Energy Independence

The Impossible Dream?

IRWA

May 11, 2010

Today's Agenda

- Some Definitions
- Current Energy Sources
- Alternative Energy Potential
- Reality Check

ENERGY

The Ability to Do Work

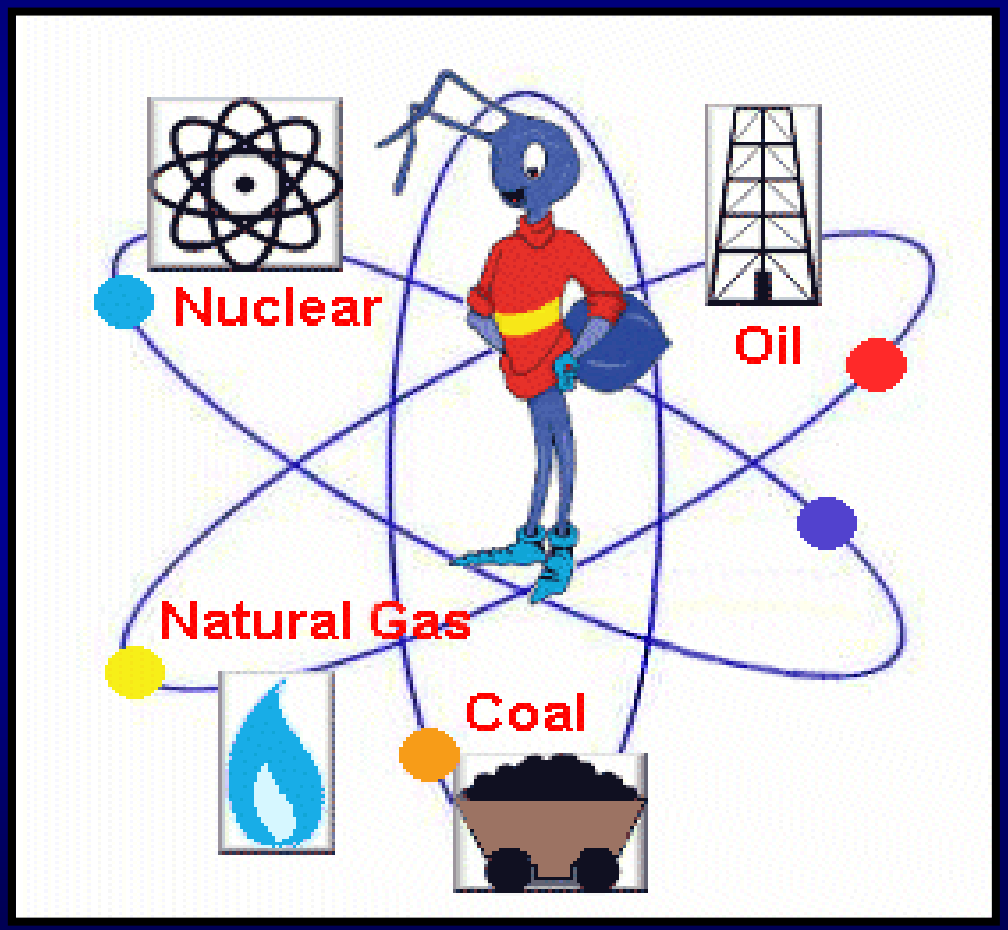
Kinds of Energy

- Heat (Thermal)
- Light (Radiant)
- Mechanical
- Electrical
- Chemical
- Nuclear

Uses of Energy

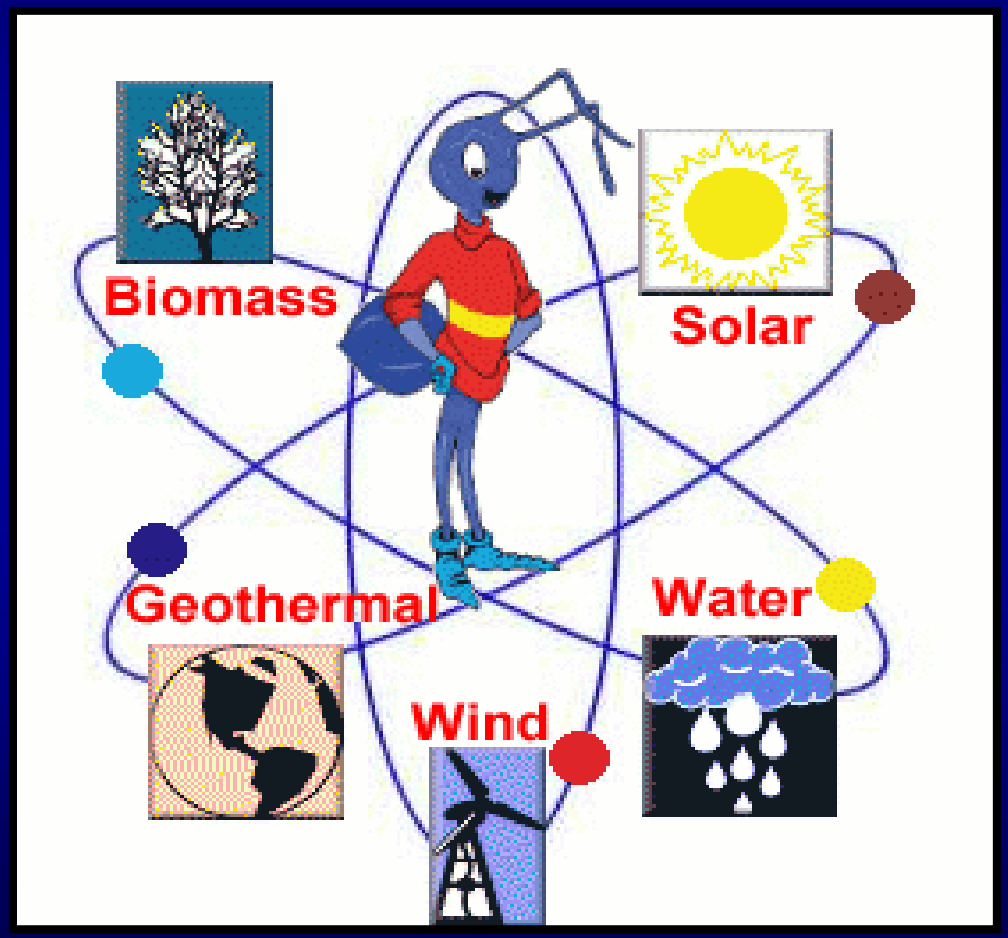
- Transportation
- Heating/Cooling
- Cooking
- Lighting
- Manufacturing
- Communication
- Entertainment
- Etc, Etc, Etc

Non- Renewable Energy Sources

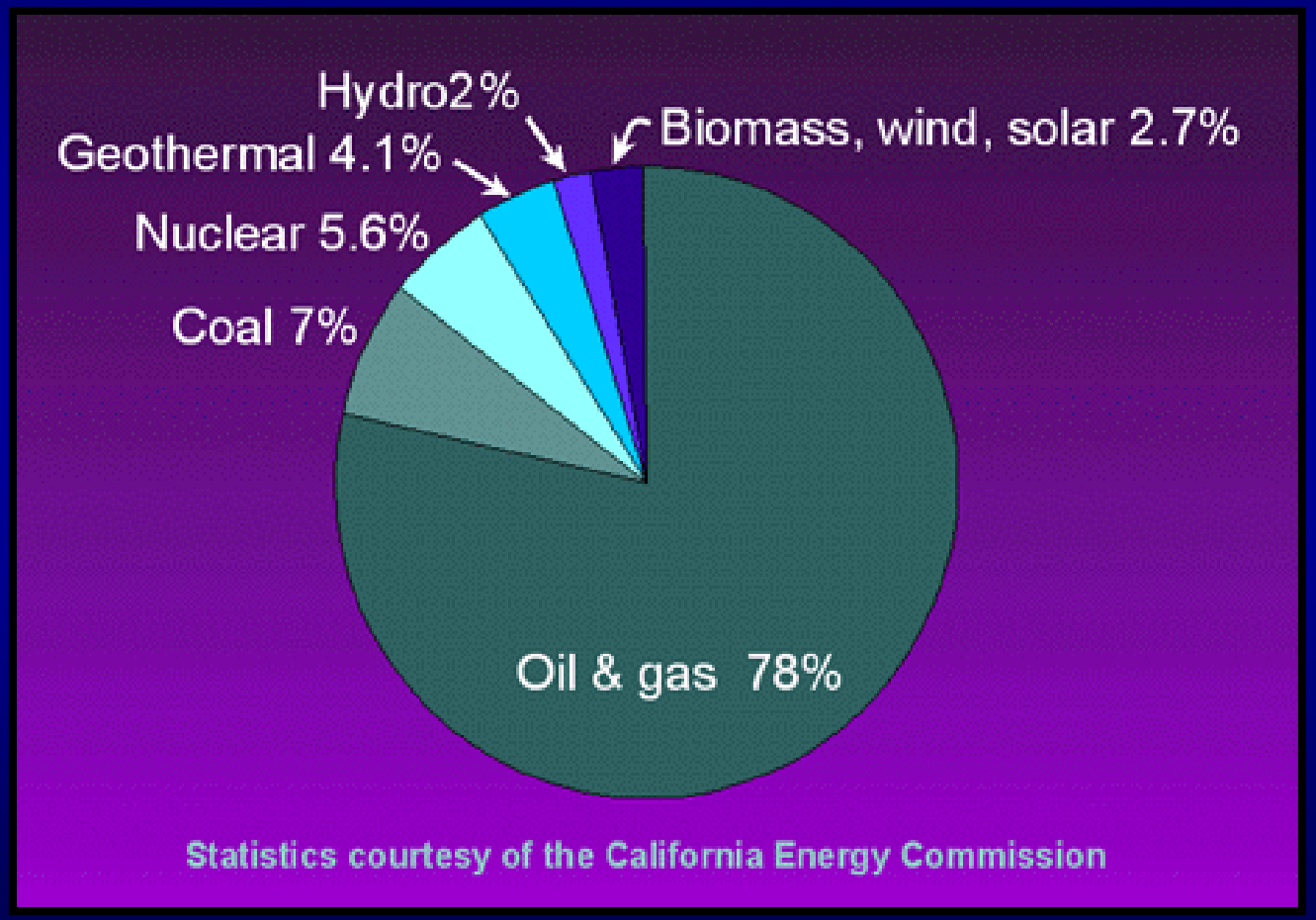


Renewable Energy Sources

(AKA "Alternative Energy")



Energy Sources in California

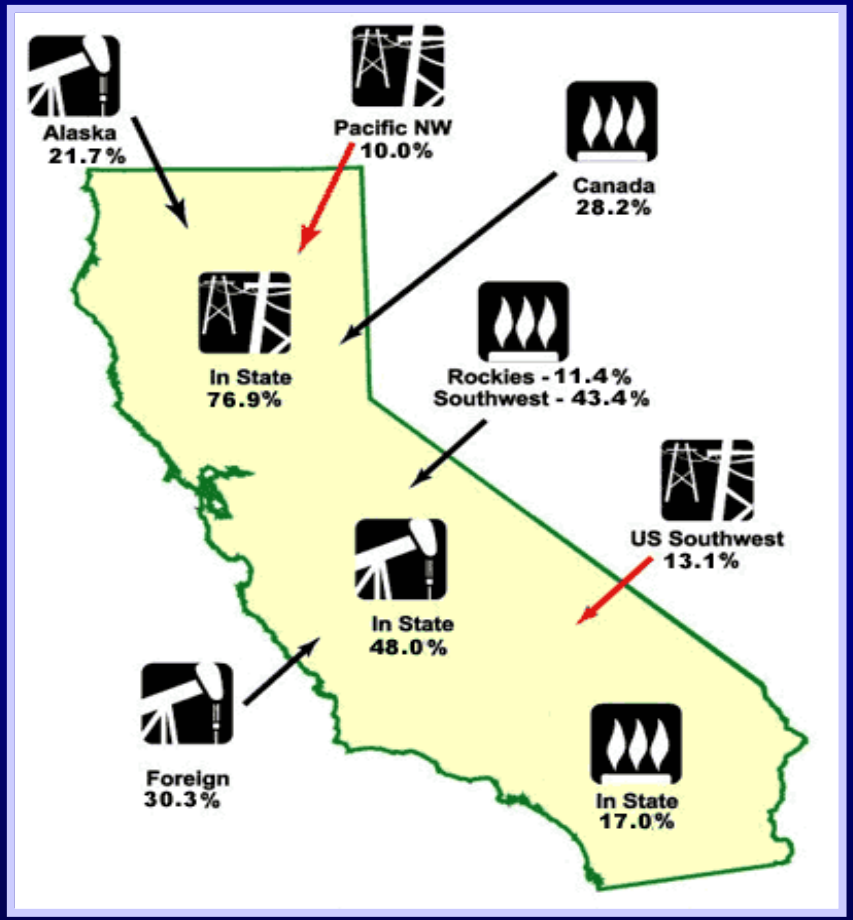


The California Energy Picture

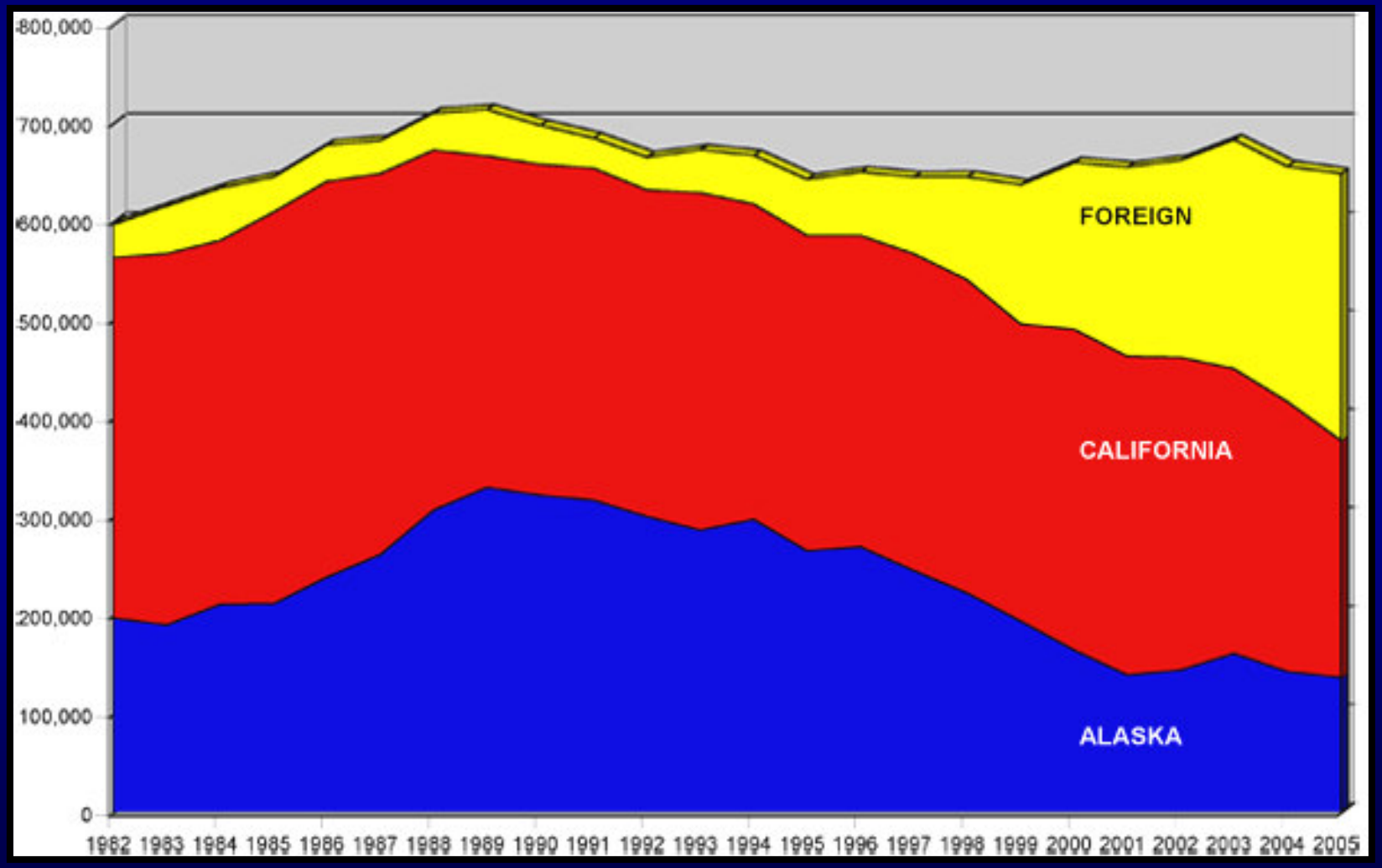
Imports

- **Gas -- 83%**
- **Oil -- 52%**
- **Elec -- 23%?**

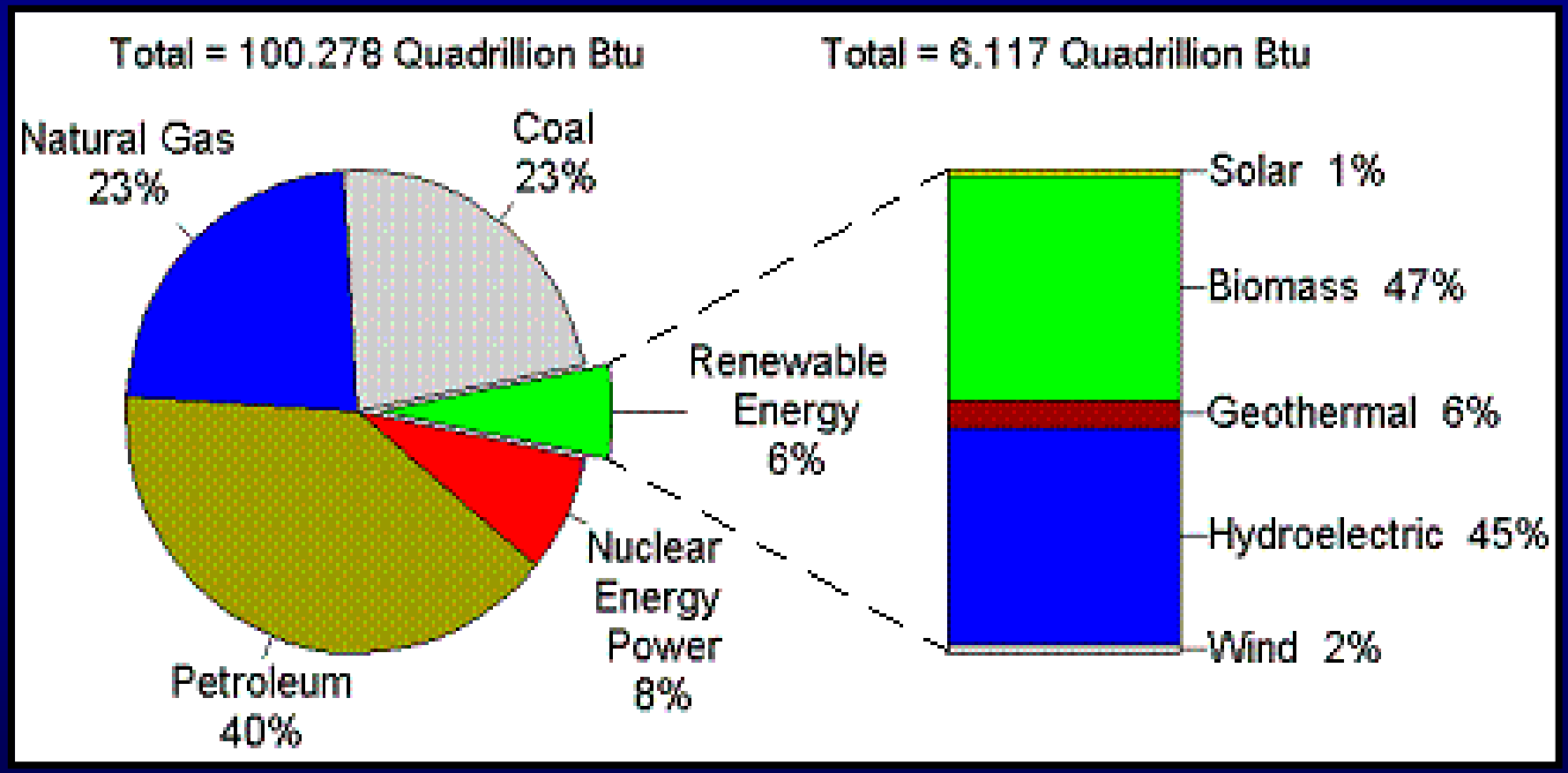
(50%)



California's Sources of Oil



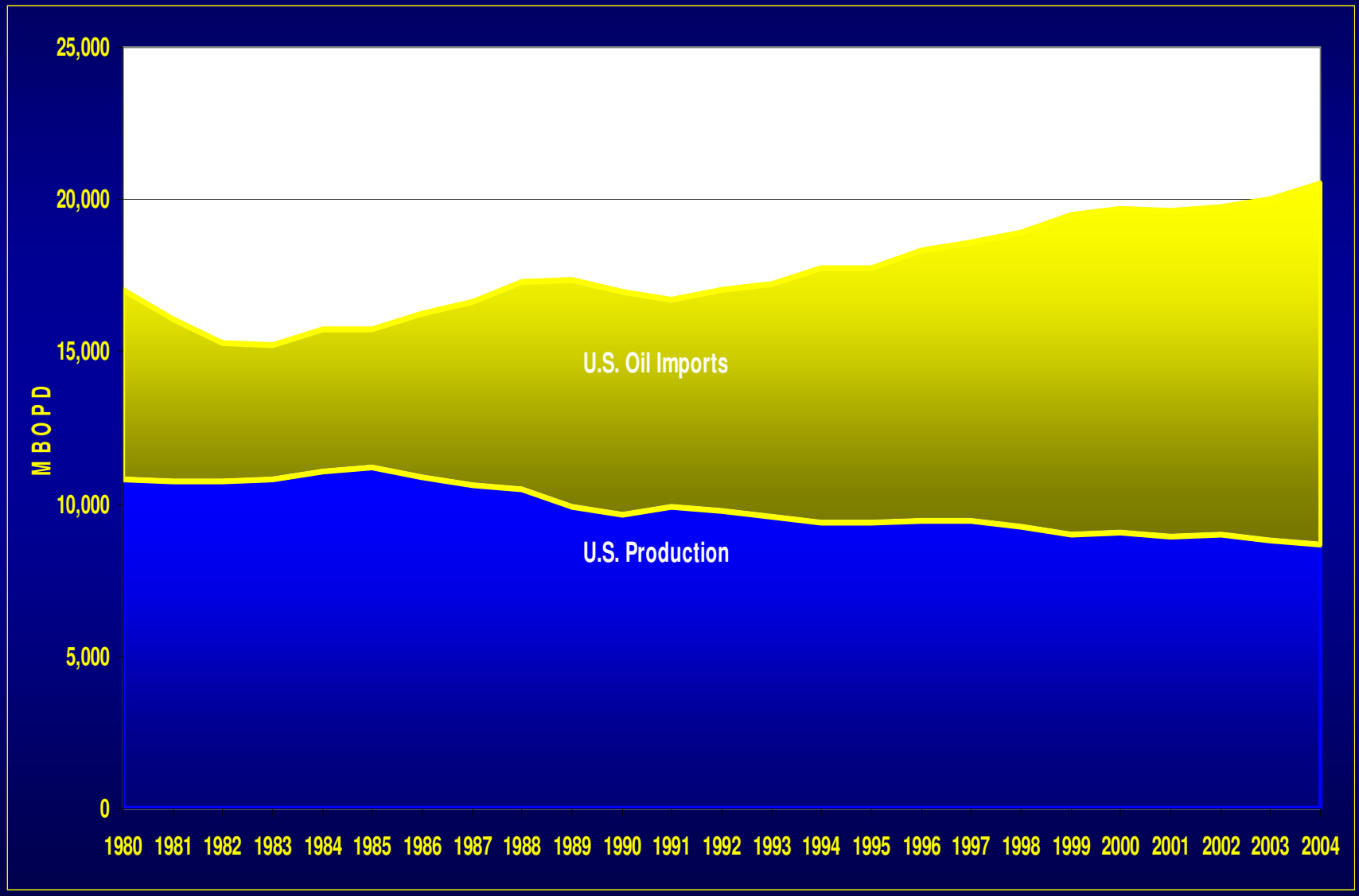
Energy Sources in the United States



"Energy Independence"

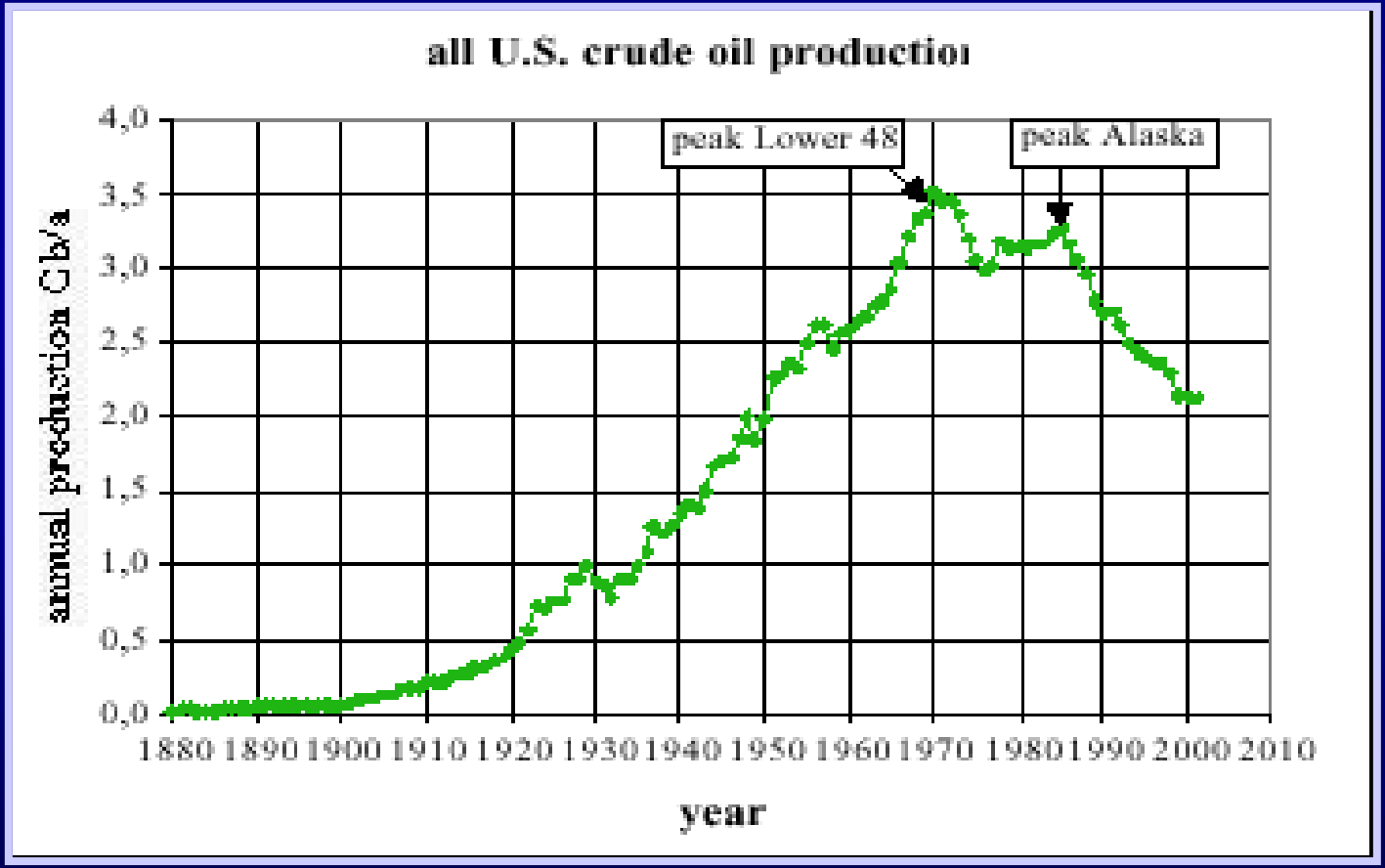
- Every U.S. President in the last 30 years has stated that energy is of crucial importance to our national security.
- Every U.S. President in the last 30 years has also declared that we can achieve energy independence.
- Let's look at the results…….

U.S. Oil Production and Imports

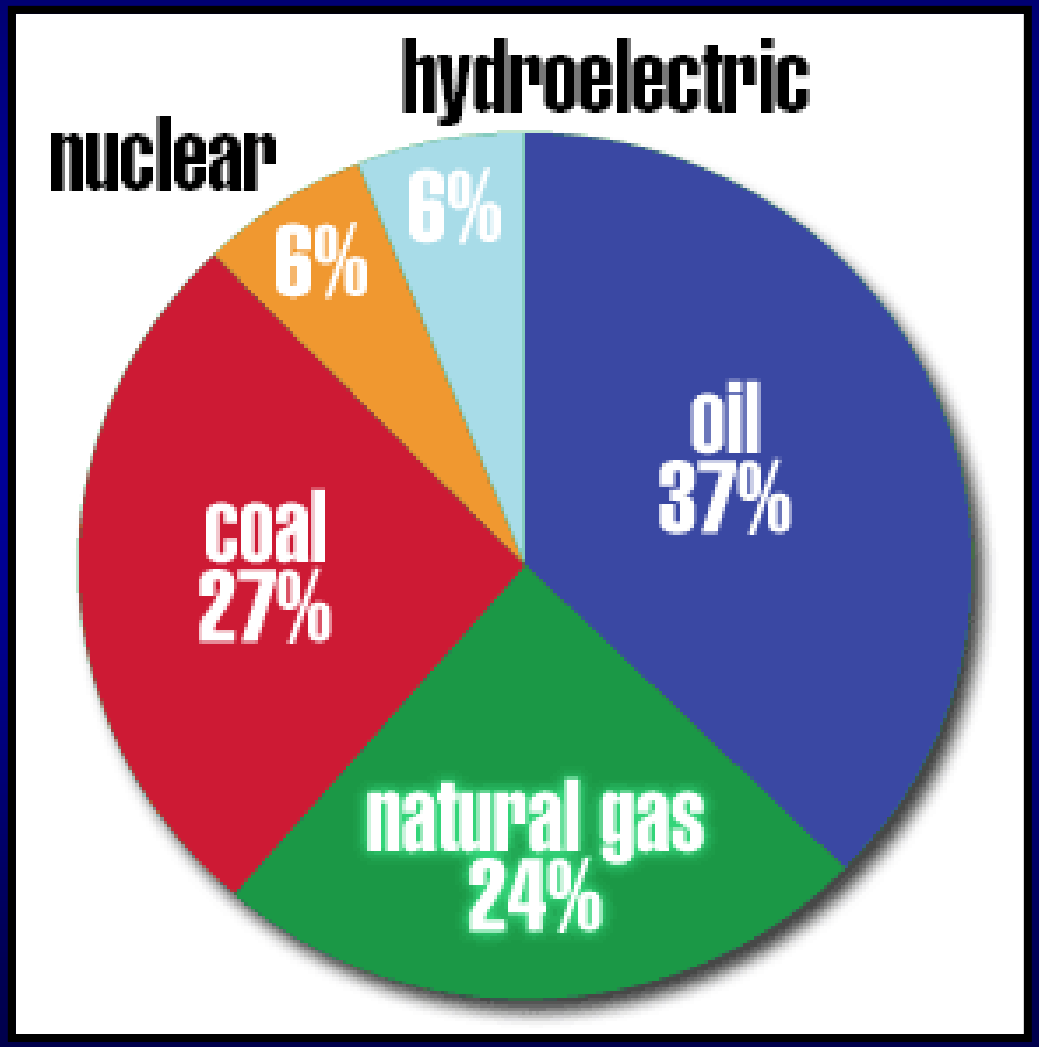


U.S. Oil Production

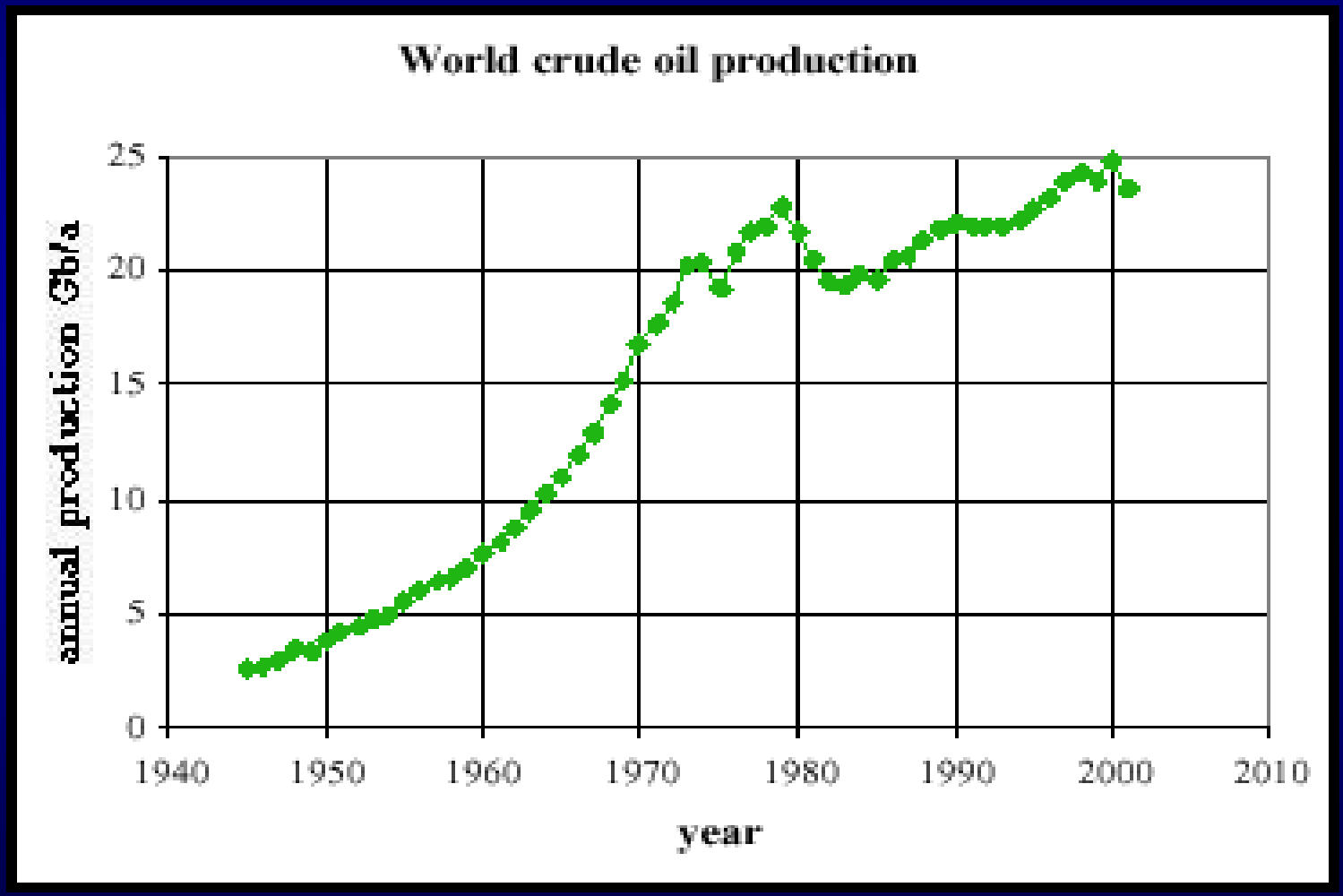
(Including Alaska)



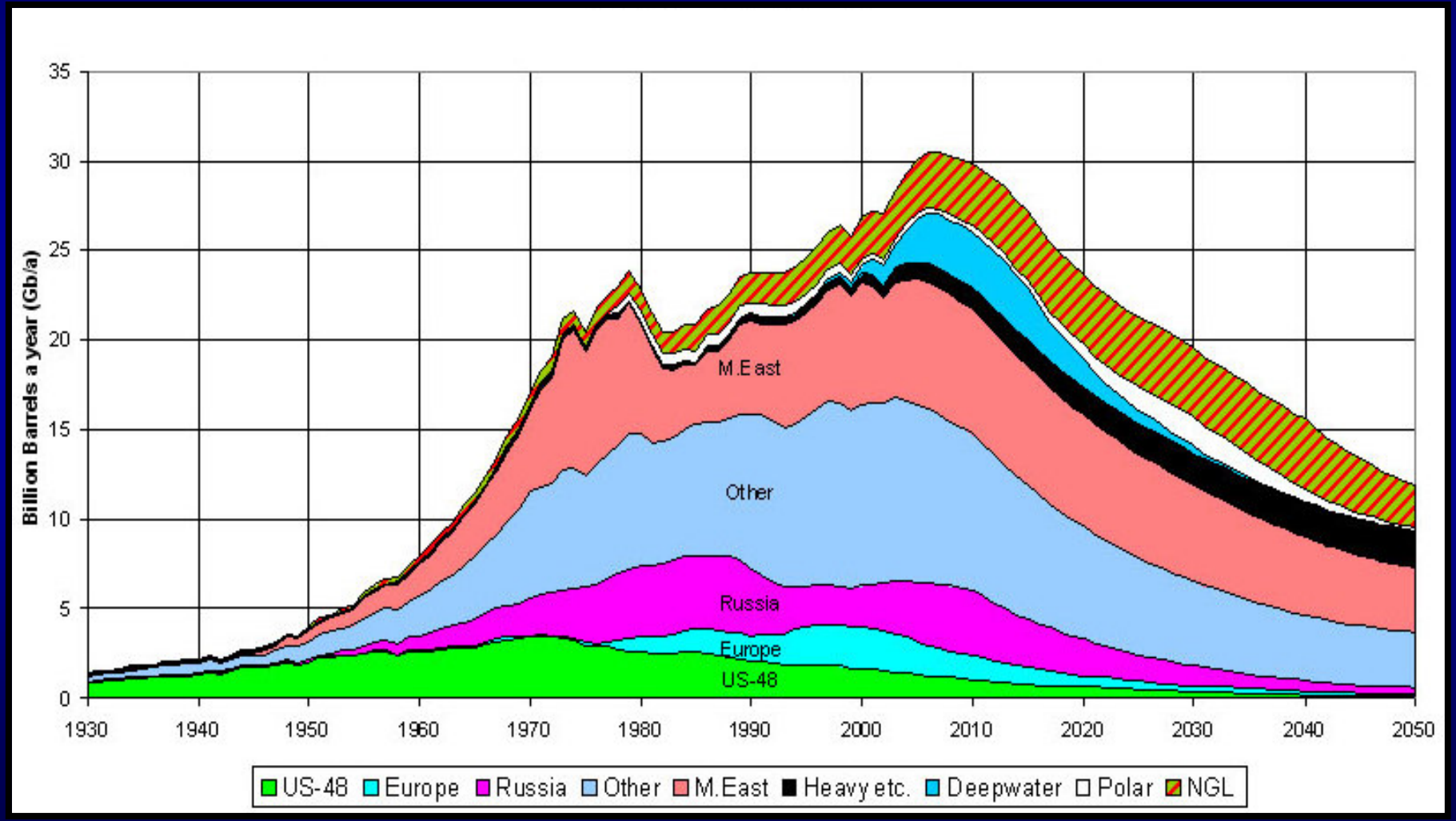
World Energy Sources



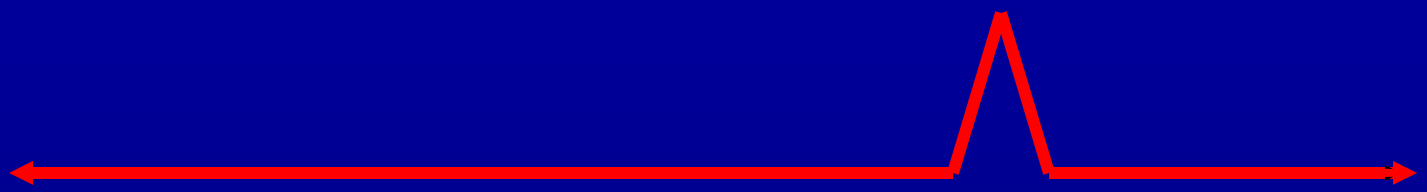
World Oil Production



Some Worry about a Peak



“Hubbert’s Peak”

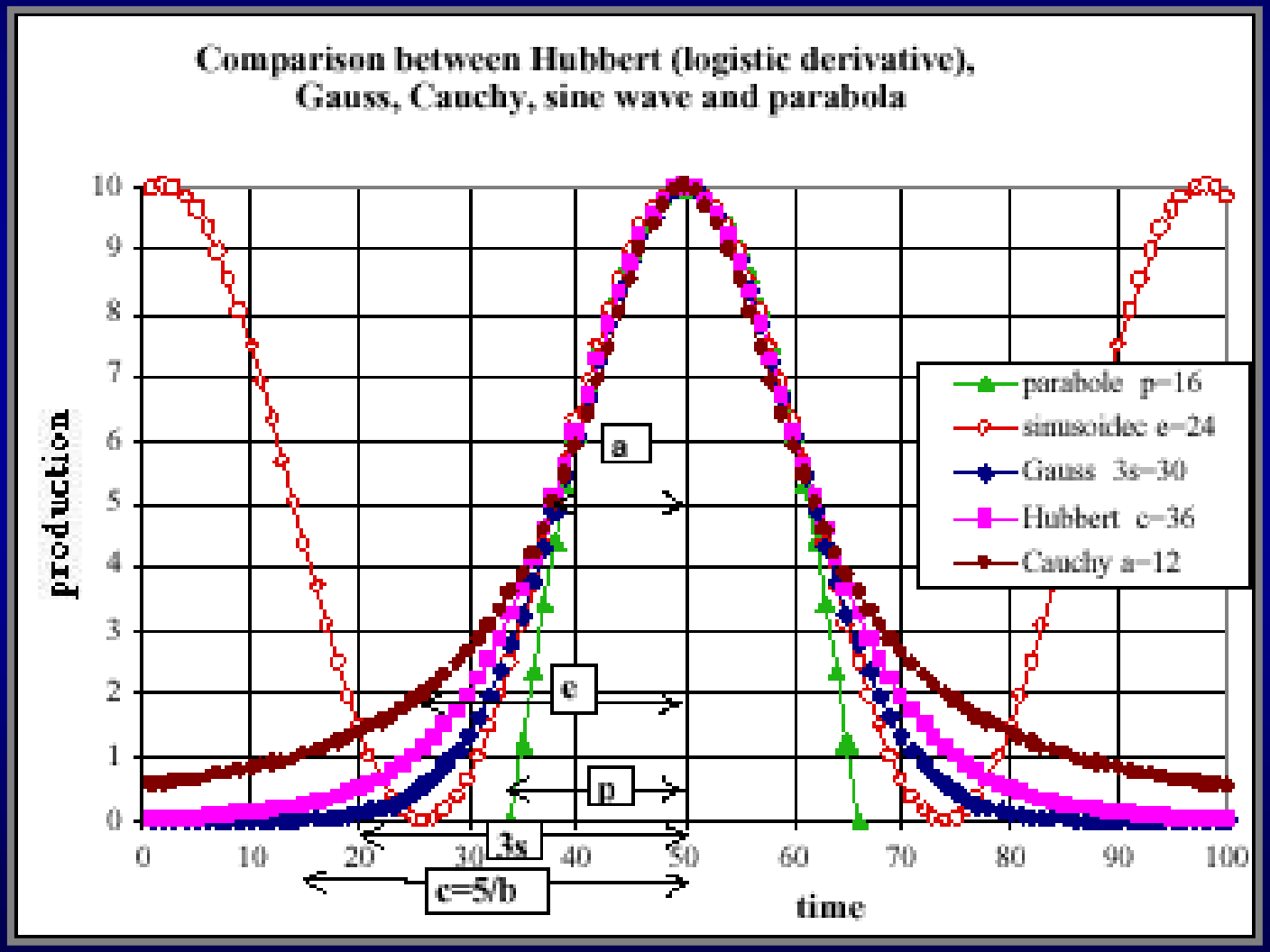


Millions of years to create oil……..……..100 years to use it

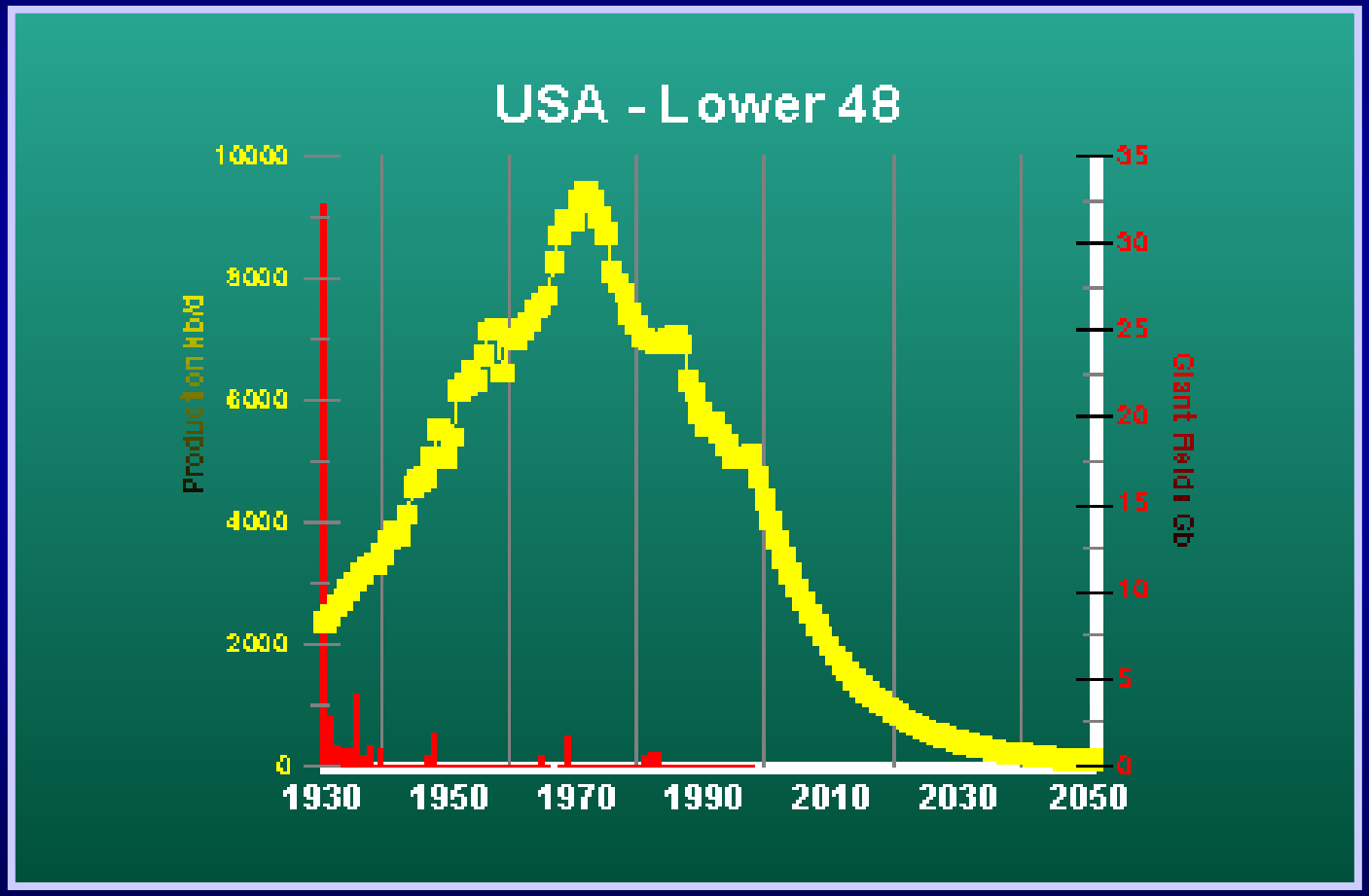
Hubbert's Concept

- Oil is a Finite Resource -- Depletable
- The Cycle of Production
  - Production starts at Zero
  - Production Rises to Peak Level
  - Discovery sizes shrink with maturity
  - After Peak, Production declines
- Results in Normal Distribution Curve

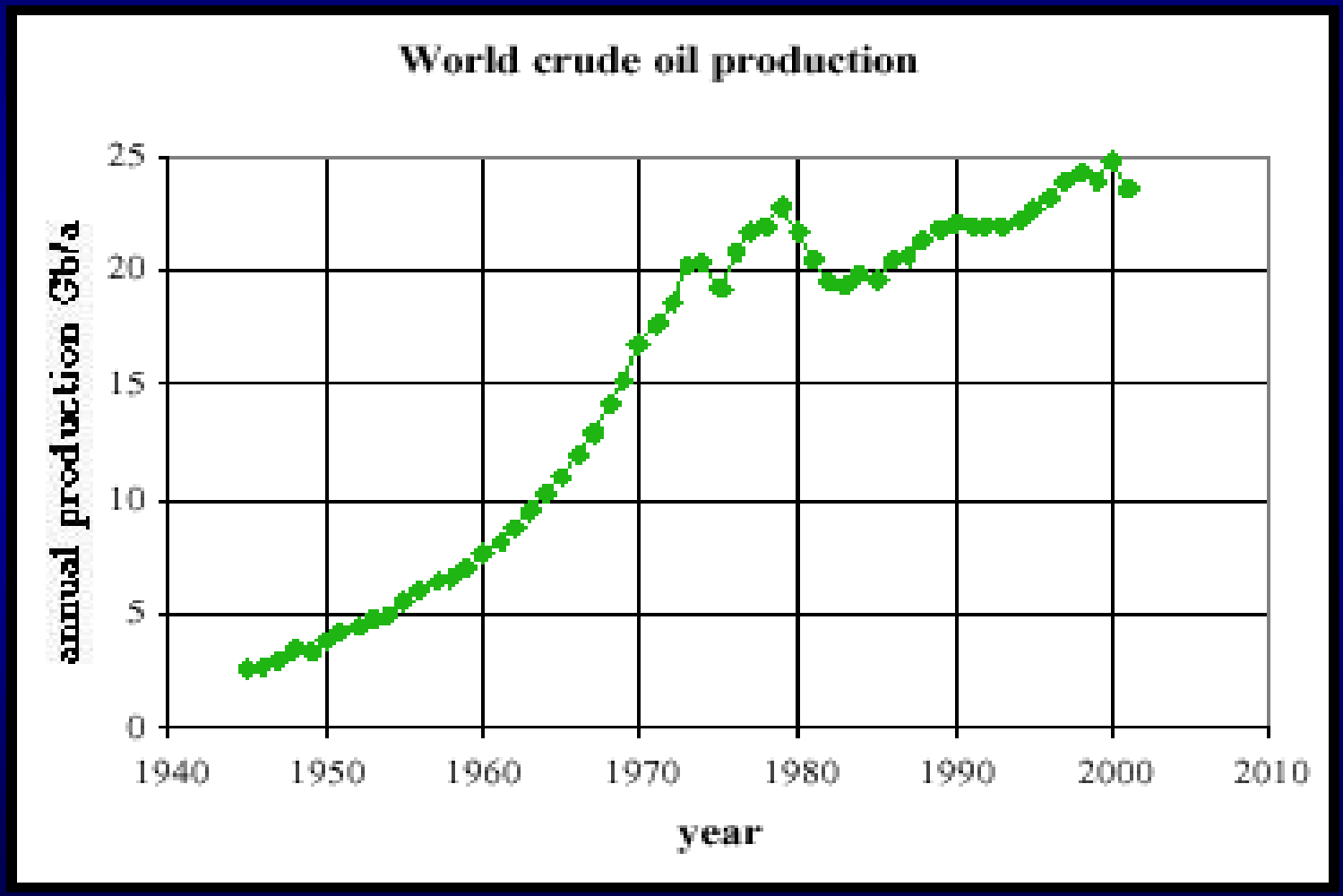
Hubbert's Prediction



Actual U.S. Oil Production

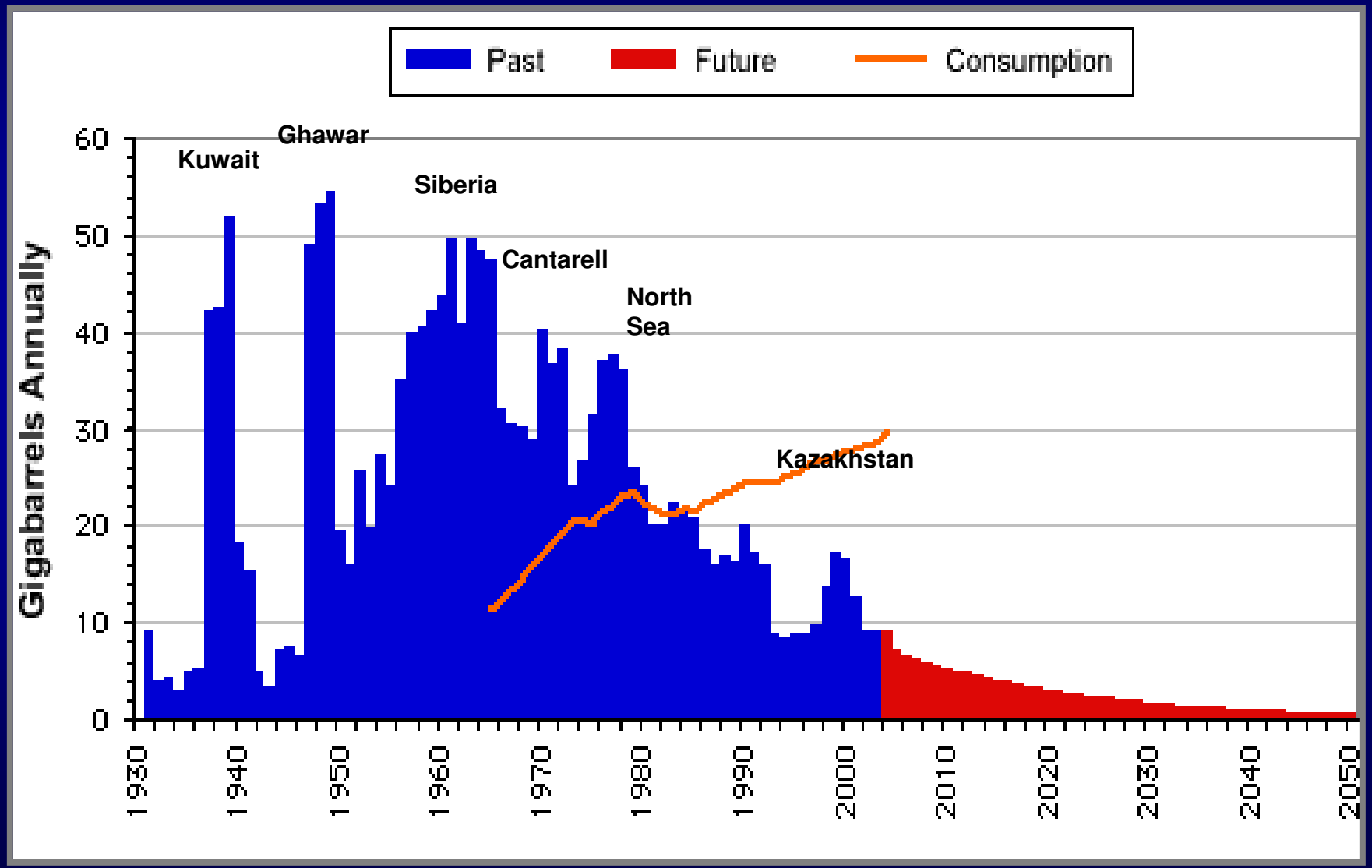


World Oil Production



World Oil Supply

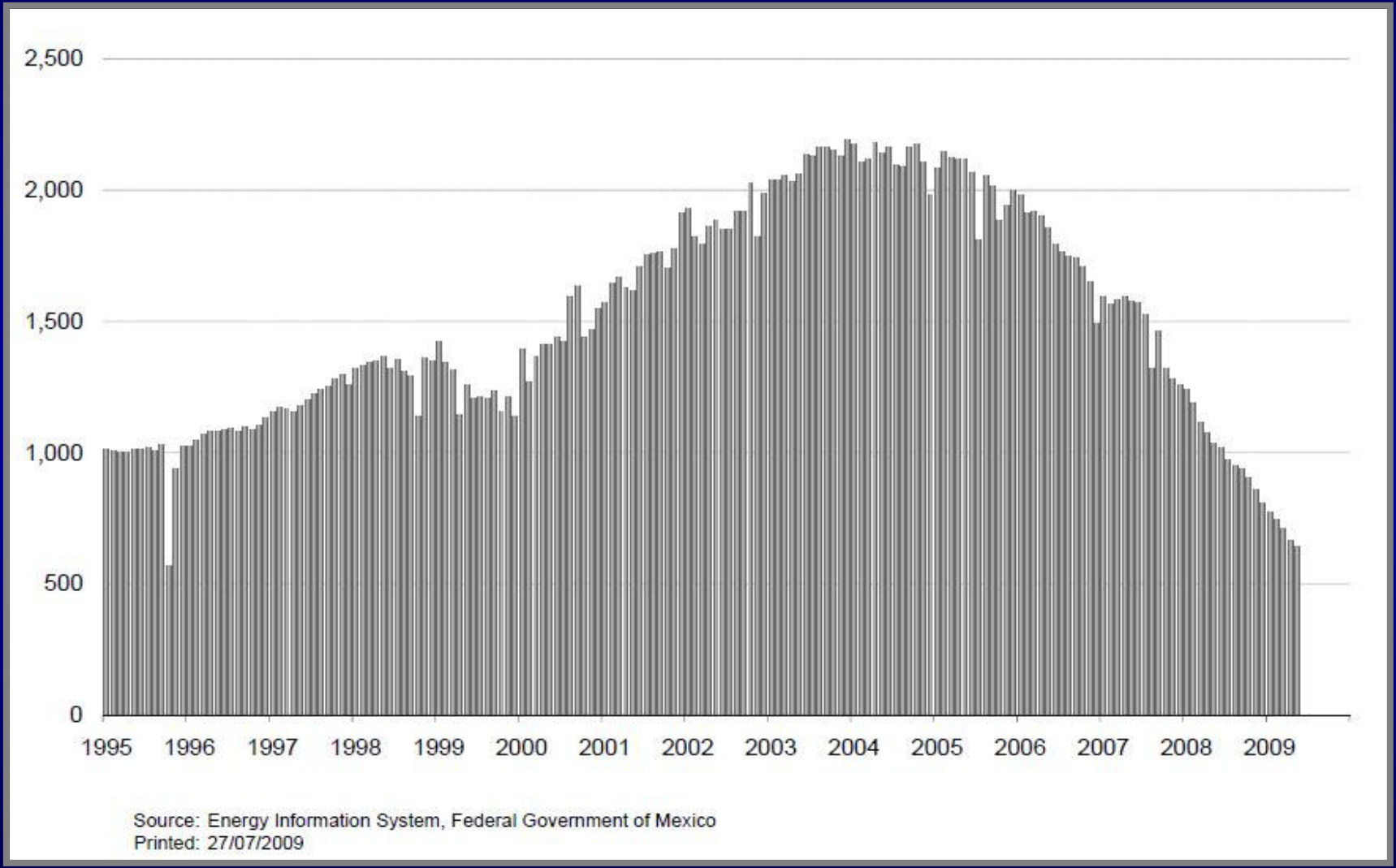
Reserve Additions and Production



Kilpatrick Energy Group

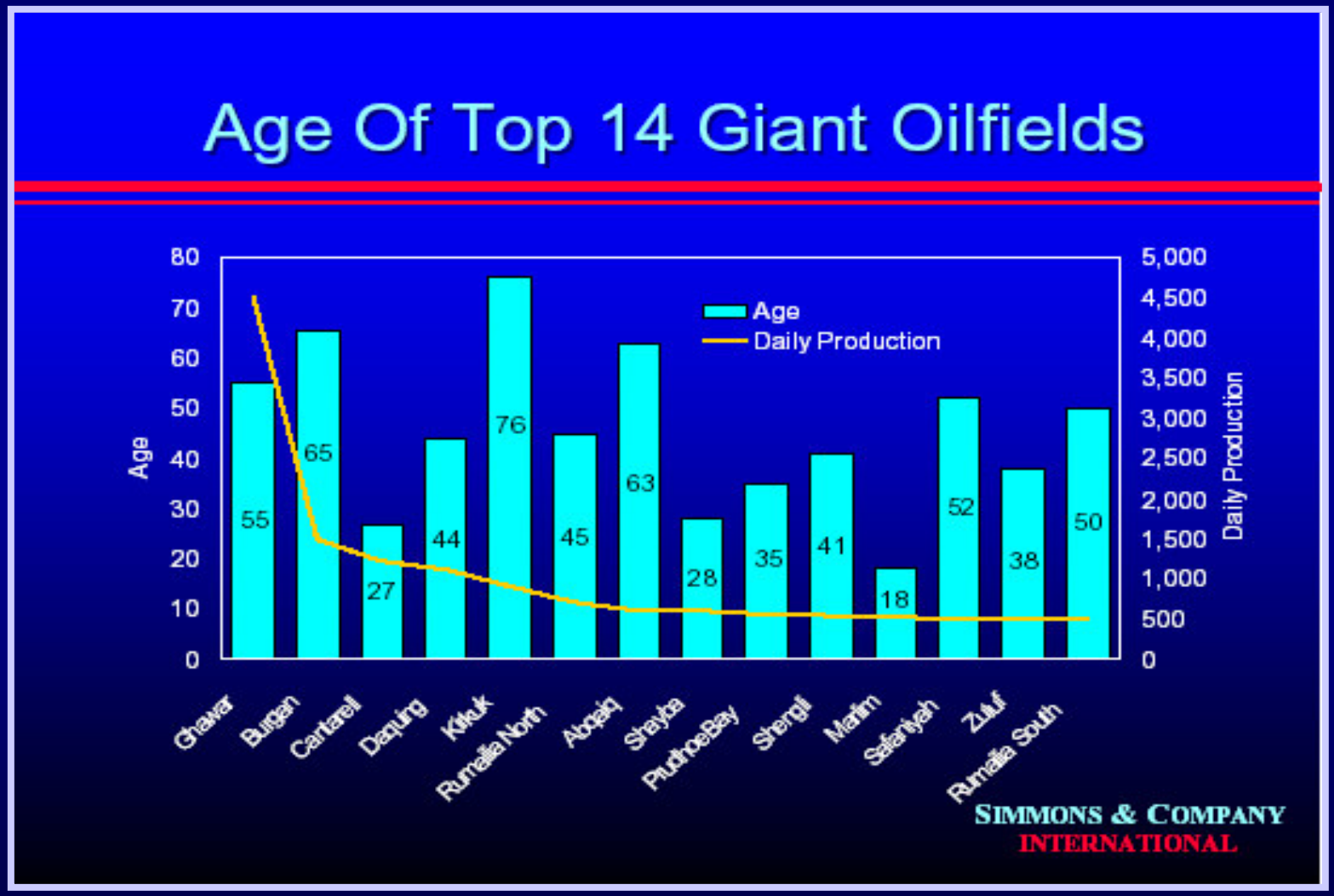
Mexico's Cantarell Field

A Classic Example of a Depleting Resource

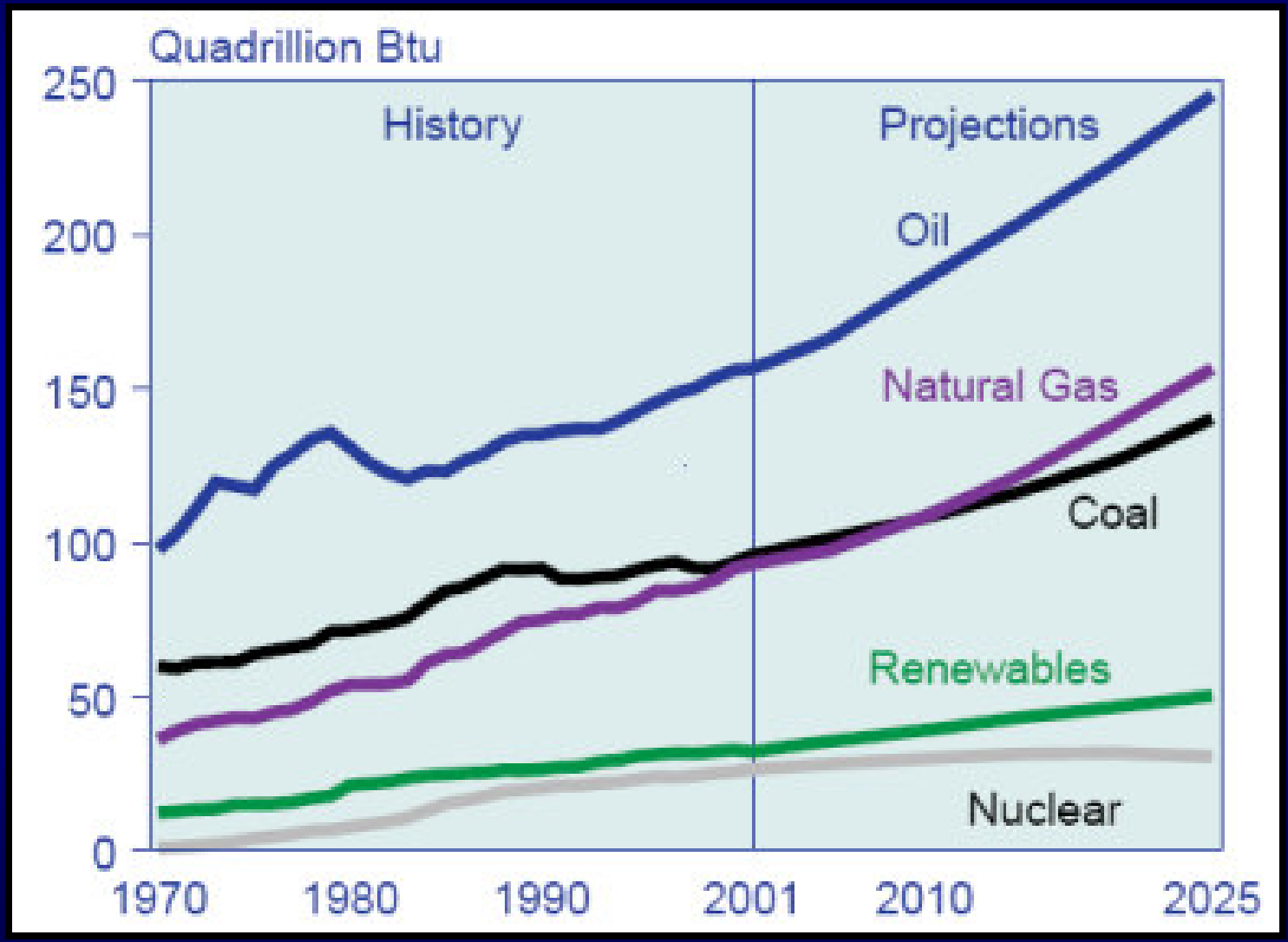


Discovered in 1970's -- Peaked in 2004 -- May stabilize at 400,000 BOPD?

The Aging Giants….



Bigger Worry – **Increasing Demand**



"Chindia"
Our Newest Competitor for Energy

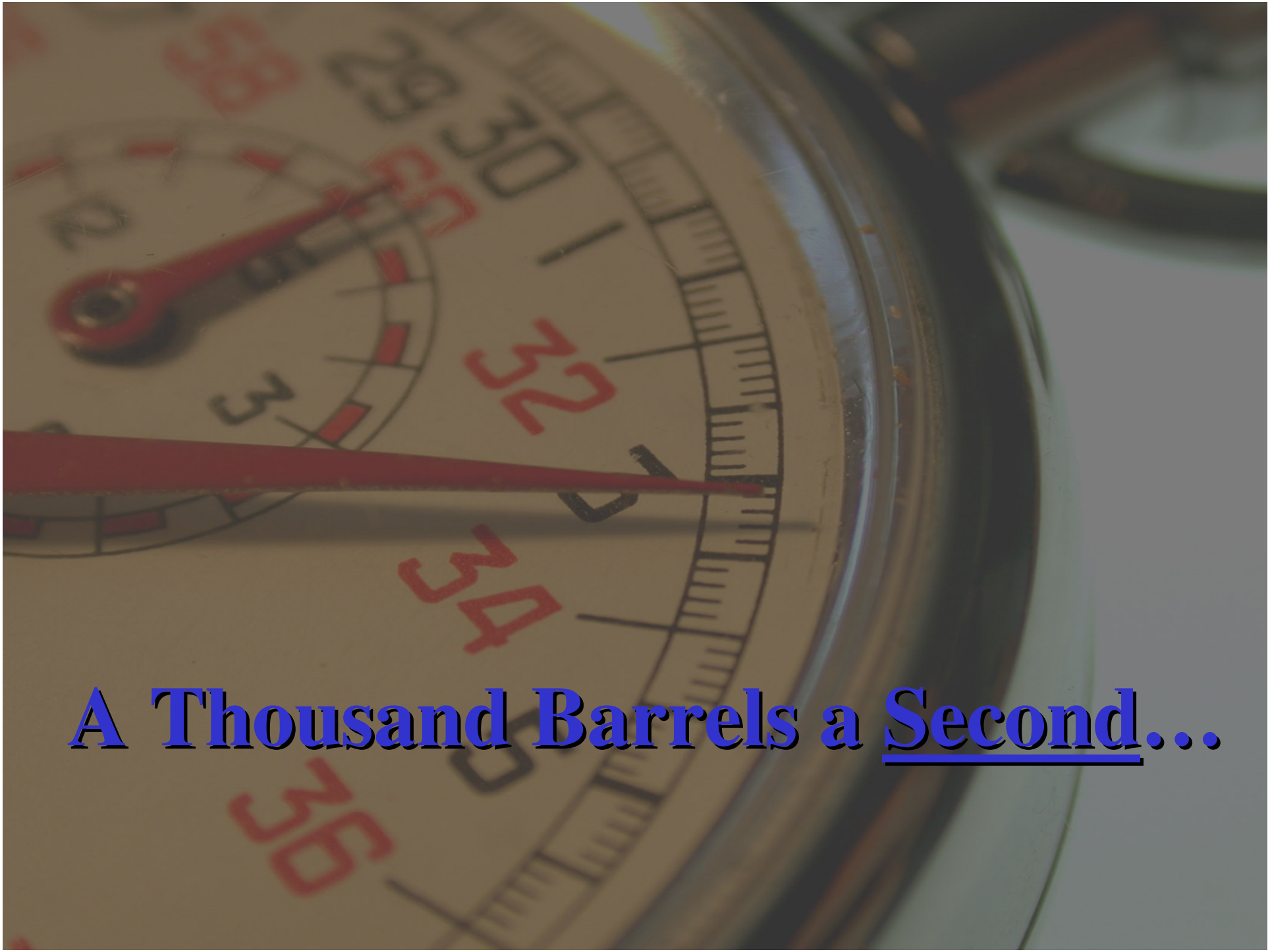
- 2.3 billion People
- Growing Consumption
  - Only Five barrels per person
  - Emerging Middle Class
- Aggressive Buyers
  - Foreign Oilfields/Contracts
  - Foreign Companies

Chinese Crude Oil Imports

Now Importing over 50% of their Crude Oil

India's Solution: "Frugal" Engineering

Tata's Nano – the $2500 automobile

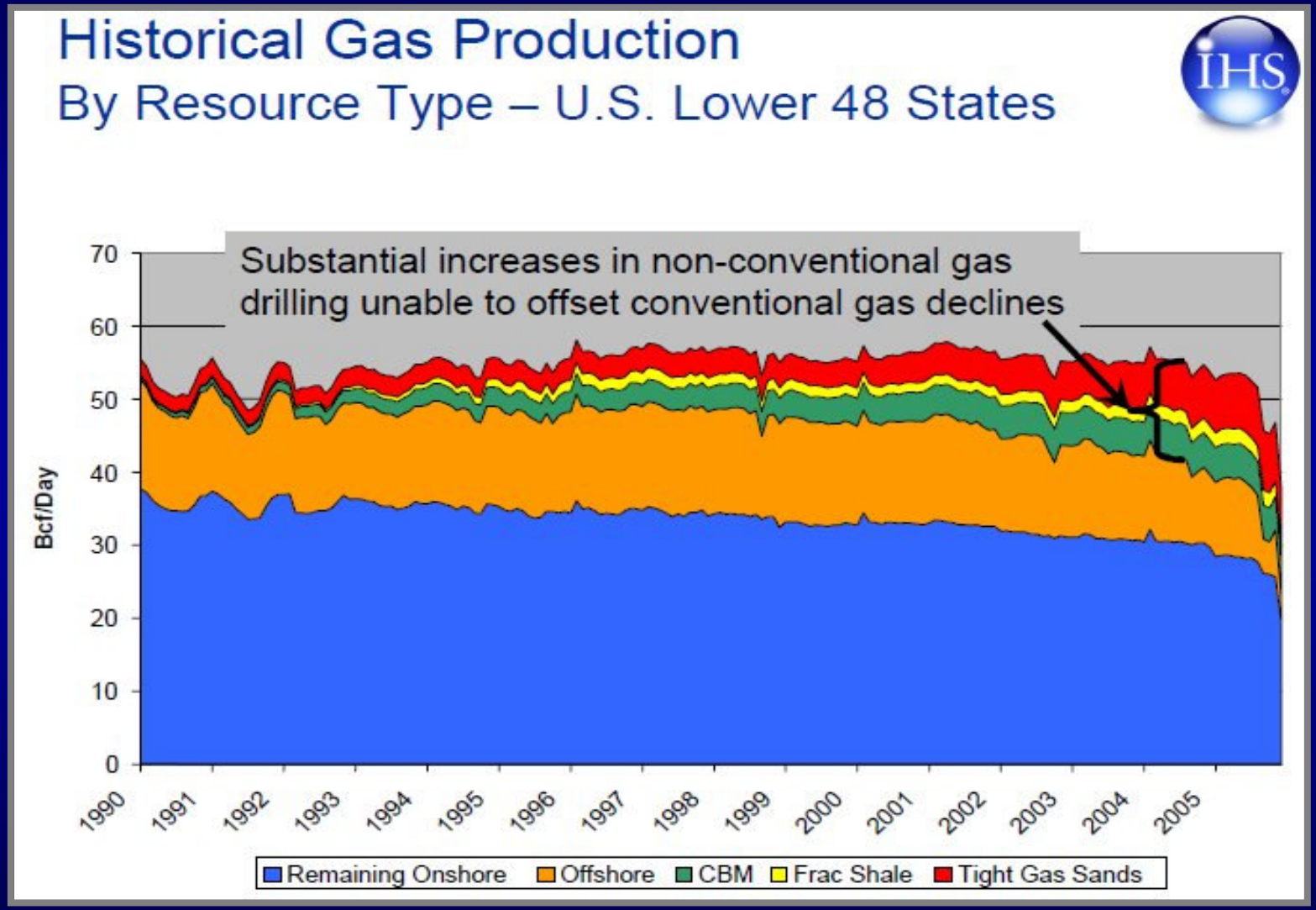

A Thousand Barrels a Second…

Big Picture for World Energy

- Demand Growth in Emerging Economies
- Energy – need 40-50% more by 2030
- Capital Required – $20-30 Trillion
- Double the current annual investment levels
- Need every source of energy
- Constraint – carbon emissions reductions
- Only clear solution – Natural Gas

Natural Gas – A Whole New World?

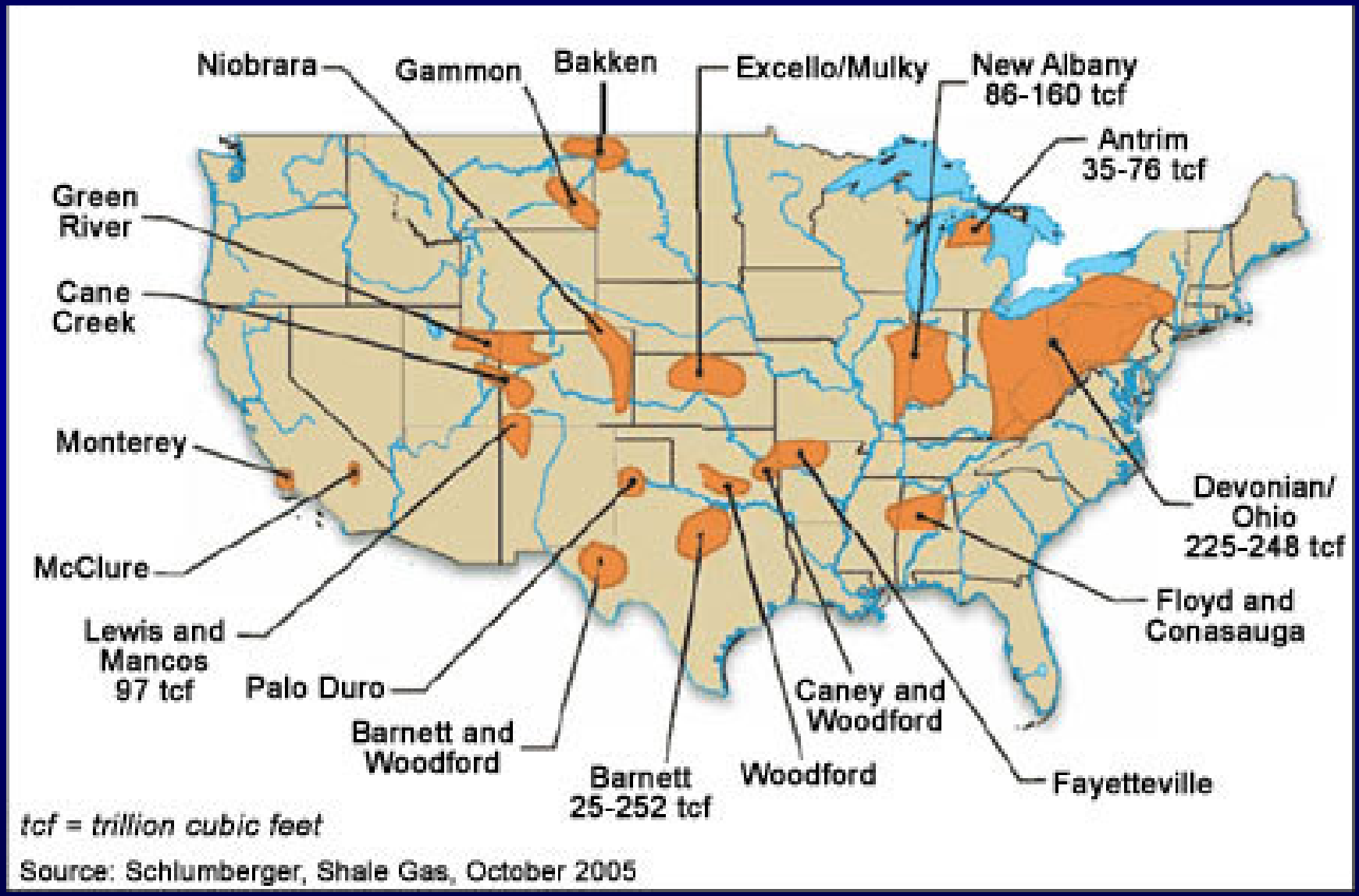
"Old" Thinking on Supply – circa 2006



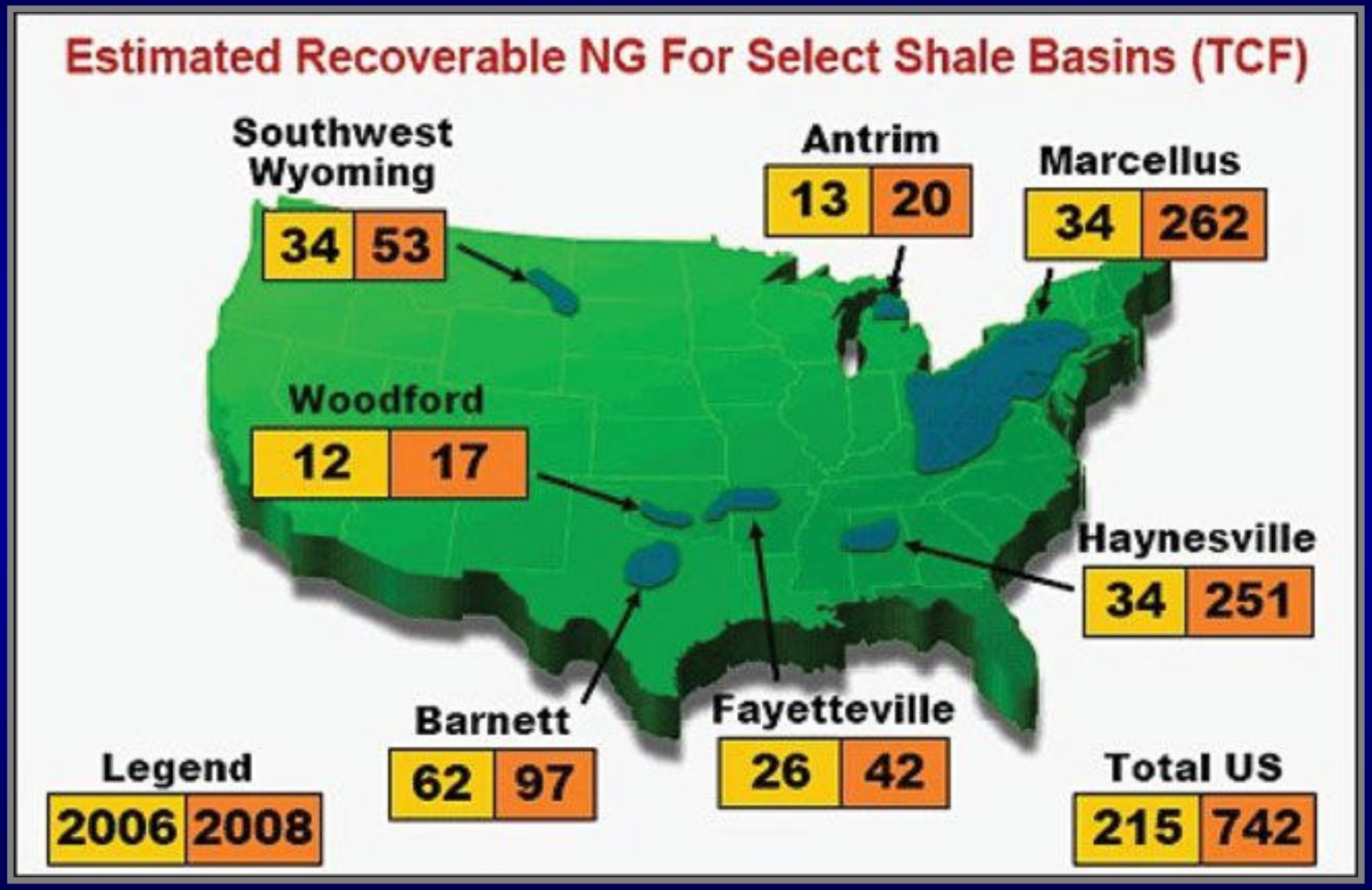
We Thought U.S. Gas Production had peaked and would forever fall

Major U.S. Shale Basins

We have always known where they are!

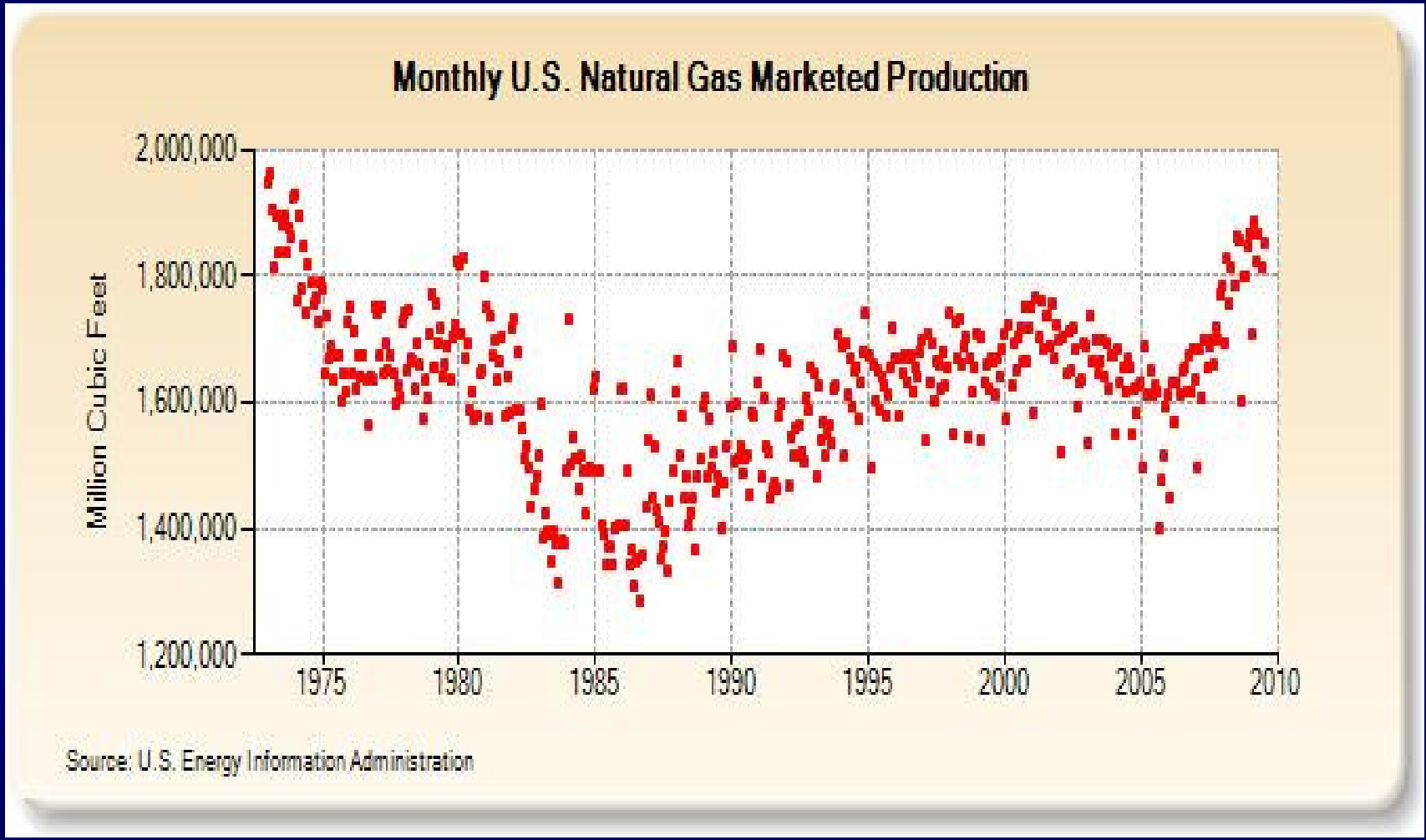


Shale Gas – A "Black Swan" Event?



500-1000 TCF Potential Reserve Additions in North America?

Amazing Growth in Last Three Years



Production up over 10 Bcf/D in last 3 years….offsetting decline

Huge Impact – 500 TO 1000 TCF Potential in North America?

- Barnett – 4.8 BCFPD
- Fayetteville – 1.5 BCFPD and growing
- Haynesville – 1.0 BCFPD and growing
- Woodford – 200 MMcfpd and growing
- Marcellus – 200 MMcfpd and growing
- Canada - Horn River/Montney – 400 MMcfpd

Finding and Development Costs = $5-7 per mcf ??

Nat Gas Thoughts

- World Supply of Stranded Natural Gas is huge – 6000 Tcf +
- Qatar, etc. LNG investments – will they tip the scales to a world price for natural gas?
- F&D Cost for Unconventional Gas – the jury is still out
- Oil/Gas Price Decoupling – amazing phenom – probably short-lived

Real Potential -- Natural Gas Vehicles (CNG)

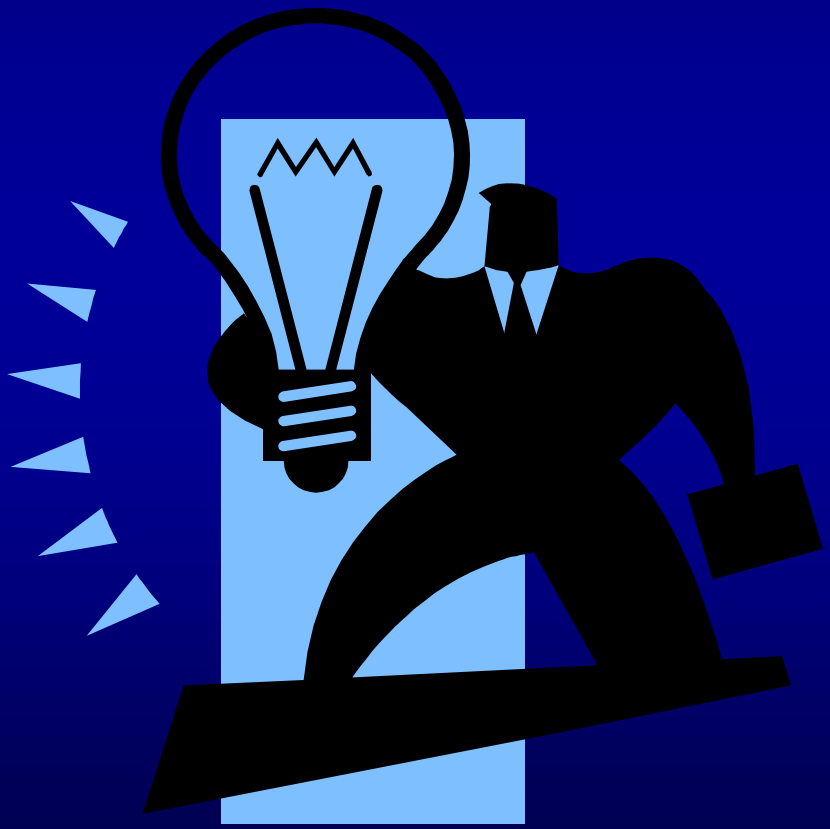
25-35 MPG --- $1.25 per gallon --- 200 miles per tank --- nearly zero emissions

Natural Gas Infrastructure is Already Here

CNG Tank Takes up Part of Trunk

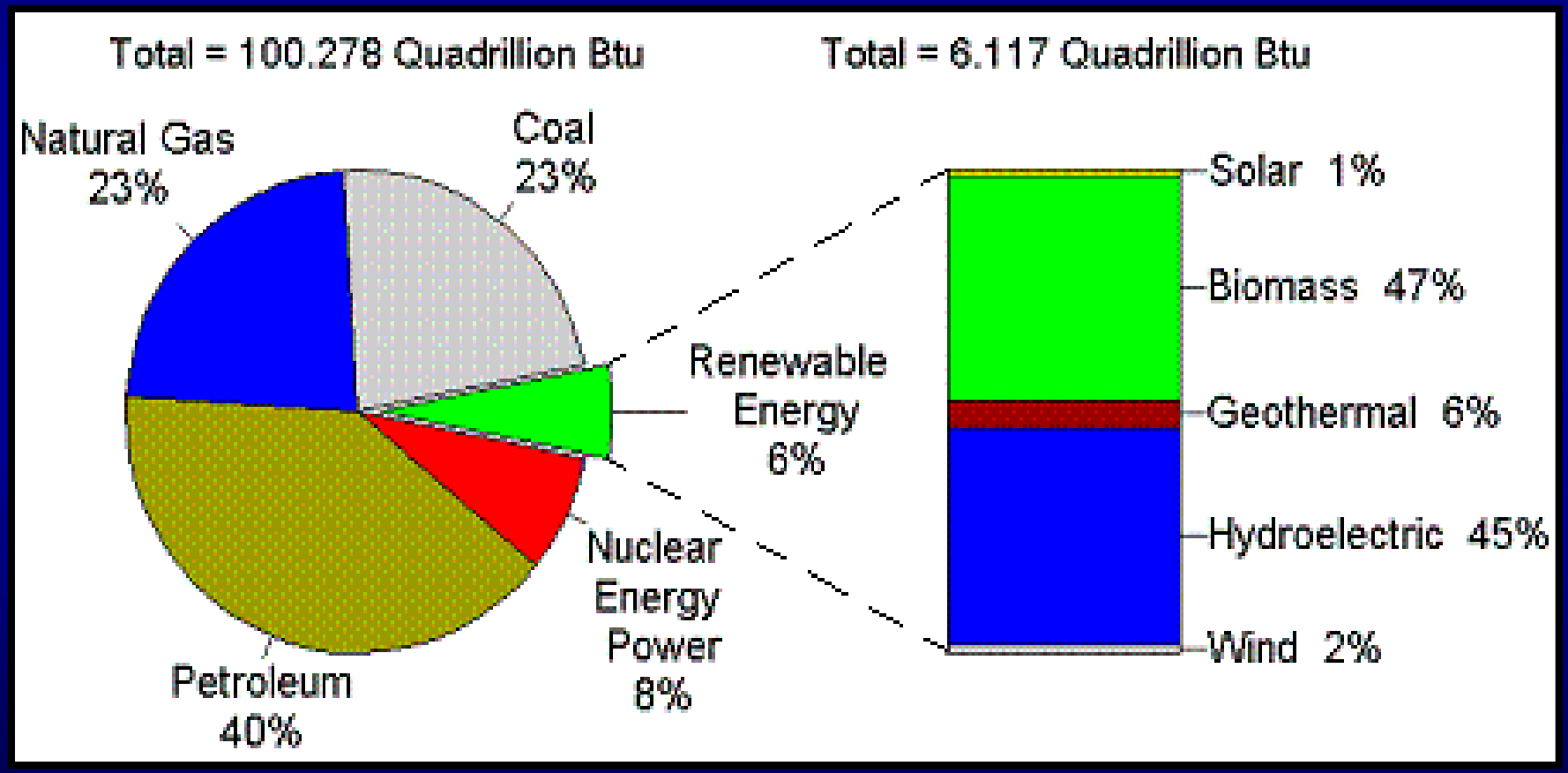
Overnight Fill-Up at Home

How About those *Alternatives* to Fossil Fuels?

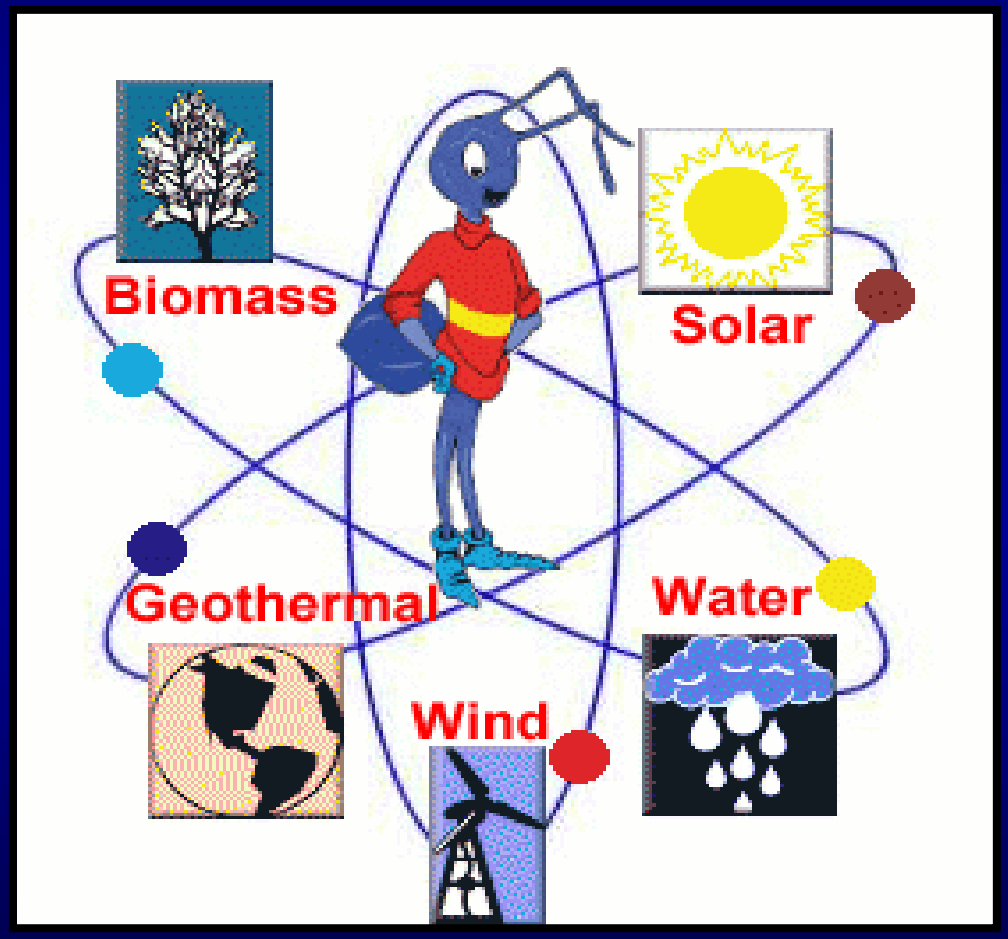


Current "Alternative Energy" -- 6%

Hydroelectric –Half of Total Renewables



Renewable Energy Sources



Wind Energy

- Nearly 100,000 Mw worldwide
- 30% Increase in 2008
- Projected to more than double in the next two years

New, Larger Turbines

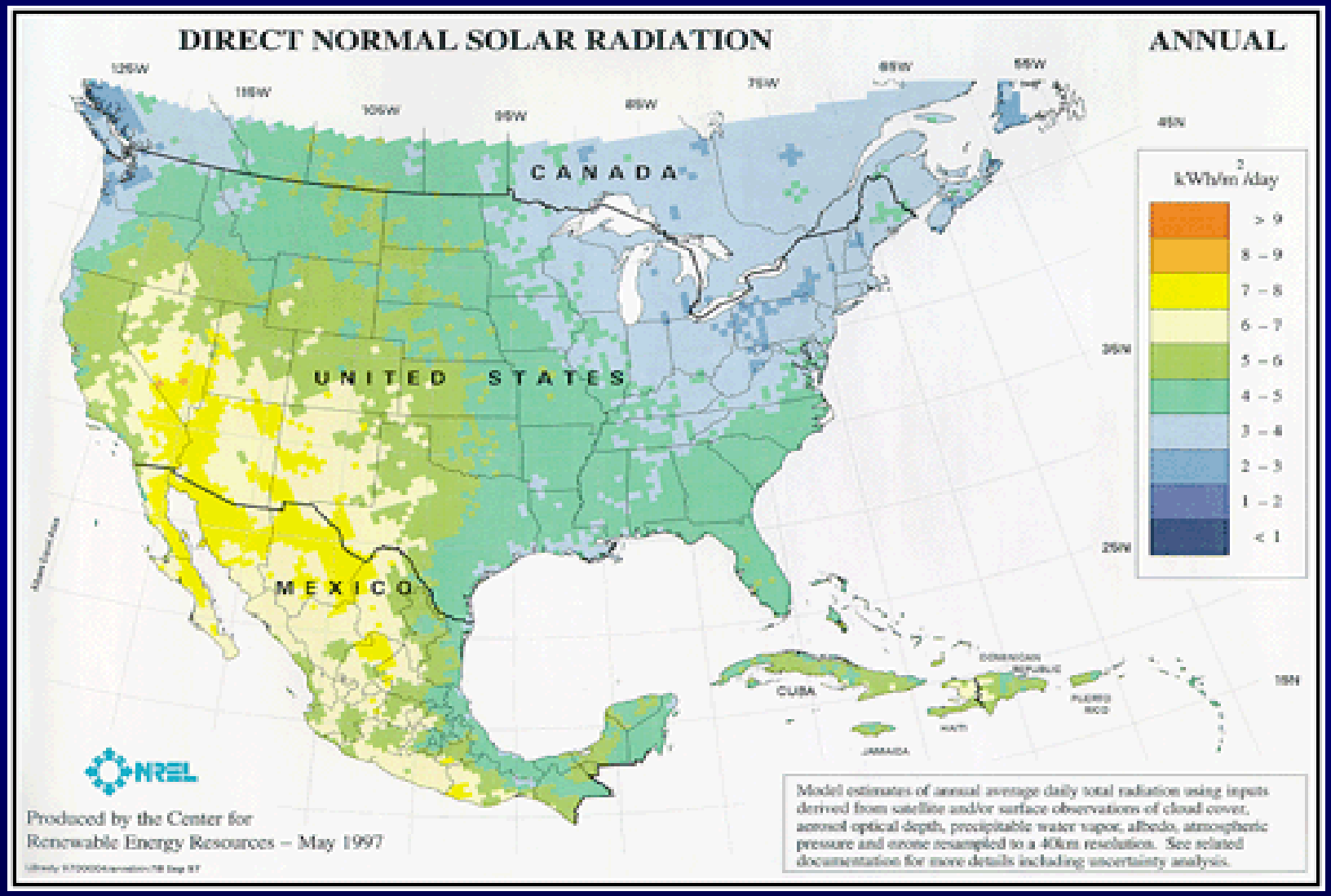
- Higher Output per Turbine
- Less Turbines required

Wind Energy Challenges

- Only Certain Locations can Work
- Environmental Issues
- Transportation and Distribution
- Small Overall Impact in U.S. in the Near-Term

Solar Energy

Areas with Solar Potential



Excellent Energy Saving Applications

Remote Power Needs

Walk Lights

Water Heaters

Major Power Plant Proposals

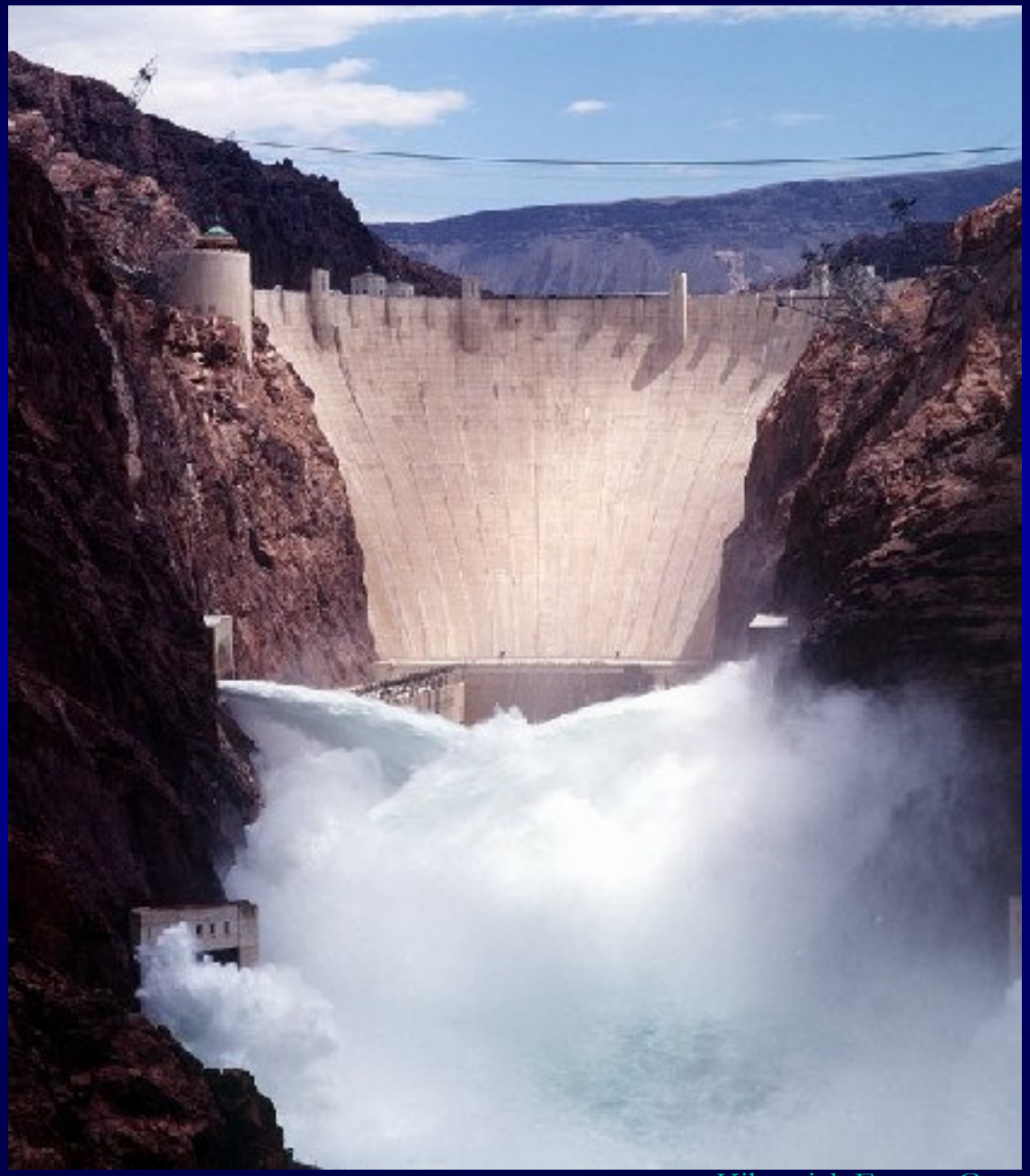
300,000 acres for 24,000 MW

Kilpatrick Energy Group

Solar Energy Challenges

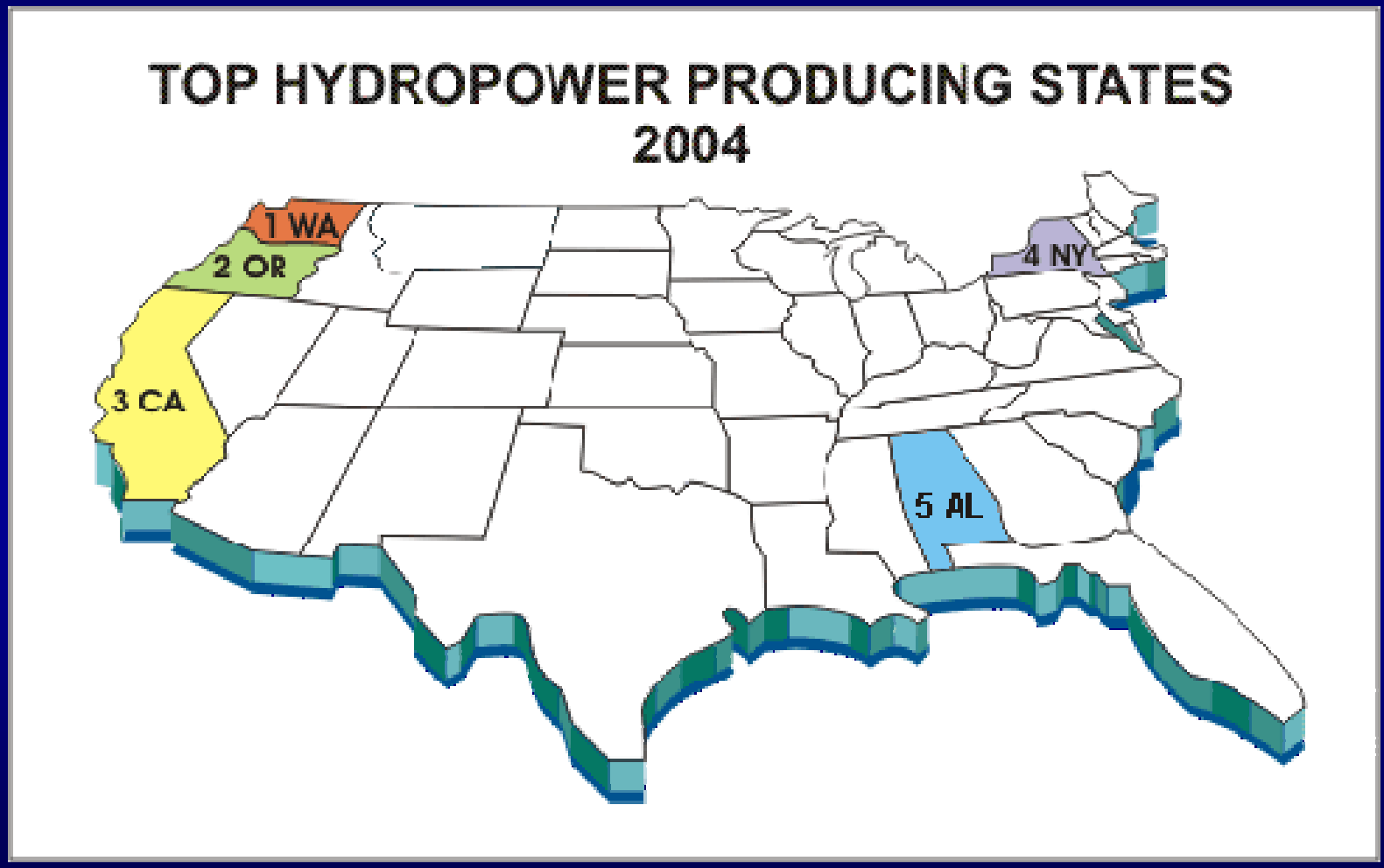
- Limited Areas where Solar is Effective
- Huge Surface Requirements for Large Power Plant
- Cost – still need more R&D

Hydro



Hydropower in the U.S.

7% of U.S. Electric Generation, 75% of Total Renewable Energy



Over 50% from only Three Western States

Hydropower Challenges

- Limited New Expansion Locations
- Current Trend – destroy dams!
- Environmental Challenges
  - Wild Rivers
  - Destruction of Fish Habitat

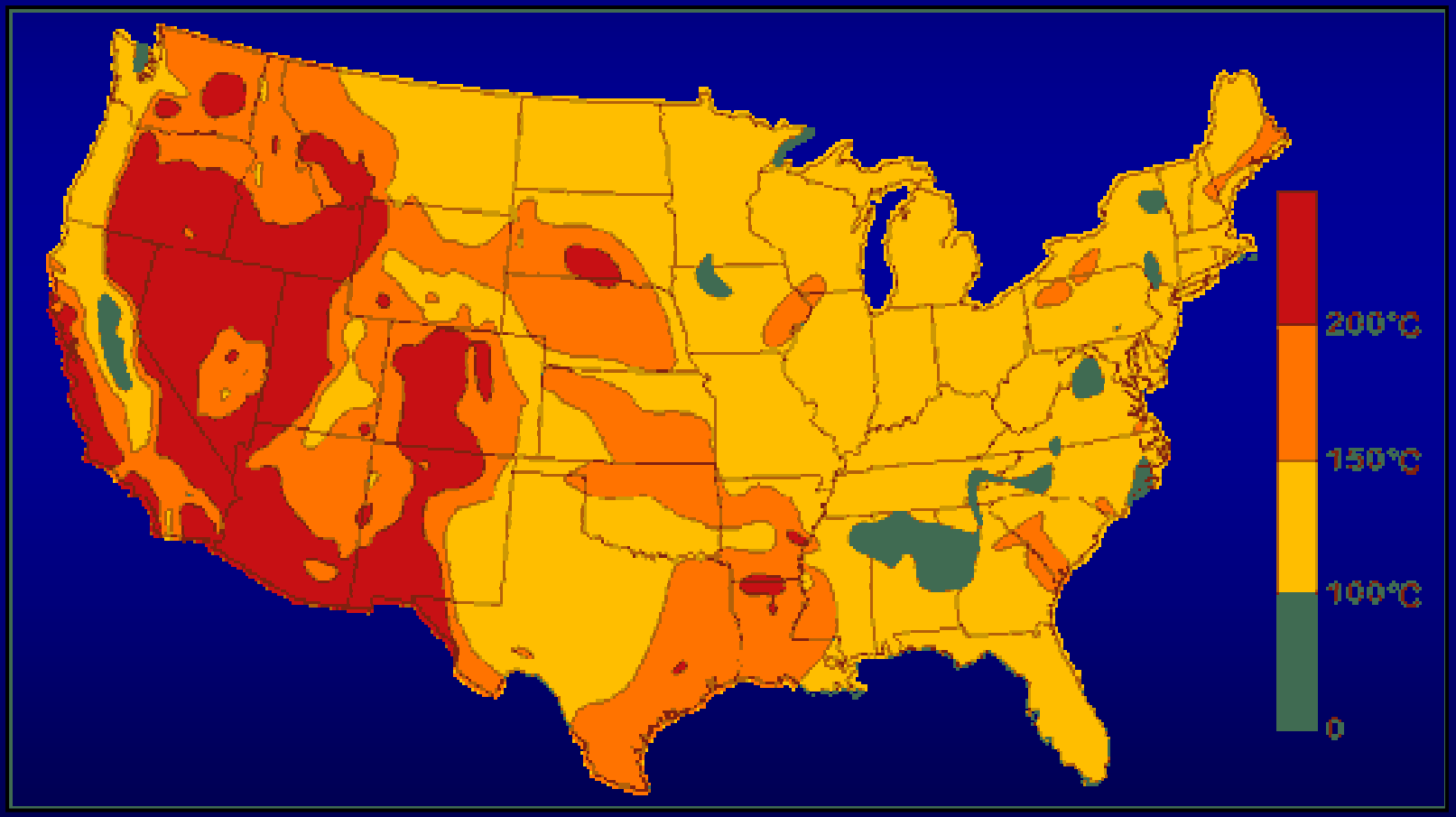
Geothermal Energy

Geothermal Power Plants

The Geysers in California

Geothermal Potential in The U.S.

Largest Geothermal Producer in the World



Temperatures at a Depth of 6 km.

Kilpatrick Energy Group

Geothermal Challenges

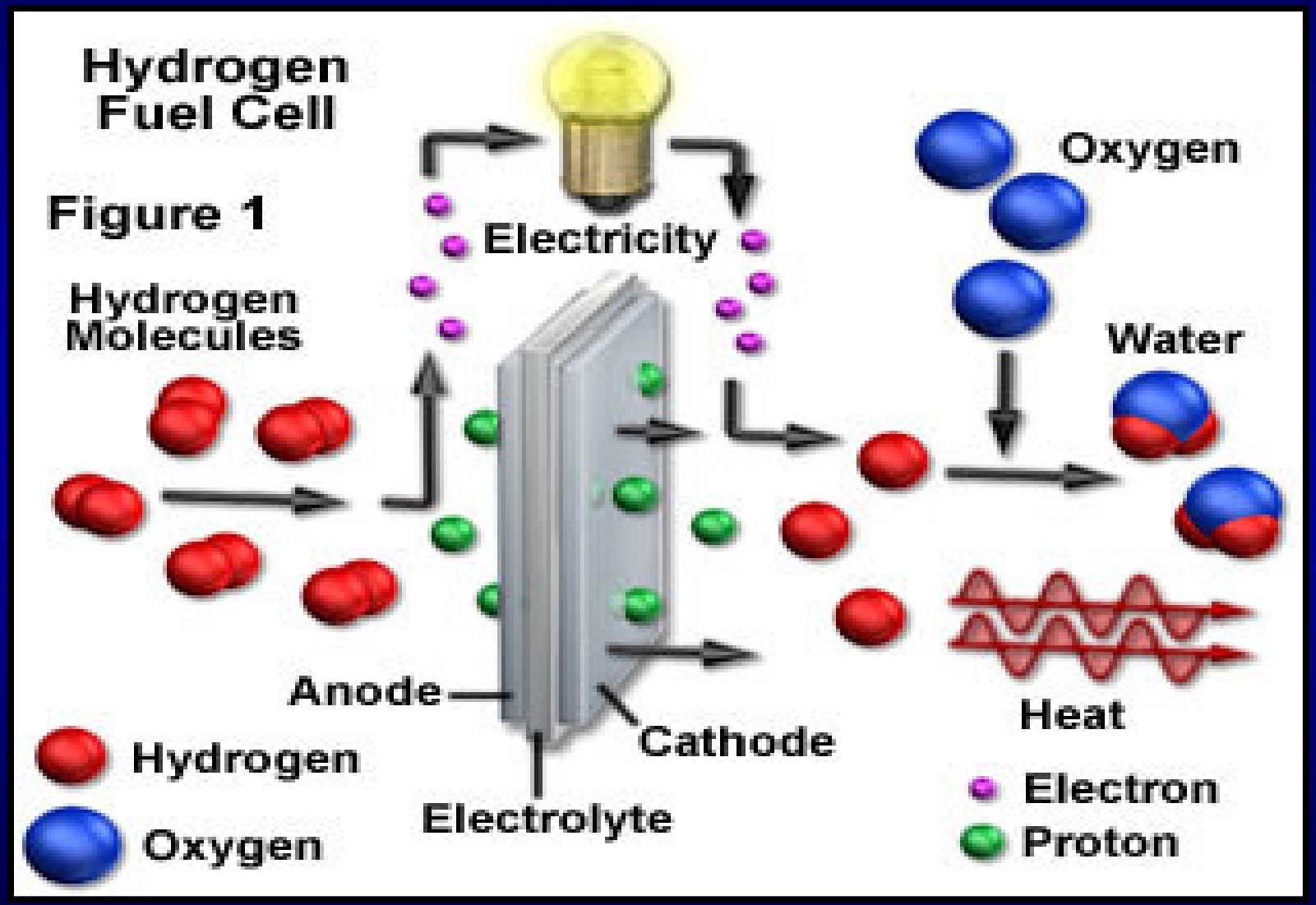
- Limited Areas to Expand
- Technological Challenges in Drilling
- Research in More Efficient Conversion of Heat to Power

Hydrogen Energy

The Simplest Element

The Most Plentiful Gas in the Universe

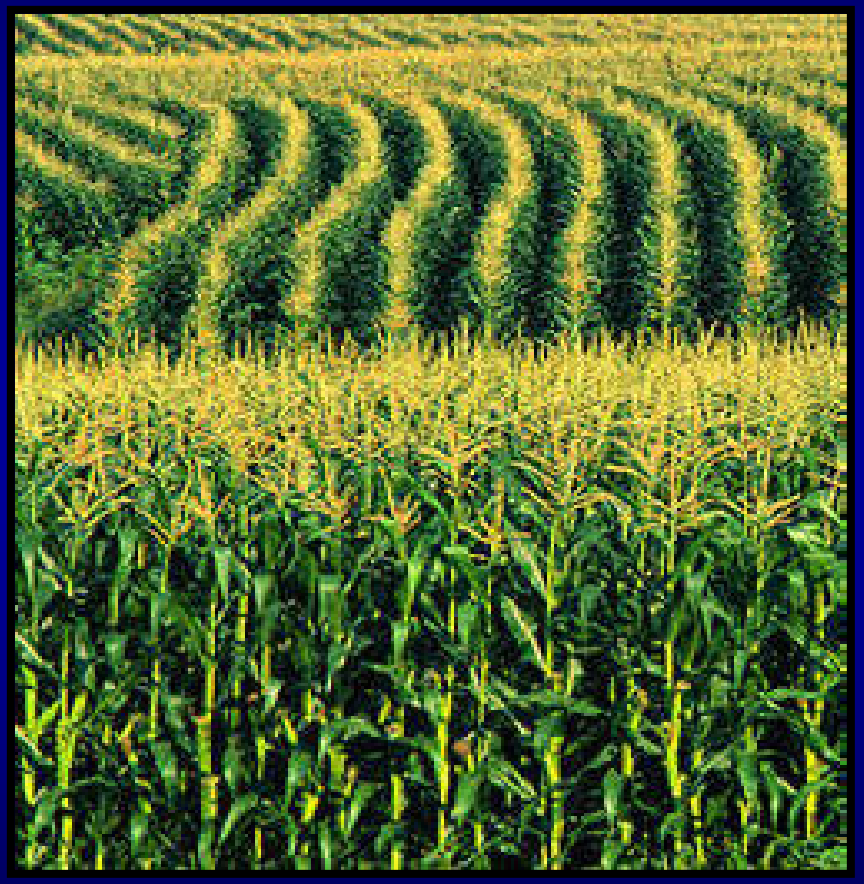
The Hydrogen Fuel Cell



Hydrogen Energy Challenges

- Cost to Separate Hydrogen
  - Electrolysis (need electricity)
  - Natural Gas Steam Reforming (need natural gas)
- Infrastructure
- Low Amount of Energy per Volume

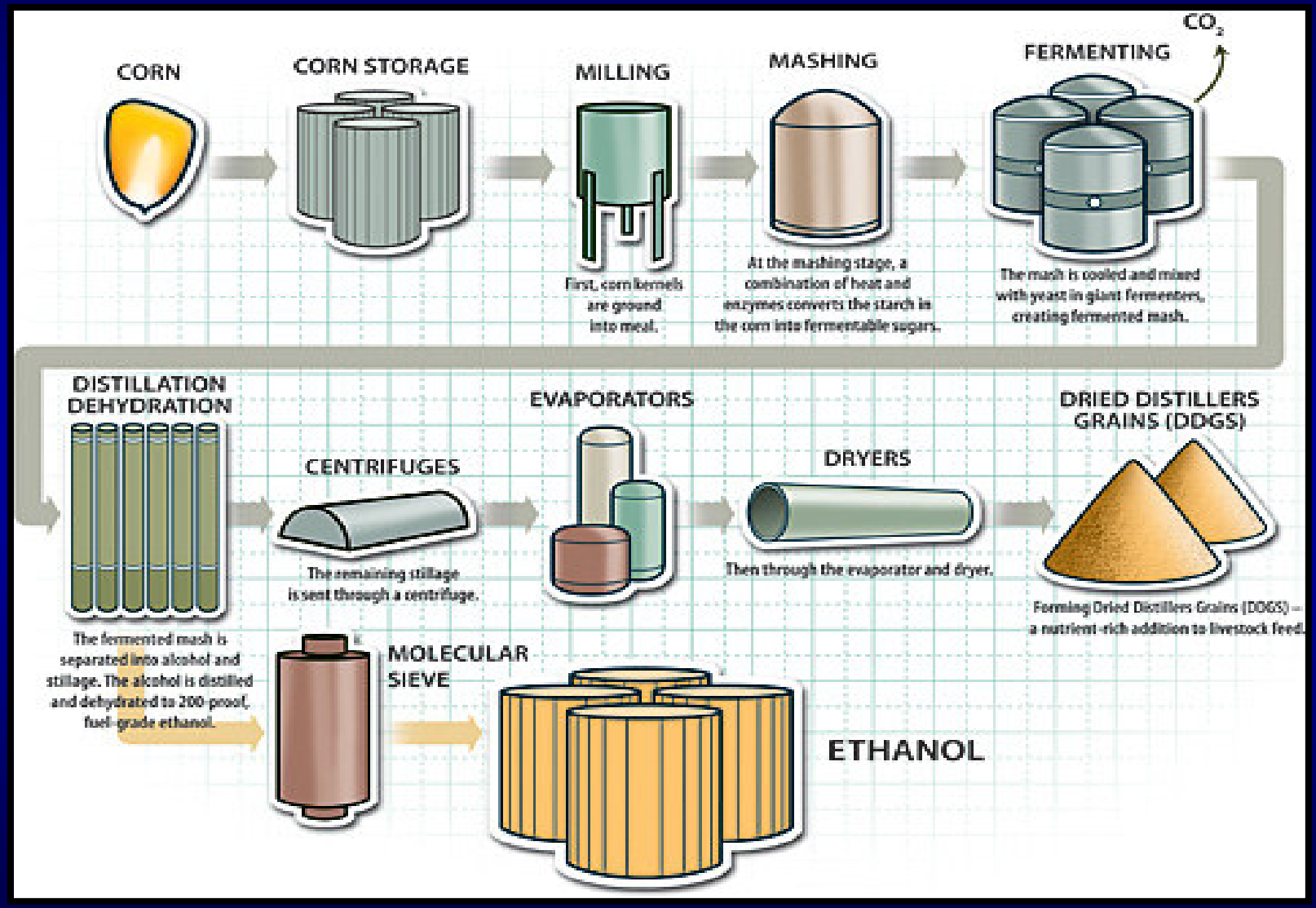
Ethanol



The Political Energy Source

"By God, you better like Ethanol – it's American!"

Cracking the Kernel – Power Intensive!



Gasoline Replacements?

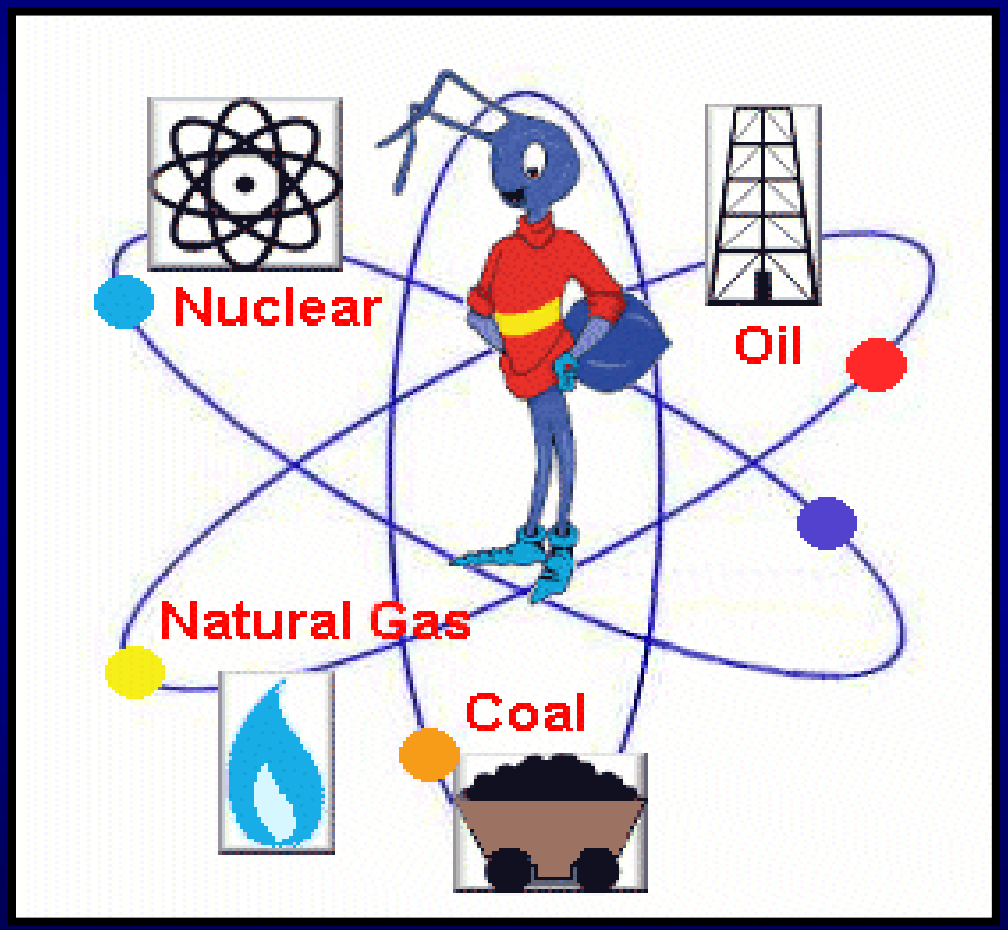
- Ethanol
  - Corn requires 29% more fossil energy
  - Switch Grass requires 45% more fossil energy
  - Wood Biomass requires 57% more fossil energy
- 1-1/2 gal of ethanol = 1 gal of gasoline
- Biodiesel
  - Soybeans require 27% more fossil energy
  - Sunflowers require 118% more fossil energy

Cornell University & UC Berkeley Study

Biomass Challenges

- Research to achieve Energy Efficiency
- Impact on Food Prices
- Soaring Farmland Prices
- Real Cost to Consumer -- Subsidies?
- **Reality Check** – is this really a Solution or a Distraction?

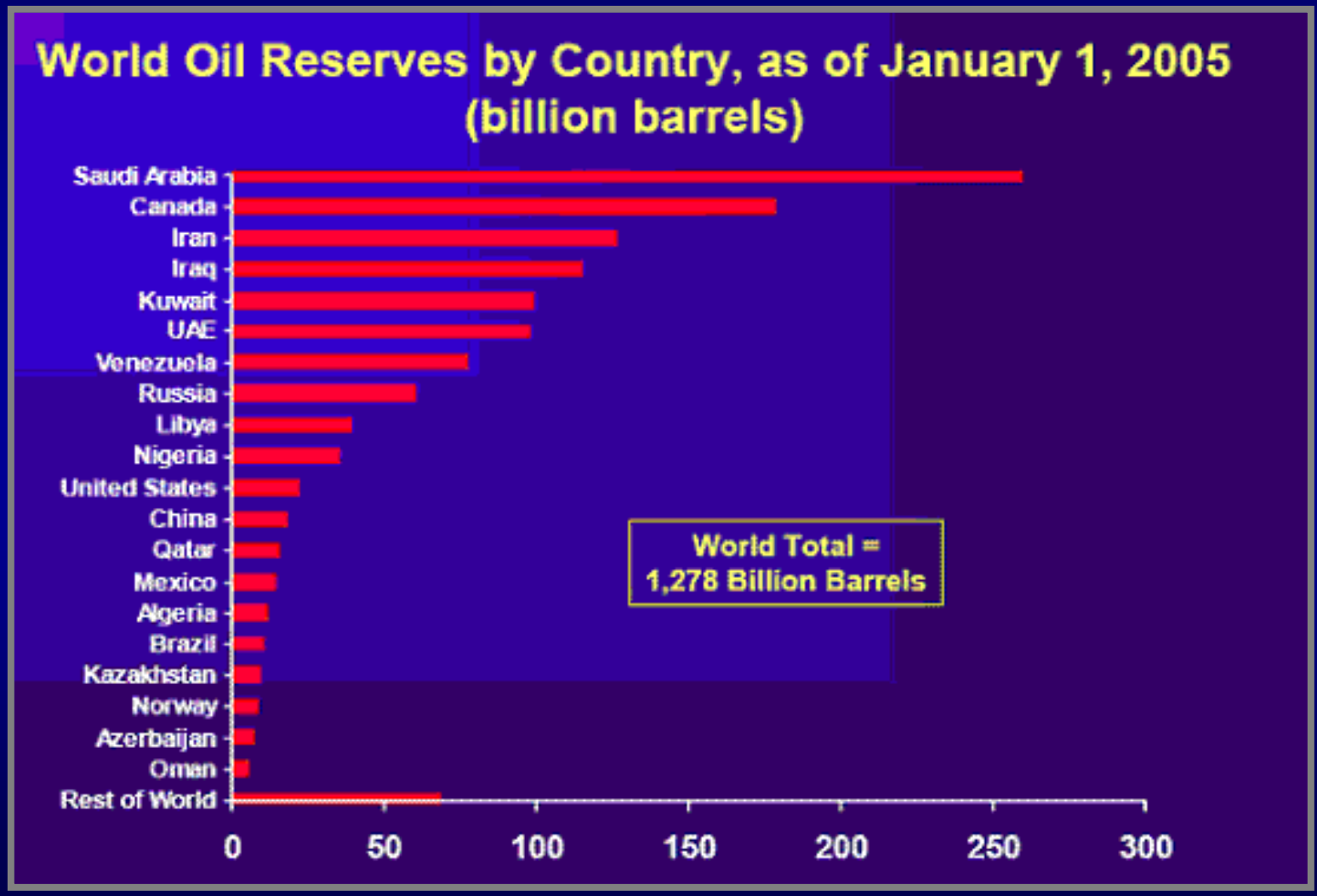
How about Alternative Energy from Non-Renewable Sources?



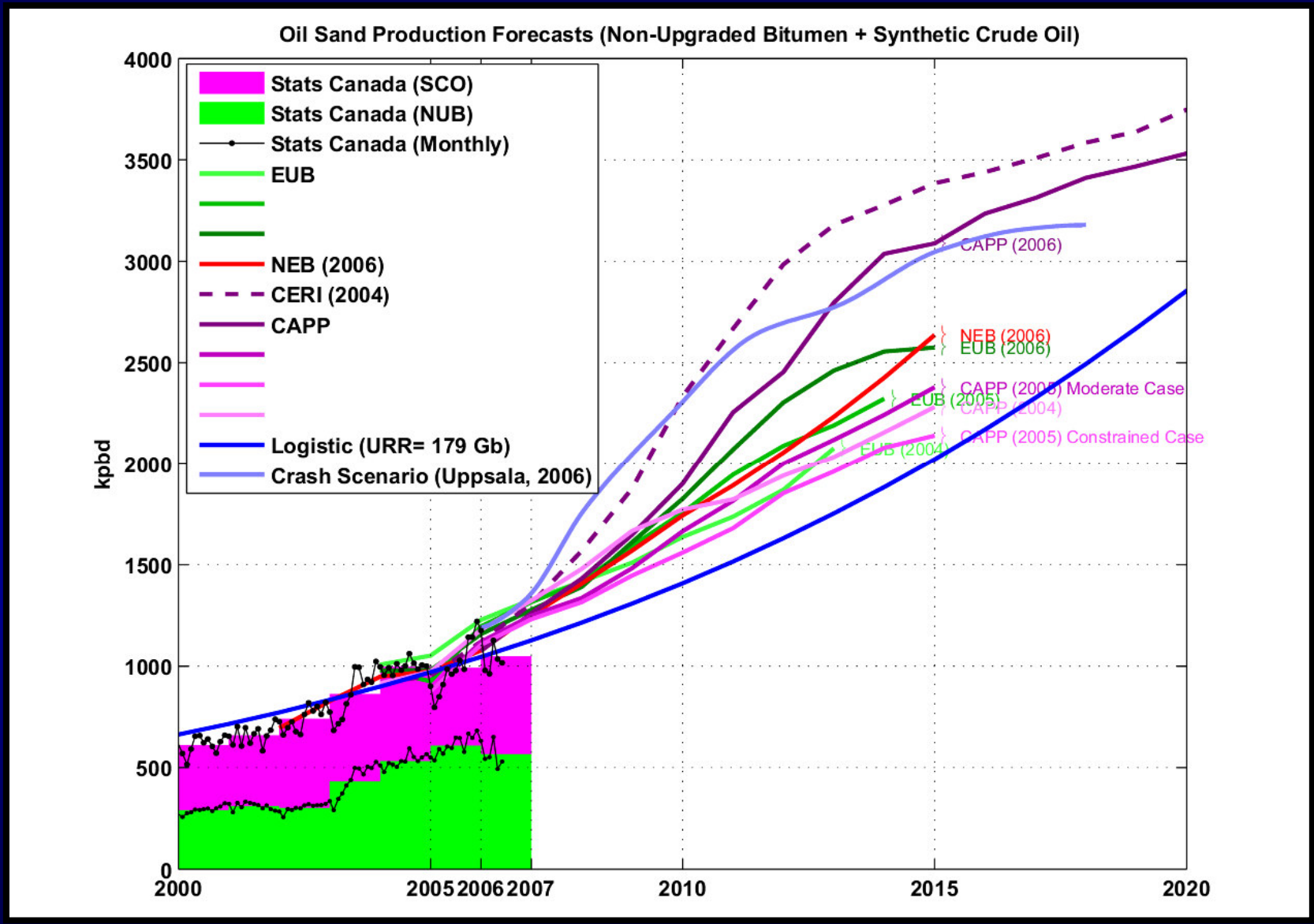
CANADA

1.7 Trillion Barrels of Heavy Oil

Canada's Reserves – Number Two and Growing



Growing Canadian Production



Canadian Oil Sands Mining

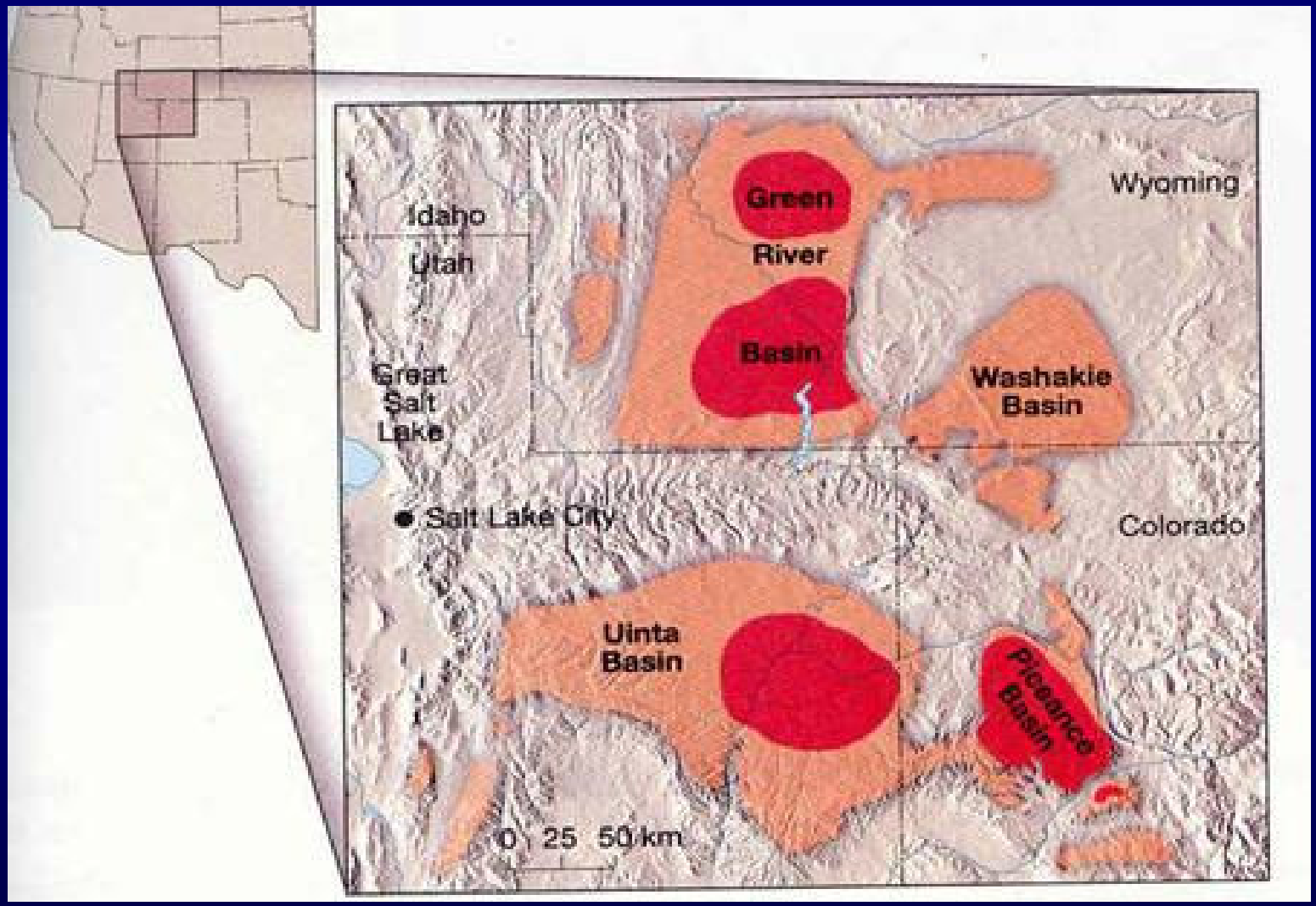
Heavy Oil Sands Challenges

- Greenhouse Gas Emissions
- Surface Disturbance
- Uncertain Economics
  - Huge Front-End Capital Costs
  - Large Natural Gas Needs
  - Upgrading Costs

Oil Shale

Two Trillion Barrels in the U.S.

About Twice the Current World's Oil Reserves



Large Surface Mines

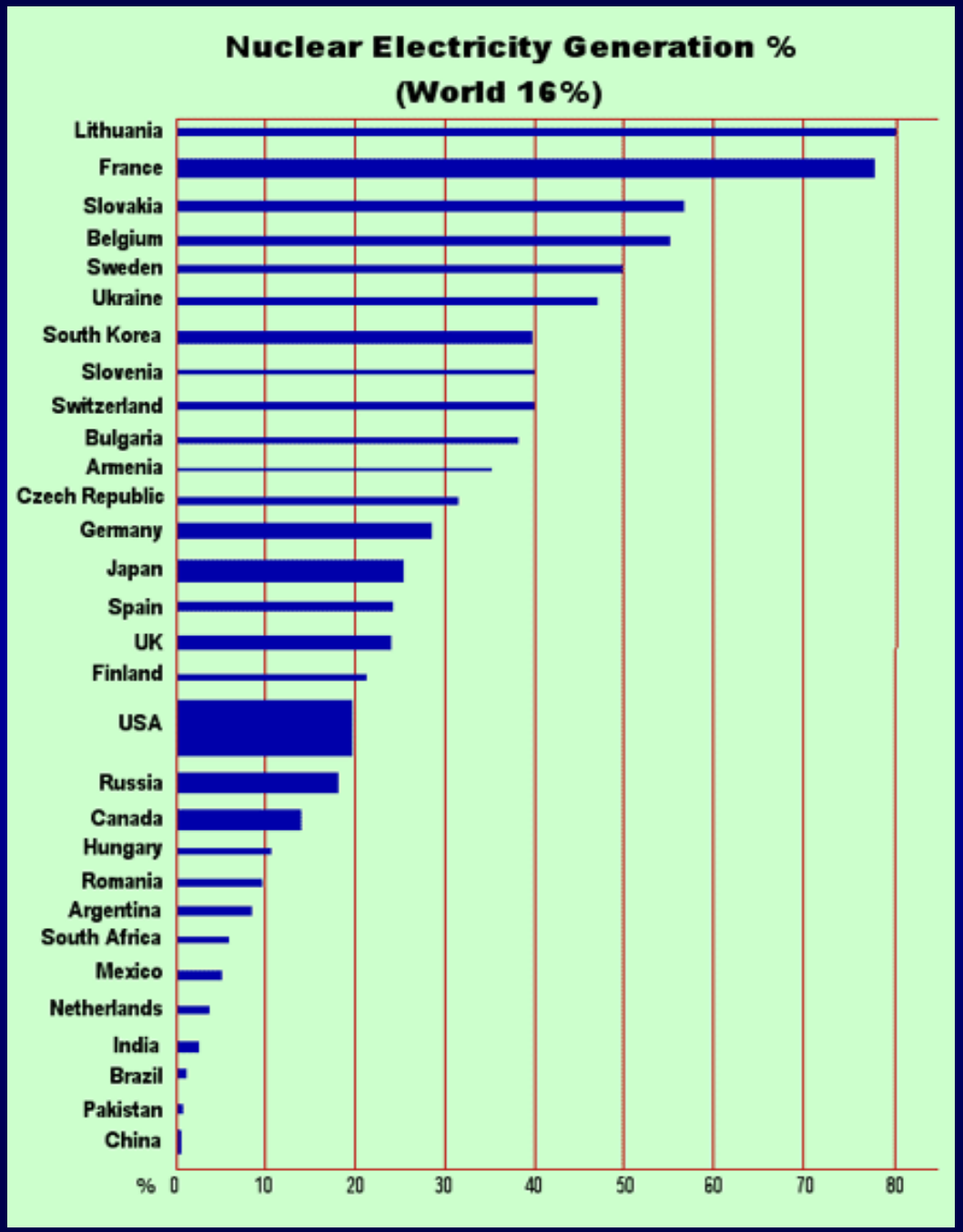
Research – In-situ Recovery

Oil Shale Challenges

- Greenhouse Gas Emissions
- Surface Disturbance
- Uncertain Economics
  - Huge Capital Costs
  - Large Natural Gas Needs
  - Upgrading Costs

Nuclear Power

Nuclear Power in the U.S.



Nuclear Power in the World

Nuclear Energy Challenges

- Perception of Safety Issues
- Radioactive Waste Disposal
- Environmental – water usage

Bottom Line on Alternatives

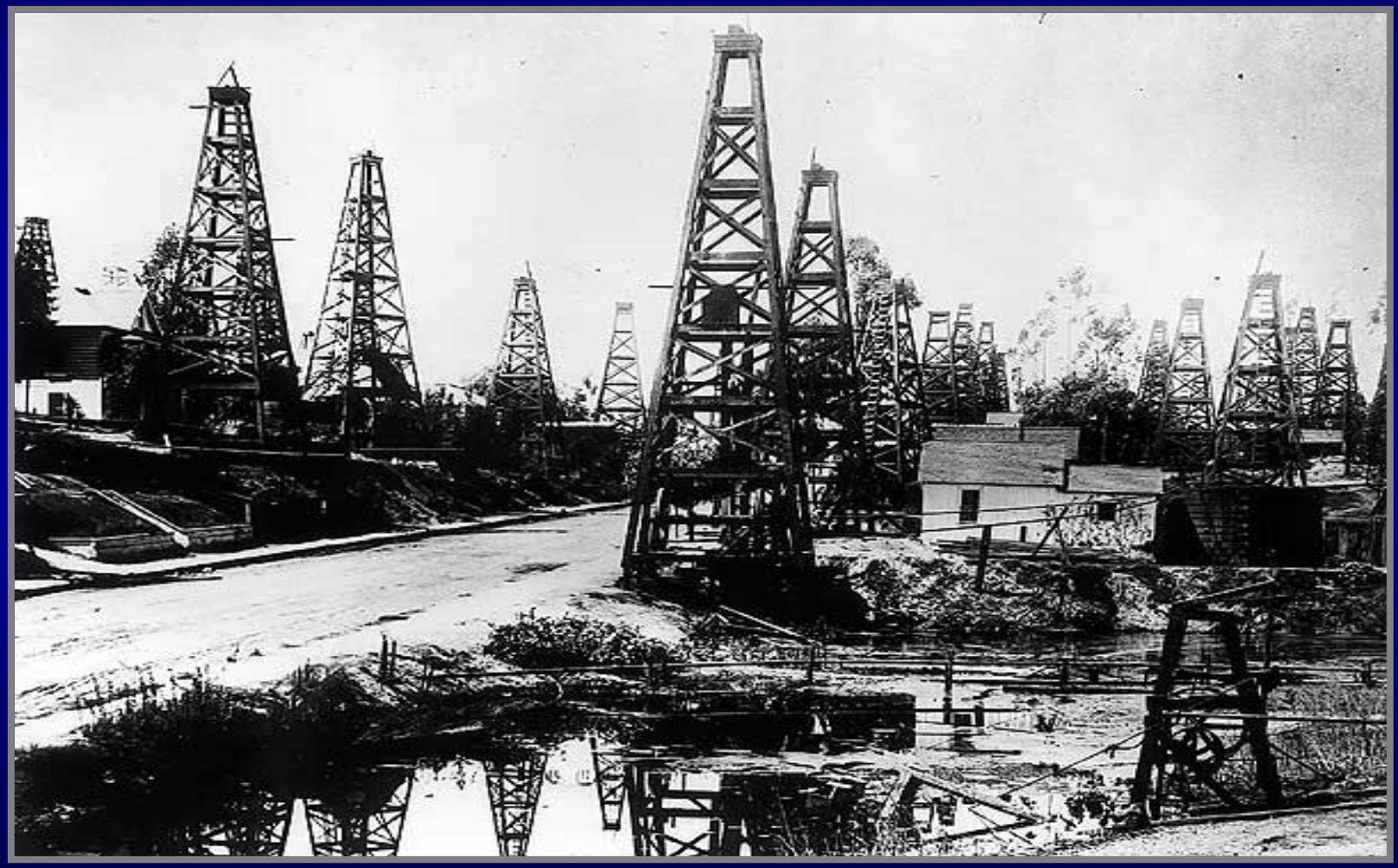
- Renewables – important to continue research, but small near-term impact
- Non-Renewables – huge potential to be game changing source of energy

Home of Those Responsible for Solving our Nation's Problems

545 Leaders for 300 million people

U.S. Energy Policy – True Chaos

The Past – Easy and Cheap

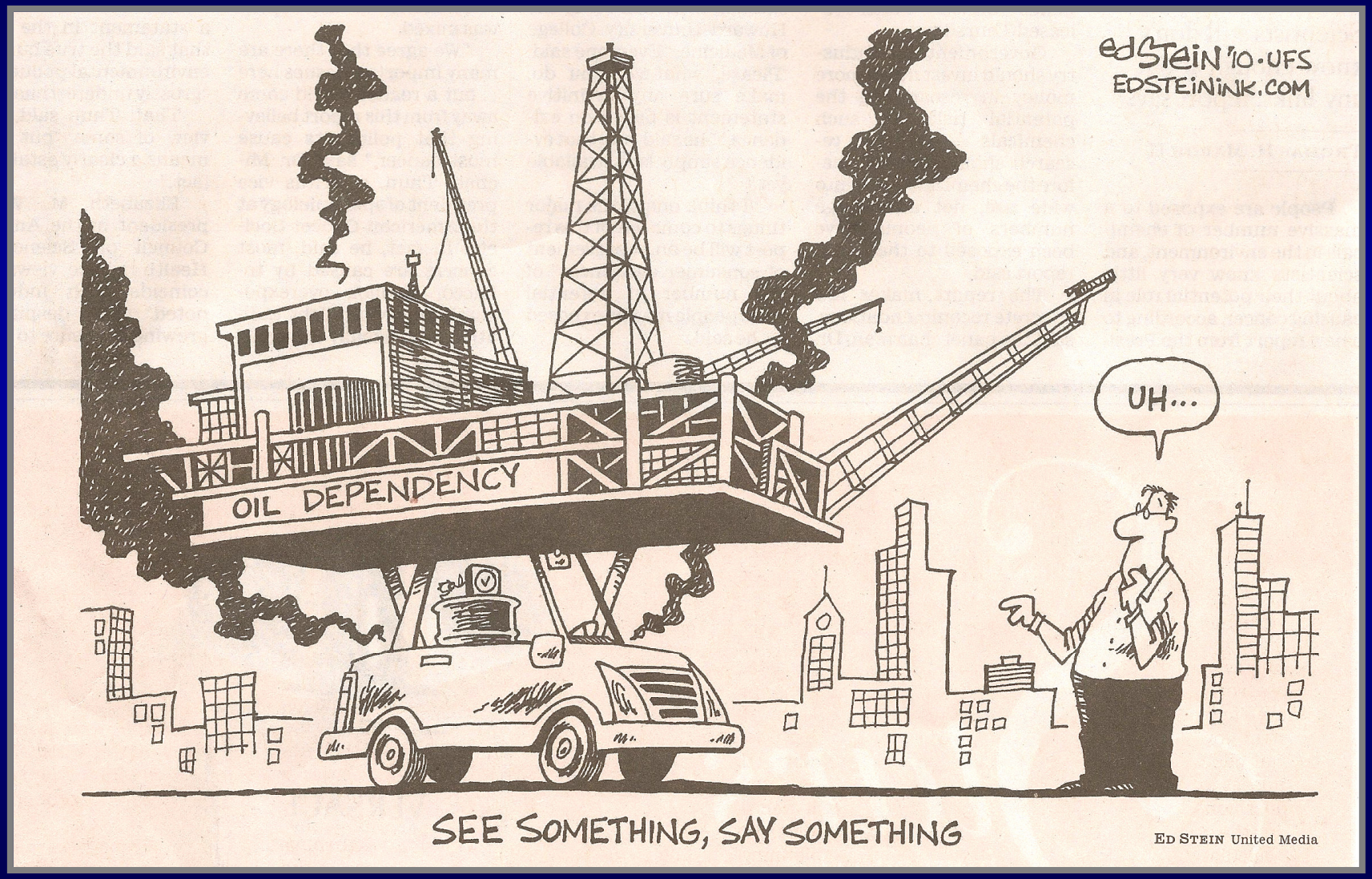


Today – The Search is Challenging

(and much more expensive!)

Who is Really Responsible for This Tragedy?

"We have found the enemy and he are us" Pogo

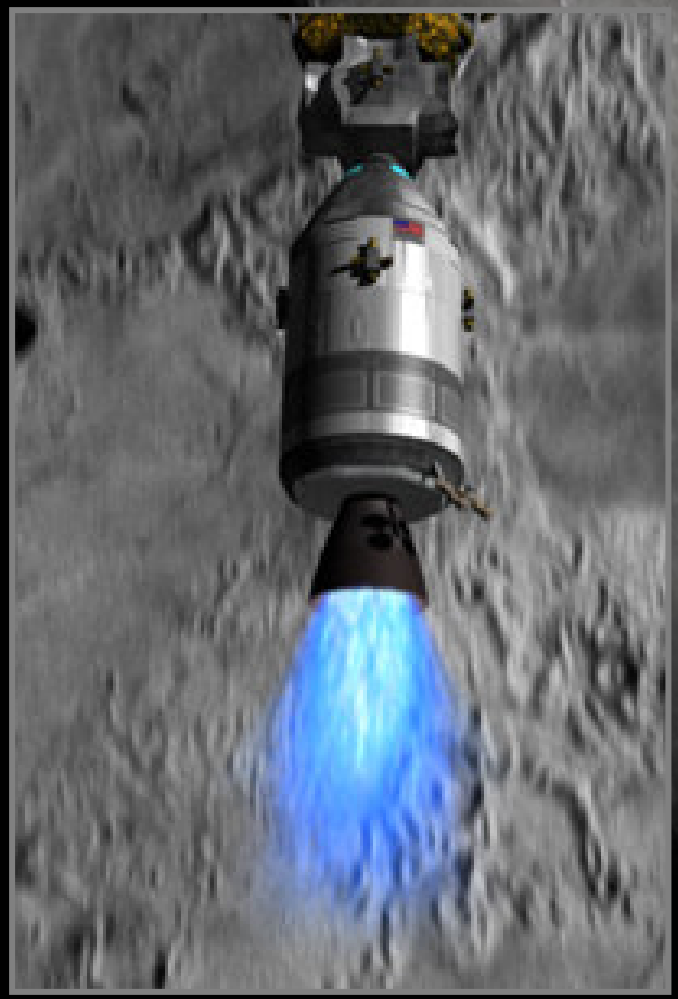


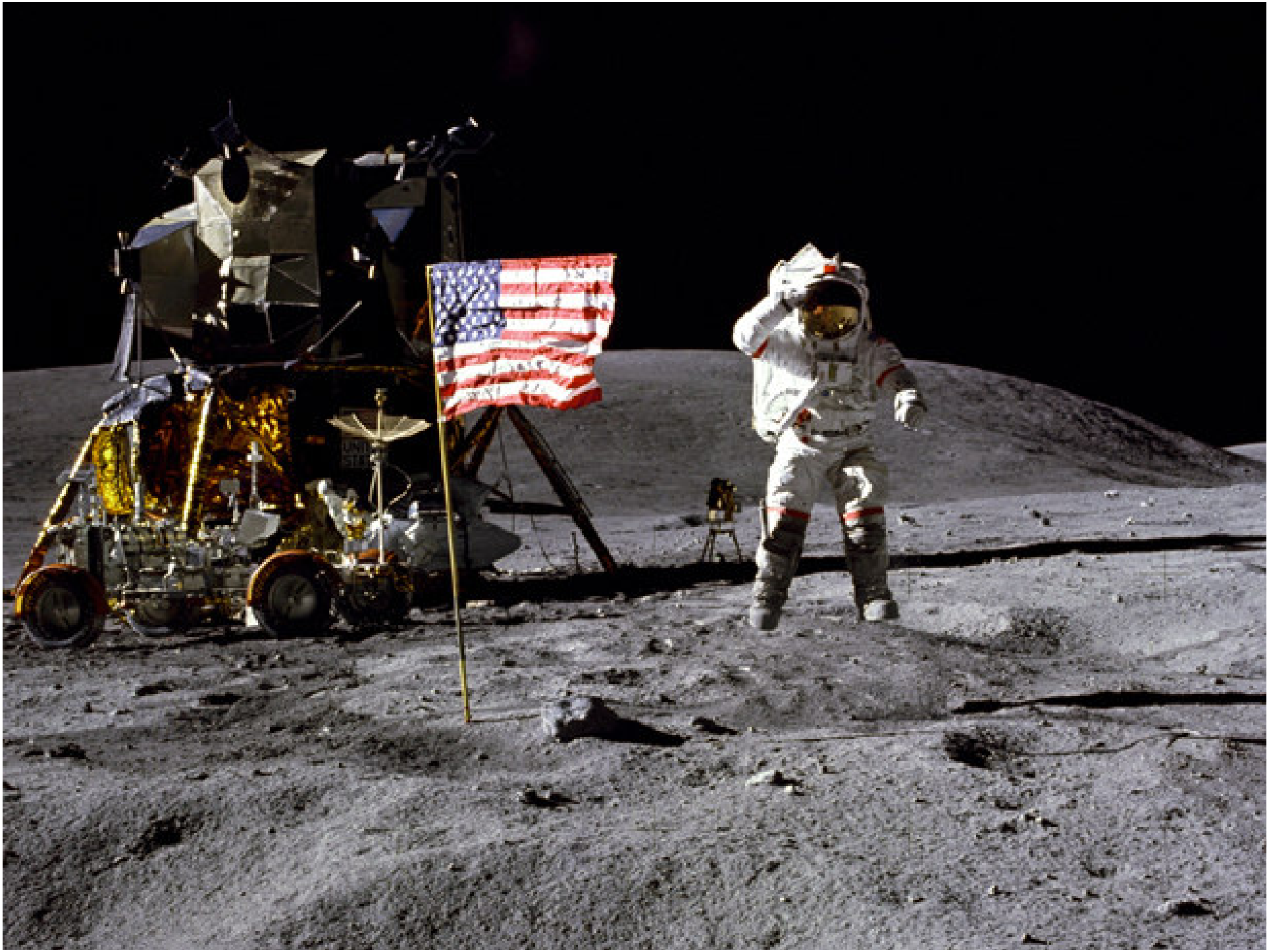
L.A. Times Op Ed – May 6, 2010

Our Future Challenge

- Energy Independence for the U.S.
- Current Consensus – Not Possible
- Why isn't it possible?

Challenges in the Past





Kilpatrick Energy Group