Bioenergy in the Classroom: Fermentation in a Bag

OSU Oregon State UNIVERSITY

College of Education

Procedure

- Add ¼ cup water to your bag (60ml)
- Add 1 teaspoon (one level plastic spoon of yeast to the bag.
- Add your station's material to the bag (~ 1 level spoon's worth).
- As you seal the bag, be sure to remove all air.
- Bring to the front of the room and return to your seat.

Energy IQ Quiz – Adults

- How is most of the electricity generated in the US?

- Which fossil fuel has the highest use in the US?

- In the past ten years, has the average MPG increased or decreased?

- Does the the US import more oil than it produces?
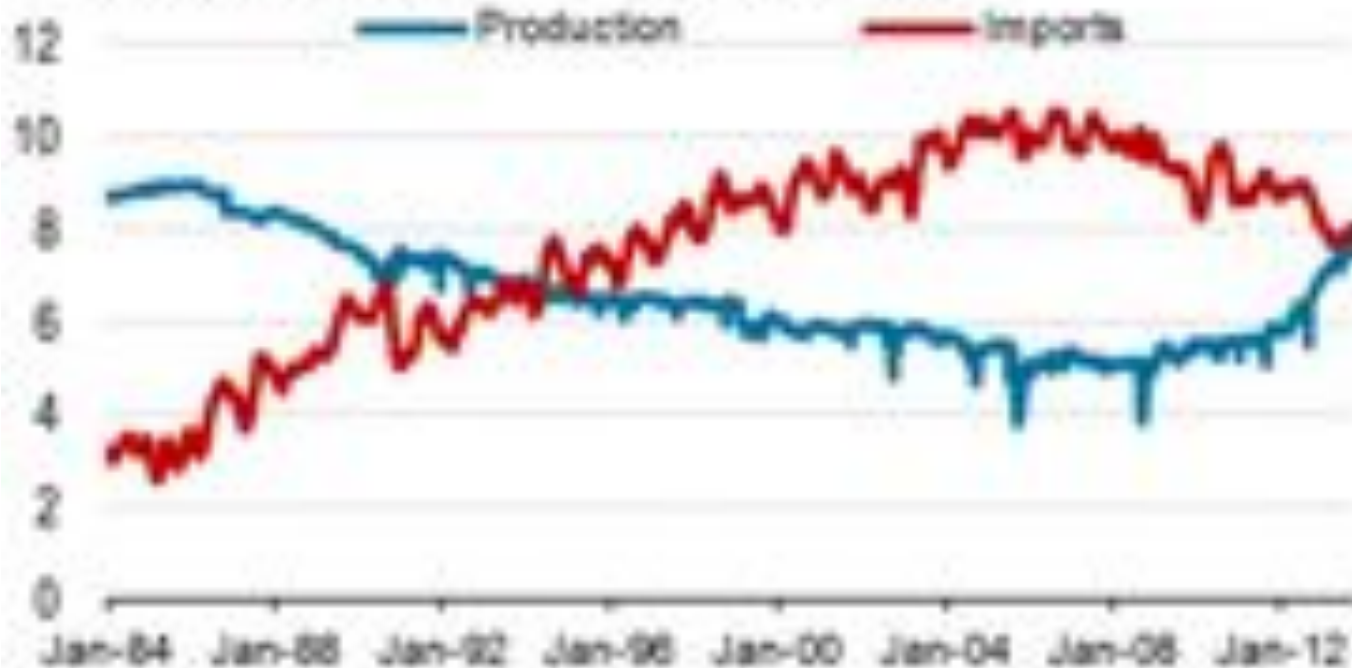
Energy IQ Quiz – MS / HS

- Which fossil fuel has the highest use in the US? 25% 33%

- The term renewable energy means? 50% 66%

- Why can't we just switch to electric cars when we run out of fossil fuels? 50% 60%
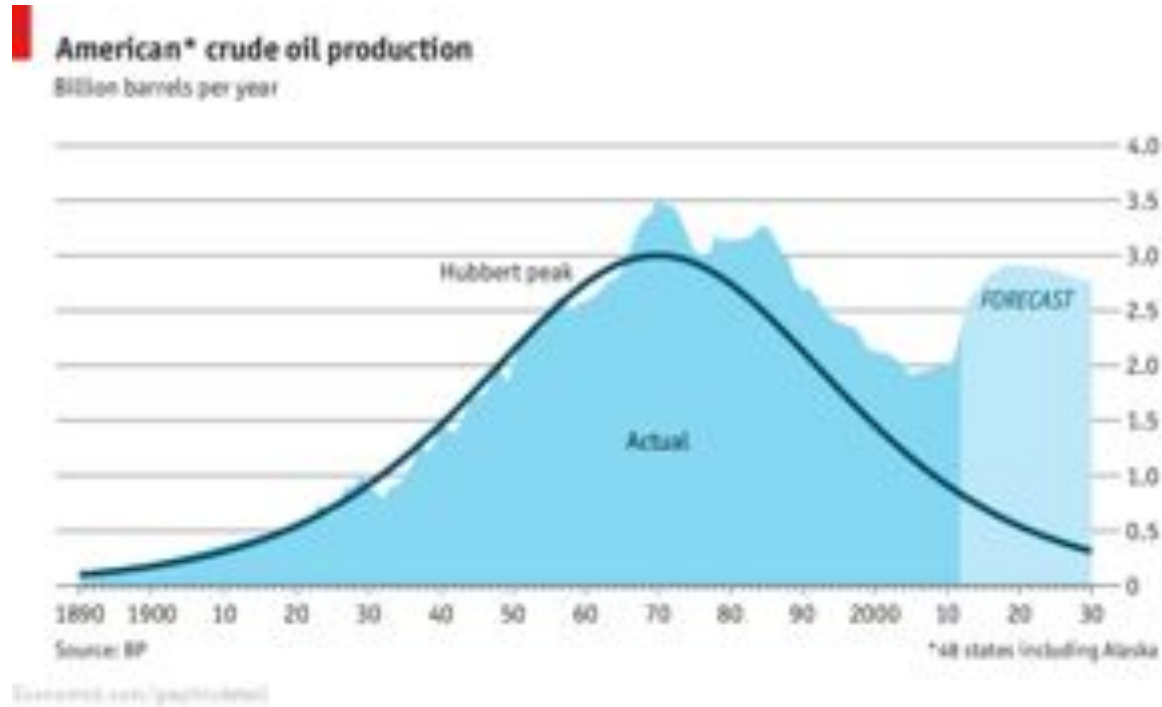
Dewaters & Powers, 2011

US Oil Imports

Crossing Over
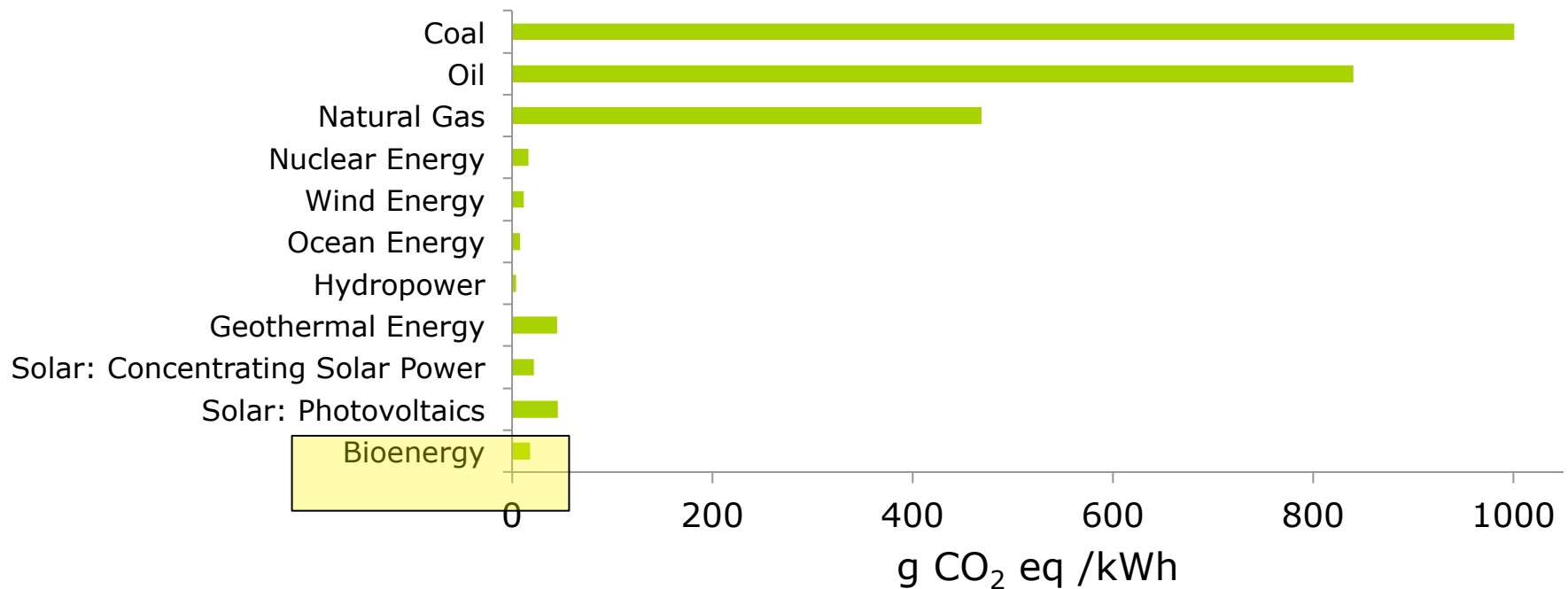Average daily crude-oil production and imports (12-week moving average), in millions of barrels.

— Production — Imports

Source: Energy Information Administration

The Peak

American* crude oil production
Billion barrels per year

Hubbert peak

Actual

FORECAST

1890 1900 10 20 30 40 50 60 70 80 90 2000 10 20 30
Source: BP   *48 states including Alaska

PEAK OIL AHEAD

Why Renewable Energy?

- Sustainable supply of energy
- Reduce CO_2 emission
- Stronger rural economy

Bar chart: g CO_2 eq /kWh

Source	g CO_2 eq /kWh (approx.)
Coal	~1000
Oil	~840
Natural Gas	~470
Nuclear Energy	small
Wind Energy	small
Ocean Energy	small
Hydropower	small
Geothermal Energy	small
Solar: Concentrating Solar Power	small
Solar: Photovoltaics	small
Bioenergy	small

Where does the US get its energy?

Total = 99.578 Quadrillion Btu

Petroleum 37%

Natural Gas 25%

Coal 21%

Nuclear Electric Power 9%

Renewable Energy 8%

Total = 7.744 Quadrillion Btu

Solar 1%
Geothermal 5%
Wind 9%
Hydropower 35%
Biomass 50%
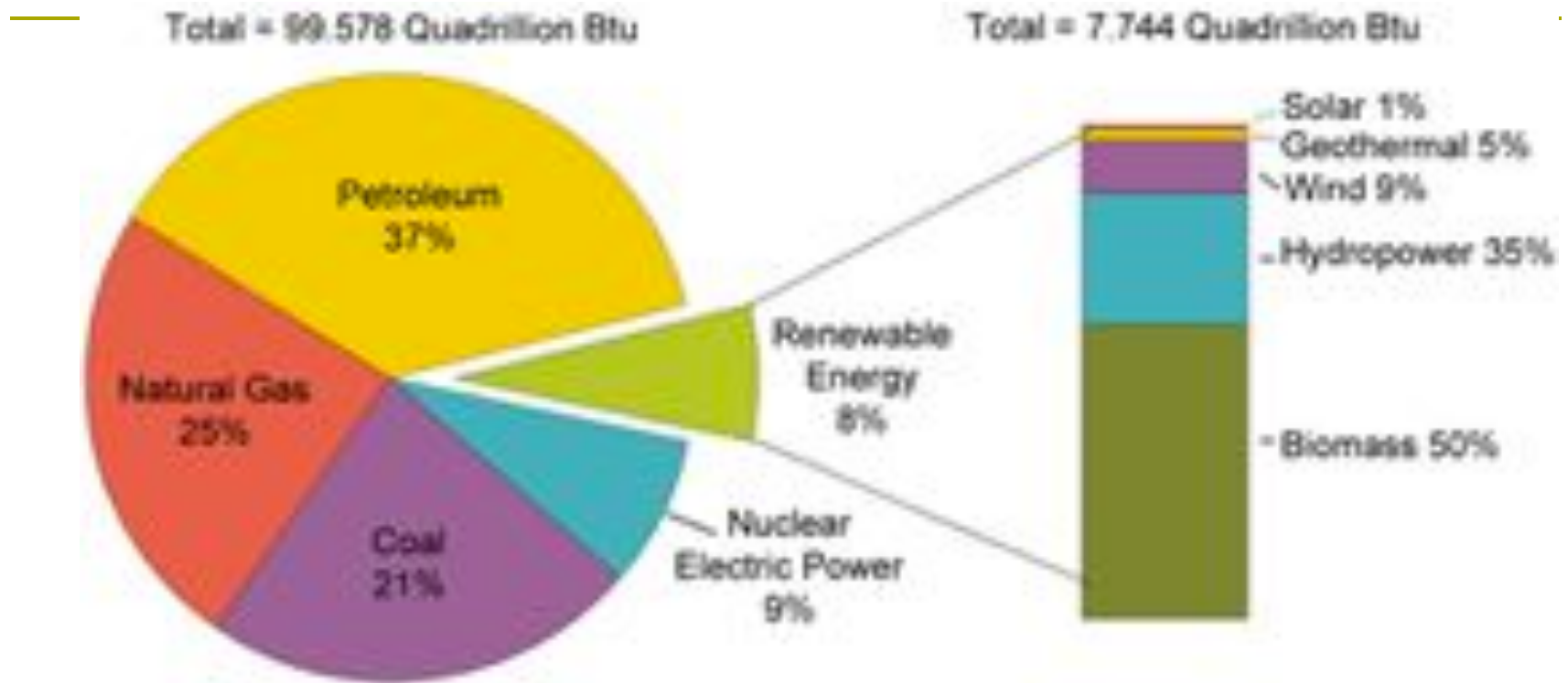
Sources of Biomass energy?

Sources of Biomass Energy 2010

Municipal Waste 11%

Biofuels (Mostly Ethanol) 43%

Wood or Wood-Derived Biomass 46%
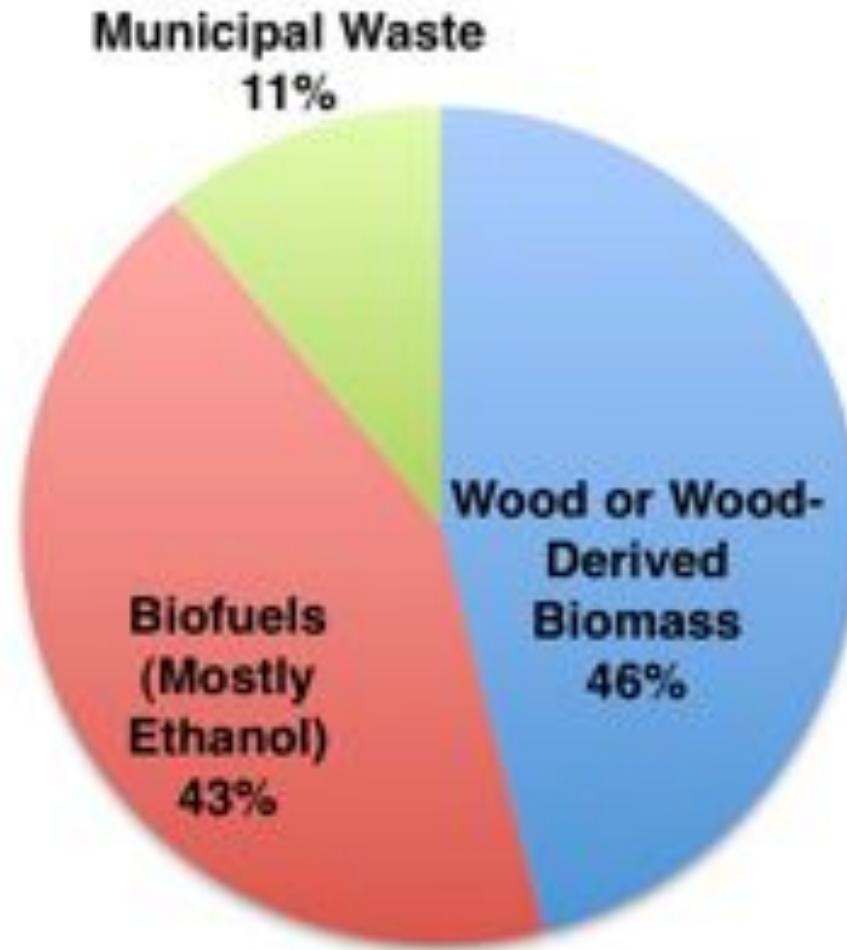
What part of the country has the best woody biomass?

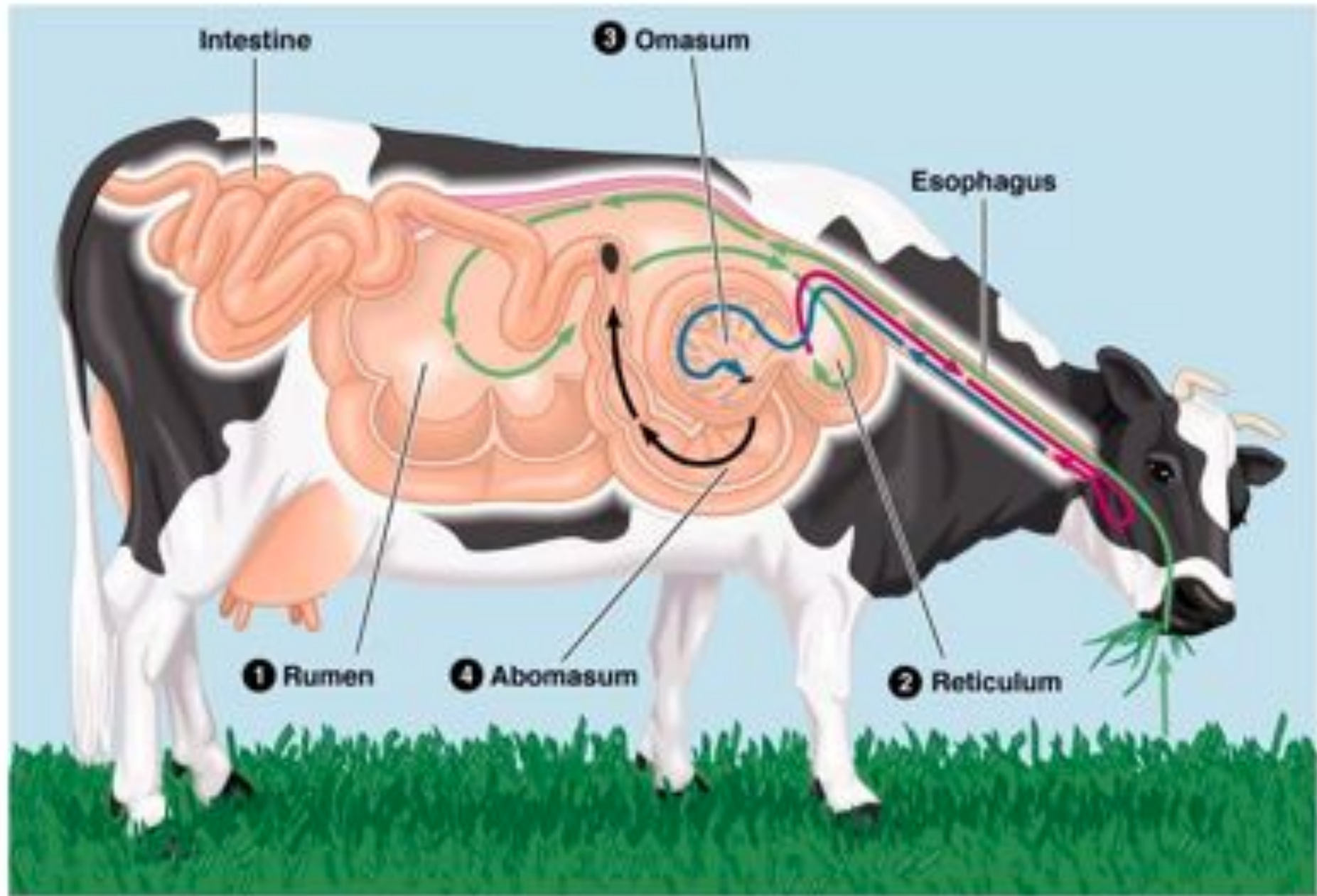**Biomass Resources of the United States**
Total Resources by County

Thousand Tonnes/Year
- > 500
- 250 - 500
- 150 - 250
- 100 - 150
- 50 - 100
- < 50
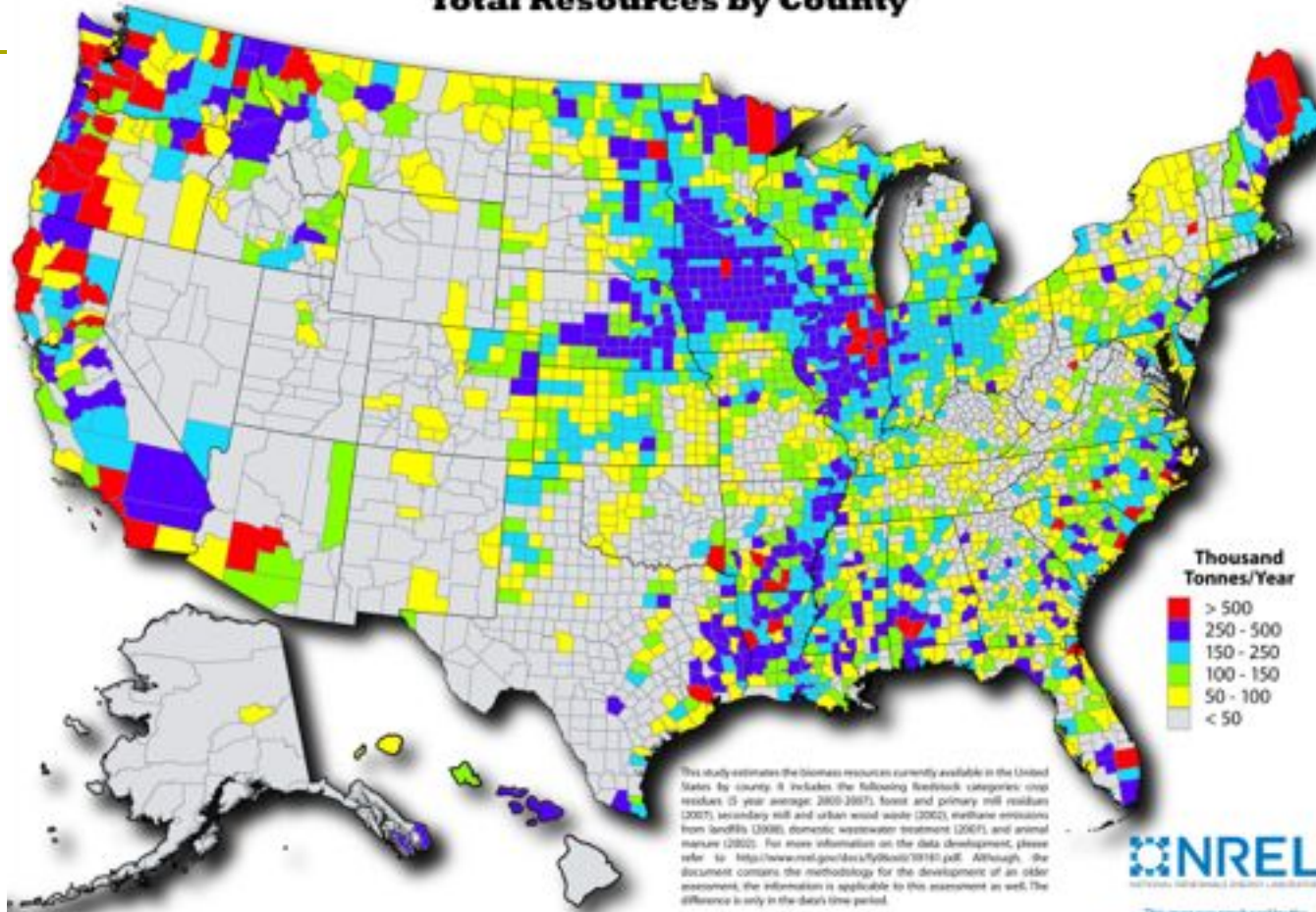
Author: Billy Roberts - September 23, 2009

This map was produced by the National Renewable Energy Laboratory for the U.S. Department of Energy

Evolution of Biofuels

Cereals

Starch

FIRST GENERATION BIOFUELS

Sugars

Oil Crops

Second Generation Biofuels

Woody remains   Wood shavings   Corn stover

Intestine

❸ Omasum

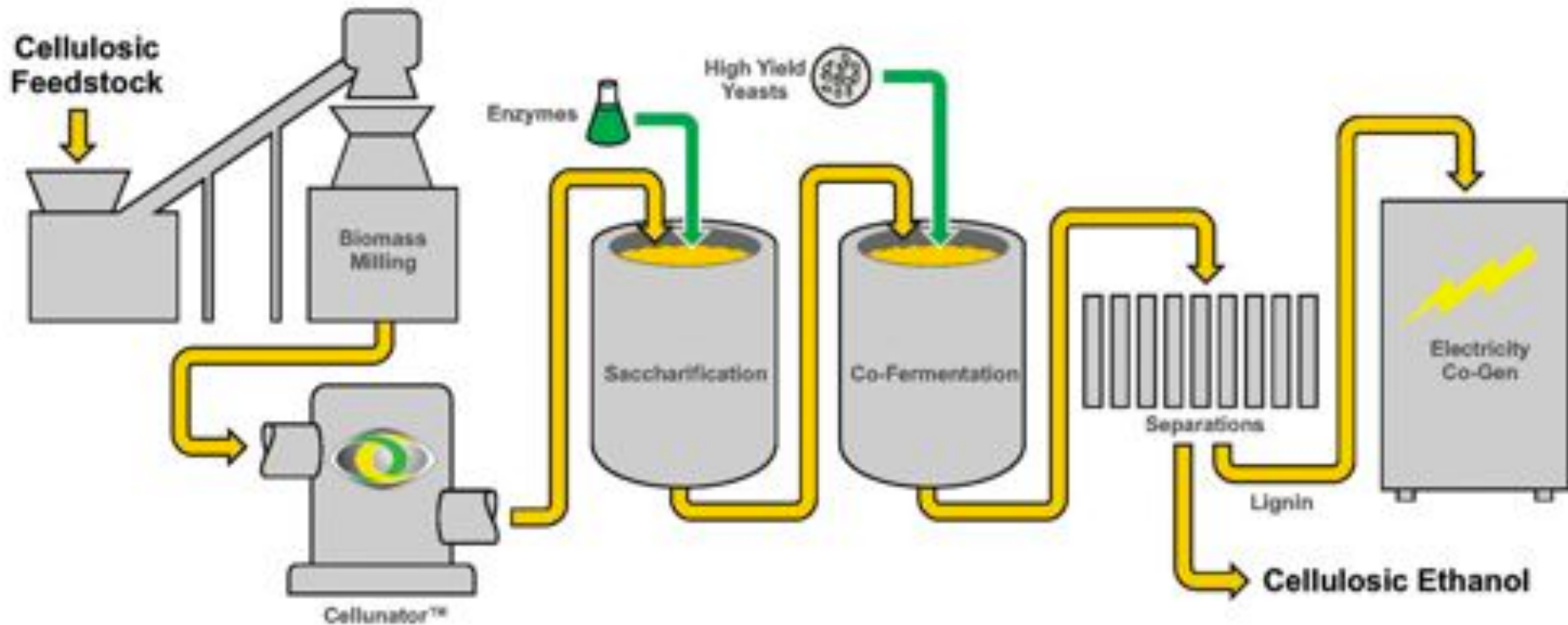Esophagus

❶ Rumen

❹ Abomasum

❷ Reticulum

©1999 Addison Wesley Longman, Inc.
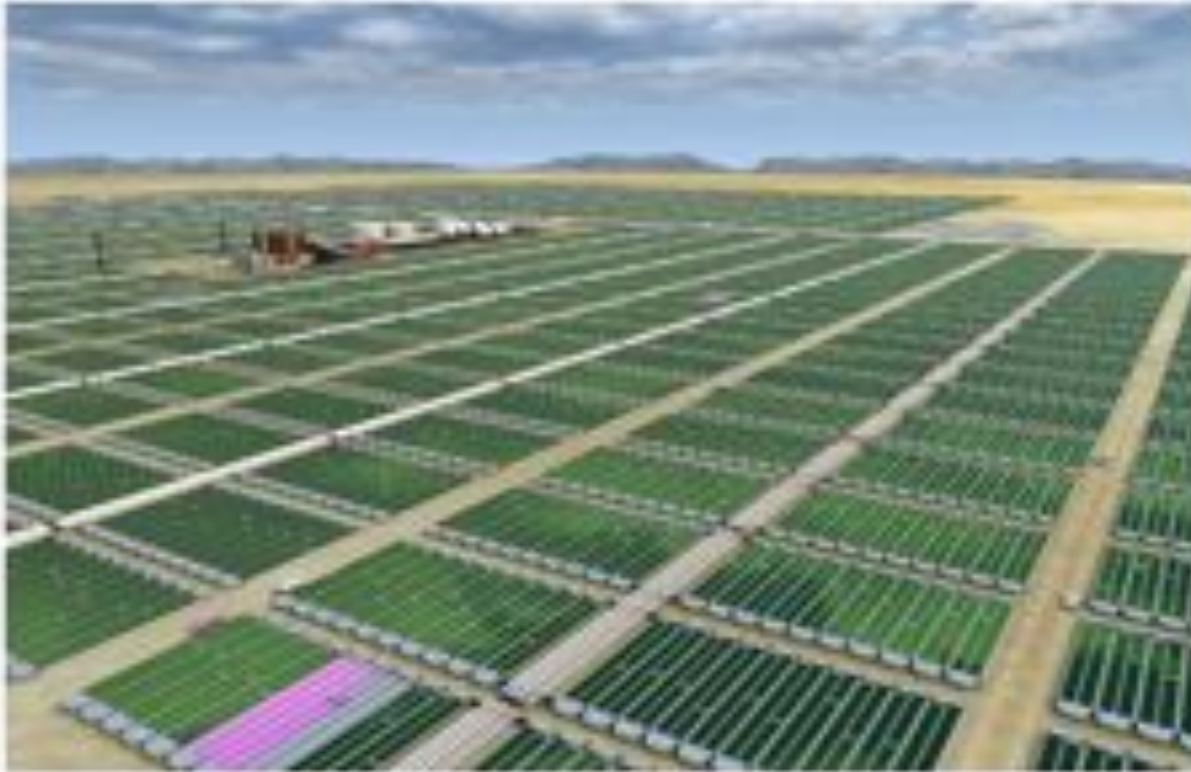
Cellulosic Ethanol

Which Materials Do Yeast Digest?

- ❑ Cornmeal
- ❑ Corn starch
- ❑ Corn kernels
- ❑ Sugar
- ❑ Sugar substitutes

What factors affect ethanol production?

Third Generation Biofuels

QUATERNARY
CONSUMERS

TERTIARY
CONSUMERS

SECONDARY
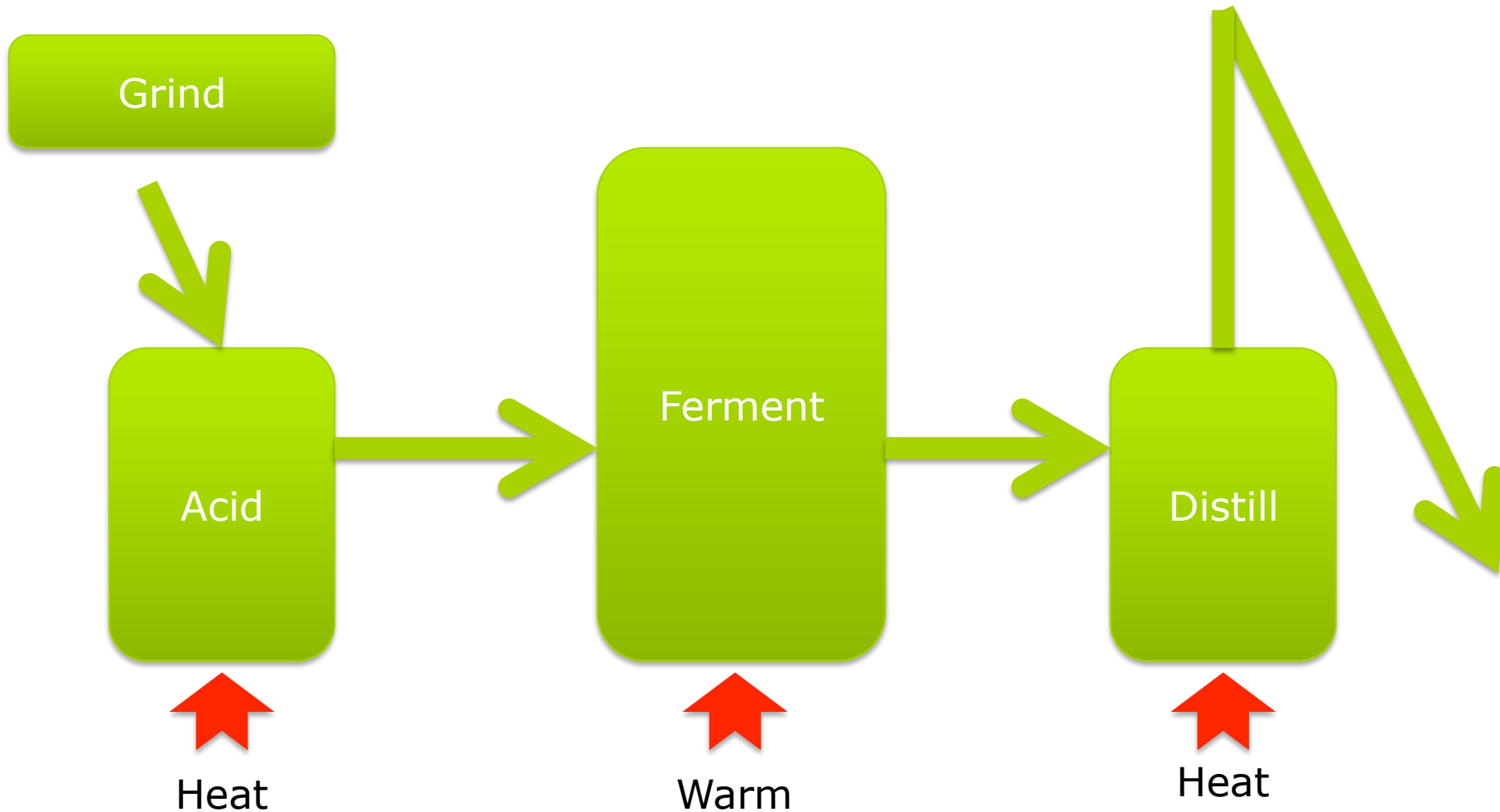CONSUMERS

PRIMARY
CONSUMERS

PRIMARY
PRODUCERS

Green Crude

Design an Ethanol Plant

Design an Ethanol Plant

Grind

Acid

Ferment

Distill

Heat

Warm

Heat

Implementation

- How could this activity be implemented in the curriculum?