Lecture 5: Wednesday, February 6, 2008

HW#1 is due in class TODAY.
Please make sure your name is written clearly.

The class web site
http://www.physics.rutgers.edu/~karin/140
includes required reading (articles and weblinks) and useful course information (including the homeworks)

If you find cartoons, ads, or interesting articles,
please send me the link
(various viewpoints appreciated) at
rabe@physics.rutgers.edu

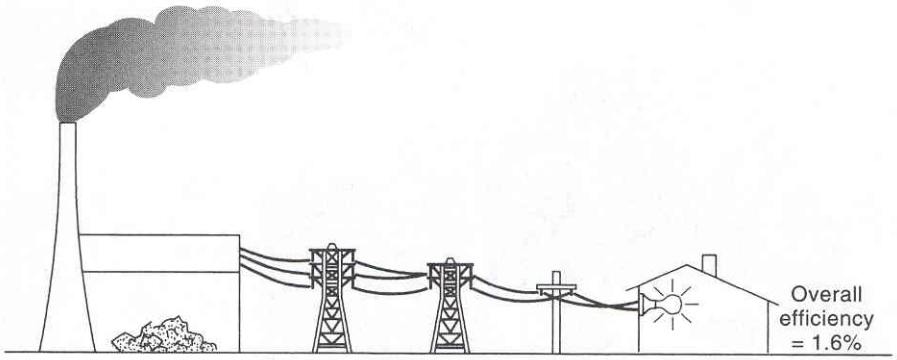
Niagara Falls–potential energy & power of falling water

Horseshoe Falls

length of brink: 2600 feet
height: 167 feet
volume of water: 600,000
U.S. gallons per second

Table 3.1 EFFICIENCIES OF SOME ENERGY CONVERSION DEVICES AND SYSTEMS

Device	Efficiency
Electric generators (mechanical → electrical)	70–99%
Electric motor (electrical → mechanical)	50–95%
Gas furnace (chemical → thermal)	70–95%
Wind turbine (mechanical → electrical)	35–50%
Fossil-fuel power plant (chemical → thermal → mechanical → electrical)	30–40%
Nuclear power plant (nuclear → thermal → mechanical → electrical)	30–35%
Automobile engine (chemical → thermal → mechanical)	20–30%
Fluorescent lamp (electrical → light)	20%
Incandescent lamp (electrical → light)	5%
Solar cell (light → electrical)	5–28%



Overall efficiency for chemical energy to light energy conversion $= E_1 \times E_2 \times E_3 = 0.35 \times 0.90 \times 0.05 = 0.016$

FIGURE 3.4

Calculation of the overall efficiency for a multistep process involves multiplying the efficiencies of the individual steps.


POWER PLANTS
TEL: 642339
CHEESE PLANT
BIG CHEESE PLANT
CACTI
dave. +S.C.

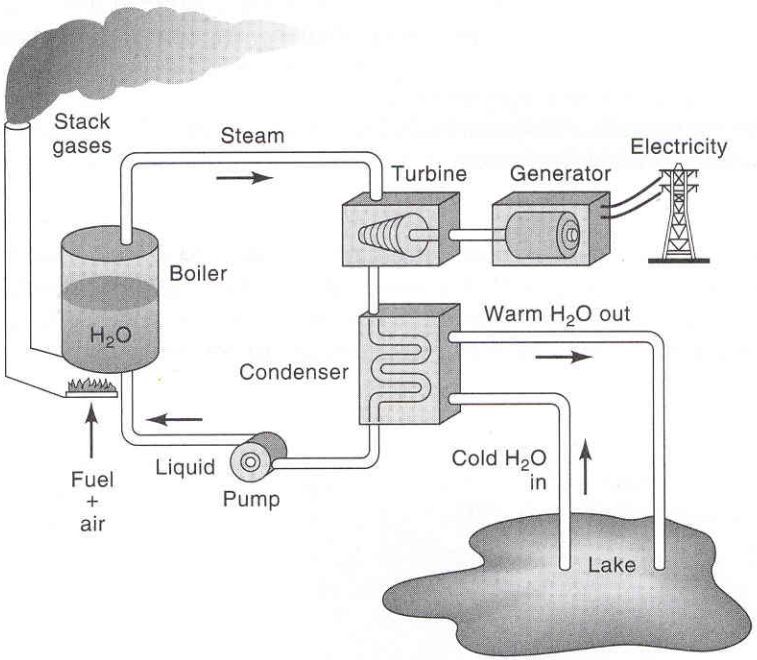


FIGURE 3.3
Block diagram of a fossil-fuel-powered electric generating station. Energy in = energy out, because no energy is stored.

Efficiency of 35%

- Higher relative cost of electricity
- More waste heat than useful electricity!!

Thermal pollution

PSE&G Electric

Usage	Meter 126628218
Actual reading Jan 17	26155
Actual reading Dec 15	25647
Total kWh	508

Charges		Rate - RS
Delivery		
Service charge		$2.41
Distribution charges		
kWh charges	508 kWh @ $0.053818898	27.34
Sub-Total Delivery		**$29.75**
Supply*		
BGS Energy		
Charges	508 kWh @ $0.054842520	27.86
Sub-Total Supply		**$27.86**
Total electric charges		**$57.61**

The Brayton Point Power Plant (1961) in Somerset, Massachusetts continues to be one of the worst industrial polluters in New England.
3 coal, one oil-fired generator
One of the “Filthy Five” (just in Massachusetts!!)


Services
Building
P
Motor
Pool
A
B
G
H
ussell Apartments
P
Busch
Cogeneration
Plant
54A
TITSWORTH PL
Center
for Packaging
Engineering
51B
56
Nelson
Biology
Smithers
Hall
57A
57B
54
Security
Headquart
Genetics &
Doolittle
Biome
Engine

The Busch cogeneration plant, which produces electricity and hot water for the Busch and Livingston campuses, has earned a certificate of recognition from the U.S. Environmental Protection Agency (EPA) under a new program designed to encourage innovation among power-generating facilities.

The Combined Heat and Power Certificate of Recognition honors cost-effective power-generating facilities that increase the nation's electric power capabilities while minimizing pollutants. The program is managed by the EPA's EnergyStar program, which encourages energy efficiency and pollution reduction. Rutgers is one of only three facilities in the country honored with the certificate.

The plant, in service since 1995, uses natural gas to produce 13.5 million watts of electric power, enough to meet the needs of 2,700 single-family homes. It produces roughly 90 percent of the electric power for the university's Busch and Livingston campuses each winter and half the campuses' electricity in the summer.

"This plant delivers. It has been an efficient and reliable source of energy for the two campuses since it first went into service in 1995," said Richard Bankowski, manager of utility services for Rutgers.

Cogeneration plants produce two types of energy from a single fuel. The Busch plant uses natural gas, which is burned to generate electricity via a turbine generator. Heat generated in that process is used to heat water under pressure to 370 degrees Fahrenheit. The water is then piped to various buildings. This "thermal recycling" reduces emissions and improves the efficiency of the operation.
[Note: the efficiency of the Rutgers plant is 73%]

From Rutgers Focus, Sept 15, 2000