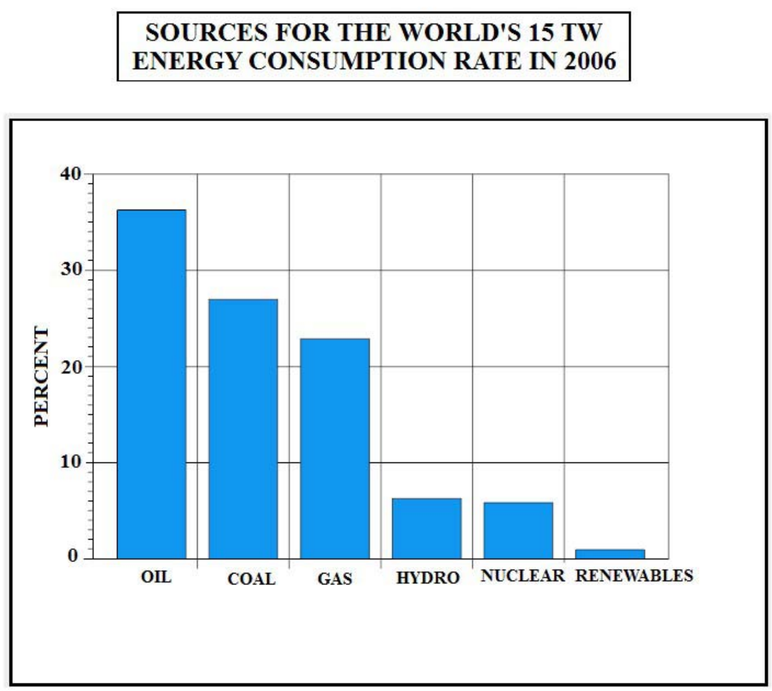
WORLD ENERGY CONSUMPTION

The world consumption of energy is estimated to be about **474 exajoules=474x10^{18}J o**f which about 88% comes from fossil fuels. This implies an energy consumption rate of-

$$\frac{474x10^{18}J}{[365x24x3600]s}=1.50x10^{13}W=15TeraWatts$$

The sources for this energy are oil, coal, gas , hydro, nuclear, and renewable in descending order. Here is a graph of the breakdown-



The United States with about 309 million/6.86 billion=4.4% of the world's population consumes about 21% of this amount with China rapidly coming up from second place. Comparing the energy consumption rate per capita, one has that the United States consumes energy at a rate of-

$$\frac{0.21x6.86x10^{9}}{3.09x10^{8}}=4.67\ times\ the\ world\ average$$

This number amounts to a US per capita consumption of about 8 tons of oil equivalent per capita per year.

From the above chart we see the world's heavy dependence on the use of hydrocarbon fuels and the present miniscule amount of energy derived from renewable resources such as solar, wind, and geothermal. Attempts to expand the use of renewable energy sources (as is currently in vogue) to amounts matching fossil fuels appears to be un-realistic in view of the infrastructure required to achieve this. Nuclear fission appears to be the best route to meet the world's future energy needs by a rapidly growing world population(4 billion in 1974 to 6.8 billion today, to 8 billion in 2025) and hydrocarbon fuel sources will continue to be the major energy suppliers in view of new discoveries being made at ever deeper drilling sites around the world. The problems of nuclear waste disposal and carbon emission are the two major problems which still need to be solved. I am optimistic that this can be done. I don't have much faith in the role of man-made nuclear fusion as an energy source, at least not for the next 100 years. Every time I talk with experts in the nuclear fusion business they say it will take another twenty years to break even. I have been hearing this ever since my graduate days at Princeton five decades ago when they were playing around with stellarators.

Finally let's look at the cost of energy. I pay about $2.90 per gallon for gasoline and 14 cents/kWh for electricity at my home. A gallon of gasoline contains 114,000 BTU =1.20 x 10^8 J of chemical energy. For typical driving one uses about 1.5 gallons per hour which means an energy usage of

$$\frac{(1.5\ x\ 120\ x\ 10^6) J/hr}{3600\ \sec/hr} = 50\ kW\ \ for\ a\ total\ of\ 50 kWh$$

The driving cost is thus 580/50=16 cents/kWh which is comparable with my home electricity cost of 14 cents/kWh. This result has implications for the electric automobile business. They claim a miles per gallon equivalent of several hundred when in reality transportation cost is about the same as for gasoline driven cars. The only advantage electric cars would appear to have is that it is easier to control pollution at large power plants then in millions of moving automobiles. At the present, electric cars have the built in disadvantage of too high a cost and limited mileage between battery recharging. I envision a future were local transportation will be supplied by small electric cars powered by electricity from nuclear power plants with the majority of long range transportation accomplished by high speed rail and air transportation.