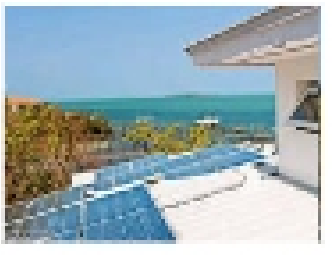
Extra Credit #4 – due Wednesday October 22 in class.

Suppose one installs a photovoltaic system for one's house, that costs $24,000. However, with all the different subsidies, one only pays $12,000 out of pocket.



If one sells the house 5 years later, does this investment add $12,000 or $24,000 or nothing or negative to the value of the house – in terms of the sale price.

Write a few paragraph answer, and include references (and where you got any information, e.g. realtor).

Reminders….

- Office hours today 11 am. Also available by appointment later this week.
- Homework #6 due today at 5 pm.
- Homework #7 now available, due next Wednesday.
- Exam #2 next Friday October 24 in class.
- I am out of town next Thursday and Friday (October 23-24), so ask questions earlier in the week.
- Research Project #1 due Friday, October 31 in class.

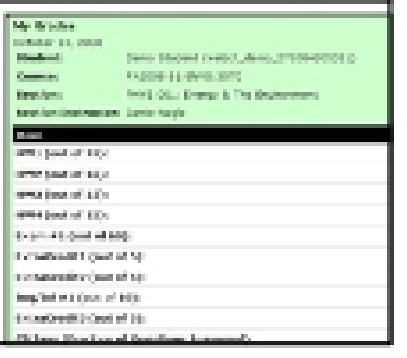
Exam #2 will have a similar format as the first exam.
Open textbook and calculators allowed, no other materials.

Practice exam and solutions are available on the web page.

Material covered Chapters 3-5 (but not including biomass or geothermal – sections 5.5-5.10). Includes homework #4-7, and lectures through Monday, October 20.

Also note that scores are now available on the CULearn page. Please check them and in particular your clicker number (fraction of questions answered).

Let me know ASAP if there are any problems.



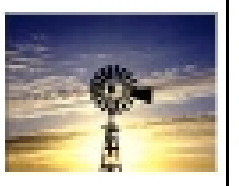
What about other renewables (still solar in origin)…

What about these other renewable energy sources?

US Renewable Energy Consumption in 2003 in QBtu

Energy Source	QBtu	Percent of US Total
Hydroelectric	2.8	2.8%
Geothermal	0.3	0.3%
Biomass	2.8	2.8%
Solar	0.06	0.06%
Wind	0.11	0.11%
Total	6.15	6.3%

Clicker Question



What does "renewable energy" mean again?

A) The energy is not actually used

B) the energy comes from living things

C) The energy that is used is returned to the environment in a re-usable form

D) the source of energy is not depleted by using it.

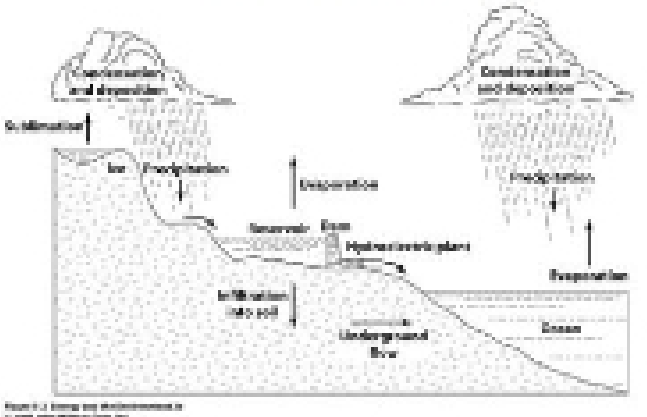
E) the energy is "green" - it does not damage or significantly alter the environment

D - you don't deplete it by using it. (Like sunshine)

Hydroelectric

Sun heats water → evaporation → vapor lifted up → rain falls → flowing water goes downhill by gravity.

Nature's heat engine !



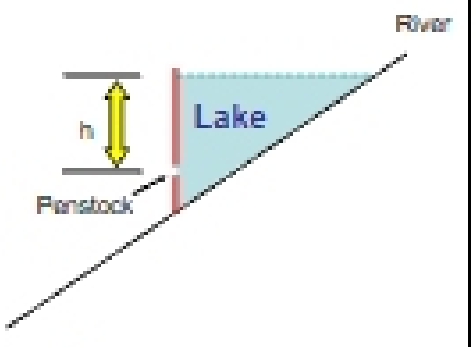
Gravitational Potential Energy

$$PE = mgh$$

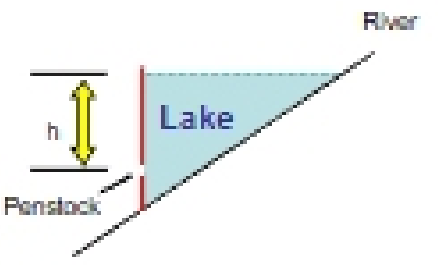
$$m = 10^3 \frac{kg}{m^3} \times V\ m^3$$

$$g = 9.8 \frac{m}{s^2}$$

$$PE = 9.8 \times 10^3 Vh$$



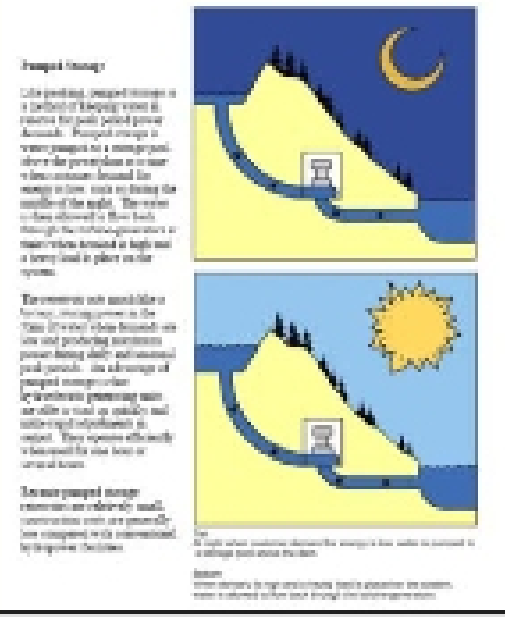
h = height in meters
V = Volume in meters^3
Potential Energy = PE in Joules

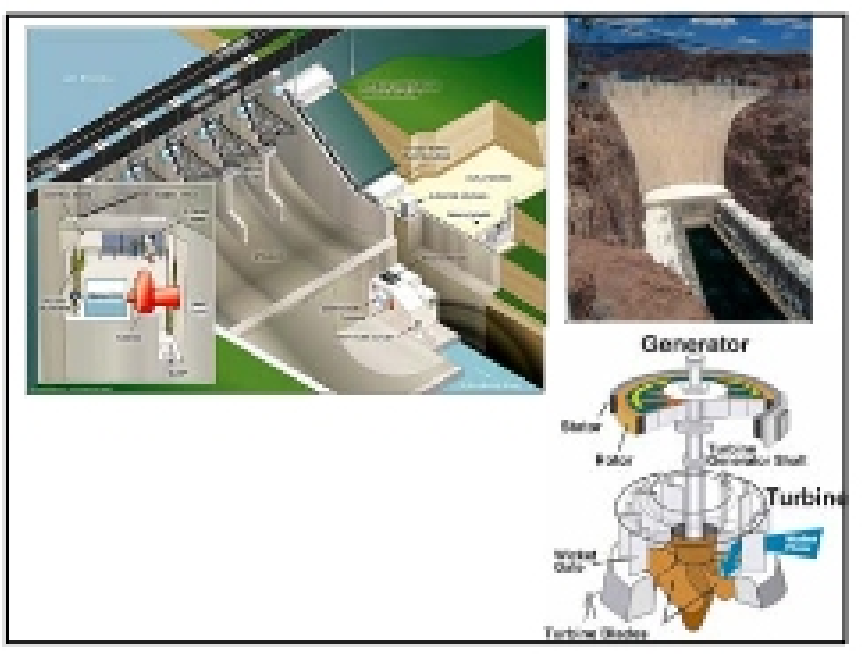


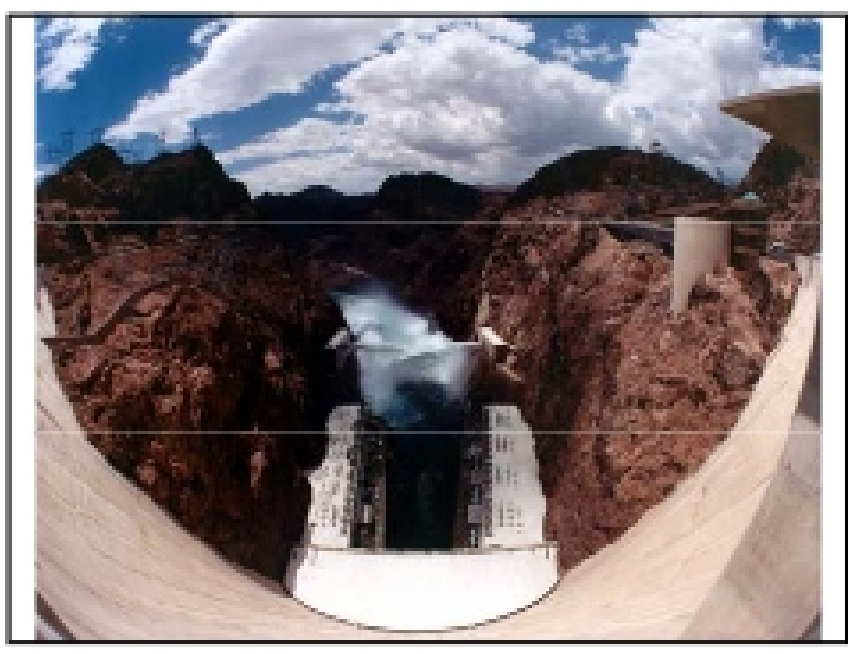
Conversion of this gravitational potential energy to electrical energy can be very efficient (80-90%).

No significant pollutants or heat. Costs less than ⅓ of current fossil fuel plants per kiloWatt-hour of energy produced.

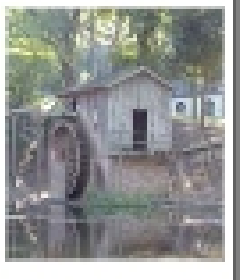
There is no thermodynamic limit for this conversion!
Also, you can pump water uphill for storage of energy. This works if you have natural places and hills/mountains around.







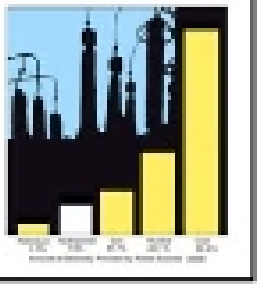
Long history (dating back to water wheels)…



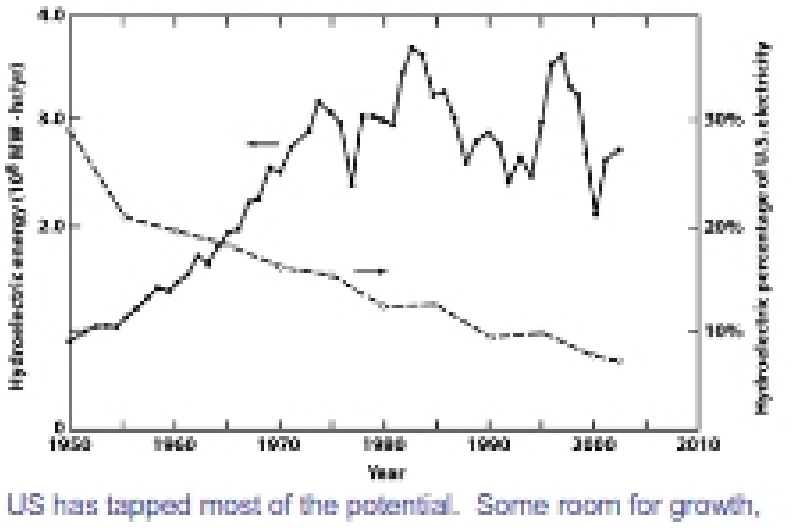
Some countries have major resources for hydroelectricity generation.

Norway: 99% of electricity! (10 GigaWatts)
Brazil: 93% of electricity
Canada: 58% of electricity
USA: 10% of electricity

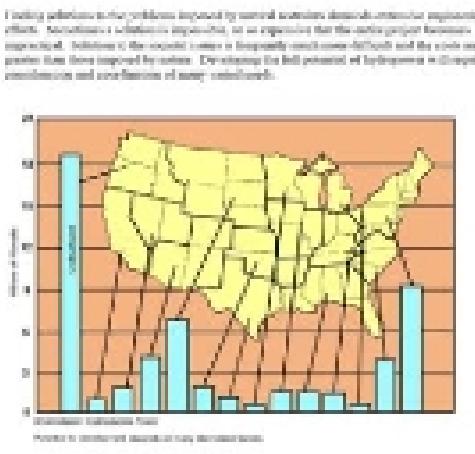
Globally: 24% of total electricity production.



Trends in US Hydroelectric Generation



US has tapped most of the potential. Some room for growth, but large environmental and cost issues now.



In the United States we are not building any new large scale hydroelectric generating facilities (dams). Some small scale projects are promising (e.g. Boulder hyrdo!).

Aswan High Dam

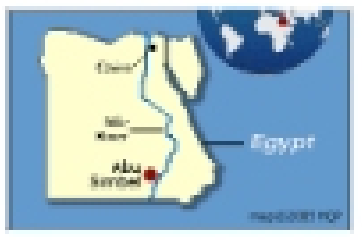
White Nile (Lake Victoria) + Blue Nile (Ethiopia)= Nile (Khartoum)
Aswan Low Dam (1889, 1912, 1933)

Aswan high dam (1952, …)

Good News ☺
12 × 175 MW= 2100 MegaWatts
Brought electricity to some areas for the first time
Controls very damaging floods

Bad News ☹
4 Million tons of sediment per year not delivered down stream and accumulating behind the dam.
Significant ecological damage to the Nile delta region

"The upper Nile region, which will be submerged by the water behind this dam, contains many sites of historical and archeological importance, including the temples at Abu Simbel and the town of Syrene, where Eratosthenes first proved that the Earth was round …"



"Every square meter of this country is significant historically or archeologically. If we preserved every antiquity we could never build anything …"