

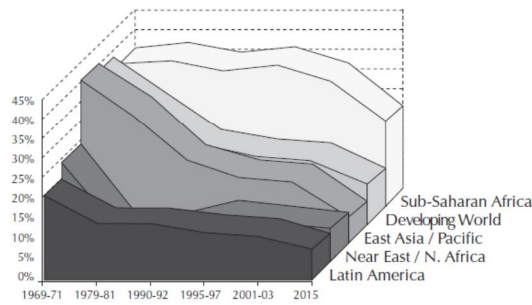
B. Long-term trends show that human beings will be able to live on the earth, enjoying ever-increasing prosperity, and never exhausting its resources. (Continued from previous outline, Chapt.10a)

a. *World population* (On previous outline, Chapt.10a)

b. *Land for Growing Food – is there enough?*

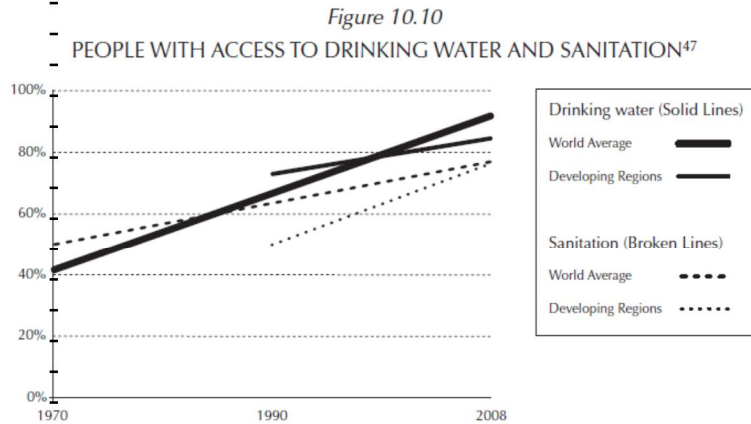
- 24% of the earth's land is "arable," 7.9 billion acres; 3x the area currently used in any given year
- could feed about 35 billion people (2,350 kcal per day) = < ½ the average production of the "Corn Belt," U.S.; Harvard University's Center for Population Studies, 1984.
- Another estimate=could feed 18 bil. people per year, 3x world pop. (estimates = pop. stabilization at 11 bil.)
- Food production per acre has increased remarkably in the last sixty years and will likely continue to increase. (1 hectare = 2.47 acres):
- amount of cereal grain grown per hectare in N. America, C. America, and Europe < 2x btwn. 1950 and 1990, and the amount grown per hectare in the world as a whole = significantly increasing trend; see:
- calories consumed per day have increased, see *Daily Calories chart*.
- 2x the population of 1961 = each has more to eat per person; Lomborg
- However, estimates = 12% of world pop. still starving, but down from 35% in 1970, long term estimates encouraging.
- Yet, sub-Saharan Africa has not kept pace with the progress in the rest of the world, see figure 10.9.

Figure 10.9  
PROPORTION OF STARVING IN PERCENT—DEVELOPING WORLD BY REGION 1969-2015



c. *Water*

- % of people in developing countries with access to clean drinking water increased from 30% in 1970- 80% in 2000, see figure 10.10.



- 71% of the earth's surface covered by water, see 10.11:
- Of the water that is accessible for human use, we use less than 17% of the annually renewable water on the earth; Not 17% of the fresh water on earth. Who uses water?, see fig. 10.12.
- Currently, there is much waste of water the world over through leakage and inefficient usage.
- Desalination of water cost = less than 1/5 of a cent per gallon (\$.50/cubic meter), less than the \$.69/cubic meter that I currently pay at my home in AZ
- Many countries today derive a significant portion of their water use from salt water; desalted water still makes up just 0.2% of all water use.

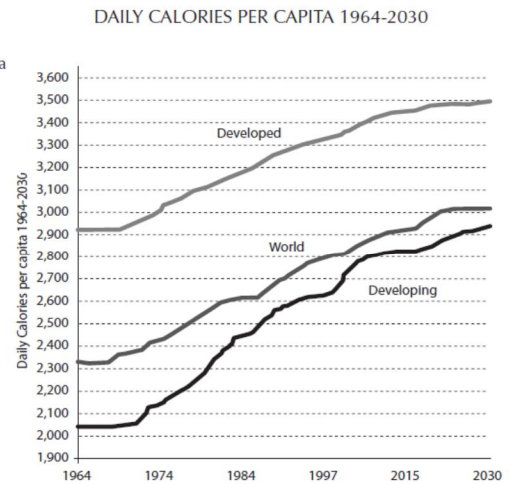
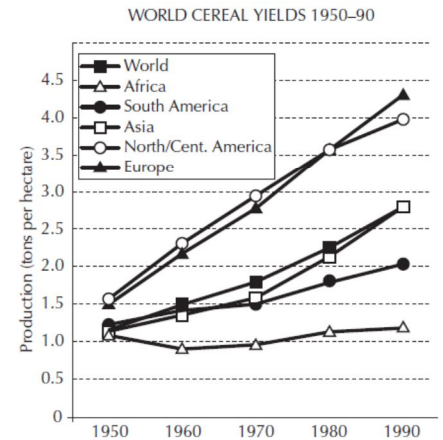


Figure 10.11  
TOTAL WATER ON EARTH

|  |                       |
|--|-----------------------|
| Water in the oceans  | 97.20%                |
| Water in polar ice   | 2.15%                 |
| Remaining water, including all fresh water lakes, river, and ground water (water under the ground) | 0.65%                 |
| Total  | 100.00% <sup>48</sup> |

Figure 10.12

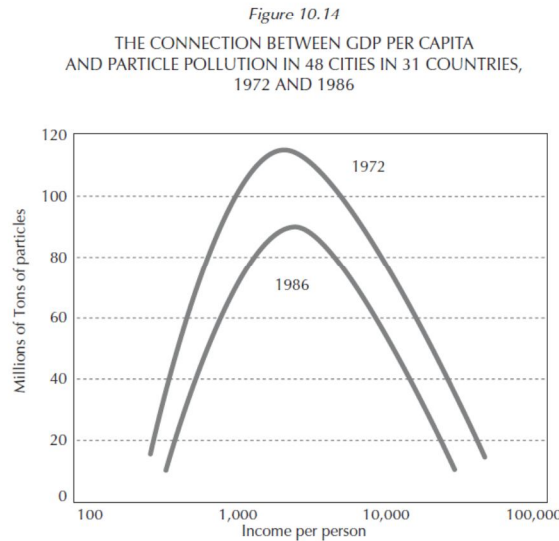
GLOBAL USAGE OF WATER

|             |                       |
|-------------|-----------------------|
| Agriculture | 69.0%                 |
| Industry    | 29.0%                 |
| Households  | 8.0%                  |
| Total       | 100.00% <sup>51</sup> |

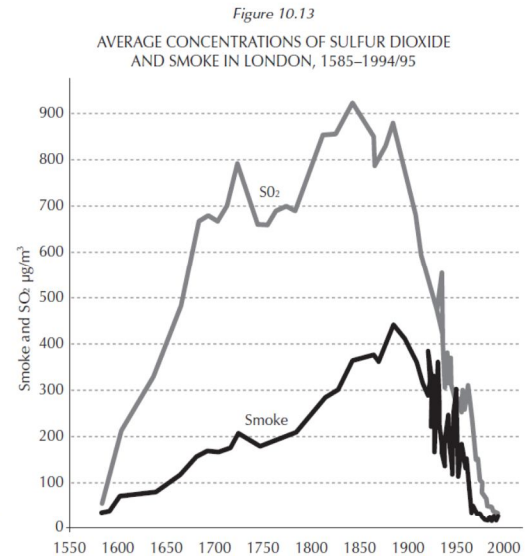
- Therefore, stabilization of world pop. + increased efficiency of water use + 80% of renewable fresh water not being used + virtually unlimited water for desalination in the oceans = no reason to expect that the earth will run out of water, ever.
- There are regional areas where water is difficult to get, but those are local problems that deal with access to water, not with global water supply.
- Water shortages are caused by 1. lacking economic development or 2. legal and political hindrances (ref. political opposition to desalination plants in California, and *man-made drought* in California, 2009).

#### d. Clean Air

- Clean Air regulation in the US was a decision made by the American People via elected officials.
- Voluntarily incurring extra expense to clean up air pollution is a pattern followed by countries as their economies grow (example: see fig. 10.13 which shows the concentrations of SO<sub>2</sub> and smoke in London over a 400-year period)
- Economic development = nations can overcome air pollution, 10.14
- Btwn '72-'86 - pollution particles lower for every level of economic development.
- In the U.S.: car miles doubled, pop. increased, yet emissions of decreased.



Source: See next chart (p. 345)



#### e. Waster Disposal

- Energy production from waste incineration is cheap.
- Freshkills Landfill = new park, bigger than Central
- How much space would be required to receive all the garbage being produced in the United States? All the waste generated in the United States for the next hundred = square area, 18 miles each side, 100 ft. high, less than 0.009% of the U.S. land area
- Recycling worthwhile, then? factual analysis needed for the expense, time, effort vs. benefit for each product. (ex. recycle paper, or burn at incineration plants and produce new energy?)
- Paper = renewable resource, recycled paper much more expensive.

#### f. Global Forests

- World running out of trees? Answer = Analysis of the facts that show worldwide trends.
- 1/3 of earth covered by trees - number has remained relatively stable since World War II.
- Whole world = 2-3x as much land is taken up by forests as by agricultural land used for crops
- U.S. = since 1920, (nearly a century) the amount of forest land has remained quite stable.
- Wood growth in U.S. = is 3½ times what it was in 1920 due to efficient planting of trees for paper use.
- Continuing trend, total number of cubic feet growing in U.S. increases from '52-'87. See fig. 10.16.
- World = 20% loss of the original forest cover on the earth since agriculture began, but has stabilized
- As countries develop well, other sources of energy are used (vs. trees for fire), and more efficient agricultural methods

Figure 10.16  
GROWING COMMERCIAL TIMBER IN THE USA, NET VOLUME

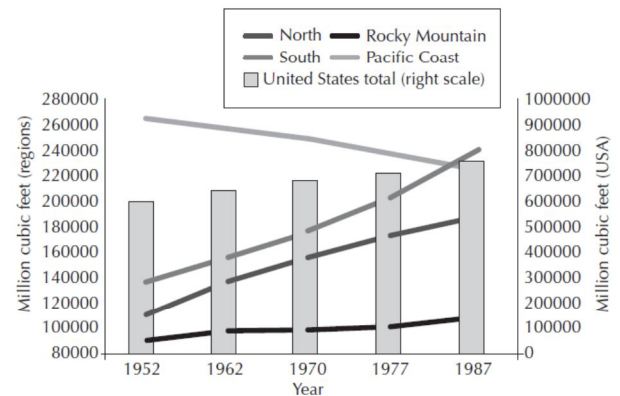


Figure 10.17  
NUMBER OF SPECIES AND DOCUMENTED EXTINCTIONS, 1600—PRESENT

| Taxa            | Approximate number of species | Total extinctions since 1600 |
|-----------------|-------------------------------|------------------------------|
| Vertibrates     | 47,000                        | 321                          |
| Mammals         | 4,500                         | 110                          |
| Birds           | 9,500                         | 103                          |
| Reptiles        | 6,300                         | 21                           |
| Amphibians      | 4,200                         | 5                            |
| Fish            | 24,000                        | 82                           |
| Mollusks        | 100,000                       | 235                          |
| Crustaceans     | 4,000                         | 9                            |
| Insects         | >1,000,000                    | 98                           |
| Vascular Plants | 250,000                       | 396                          |
| Total           | Approx. 1,600,000             | 1,033                        |



3

are used – causes stabilization.

- Tropical Rain Forest – 86% remaining, 0.46% loss per year. Cause = over-use of wood fuel due to lack of development in nations.

g. *Species Loss* – see fig. 10.17

- Total number of documented extinctions is only 1,033 out of 1.6 million species, or 0.06% total over the last five hundred years.
- Compare claims of Norman Myers – 40,000 lost every year.
- Delta Smelt vs. people in California

h. *Herbicides and Pesticides*

- Invention of herbicides and pesticides = increased food production worldwide.
- Pesticides or herbicides restricted or outlawed = 2x the cost of food in N. America & Europe. = eat fewer fruits and vegetables, buy more primary starch, and consume more fat.
- Drastic effect on the poor
- 26,000 additional cancer deaths per year in the United States
- Herbicides and pesticides create *great health benefits, significantly higher food production, and less required use of land.*
- One of the most respected studies of various causes of cancer in the United States concluded that they could find no significant percentage of cancers caused by pesticides in the United States. “virtually no one dies of cancer caused by pesticides in the U.S.” – Lomborg.
- 20 deaths per year out of 560,000,90 / one death out of every 28,000 people who die of cancer. Weighed against the immense benefits that come from pesticide use, and the great harm that would come to the world population and world diets if pesticide use were abolished, it appears that there should be no significant objection to their current level of wise and carefully restricted use.

i. *Life Expectancy*

- Earth getting safer or more dangerous? – a good measure is overall life expectancy trends.
- Better health, medical advancement, safety from natural disasters, good nutrition = long life expectancy
- As nations develop economically, life expectancy advances, see 10.18 for a typical trend (England)
- Life expectancy in the last 200 years has increased from about 38 years to about 78 years.
- Even in less developed countries: early 1900s = 30 yrs, 1950 = 41 yrs, 1998 = 65 yrs. – More than doubled.
- The predictions for future development are continually upward for all parts of the world, see fig. 10.19.

Figure 10.18  
LIFE EXPECTANCY IN ENGLAND AND WALES (1600–2000)

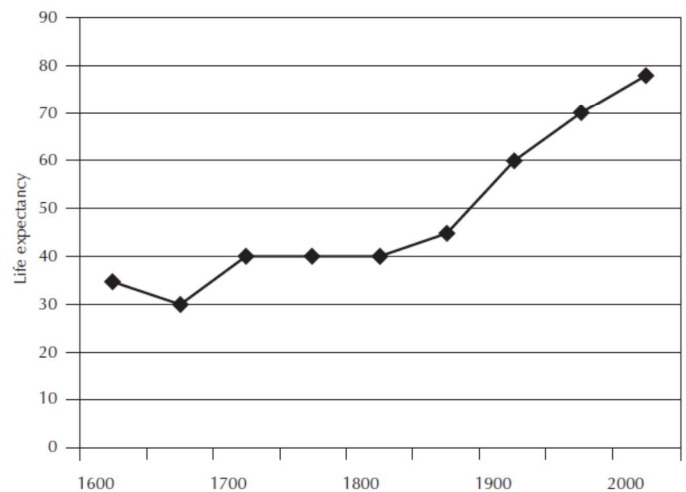
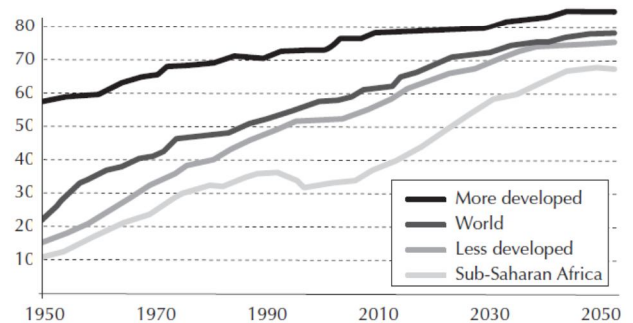


Figure 10.19  
LIFE EXPECTANCY FOR INDUSTRIALIZED COUNTRIES, DEVELOPING COUNTRIES, SUB-SAHARAN AFRICA, AND THE ENTIRE WORLD, 1950-2050



C. *Energy Resources and Energy Uses*

- a. We are not running out of energy resources
- b. Energy production is derived from several different sources; for the distribution of energy sources used in a particular year for the entire world, see fig. 10.20

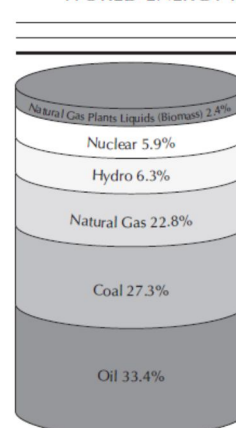
c. *Wind Power*

- In 2008, the total amount of world energy capacity from wind-power was 121 gigawatts, growing by 29% from 2007.
- Wind power is unreliable, actual production likely 20% of capacity. 1.9% of America’s electricity.
- Not a dependable source of energy/requires huge swaths of land.

d. *Hydroelectric Power*

- U.S. currently gets 5.7% of its energy (247,509,974 BTUs) from hydroelectric dams on rivers – yet, no likely expansion

Figure 10.20  
WORLD ENERGY PRODUCTION BY SOURCE 2006



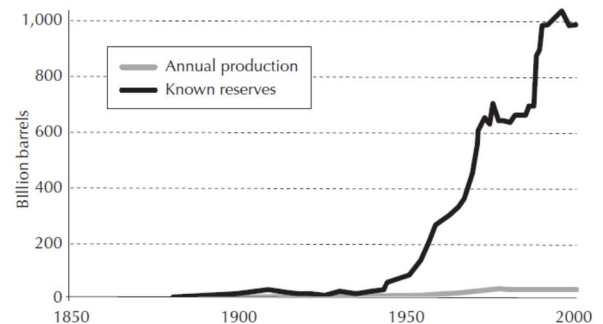
Sources: World Primary Energy Production by Source 1970-2006.  
www.eia.doe.gov/aer/txt/ptb1101.html.  
Energy Sources: Renewable Energy.  
www.green3dhome.com/EnergySources/  
RenewableSources.aspx.

- 4 - World hydroelectric production = 6.6%, no likely expansion

e. *Oil*

- We are constantly discovering new reserves of oil
- Price of oil increases, drilling in difficult areas becomes economically feasible. See fig 10.21.
- Oil available in tar sands and shale oil fields + typical locations = amount of oil remaining equal to the total energy consumption of the entire world for 5,000 years plus.
- Combined with other energy resources, tech. developments = likely never run out of oil.
- Dependence on foreign oil should be reduced: 1) Increase alternative fuels when practical to do so, 2) U.S. should develop more of its own supplies of oil, with adequate safeguards against accidents.
- Alaskan National Wildlife Refuge has no human inhabitants and U.S. could retrieve as much oil as is presently imported from Saudi Arabia.
- Colorado can produce 46,000 barrels per day – would bring down prices by increased availability.
- We need to expand oil refining. Decreases over the last 28 years have kept gas prices artificially high.
- Various states (like AZ) should adopt a national standard for gasoline rather than boutique mixtures – a big contributor to high gas prices and periodic shortages.

Figure 10.21  
KNOWN WORLD OIL RESERVES AND WORLD OIL PRODUCTION – 1900-2008



- f. *Coal* - a widely used source of energy, modern coal-burning power plants are much cleaner and more efficient than in previous years. The total availability worldwide = 1,500 years worth of usage.

- g. *Natural Gas* – excellent for home heating and electrical power. Powers cars, transports easily, cheaper than gas.

h. *Nuclear Power*

- Energy produced by one gram of uranium-235 is = to the energy produced by almost three tons of coal
- Almost no pollution, but radioactive waste requires safe storage.
- The yearly nuclear waste of over a million people could be stored in a properly made container the size of a 40-gallon steel drum (being done in France, Japan, other countries - it is periodically stored & eventually buried).
- 76.8% of the electricity generated in France is from nuclear power. Japan = 25.6%.
- 104 operating nuclear power plants in the United States provide over 20% of our electricity.
- Because of endless legal and regulatory barriers, no new nuclear power plants have been built in the United States since 1975, though many were once slated to be built in the early 70's.
- (1) "many Americans have an irrational fear of anything 'nuclear,' " and (2) "the policy of deliberate misinformation that opponents of nuclear energy employ with shameless disregard of the truth." – Senator Domenici, New Mexico, past chairman of the Energy and Natural Resources Committee of the US Senate
- Three Mile Island – no deaths, no injuries, resumed service in 1985.
- Chernobyl – flagrantly poor quality construction and maintenance, blatant disregard for safety, under communist government.
- According to the US Nuclear Regulatory Commission, "U.S. reactors have different plant designs, broader shutdown margins, robust containment structures, and operational controls to protect them against the combination of lapses that led to the accident at Chernobyl."
- With a fast-breeder reactor, there is now sufficient uranium for up to 14,000 years of energy production
- Nuclear energy from its start in 1952 has proved to be the safest of all energy sources.

i. *Solar Energy*

- Price is not yet competitive, though solar cells have made solar more affordable.
- Use will likely increase
- Unreliable due to overcast, cannot be generated at night
- Solar is greatest source for energy available
- Solar energy falling on the earth each year is equal to about 7,000x our present global energy consumption.

j. *Conclusion*

- Incredibly abundant amount of energy available for human use on the earth
- God put us on the earth so that we would develop and use his resources wisely. - reasonable that he would provide us with multiple sources of energy that we could discover in order to perform the tasks he gives us to do.
- Energy reduction is not a virtue. Energy is what replaces human physical work, animal work, and make economic development possible.
- Increasing energy usage for good productive work that glorifies God is a virtue. It decreases the time we need to spend, increases our productivity and prosperity, and increases our freedom.
- Reducing personal energy use to save money is wise. Reducing energy use to the extent that quality of life and work efficiency suffer is not.
- Due to *human ingenuity* related to technological progress made, we will likely realize that the amount of energy remaining in these sources will last even beyond the current predictions.