

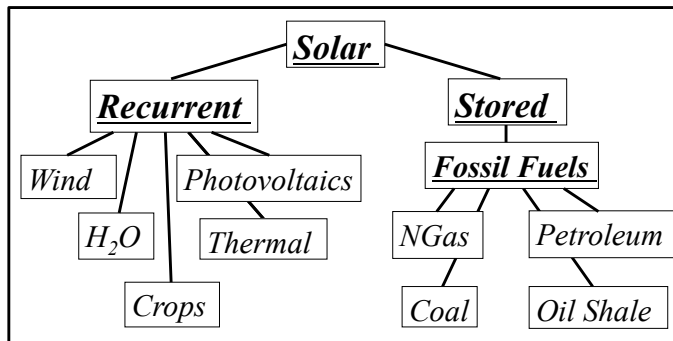
Fossil Fuel Resources

EGR325
February 7, 2011

Objectives

- Percentage of total energy from different fuels
- * Terminology *
 - Energy
 - Capacity
 - Capacity factor
- Familiarity with representation of energy data
- Discussion on projections of coal use

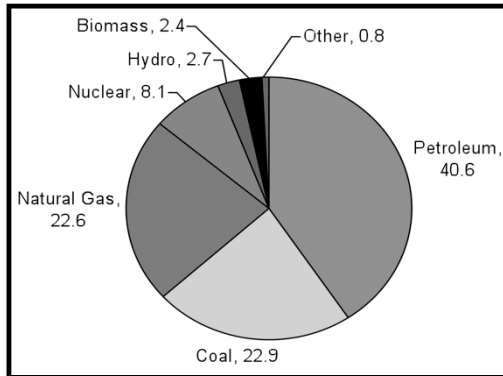
Fuels Source – the Sun



Generation – Fuel Type

- Thoughts on the relative percentage of each fuel type?
- Coal, nuclear, oil, wind, etc.

US Total Energy Pie: ~ 86% Fossil Fuels



Source: EIA Energy Outlook 2007, Table 1, 2005 Data

Basic Terms

- Energy
- Capacity (= power)
- Capacity factor
- Handout on simple calculations

Energy, Capacity and Units

- Energy units
 - A British Thermal Unit, BTU, is the amount of heat to raise one pound of water by 1 degree Fahrenheit (F).
 - 1 Joule (J) is equal to the force of one Newton acting through one meter.
 - 1 BTU = 1055 J (the mechanical equivalent of heat relation)
 - 1 Quad = 10^{15} BTU
- Power = Voltage * Current ($P = VI$)
 - 1 Watt is the power from _____?
 - 1 horsepower (hp) = 745.7 W
- Back to energy
 - 1 kilowatt-hour, kWh, is the energy of one kilowatt of power flowing for one hour.
 - 1 kWh = 3.6×10^6 J = 3.6 million Joules
- Generation Capacity = Power
 - Watt, kilowatt: kW, megawatt: MW

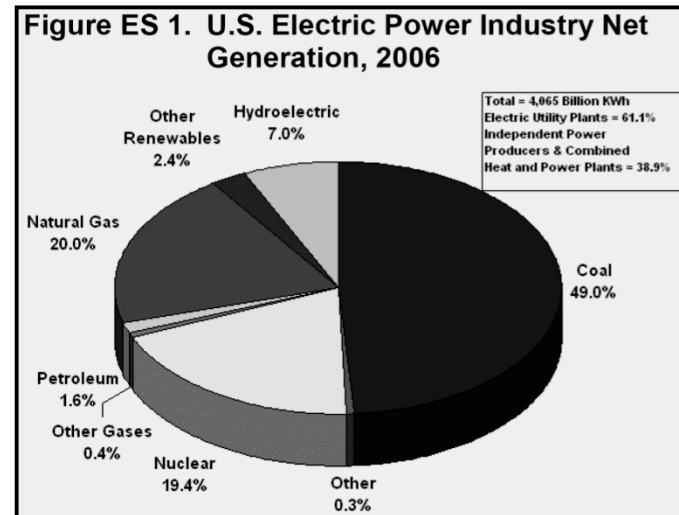
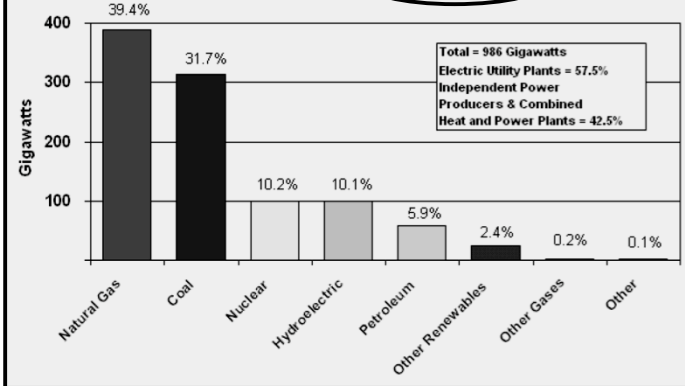
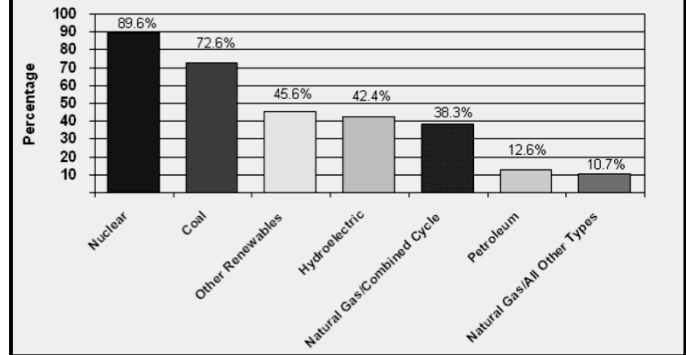


Figure ES 2. U.S. Electric Power Industry Net Summer Capacity, 2006



"Capacity" is the total MW built and ready to be used

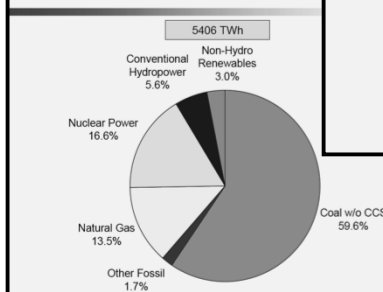
Figure ES 3. Average Capacity Factor by Energy Source, 2006



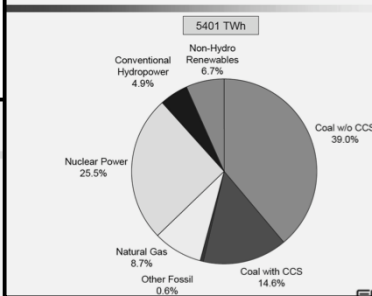
"Capacity Factor" is the percentage of *time (hours)* that a given generating plant is running

Future Possibilities

Total U.S. Electricity Generation: 2030 EIA Base Case

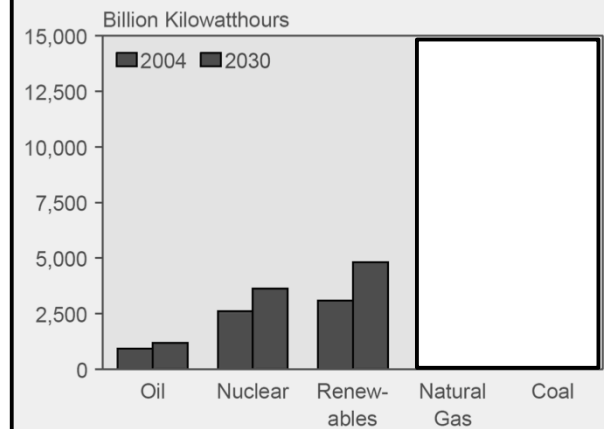


Total U.S. Electricity Generation: 2030 Advanced Technology Targets

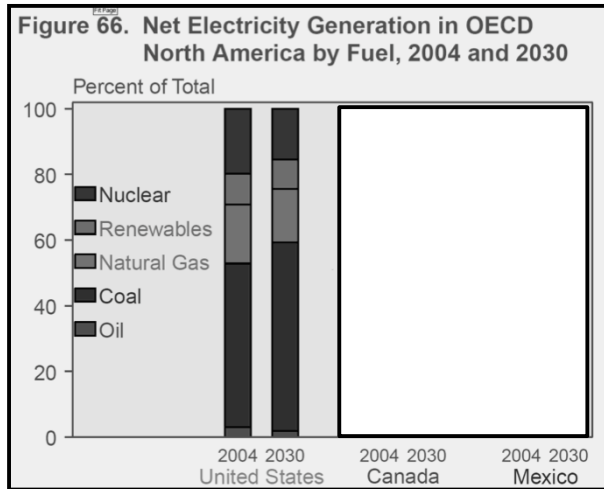


From EPRI presentation: http://mydocs.epri.com/docs/CorporateDocuments/Newsroom/EPRIUSElectSectorCO2Impacts_021507.pdf

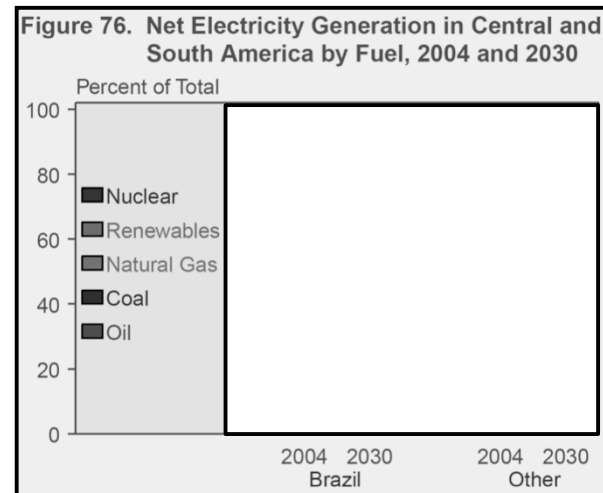
Figure 63. World Electricity Generation by Fuel, 2004 and 2030



<http://www.eia.doe.gov/oiaf/ieo/pdf/electricity.pdf>



<http://www.eia.doe.gov/oiaf/ieo/pdf/electricity.pdf>



<http://www.eia.doe.gov/oiaf/ieo/pdf/electricity.pdf>

Generation – Fuel Type
 → Future Projections

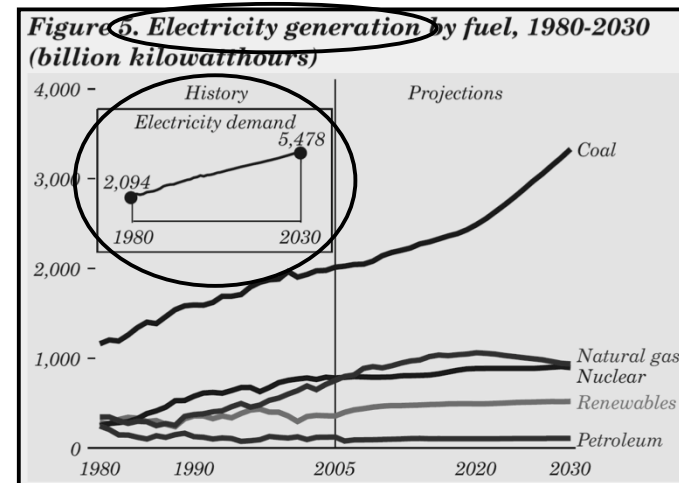


Figure 15. Additions to electricity generation capacity in the electric power sector, 1990-2030 (gigawatts, net summer capacity)

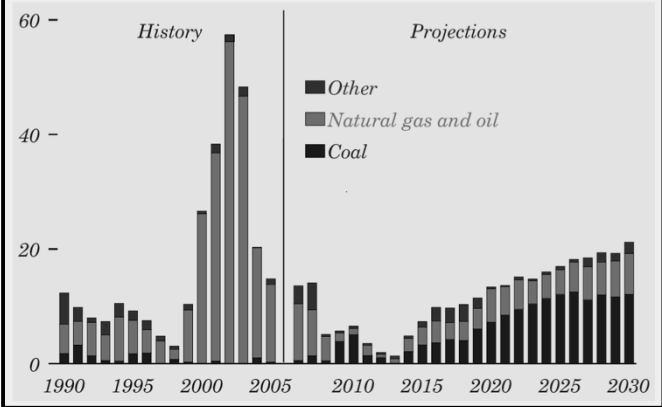


Figure 7. Energy production by fuel, 1980-2030 (quadrillion Btu)

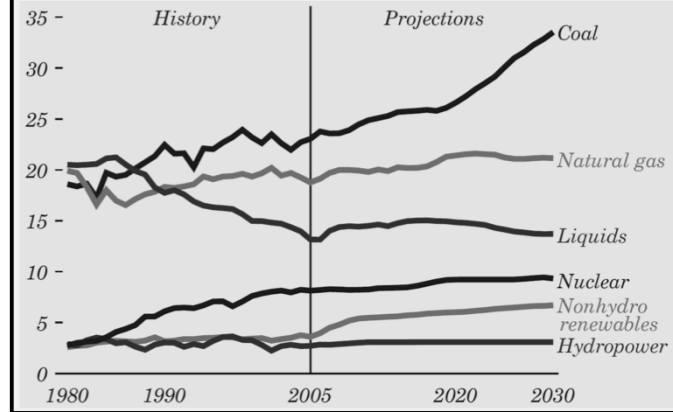
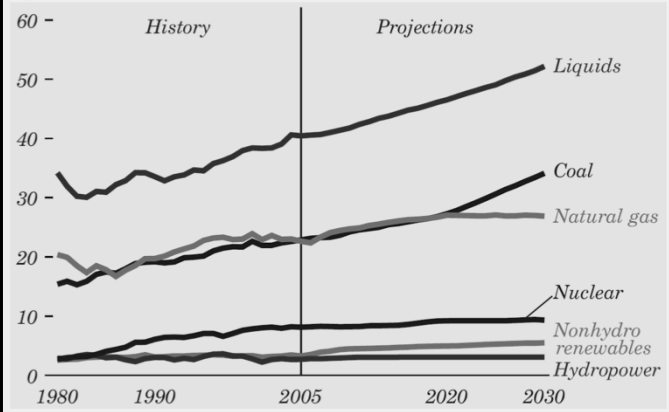


Figure 3. Energy consumption by fuel, 1980-2030 (quadrillion Btu)

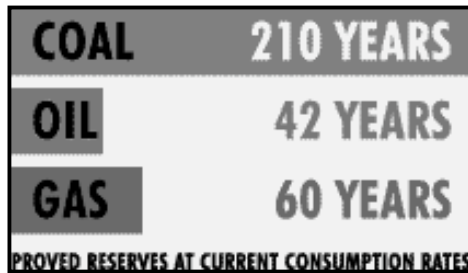


Remaining Reserves?

- Coal: 100 years
- Oil: 50 to 75 years
- Natural Gas: 40 years
 - Recent study claims 200 years

• data from:
http://www.physics.emich.edu/ebehringer/FossilFuels/overview_fossilfuels.html
 based on USDOE EIA data

Or... from Shell...Remaining Reserves?



<http://www.solcomhouse.com/fossilfuels.htm>

Country	Oil Reserves
Saudi Arabia	264.3
Canada	178.8
Iran	132.5
Iraq	115.0
Kuwait	101.5
UAE	97.8
Venezuela	79.7
Russia	60.0
Libya	39.1
Nigeria	35.9
United States	21.4
China	18.3
Qatar	15.2
Mexico	12.9
Algeria	11.4
Brazil	11.2
Kazakhstan	9.0
Norway	7.7
Azerbaijan	7.0
India	5.8
Rest of World	68.1
World Total	1,292.5

Country	Reserves (Trillion Cubic Feet)	Percent of World Total
World	6,112	100.0
Top 20 Countries	5,510	90.2
Russia	1,680	27.5
Iran	971	15.9
Qatar	911	14.9
Saudi Arabia	241	3.9
United Arab Emirates	214	3.5
United States	193	3.1
Nigeria	185	3.0
Algeria	161	2.6
Venezuela	151	2.5
Iraq	112	1.8
Indonesia	98	1.6
Norway	84	1.4
Malaysia	75	1.2
Turkmenistan	71	1.2
Uzbekistan	66	1.1
Kazakhstan	65	1.1
Netherlands	62	1.0
Egypt	59	1.0
Canada	57	0.9
Kuwait	56	0.9
Rest of World	602	9.8

World Recoverable Coal Reserves (Billion Short Tons)

Although coal deposits are widely distributed, 67 percent of the world's recoverable reserves are located in four countries: the United States (27 percent), Russia (17 percent), China (13 percent), and India (10 percent).

Region/Country	Bituminous and Anthracite			Total
	Anthracite	Subbituminous	Lignite	
World Total	530.4	297.0	173.4	1,000.9
United States	125.4	109.3	36.0	270.7
Russia	54.1	107.4	11.5	173.1
China	68.6	37.1	20.5	126.2
India	99.3	0.0	2.6	101.9
Other Non-OECD	50.1	18.7	31.3	100.1
Europe and Eurasia				
Australia and New Zealand	42.6	2.7	41.9	87.2
Africa	55.3	0.2		55.5
OECD Europe	19.5	5.0	18.8	43.3
Other Non-OECD				
Asia	1.4	2.0	8.1	11.5
Brazil	0.0	11.1	0.0	11.1
Other Central and South America	8.5	2.2	0.1	10.8
Canada	3.8	1.0	2.5	7.3
Other*	1.8	0.4	0.1	2.3

Credit: Energy Information Administration (OECD-Organization for Economic Cooperation and Development)

<http://www.solcomhouse.com/fossilfuels.htm>

Summary

- We are using up our energy reserves
 - Electricity demand continues to grow
- Power industry analysts project significant increase in coal-fired power plants
- Coal represents the status quo
 - Alternative fuels will require some change in lifestyle
 - Coal generation produces the highest CO₂ emissions