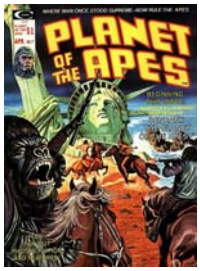
Energy

19 March 2007
26th class meeting

(http://www.earth911.org/master.asp)



READINGS, Mon 19 March:
None
Wednesday 21 Mar:
Miller Chapter, NG Coal Article

Lab 21/23 Mar:
Energy Lab
(see website)
Saturday 24 March MT LEMMON!
BSE 7am, return 6pm
Lab 28/30 March:
meet in lab

Environmental Biology (ECOL 206)
University of Arizona, spring 2007

Kevin Bonine, Ph.D.
Anna Tyler, Graduate TA

http://eebweb.arizona.edu/courses/Ecol206/206_Page2007.html

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Mt. Lemmon Ski Area, March or April 2005

Mt. Lemmon this Saturday…

24 March

Meet 0700h at S side of BSE (corner of 4th and Highland)
"Be on time or get left behind."
Return around 1800h to campus

Please Bring:

Food (snacks and lunch)
We will bring a cooler with ice for you to put stuff in if you wish.
Water (bring a small **bottle**, we will bring big jug for refills)
Hat
Clothes for variable weather conditions. Up top it *might* be in the 30s F and raining or snowing.
Be prepared to enjoy yourself no matter the weather.

Small Notebook, Writing Instruments, Handout from 206 lab website
Sunscreen?
Binoculars?
Camera?
Money?

Please don't bring personal music devices, no text-messaging or phone calls, etc.
We will be interacting as a group all day.

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SNR Special Seminar Information
Thanks to financial support from the Graduate Student and Professional Council, Institute for the Study of Planet Earth, and USGS, we are honored to welcome **Dr. Sharon Collinge** from The University of Colorado at Boulder for a visit to SNR on March 27th and 28th. Dr. Collinge will be giving a talk entitled Got plague?: Links between landscape change and disease occurrence in western USA grasslands, as part of the School of Natural Resources Seminar Series (Wednesday, March 28th at noon in the Old Chem Bldg (across the quad) room 209).
Dr. Collinges current research focuses on the role of landscape spatial heterogeneity in shaping ecological processes, including responses of individual organisms, populations, and communities to spatial variation in landscape structure. More information on Dr. Collinges lab can be found at <<http://www.colorado.edu/eeb/EEBprojects/CollingeLab/index.html>.

A selection of Dr. Collinges papers can be found by following this link (http://www.u.arizona.edu/~obrienc/research/collinge/collinge.html).

Tuesday, March 27th
Undergraduate student luncheon, 12:00 1:00 pm, room 218 BSE
Break-out session (professional development and research), 1:15 2:15, room 218 BSE

Wednesday, March 28th
SNR Noon Seminar, 12:00-1:00, Old Chem Bldg room 209
Potluck social, 6:00 9:00 (more information to come)

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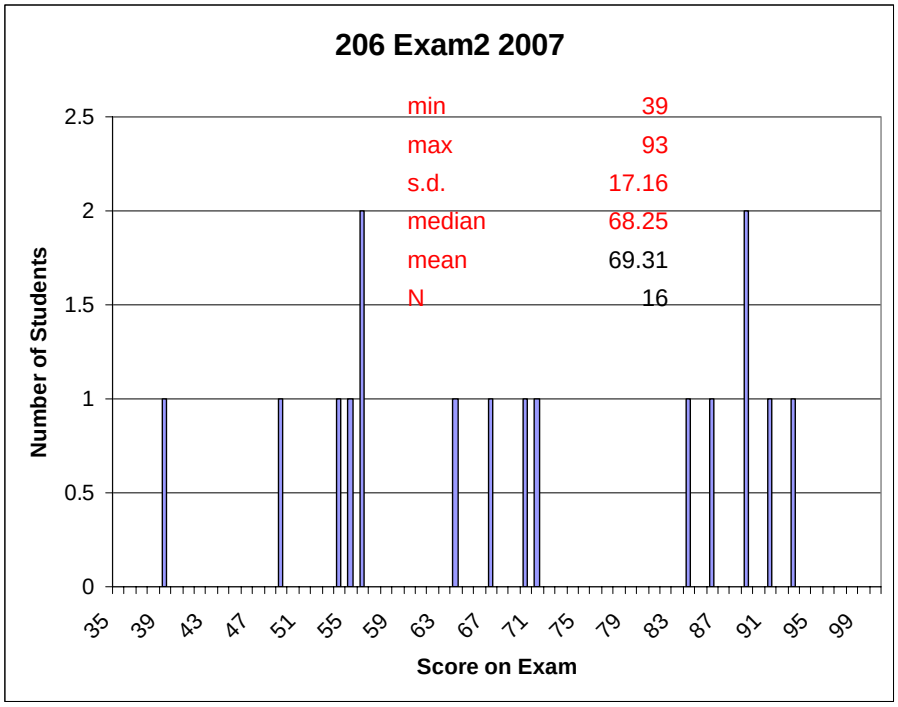
206 Exam2 2007
min 39
max 93
s.d. 17.16
median 68.25
mean 69.31
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Number of Students
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35 39 43 47 51 55 59 63 67 71 75 79 83 87 91 95 99
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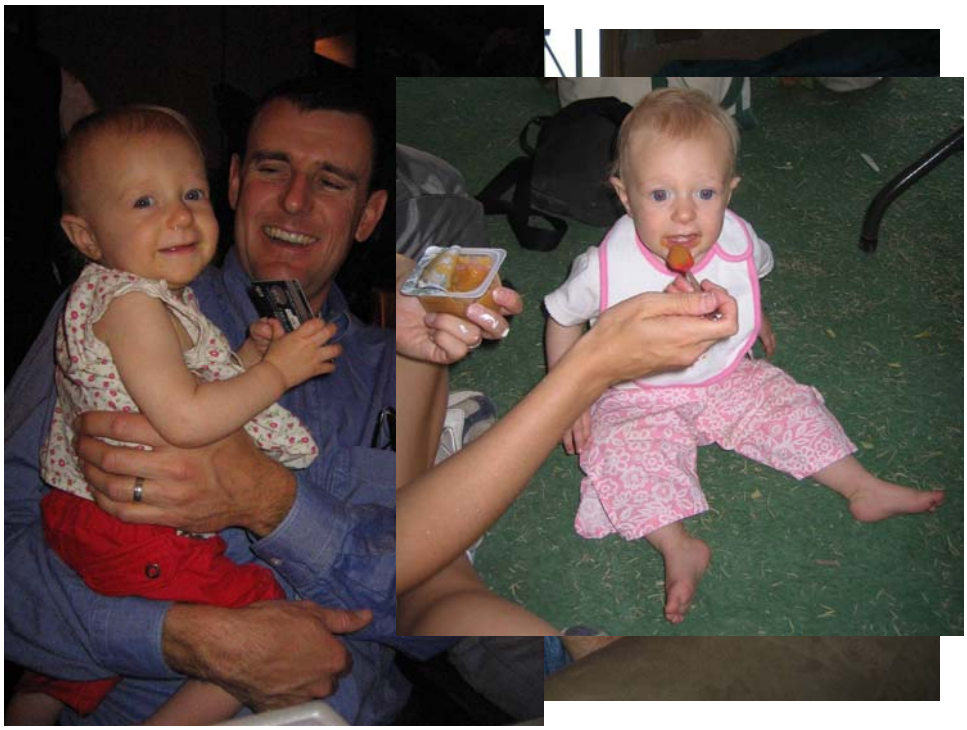


http://www.earth911.org/master.asp (make every day earthday)

http://www.earth911.org/master.asp?s=lib&a=Energy/Conservation/FlexYourPower/flexyourpower.html
(energy conservation)

http://www.earth911.org/master.asp?s=lib&a=energy/transport.asp
(transportation efficiency)

http://www.earth911.org/master.asp?s=lib&a=energy/EnergyFacts.html
(energy and recycling)

http://arizona.earth911.org/usa/master.asp?s=ls&a=Recycle&cat=1&serviceid=
(where to recycle)

7

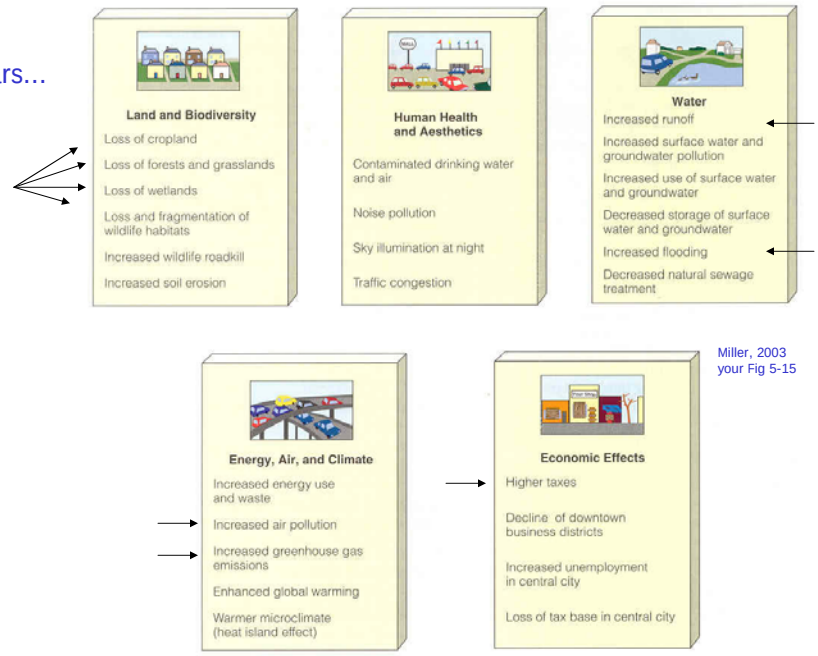
Urbanization and Sprawl
Role of the automobile?

U.S. 4.6% population
~33% of world's cars

Bicycles!!
Mass transit

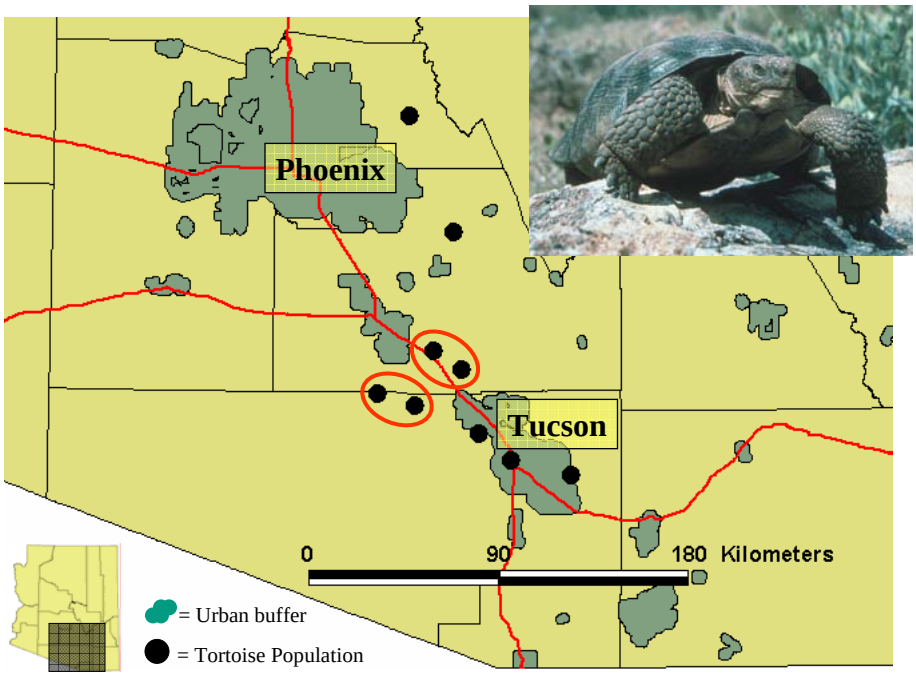
8

Sprawl
and Cars...



Miller, 2003
your Fig 5-15

Figure 11-23 Some of the undesirable impacts of urban sprawl and car-dependent development.



Reining in Urban Sprawl
Stoel, 1999

- Sprawl, suburbs, city center

- greenspace, pollution, traffic, erosion, water

- Travel delays cost DC area residents >$1,000/year

- more highways do not help

(Buying larger pants to deal with weight problem)

- wealth vs. quality of life

- fossil fuels
- gov't subsidies
- divided jurisdictions

- symptoms vs. causes

- Portland, Oregon
  success attracts people!

- antisprawl legislation
  developers and property rights advocates opposed

- last sentence about need to tax fossil fuels

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"Cars Rule"

Miller p. 95

75% Americans drive to work alone
5% commute on public transit
0.5% bicycle to work

In US we drive 2.5 trillion miles/year
(same as all other people combined)

China and others aspiring...

In US, $1 of every $4 related to automobile

Globally: 1.2 million killed each year, 15 million injured

Cars: 25% of CO_2 emissions
Urban areas: 33-50% car related

Externalities accounted: + $5-8 / gallon gasoline

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Pooches' poo to help power Frisco

Arizona Daily Star
Published: 02.22.2006
Pooches' poo to help power Frisco
THE ASSOCIATED PRESS

SAN FRANCISCO — City officials are hoping to harness the power of dog doo-doo.
San Franciscans already recycle two-thirds of their garbage, but in this dog-friendly town, **animal feces make up nearly 4 percent of residential waste, or 6,500 tons a year — nearly as much as disposable diapers**, according to the city.
Within the next few months, Norcal Waste, a garbage hauling company that collects San Francisco's trash, will begin a pilot program under which it will use biodegradable bags and dog-waste carts to pick up droppings at a popular dog park.
The droppings will be tossed into a contraption called a **methane digester, which is basically a tank in which bacteria feed on feces for weeks to create methane gas.**
The methane could then be piped directly to a gas stove, heater, turbine or anything else powered by natural gas. It also could be used to generate electricity.
Methane digesters are nothing new. The technology was introduced in Europe about 20 years ago, and more than 600 farm-based digesters are in operation there. Nine are in use on California dairy farms, and chicken and hog farms elsewhere in the United States also use them.
Neither Norcal Waste spokesman Robert Reed nor Will Brinton, a Maine-based recycling and composting consultant, knew of anyone in the United States who is using the $1 million devices to convert pet waste to energy. But Brinton said some European countries process dog droppings along with food and yard waste.
"The main impediment is probably getting communities around the country the courage to collect it, to give value to something we'd rather not talk about," Brinton said. "San Francisco is probably the king of pet cities. This could be very important to them."
San Francisco — the city named after St. Francis, patron saint of animals — has an estimated population of 240,000 dogs and cats.

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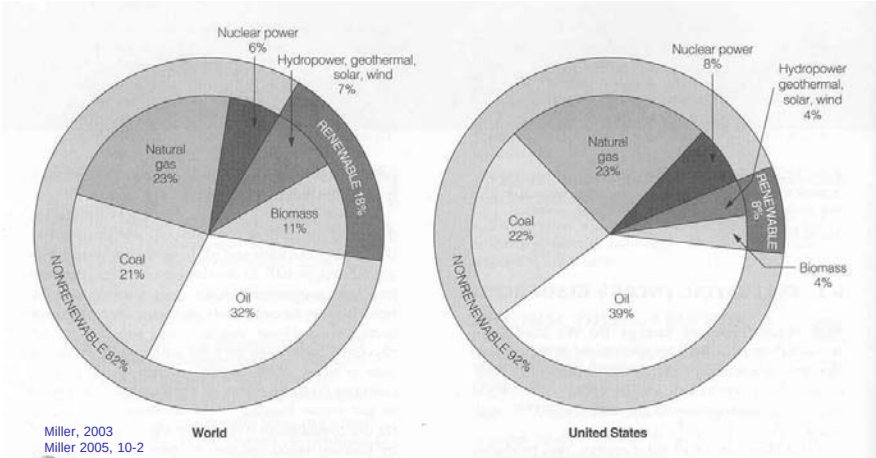
Energy (Miller Ch 10)

-Solar 99% (not in market place)
-Commercial 1% (82% nonrenewable)
(incl. indirect solar: wind, water, biomass)



Miller, 2003
Miller 2005, 10-2

Figure 6-2 Commercial energy use by source for the world (left) and the United States (right) in 2000. Commercial energy amounts to only 1% of the energy used in the world; the other 99% is direct solar energy received from the sun and is not sold in the marketplace. (Data from U.S. Department of Energy, British Petroleum, and Worldwatch Institute)

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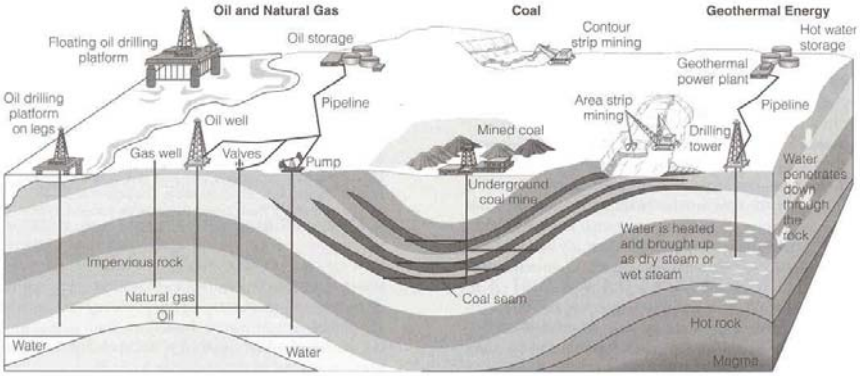
NonRenewable
Energy

U.S. 4.6% population, 24% commercial energy
India 16% population, 3% commercial energy

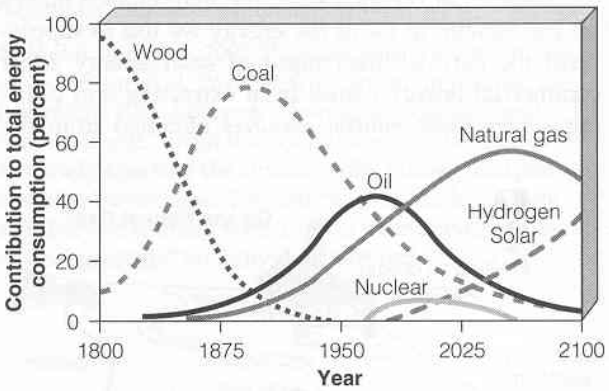


Miller, 2003 (2005: 10-1)

Figure 6-1 Important *nonrenewable energy resources* that can be removed from the earth's crust are coal, oil, natural gas, and some forms of geothermal energy. Nonrenewable uranium ore is also extracted from the earth's crust and then processed to increase its concentration of uranium-235, which can be used as a fuel in nuclear reactors to produce electricity.

U.S. Energy Sources

1. Availability
2. Net Energy
3. Costs to Develop
4. Subsidies, Tax Breaks
5. National Security
6. Terrorism
7. Environment, Climate, Human Health



Miller, 2003 (2005: 10-3)

Figure 6-3 Shifts in the use of commercial energy resources in the United States since 1800, with projected changes to 2100. Shifts from wood to coal and then from coal to oil and natural gas have each taken about 50 years. The projected shift to 2100 is only one of many possible scenarios depending on a variety of assumptions. (Data from U.S. Department of Energy)

Net Energy

1. Find
2. Extract
3. Transfer
4. Process
5. Transport
6. Burn

- 2nd Law of Thermodynamics

Energy Efficiency

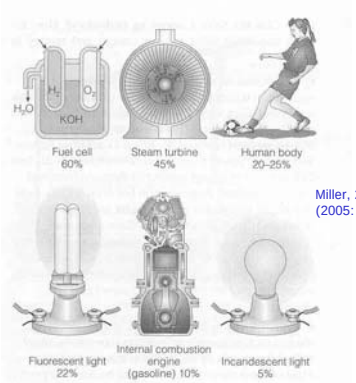
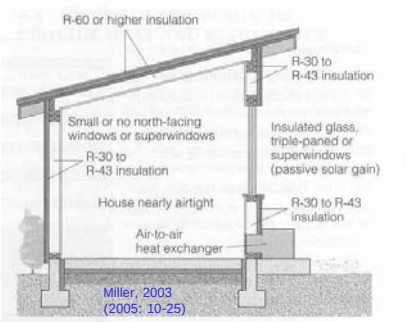


Figure 6-7 Energy efficiency of some common energy conversion devices.

Miller, 2003 (2005: 10-21)



Miller, 2003 (2005: 10-25)

Figure 6-9 Major features of a *superinsulated house*. Such a house is so heavily insulated and so airtight that it can be warmed by heat from direct sunlight, appliances, and human bodies, with little or no need for a backup heating system. An air-to-air heat exchanger prevents buildup of indoor air pollution.

Energy Efficiency

- Lightbulbs

  Incandescent
  vs. Fluorescent

- Hybrid Cars

  Fuel Efficient and Battery

  80-300 miles/gallon

- Hydrogen Cells (cars etc.+)

  $H_2 + O_2 =$ energy $+ H_20$

- Cogeneration (heat and power)
- Electric Motors

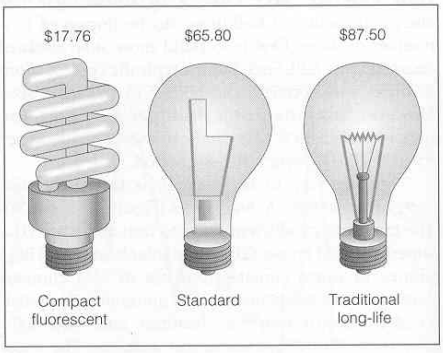


Figure 6-11 Cost of electricity for comparable lightbulbs used for 10,000 hours. Because conventional incandescent bulbs are only 5% efficient and last only 1,500 hours, they waste enormous amounts of energy and money and add to the heat load of houses during hot weather. Socket-type fluorescent lights use one-fourth as much electricity as conventional bulbs. Although these bulbs cost $6–15 per bulb, they last up to 100,000 hours (60–70 times longer than conventional incandescent bulbs and 25 times longer than halogen bulbs), saving a lot of money (compared with less efficient incandescent and halogen bulbs) over their long life. Recently, smaller compact fluorescent bulbs (costing about $6) that fit into ordinary light fixtures and ones that can be dimmed have been developed. (Data from Electric Power Research Institute) Miller, 2003

U.S. Flow of Energy

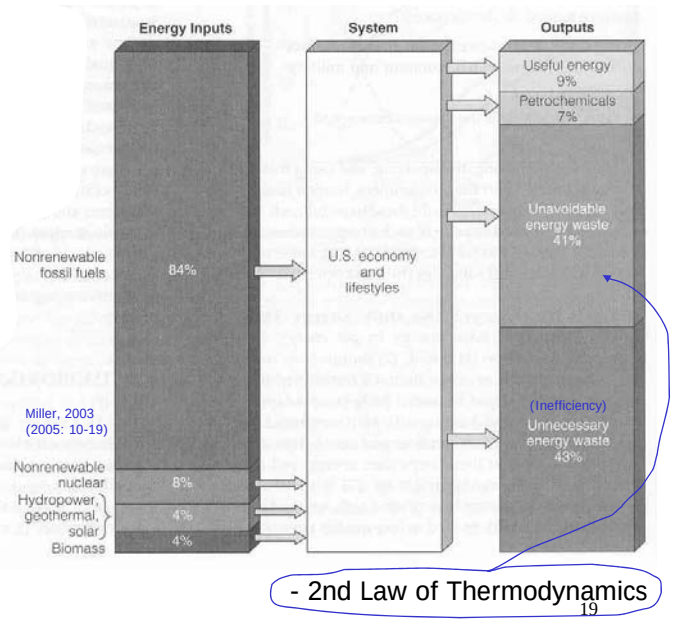


Figure 6-5 Flow of commercial energy through the U.S. economy. Note that only 16% of all commercial energy used in the United States ends up performing useful tasks or being converted to petrochemicals; the rest is either automatically and unavoidably wasted because of the second law of thermodynamics (41%) or wasted unnecessarily (43%).

Miller, 2003 (2005: 10-19)

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Energy Sources

Solar – passive or active
Hydrogen - (green algae??)
need to decompose water

Hydropower
Wind
Biomass
Geothermal

Fossil Fuels
Oil
Natural Gas
Coal

Nuclear

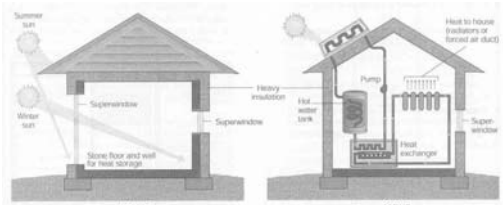
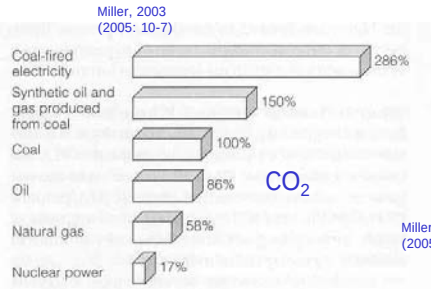


Figure 6-12 Passive and active solar heating for a home.

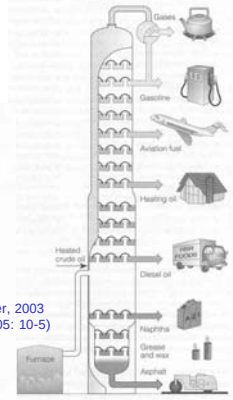
Miller, 2003 (2005: 10-25)

Miller, 2003 (2005: 10-7)



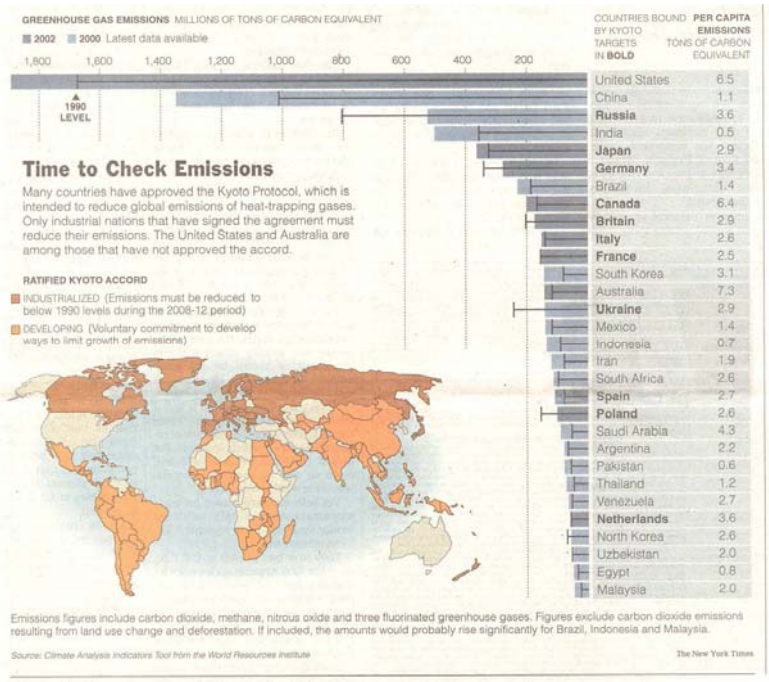
CO_2

Figure 6-25 CO_2 emissions per unit of energy produced by various fuels, expressed as percentages of emissions produced by coal.



Miller, 2003 (2005: 10-5)

Figure 6-24 Refining crude oil. Based on their boiling points, components are removed at various levels in a giant distillation column. The most volatile components with the lowest boiling points are removed at the top of the column.



Fossil Fuels

Oil

Natural Gas

Coal

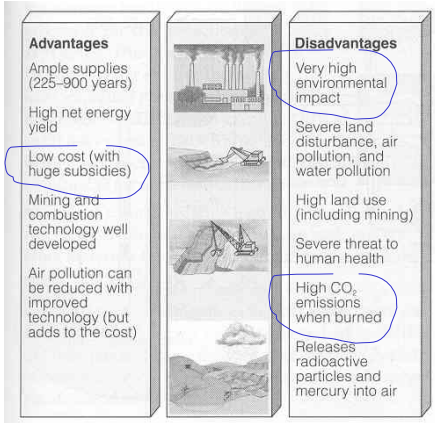


Figure 6-30 Advantages and disadvantages of using coal as an energy resource.

Miller, 2003 (2005: 10-11)

coal

Natural gas

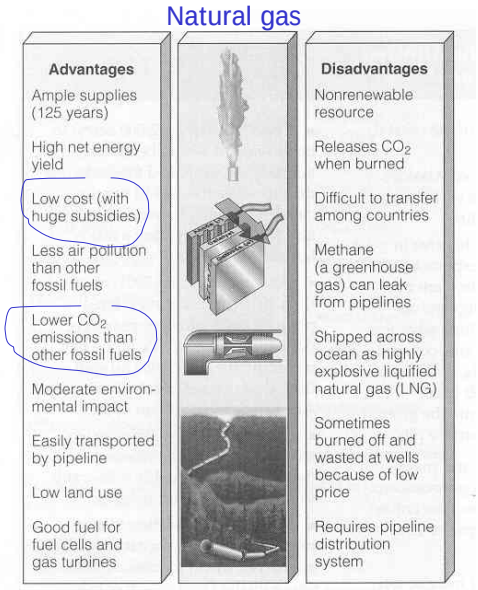


Figure 6-28 Advantages and disadvantages of using conventional natural gas as an energy resource.

Miller, 2003 (2005: 10-9)

NATIONAL GEOGRAPHIC

March 2006

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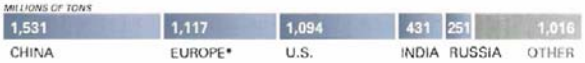
When you turn up the AC, think of Gibson and the grimy fuel it devours at the rate of three 100-car trainloads a day.

WHO HAS COAL? The world has more than a trillion tons of readily available coal. The U.S. has the largest share, but other energy-hungry countries, such as China and India, are richly endowed as well.

WHO USES COAL NOW? Global coal consumption is roughly five billion tons a year, with China burning the most. Western Europe has cut coal use by 36 percent since 1990 by using available natural gas from the North Sea and Russia.



WHO WILL USE IT TOMORROW? China's coal needs will more than double by 2025 to satisfy factories and consumers. The country also plans to convert coal to liquid motor fuels. Worldwide, consumption will rise by 56 percent.

*Excluding Russia

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