

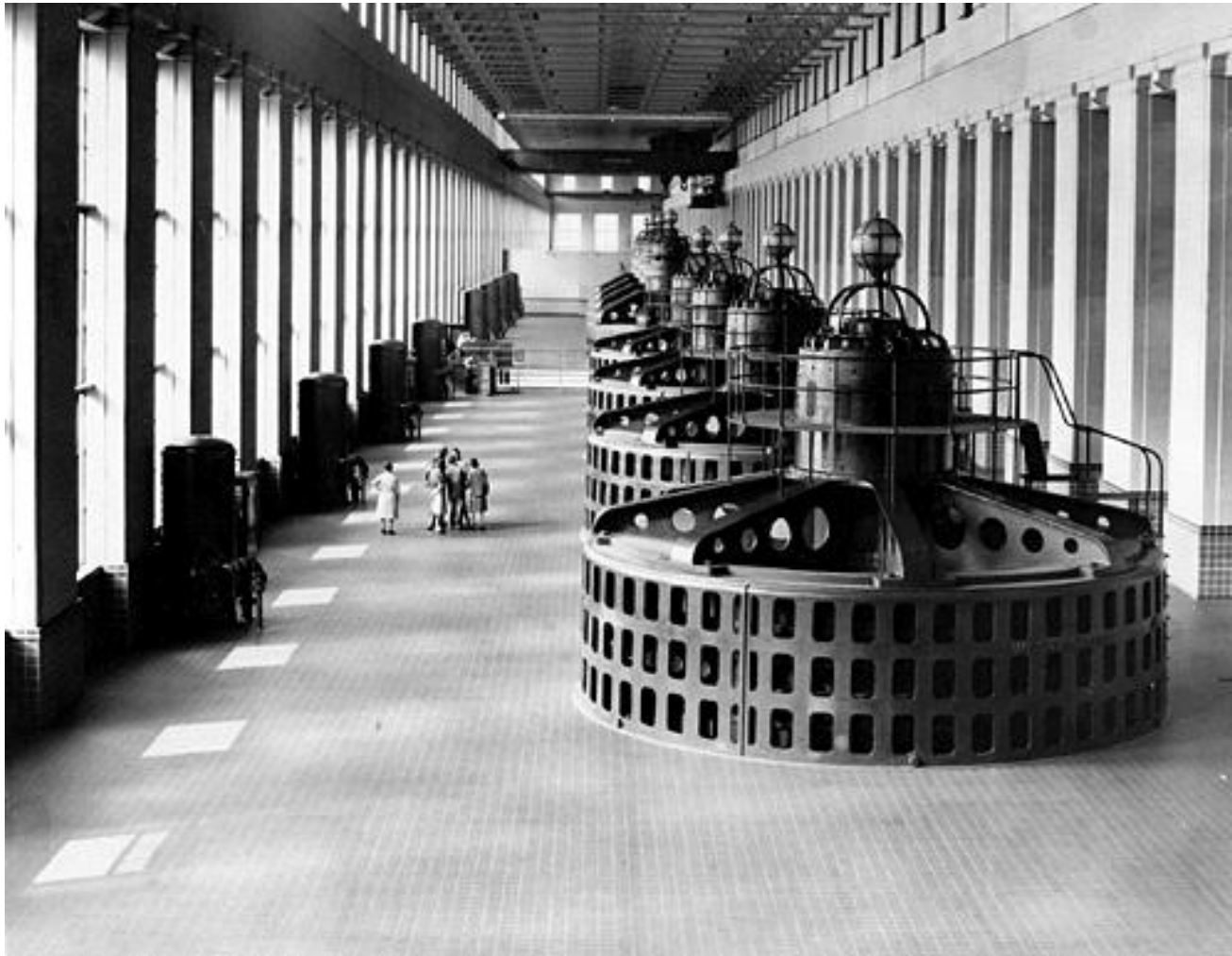
8.2 World Energy Sources

8.06	Identify different world energy sources
8.07	Connect world energy sources to CO ₂ emissions
8.08	Outline & distinguish between renewable & non-renewable energy sources
8.09	Define the energy density of a fuel
8.10	Discuss how choice of fuel is influenced by its energy density
8.11	State the relative proportions of world use of the different energy sources that are available
8.12	Discuss the relative advantages & disadvantages of various energy sources

8.2 World Energy Sources

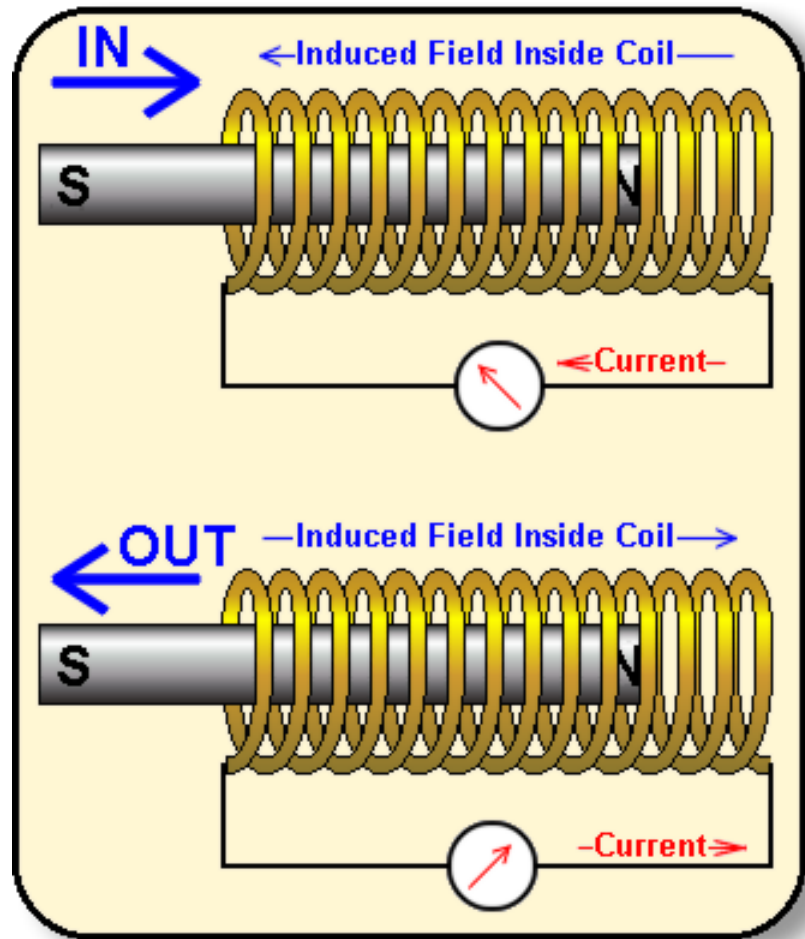
- Essential Questions
 - What are the major methods of producing energy in the world?
 - What differentiates those methods?
- Enduring Understandings
 - Energy is not all equal
 - It requires energy to make energy
 - This issue is complex!

8.06 World Sources: Electromagnetic induction



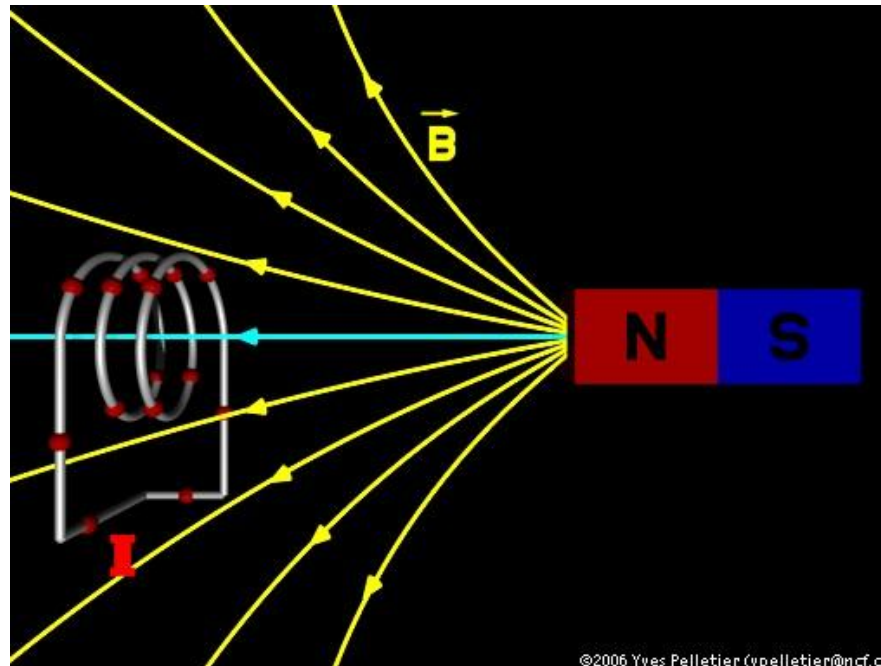
8.06 World Sources: Electromagnetic induction

If a magnet is **moved** inside a coil an electric current is **induced** (produced)



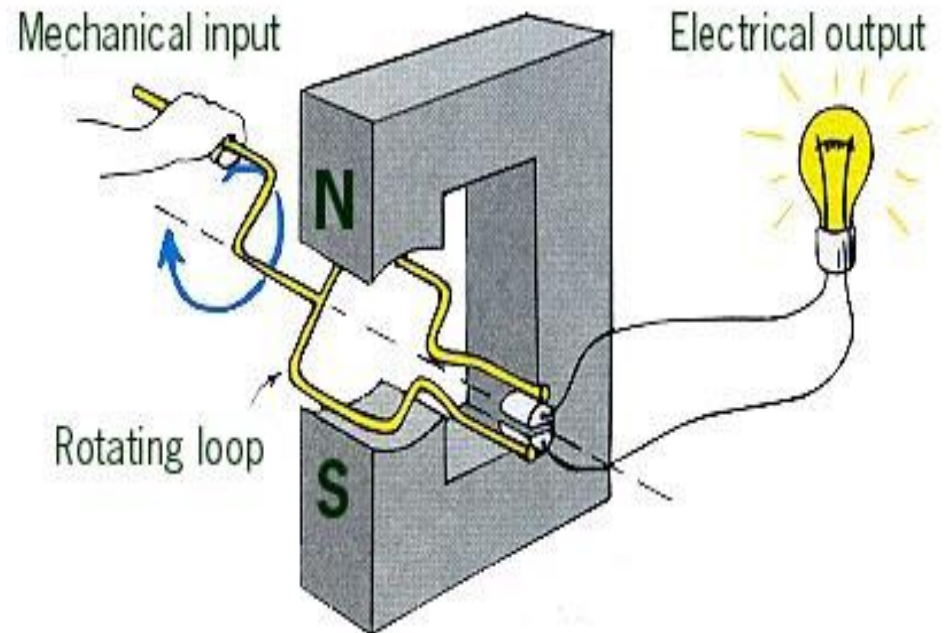
8.06 World Sources: Electromagnetic induction

A electric current is **induced** because the **magnetic field** around the coil is **changing**.

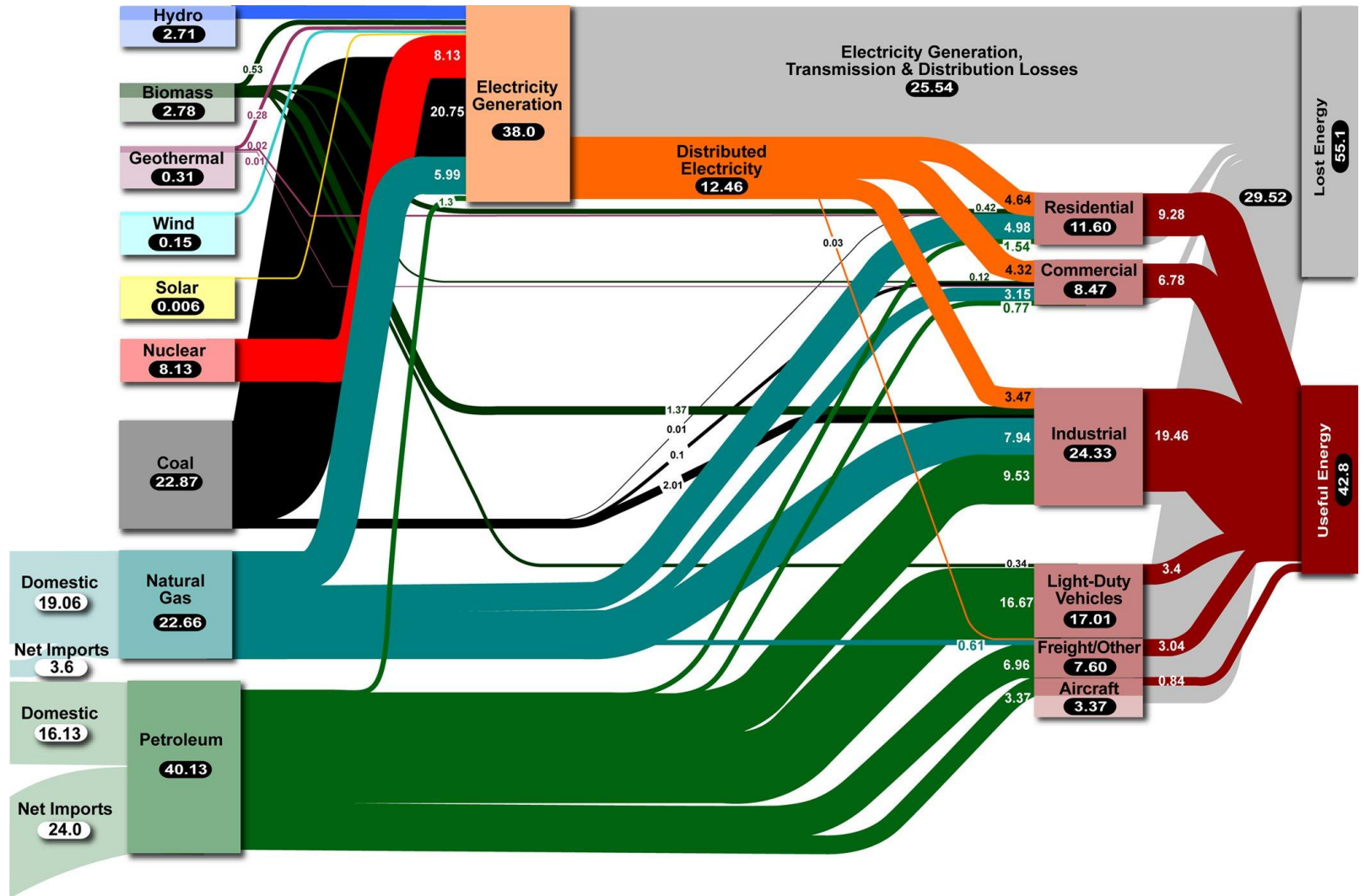


8.06 World Sources: Generator/dynamo

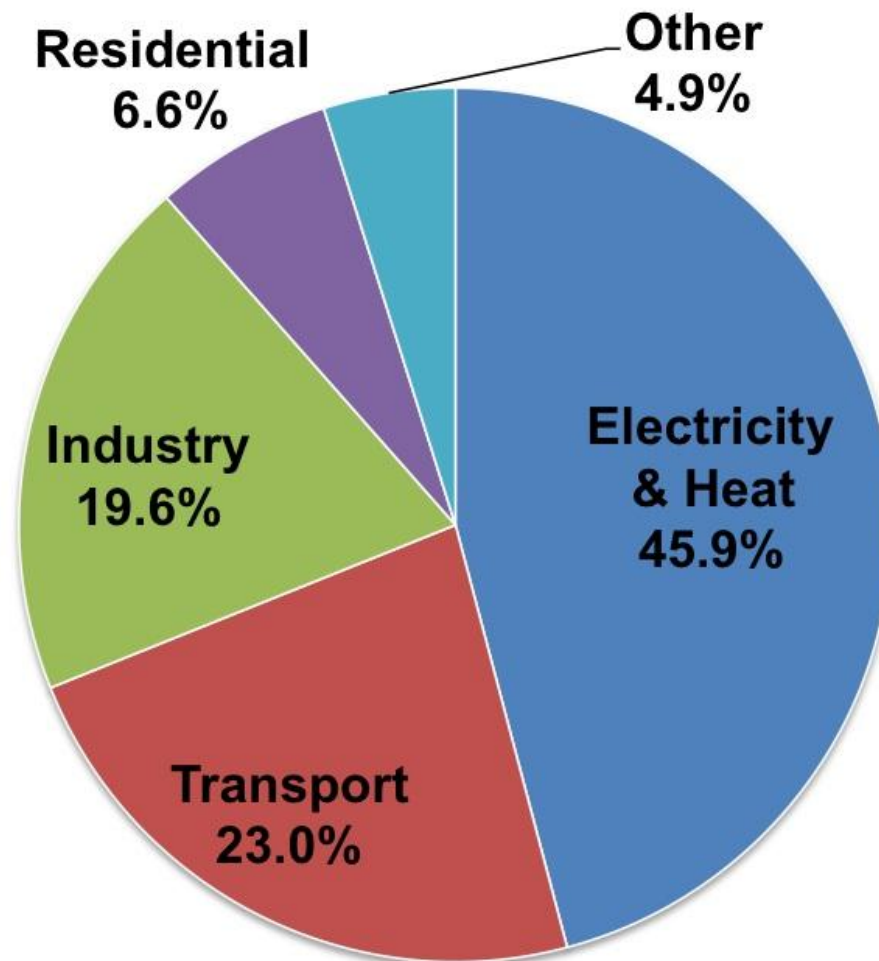
A generator works in this way by rotating a coil in a magnetic field (or rotating a magnet in a coil)



8.06 World Energy Sources: US Use



8.07: CO₂ emissions by sector

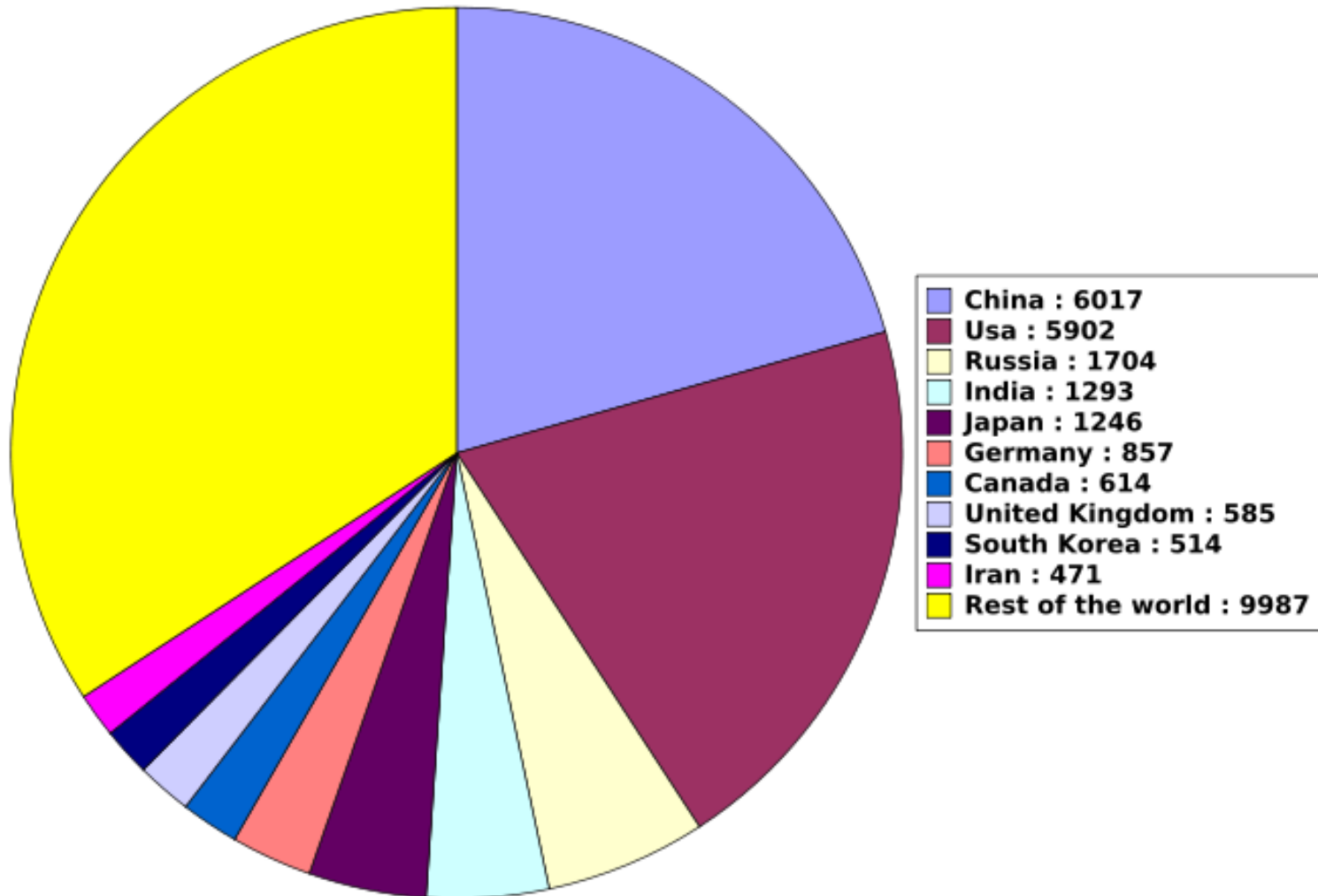


Carbon Dioxide Emissions by sector in 2006

Source: Ministry of Land, Infrastructure, Transport and Tourism Japan

8.07: CO² emissions

World Carbon Dioxide Emissions from the Consumption and Flaring of Fossil Fuels, 2006
(Million Metric Tons of Carbon Dioxide)



Source : Energy Emission Administration

8.07: CO² emissions

<http://www.google.com/publicdata/directory>

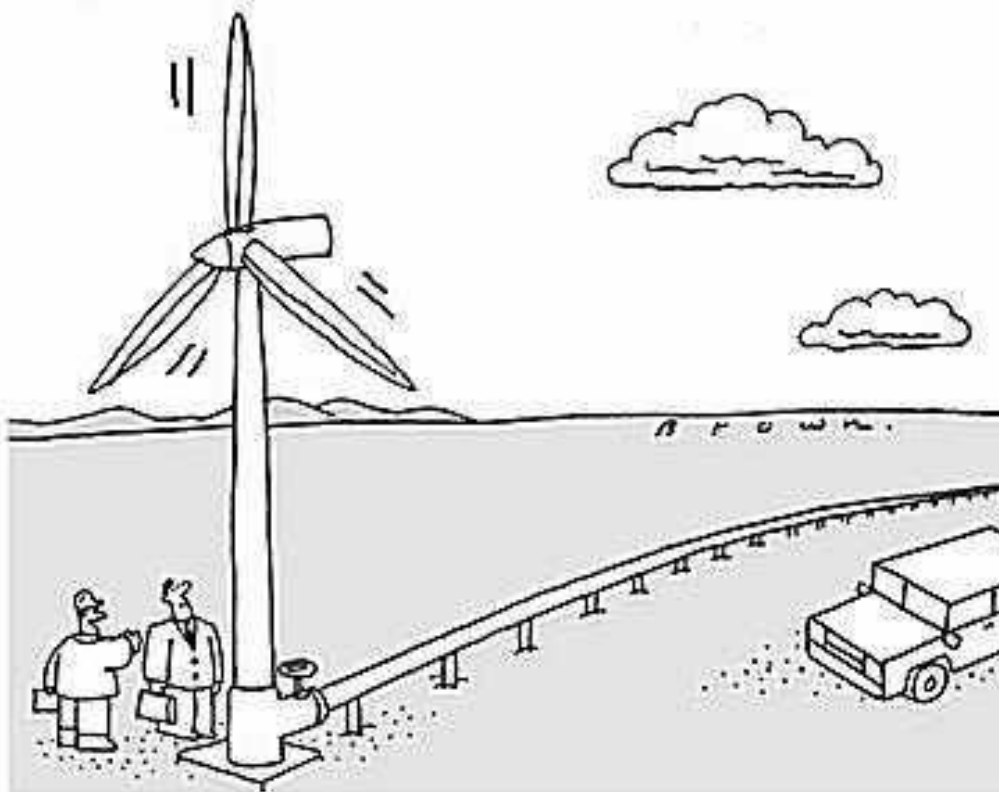
8.07: CO₂ emissions

Fuel	% total energy production	CO ₂ emission g.MJ ⁻¹
Oil	40	70
Natural gas	23	50
Coal	23	90
Nuclear	7	-
Hydroelectric	7	-
Others	< 1	-

8.08 Renewable vs Non-renewable

- Define Renewable

8.08 Non-renewable?



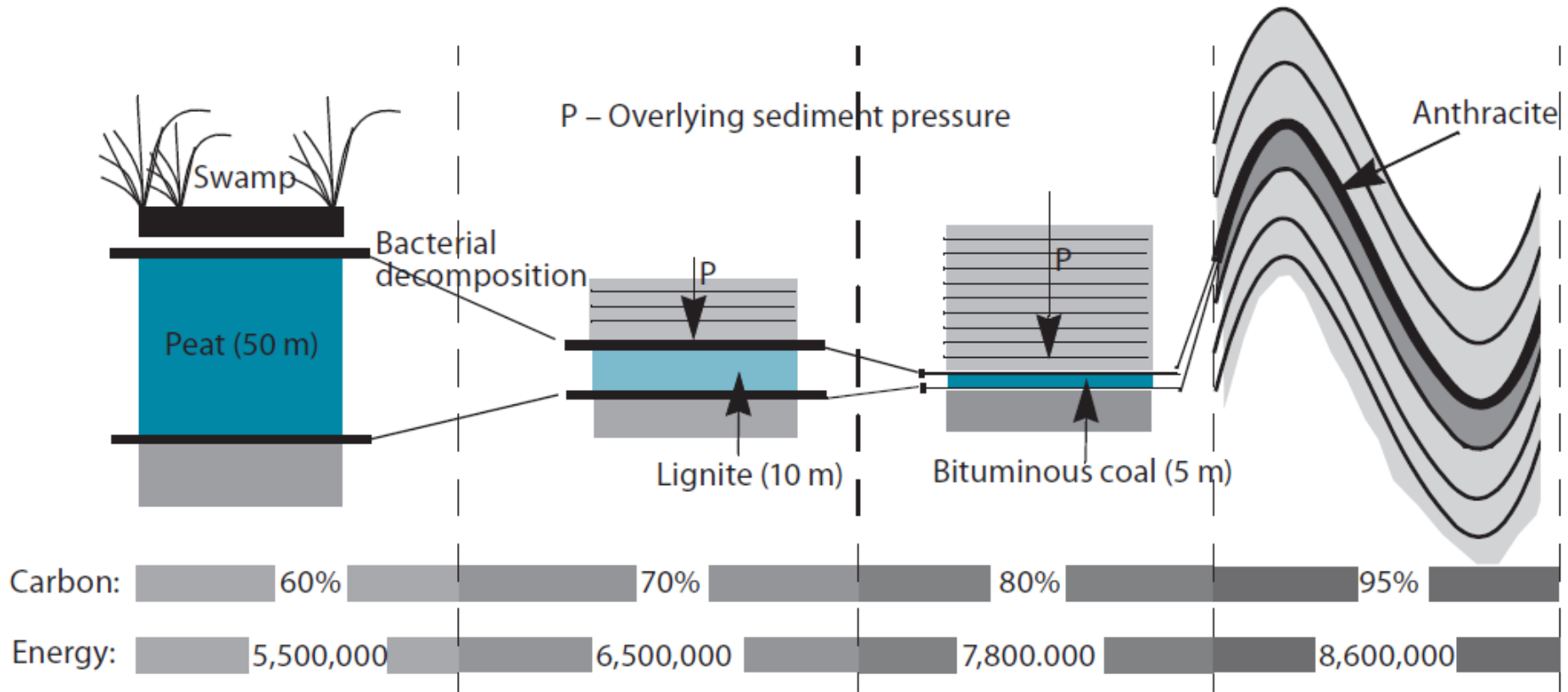
"This is our most successful project. When we dug the footing for the wind turbine, we struck oil."

8.08 Non-renewable

- Finite (being depleted – will run out)
- In general from a form of potential energy released by human action



8.08 Non-renewable: Coal



NB: The energy is the Energy per kilogram (calories).

Figure 811 The formation of coal

8.08 Non-renewable: Coal

Component	Percentage By Mass			
	Peat	Lignite	Bituminous Coal	Anthracite
Carbon	50 – 60	60 – 75	80 – 90	90 – 95
Oxygen	35 – 40	20 – 30	10 – 15	2 – 3
Hydrogen	5 – 6	5 – 6	4 – 5	2 – 3
Volatile matter	60 – 65	45 – 55	20 – 40	5 – 7

Figure 816 Composition of coal

What Questions can we ask from this table that help us better understand the various types of coal?

8.08: Non-renewable sources: Oil

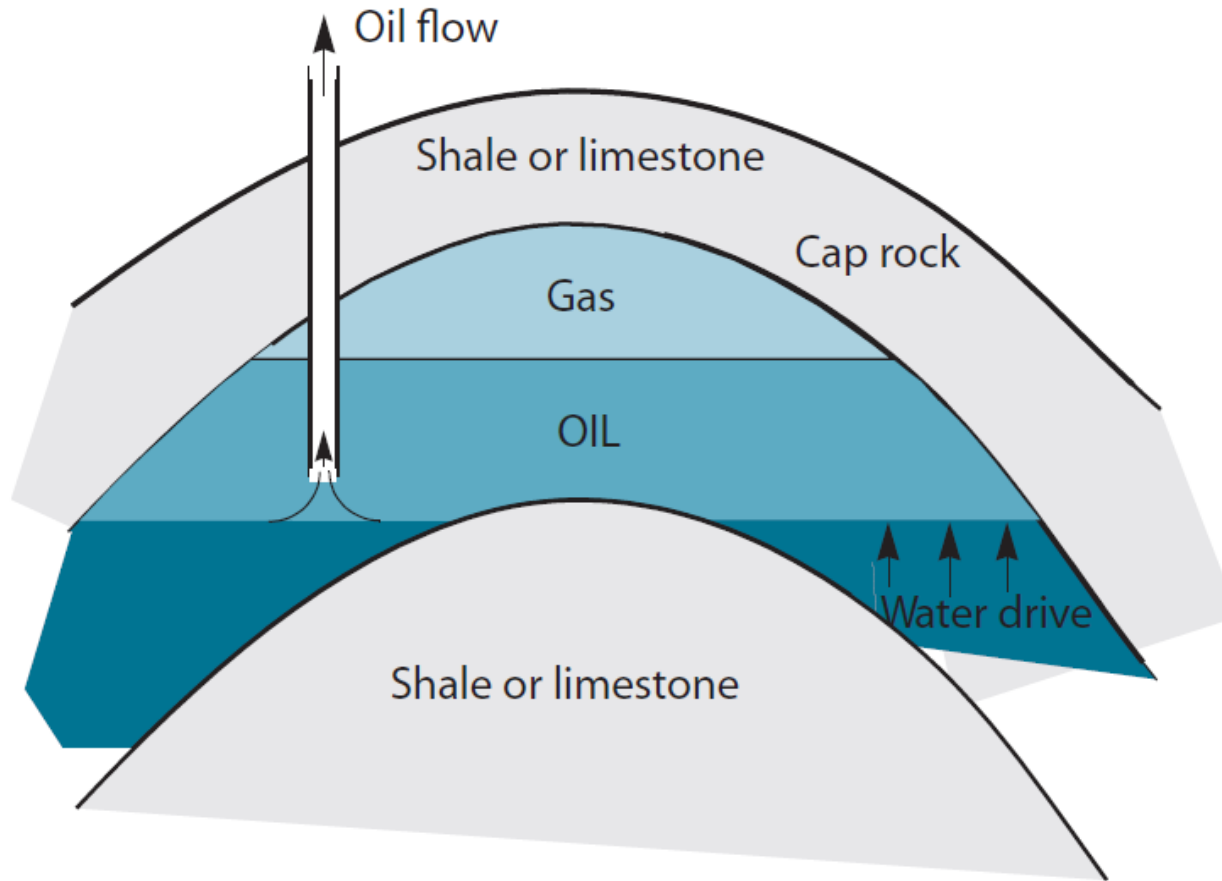


Figure 812 Accumulation of oil in reservoir rock

8.08 Non-Renewable Oil

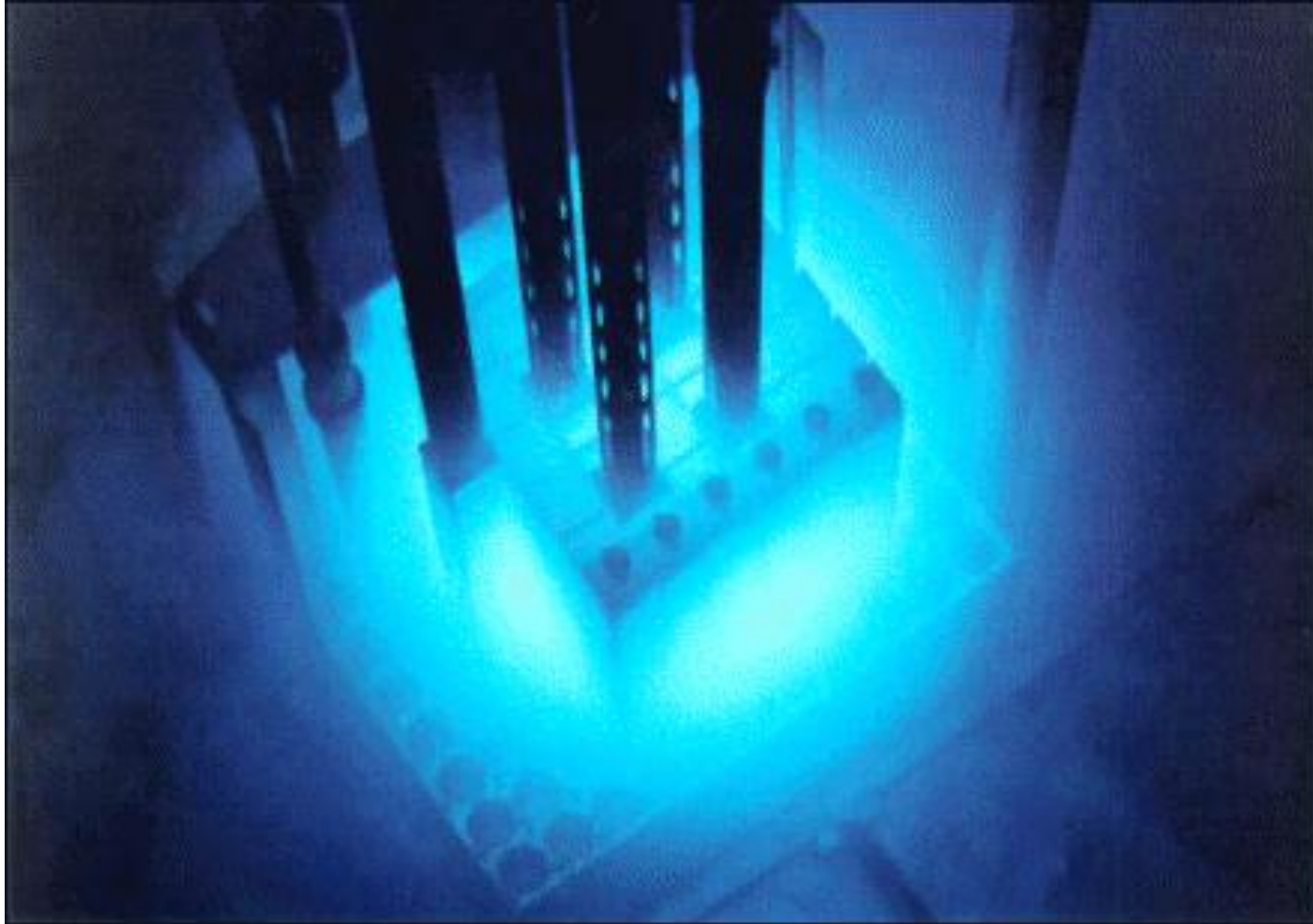
- Keystone Pipeline?
- Agree or disagree?
- Why?
- What questions?

8.08: Non-renewable: Keystone Pipeline

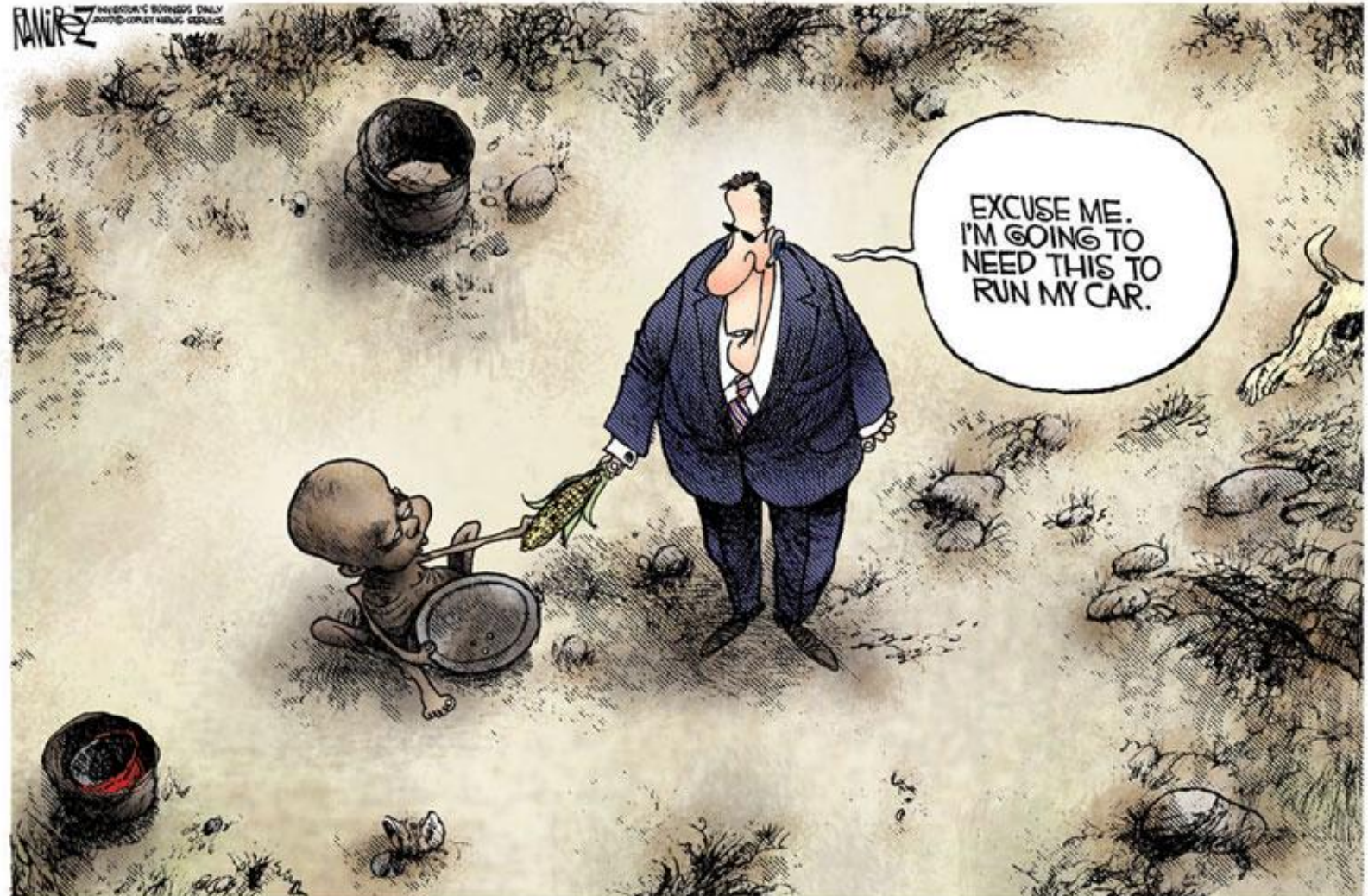




8.08 Nuclear fuels

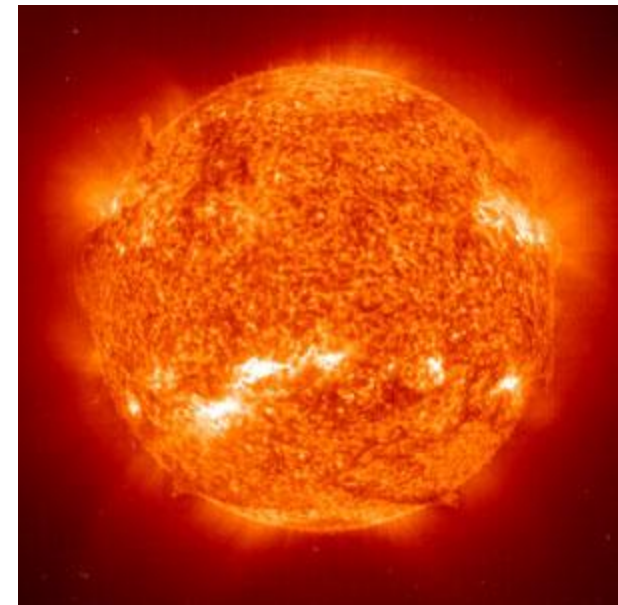


8.08 Renewable, at what cost?



8.08 Renewable

- Mostly directly or indirectly linked with the sun
- The exception is tidal energy



8.08 Renewable Energy Sources

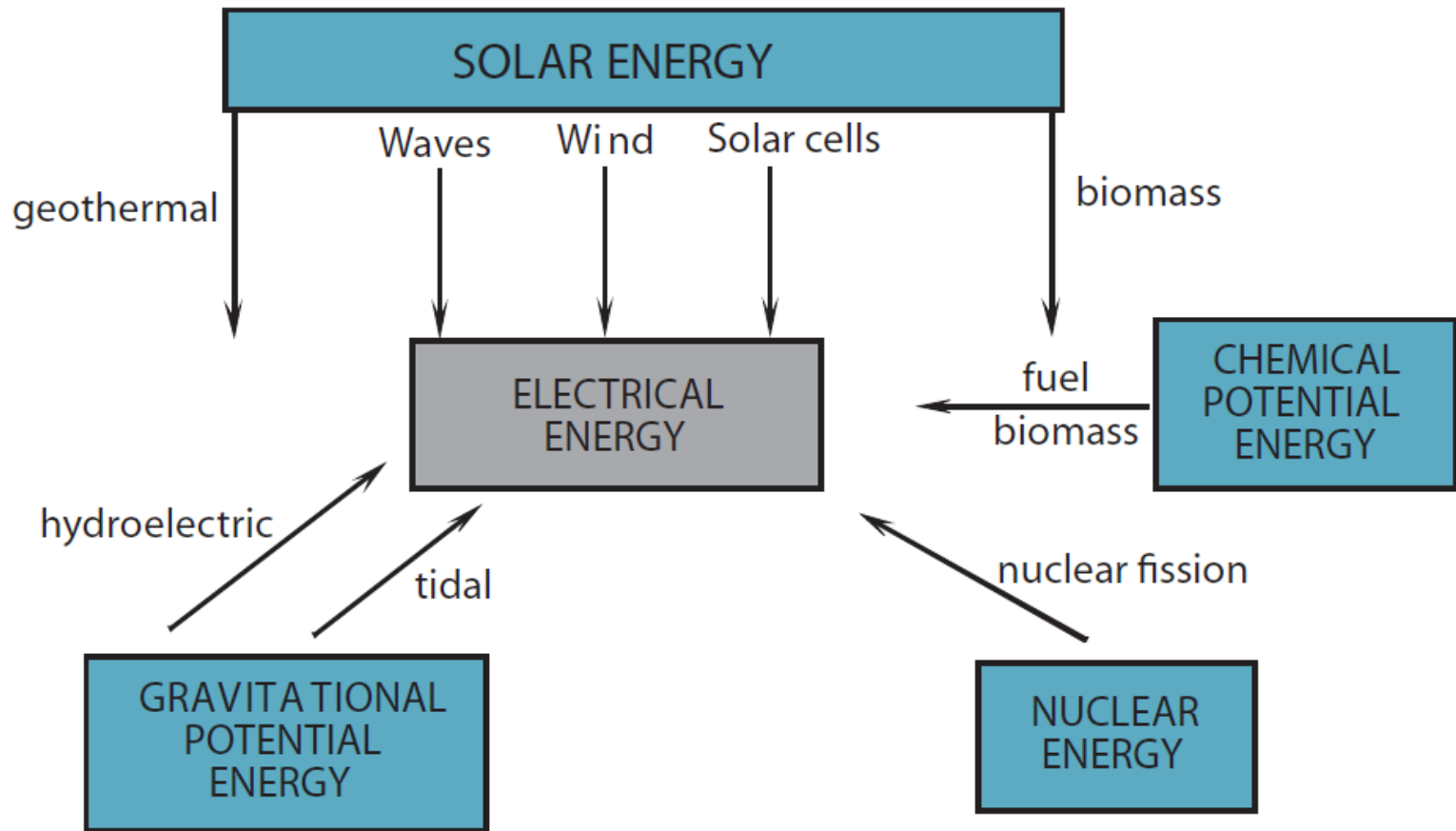
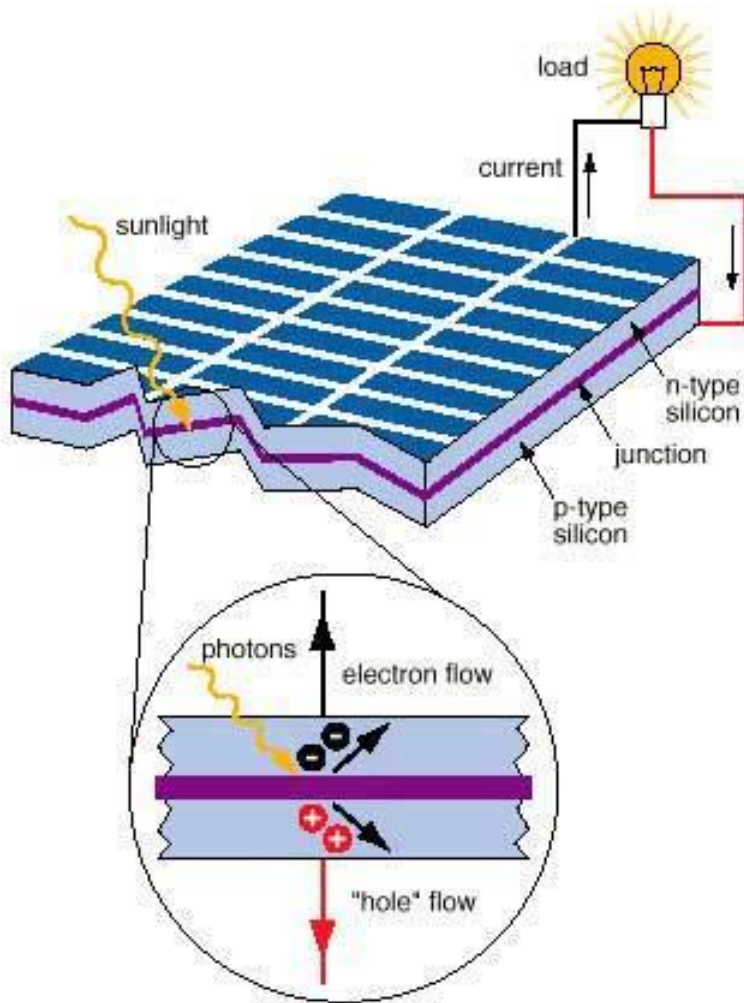
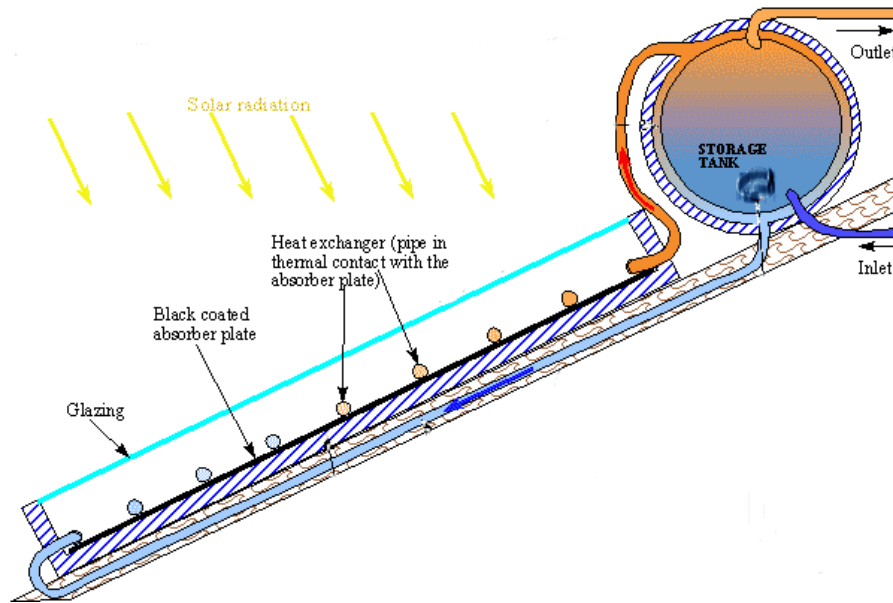


Figure 813 Renewable energy transformations

8.08 Photovoltaic cells



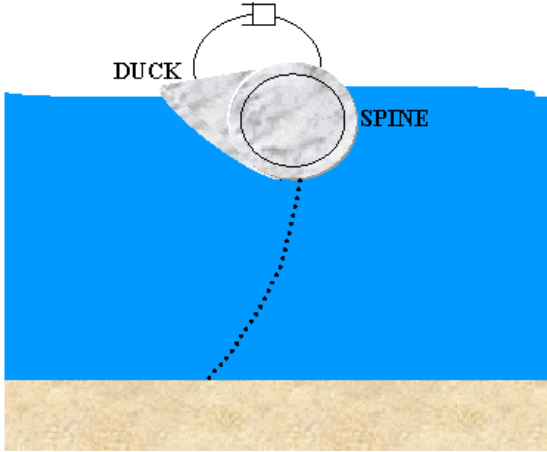
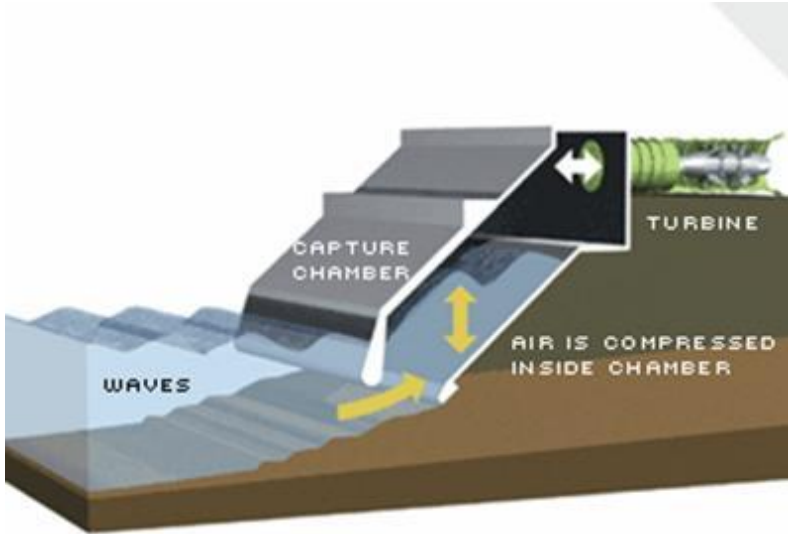
8.08 Active solar devices



8.08 Wind



8.08 Wave



8.08 Tidal



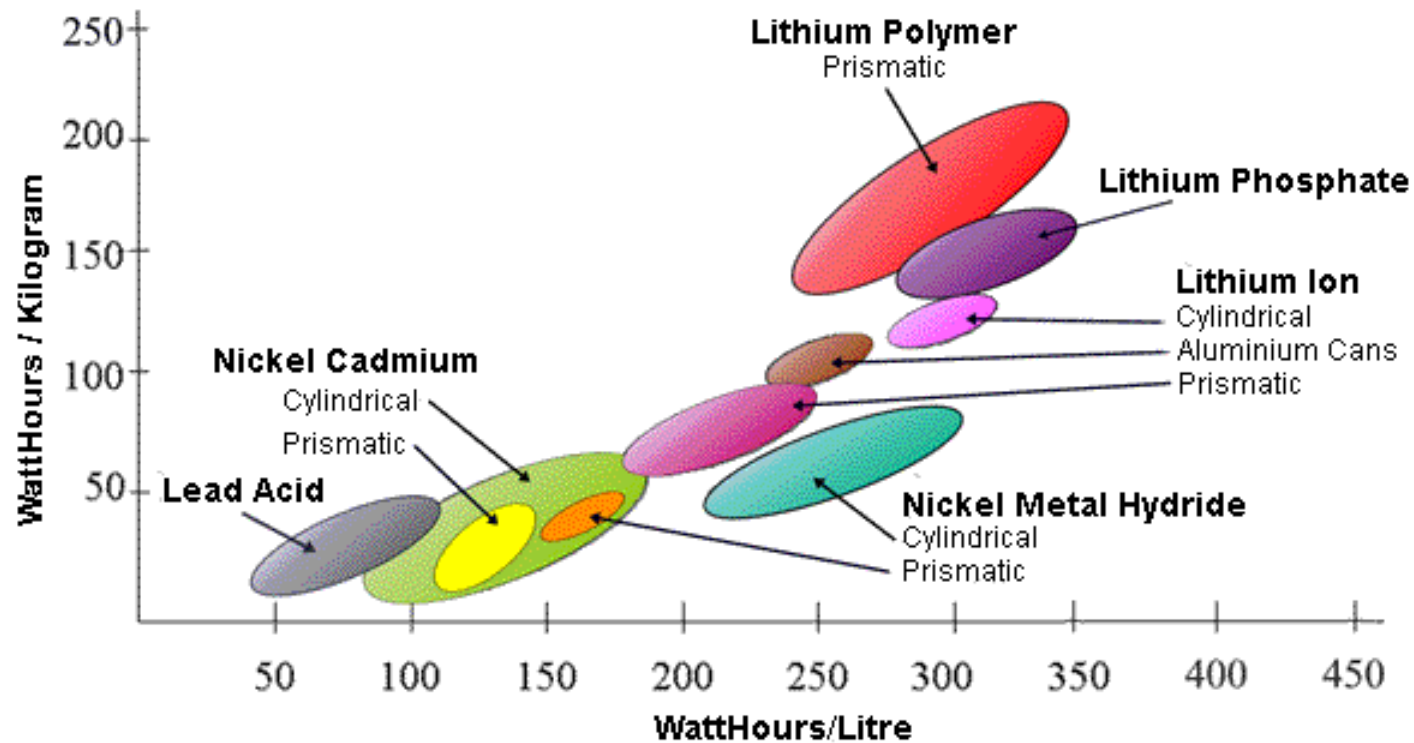
8.08 Biomass



8.09 Energy Density

- Energy Density = Chemical Potential \div mass
- From last class, what has the greatest energy density?
- Why?

8.09 Energy Density of Batteries



8.09 Energy Density

- The energy that can be obtained from a unit mass of the fuel
- J.kg^{-1}
- If the fuel is burnt the energy density is simply the heat of combustion



8.09 Energy Density

- Coal - 30 MJ.kg^{-1}
- Wood - 16 MJ.kg^{-1}
- Gasoline – 47 MJ.kg^{-1}
- Uranium – $7 \times 10^4 \text{ GJ.kg}^{-1}$ (**70000000** MJ.kg^{-1})

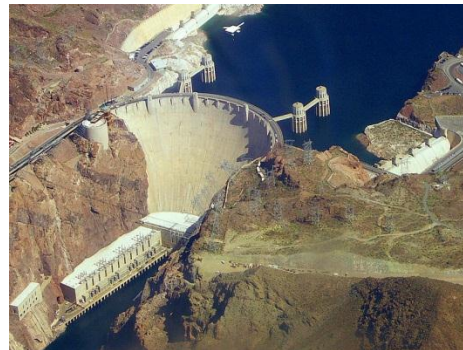


8.09 Hydroelectric energy density?



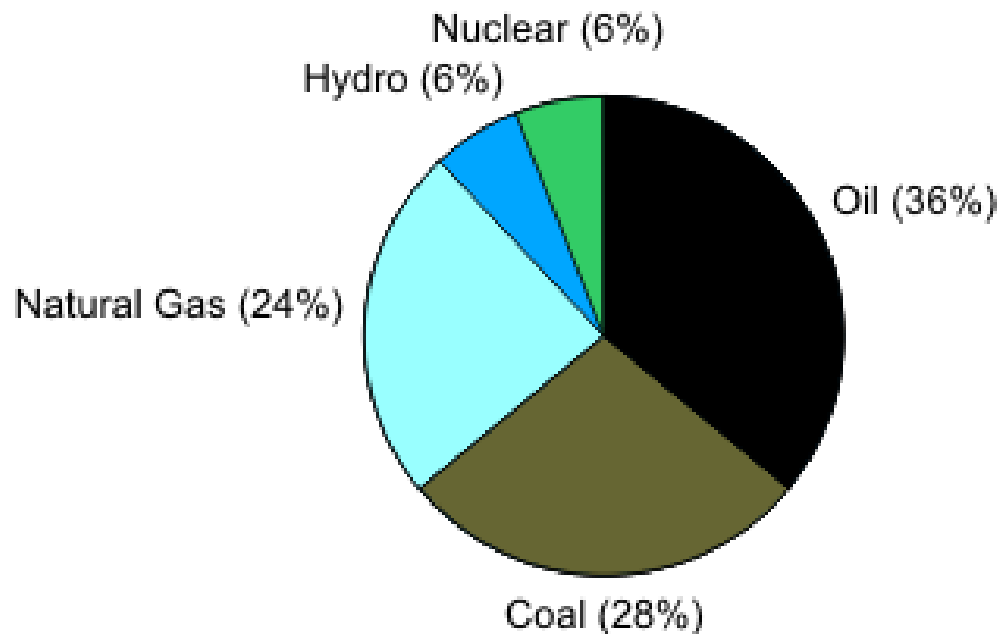
8.09 Hydroelectric energy density?

- Imagine 1 kg falling 100m.
- Energy loss = $mgh = 1 \times 10 \times 100 = 10^3 \text{ J}$
- If all of this is turned into electrical energy it gives an “energy density” of the “fuel” of 10^3 J.kg^{-1}



8.10 Discuss how choice of fuel
is influenced by its energy
density

8.11 State the relative proportions of world use of different energy sources that are available



Energy by power source 2008 ^[19]		
	TWh	%
Oil	48 204	33.5%
Coal	38 497	26.8%
Gas	30 134	20.9%
Nuclear	8 283	5.8%
Hydro	3 208	2.2%
Other RE*	15 284	10.6%
Others	241	0.2%
Total	143 851	100%

Source: IEA * = solar, wind, geothermal and biofuels

8.12 Discuss the relative advantages & disadvantages of various energy sources

- What do we already know of advantages and disadvantages?
- Research in class/home 2 energy sources

Renewable (lets list them)

Non-
Renewable

8.2 Energy Sources IB Questions

- World energy resources include coal, nuclear fuel and geothermal energy. Which of the following lists these resources in order of **primary** energy use in the world?
 - nuclear, geothermal, coal
 - nuclear, coal, geothermal
 - coal, geothermal, nuclear
 - coal, nuclear, geothermal
- Which of the following correctly shows a renewable and a non-renewable source of energy?

	Renewable	Non-renewable
A.	oil	geothermal
B.	wind	biofuels
C.	ocean waves	nuclear
D.	natural gas	coal

Current Events

- <http://www.npr.org/sections/energy/>
- <http://www.youtube.com/watch?v=cJ-J91SwP8w>

What about Wyoming?

- Where does Wyoming sit in the energy landscape?

Questions?

- What areas are of key interest to you in regards to energy?
- What conflicts, debates, issues are relevant to you?
- What local issues are you curious about with regards to energy?