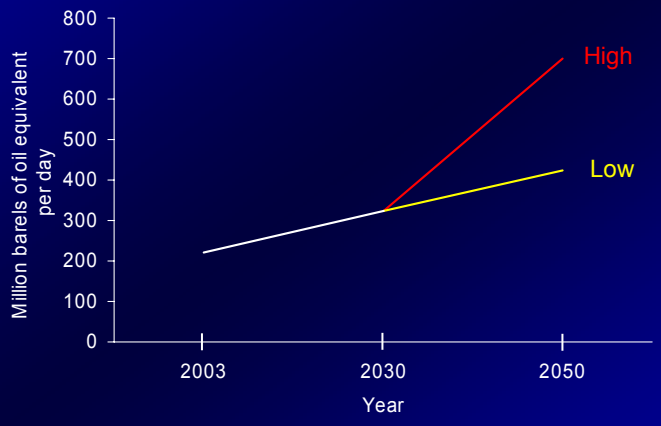
Fundamental Energy Axioms

- **We have multiple goals for our use of energy. We want it to be secure, abundant, safe, inexpensive, environmentally-friendly, and unobtrusive**
- **Our fossil-fuel based energy system has been shown to be incapable of fulfilling the goals, above, simultaneously**
- **We need to begin creating an energy system that simultaneously meets the needs of the poor while fulfilling sustainability goals or criteria**

EERC

Projected Global Energy Consumption



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The *Supply* of BTUs is NOT the issue
We are not "running out of energy"

- The annual production of:
  - ----coal is 0.5% of reserves
  - ----natural gas is 1.6% of reserves
  - ----of oil is 3% of reserves
- There are huge, unconventional fossil fuel resources such as tar sands, and methane hydrates
- Renewables can supply large quantities of BTUs

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The Basic Concerns about Energy are:

- Price
- Location
- Environmental and Health Impacts

Price

- Commercial energy is not an affordable commodity for many today
  - --- 2.4 billion people still rely on non-commercial energy
  - --- 1.6 billion people lack access to electricity
  - --- per capita energy consumption in industrial countries is seven times that of consumption in developing countries
- Lower energy prices promote economic development
- Renewable resources cost consumers more than fossil-fuel resources

Non-Commercial Renewable Energy

WHO/P.Virot

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Location and Quantity of World Proven Oil Reserves

Rank	Country	Reserve in million tonnes
1	Saudi Arabia	35,700
2	Iraq	13,400
3	Kuwait	13,300
4	United Arab Emirates	12,700
5	Iran	12,000
6	Venezuela	9,300
7	Former USSR	7,800
8	Mexico	7,100
9	Libya	3,900
10	USA	3,700
11	China	3,300
12	Nigeria	2,800
13	Algeria	1,200
14	Norway	1,100
15	Canada	900
16	India	800
17=	Indonesia	700
17=	Oman	700
20=	Malaysia	600
20=	United Kingdom	600

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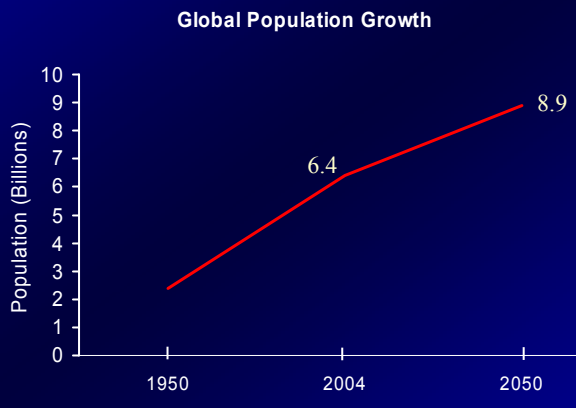
The Basic Environmental/Sustainability Issue

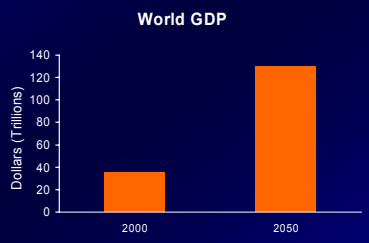
Impact = Population x Affluence x Technology

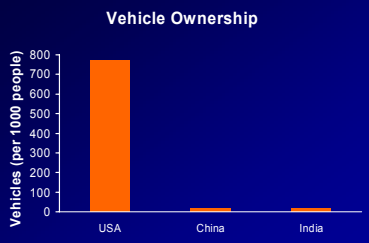
IPAT

Population



Affluence





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Environmental and Health Concerns: (1) Indoor Air Pollution

WHO claims that 1.6 million women and children die prematurely from indoor air pollution every year

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Environmental and Health Concerns
(2) Outdoor/Ambient Air Pollution

WHO estimates that 800,000 individuals die from outdoor air pollution every year

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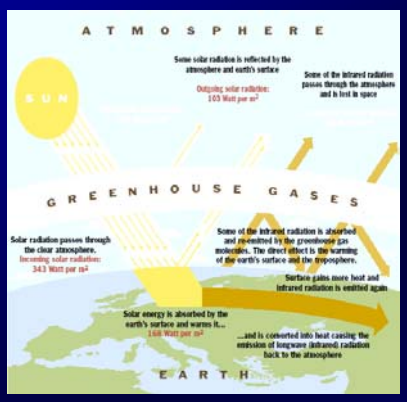
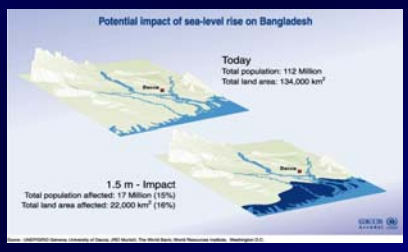
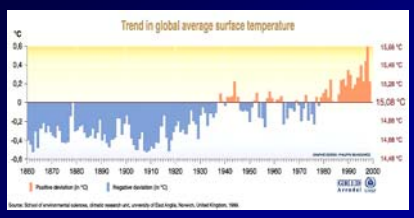
Environmental and Health Concerns
(3) Climate Change







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Alternatives to Fossil Fuels

- Biomass Systems
- Solar
- Ocean energy
- Wind
- Geothermal

•Hydroelectric?
•Nuclear?
•Hydrogen?

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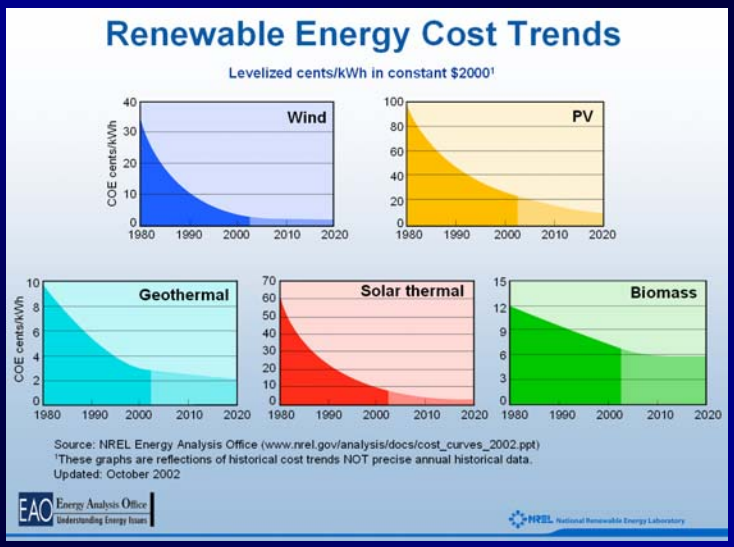
Changes to renewables over time



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Moving toward a New Energy World (2)

- Energy Conservation/Efficiency (behavioral and technical)
- Research and Development
- Charge Full Costs for Conventional Energy
- Subsidize Clean, Renewable Energy Sources
- Set Targets and Goals

Transportation/Automobiles

•Build automobiles to higher efficiency standards

•Build more current-day hybrid vehicles

•Introduce plug-in vehicles

•Combine hybrids with diesel fuel

•Substitute biofuels for petroleum (biodiesel, ethanol)

•Introduce H2 with or without fuel cells

Moving to a New Energy World (1)

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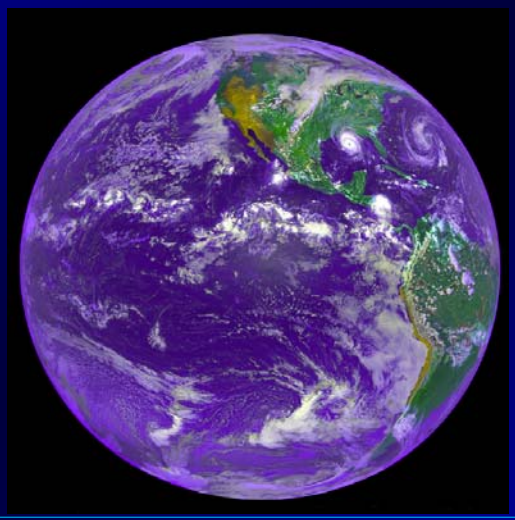
We have only one



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