

The Energy Crisis

- Are our communities sustainable?
- Is the world becoming more or less sustainable?
- What direction should we take towards a sustainable future?

Sustainability

- The ability to meet the needs of the present, without compromising the ability of future generations to meet their own needs.
- Is the current American lifestyle sustainable?

What are the Basic Elements?

What are the Basic Elements?

- Air
- Water
- Food
- Shelter
- Energy

Air

- Air Pollution - substances in the air that can cause harm to animals and the environment
- Primary Pollutants:
 - Sulfur oxides
 - Nitrogen oxides
 - Carbon monoxide
 - Carbon dioxide
 - smoke and dust
 - toxic metals (lead, cadmium, copper)



Pollution

- Great moments in pollution
 - 1852: Great Smog of 1852 in London - 4000 fatalities in 4 d
 - 1954: air qual. LA is blamed for 2000 auto accidents in 1 day
 - 1969: Cuyahoga river catches fire (flames reach 60' high)
 - 1978: acid rain in Wheeling, WV, has pH of 2 (5000x av.)
 - 2008: 6% of deaths in Shanghai attributed to air pollution



Downtown LA seen from Griffith Observatory

Water Crisis

- Great moments in water shortages
 - 1972: Yellow River failed to reach the sea for 15 days
 - 1997: Yellow River failed to reach the sea for 226 days
 - 2005: Lake Powell hits low of 33% capacity
 - 2008: 36 states will face water shortages within 5 years



Barges stranded on the dry Yellow River



Water

- Many of the world's major rivers are running dry: the Colorado, Rio Grande, Ganges, Indus, Yellow, ...



Orphaned Ship in the Aral Sea

Once the 4th largest inland sea, now a wasteland

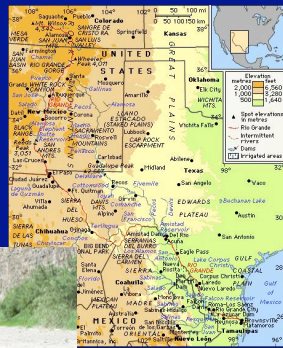
- 40% of the world's population faces water shortages

Water Crisis

- Rio Grande now peters out a few hundred feet from the ocean

It takes 4 bottles of water to produce one bottle of bottled water

Rio Grande runs dry East of El Paso



Clicker Question:

Where does the water we use in Albuquerque come from?

- A: Rio Grande
- B: Underground aquifers
- C: Cochiti Lake
- D: Imported bottled water

Clicker Question:

Which is safer and uses less water and energy?

- A: tap water
- B: bottled water

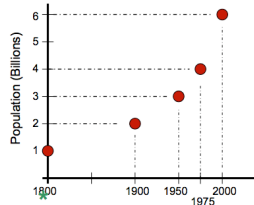
Clicker Question:

What is the current world population :

- A: Less than 5 billion
- B: between 5 and 6 billion
- C: between 6 and 7 billion
- D: over 7 billion

Food Crisis

- World's population is 6,864,952,000 and is currently increasing by 100 Million people/year
- 40 Million people/year die from hunger



POPULATION –

- In 1800 - One Billion people.
- By 1900 - Two Billion people.
- By 1950 - Three Billion people.
- By 1975 - Four Billion people.
- By 2001 - Six Billion people.

Food Crisis

- 1 calorie of food requires 10 calories to produce
- Food you eat travels 1500 miles to get to you
- 1 pound of beef requires 2500 gallons of water
- Food prices have gone up globally by about 40%

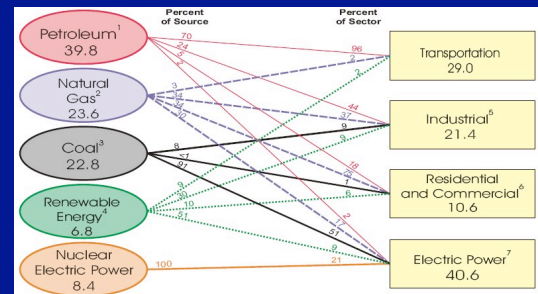


food vs fuel debate

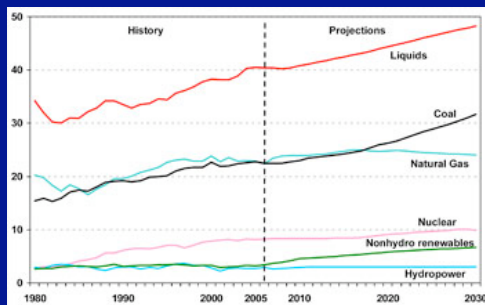
The Energy Crisis

- We use Energy to deliver and to purify our air and water
- We use Energy to make food and deliver it
- We use Energy to build homes, and to make goods
- We use Energy to heat our homes and to go places
- We use 10,000 years of stored carbon-based energy every year

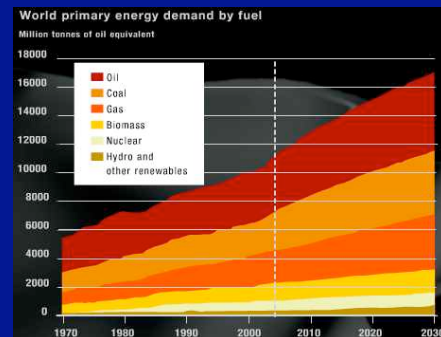
Sources of Energy and Where it Goes



Projected Energy Production



Projected Energy Production



Biofuel

- 1 gallon of ethanol requires:

- 3.5 gallons of water
- 11 acres of land
- enough corn to feed 7 people for a year

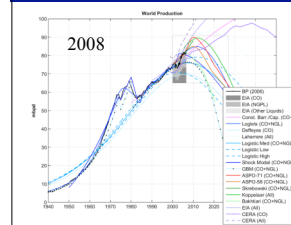
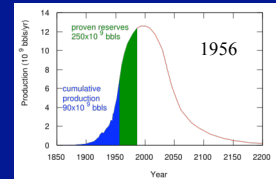


1/3 of world food production needs man-made fertilizers

Production of fertilizer requires energy

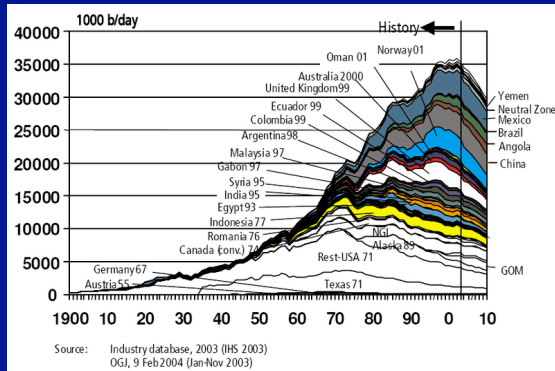
Oil

- Production follows a Gaussian distribution (Hubbert 1956)

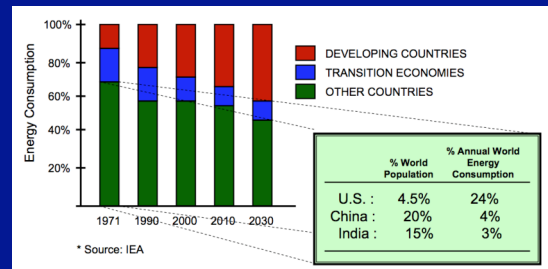


- 86 million barrels/day
- Production is decreasing
- Demand is increasing
- US imports 60% of its oil

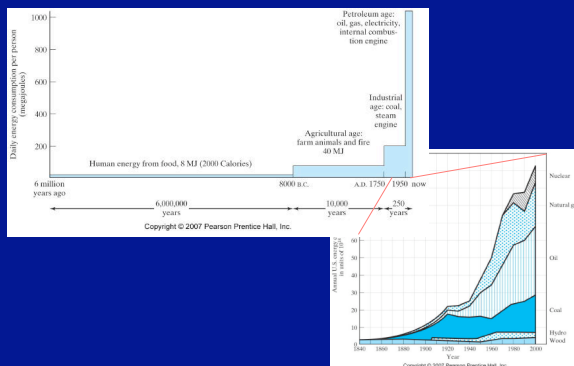
Oil



Competition for Energy

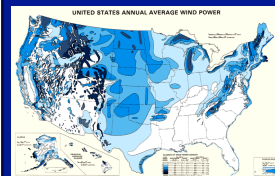


History of Energy Use



Renewables - Wind Power

Clean
Renewable
1% of Worldwide energy use
Issues
- Distribution
- Intermittency

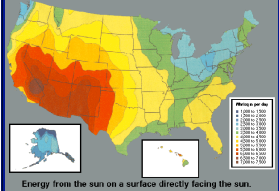


Wind Farm near Fort Sumner NM

Renewables - Solar Power

Clean
Renewable
0.01% of Worldwide energy use
Issues
- Cost
- Distribution
- Intermittency

Average daily solar radiation, 1961-1990



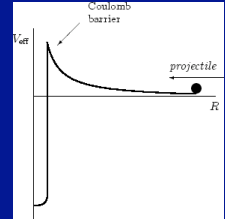
Energy from the sun on a surface directly facing the sun.



0.003 MW installation in Albuquerque
Lots of talk

Fusion Power

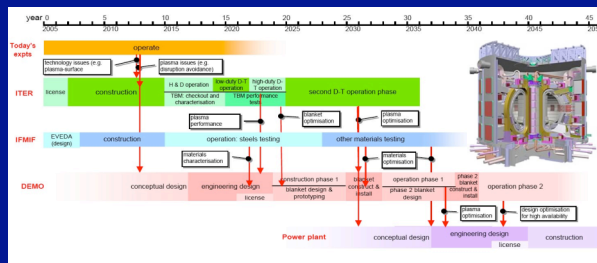
- Fusion power (burning H, deuterium or tritium) could meet the world's energy needs for billions of years
- Fuel (H, D, T) is readily abundant
- Byproducts and spent fuel is harmless
- Clean (no CO₂)



Problems:

- D-T produces lots of neutrons
- Not easy to activate/maintain reaction

Roadmap to Fusion



Still 40 years away! And 40 years ago it was 40 years away too.

Shelter

- More than 50% of the world's population lives in cities

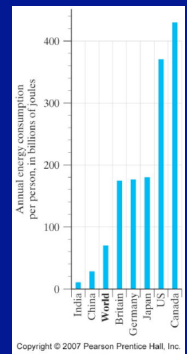


Shelter

- Buildings consume 40% of energy use worldwide now
- Global warming forces more people inside
 - increase in heat waves
 - increase in extreme weather
 - increased pollen
 - increased pollution

The Way Forward

- Is our American lifestyle sustainable?
- Is the World we live in sustainable?
- What can we do about it?
 - Be aware of the issues
 - Think globally, act locally
 - There is no "magic bullet"



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Reduce Energy Consumption

- Pounds of CO₂ is the new currency
- Reducing carbon footprint the goal



Choice of Automobile

Model	MPG	Lbs of CO ₂
Ford Taurus	25	9,802
Toyota Prius	55	4,456
Savings =		5,346 lbs

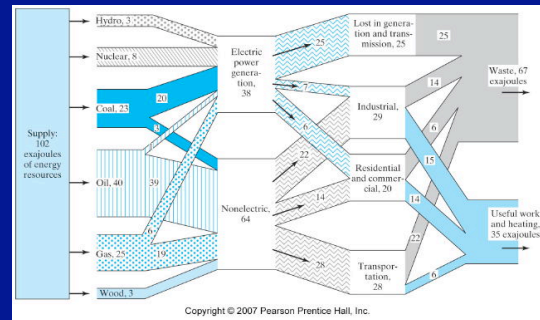
HVAC Upgrades

	Savings Lbs of CO ₂
High Efficiency Furnace	3,011
High Efficiency A/C	3,788
Programmable T'stat	1,488
Savings =	8,287 lbs

Source: U.S. Environmental Protection Agency
http://www.epa.gov/climatechange/emissions/ind_calculator.html

Transportation and Heating/Cooling (HVAC) are 2 big energy demands

Increase Efficiency



Reuse and Recycle



Clicker Question:

Which takes more, the amount of energy to run a car for a year, or to make it?

- A: energy to run a car for a year (~12,000 miles)
- B: energy to make a car from raw materials
- C: about the same

Clicker Question:

Is it better to use paper or plastic at the grocery store?

- A: paper
- B: plastic

Clicker Question:

Is it better to leave [cars, computers] on when not in use, or restart them :

- A: cars on, computers off
- B: computers on, cars off
- C: leave them both on
- D: turn them off and restart them when needed