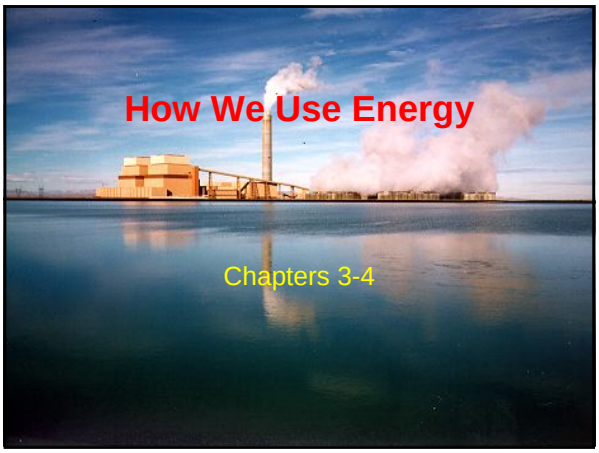
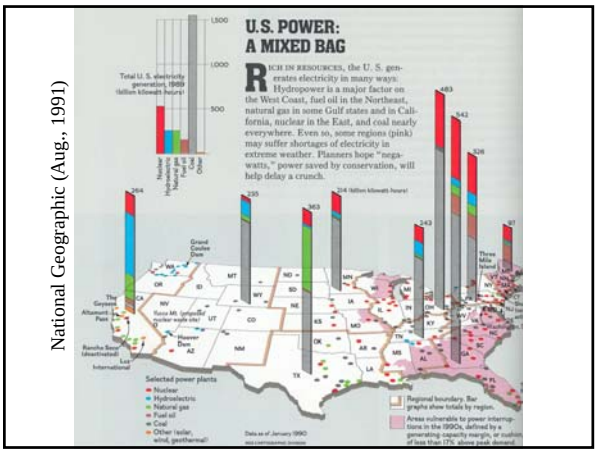
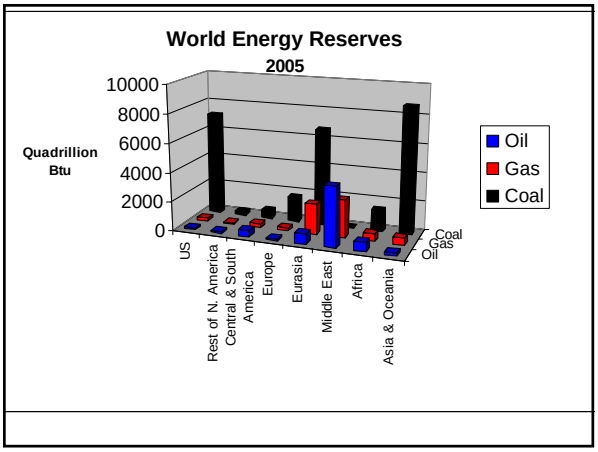




U.S. Satellite Image at Night

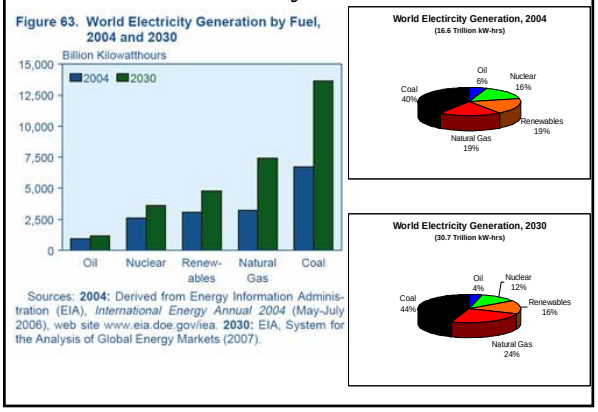
http://antwrp.gsfc.nasa.gov/apod/image/0011/earthlights_dmsp_big.jpg

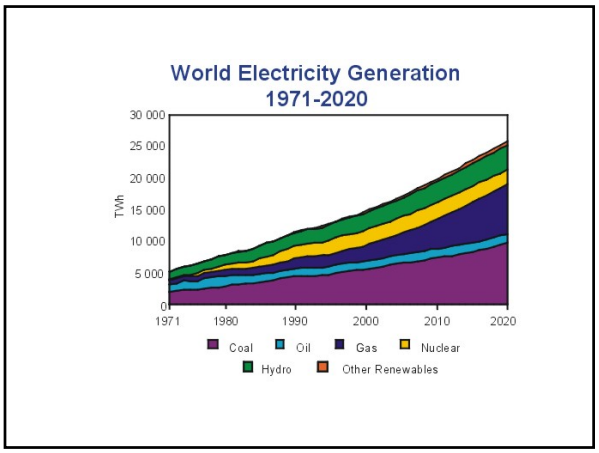


World Satellite Image at Night

http://apod.nasa.gov/apod/image/0011/earthlights2_dmsp_big.jpg

Electricity Forecast




World Electricity Generation
1971-2020
30 000
25 000
20 000
15 000
10 000
5 000
0
TWh
1971
1980
1990
2000
2010
2020
Coal
Oil
Gas
Nuclear
Hydro
Other Renewables

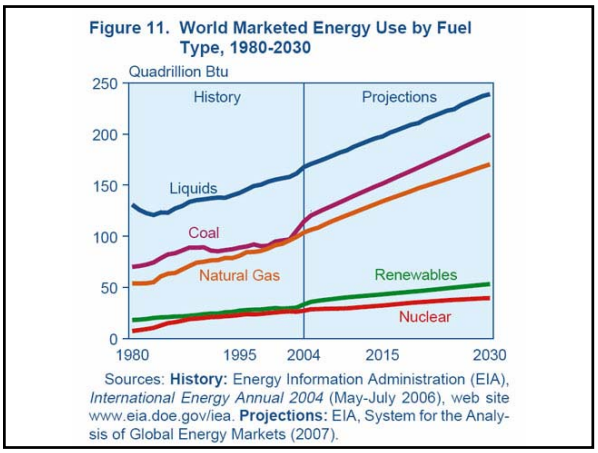
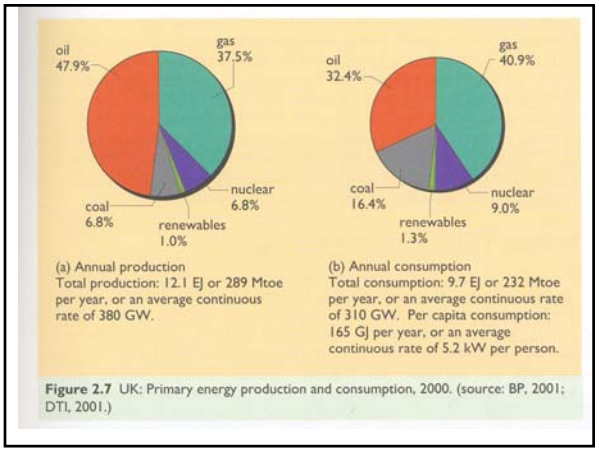
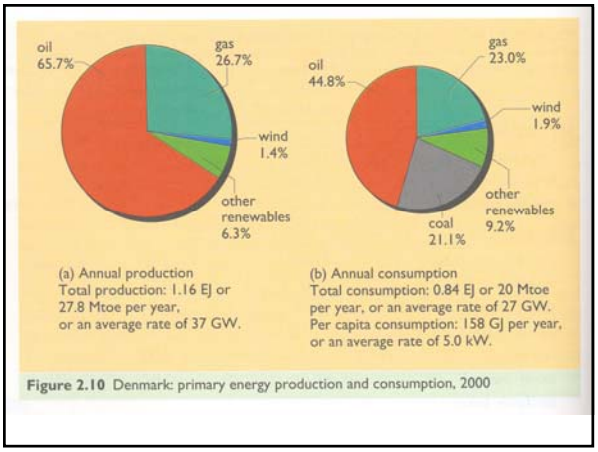
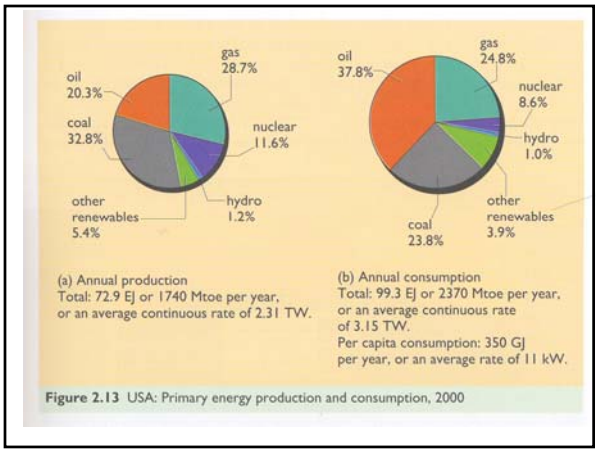
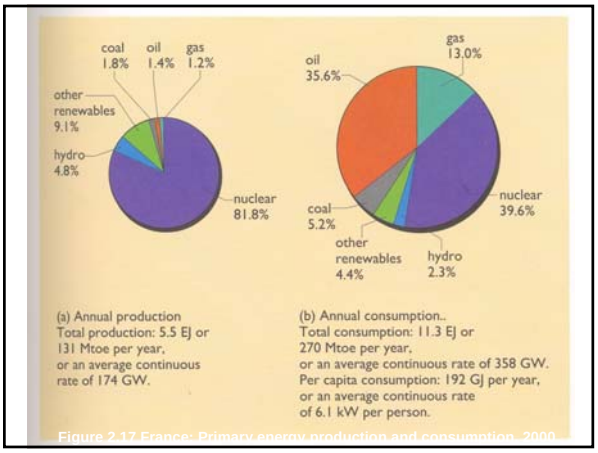


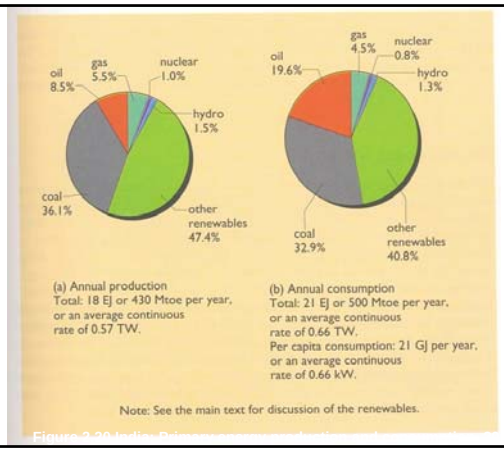
Figure 11. World Marketed Energy Use by Fuel Type, 1980-2030
Quadrillion Btu
250
200
150
100
50
0
History
Projections
Liquids
Coal
Natural Gas
Renewables
Nuclear
1980
1995
2004
2015
2030
Sources: History: Energy Information Administration (EIA), International Energy Annual 2004 (May-July 2006), web site www.eia.doe.gov/iea. Projections: EIA, System for the Analysis of Global Energy Markets (2007).


oil 47.9%
gas 37.5%
nuclear 6.8%
coal 6.8%
renewables 1.0%
(a) Annual production
Total production: 12.1 EJ or 289 Mtoe per year, or an average continuous rate of 380 GW.
oil 32.4%
gas 40.9%
coal 16.4%
nuclear 9.0%
renewables 1.3%
(b) Annual consumption
Total consumption: 9.7 EJ or 232 Mtoe per year, or an average continuous rate of 310 GW. Per capita consumption: 165 GJ per year, or an average continuous rate of 5.2 kW per person.
Figure 2.7 UK: Primary energy production and consumption, 2000. (source: BP, 2001; DTI, 2001.)


oil 65.7%
gas 26.7%
wind 1.4%
other renewables 6.3%
(a) Annual production
Total production: 1.16 EJ or 27.8 Mtoe per year, or an average rate of 37 GW.
oil 44.8%
gas 23.0%
wind 1.9%
other renewables 9.2%
coal 21.1%
(b) Annual consumption
Total consumption: 0.84 EJ or 20 Mtoe per year, or an average rate of 27 GW. Per capita consumption: 158 GJ per year, or an average rate of 5.0 kW.
Figure 2.10 Denmark: primary energy production and consumption, 2000

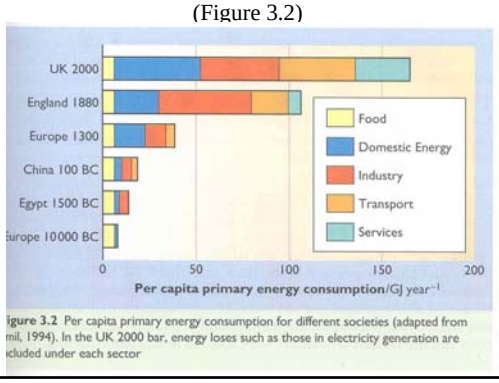

oil 20.3%
gas 28.7%
nuclear 11.6%
coal 32.8%
other renewables 5.4%
hydro 1.2%
(a) Annual production
Total: 72.9 EJ or 1740 Mtoe per year, or an average continuous rate of 2.31 TW.
oil 37.8%
gas 24.8%
nuclear 8.6%
hydro 1.0%
other renewables 3.9%
coal 23.8%
(b) Annual consumption
Total: 99.3 EJ or 2370 Mtoe per year, or an average continuous rate of 3.15 TW.
Per capita consumption: 350 GJ per year, or an average rate of 11 kW.
Figure 2.13 USA: Primary energy production and consumption, 2000


coal 1.8%
oil 1.4%
gas 1.2%
other renewables 9.1%
hydro 4.8%
nuclear 81.8%
(a) Annual production
Total production: 5.5 EJ or 131 Mtoe per year, or an average continuous rate of 174 GW.
oil 35.6%
gas 13.0%
nuclear 39.6%
coal 5.2%
other renewables 4.4%
hydro 2.3%
(b) Annual consumption..
Total consumption: 11.3 EJ or 270 Mtoe per year, or an average continuous rate of 358 GW.
Per capita consumption: 192 GJ per year, or an average continuous rate of 6.1 kW per person.



Look How Far We Have Come!

(Figure 3.2)



igure 3.2 Per capita primary energy consumption for different societies (adapted from mil, 1994). In the UK 2000 bar, energy loses such as those in electricity generation are ncluded under each sector

"a sad hoax, for industrial man no longer eats potatoes made from solar energy, now he eats potatoes made of oil." (Odum, 1971)

Efficacy of Lighting Sources

(Table 3.1)

Lighting Source	~Efficacy (lumens/W)
Candle	0.07
Gas mantle	0.9
Light Bulb	5
Compact fluorescent bulb	25
Sodium street lamp	60

Raw Materials

(from p. 106, for RQ #1)

Material	Energy Cost (MJ/kg)	Production Process
Al	227-342	from ore (bauxite)
Cement	5-9	from raw materials
Cu	60-125	from ore
Plastics	60-120	from crude oil
Glass	18-35	from raw materials
Iron	20-25	from ore
Bricks	2-5	from clay
Paper	25-50	from wood

Figures 3.10-3.12

(RQ #2)

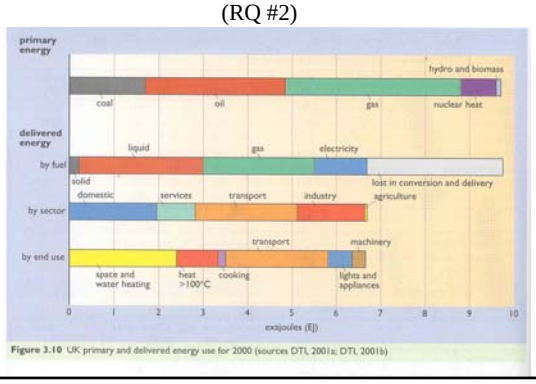


Figure 3.10 UK primary and delivered energy use for 2000 (sources DTI, 2001a; DTI, 2001b)

Figures 3.10-3.12
(RQ #2)

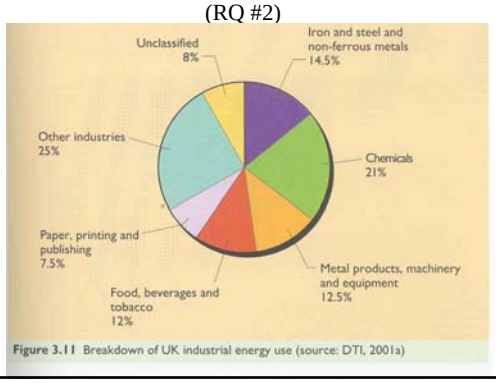


Figure 3.11 Breakdown of UK industrial energy use (source: DTI, 2001a)

Figures 3.10-3.12
(RQ #2)

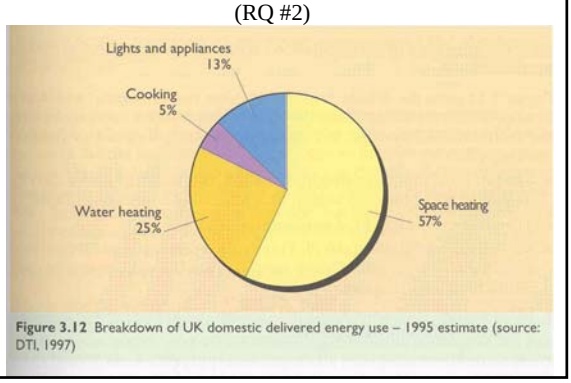


Figure 3.12 Breakdown of UK domestic delivered energy use – 1995 estimate (source: DTI, 1997)

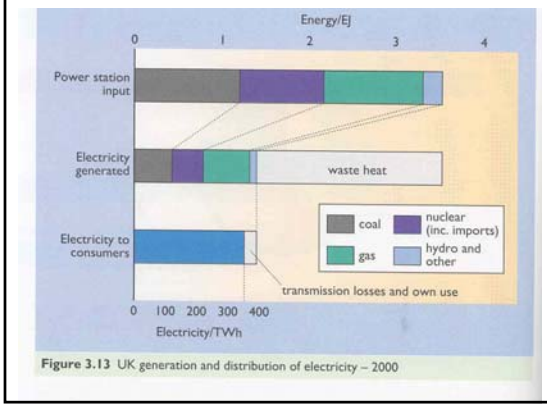


Figure 3.13 UK generation and distribution of electricity – 2000

Figures 3.17, 3.18
(RQ #7)

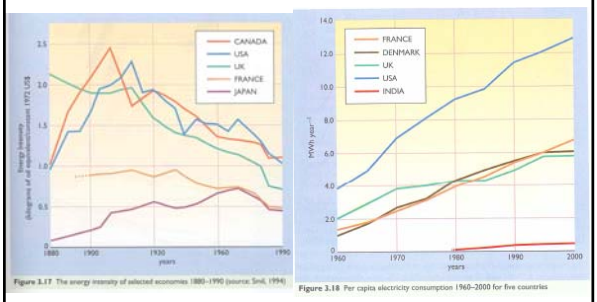
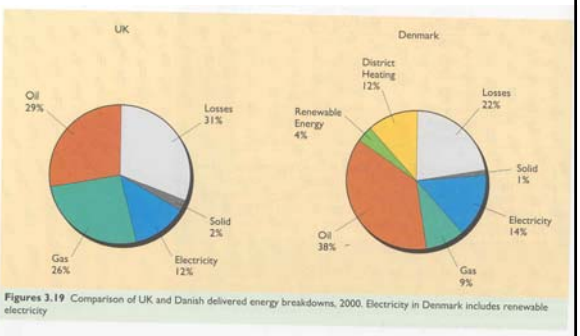


Figure 3.17 The energy intensity of selected economies 1880–1990 (source: Smil, 1994)

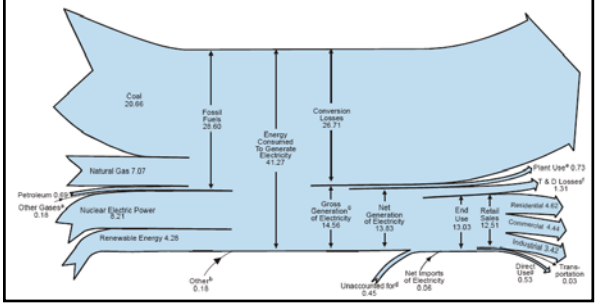
Figure 3.18 Per capita electricity consumption 1960–2000 for five countries



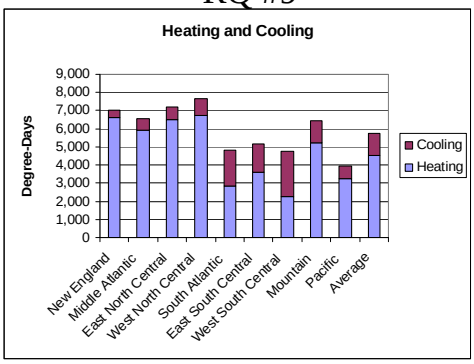
Figures 3.19 Comparison of UK and Danish delivered energy breakdowns, 2000. Electricity in Denmark includes renewable electricity

Electricity Flow in U.S.
(Reading Question 6)

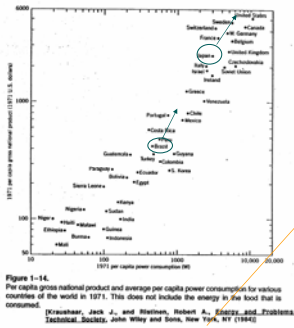
2006 Data, Units are in quadrillion BTU



RQ #9



Reading Question 10



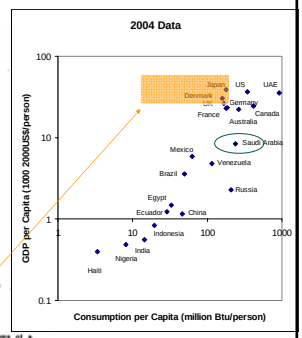


Figure 1–14.
Per capita gross national product and average per capita power consumption for various countries of the world in 1971. This does not include the energy in the food that is consumed.
[Kraushaar, Jack J., and Ristinen, Robert A., Energy and Problems of a Technical Society, John Wiley and Sons, New York, NY (1984)]

Where are the most efficient nations?