

Fossil Fuels

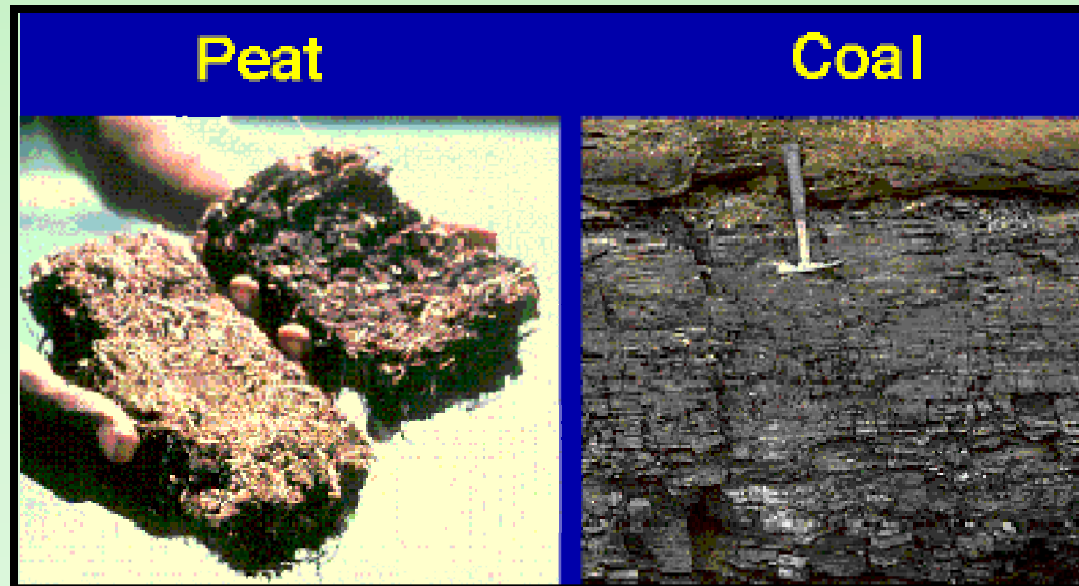
Nonrenewable carbon based fuels made from the remains of plants and other organisms that were buried in the earth's crust and altered by heat and pressure over millions of years.

COAL

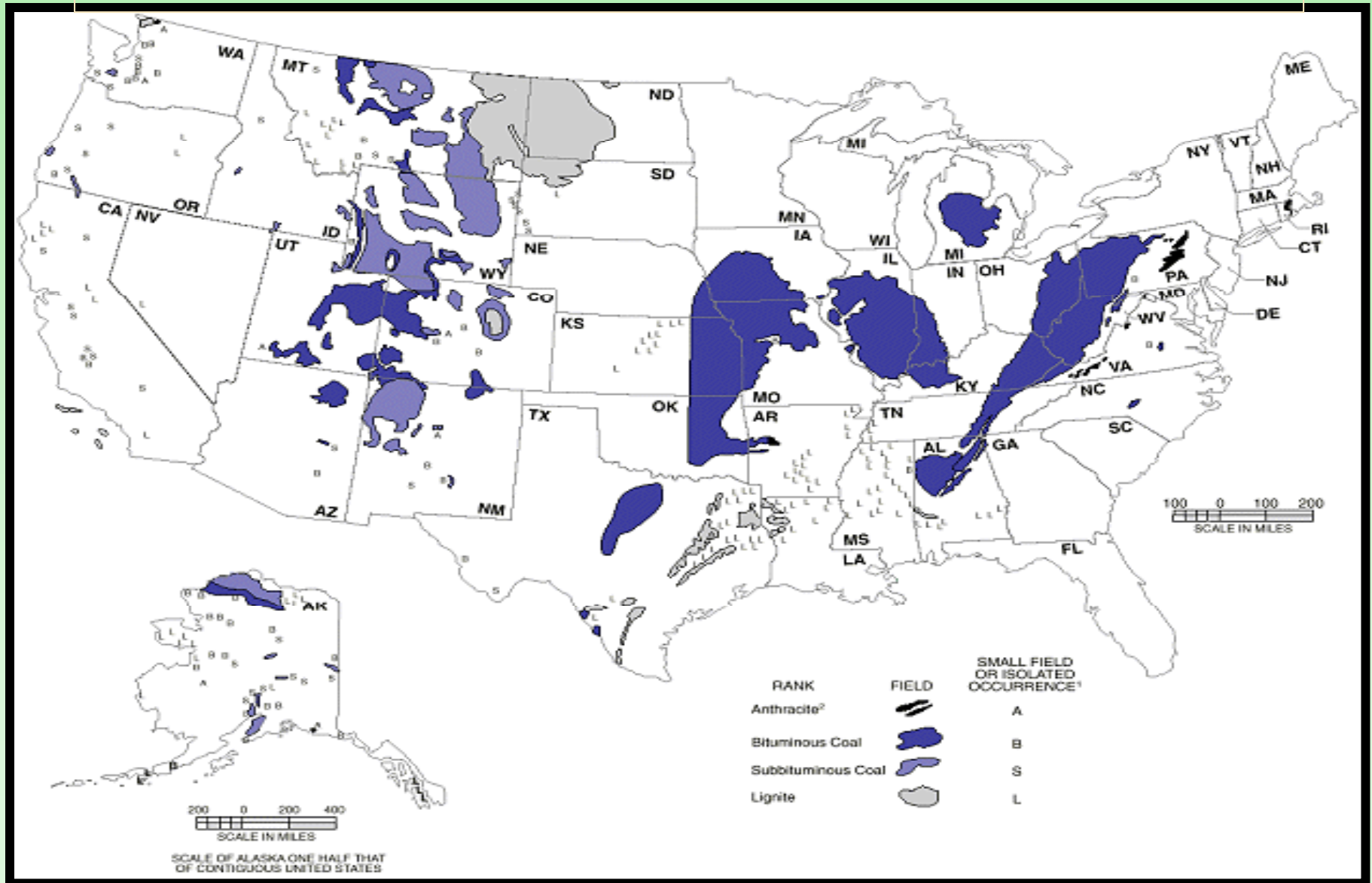


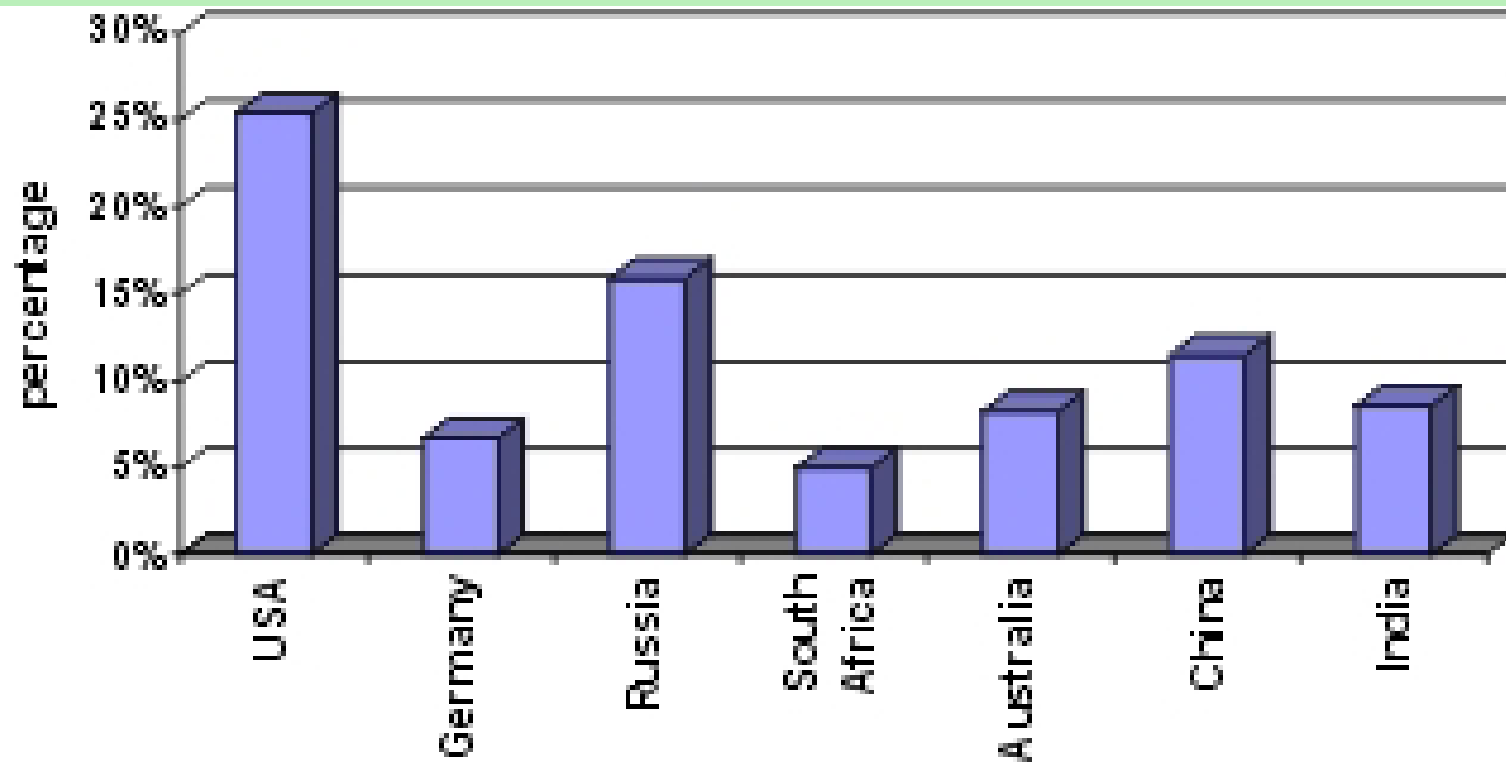
COAL

- ✓ The most abundant fossil fuel
- ✓ 4 main grades: peat, lignite, bituminous and anthracite



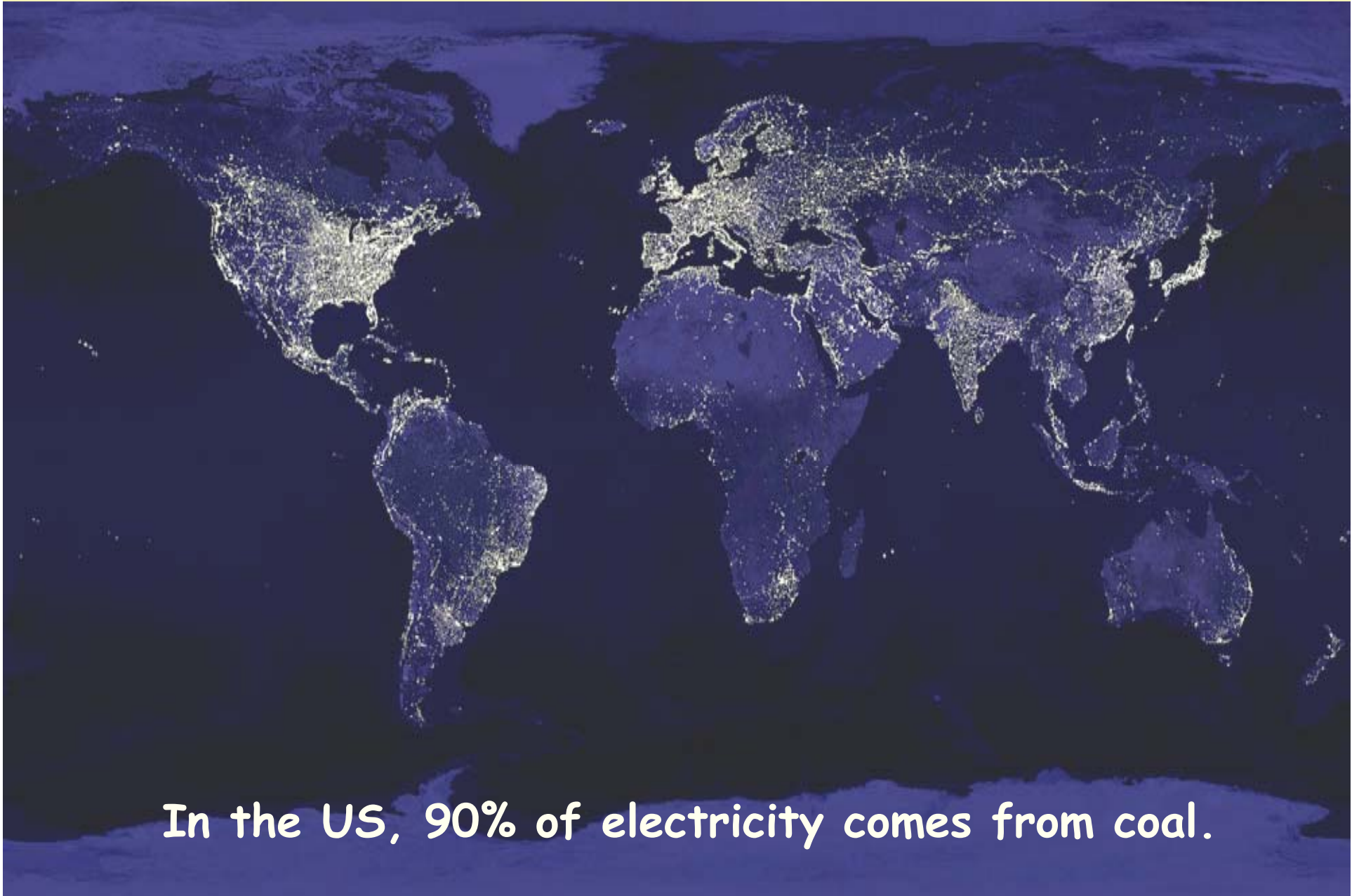
Coal Deposits in the U.S.



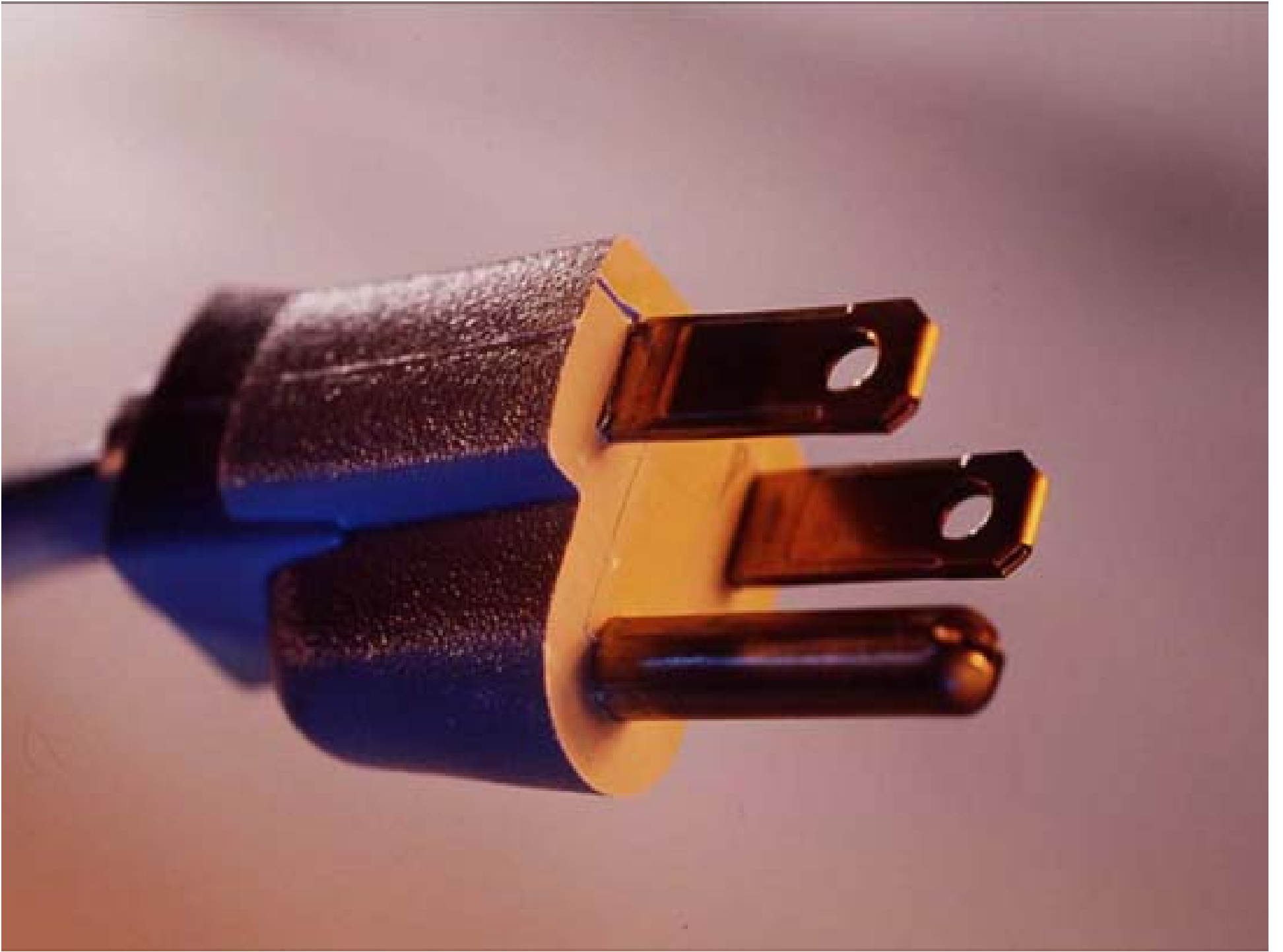




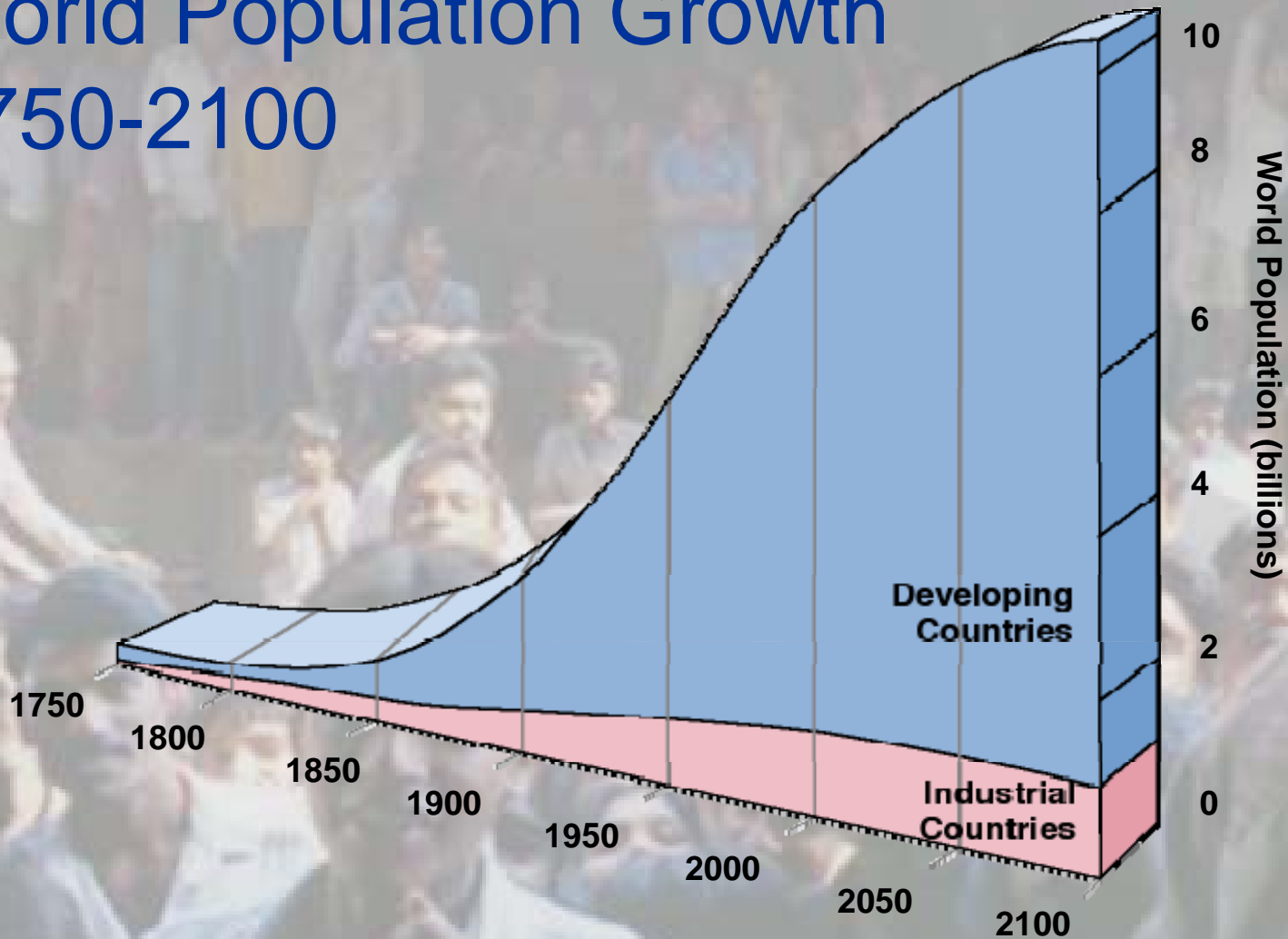
✓ World Energy Use at Night



In the US, 90% of electricity comes from coal.



World Population Growth 1750-2100



EIA projects 60% energy consumption increase by 2020

Source: Population Reference Bureau

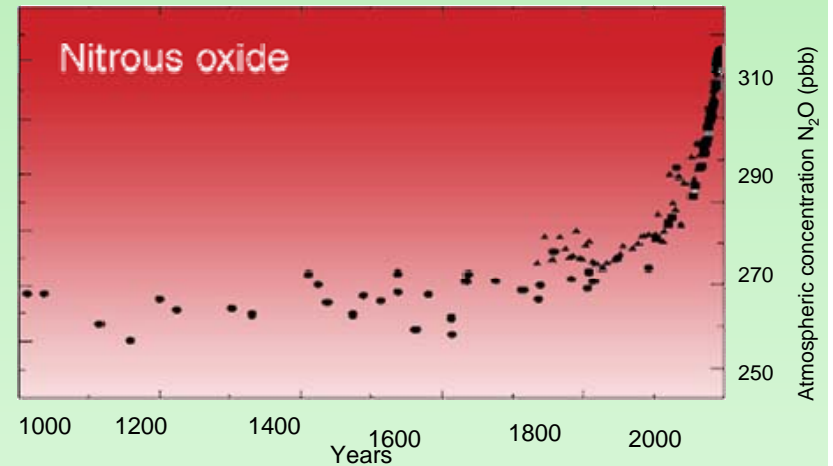
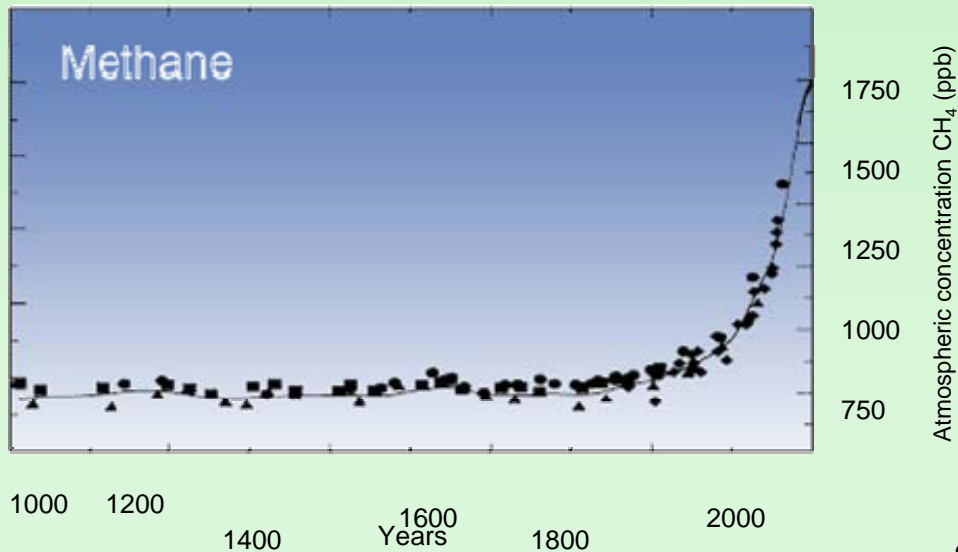
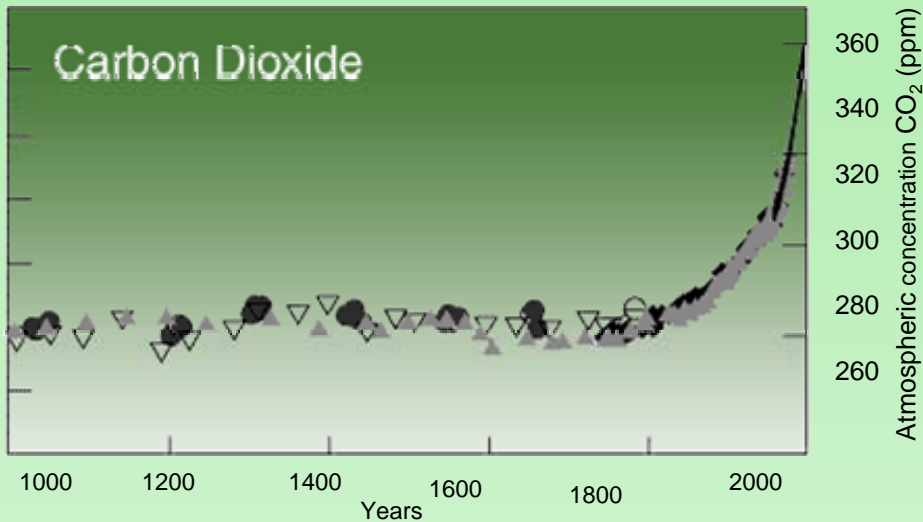
Source: Energy Information Administration, *International Energy Outlook 2000*, Table A2

Global Warming:

An increase in the average temperature of the earth's atmosphere (especially a sustained increase that causes climatic changes).

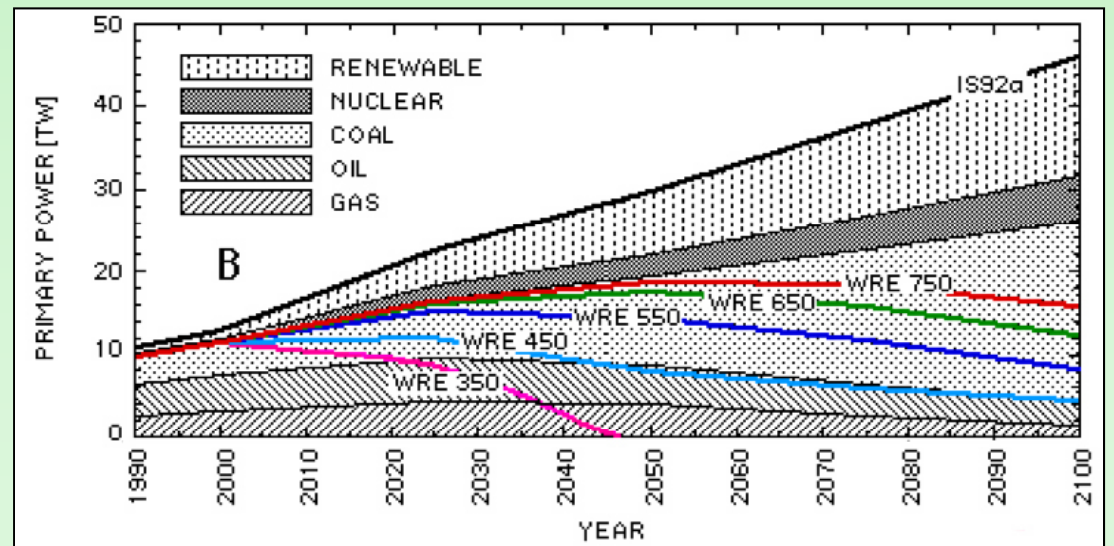
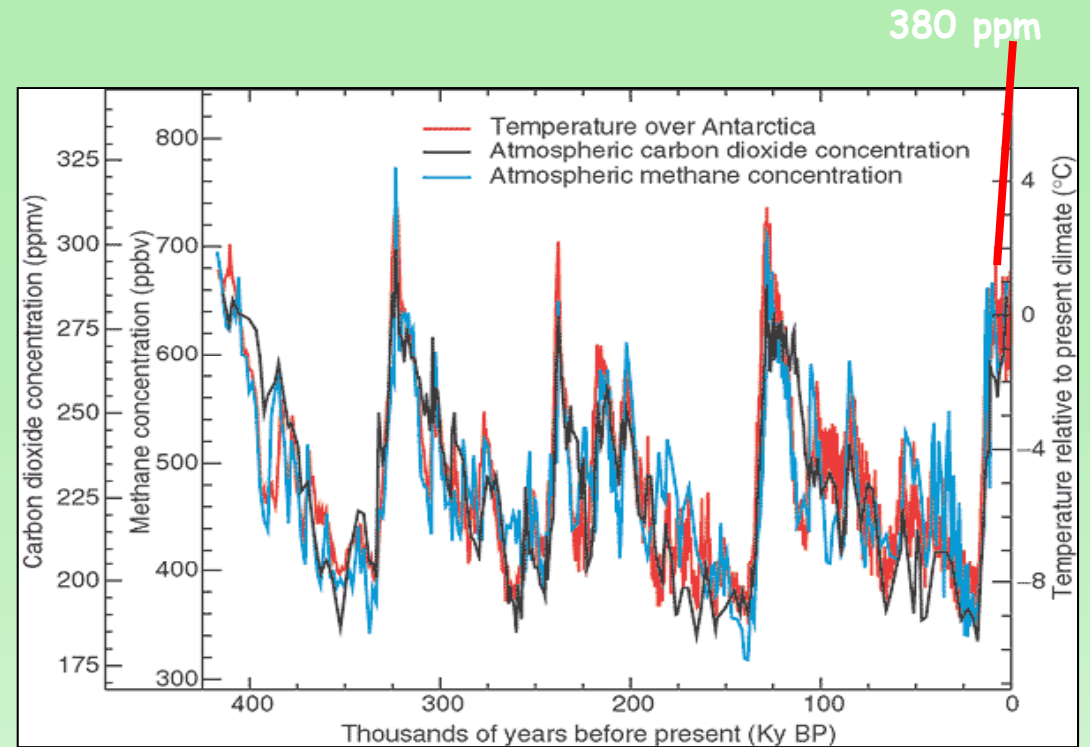


Changes in Atmospheric Concentration CO₂, CH₄, and N₂O – A Thousand Year History



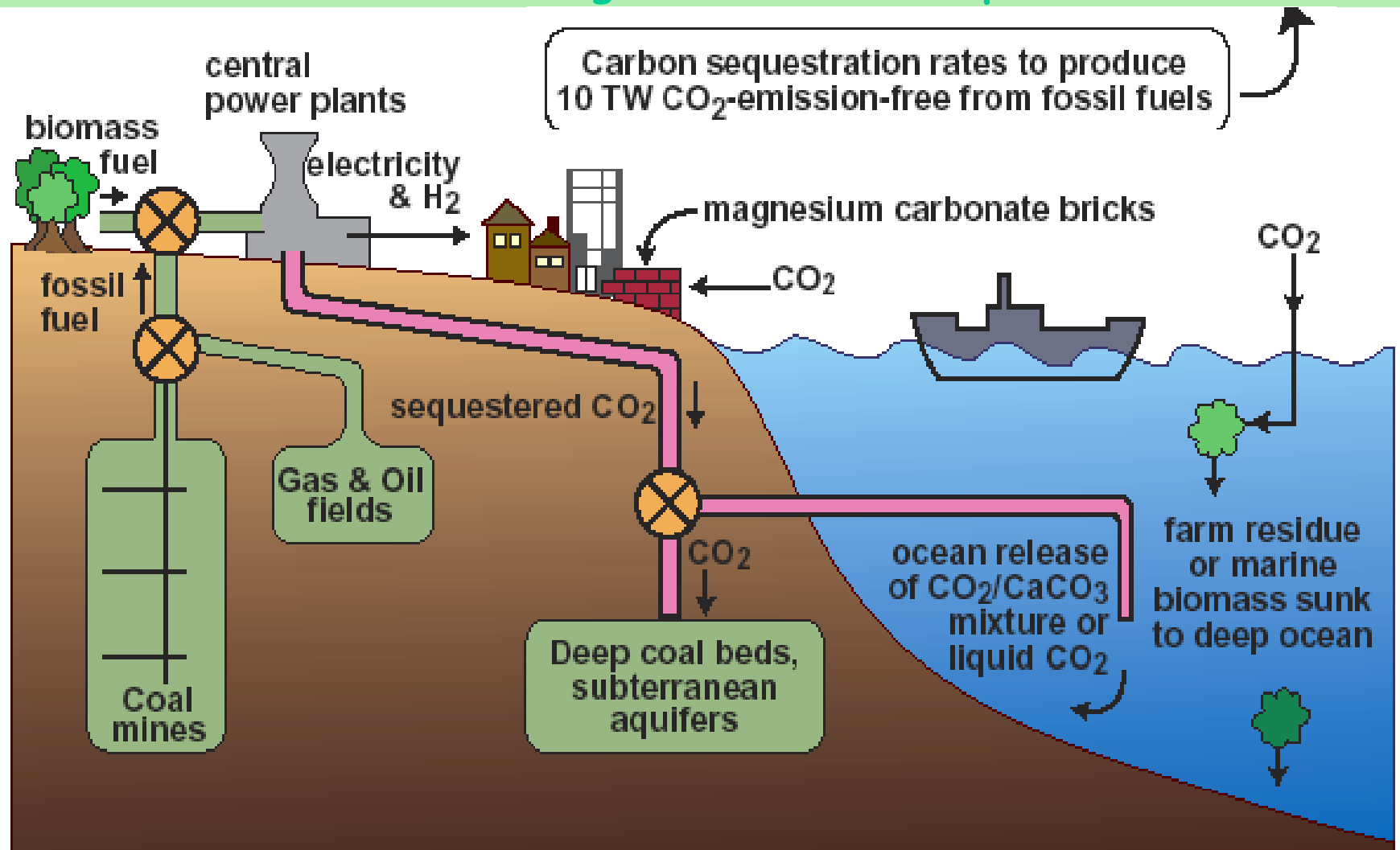
Source: IPCC Third Assessment Report (2001)

CO₂ and Global Climate Change



Carbon Sequestration

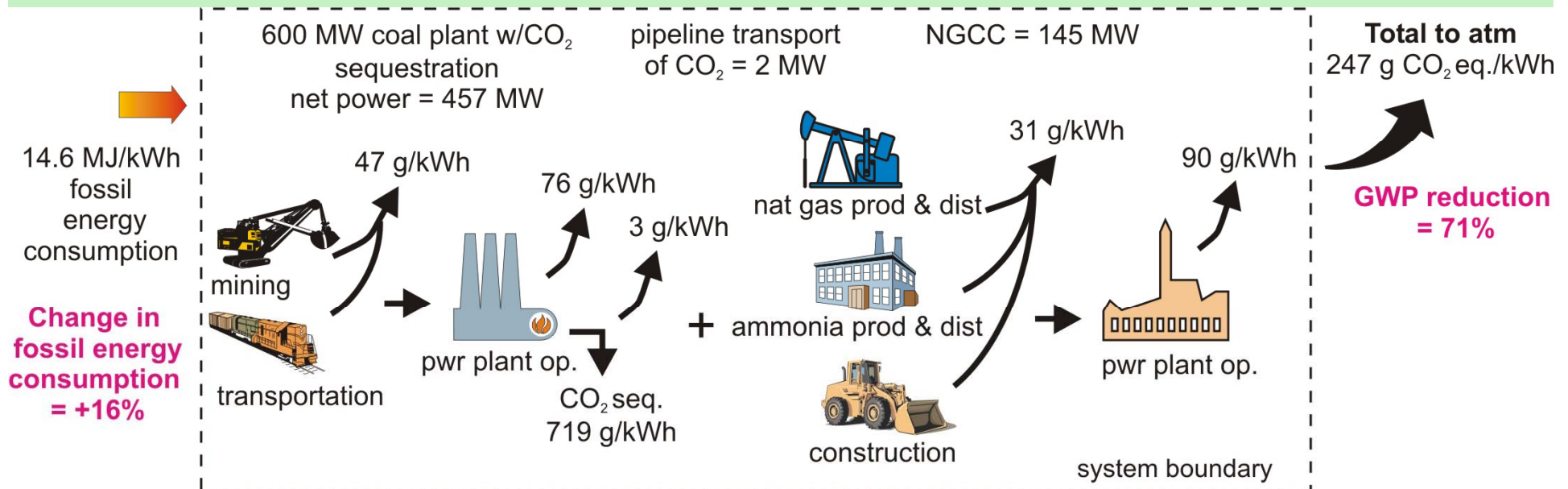
Capturing carbon dioxide from a power plant and storing it someplace so that it cannot get into the atmosphere.



Renewable Energy vs. Sequestration

Broad Perspective – J. Turner view

- ✓ To modify or build a new energy infrastructure requires money and energy - that energy must come from existing resources.
 - ✓ Sequestration is only a temporary fix.
 - ✓ Sequestration increases the rate at which we consume our finite resources.



HOW IT THREATENS YOUR HEALTH
HOW CHINA & INDIA CAN HELP
SAVE THE WORLD—OR DESTROY IT
THE CLIMATE CRUSADERS



What's New in China?

- *1 new coal power plant coming into service every 6 DAYS.*
- *5000 humans died in China's coal mines in 2005.*

WIRED

MAY 2008 USE SUNSCREEN

CLIMATE CRISIS!

THE PRO-GROWTH, PRO-TECH FIGHT
TO STOP GLOBAL WARMING

AL GORE
& THE RISE OF
NEO-GREENS

8 PEOPLE &
TRENDS TO WATCH

12 D.I.Y. WAYS
TO GO GREEN

ROBBED BLIND
Smartcards & the
New RFID Hackers

SPEED DEMON
Can You Survive the
Fastest Boat on Earth?

WATCH "NAKED SCIENCE" ON NATIONAL GEOGRAPHIC CHANNEL, MONDAYS, 9 P.M. ET/PT

WHO HAS
THE BOMB ⁹⁸

NATIONALGEOGRAPHIC.COM/MAGAZINE AUGUST 2005

NATIONAL GEOGRAPHIC



After Oil Powering the Future

PLUS

HURRICANE FORECAST
30 Years of Fury

Brazil's Wild Wet • Cave Art Mystery • China Fossils



The Experts Say....

- Worldwide, leading scientists say it's too late to stop the effect of increased CO₂ levels on Earth's climate.
- We need to be flexible and ADAPT to the changes.

Sea Level Rise of 17 Feet (5.2 m)

Western Antarctic Ice Sheet Melts



<http://www.pbs.org/wgbh/warming/waterworld/>

COAL

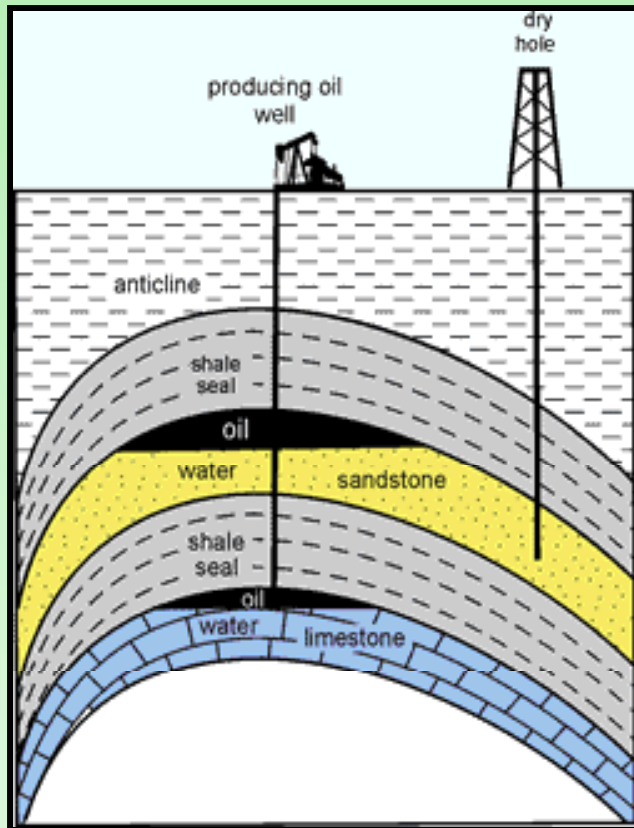
BENEFITS

- ✓ Many coal burning power plants are already in place
- ✓ Costs are relatively low
- ✓ World reserves should last for about 200 years.

CONCERNS

- ✓ Burning coal causes **air pollution** and is a serious contributor to **global warming**
- ✓ Pollution controls are expensive.
- ✓ Many countries are gearing up to use more coal, thus depleting world supplies quicker than expected.
- ✓ A 200 year supply is not a long time!

OIL



Facts

- ✓ Oil can be a viscous thick or thin black liquid formed from the buried remains of marine organisms
- ✓ Natural gas forms under similar conditions, but as a gas
- ✓ Geologic faults and folds in the earth help to trap oil and gas under anticline cap rocks

Well. Well. Well.

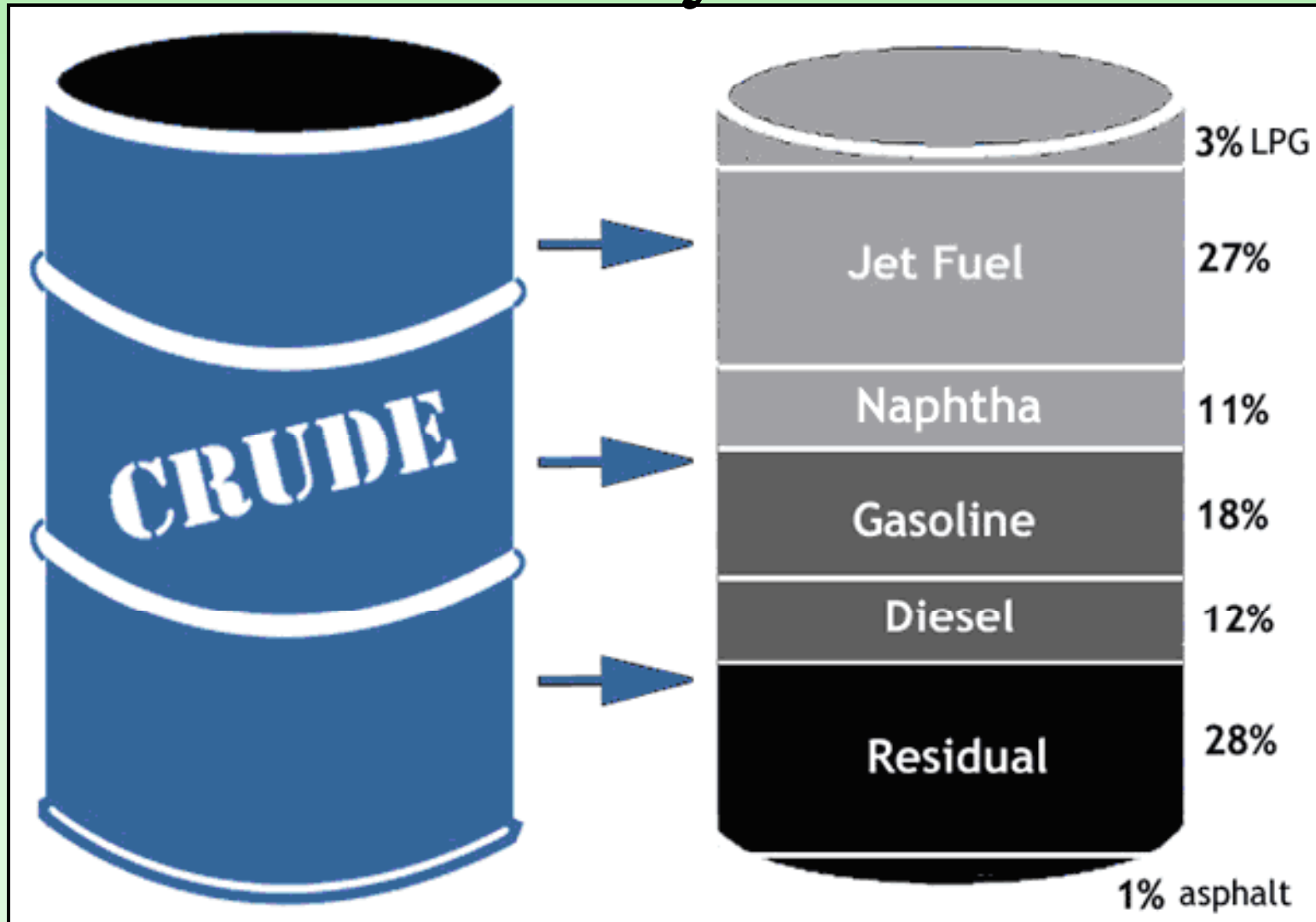


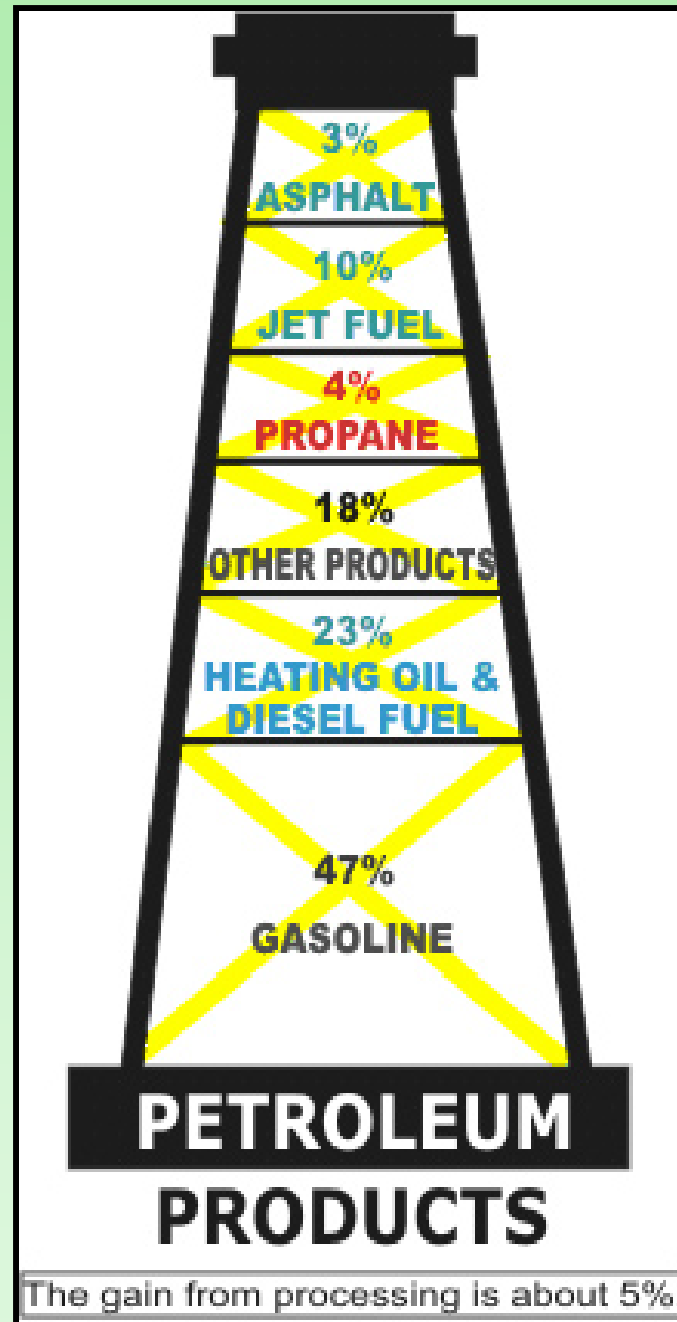


Oil Refineries



The Price of “Crude” Impacts Our Daily Lives





✓ **Oil** → ✓ **Gasoline**



Oil price climbs to ~~\$54~~ ^{\$78} neighborhood

Gas prices rise to record average \$2.368 per gallon

By James R. Healey
USA TODAY

Prices of gasoline and crude oil shot to records Monday.

Energy The price spikes resulted from worries about potential terrorist attacks in oil giant Saudi Arabia, government warnings of unusually stormy weather that could disrupt U.S. oil operations in the Gulf of Mexico and concern that aging U.S. refineries can't keep up with demand for gasoline.

"We also broke an important barrier. Once oil broke \$62.50, a lot of mutual funds and speculators started buying,"

says Peter Beutel, head of Cameron Hanover energy consultants and veteran energy tracker. They expect the price momentum to bring higher prices and, thus, profits for those who buy now.

West Texas intermediate, also called light, sweet crude oil, hit \$63.99 a barrel in New York trading Monday and closed at a record \$63.94, up \$1.63 from Friday's record close. It shot as high as \$64.27 today in Singapore, retreating to \$64.06 by midmorning.

Helping ignite the oil fire: The U.S. shut its embassy and other offices in Saudi Arabia, the world's biggest oil supplier, for two days because of a "threat against U.S. government buildings" there. And Britain said it believes terrorists plan to strike Saudi Arabia soon.

Beutel agrees with "a mild consensus that's emerging" among analysts that oil will hit \$70 to \$72 a barrel by Labor Day, less than a month off.

Adjusted for inflation, oil would have

Record price for oil

Oil prices reached nearly \$64 Monday. Light sweet crude, per barrel:



Source: The Associated Press

By Adrienne Lewis, USA TODAY

to hit \$86.20 to match the then-record \$39 reported February 1981.

Oil accounts for about half the price of gas. If oil held steady at \$72, gas eventually would be about \$3.40 a gallon.

Gasoline has jumped to a record nationwide average \$2.368 a gallon for un-

leaded regular, the U.S. Energy Information Administration reported Monday. That's up a hefty 7.7 cents from the previous week and is 5.2 cents more than the previous record on July 18.

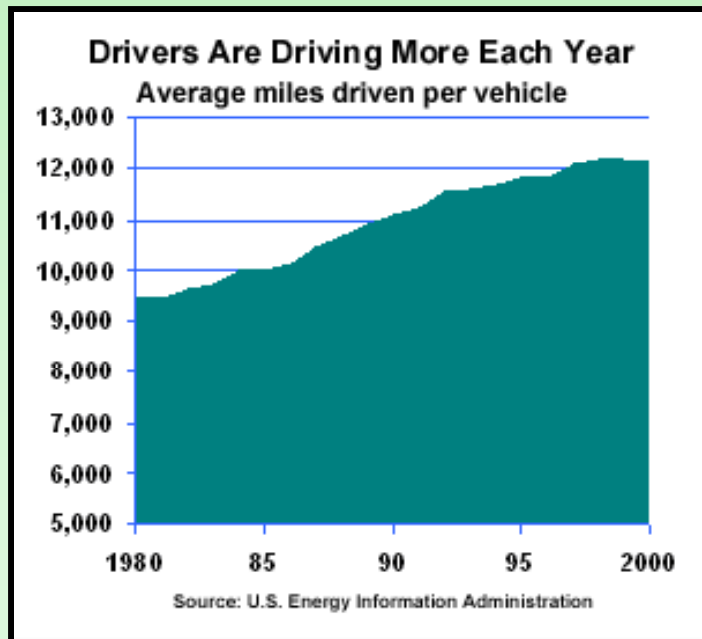
"The nationwide average could easily push through \$2.50 per gallon this week," says Tom Kloza, senior analyst at the Oil Price Information Service. Pump prices haven't yet reflected all the rise in wholesale gas prices, he says.

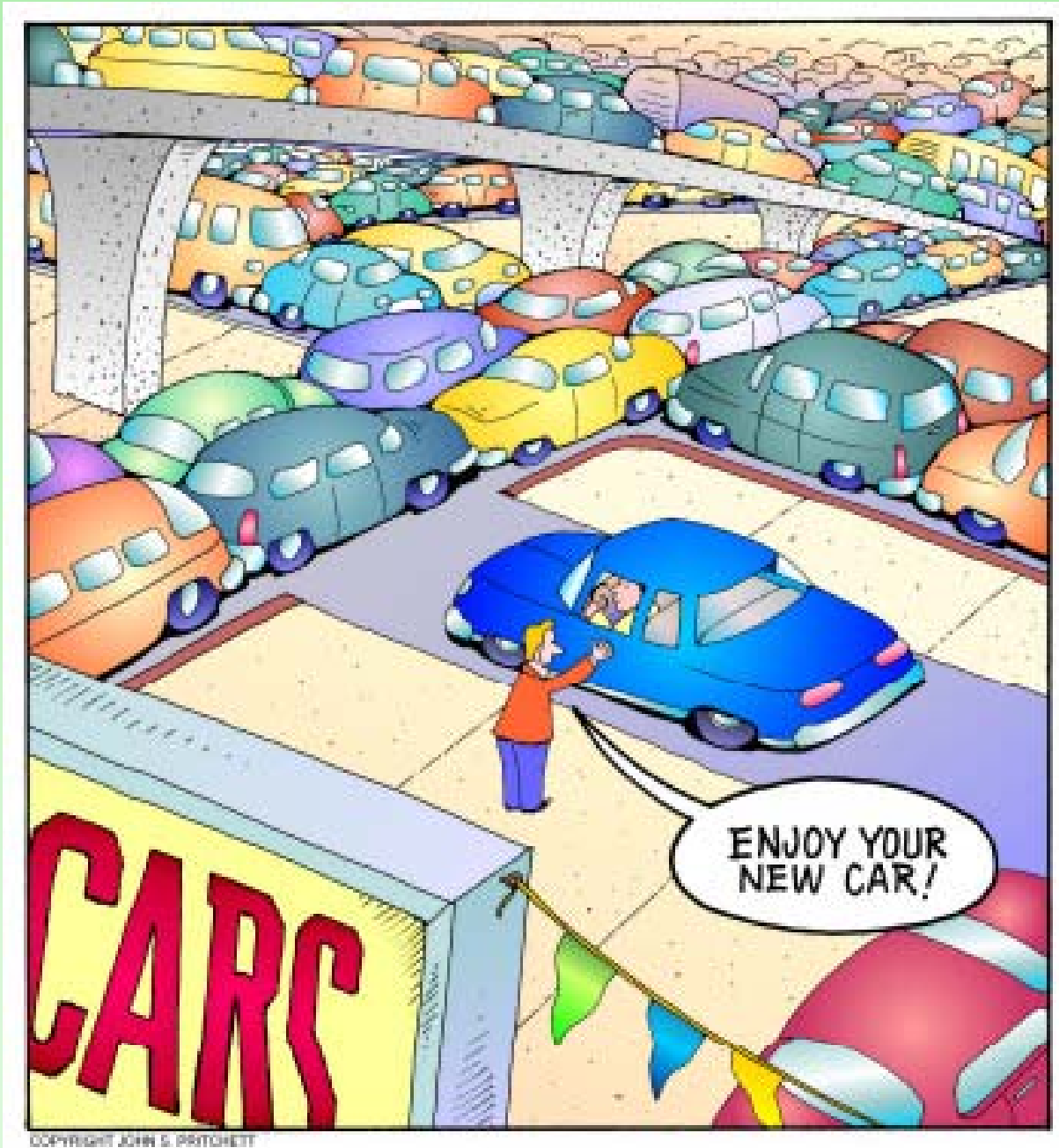
Adjusted for inflation, gas would have to top \$3.108 to beat the March 1981 record.

Beutel says every penny that gas goes up costs \$3.8 million a day. That would mean Americans are spending \$187 million more daily on fuel than a year ago, when it was 49.1 cents less.

"It makes no sense to me that we aren't seeing it" slowing the economy, he says. "I have a very bad feeling that one day we'll wake up and this will have caught up with us, and it will be misery."

World wide 4 million cars are made each month.

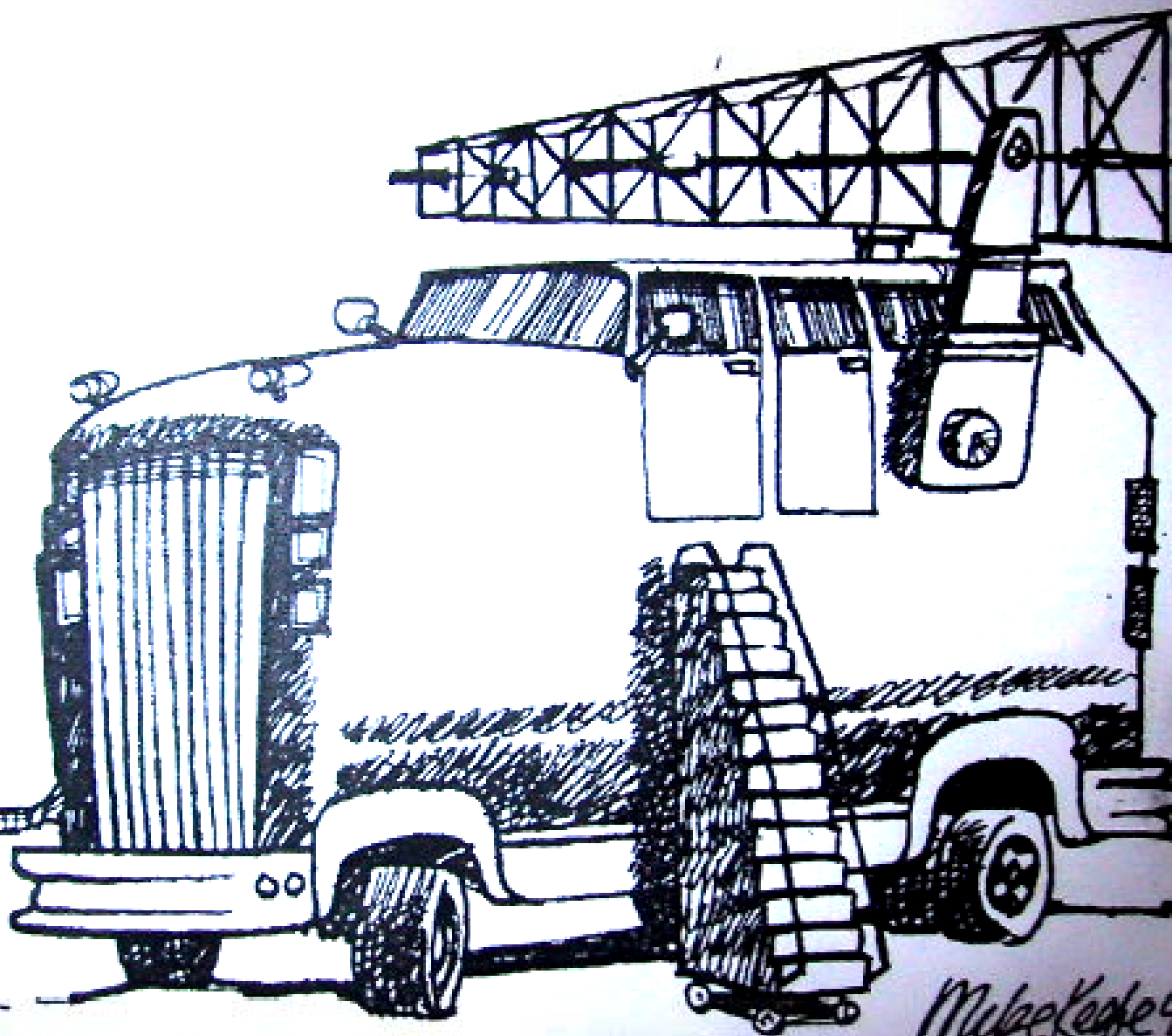




COPYRIGHT JOHN S. PRITCHETT



NO NEED
TO WORRY
ABOUT
PETROLEUM
RESERVES...
OUR LATEST
SPORT UTILITY
VEHICLE IS
EQUIPPED WITH
ITS OWN
DRILLING RIG!

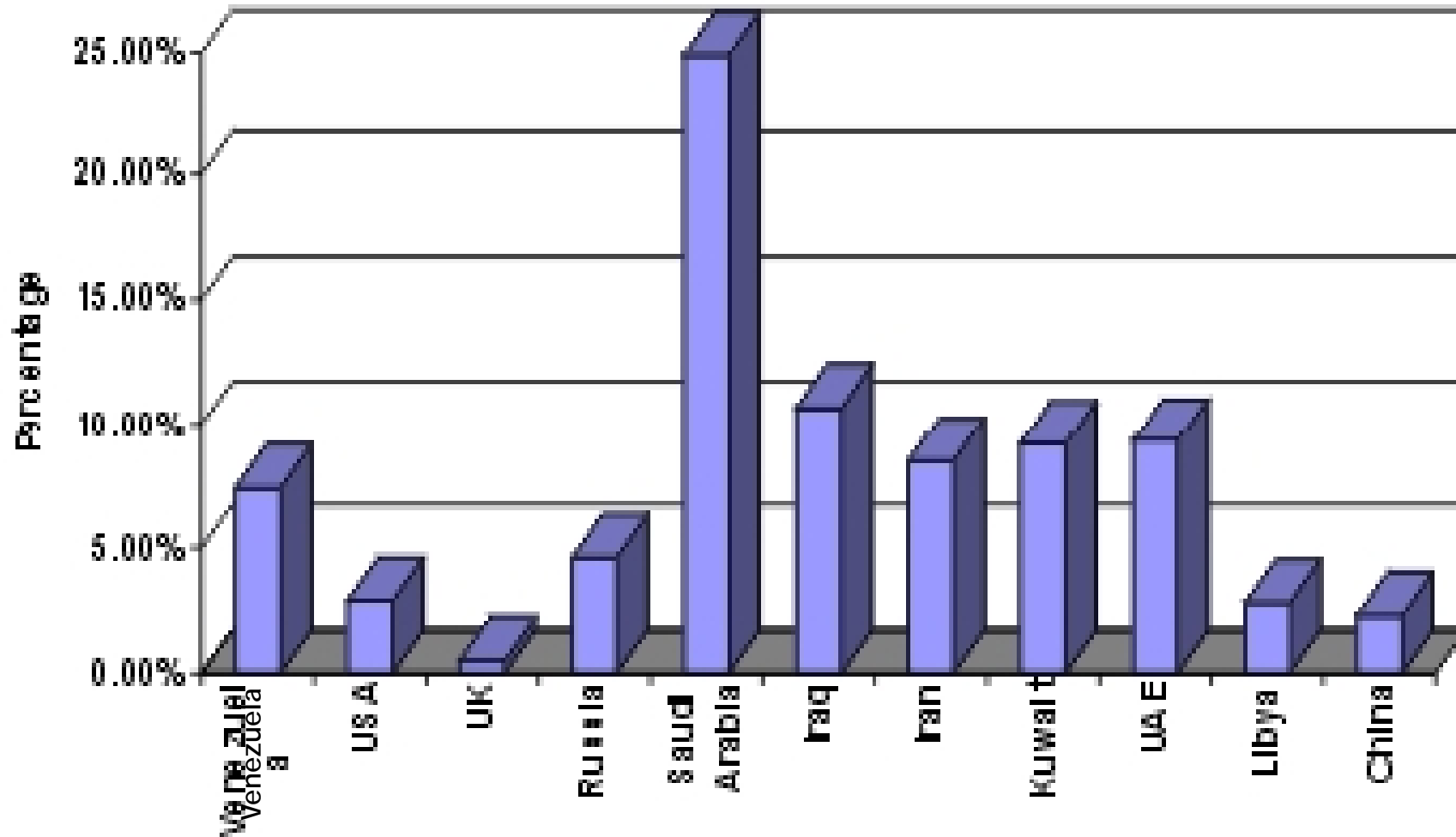


Mike Keefe

✓ Colorful Colorado



World oil reserves by country 2001



✓ U.S. Dependancy on Foreign Oil

Have Oil

Saudi Arabia	26%
Iraq	11%
Kuwait	10%
Iran	9%
UAE	8%
Venezuela	6%
Russia	5%
Mexico	3%
Libya	3%
China	3%
Nigeria	2%
U.S.	2%

Use Oil

U.S.	26%
China	9%
Japan	6%
Germany	4%
Russia	3%
S. Korea	3%
France	3%
Italy	3%
Mexico	3%
Brazil	3%
Canada	3%
India	3%

The U.S. uses more than the next 5 highest consuming nations combined.

Geopolitical Concerns





Geopolitical Concerns...not just the Middle East



**PETRO-POWER,
PETRO-PERIL**



Venezuelan President Hugo Chavez

Environmental Concerns



Environmental Concerns



Environmental Concerns



The government of Spain puts the estimated cost of cleaning up the *Prestige* oil tanker spill at more than \$1 billion.

Environmental Concerns

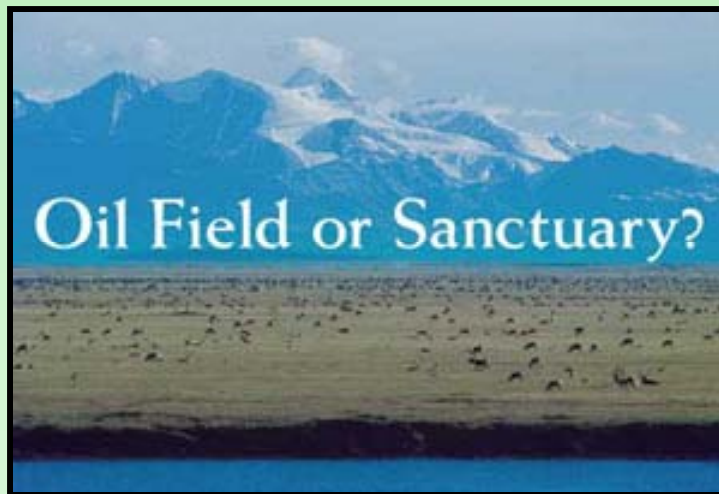


Environmental Concerns



At What Cost Do We Drill?

The debate about ANWR



Prospecting for more crude

Oil companies are looking offshore, and want to open public lands like part of the Arctic National Wildlife Refuge.

- Active Oil/Gas Sites
- Oil/Gas Prospects

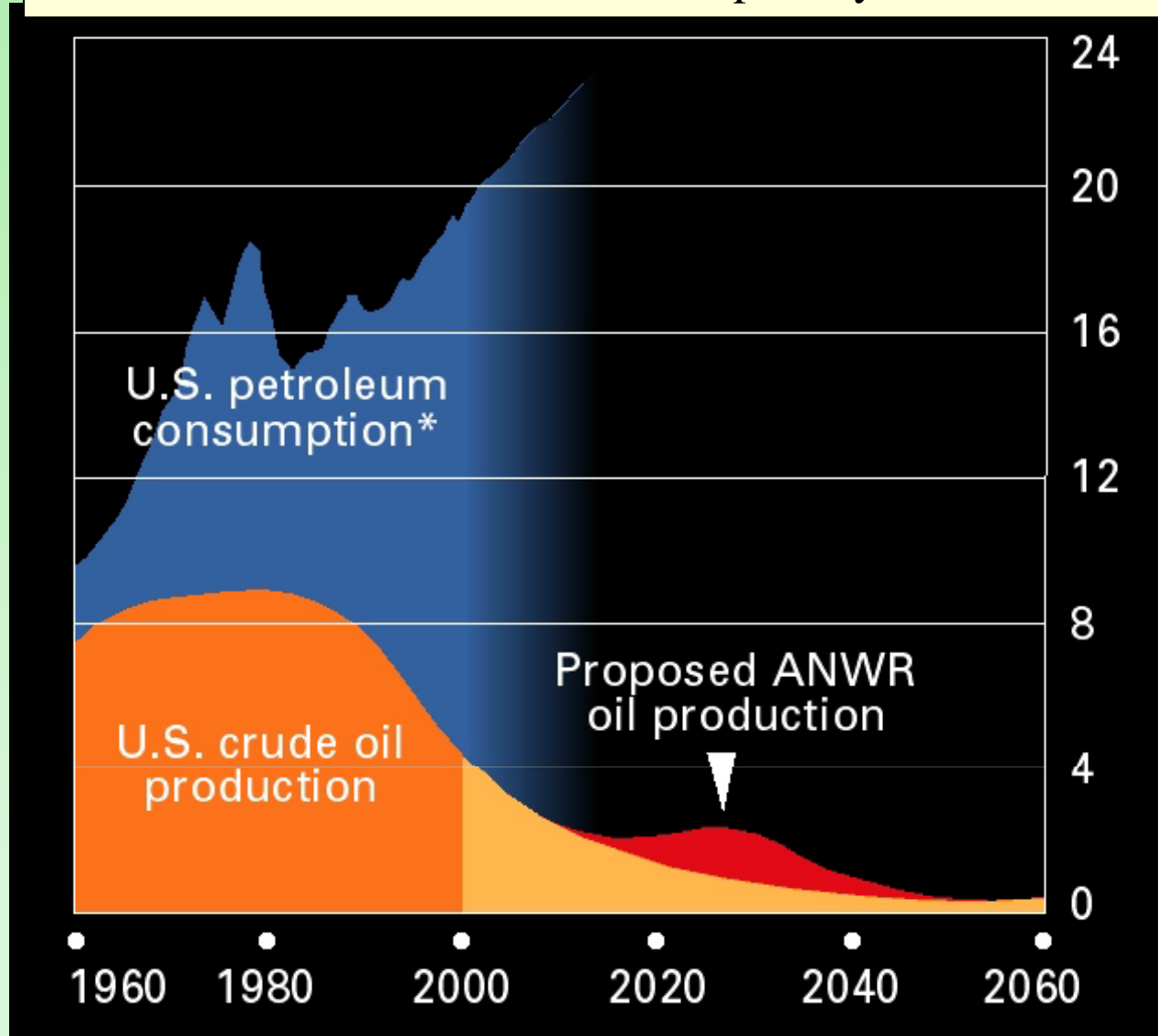


MSNBC



Crude Reality

In millions of barrels per day



*Includes oil imports as well as U.S. crude and natural gas liquids.
Source: National Geographic, August 2001 "Oil Field or Sanctuary?"

Oil

BENEFITS

- ✓ Relatively low cost
- ✓ Infrastructure in place (wells, refineries, gas stations, automobiles)

CONCERNS

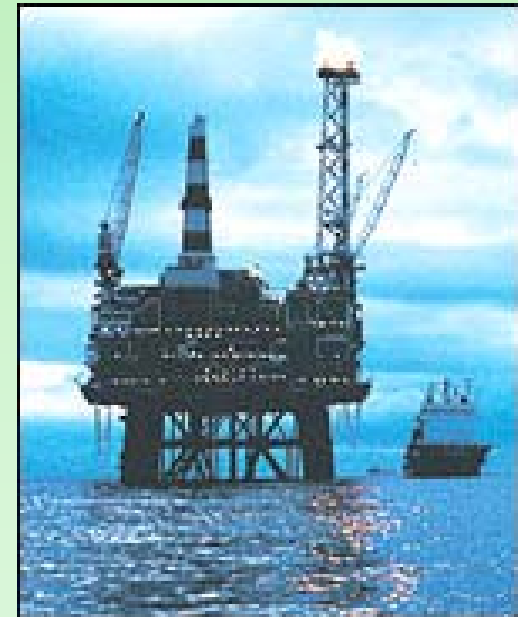
- ✓ Increases global warming
- ✓ Makes the air polluted
- ✓ Oil spills can kill many species and ruin habitats.
- ✓ Not renewable, limited supplies.
- ✓ Geopolitical concerns



Natural Gas

Facts

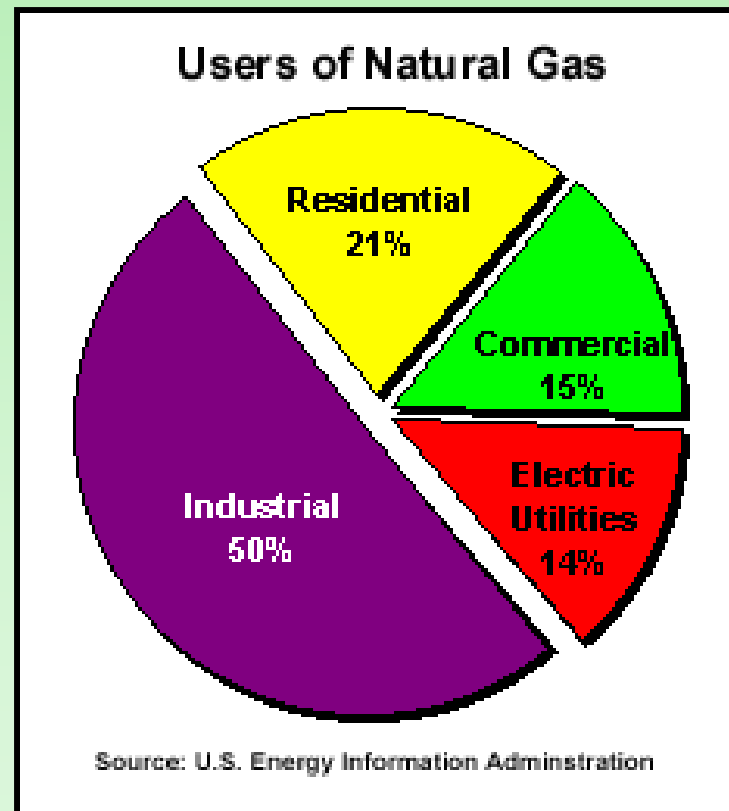
- ✓ Colorless, odorless fuel that burns cleaner than other fossil fuels
- ✓ Made up of hydrocarbon gases, primarily methane
- ✓ Removed from underground with the same equipment that is used with crude oil



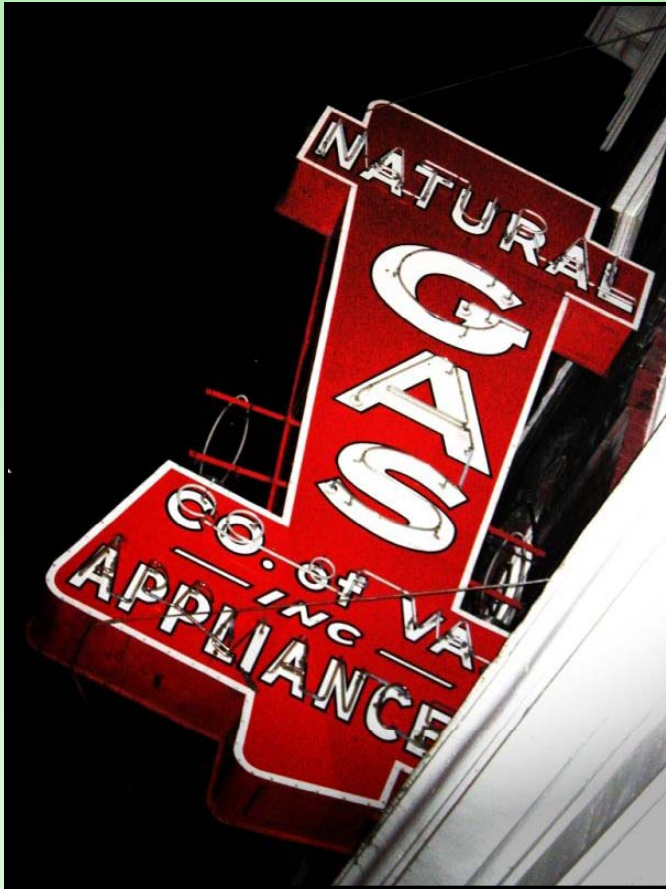
Ships that gas in the night.



How Do We Use Natural Gas?

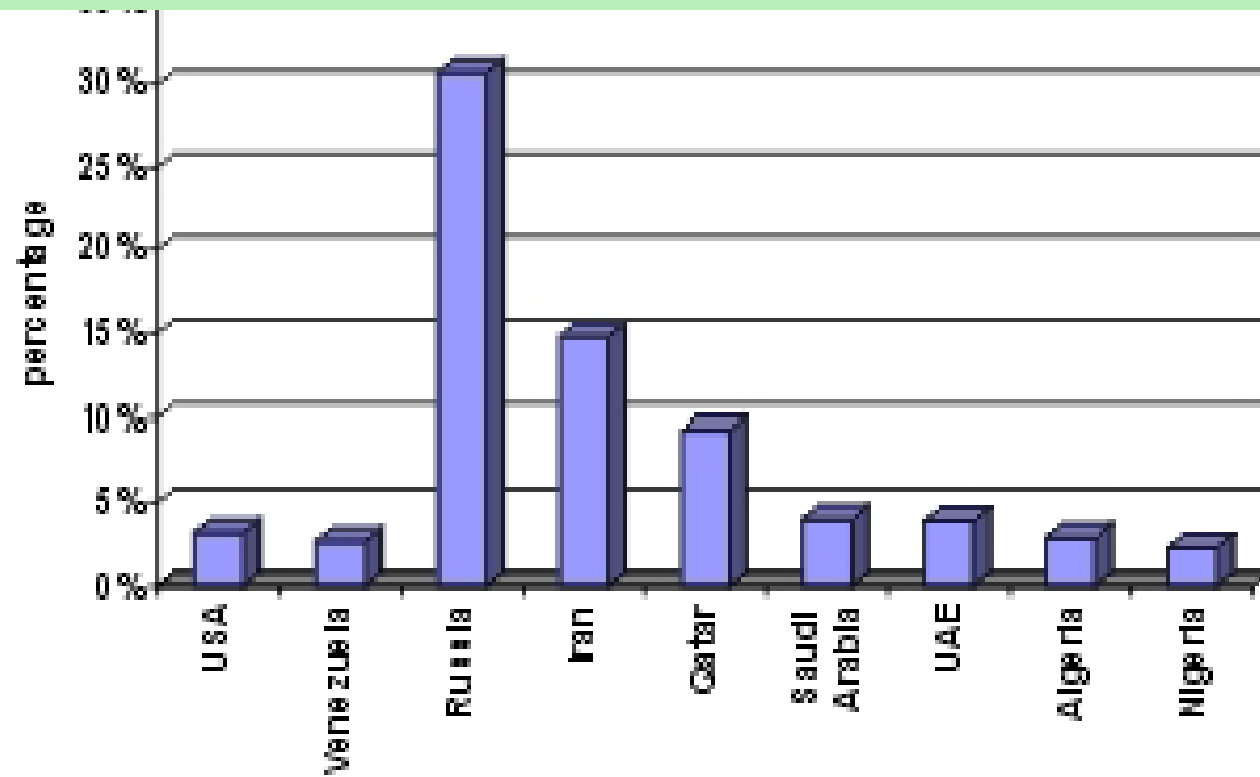


Natural Gas Uses



- ✓ Heating
- ✓ Cooling
- ✓ Production of electricity





Natural Gas

BENEFITS

- ✓ Relatively low cost
- ✓ Infrastructure in place (wells, refineries, pipelines, power plants, appliances)
- ✓ Cleanest burning fossil fuel

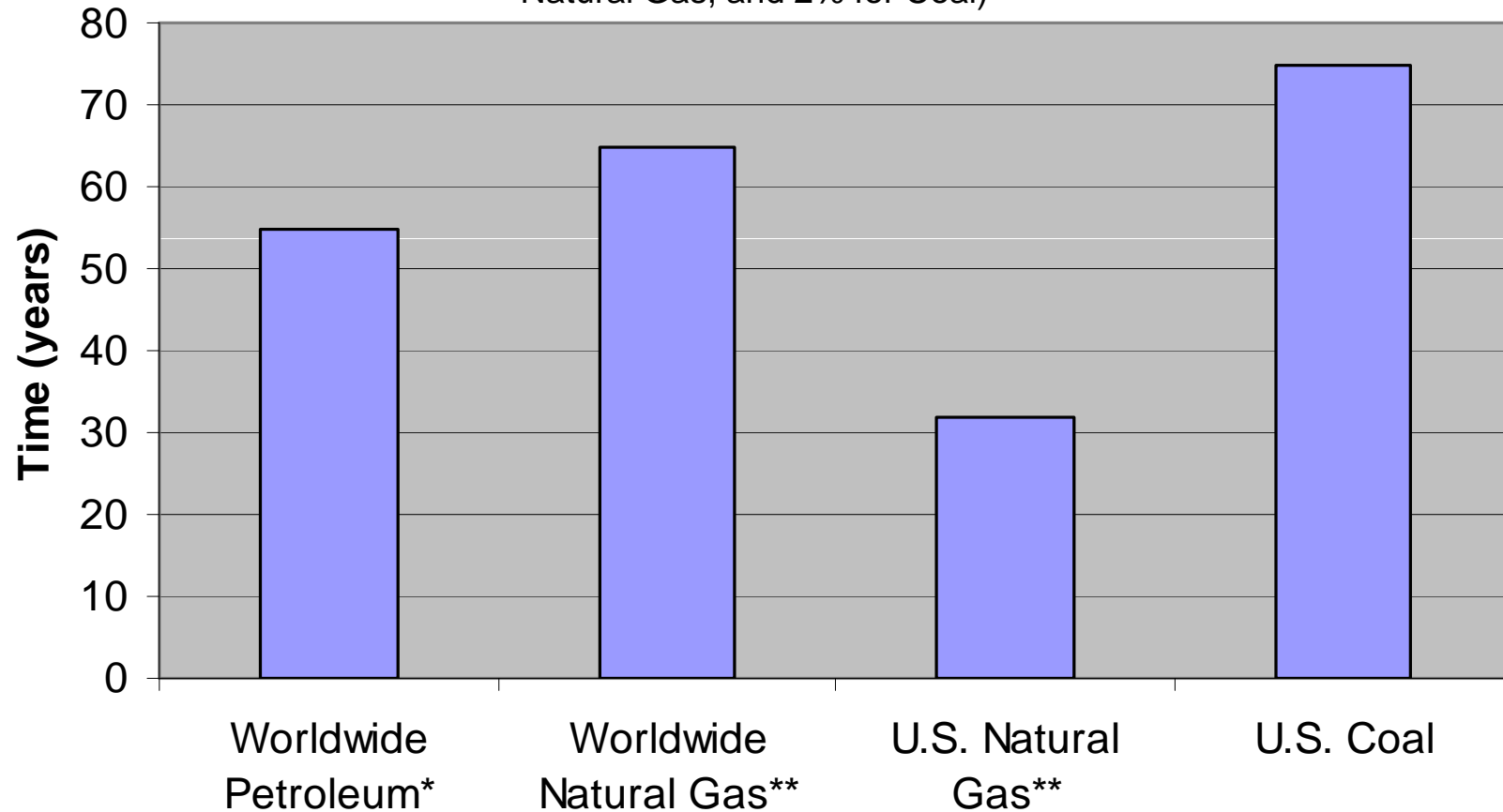
CONCERNS

- ✓ Increases global warming
- ✓ Prices on rise
- ✓ 40 year supply

Outlook for Fossil Fuel Resources

Estimated Lifetimes of Fossil Fuel Resources

(Based on Projected Annual Growth Rates: 1% for Petroleum, 2.8% for Natural Gas, and 2% for Coal)



*Estimated peak in world petroleum supply

** Based on estimated natural gas resources

Source: Weisz, Physics Today, p. 47, July 2004

Review

Part 1. Nonrenewable Energy Sources

- ✓ Define nonrenewable energy.
- ✓ How are fossil fuels formed?
- ✓ Compare and contrast the three main types of fossil fuels.
- ✓ Interpret the consequences of the rise in human population and the supply of fossil fuels.
- ✓ What will driving be like in 10 years? 50 years?
- ✓ What can you do about global warming?

Acknowledgements

- NREL Office of Education
- Dr. John Turner, Hydrogen Wizard, NREL
- Ken Sheinkopf, President of the Florida Solar Energy Society
- Google Images

