Energy Futures

Here and worldwide

Guilford High School and JustGoods

1 KW Solar

3 K W Vertical axis wind

GLOBAL WARMING CALL TO ACTION

"WE ARE IN IMMINENT PERIL. WE HAVE AT MOST 10 YEARS – NOT 10 YEARS TO DECIDE UPON ACTION, BUT 10 YEARS TO ALTER FUNDAMENTALLY THE TRAJECTORY OF GLOBAL GREENHOUSE EMISSIONS AND TAKE SIGNIFICANT ACTIONS TO REDUCE THEM. IF NOT WE WILL HIT A CRITICAL TIPPING POINT AFTER WHICH IT BECOMES IMPRACTICAL TO MAKE FURTHER CHANGES. WE ARE THAN LOCKED INTO DISASTROUS EFFECTS INCLUDING MAJOR COASTAL FLOODING AND DROUGHTS."

JIM HANSEN – NASA's CHIEF CLIMATE CHANGE SCIENTIST

GLOBAL WARMING CALL TO ACTION

“IF THERE IS NO ACTION TO REVERSE THE GROWTH OF GREENHOUSE GAS EMISSIONS BEFORE 2012, THAT’S TOO LATE. WHAT WE DO IN THE NEXT TWO TO THREE YEARS WILL DETERMINE OUR FUTURE.”

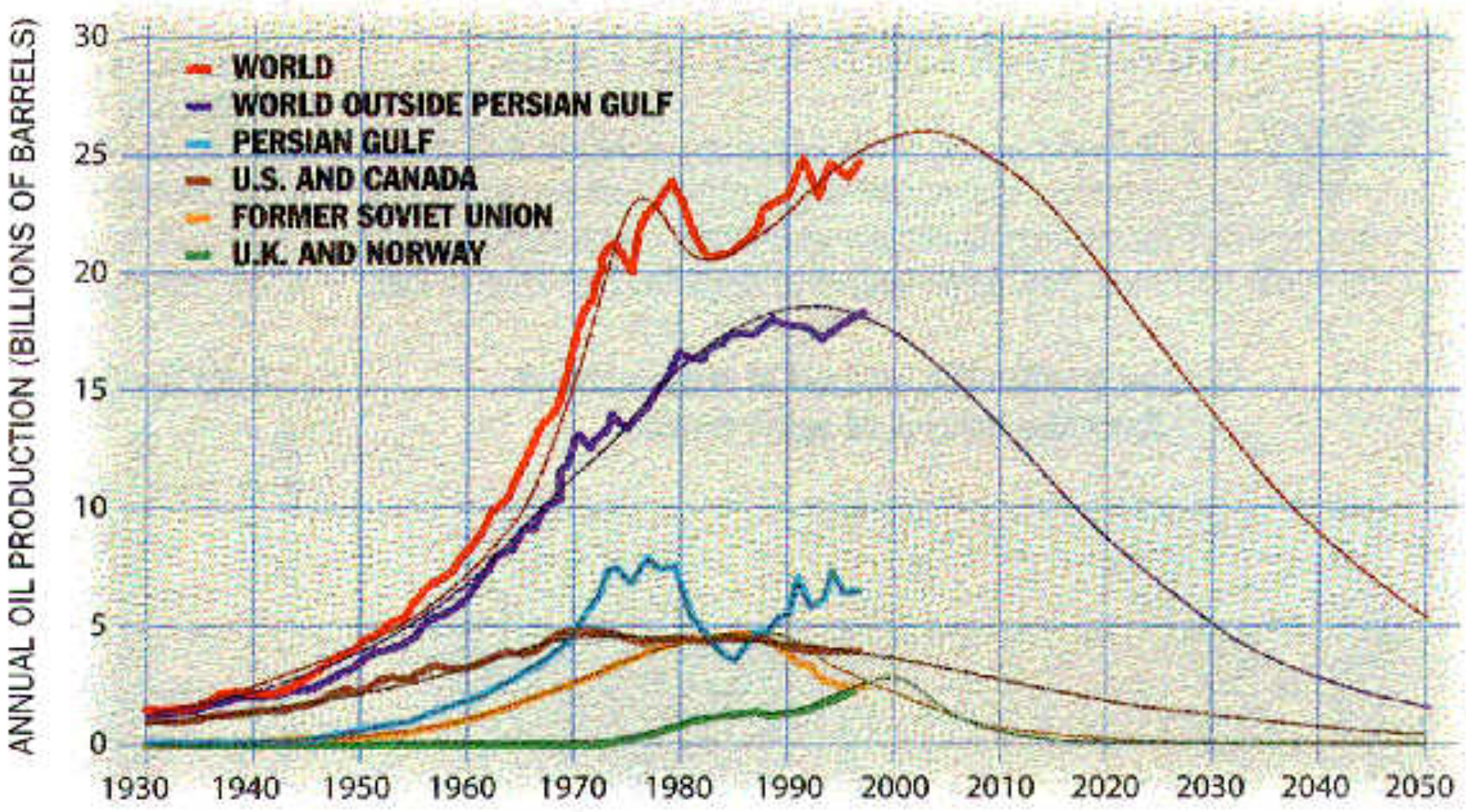
RAJENDRA PACHAURI

CLIMATE SCIENTIST, HEAD OF U.N. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (CO-NOBEL PEACE PRICE WINNER)

GLOBAL WARMING REDUCTION STRATEGIES AND TIME HORIZONS

1. **LEGISLATION – 5 TO 10 YEARS**
2. **SCALING UP NEW TECHNOLOGIES – 10 YEARS PLUS**
3. **SCALING UP RENEWAL ENERGY – 10 YEARS PLUS**
4. **CONSERVATION – AVAILABLE NOW**

Projected World Peak Production



US Energy usage for 2008

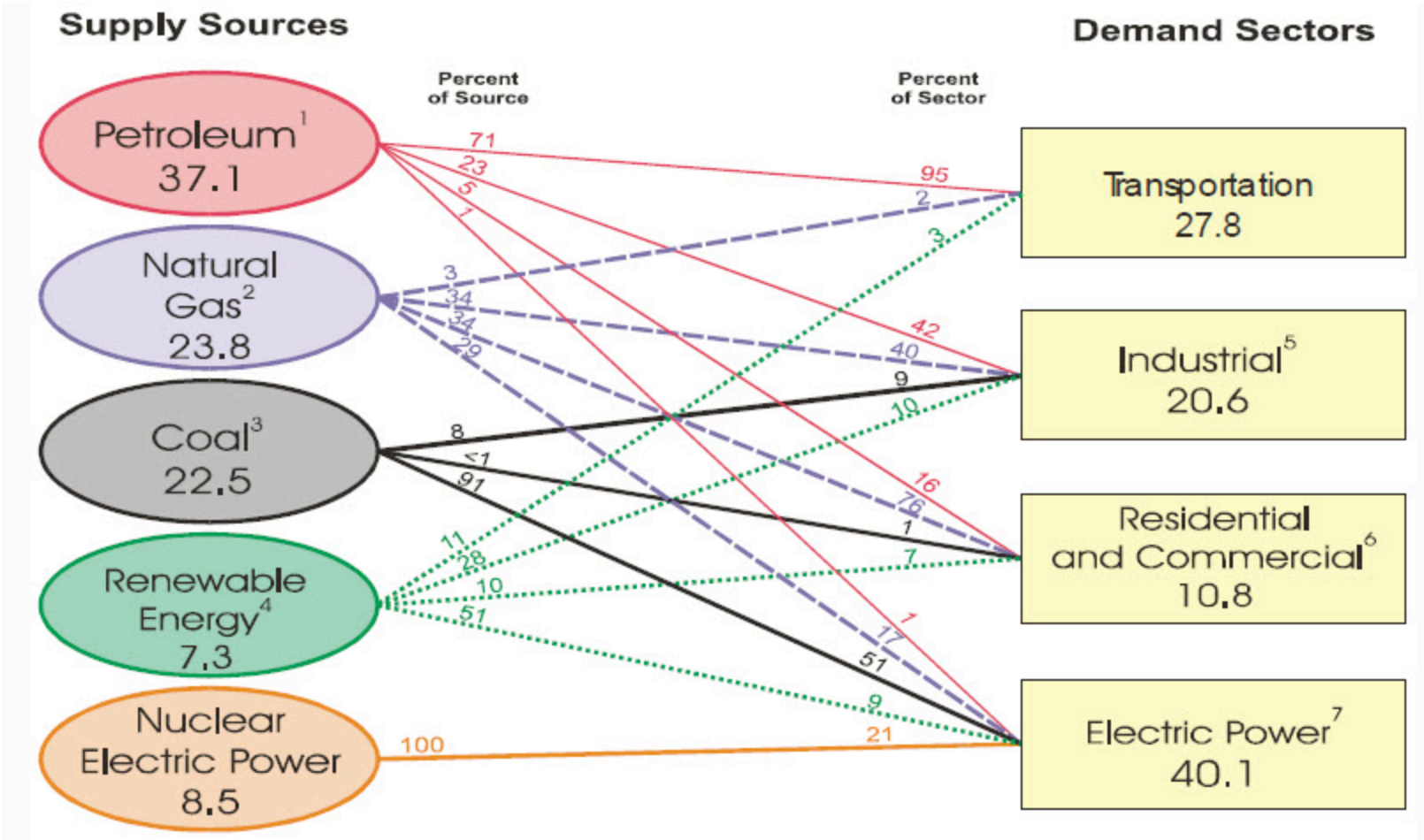
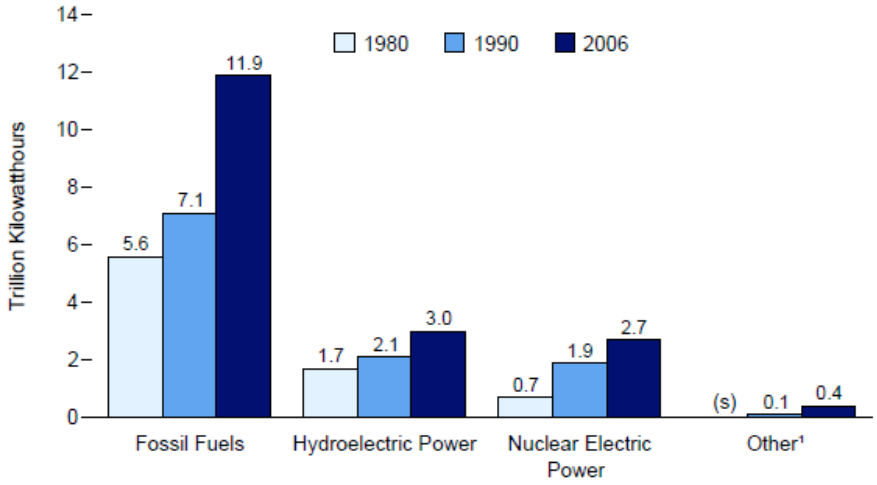
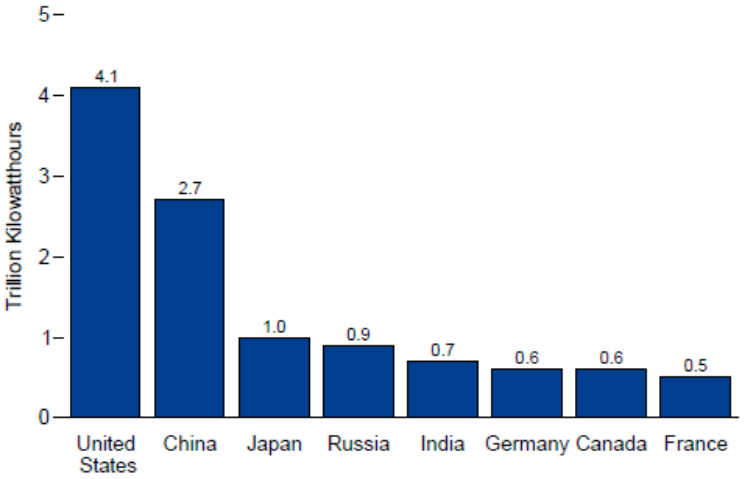


Figure 11.16 World Net Generation of Electricity

Net Generation by Type, 1980, 1990, and 2006

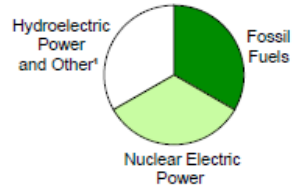


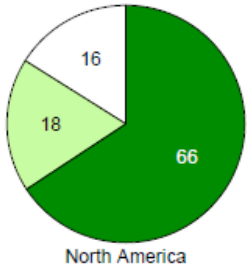
Top Net Generating Countries, 2006

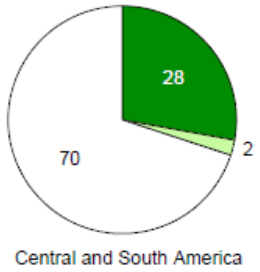


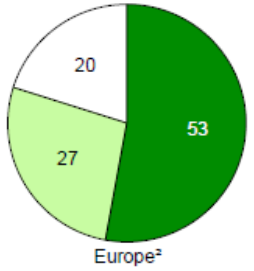
Net Generation by Type by Region, 2006

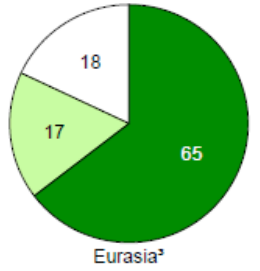
(Percent of Regional Total)

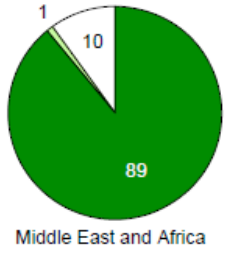


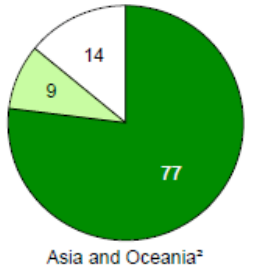










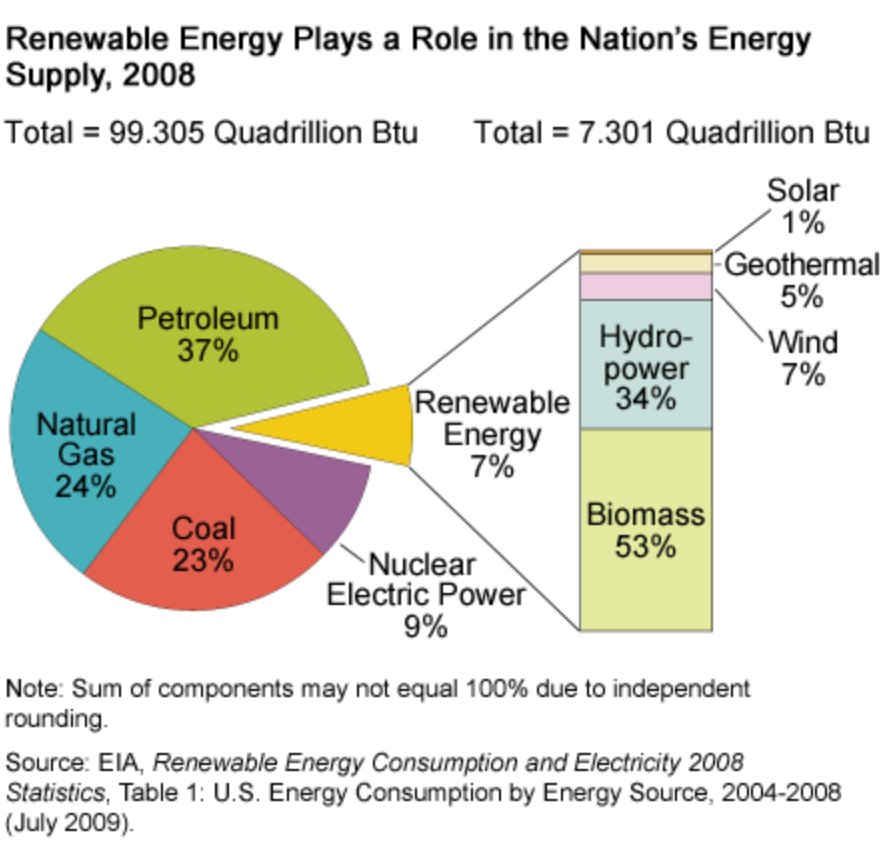


¹ Wood, waste, geothermal, solar, wind, batteries, chemicals, hydrogen, pitch, purchased steam, sulfur, and miscellaneous technologies.
² Excludes countries that were part of the former U.S.S.R. See "U.S.S.R." in Glossary.
³ Includes countries that were part of the former U.S.S.R. See "U.S.S.R." in Glossary.
(s)=Less than 0.05 trillion kilowatthours.
Source: Table 11.16.

U.S.Alternative Energy Sources

percentage of total for alternative energy

- Biofuels 53%
- Solar. 1%
- Wind 7 %
- Hydrogen
- Geothermal 5%
- Hydroelectric 34%



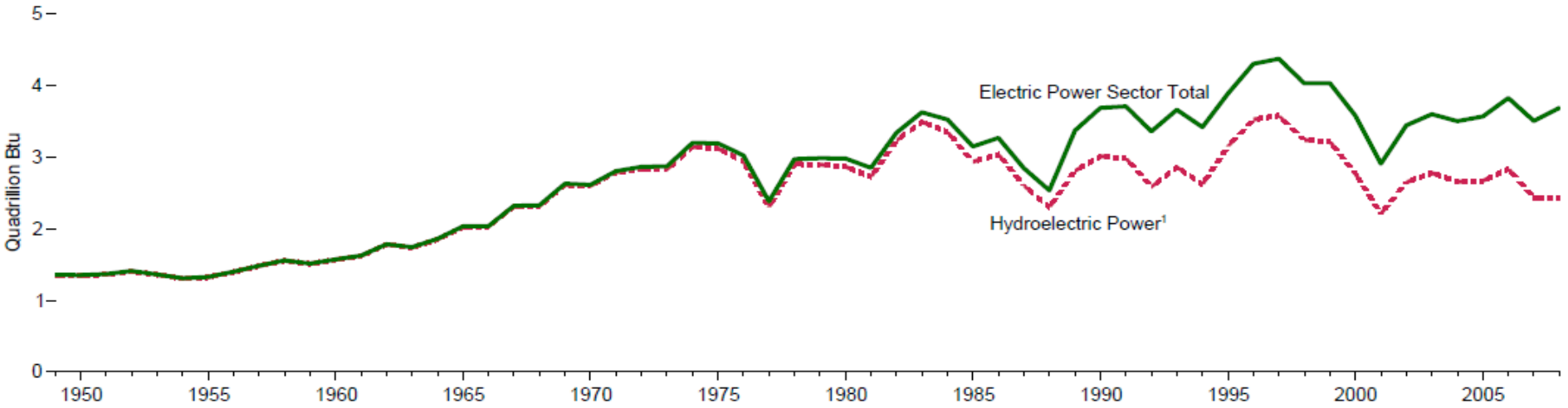
World top 10 renewable electricity producers (TW·h)

Rank	Country	Year	Total	Hydroelectricity[1]	Wind Power[2]	Biomass	Solar[3]	Geothermal[4]	Other sources*
1	China	2008	576.1	563.3	12.8	3.0[5]	0.140[5]		
-	European Union[6]	2007	525.3	310.0	104.3	101.8	3.8	5.8	
2	Brazil	2008	385.8 [7]	371.5	0.6	14.3			
3	United States	2008 [8]	371.6	248.0	52.0	55.8	0.843	14.8	
4	Canada	2008	369.7	368.2	2.5		0.017		
5	Russia	2008	179.1	174.6	0.007				0.41
6	India	2008	137.1	122.4	14.7				
7	Norway[9]	2008	120.5	119.4	0.673	0.2[10]			
8	Japan	2008	95.0	86.3	1.754		0.002	3.027	
9	Venezuela	2008	83.9	83.9					
10	Germany	2008	74.1	20.0	30.7	21.3	3.500[11]		

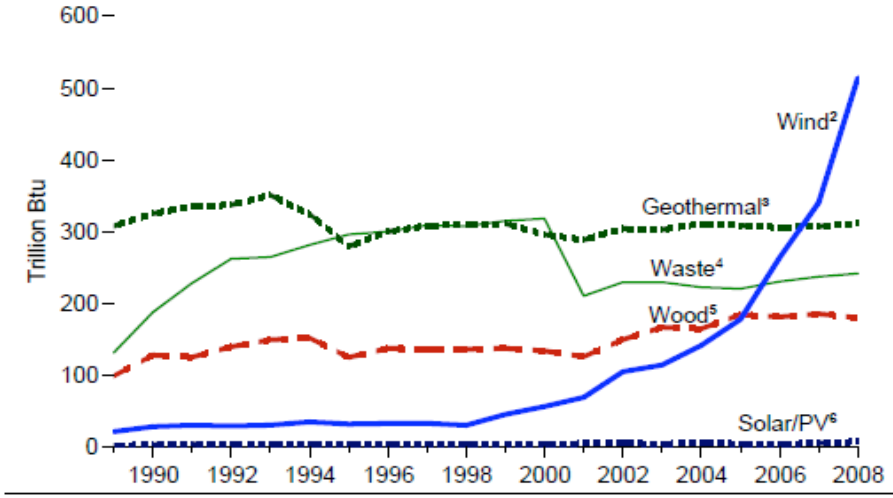
* Other sources include wave energy and waste-to-energy.

Figure 10.2c Renewable Energy Consumption: Electric Power Sector

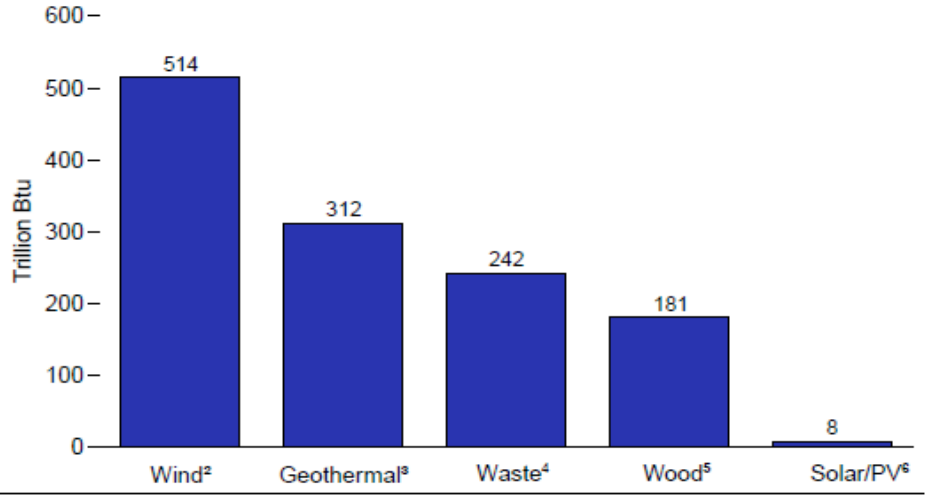
Electric Power Sector Total and Hydroelectric Power, 1949-2008



Non-Hydroelectric Power Sources, 1989-2008

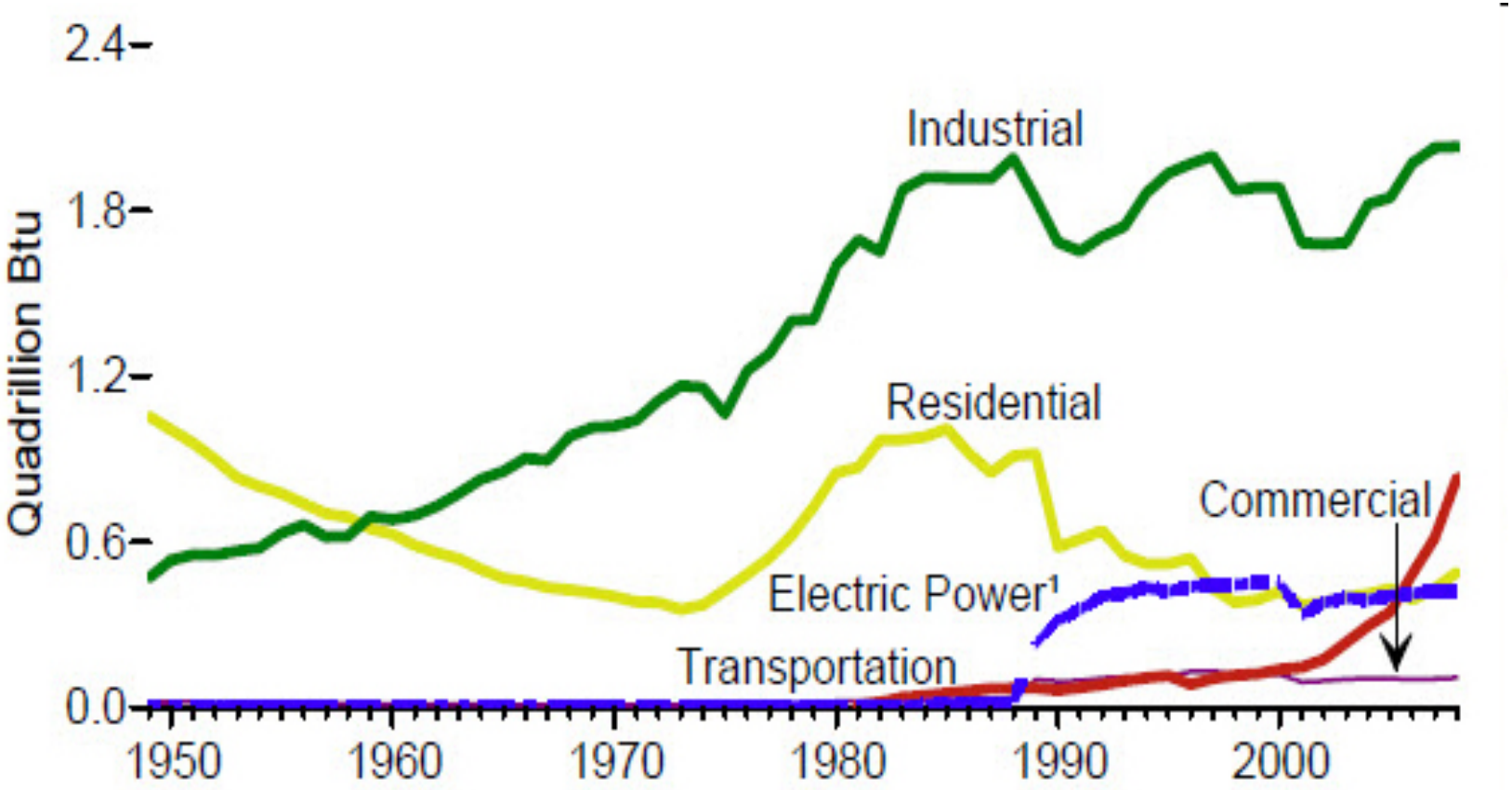


Non-Hydroelectric Power Sources, 2008

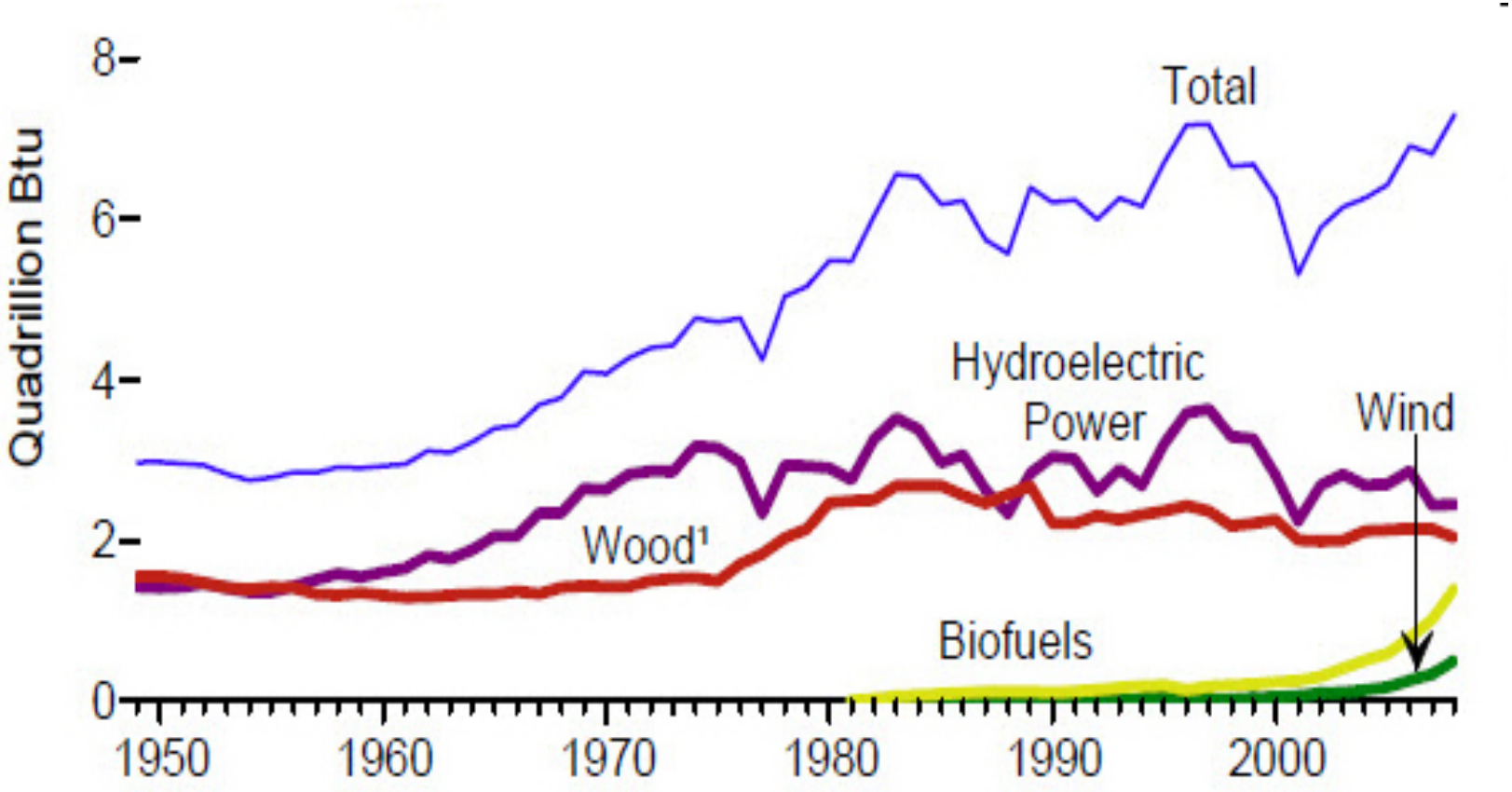


[1] Conventional hydroelectricity net generation.
[2] Wind electricity net generation.
[3] Geothermal electricity net generation.
[4] Municipal solid waste from biogenic sources, landfill gas, sludge waste, agricultural byproducts, and other biomass. Through 2000, also includes non-renewable waste (municipal solid waste from non-biogenic sources, and tire-derived fuels).
[5] Wood and wood-driven fuels.
[6] Solar thermal and photovoltaic electricity net generation.
Note: See related Figures 10.2a and 10.2b on the end-use sectors.
Source: Table 10.2c.

US Energy Use by category



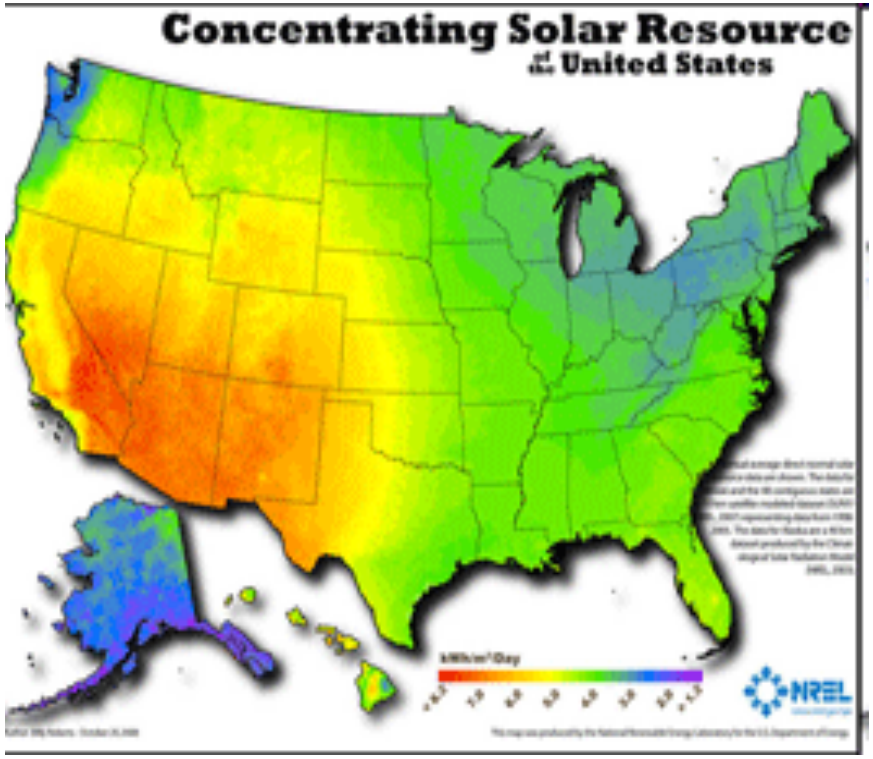
U.S. Renewable Energy by Type



Alternative Energy Review

- Solar
- Wind
- Hydrogen
- Bio-fuels

Solar resources



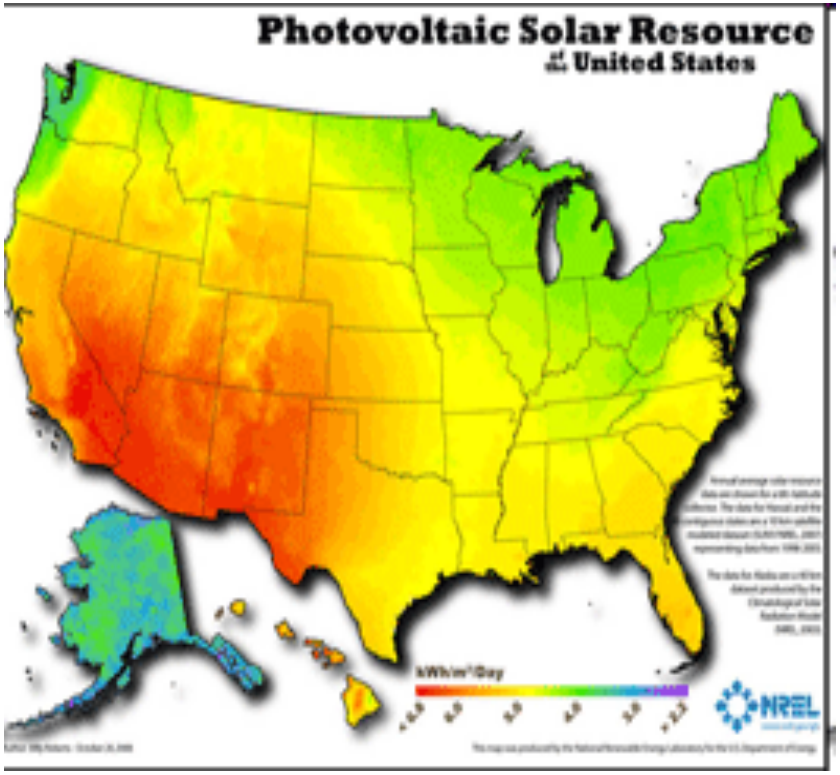
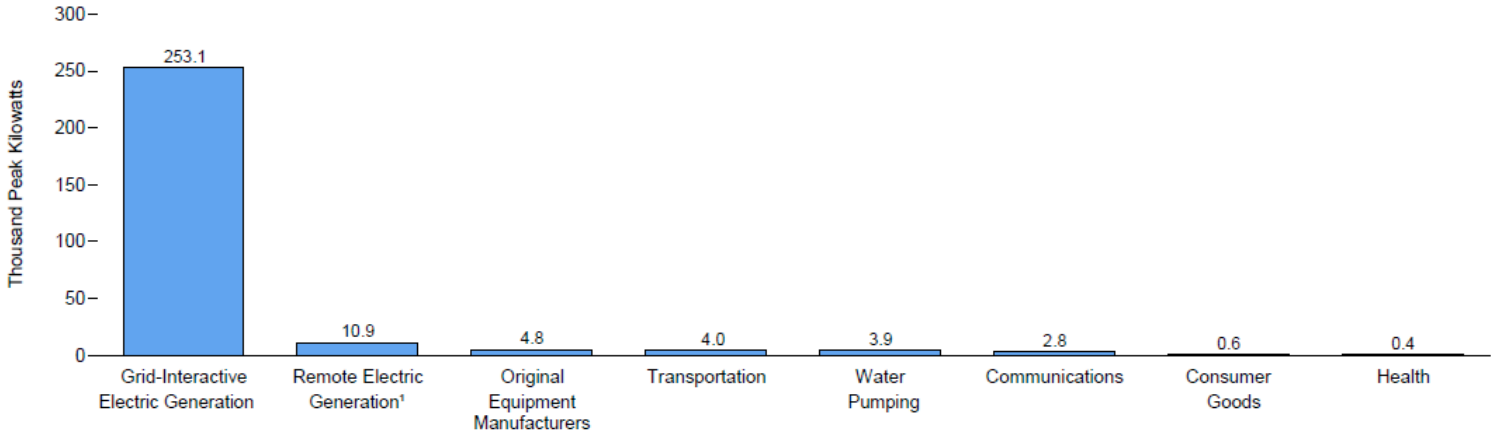
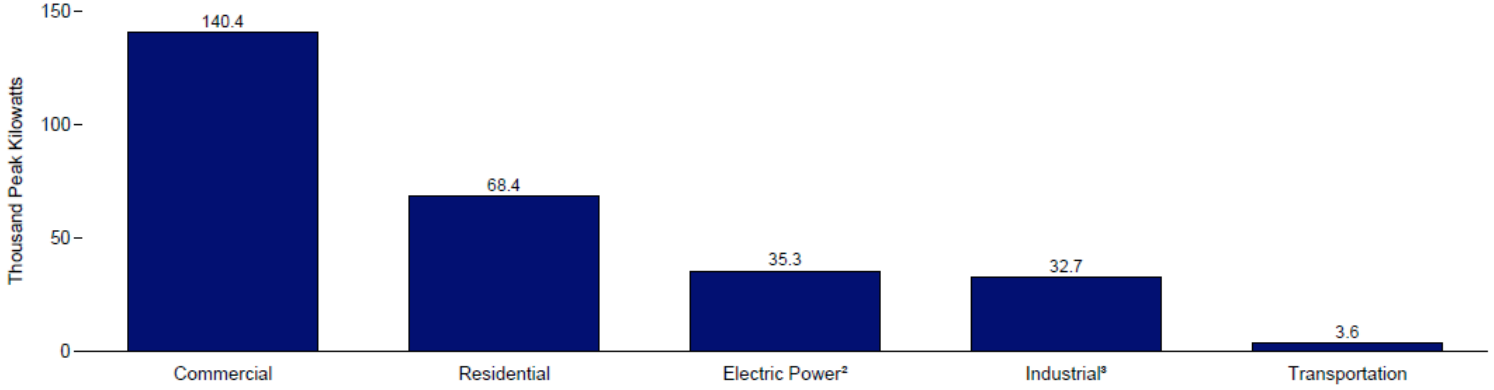


Figure 10.9 Photovoltaic Cell and Module Domestic Shipments by Market Sector and End Use, 2007

By End Use



By Market Sector



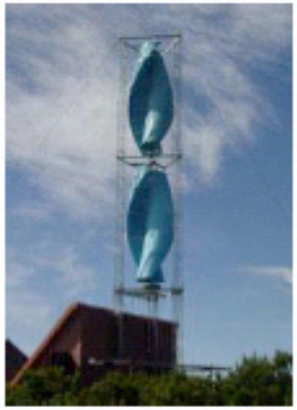
[1] Electricity for general use that does not interact with the electrical distribution system.
[2] Electric utilities and independent power producers.
[3] Industrial sector only; independent power producers are included in "Electric Power."
Source: Table 10.9.

Wind Power

Basic Types

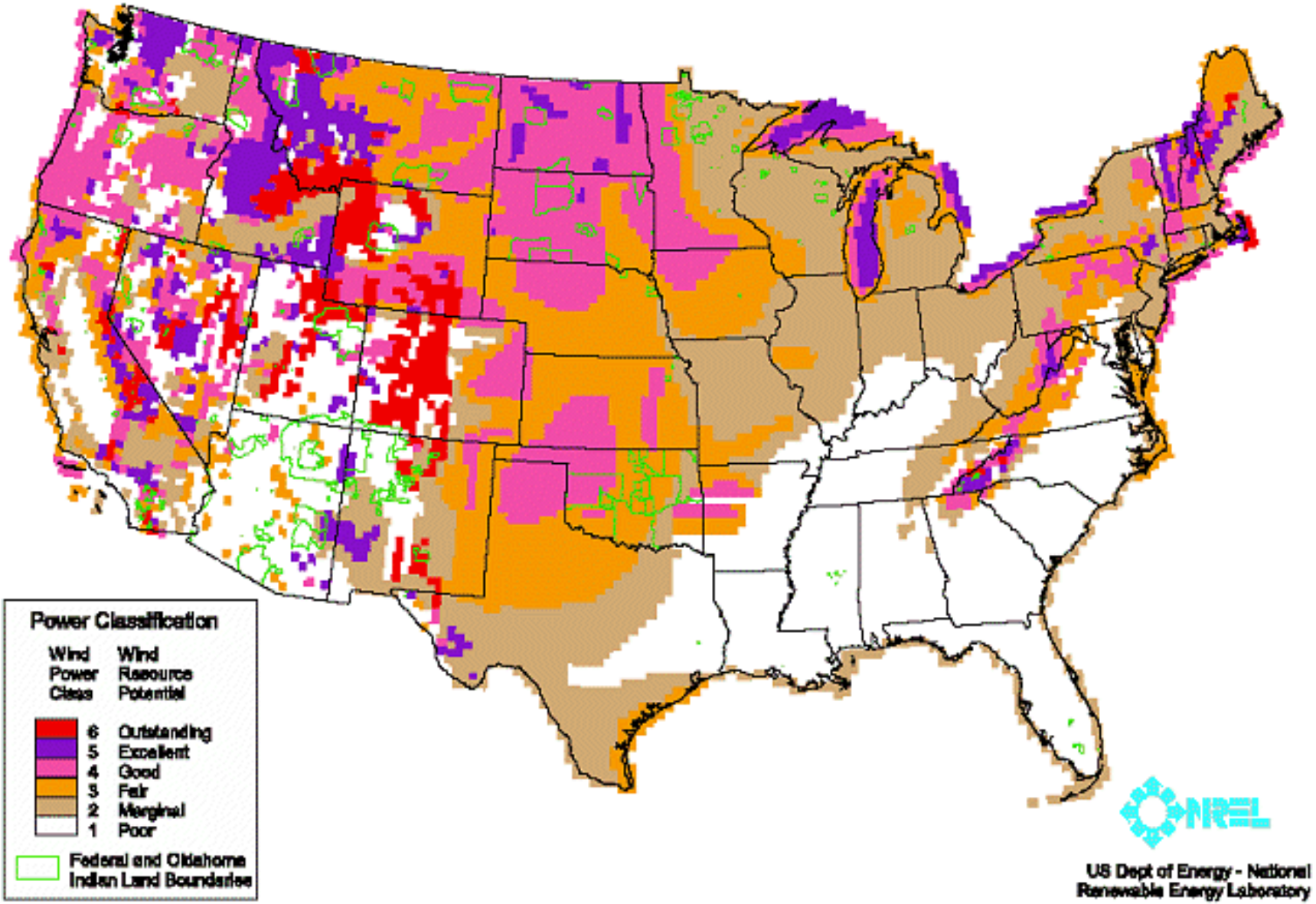
- Horizontal axis most common
- Vertical axis
  - Increasing in popularity, but have lower efficiencies

Darrieus

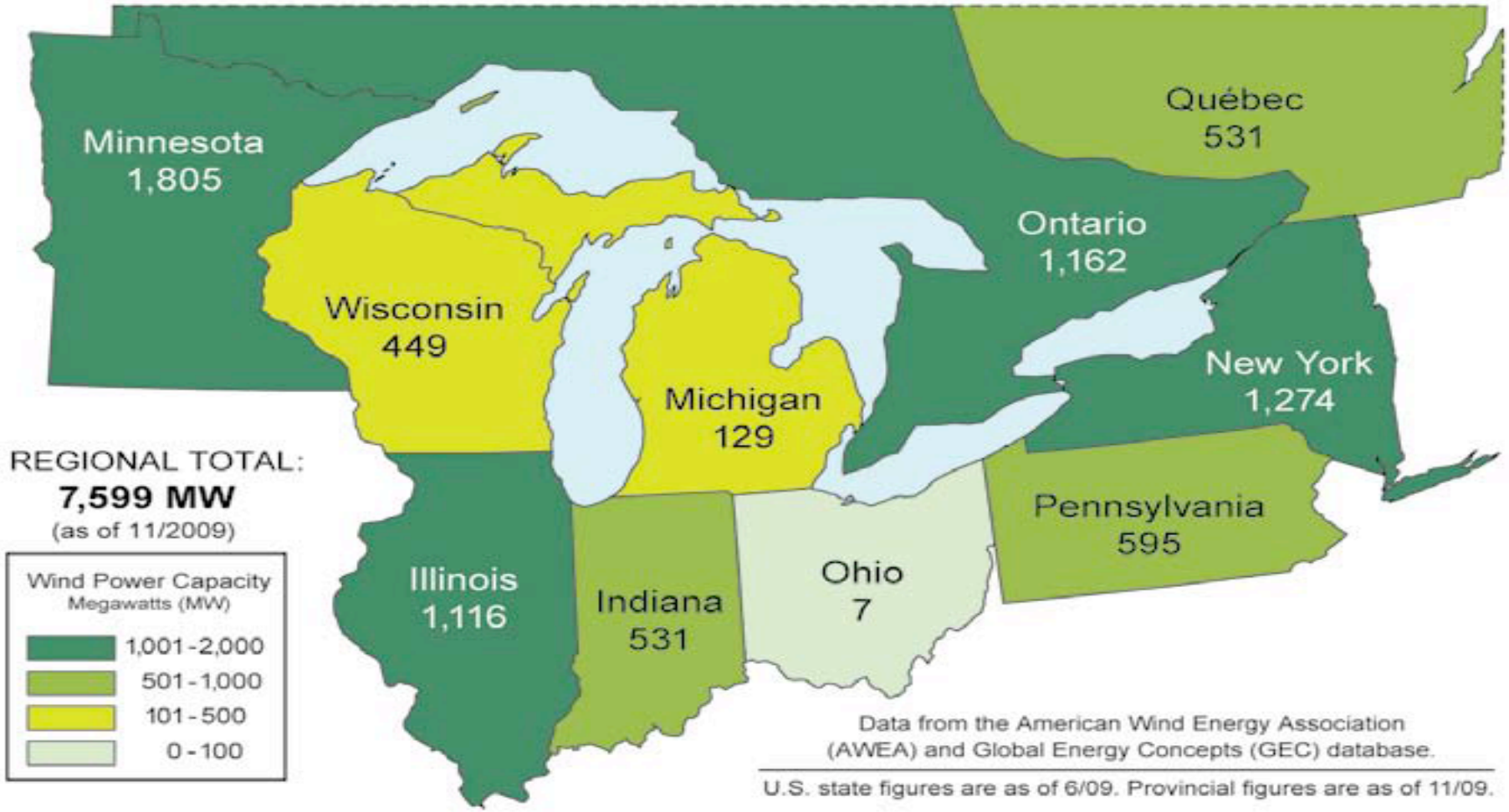


Savonius

Figure 13. Wind Resource Potential



Midwest Wind energy



Hydrogen Power

Challenges

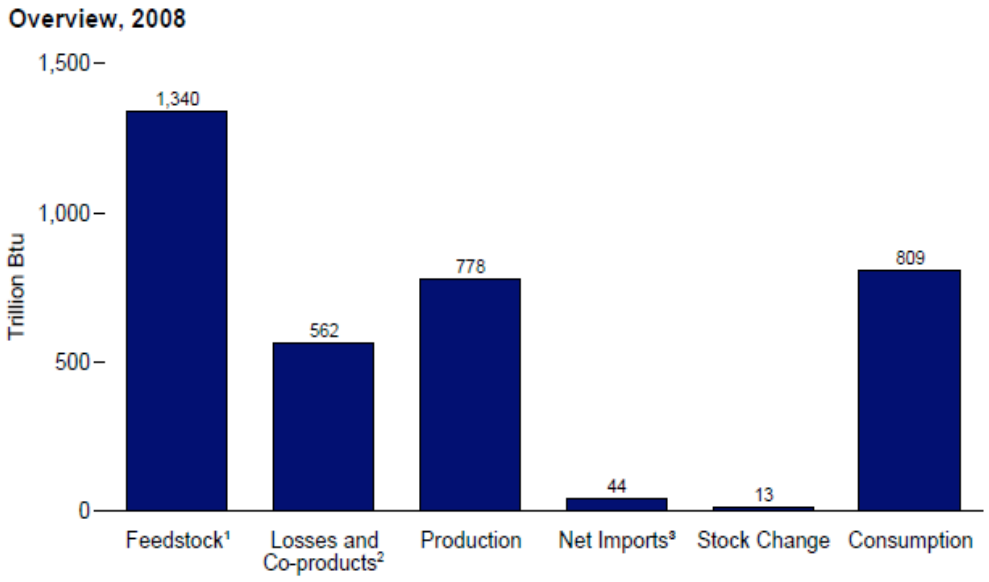
Fuel Cell Cost and Durability. Statistical data for fuel cell vehicles that are operated under controlled, real-world conditions are very limited and often proprietary. Vehicle drivability, operation, and survivability in extreme climates and emissions (hydrogen ICE) have not been proven yet.

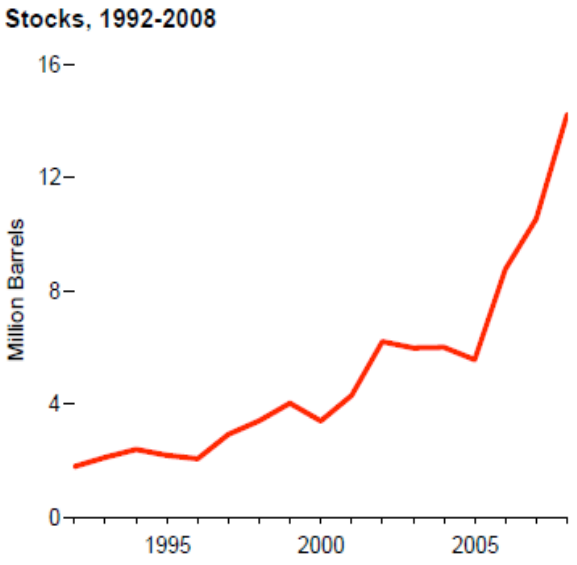
Hydrogen Storage. Statistical cost, durability, fast-fill, discharge performance, and structural integrity data of hydrogen storage systems will be needed to proceed with technology commercialization. Current technology does not provide reasonable cost and volume for transportation or stationary applications.

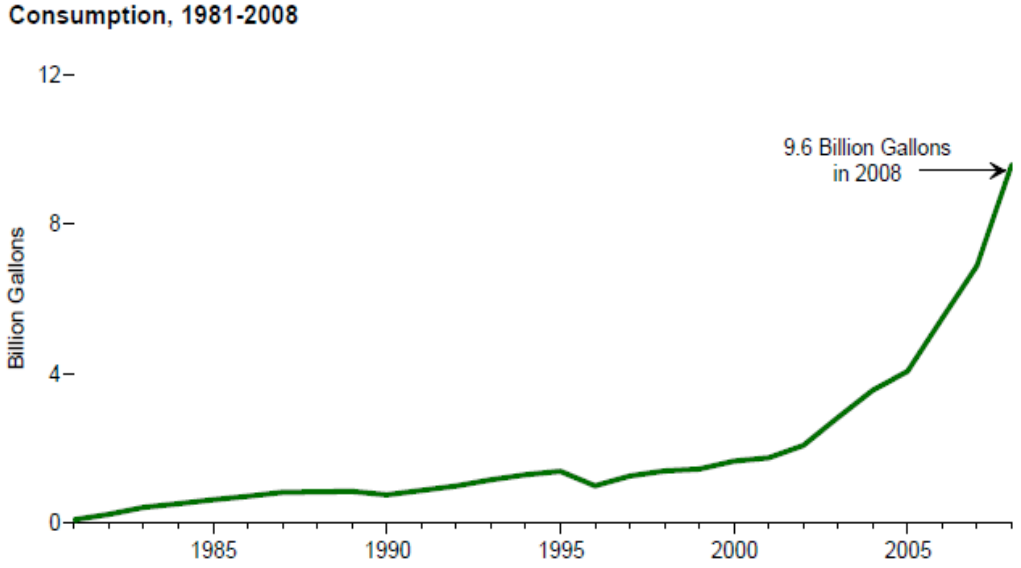
Hydrogen Production and Delivery. The high cost of hydrogen production, low availability of the hydrogen production systems, and the challenge of providing safe production and delivery systems are all early penetration barriers.

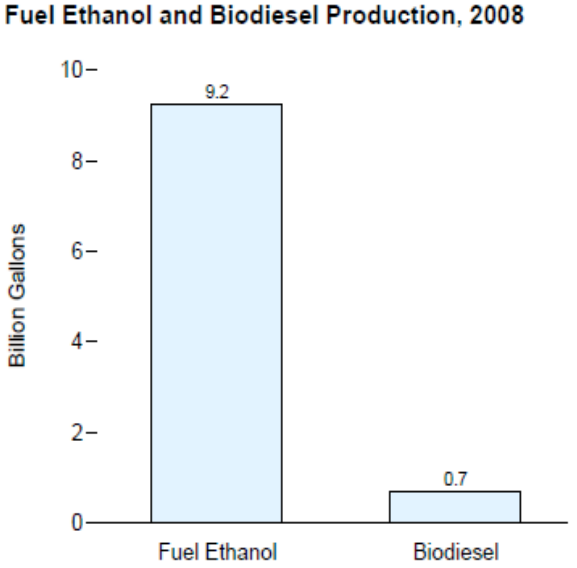
Public Acceptance. The hydrogen economy will be a revolutionary change from the world we know today. Education of the general public, training personnel in the handling and maintenance of hydrogen system components, adoption of codes and standards, and development of certified procedures and training manuals for fuel cells and safety will foster hydrogen's acceptance as a fuel.

Figure 10.3 Fuel Ethanol Overview









[1] Total corn and other biomass inputs to the production of fuel ethanol.
[2] Losses and co-products from the production of fuel ethanol.
[3] Fuel ethanol imports only. Data for fuel ethanol exports are not available.
Sources: Tables 10.3, 10.4, and A3.

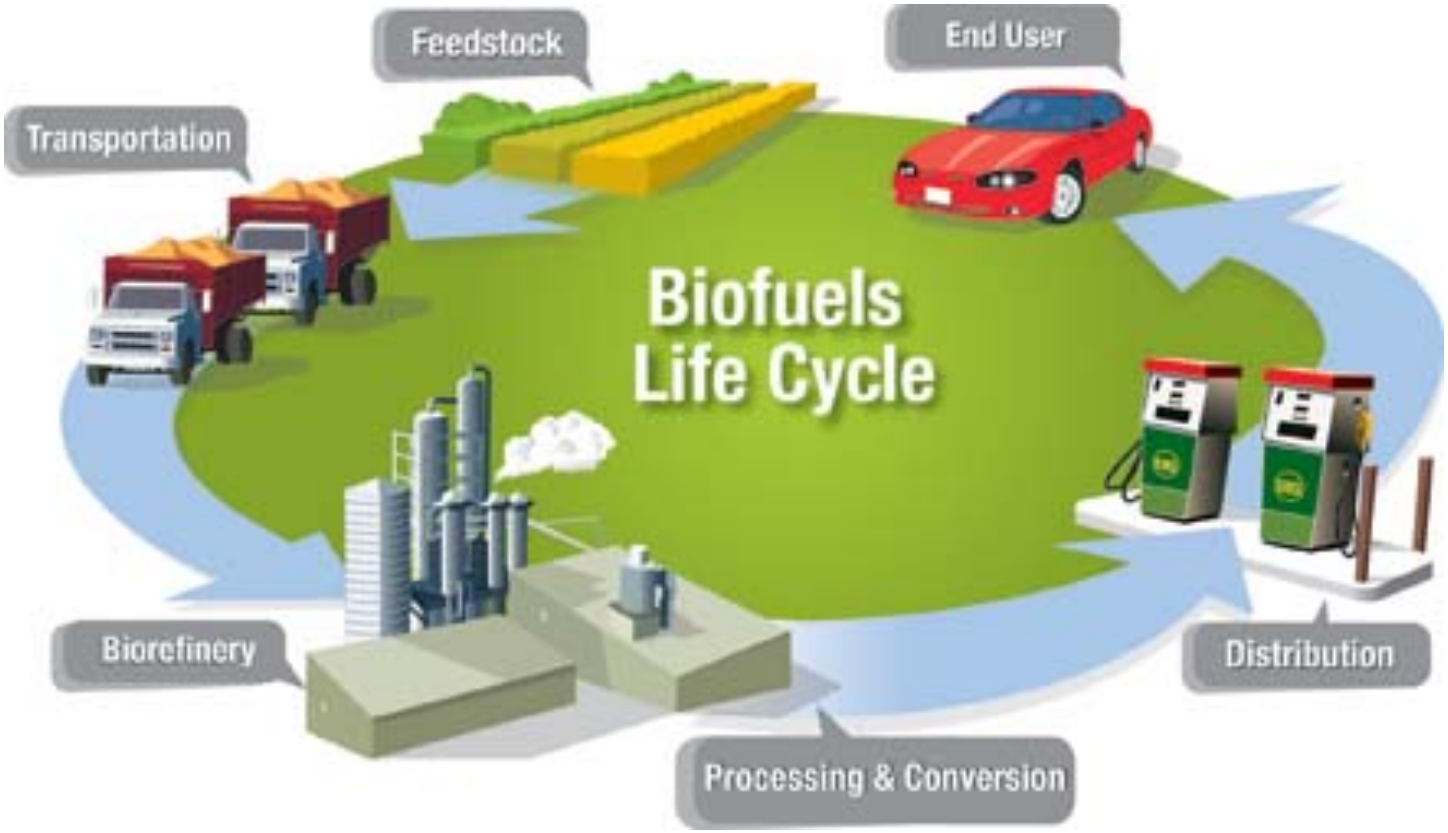
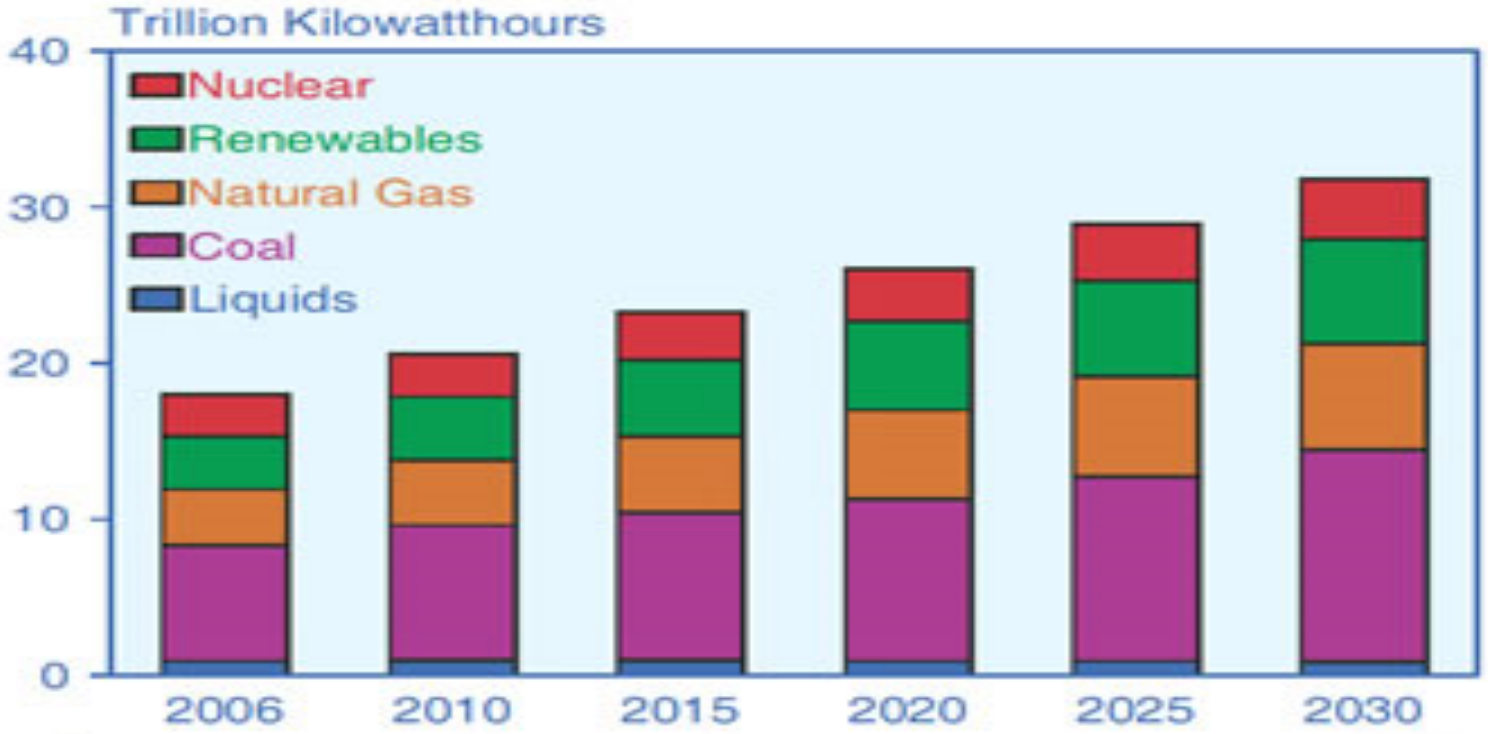

Feedstock
End User
Transportation
Biofuels
Life Cycle
Biorefinery
Distribution
Processing & Conversion

Figure 6. World Electricity Generation by Fuel, 2006-2030

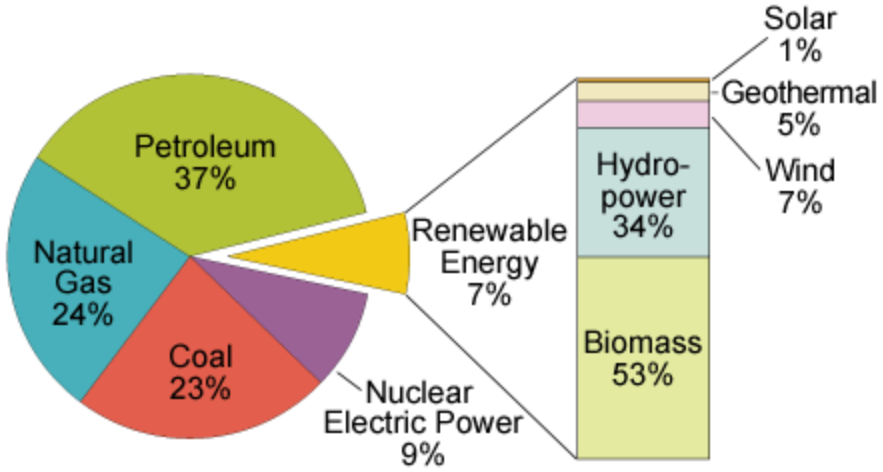


Sources: **2006:** Energy Information Administration (EIA), *International Energy Annual 2006* (June-December 2008), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2009).

By 2020 renewable energy should account for 20% of the EU's final energy consumption (9.2% in 2006).

Renewable Energy Plays a Role in the Nation's Energy Supply, 2008

Total = 99.305 Quadrillion Btu Total = 7.301 Quadrillion Btu



Note: Sum of components may not equal 100% due to independent rounding.

Source: EIA, *Renewable Energy Consumption and Electricity 2008 Statistics*, Table 1: U.S. Energy Consumption by Energy Source, 2004-2008 (July 2009).

The American Recovery Reinvestment Act included more than $80 billion in clean energy investments that will jump-start our economy and build the clean energy jobs of tomorrow:

- **$11 billion for a bigger, better, and smarter grid that will move renewable energy from the rural places it is produced to the cities where it is mostly used, as well as for 40 million smart meters to be deployed in American homes.**

- **$5 billion for low-income home weatherization projects.**

- **$4.5 billion to green federal buildings and cut our energy bill, saving taxpayers billions of dollars.**

- **$6.3 billion for state and local renewable energy and energy efficiency efforts.**

- **$600 million in green job training programs – $100 million to expand line worker training programs and $500 million for green workforce training.**

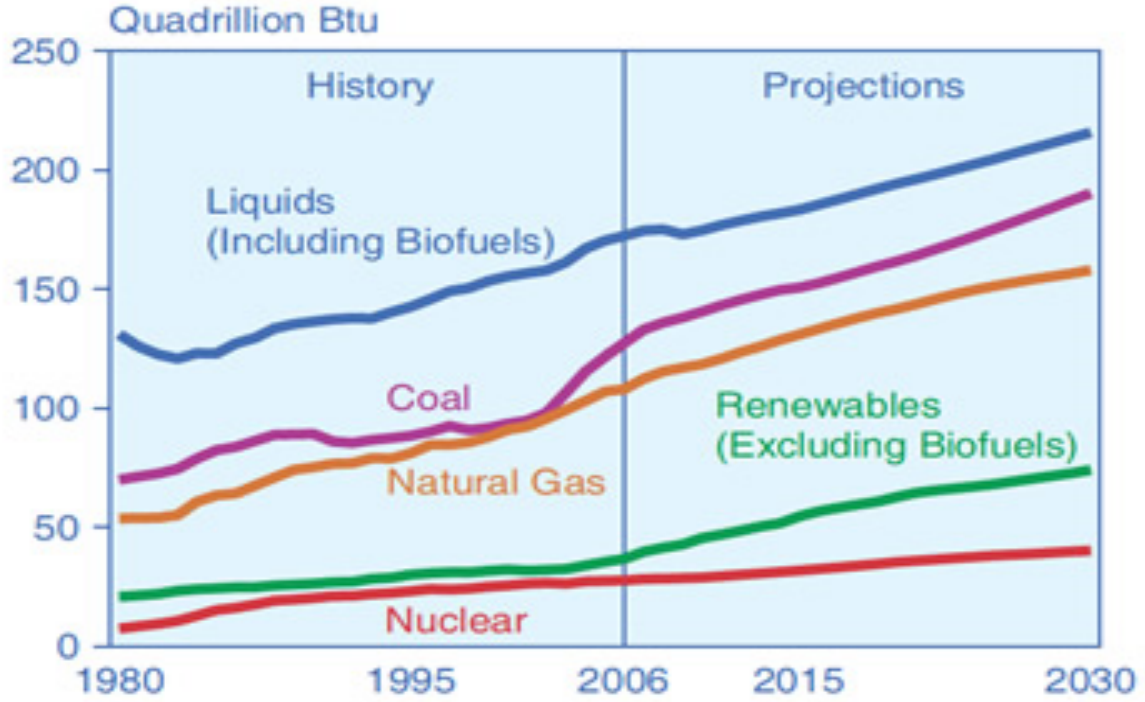
- **$2 billion in competitive grants to develop the next generation of batteries to store energy.**

Recently we have see subsidies for Nuclear power plant construction, opening areas to offshore drilling and exploration, and increased mileage standards for automobiles

Such policy will mean, in the Commission words, "**the EU taking global leadership in catalyzing a new industrial revolution**", defining the following lines of action:

Energy efficiency;
raising the share of renewable energy in the energy mix;
reinforcing solidarity among Member States;
a renewed focus on nuclear safety and security;
determined efforts for the EU to "speak with one voice" with its international partners

Figure 14. World Marketed Energy Use by Fuel Type, 1980-2030



Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2006* (June-December 2008), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2009).

Predictions for 2035

By 2034, according to Black & Veatch, nearly half of U.S. electricity will come from natural gas combustion turbines or combined-cycle units, whereas conventional coal-fired generation will shrink to just 23 percent (although few of the power plants will be shut down). Nuclear will grow to provide nearly 150,000 megawatts of electricity as renewable energy jumps from just 54,000 megawatts today (excluding hydroelectric dams) to more than 165,000 megawatts in 2034. (Scientific American Feb. 2010)

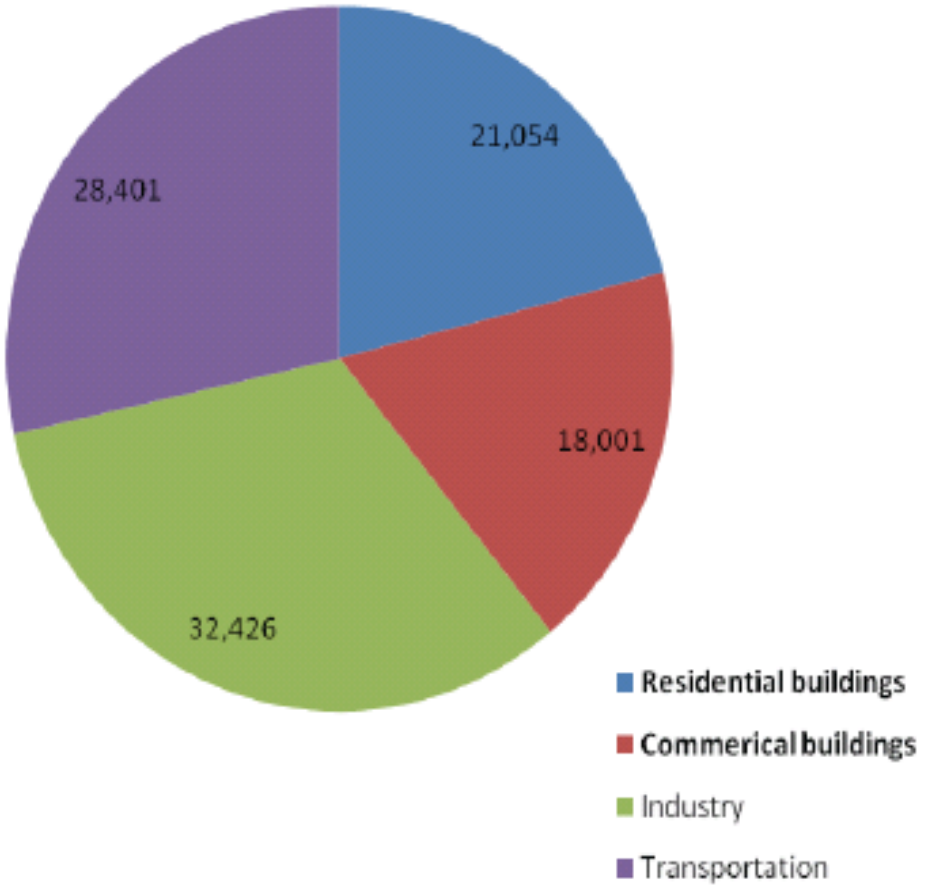
Predictions for 2035 -2

It's primarily wind. That's the lion's share of it. There's a little geothermal in there and a little solar. There's been a lot of advancements in thin-film technology but the balance of [a solar power] plant [all the materials other than the photovoltaic cells themselves] is not getting any cheaper. The [solar] cells are getting cheaper, and it's not at all clear where the bottom for that is.

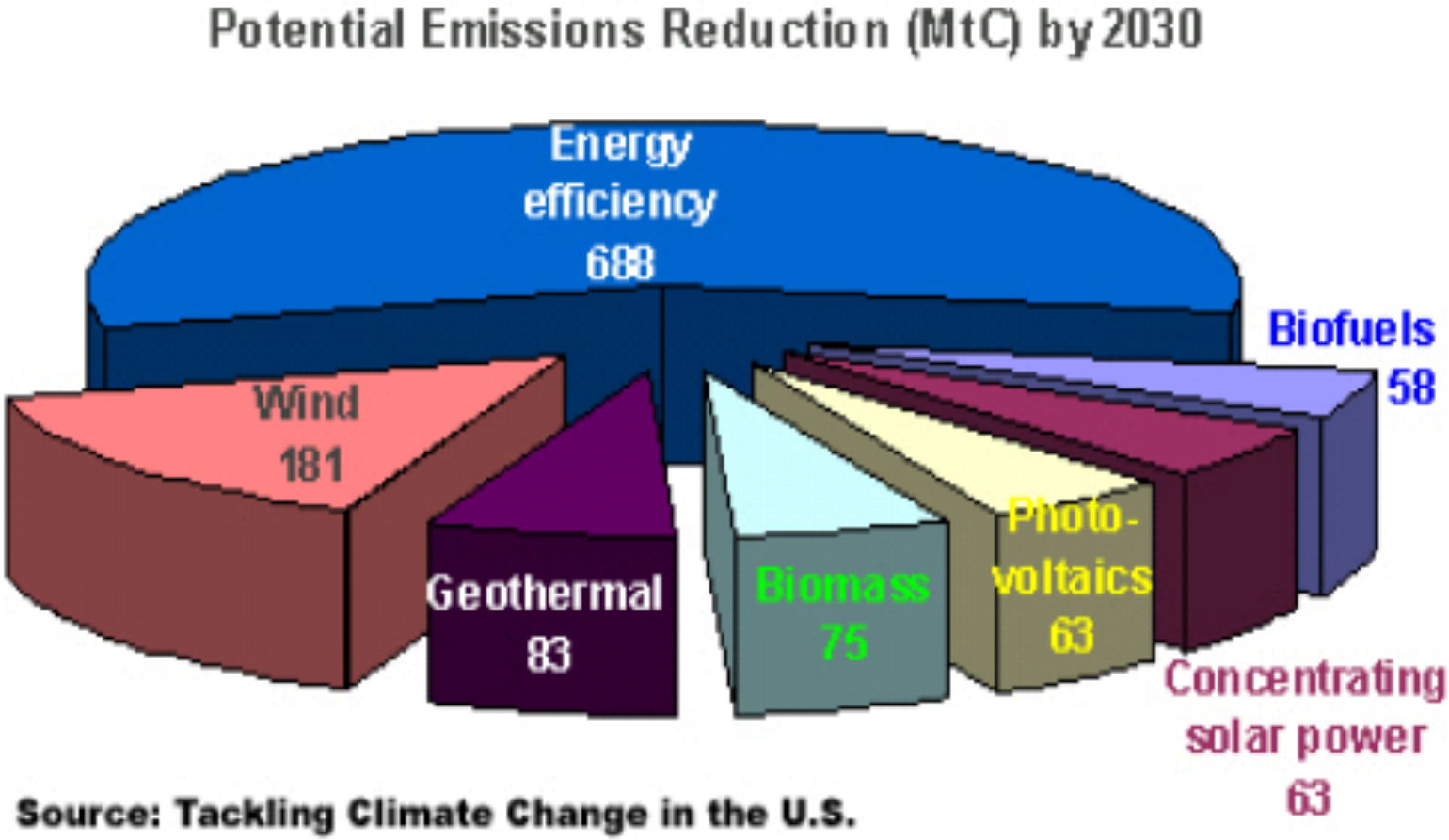
Why focus on efficiency?

- **Reduce Energy Costs + Green House Gas Emissions:**

- America's 101 million households and 4.6 million commercial structures account for two-fifths of U.S. energy consumption and GHG emissions.



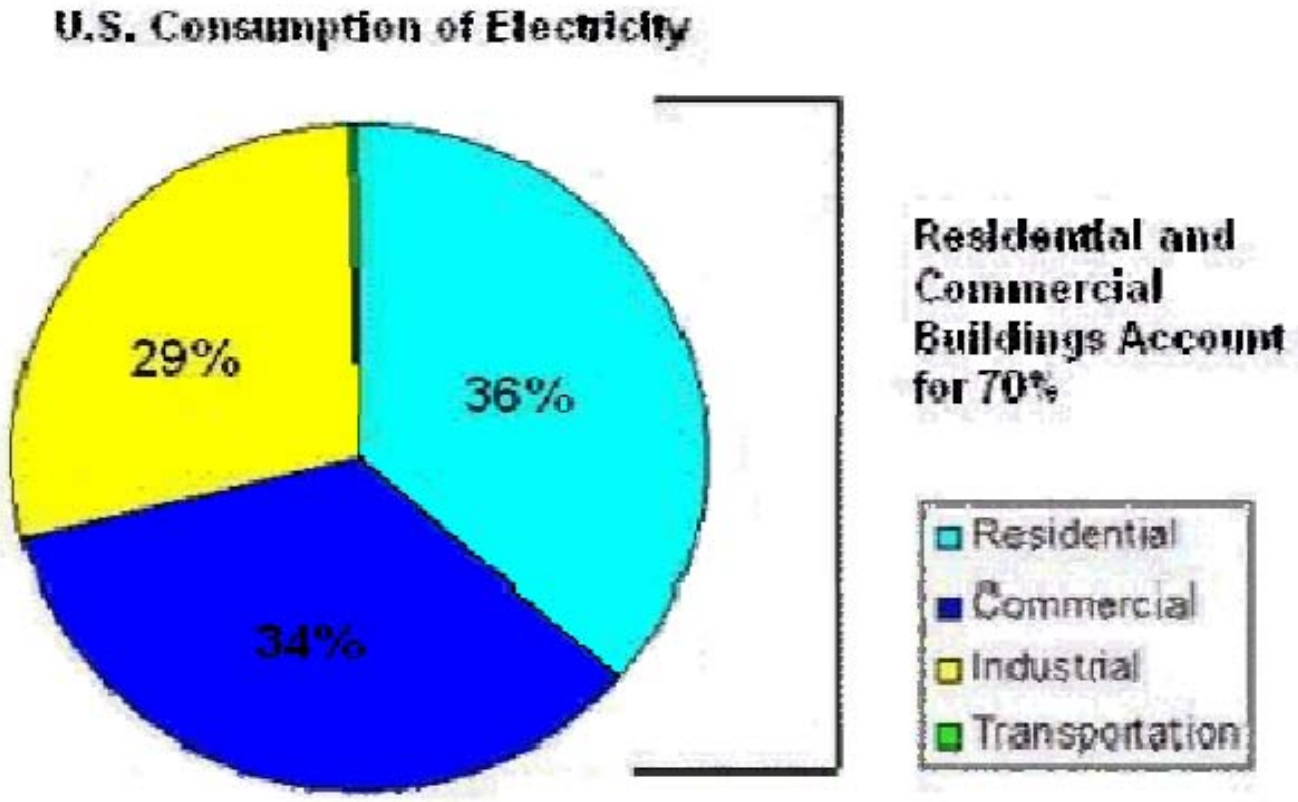
Energy Efficiency's potential is greater than all Renewable Energy systems COMBINED



Source: Tackling Climate Change in the U.S.

http://www.ases.org/climatechange

Why Buildings are Important

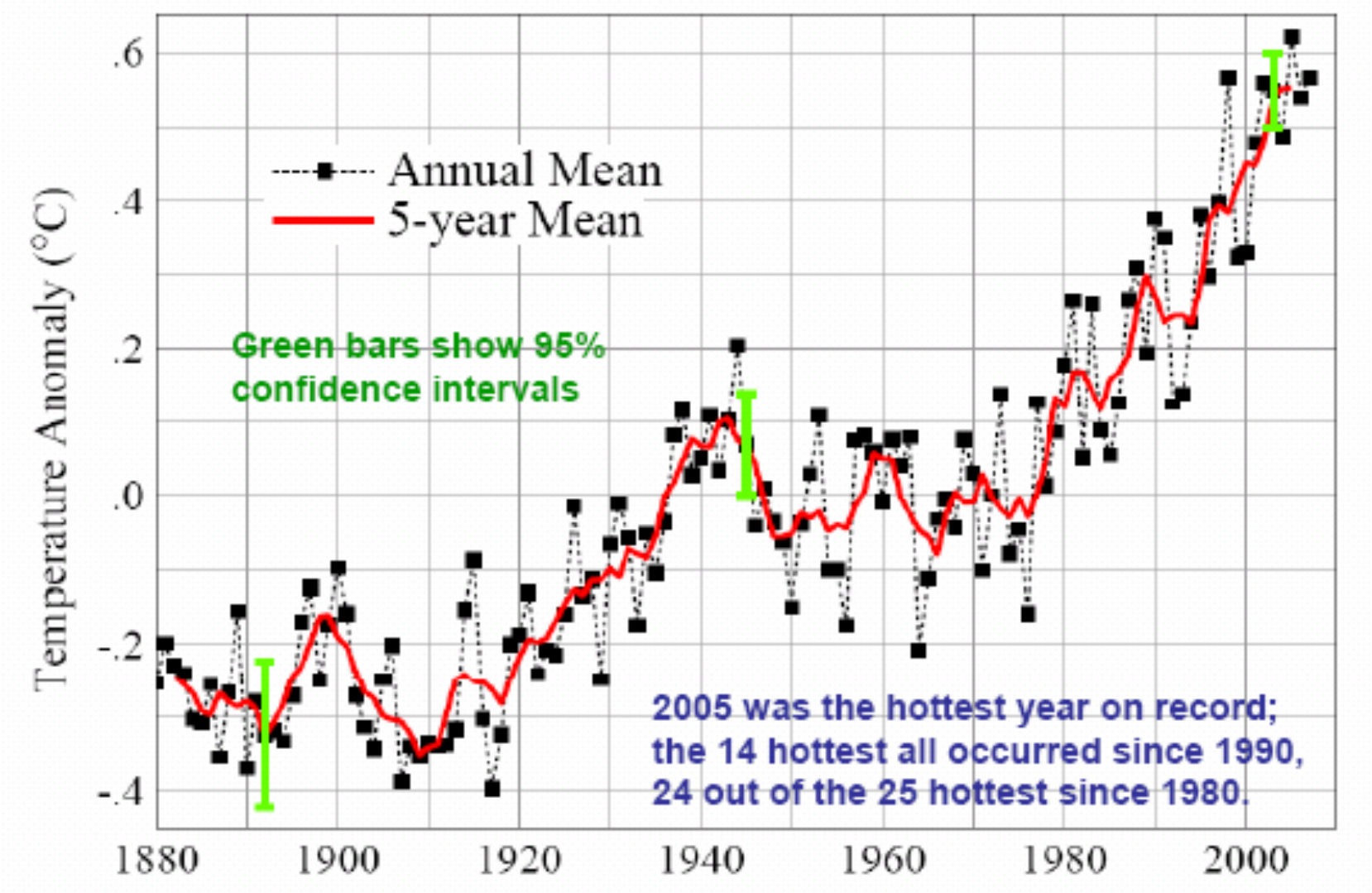


Energy Efficiency is the World's

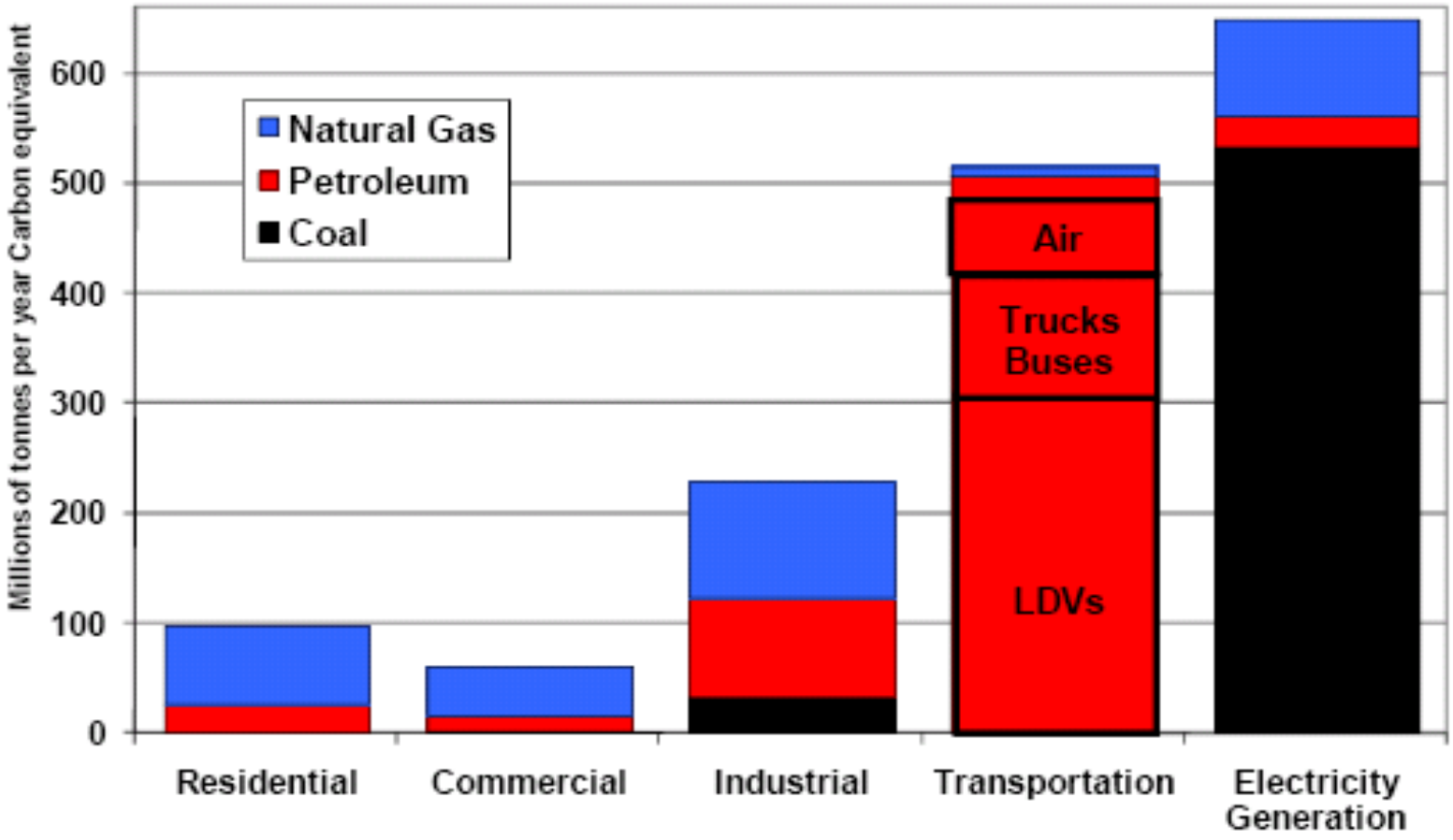
- **Cleanest**
- **Cheapest**
- **Quickest**
- **Most Reliable**
- **Renewable**

Energy Source

The Earth is getting hotter.



U.S. CO_2 Emissions by Sector and Fuels 2005: 1,568 Tonnes Carbon (5,751 Tonnes CO_2)



Source: U.S. EPA Inventory of Greenhouse Gas Emissions, April 2007

1. Our ecological crises are enormous and quickly getting worse.

2. These problems are urgent and time is running out.

3. There *are* alternatives, and a better future *is* possible.

http://www.webofcreation.org/

The Real Reason