Energy & the Environment

Environmental Problem Sources

- **Philosophy**
  - Lifestyles that emphasize consumption
  - Consumption vs. Quality
    - Yugo vs. Mercedes
    - Disposal ball point pens
    - Fast food packaging

- **Combustion & air pollutants**
  - *Incomplete* combustion
    - Carbon monoxide
    - Volatile hydrocarbons
    - Soot and smoke
Environmental Problem Sources

- Combustion & air pollutants
  - Complete combustion products
    - Carbon dioxide (primary "Green house gas")
    - Nitrogen oxide
    - Sulpher dioxide
    - Heat

- Use of Non-Renewable Resources
  - Example: Lead
    - It is a "valuable" pollutant
    - Finite quantity in earth
    - Dispersing of lead in air and water
    - Contamination
    - Unsalvageable

- Affluence
  - Use beyond needs
    - "Why have two hats when you can wear only one at a time?"
  - Wasteful of resources
  - Not morally justifiable in a world of starvation
### Primary pollutants
- Discharge directly to air (SO₂)

### Secondary
- Formed by reactions in atmosphere
  - SO₂ causes Acid Rain

### Contamination of local air
- Automobile exhaust
  - CO and O₃

### Regional air pollution
- Low altitude ozone & acid rain

### Global pollution
- Stratospheric ozone destruction (CFCs)
  - Fix: Floroflorocarbons (FFCs)?
- Global warming
<table>
<thead>
<tr>
<th>Global Warming</th>
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<tbody>
<tr>
<td>☐ “Greenhouse” effect</td>
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<tr>
<td>☐ Three major gases</td>
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<tr>
<td>☚ Carbon Dioxide (CO$_2$)</td>
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<tr>
<td>☚ Methane (CH$_4$)</td>
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<tr>
<td>☚ Chloroflorocarbons (CFCs)</td>
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<td>☐ Natural “disasters”</td>
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<tr>
<th>Heat Engines</th>
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<tbody>
<tr>
<td>☐ Thermal Efficiency</td>
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<tr>
<td>$\eta_{\text{thermal}} = 1 - (T_L/T_H)$</td>
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<tr>
<td>Where $T_L$ &amp; $T_H$ are absolute temperatures (0°K = -273°C)</td>
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<td>☐ Steam to Ice $\Rightarrow$ 26.8% max.</td>
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<th>Forms of Solar Energy</th>
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<tr>
<td>☐ Fossil Fuels</td>
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<tr>
<td>☚ Coal</td>
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<td>☚ Gas and Oil</td>
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<td>☐ Biomass</td>
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<td>☐ Geothermal</td>
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<td>☐ Nuclear</td>
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</table>
Lighting

- Incandescents—75 Wt bulb
  - Inexpensive—75¢ each
  - Mostly HEAT
  - 16 Lumens/watt
  - Operating life: 1000 hours
  - Total cost for 10,000 hr: $78.89

Lighting

- Compact Fluorescent—20 Wt bulb
  - Expensive—$29 each
  - Mostly LIGHT
  - 60 Lumens/watt
  - Operating life: 10,000 hours
  - Total cost for 10,000 hr: $48.71
Solid Waste—
The 4 Step Path to Enlightenment

- Reduce
- Recycle
- Treat
- Dispose

Hazardous Waste

- 300 Million tons/year in US
- Characteristics of “Hazardous Waste”
  - Flammable
  - Corrosive
  - Reactive
  - Toxic

Hazardous Waste

- Waste Minimization
  - High cost of disposal
- Land Ban
  - No more “dumping”
- Treatment
  - EPA specs (expensive)
CERCLA—“Superfund”
- Comprehensive Environmental Response, Compensation, and Liability Act
- Fixes responsibility and provides a source of funds
- Over 30,000 sites
- Estimated cost of cleanup is over 20% value of nation

Local Dump Sites
- Bumpass Cove
  - Embreeville
- East Tennessee Chair
  - Elizabethton
- C&C Millwrights
  - Greeneville

LUST—East Tennessee Style
- LUST—Leaking Underground Storage Tanks
- Region: approx. 4000 sites
  - 3 to 6 tanks per site
- Avg. cleanup cost: $125,000
Spaceship Earth... it's all we have!