A bright future: how we can begin

Union of Concerned Scientists
Where do greenhouse gases come from?

• CO$_2$: burning fossil fuels (coal, oil, natural gas) to provide energy
• CH$_4$: anoxic decay in rice paddies, ruminants, landfills, swampy or boggy land
• CFCs: refrigerants, propellants, cleansers; no longer produced (yay!)
• Ozone (O$_3$): urban pollution
Near-term solutions

• Reduce growth of methane (farms, landfills, mining)
• Air pollution
• Make sure CFC problem stays solved
• Do our best on CO$_2$

Source: Hansen and Sato, PNAS 2001
Slowing climate change

\[ \frac{dC}{dt} = P \times \frac{\$}{P} \times \frac{E}{\$} \times \frac{Ec}{E} - S \]

- Reduce population growth
- Reduce economic growth
- Increase energy efficiency
- Switch to renewables
- Increase sinks
Increase Energy efficiency

Buildings: huge net positive
Industry: mostly net positive
Home appliances: mostly net positive
Transportation: net costs less than $25/ton carbon

Source: IPCC WG3 (1,2,4)
Hybrid car

Source: Ken Kelley
Switch to renewables

- Wind
- Biomass
- Solar
- Hydropower
- Nuclear
- Fuel cells (transportation)
- Other (geothermal, wave/tidal)
Wind turbines

Source: Warren Gretz
Energy Supply
Sustained Growth Scenario

Source: Shell International Limited
Levelized costs for electricity
(includes total capital, fuel, operating, and maintenance costs)

- Gas  3.9-4.4 ¢/kwh
- Wind  4.0-6.0
- Coal  4.8-5.5
- Hydro  5.1-11.3
- Biomass  5.8-11.6
- Nuclear  11.1-14.5
  - American Wind Energy Association
Changes in energy policy

- Taxes on fossil fuels? (incentive for efficiency, conservation, alternative sources)
- Subsidies to industries
- Changes in lifestyle? (incentives to buy high efficiency cars, mass transit, urban planning)
Carbon sequestration: “geo-engineering solutions”
Biological Carbon Sequestration

- Estimated global potential of biological mitigation is ~100 GtC by 2050
- Equivalent to about 10-20% of fossil fuel emissions over the same period
- Good temporary solution until other options are developed, but land is expensive
Marine sequestration: direct injection into oceans
Marine sequestration: ocean fertilization
Geologic sequestration
States and cities rising to the challenge

- Wisconsin’s climate action cost study: major cuts in emissions possible while boosting economic growth
- New Jersey: 3.5% below 1990 levels by 2005
- Oregon: new power plants must mitigate CO\textsubscript{2} emissions
- NE governors: greenhouse gas reduction plans
- 11 states: AG’s pressing Bush to act
- Cities for Climate Protection – Portland, OR; Seattle; Miami
Businesses rising to the challenge

- BP in 1998: CO$_2$ equivalent 10% below 1990 levels by 2010 using internal trading: Will meet goal in 2003
- DuPont in 1999: 65% below 1990 levels by 2010 (already halfway there by 1999)
- Stoneyfield Farm Yogurt the first “Climate Neutral” company – offsets all GHG emissions