

BioDiesel & Issues About Our Energy Future



Jim Leidel
Energy Manager

Oakland University
Biodiesel Bus Tour Stop

April 11, 2005

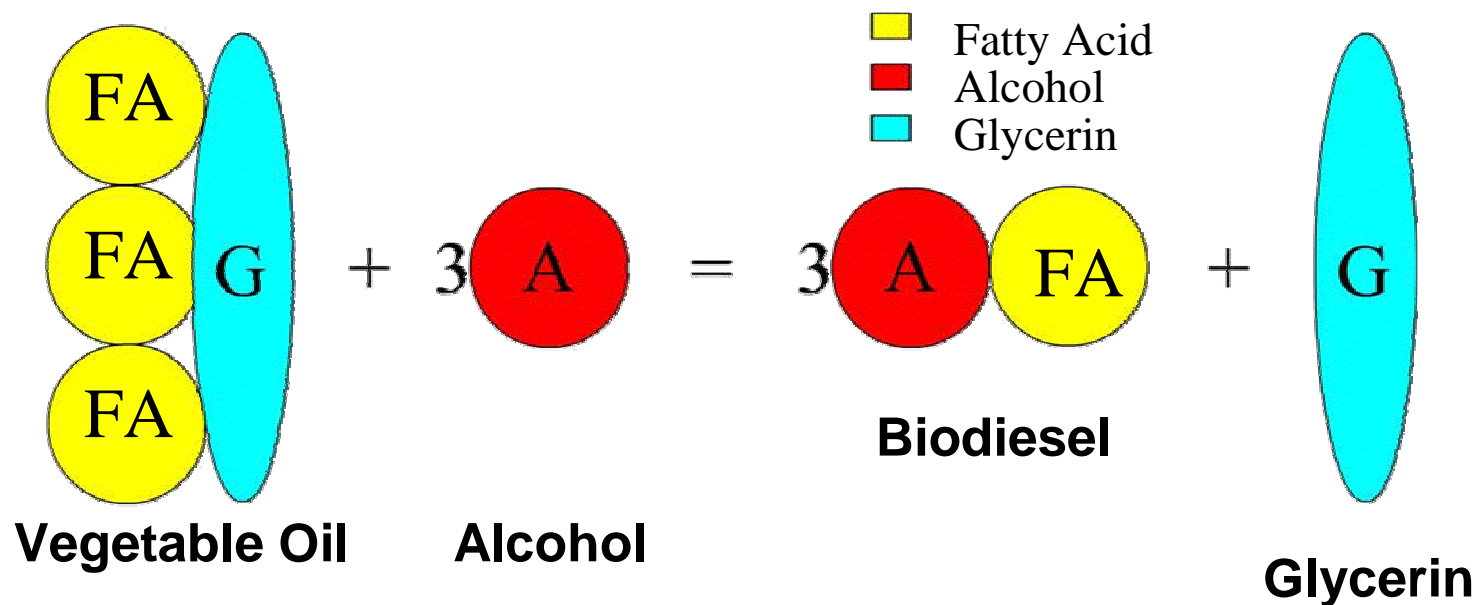
Today's discussion.....

- **What is BioDiesel? Quick overview?**
 - How is it made?
- **Demonstration: Biodiesel in Your kitchen**
- **Why use alternative fuels?**
 - What's wrong with Oil? Why should we care?
- **Energy & Climate change**
- **What Do We Do?**
- **Presentation by Loren K. Beard**
 - Senior Manager - Energy Programs, Environmental & Energy Planning
- **Lastly, we'll check back on our "kitchen biodiesel demonstration"**



What is Biodiesel ?

- Renewable fuel for diesel engines
- Made from vegetable oil or animal fat
- Lower emissions, biodegradable, non-toxic and less safer than petroleum diesel
- High centane number, high lubricity, good for your engine





100 lbs. of veggie oil

+

10 lbs. methanol

=

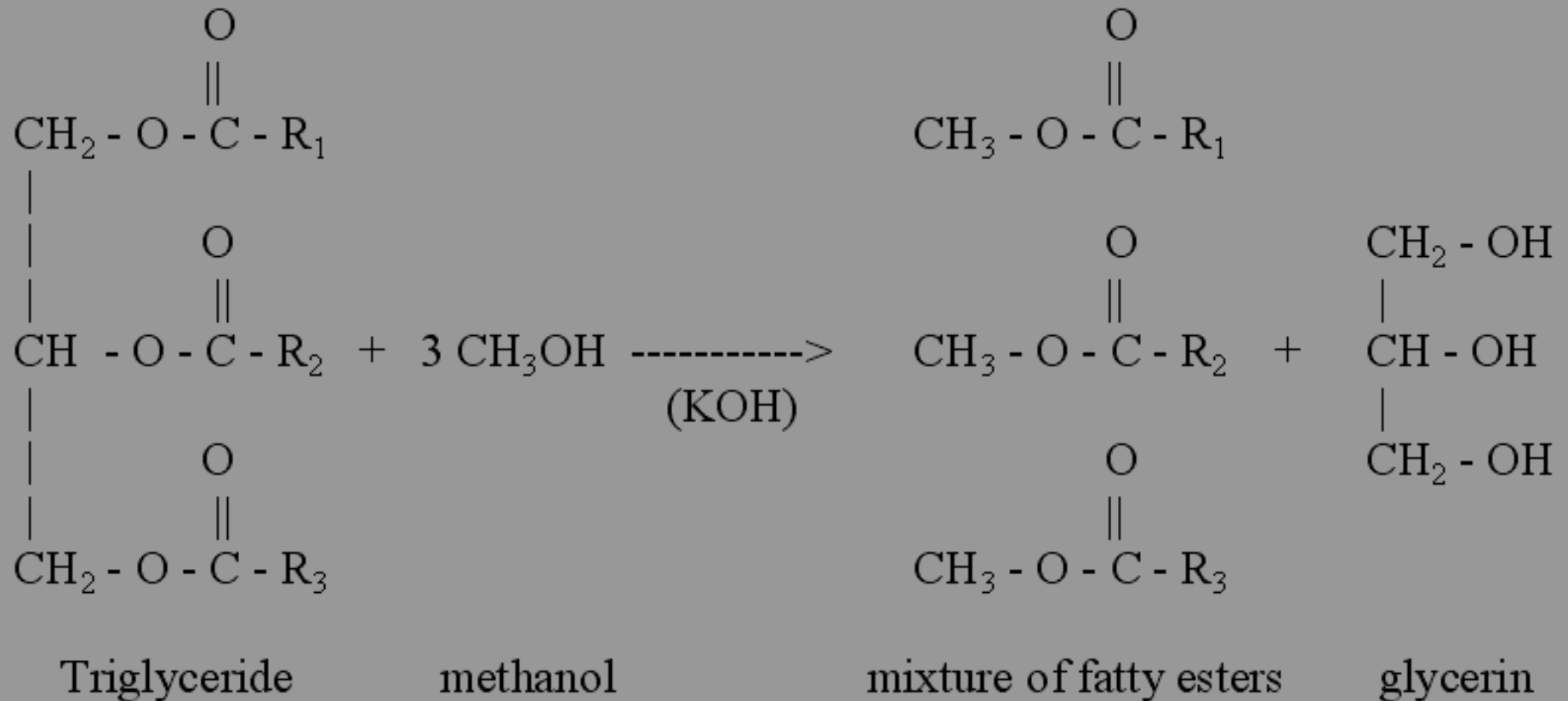
**100 lbs. biodiesel
(B100)**

+

10 lbs. of glycerin



Transesterification

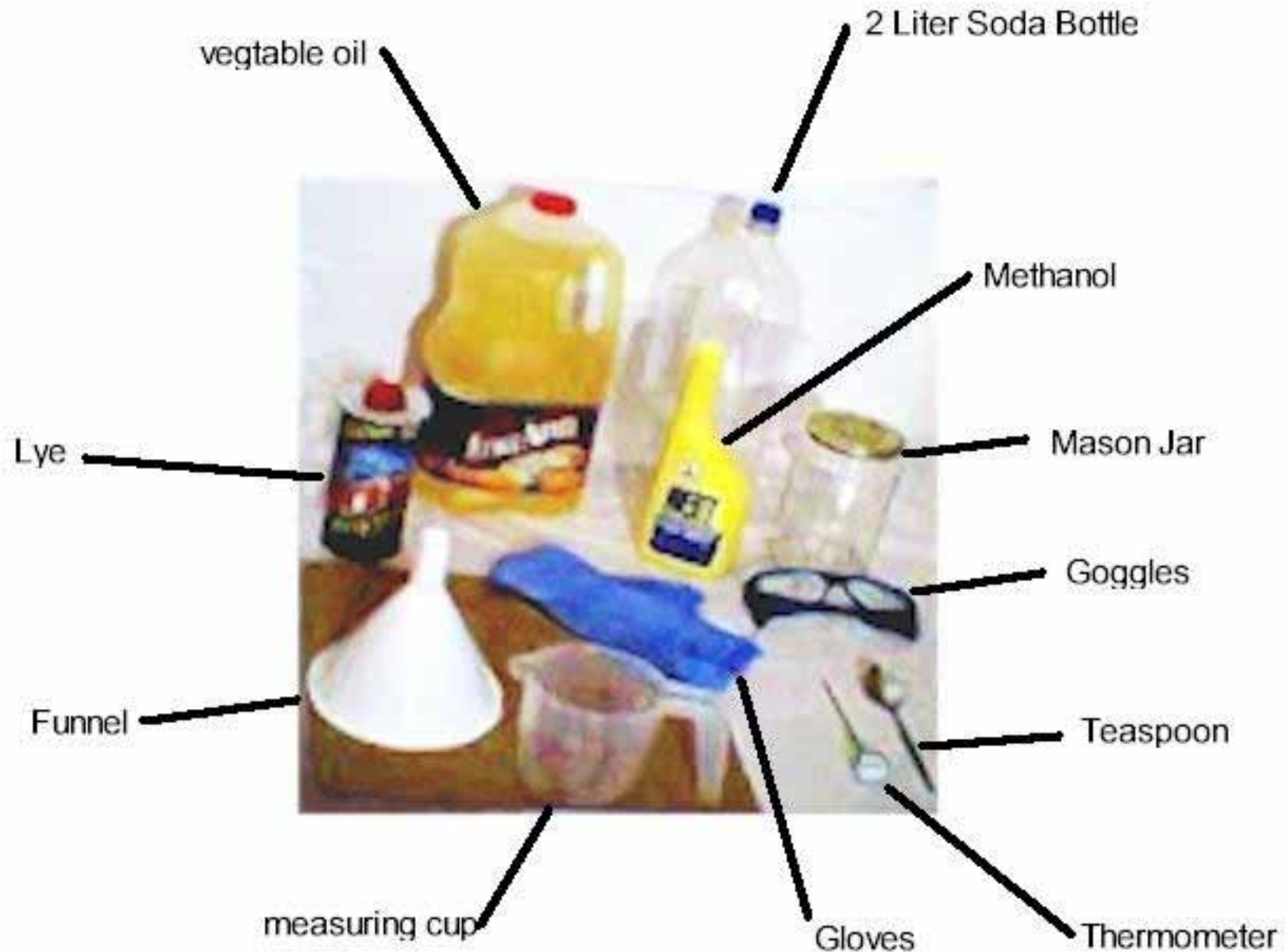


Existing diesel engines & Existing fuel infrastructure

- Pure Biodiesel (B100) or blended with petroleum diesel (example: B20, 20% biodiesel)
- Rudolf Diesel: peanut oil (the earth nut)
- No engine modifications required
- Use existing fuel distribution network
- Available now
- US grown



Kitchen Biodiesel



Images courtesy of www.kitchen-biodiesel.com



Vegetable oil

**any oil will work,
but Canola is one
of the best for
cold weather
properties**

Catalyst

NaOH - Sodium Hydroxide

Sold as Drain Cleaner in Hardware and Grocery Stores. Look by the Drano. Make sure the can reads "Contains Sodium Hydroxide"



ALCOHOL

**HEET gas line antifreeze
= 335mL of Methanol
per bottle**



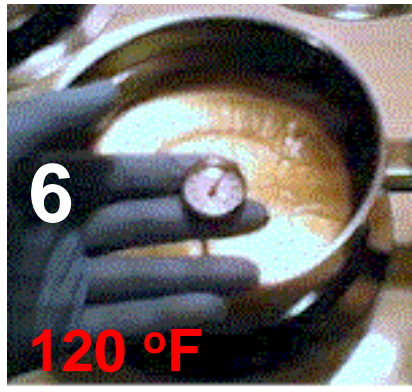
**“other cheaper brands
are available. Look
on back label for
“methyl alcohol”**



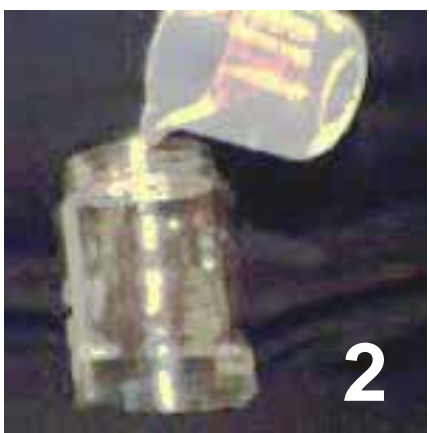
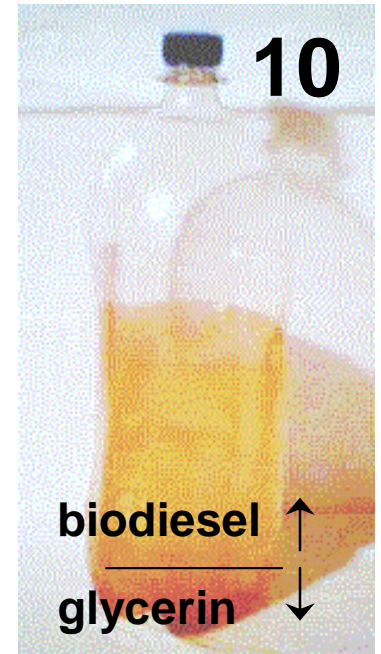
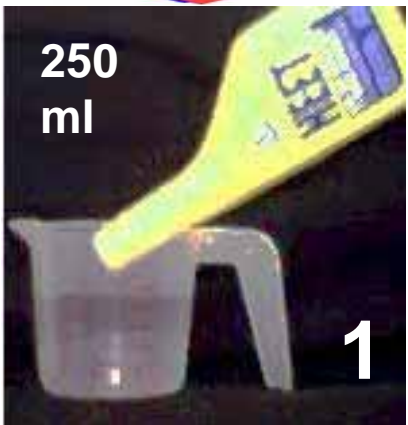
**(methanol is a race car fuel, also
used as model airplane fuel)**

Safety First !





KITCHEN BIODIESEL



More about biodiesel

- **Shake our “processors” for 5-10 minutes**
- **And then, set on table to allow glycerin to settle out**
 - we’ll return to it at the end of the discussion
- **Now, some more on biodiesel**



our friend, the soybean

Background Photo: Canola Plant

- European biodiesel uses canola: a genetically modified rapeseed plant, or “Canada Oil” from the mustard family
- US biodiesel industry uses the soybean
- Yellow Grease: recycled cooking oil



A black and white photograph of George Washington Carver in a laboratory. He is wearing a white lab coat over a dark suit and tie. He is looking down at a round-bottom flask he is holding in his right hand. In his left hand, he holds a small glass bottle. The background shows various pieces of laboratory glassware, including a large funnel and other vessels on a stand.

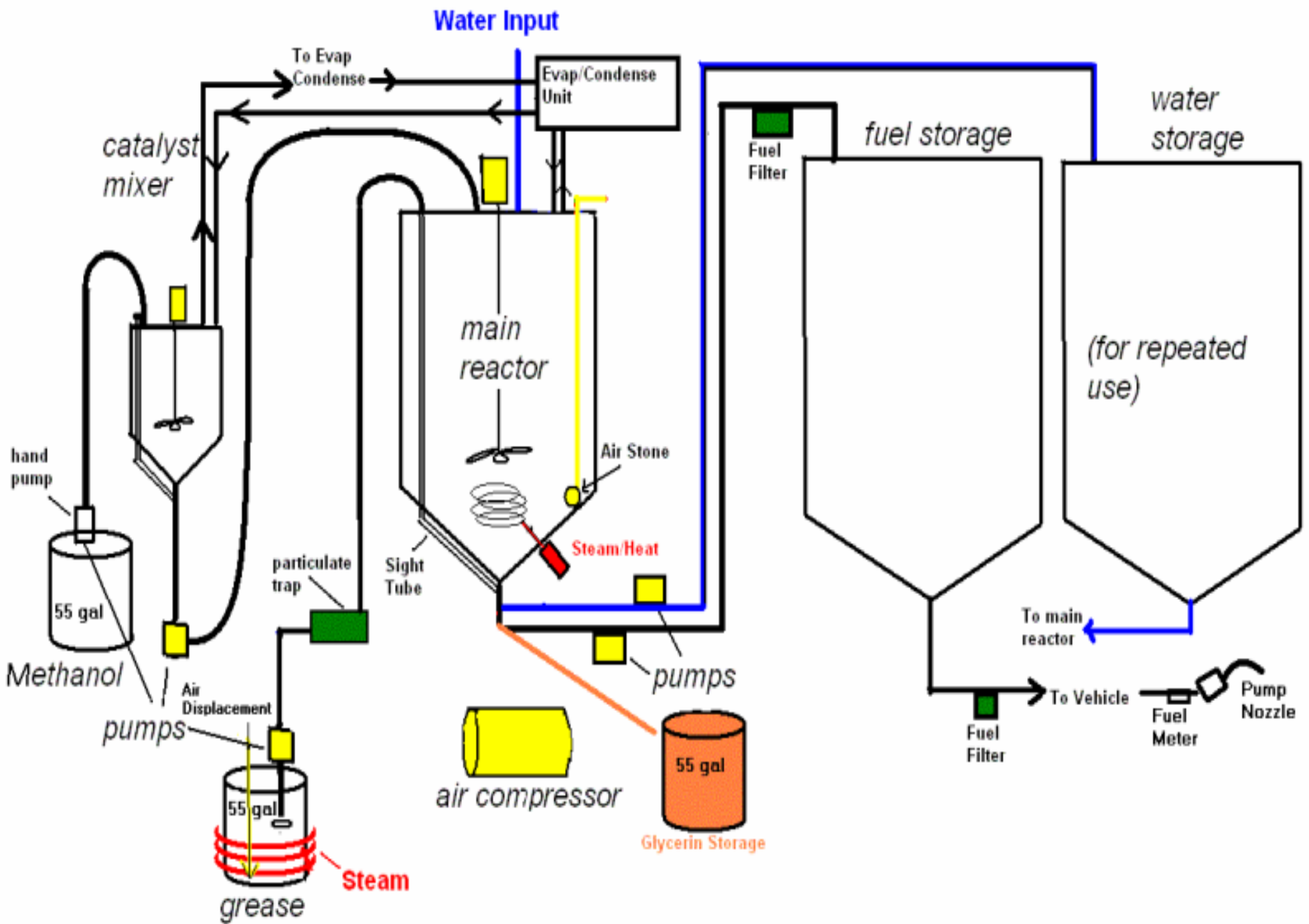
George Washington Carver

© History Channel

Modern Marvels Series

[4 min movie](#)

Conventional Biodiesel Production Process



Small Scale Processors

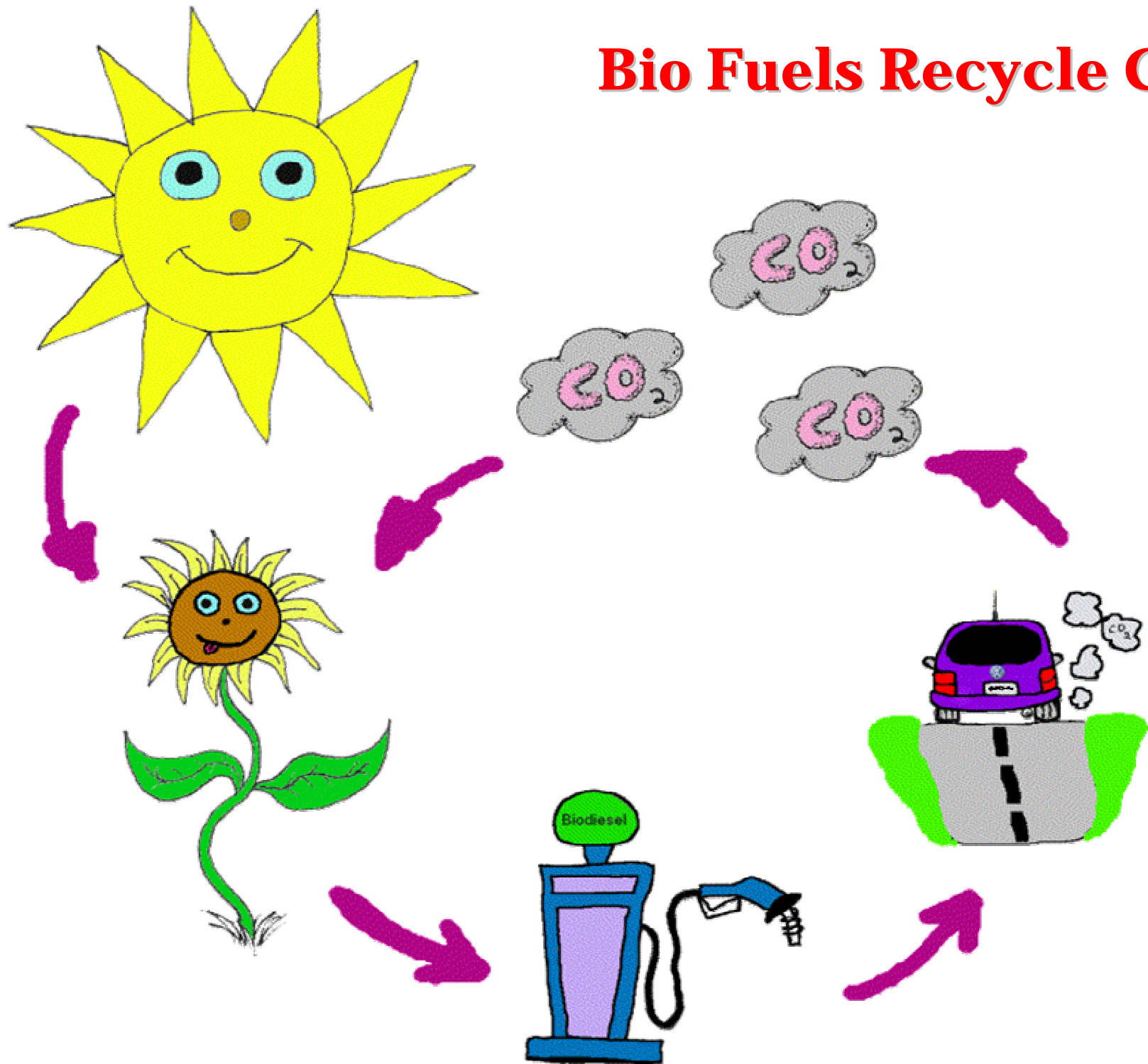


Better yet.... make your own!

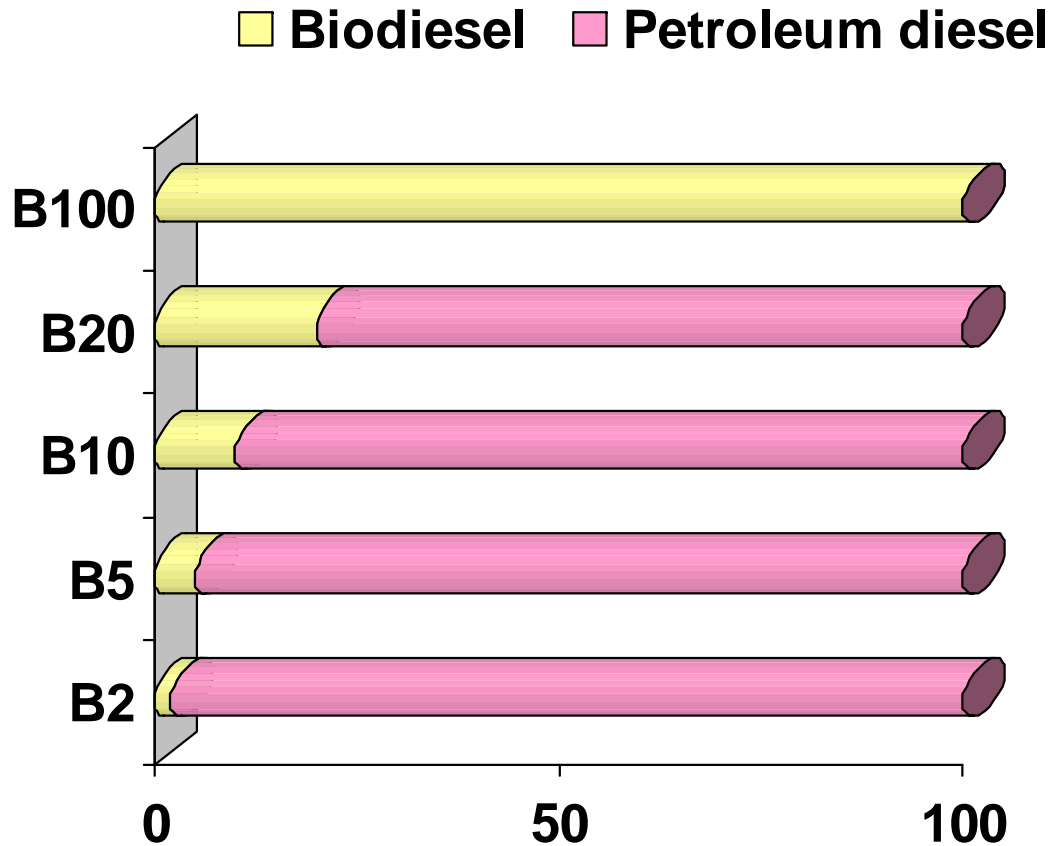
CO2 Closed Loop Biomass Cycle



Bio Fuels Recycle CO₂



Biodiesel Blends



B100 = 100% biodiesel

B20 = 20% biodiesel + 80% petroleum diesel

B10 = 10% biodiesel + 90% petroleum diesel

B5 = 5% biodiesel + 95% petroleum diesel

B2 = 2% biodiesel + 98% petroleum diesel

Biodiesel Performance

- Startup, range, cold weather performance similar to petroleum diesel
- Fuel consumption, horsepower, torque, haulage rates similar to petroleum diesel



images courtesy of the National Biodiesel Board

Biodiesel Performance



- High Lubricity
 - 2% biodiesel improves fuel lubricity by up to 66%
 - Protects, extends engine life
- High Flash Point
 - 260°F vs. 125°F diesel
 - **Safest fuel to use, handle, and store**
- Biodegradable

images courtesy of the National Biodiesel Board

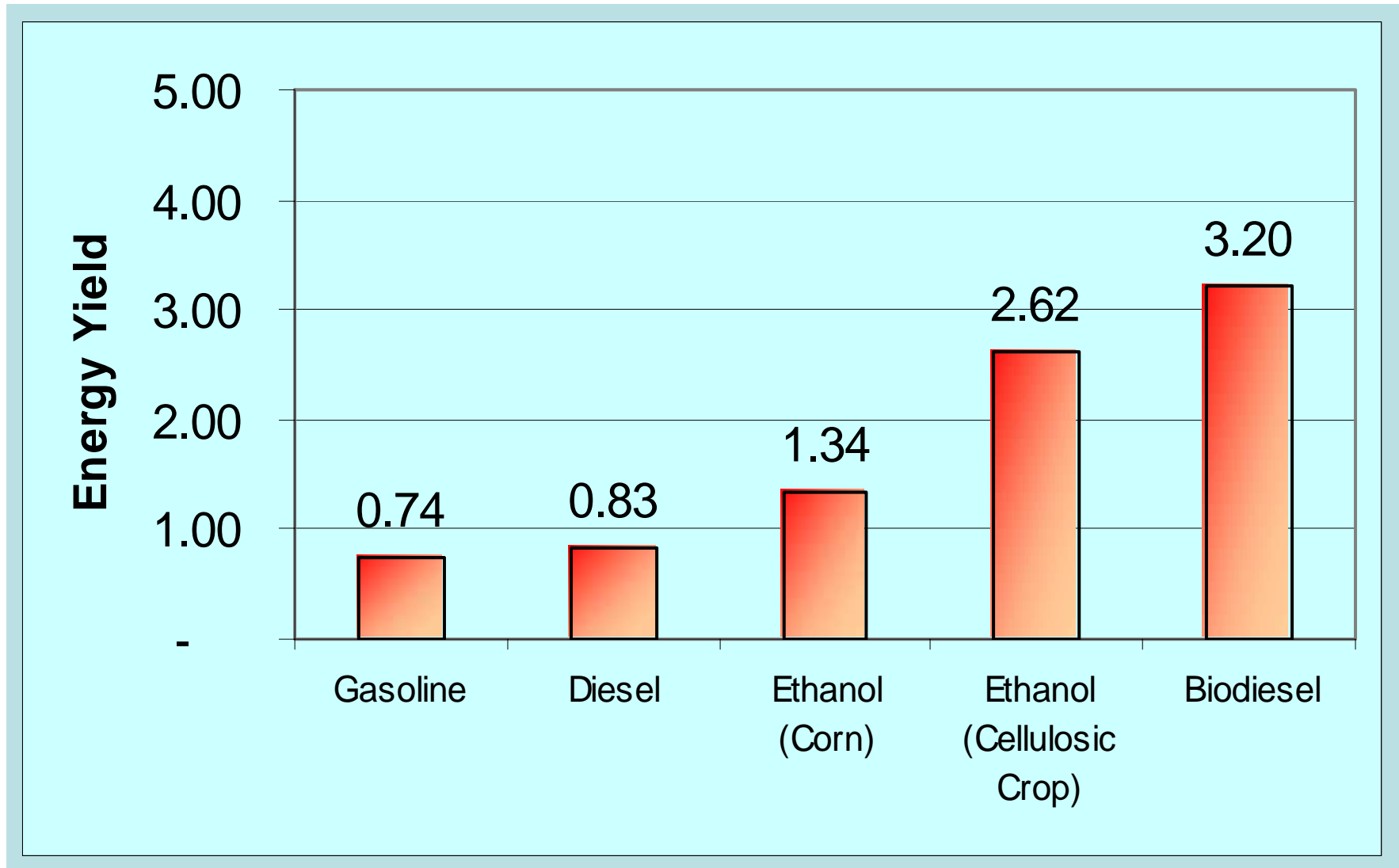
Biodiesel Performance



- Operates in conventional diesel engines and fuel injection equipment
- Cold Flow
 - For B2-B20 use same precautions as #2 petroleum diesel
 - No special storage required

images courtesy of the National Biodiesel Board

Liquid Fuels Energy Yield* - Life Cycle Basis



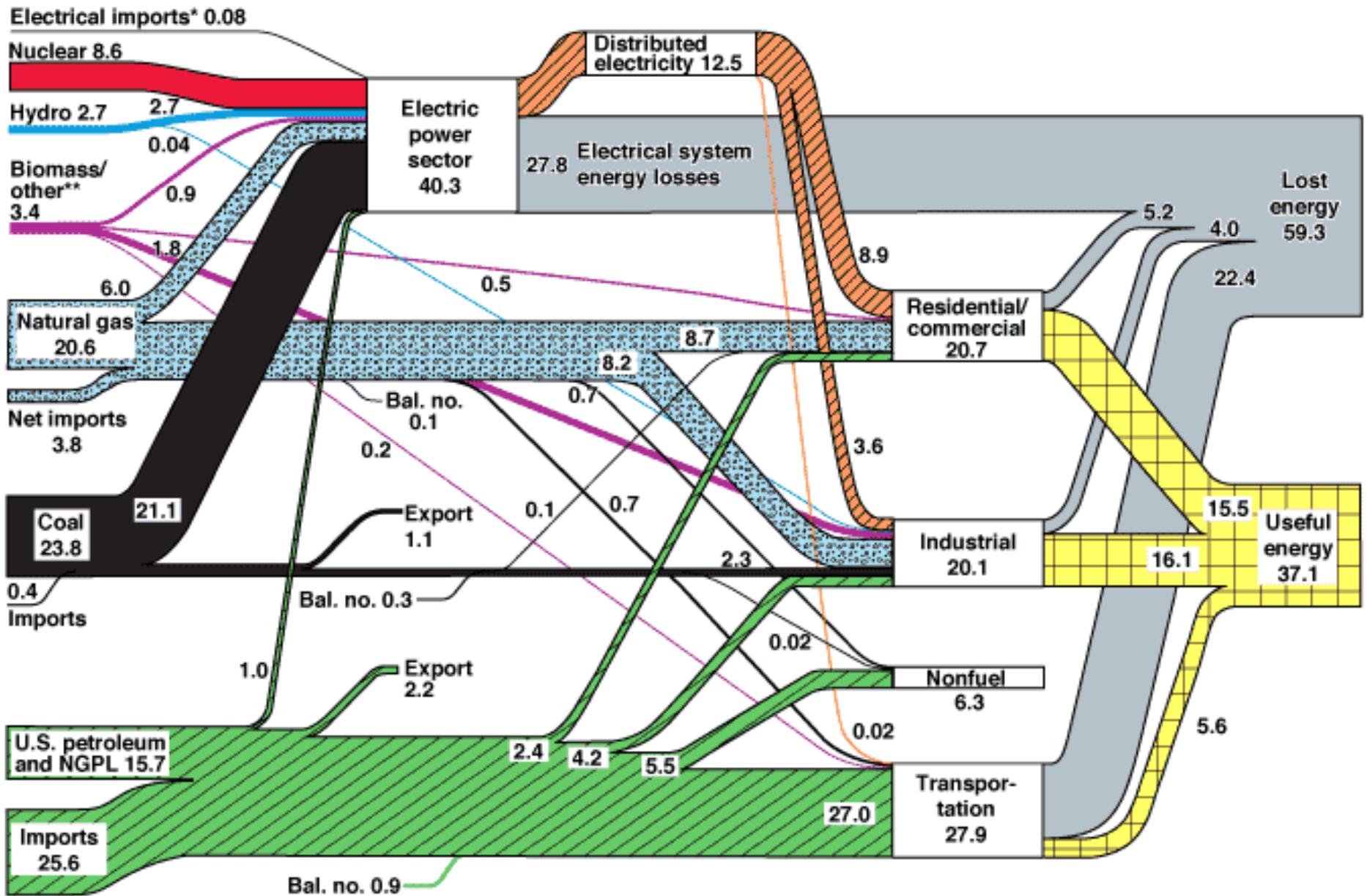
* Ratio of (liquid fuel end energy out) per (unit of fossil fuel energy in) to produce

Why use alternative fuels?

- **Dependence on foreign sources**
 - National security
 - US based jobs & profits
 - Lets produce our energy here at home
- **Environmental issues**
 - Coal: for electricity
 - emissions yield acid rain, mercury, CO₂ & climate change
 - Oil: for transportation
 - emissions = smog, CO₂ & climate change

U.S. Energy Flow Trends – 2002

Net Primary Resource Consumption ~103 Exajoules



Source: Production and end-use data from Energy Information Administration, *Annual Energy Review 2002*.

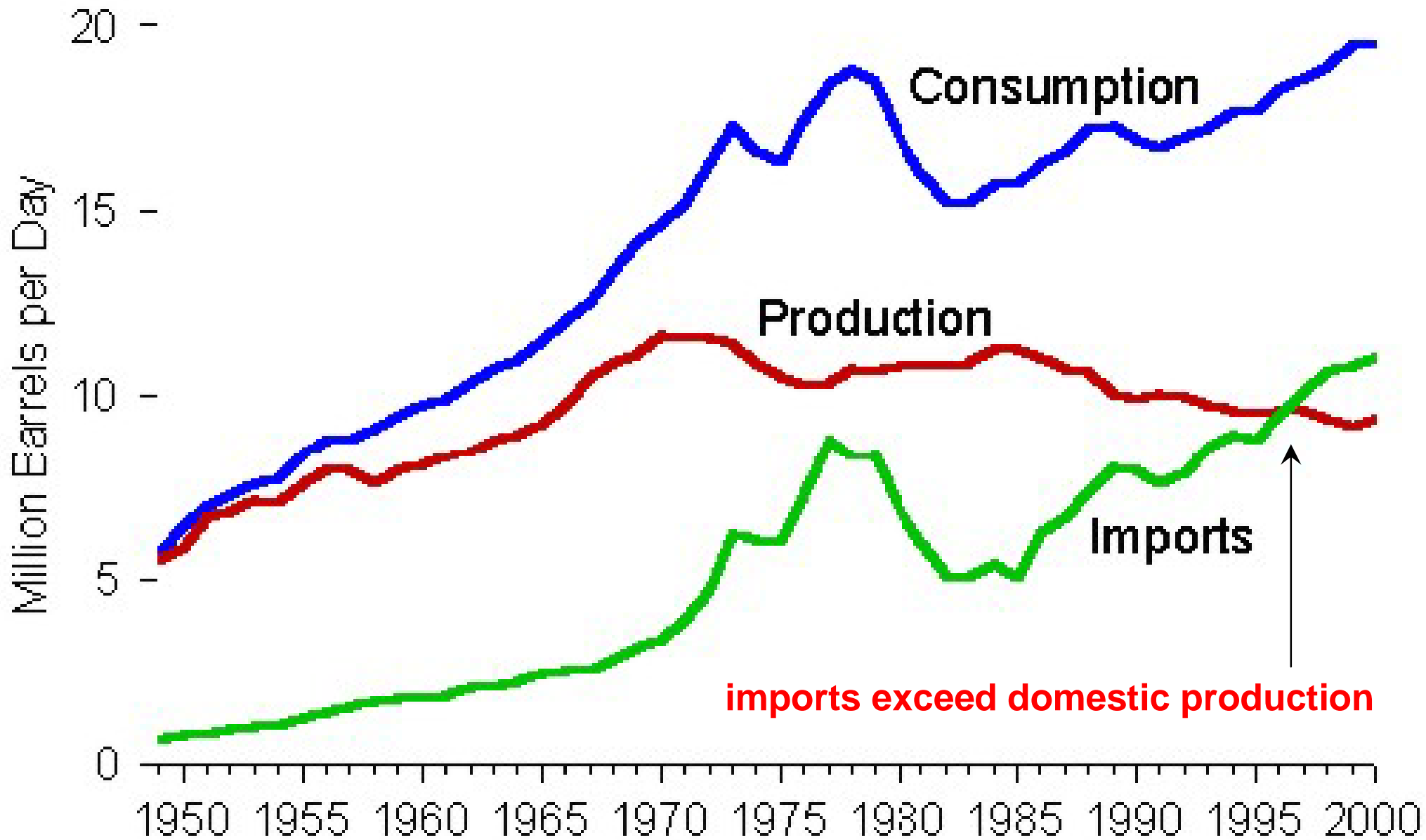
*Net fossil-fuel electrical imports.

**Biomass/other includes wood, waste, alcohol, geothermal, solar, and wind.

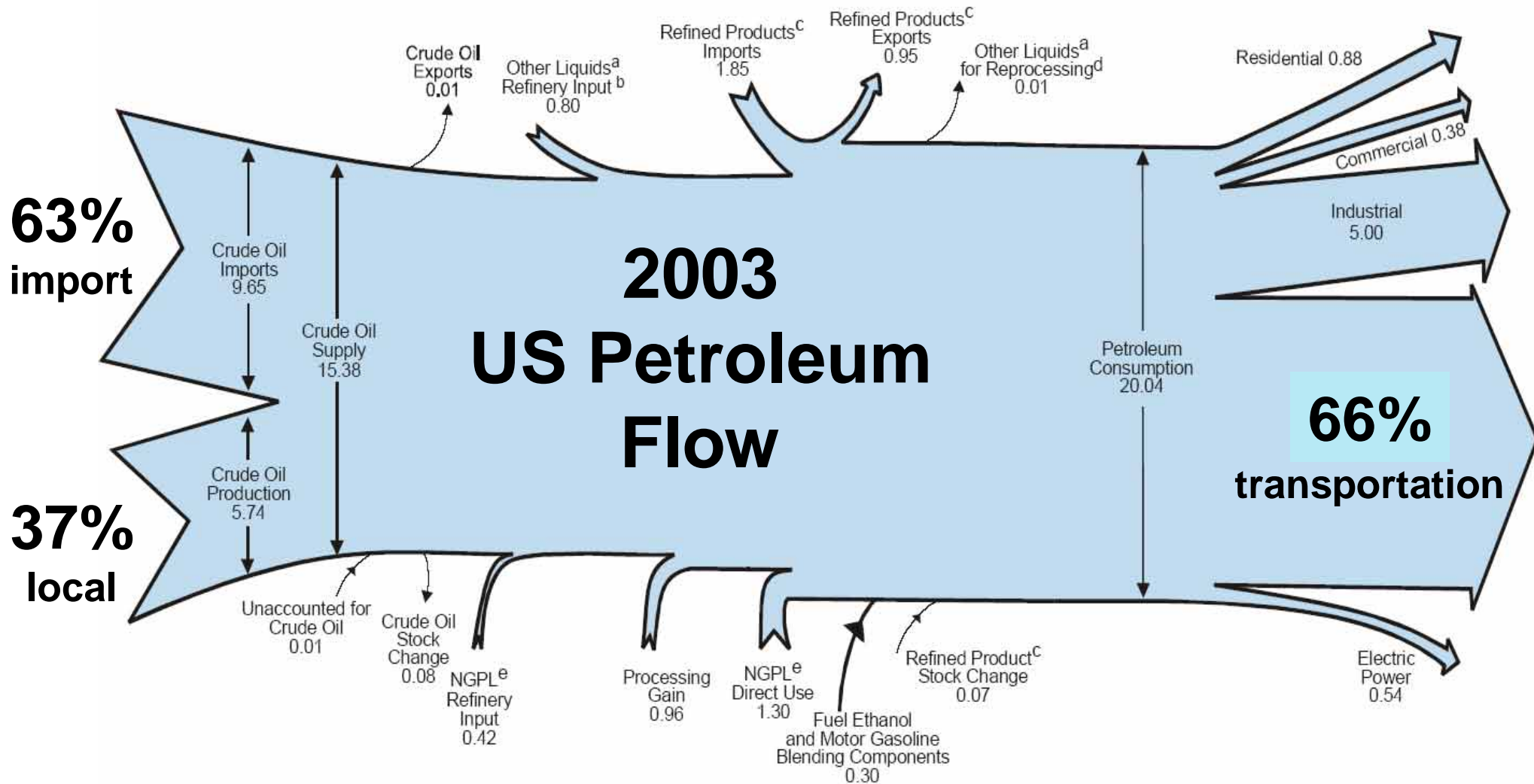
June 2004

Lawrence Livermore
National Laboratory
<http://eed.llnl.gov/flow>

US Petroleum Overview



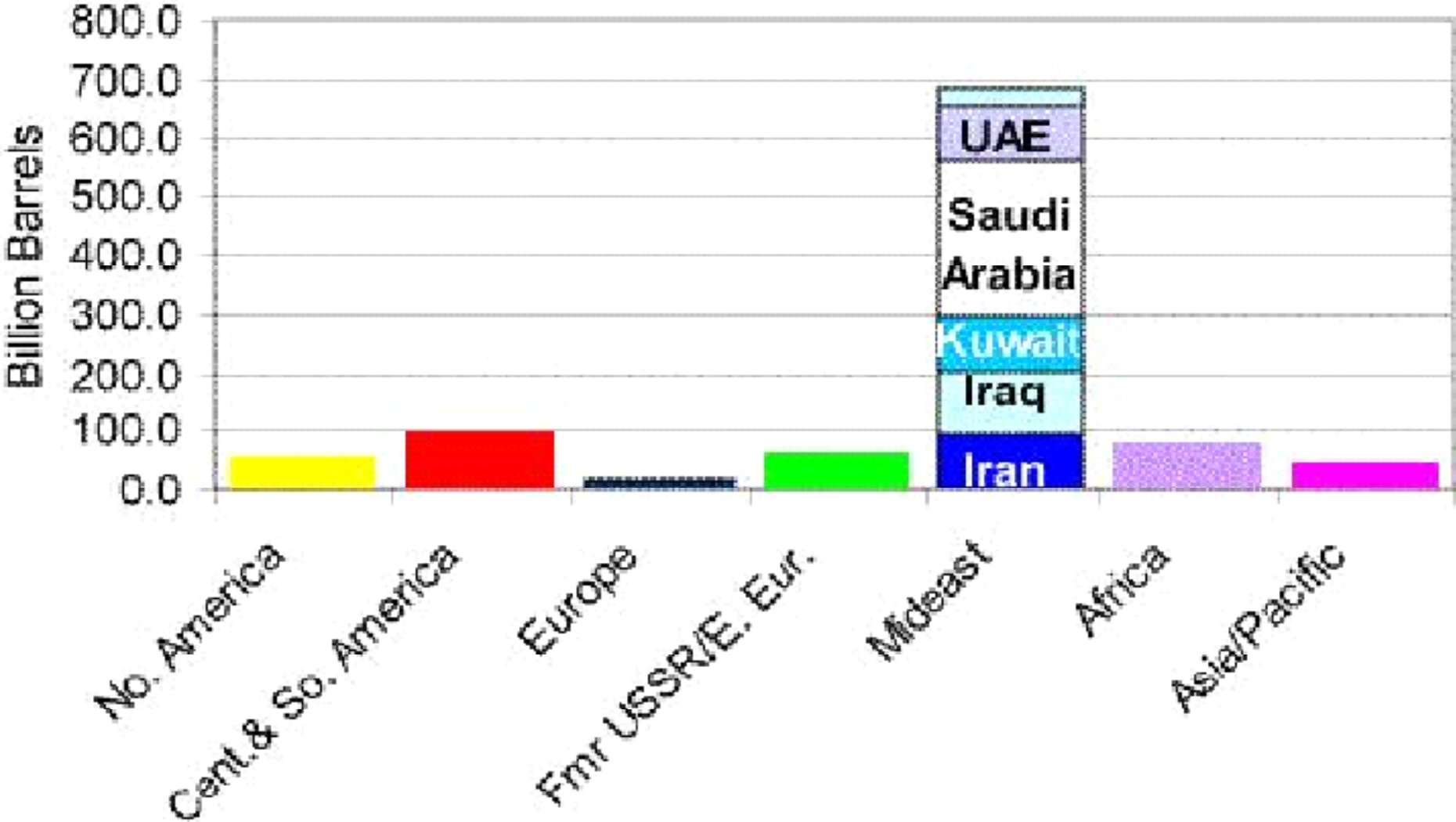
source: US Department of Energy, Energy Information Administration



source: US Department of Energy, Energy Information Administration

Estimates of World Petroleum Reserves

Oil Reserves, End-2000



NATIONALGEOGRAPHIC.COM/MAGAZINE

JUNE 2004

NATIONAL GEOGRAPHIC

**THE END OF
CHEAP**

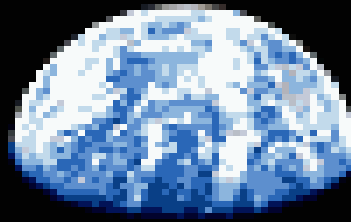
Oil

June, 2004 Issue

“Humanity’s way of life is on a collision course with geology – with the stark fact that the Earth holds a finite supply of oil. The flood of crude from fields around the world will ultimately top out, then dwindle. It could be 5 years from now or 30, no one knows for sure.”

Why use alternative fuels?

- **Dependence on foreign sources**
 - National security
 - US based jobs & profits
 - Lets produce our energy here at home
- **Environmental issues**
 - **Coal: for electricity**
 - emissions = acid rain, mercury, CO₂ & CLIMATE CHANGE
 - **Oil: for transportation**
 - emissions = smog, CO₂ & CLIMATE CHANGE



Several of the following and previous images are courtesy of Dave Konkle, City of Ann Arbor, Energy Manager. Thanks Dave, I still owe you lunch !

The McGraw-Hill Companies

BusinessWeek

AUGUST 16, 2004

www.businessweek.com

GLOBAL WARMING

Why Business Is Taking It So Seriously

BY JOHN CAREY (P. 60)



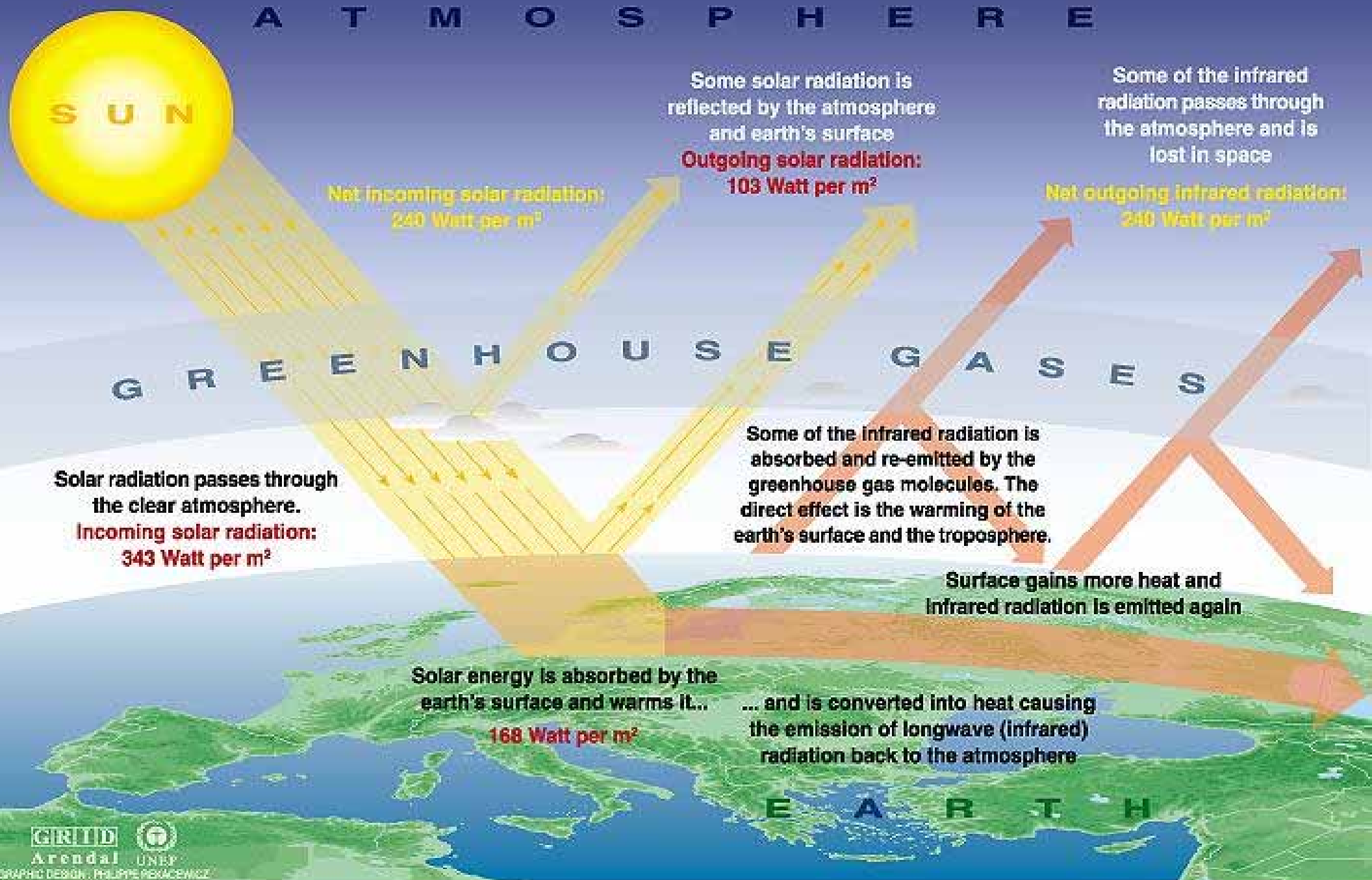
The background of the cover is a photograph of a dark, stormy sky at night. Two bright, jagged lightning bolts strike down from the clouds. Below the lightning, the lights of a city are visible, creating a bokeh effect. The overall color palette is dominated by dark blues, blacks, and oranges from the lightning and the top of the sky.

LIFE

The
YEAR of
**KILLER
WEATHER**

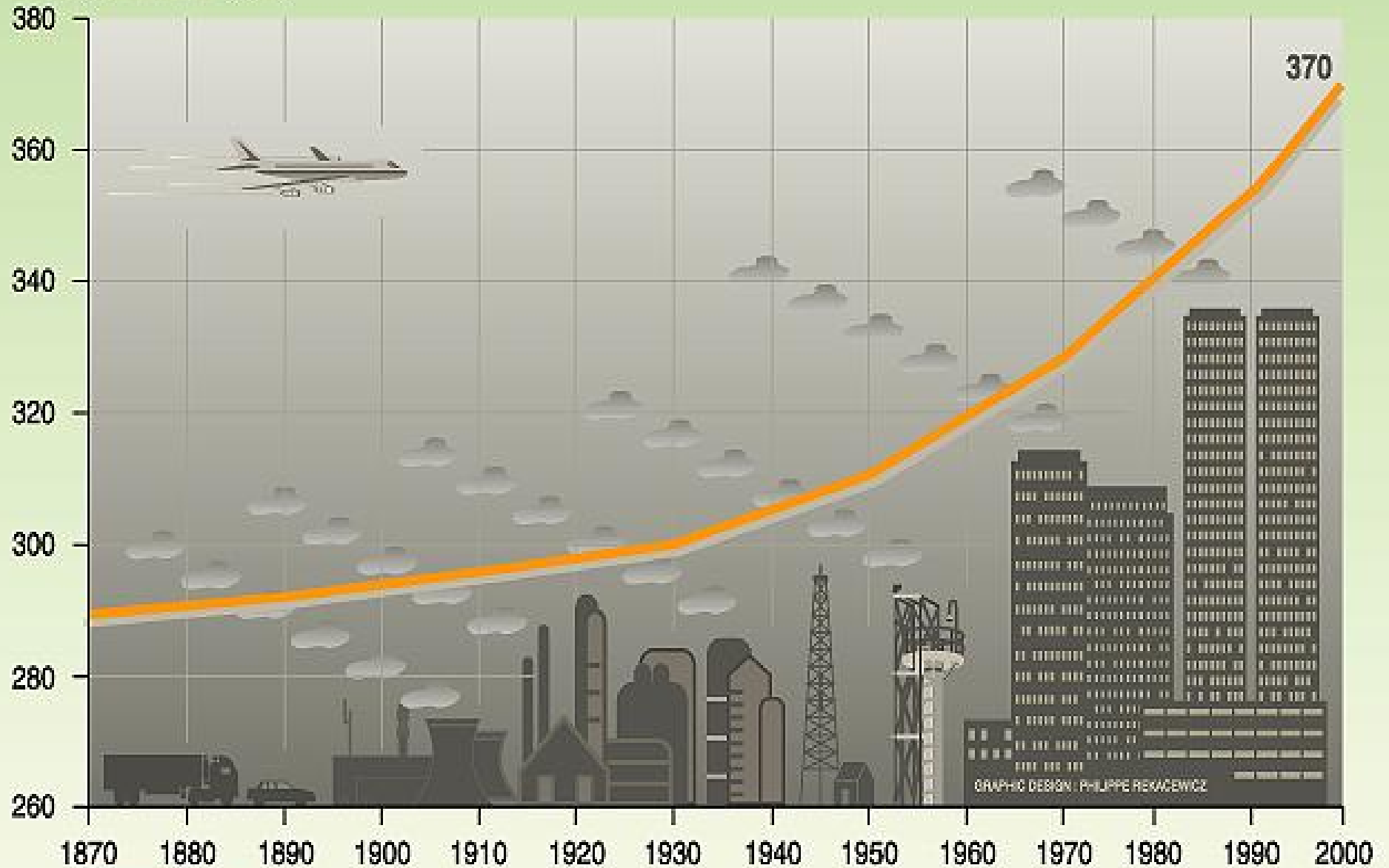
Why Has
NATURE
Gone
MAD?

The Greenhouse effect



Global atmospheric concentration of CO₂

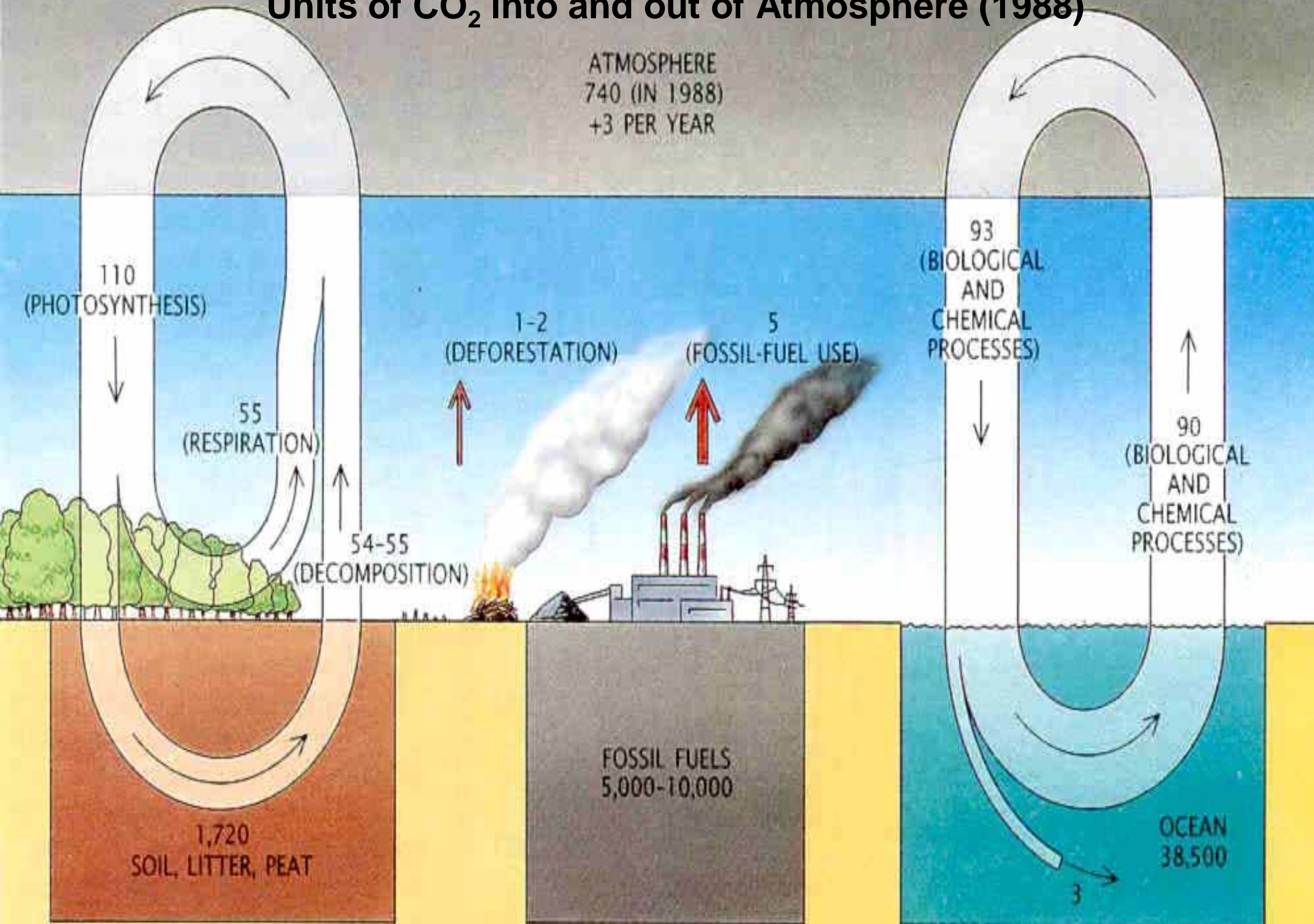
Parts per million (ppm)



GRID
Arendal UNEP

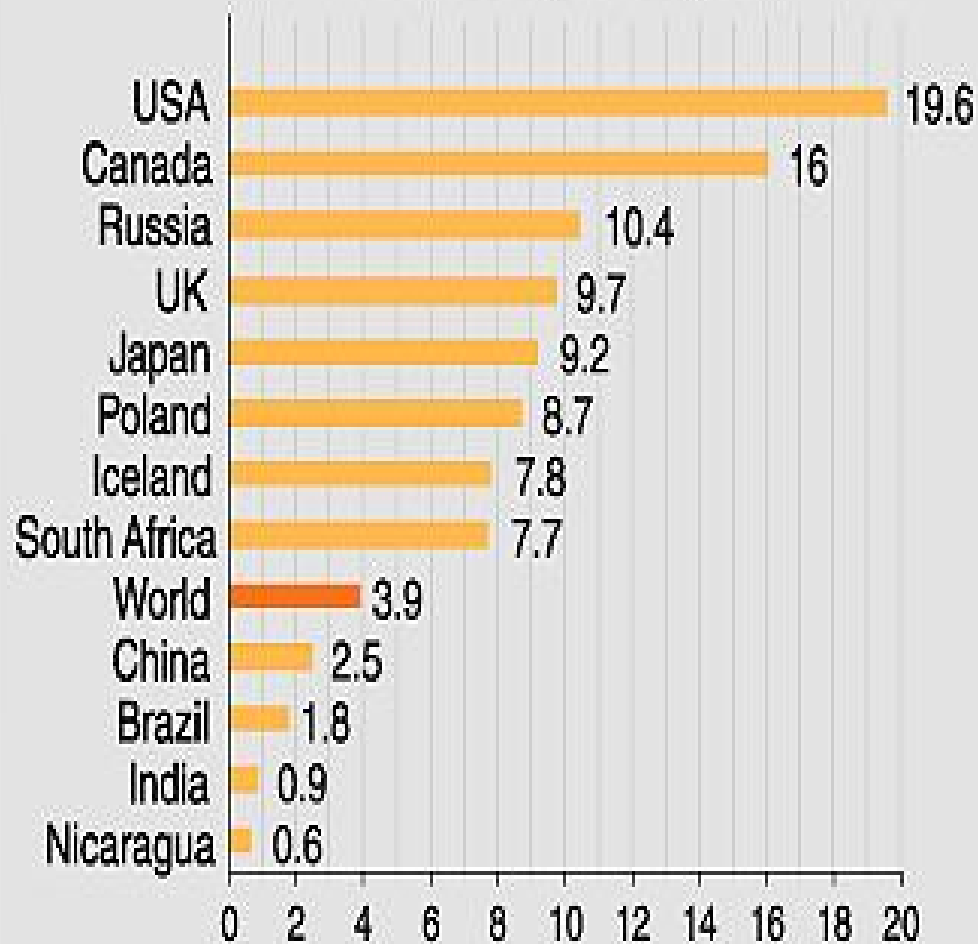
GRAPHIC DESIGN: PHILIPPE REKAWCZ

Units of CO₂ into and out of Atmosphere (1988)

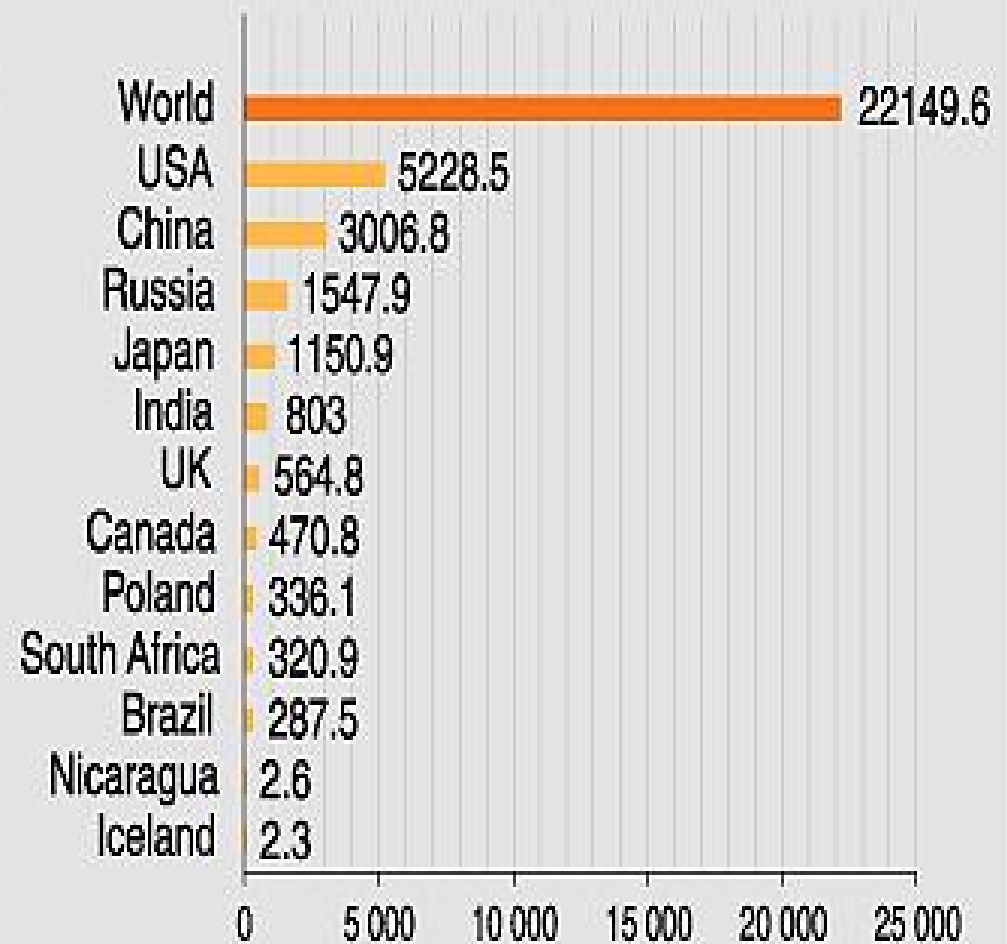


Emissions of CO₂ - selected countries (1995)

Tonnes per capita

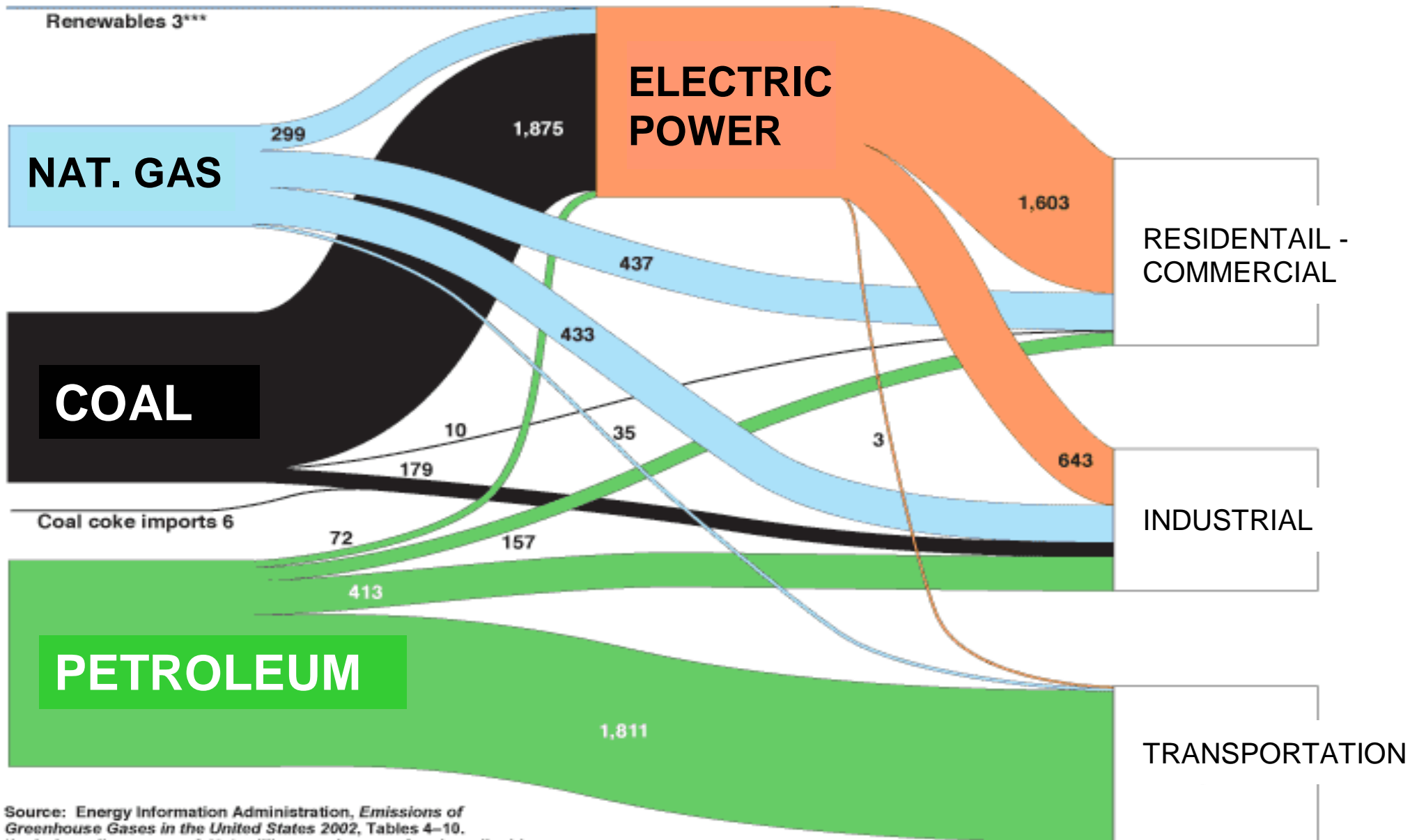


Total million tonnes



GRAPHIC DESIGN : PHILIPPE REKACZEWICZ

U.S. 2002 Carbon Dioxide Emissions from Energy Consumption — 5,682* Million Metric Tons of CO₂**



Source: Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2002*, Tables 4–10.

*Includes adjustments of 42.9 million metric tons of carbon dioxide from U.S. territories, less 90.2 MtCO₂ from international and military bunker fuels.

**Previous versions of this chart showed emissions in metric tons of carbon, not of CO₂.

***Municipal solid waste and geothermal energy.

Note: Numbers may not equal sum of components because of independent rounding.

STORM SURGE IN LOWER MANHATTAN



Rising waters could be submerging lower Manhattan periodically by 2090 if global warming proceeds as at least one climate analysis has projected.

source:
Scientific
American



2010 - 2030



2040 - 2060

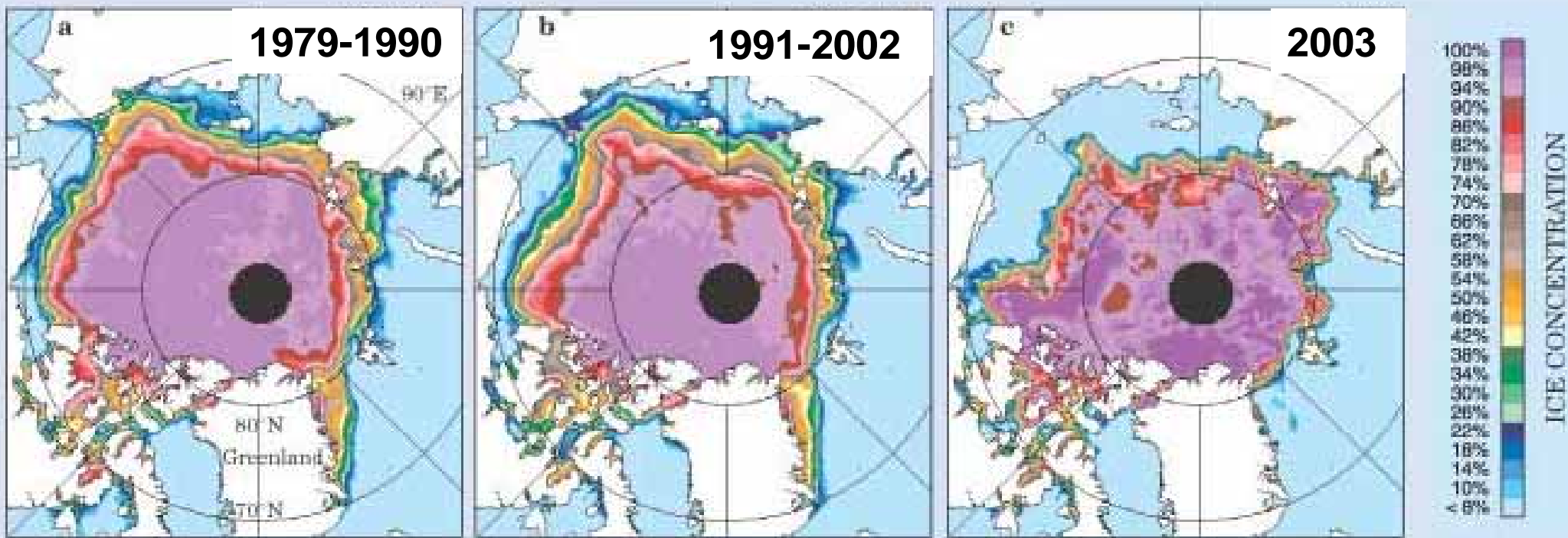


2070 - 2090

ARTIC SEA ICE is projected to shrivel.

Maps show September sea ice for three future periods.

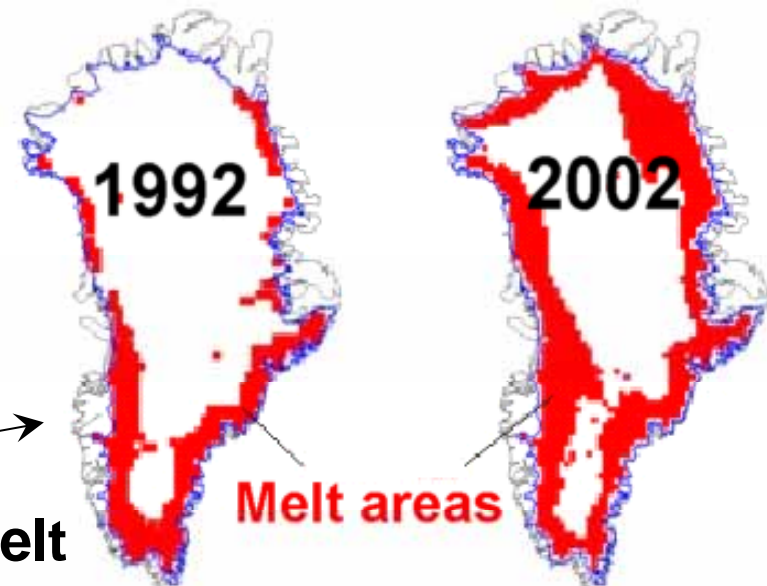
**source:
Scientific
American**



North polar ice concentrations, minimum summertime levels, for last 24 years

Satellite observations show CURRENT ice melt

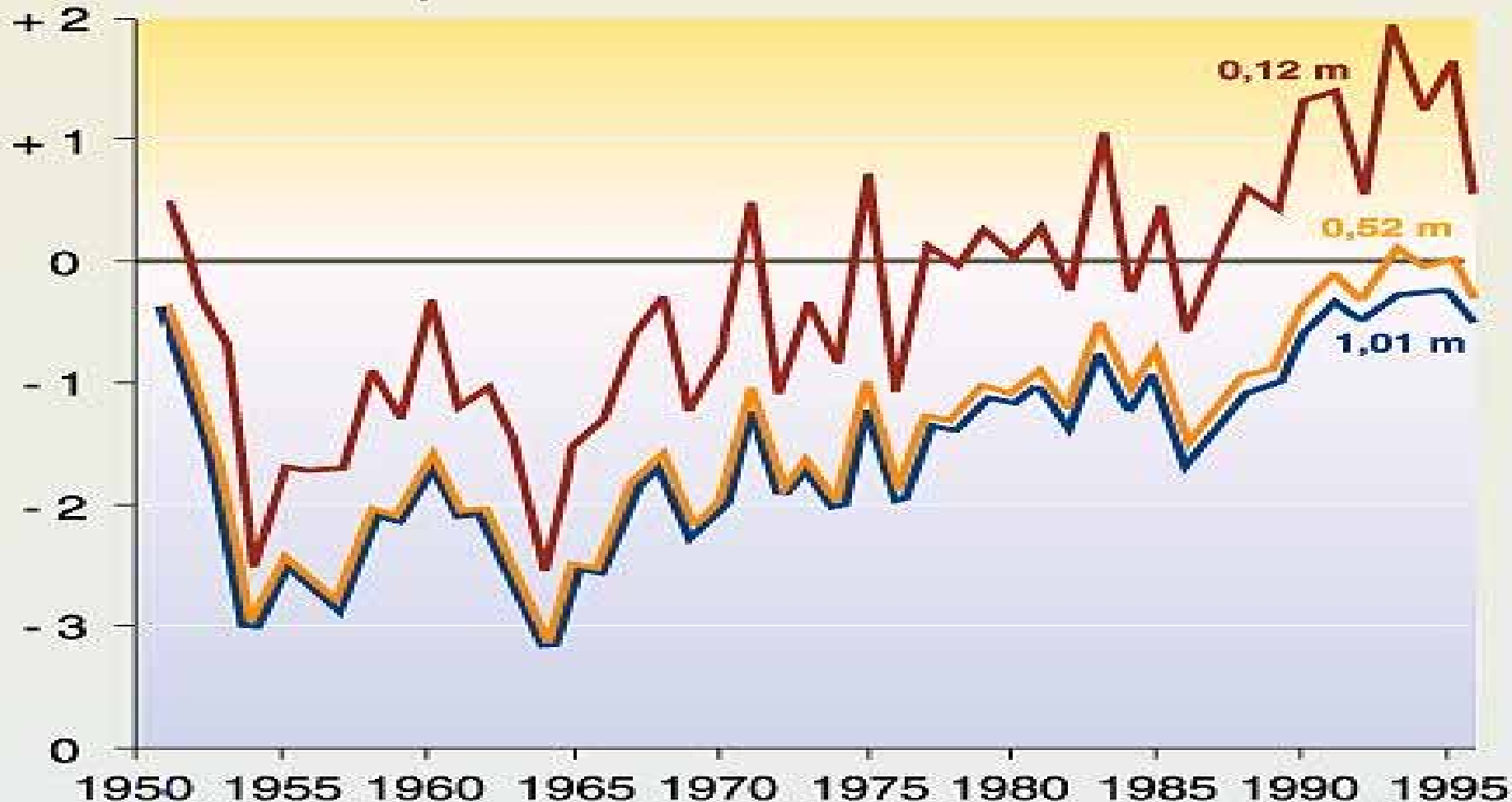
Greenland summertime ice melt



source: J Comiso and C Parkinson, "Satellite Observed Changes in the Arctic", **Physics Today**, vol. 57, issue 8 or www.physicstoday.org/vol-57/iss-8/p38.html

Change in permafrost temperatures at various depths in Fairbanks (Alaska)

Mean annual temperature °C



Soil depth (in meter)

— 0,12 m

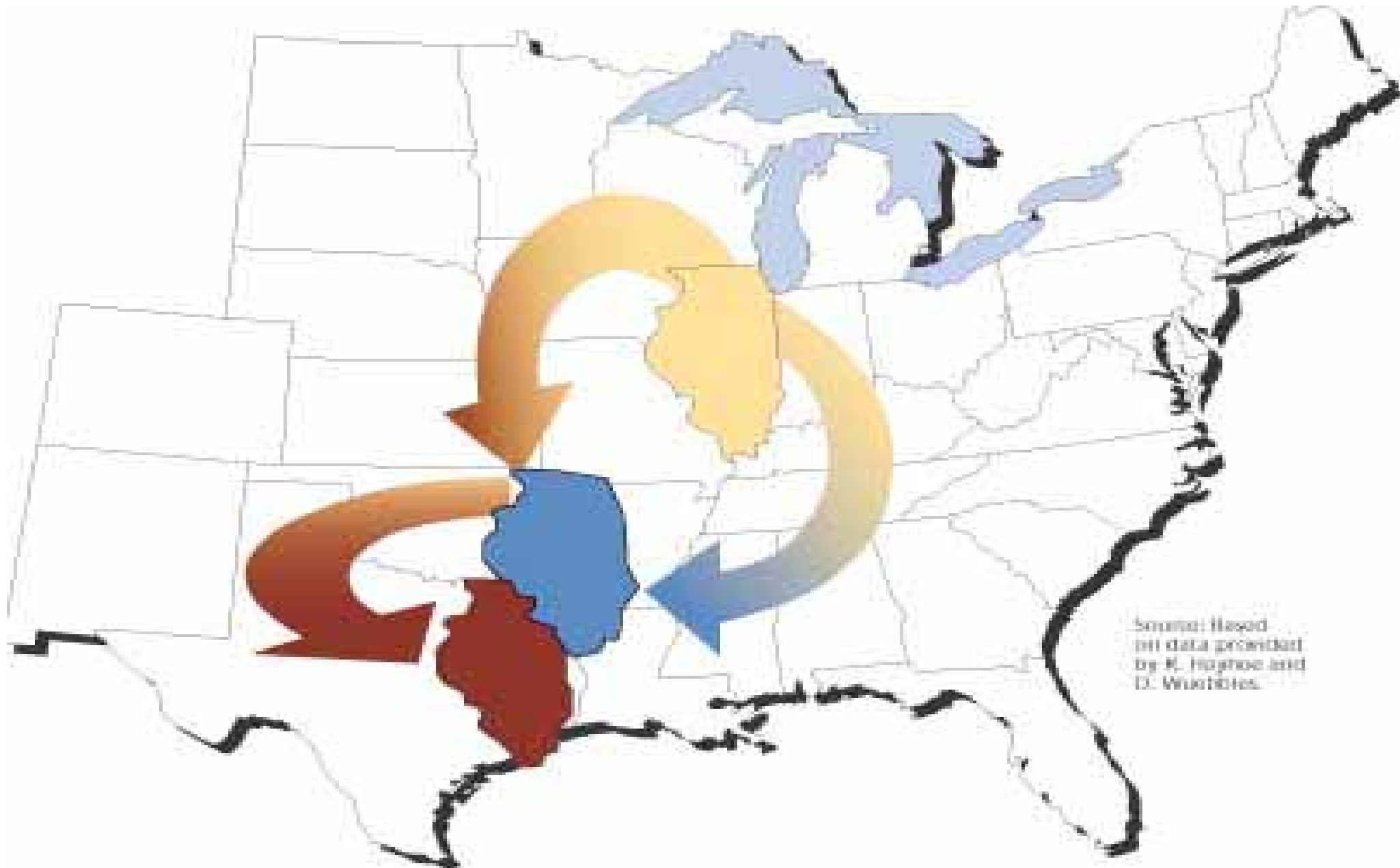
— 0,52 m

— 1,01 m

GRID
Arendal



GRAPHIC DESIGN : PHILIPPE REKACEWICZ



Source: Based on data provided by R. Higgins and D. Vrukkles.



Current



By 2030
Summer



By 2095
Summer



Winter
Changes
Over the 21st
Century



By 2095
Winter

What To Do?

- **At Home, At Work, in your Car**
- **Cheapest Path – Energy Conservation**
- **Renewable Energy**
 - solar, wind, & biomass
- **Renewable Fuels**
 - ethanol, gasahol (E10), E85, methanol
 - natural gas
 - biodiesel B20 (lets start with B2)
- **Technology to the Rescue**
 - hybrid vehicles
 - **diesels (30-40% more efficient than gas)**

The top 10 vehicles that get the best fuel economy in America

The vehicles that achieve the best fuel efficiency in city and highway driving are made by foreign automakers.

2004
Vehicles

Diesel vs Hybrid



Honda Insight

(manual transmission)
Mileage per gallon: 61/68
Engine Type: Gas-electric



Honda Insight

(automatic transmission)
Mileage per gallon: 57/56
Engine Type: Gas-electric



Toyota Prius

(automatic transmission)
Mileage per gallon: 52/45
Engine Type: Gas-electric



Honda Civic

(automatic transmission)
Mileage per gallon: 48/47
Engine Type: Gas-electric



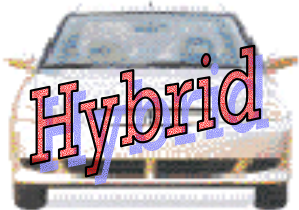
VW New Beetle

(manual transmission)
Mileage per gallon: 42/49
Engine Type: Diesel



Volkswagen Jetta

(manual transmission)
Mileage per gallon: 42/49
Engine Type: Diesel



Honda Civic

(manual transmission)
Mileage per gallon: 46/51
Engine Type: Gas-electric



Volkswagen Golf

(manual transmission)
Mileage per gallon: 42/49
Engine Type: Diesel



Honda Civic

(manual transmission)
Mileage per gallon: 36/44
Engine Type: Gasoline



Toyota Echo

(manual transmission)
Mileage per gallon: 35/43
Engine Type: Gasoline

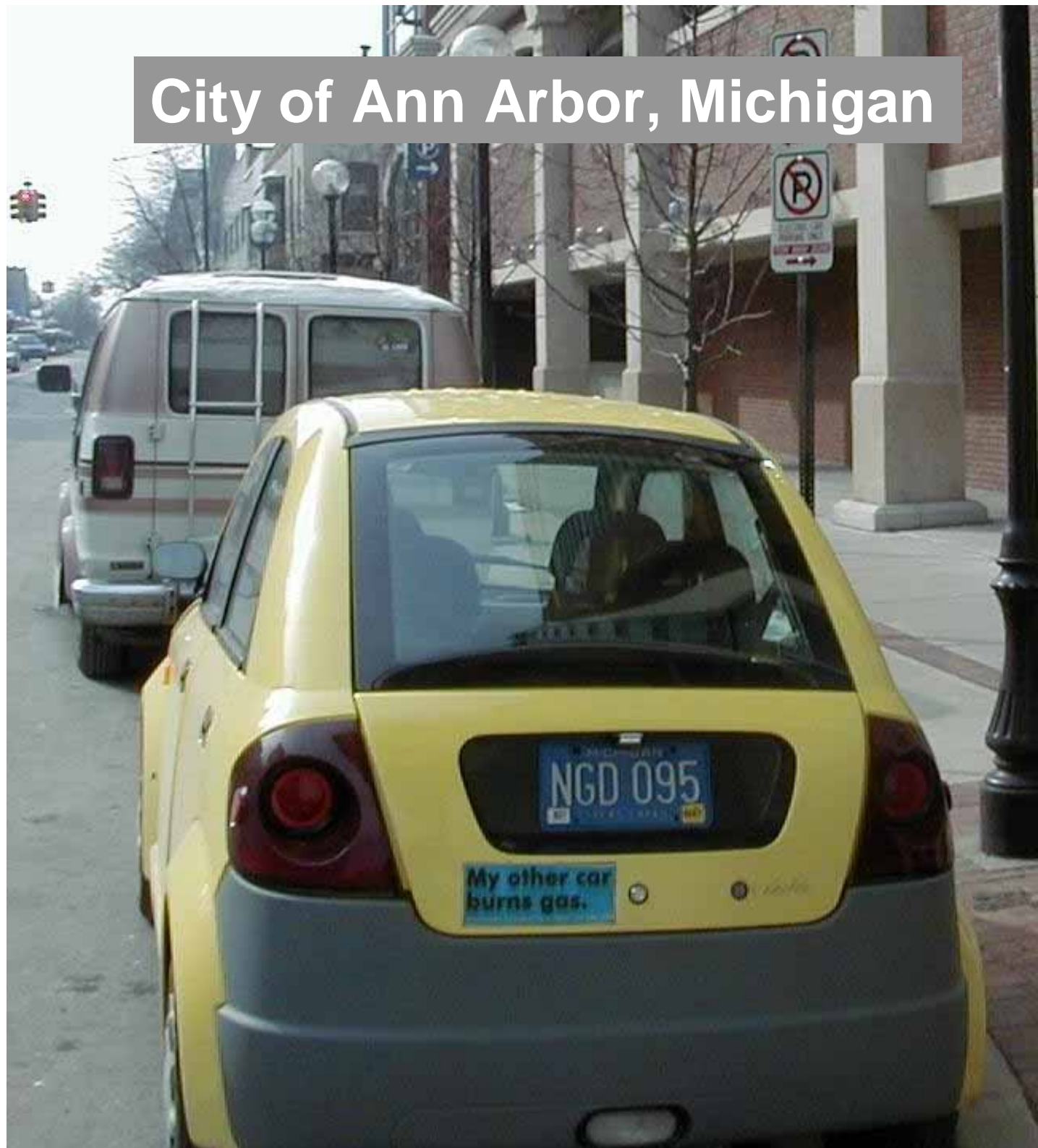


BioDiesel Fuel Pump (20%)

BP Station on Will Carlton Rd off of I-275 just west of Flat Rock, MI



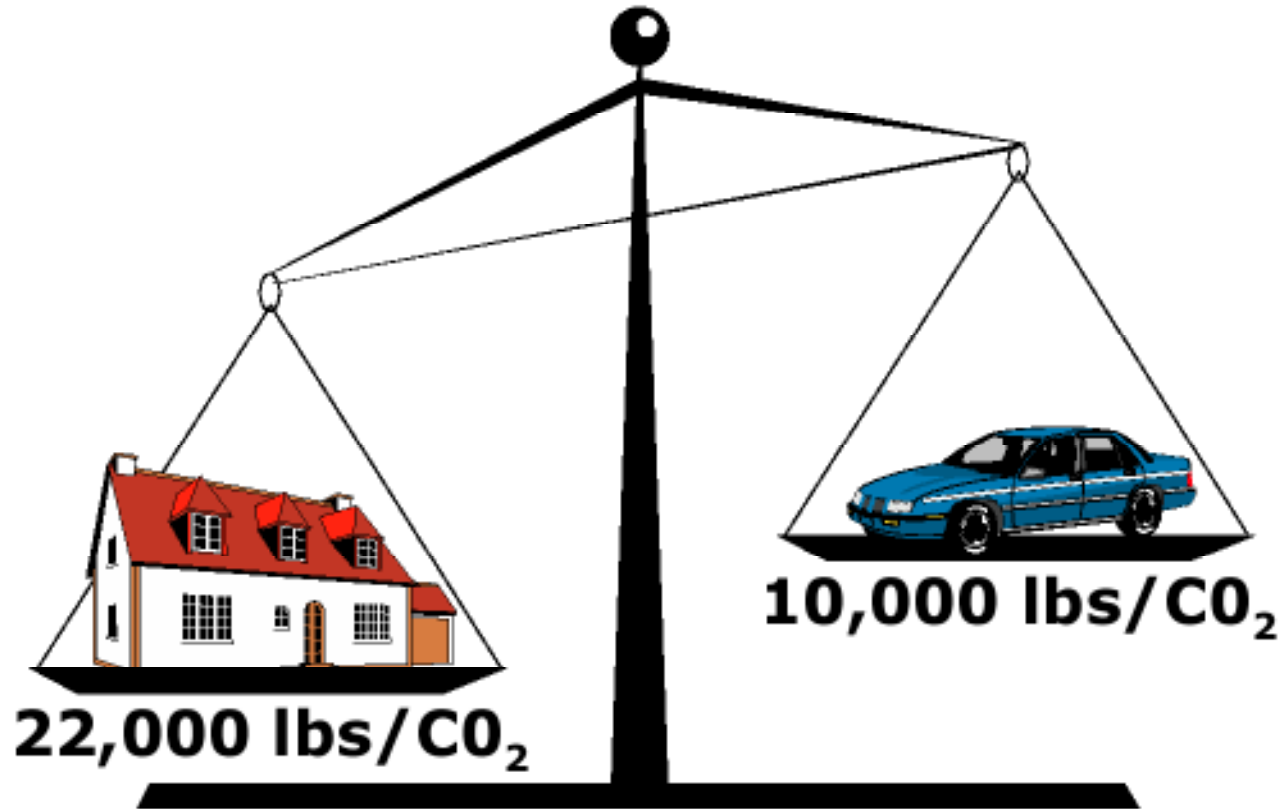
City of Ann Arbor, Michigan





**Natural Gas Fueling Station,
Ann Arbor Meijer's Store**

Annual CO₂ emissions from the average home vs. average car



Each year, the average home produces over twice the greenhouse gases as the typical auto



State of the State - 2005

“This investment in Michigan’s future will allow us to transform the state that put the nation on wheels into the state that makes those wheels run on **pollution-free fuel cells or bio-diesel technology**; the state where the research into alternative energies is done; the state where the clean technology is developed, and where the clean cars, products, and businesses are built.

And, Michigan, the Great Lakes State, could be the state that finally makes these United States **independent of foreign oil.**”

**Thanks for
listening...**



Jim Leidel
Energy Manager

**for more info, please visit
www.ouenergy.com**