

Foundations of Global Health

Environmental Health: Part I



Oh Beautiful for smoggy skies,
insecticided grain,
For strip-mined mountain's majesty
above the asphalt plain.
America, America,
man sheds his waste on thee,
And hides the pines with billboard signs,
from sea to oily sea.
-George Carlin

Smoggy skyline of Los Angeles

Learning Objectives

- Identify important environmental threats to health in low and middle-income countries
- Identify diseases related to environmental risk factors
- Identify human activities that contribute to climate change and major consequences from climate change
- Describe important energy trends
- Identify sources and health consequences of indoor and outdoor air pollution
- Describe pollution of land and sea, superfund sites
- Identify actions that we can take to limit pollution of the environment

Environmental Health Definition

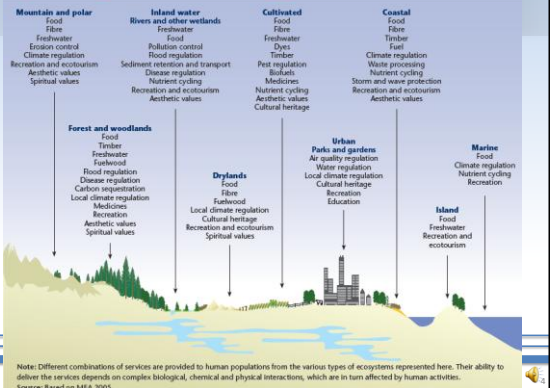
Box 1 A DEFINITION OF "ENVIRONMENT" FOR MEASURING THE ENVIRONMENTAL IMPACT ON HEALTH

The environment is all the physical, chemical and biological factors external to a person, and all the related behaviours.

This definition excludes behaviour not related to environment, as well as behaviour related to the social and cultural environment, and genetics.



Figure 14-1 Ecosystems and some of the services they provide



Importance of Environmental Health

- Environmental concerns are major risk factors in global burden of disease
 - Unsafe water
 - Hygiene and excreta disposal
 - Indoor air pollution
 - Outdoor air pollution
 - Climate change
- Addressing environmental health is central to the achievement of the MDGs

"Water and air, the two essential fluids on which all life depends, have become global garbage cans."
- Jacques Cousteau

Risk Factors

- Consequences of environmental health issues
- Indoor air pollution is household issue, whereas climate change is a global issue

TABLE 1 ENVIRONMENTAL RISK FACTORS AND RELATED DISEASES INCLUDED IN THE CRA *

Risk factors	Related diseases
Outdoor air pollution	Respiratory infections, selected cardiopulmonary diseases, lung cancer
Indoor air pollution from solid fuel use	COPD, lower respiratory infections, lung cancer
Lead	Mild mental retardation, cardiovascular diseases
Water, sanitation and hygiene	Diarrhoeal diseases, trachoma, schistosomiasis, ascariasis, trichuriasis, hookworm disease
Climate change	Diarrhoeal diseases, malaria, selected unintentional injuries, protein-energy malnutrition
Selected occupational factors: injuries, noise, carcinogens, airborne particulates, ergonomic stressors	Unintentional injuries, Hearing loss, Cancers, Asthma, COPD, Low back pain

* Source: Comparative Risk Assessment (WHO, 2002).
* COPD: chronic obstructive pulmonary disease.

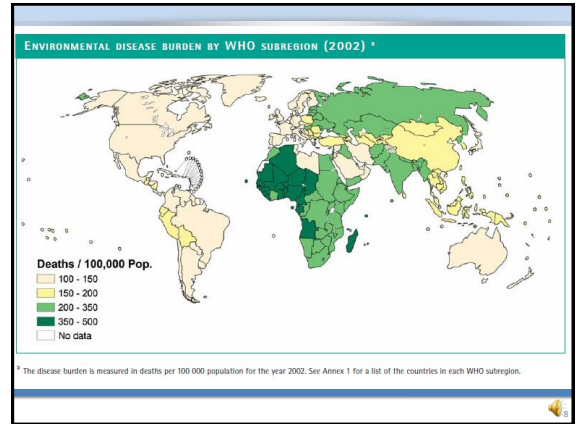
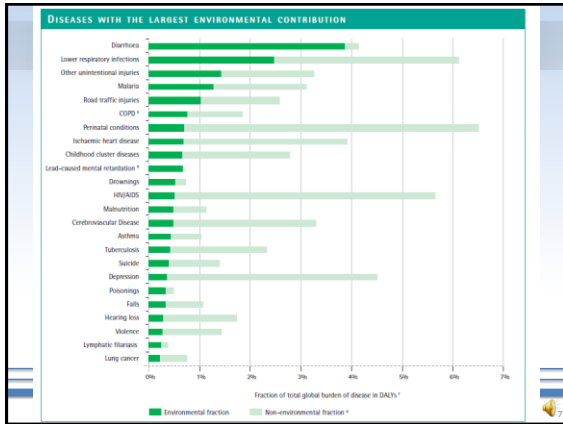


TABLE 7-1 Environmental Health and the MDGs

Goal 1—Eradicate Poverty and Hunger
Link—Reducing environmental risk factors is central to eradicating poverty by reducing the burden, which falls largely on the poor, of environmentally-related morbidity and mortality.

Goal 2—Achieve Universal Primary Education
Link—Children that do not have access to clean water and sanitation are more likely to suffer from undernutrition due to a vicious cycle of diarrheal disease and malnutrition. There is a correlation between nutritional status and learning. Children with poor nutritional status are not as likely to stay in school or learn as much as healthy children.

Goal 3—Promote Gender Equality and Empower Women
Link—Improving access to water can improve the lives of poor women in the developing world by reducing the amount of time required to get water. Reducing indoor air pollution can also substantially improve the lives of women since they suffer a disproportionate burden when they are cooking.

Goal 4—Reduce Child Mortality
Link—Addressing environmental risk factors can reduce the two leading causes of death in children—diarrheal diseases and pneumonia. Diarrheal disease is reduced through improved access to clean water and sanitation. Pneumonia can be reduced through improvements in indoor air quality.

Goal 5—Improve Maternal Health
Link—Diarrheal disease associated with poor sanitation and unsafe water can harm the nutritional status of the mother.

Goal 6—Combat HIV/AIDS, malaria, and other diseases
Link—Environmental improvements can reduce the breeding grounds for malarial mosquitoes and vectors of some other disease, such as shistosomiasis and dengue fever.

Goal 7—Ensure environmental sustainability
Link—Measures to improve water supply, sanitation, and personal hygiene promote sustainability, especially when they are carried out in community-based ways.

Source: Author commentary on the UN Millennium Goals. Available at: <http://www.un.org/millenniumgoals/> goals. Accessed July 11, 2006.

Global Climate Changes

- 2000s warmest decade on record
 - Human-induced climate change significantly increased likelihood of European summer heatwave (2003)
- Parts of Asia and Africa, frequency and intensity of droughts have increased
- Episodes of El Niño more frequent & intense since mid-1970s
- Global emissions of carbon dioxide still increasing

2003 NCEP JJA THICKNESS TEMP ANOMALY (1000-300 mb)

Temp anomaly over Europe, in red.

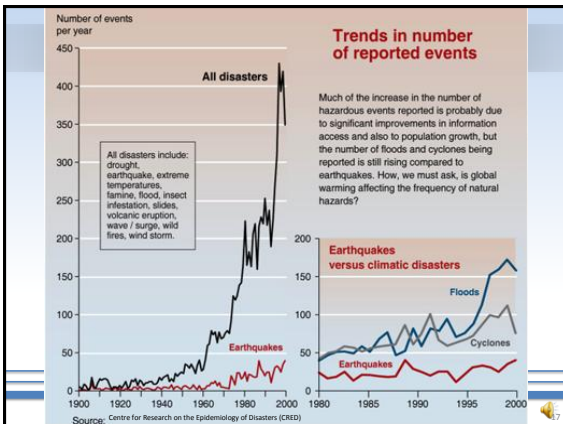
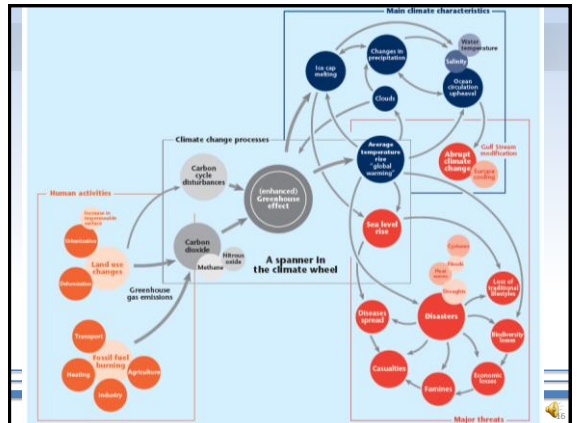
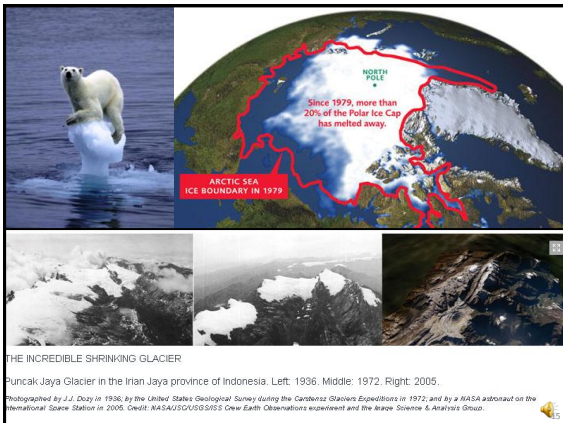
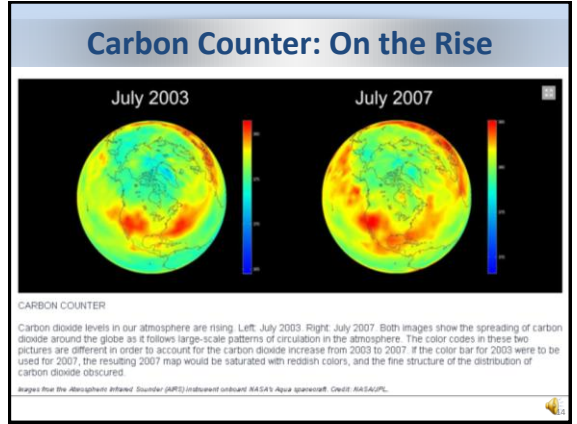
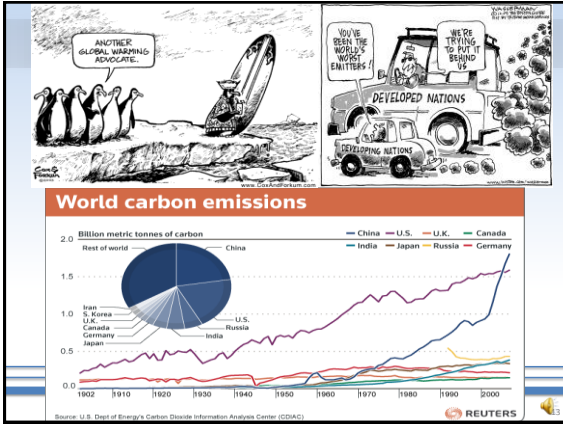
Source: Intergovernmental Panel on Climate Change (IPCC)

Global Warming

- Greenhouse gases
 - CO₂
 - Methane
 - N₂O
 - CFCs
- Global warming: natural occurrence
 - Collect gases (CO₂, H₂O, methane) trap heat
 - Additional human contribution

Dark blue, purple areas denote high levels of ozone depletion
Source: NASA 2006

Ozone "hole" reached a record size in September 2006 — 10.6 million m². Three times the size of the United States!



What Will Likely Happen...

- Public health services and high living standards will protect some populations from specific impacts
- What may happen in other countries?
 - Drought, famine, civil war
 - Floods, waterborne diseases, loss of home/crops/livelihood
 - Malnutrition
 - Malaria (vectorborne diseases)

The worst drought in 50 years turned farmland in Bishan county (China) into wasteland.

Ways to Reduce Carbon Footprint

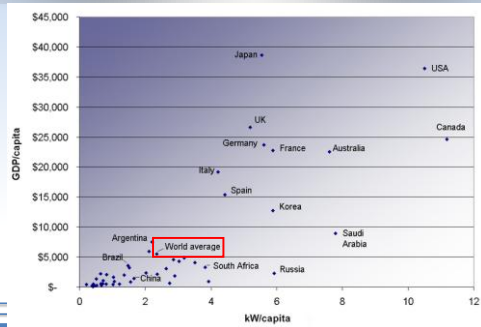
- **Government action**
 - Tougher emission standards
- Hybrid/electric cars (40+ mpg)
 - Drive better
- **Reduce. Reuse. Recycle.**
- Donate old electronics to charity
- Stop junk mail
- Eat less meat
- Turn off lights, computers



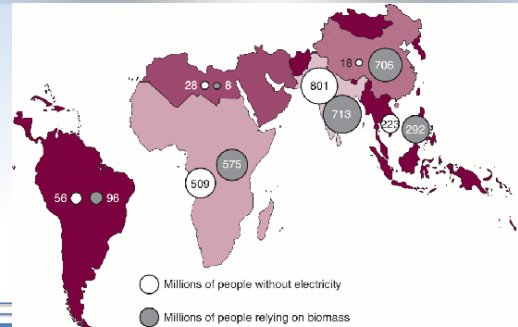
Earth By Night

- 1.5 billion people have no electricity
- Mostly in developing countries (Africa & South Asia) where 79% of people have no access to electricity

Global Energy Comparison: Consumption vs GDP



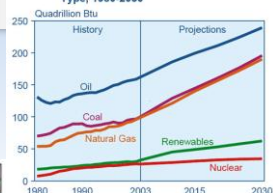
Little Energy Dependence



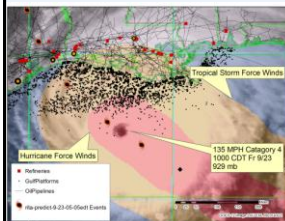
Energy Sources

- Fossil fuels
- Renewable
- Nuclear

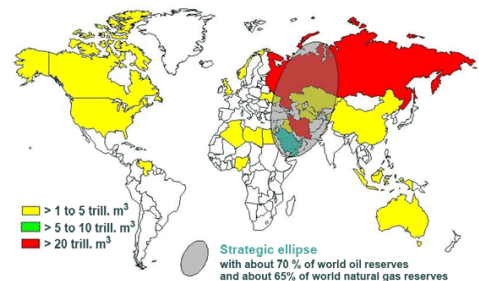
Figure 3. World Marketed Energy Use by Energy Type, 1980-2030

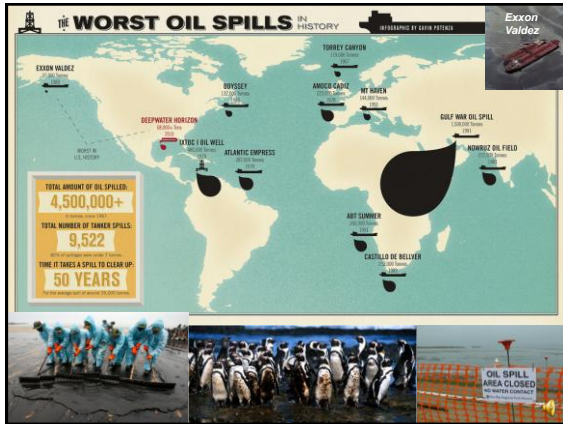


Sources: History: Energy Information Administration (EIA), International Energy Annual 2003 (May-July 2005), web site www.eia.doe.gov/iea/ Projections: EIA, System for the Analysis of Global Energy Markets (2006).



Countries with natural gas reserves > 1 trill. m³





Air Pollution

- 6 categories of pollutants (US EPA)
 - Suspended particulate matter (SPM)
 - CO
 - Lead
 - NO₂
 - SO₂
 - O₃ †

People in Tiananmen Square shrouded with smog October 2007, outskirts of Beijing, China. Source: Getty Images

†Ground level

Air Pollution & Health

- Indoor and outdoor air pollution cause 5% of the global burden of disease
- Aggravates and may even cause asthma and other allergic respiratory diseases
- Adverse pregnancy outcomes, such as stillbirth and low birth weight
- In developing countries:
 - 1.5 million deaths/year due to exposure to high concentrations of SPM indoors in rural areas
 - 500,000 deaths/year excess mortality due to outdoor levels of SPM and SO₂ amounts

Smoking & Indoor Air Pollution

- Tobacco smoke pollution contains over 4,000 chemicals- 200 are poisons & 69 known to cause cancer
- Adverse health problems include cancer, respiratory infections, and asthma
- Classified by the EPA as Group A carcinogen
- In non-smokers:
 - Secondhand smoke causes ~3,000 lung cancer deaths
 - 37,000 heart disease deaths annually
- Very harmful to young children:
 - Increases # of asthma attacks and severity of symptoms in 200,000 to 1 million children with asthma
 - Causes up to 300,000 lower respiratory tract infections
 - Results in 7,500 to 15,000 hospitalizations annually
- Spending 30 minutes in a smoke filled room = non-smoker puffing one cigarette

Fuel and Indoor Air Pollution

- Is electricity necessary?
 - Economic development
- What are the health benefits of electricity?
 - Sanitation, refrigeration, empower women & save lives
- >25% of people have no electricity in their homes and must burn solid fuels
 - smoke released into home
 - high levels of indoor air pollution
 - increased risk of respiratory diseases (and burns), especially for women and children

Indoor Air Pollution

- Limited ventilation increases exposure, especially for women and young children
- Exposed to very high levels of pollution between 3-7 hours/day over many years

Source: WHO (2006). Fuel for life. Household Energy and Health.

Figure 3: Smoky streets, smoky homes
Typical 24-hour mean levels of small particles (PM_{2.5}) in micrograms per cubic meter (µg/m³, dry at 20°C)

Berlin city centre	Bangkok roadside	Fire with open fire
30	240	3000

WHO, UN Environment Programme

Kitchen Killer

- >1.5 million deaths/year of respiratory infections due to environmental link
 - 36% lower respiratory infxns
 - 24% upper respiratory infxns
- Mothers most at risk of developing chronic respiratory disease



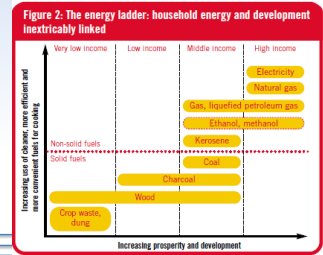
Smoke layer over houses where solid fuels are used for cooking (above), women & child cooking with wood-fueled fire (below).



Source: WHO (2006). Preventing disease through healthy environments

A Consequence of Poverty

- Role of poverty (energy ladder)
- Widespread use of biomass fuels
 - Nearly half the world continues to cook with solid fuels
 - More than 75% in India, China and nearby countries
 - 50-75% in parts of South America & Africa

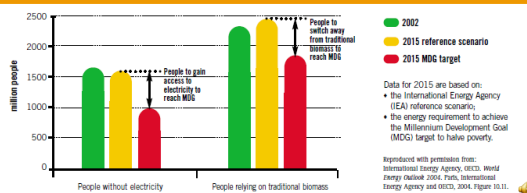


Source: WHO (2006). Fuel for life. Household Energy and Health.

Reducing Indoor Air Pollution

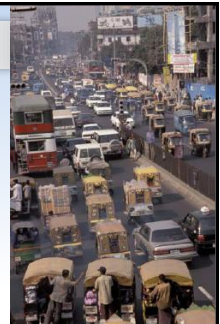
- Use improved cooking devices that divert smoke out of the home
- Use alternate energy sources like solar panels
- Increase ventilation or move kitchen outside of home or shelter
- Keep children away from smoke and boiling liquids

Figure 15: Better access to household energy can lift people out of poverty. Million people in developing countries without electricity and relying on traditional biomass, 2002 and 2015.



Outdoor Air Pollution

- Major problem in modern, urban societies
- Many pollutants enter the air as a result of human behavior
- Smog is most recognizable sign of air pollution
- High air pollution impacts health:
 - Lowers lung function
 - Associated with increased # heart attacks
 - Increased # asthma attacks

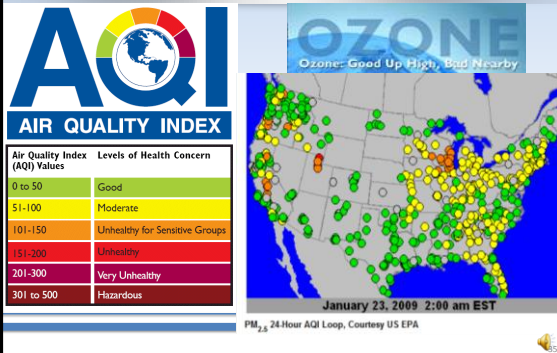


Pollution and smog standards are "too weak to protect people from the air they breathe."
—EPA administrator Stephen Johnson (June 21, 2007)

Urban environmental conditions and related behaviours interact, heightening exposure to traffic injury risk on a busy road in south-east Asia.

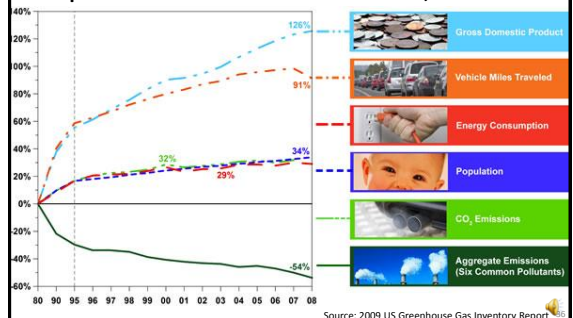
Credit: Jorgen Schytte/Still Pictures

Air Quality Index

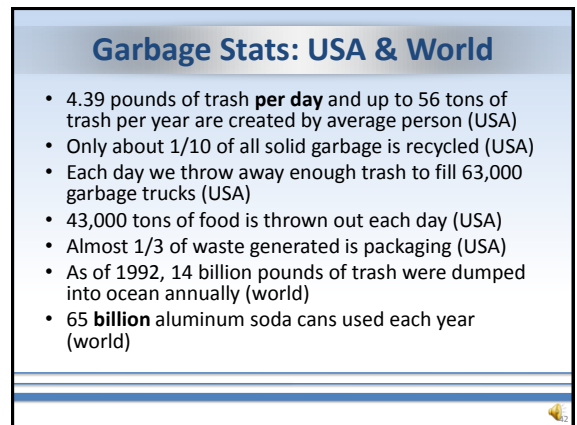
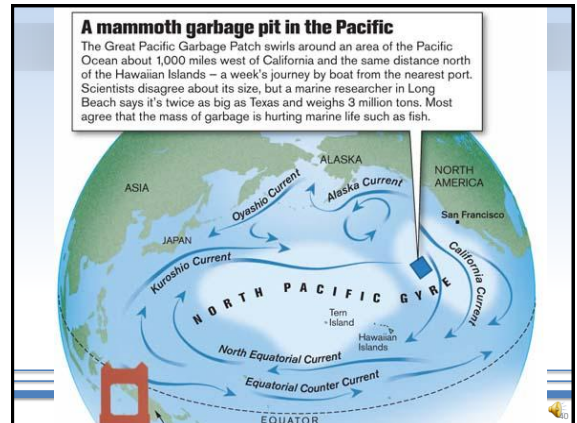
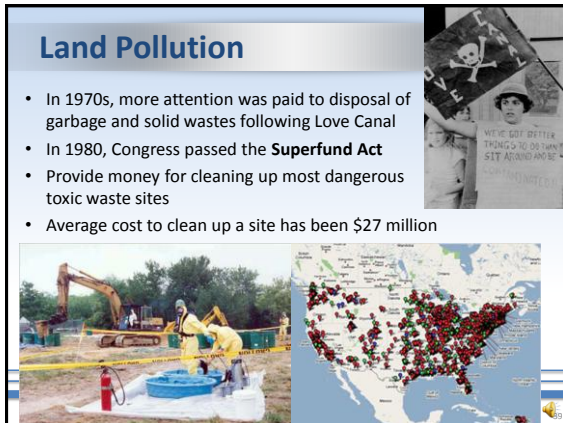
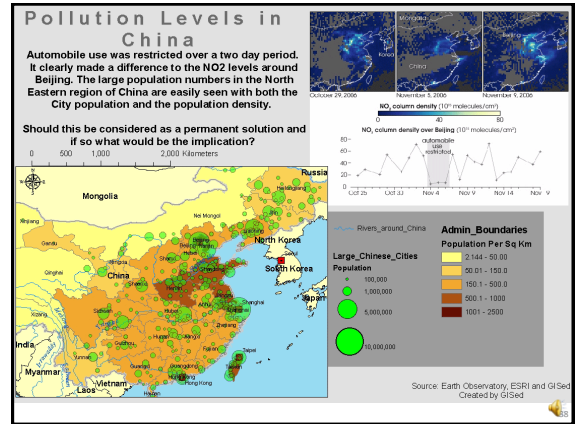
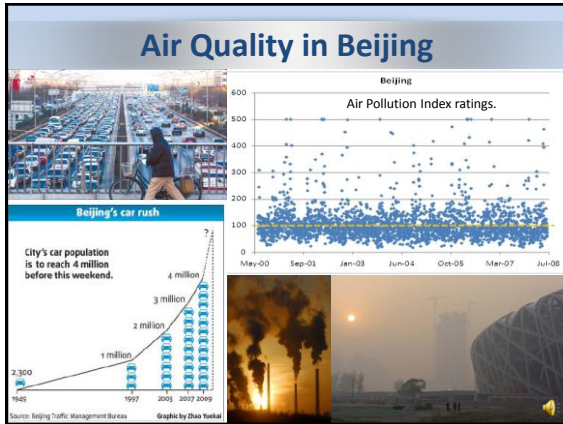


United States Key Stats

Comparison of Growth Areas and Emissions, 1980-2008



Source: 2009 US Greenhouse Gas Inventory Report



Land Fills

- As we begin to run out of space for garbage, this has become a major concern!
- **Poor landfill design and construction** may lead to further environmental degradation (e.g. leaky containment barriers contaminate groundwater)
- **Serious health consequences** in developing countries that lack adequate sanitation facilities



Practice Questions

- Define environment as it relates to health
- Name 5 services that ecosystems provide
- Match 5 environmental risk factors to disease
- What disease has the largest environmental burden?
- Identify recent trends of climate change, carbon emissions
- Identify 5 human activities and major threats of climate change
- Identify regions with little energy dependence
- Identify sources of energy and recent trends
- Name 6 criteria air pollutants
- Identify harmful health effects of tobacco smoke pollution
- Identify harmful health effects & ways to reduce indoor air pollution in developing countries
- What is a superfund site? What is found in the Great Pacific Garbage Patch?

In Summary...

- Environmental health issues have a large impact on the global burden of disease
- The impacts occur at various levels
- The risks of indoor air pollution are greatest for women and children
- The risks of environmental impacts on health are greatest in the low-income countries of Africa and South Asia