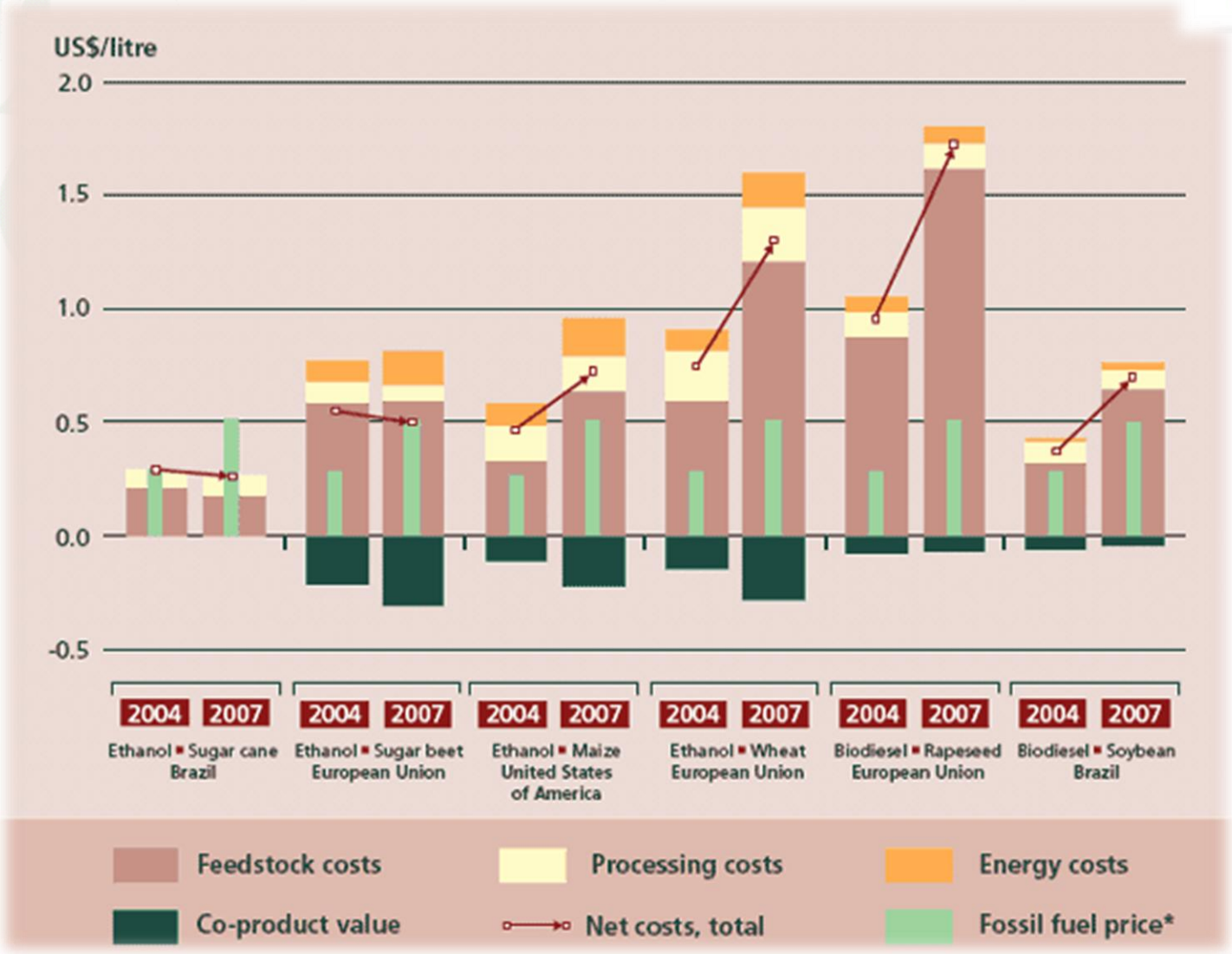


Figure 5. Biofuel production costs in selected countries, 2004 and 2007


FOOD NOT FUEL