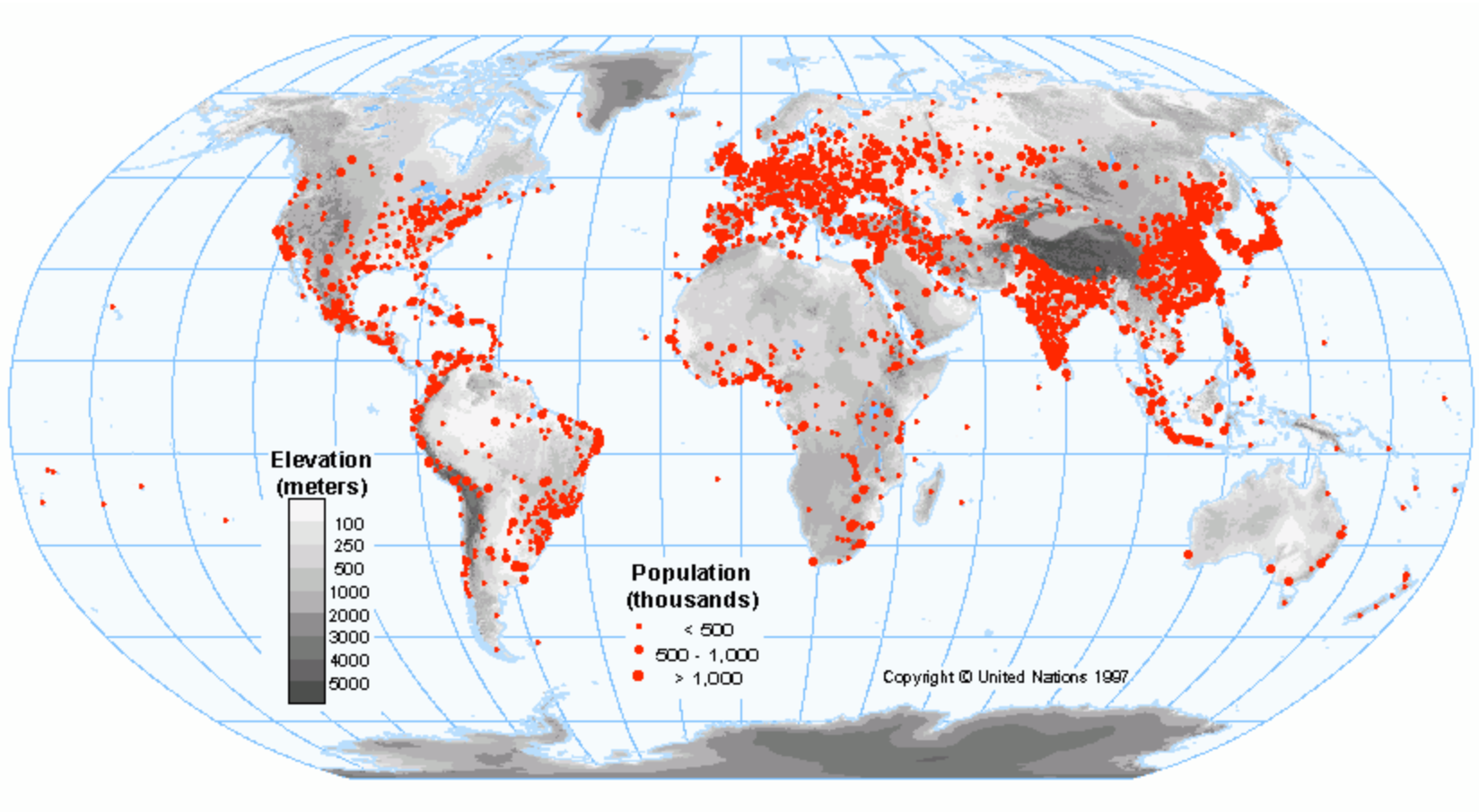
Building an Environmental Ethic:

how architecture can ~

“live lightly on the earth”

Arch 125: Introduction to Environmental Design

Urban Population Densities:



What is Environmental Design?

"the modern architect has produced the most flagrantly uneconomic and uncomfortable buildings...which can be inhabited only with the aid of the most expensive devices of heating and refrigeration. The irrationality of this system of construction is visible today in every city from New York to San Francisco: glass sheathed buildings without any contact with fresh air, sunlight, or view." Lewis Mumford.

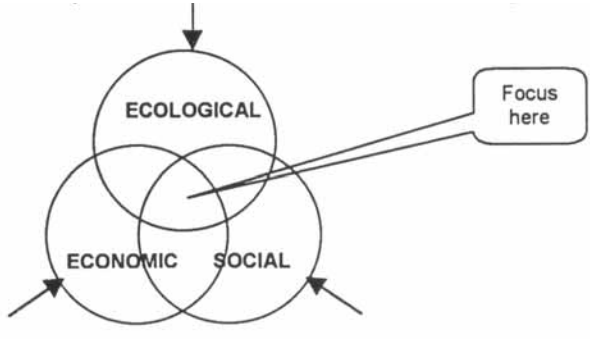
Environmentally sensitive design looks to design in harmony with, and in response to the climate. It attempts to use the natural solar and ventilation characteristics of the local climate/environment to inform the building design so to minimize use and dependency on consumptive non renewable energy sources. Sustainable building design looks to "live lightly on the earth" so that there will be quality and resources remaining for generations to come.

The Sustainable Ethic:

Sustainable building is not a new style of building. It is a way to think about how we design, construct, and operate buildings. Its primary goal is to lessen the harm poorly designed buildings cause by using the best of ancient building approaches in logical combination with the best of new technological advances. Its ultimate goal is to make possible offices, homes, even entire subdivisions that are net *producers* of energy, food, clean water and air, beauty, and healthy human and biological communities.

Green buildings try to take less from the earth and give more to people.

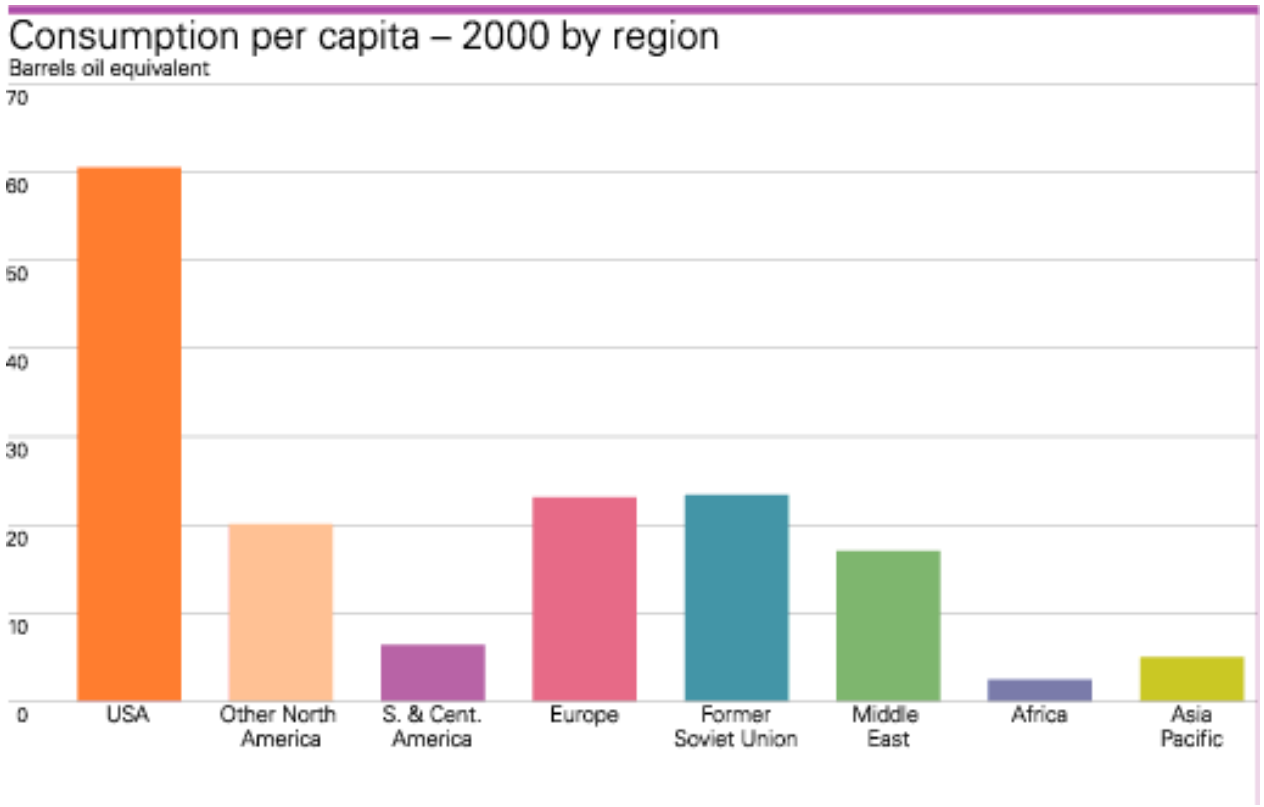
Sustainable Development:



"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

-the United Nations World Commission on Environment and Development

There is a fairly direct co-relation between the production of CO_2 and consumption of fossil fuel on a per capita basis.



Canadian GHG Stats:

Canadians create 2% of global GHGs, but are 0.05% of global population.

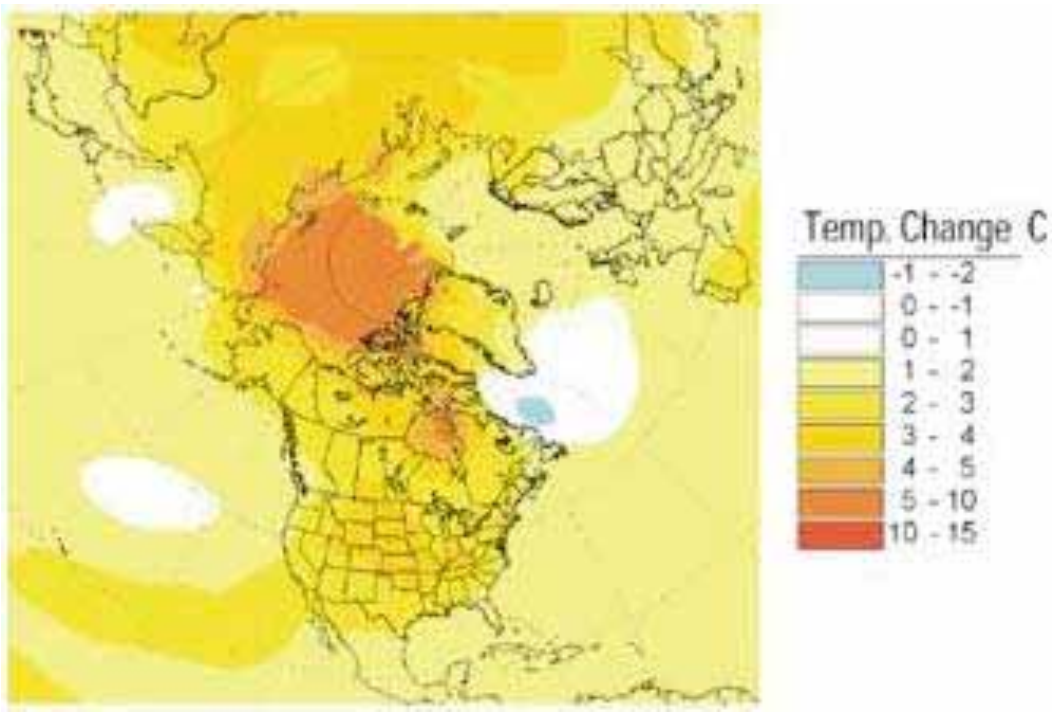
Canada is 9th largest emitter of GHG emissions, but Canadians are the 2nd highest per capita creators of GHGs in the world.

Energy use and GHGs by Sector in Canada:

Industrial	39% energy	33.3% GHGs
Transportation	29% energy	35.7% GHGs
Residential	17% energy	15.5% GHGs
Commercial & Institutional	12% energy	
Agriculture	3% energy	

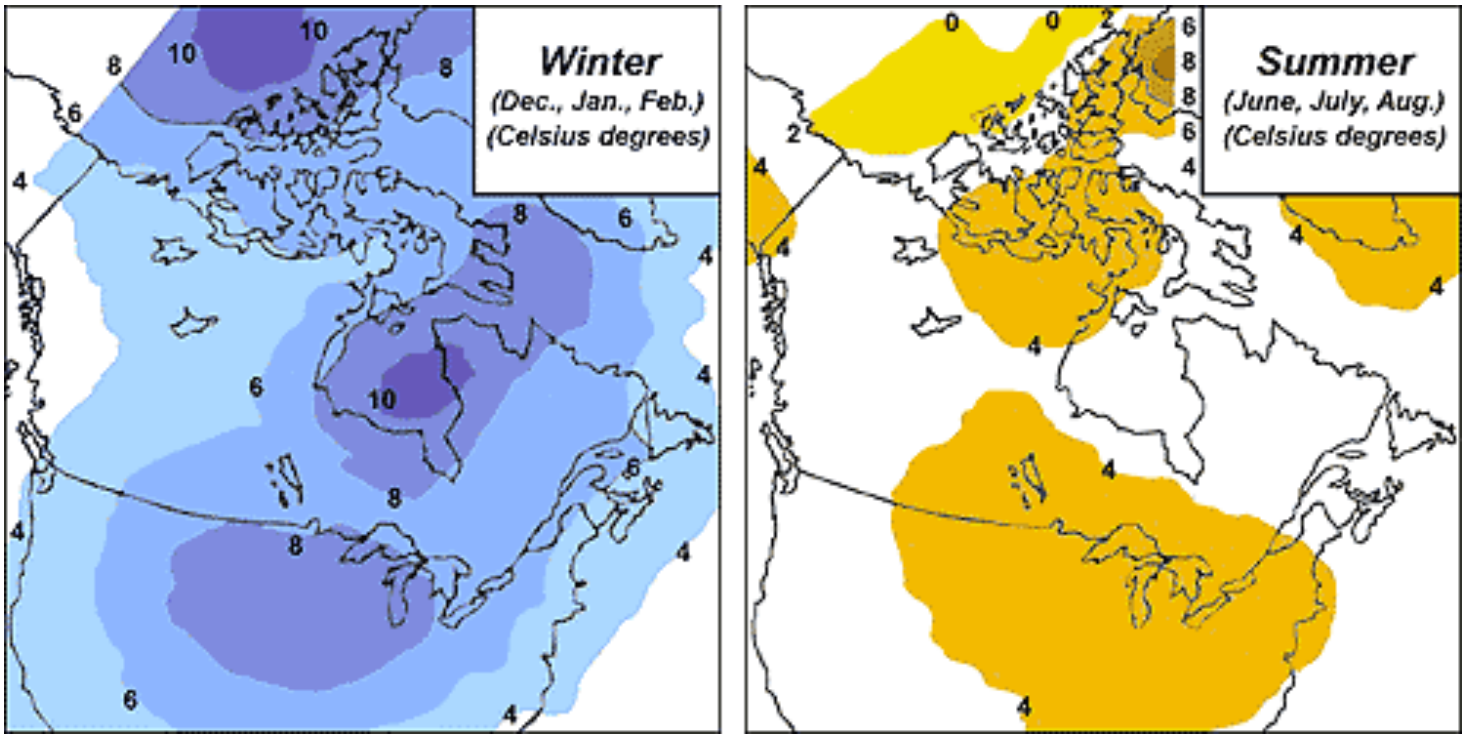
Climate Change in Canada:

Projected temperature change between 1975-1995 and 2040-2060



Combined Effects of Projected Greenhouse Gases and Sulphate Aerosol Increases - Canadian Model

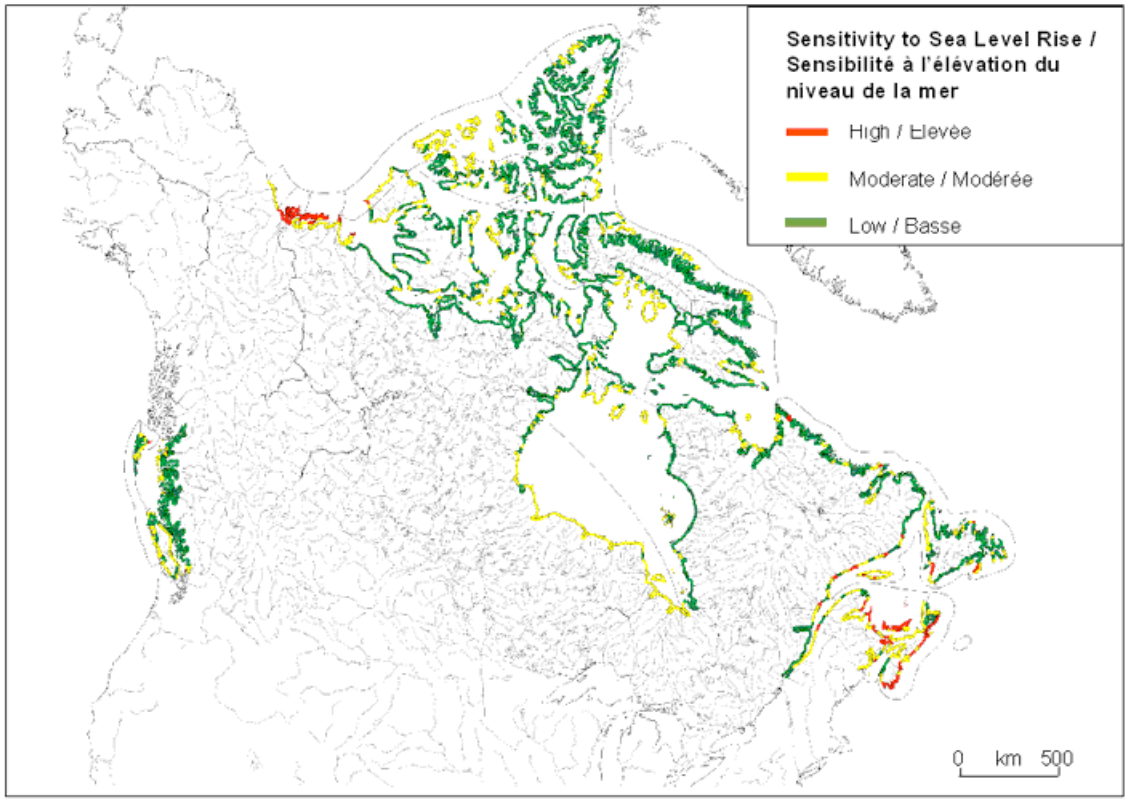
Temperature projections for Canada for winter and summer seasons under doubled concentrations of CO_2



Climate changes will not be distributed uniformly. For a doubling of carbon dioxide concentrations, Canadian climate models project projects an increase of 3.5°C in the earth's average annual temperature but shows more substantial warming over much of Canada, particularly in winter.

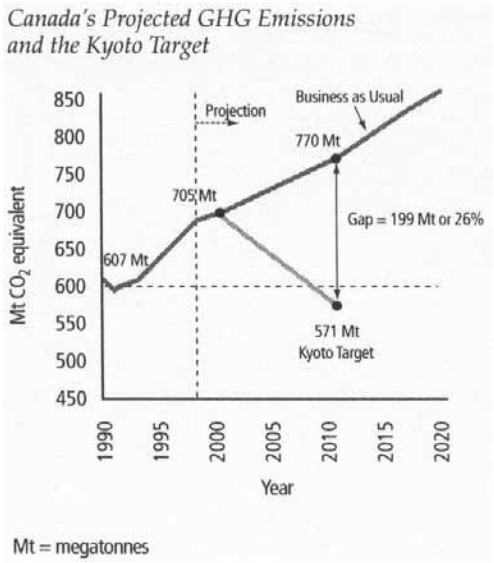
In Canada, where the total coastline exceeds 240,000 kilometres, sea level rise is a significant issue. Climate warming is expected to cause warming of the oceans and melting of glacier ice resulting in a global increase in sea level. A rise in sea level increases the level of wave attack and tides, causing changes in the stability of shorelines as well as flooding of lowlands.

Map 1 – Carte 1



Kyoto Protocol:

To stabilize atmospheric concentrations of greenhouse gases at today's levels will require reducing human-generated emissions by 80 percent immediately.



There are six greenhouse gases covered under the protocol to the international convention on climate change (the Kyoto Protocol) – carbon dioxide (CO2), methane, nitrous oxide, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF6).

The Kyoto protocol was agreed upon through international co-operation under the United Nations Framework Convention on Climate Change (UNFCCC), which was created in 1992.

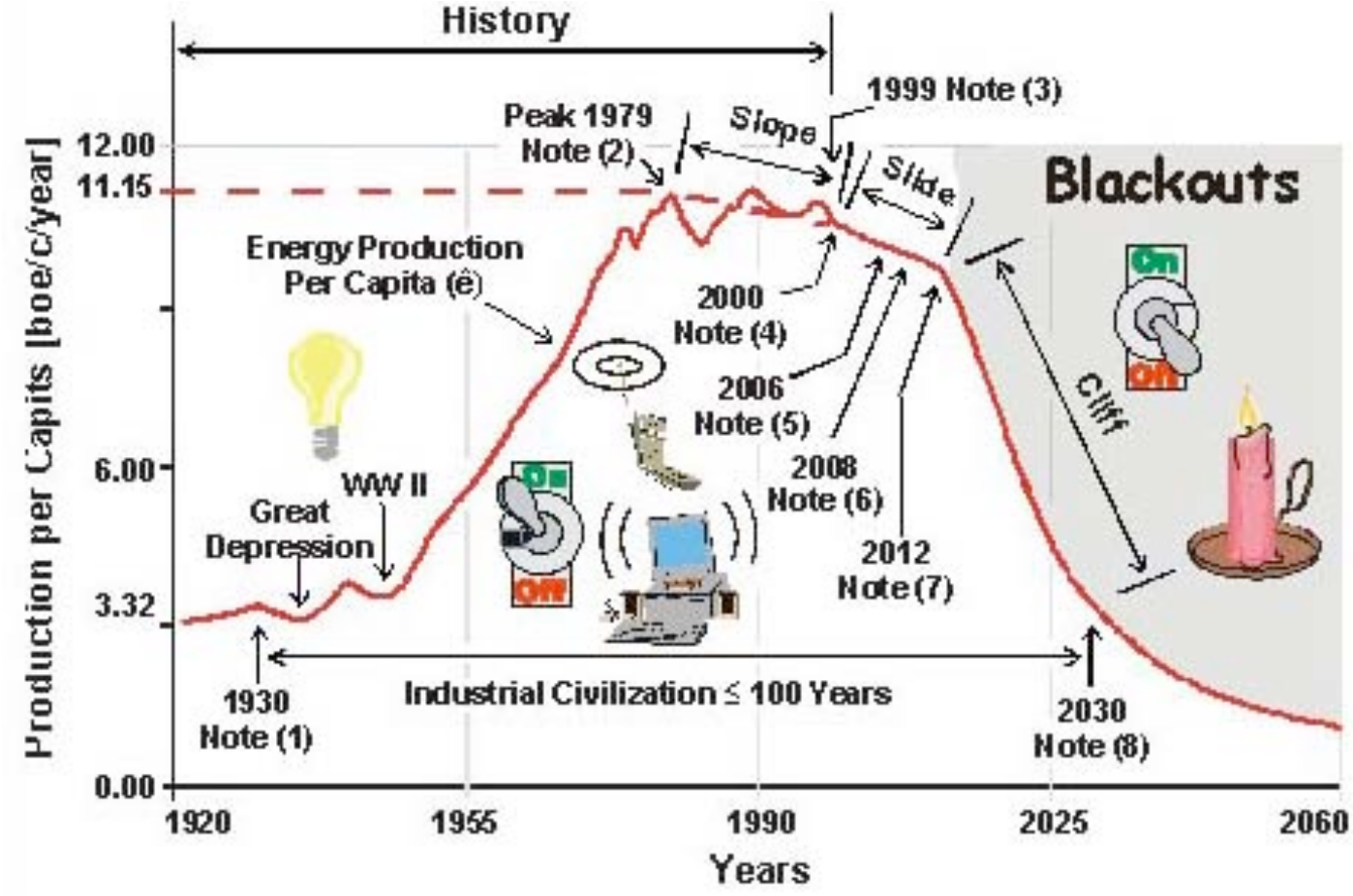
The Kyoto protocol came out of the UNFCCC's December 1997 meeting held in Kyoto, Japan.

Under the agreement, industrialized nations must *reduce their emissions of greenhouse gases by an average of 5.2 per cent (from 1990 levels) by the period 2008 to 2012.*

The conundrum...

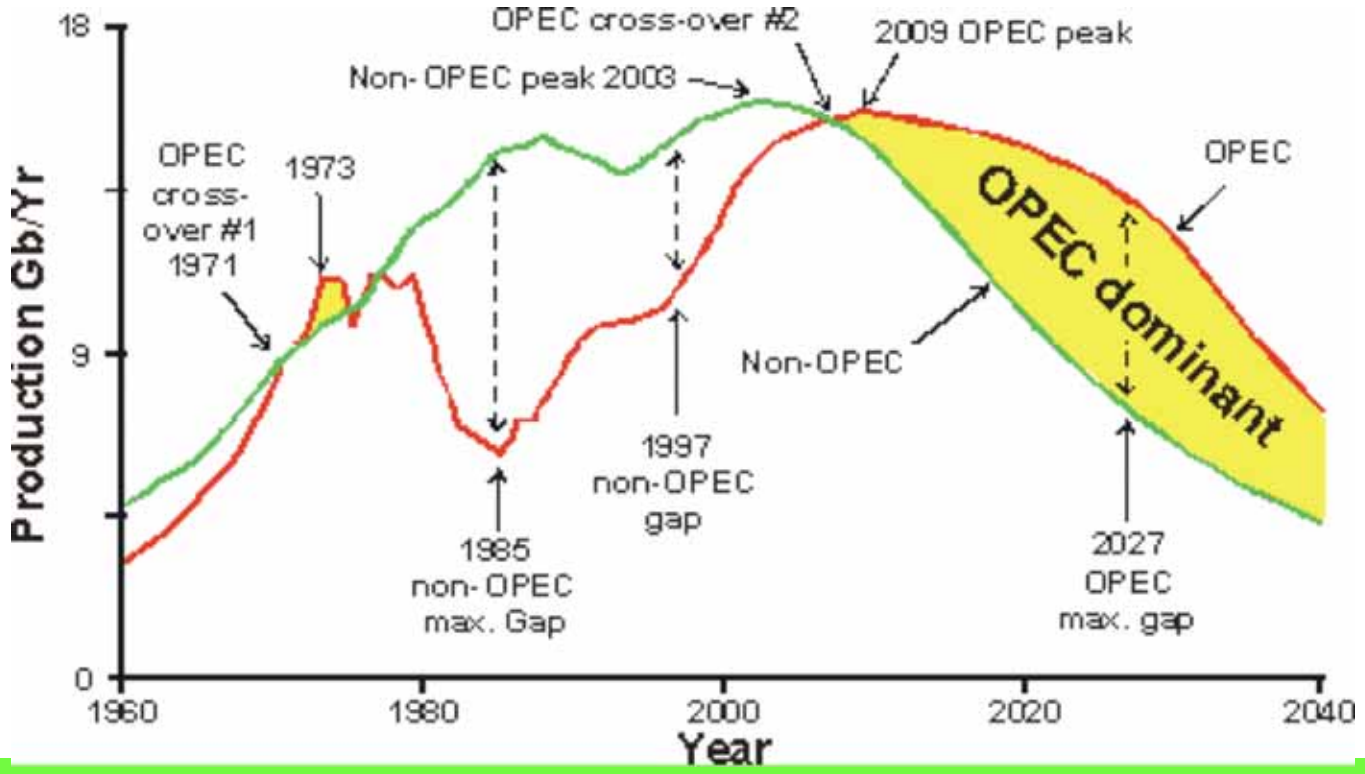
- Greenhouse gas emissions are ruining life on the planet as we know it
- Greenhouse gas comes from burning fossil fuels
- We are running out of fossil fuels, so potentially the faster we run out of fossil fuels the more quickly we can solve Global warming
- *So, why is this a problem?*

The bottom line is that while consumption is ever increasing, production is felt to have peaked and is predicted to rapidly decline.



If fuel production declines, there is not enough fuel to heat and cool the present building stock in 40 years time -- not to mention heating and cooling any buildings we might add between now and then....

Also of concern is the growing reliance on OPEC (Organization of Petroleum Exporting Countries), or non North American fuel sources, given the instability in the Middle East.



The Role of Energy Efficiency:

Worldwide energy assessments now indicate that improving the energy efficiency of buildings, appliances, office equipment, factories, and vehicles could free-up more than a trillion dollars per decade. In addition, these improvements would prevent the release of a rash of environmental pollutants.

Environmental problems like acid rain, urban smog, and global climate change are directly linked to the combustion of fossil fuels. Greater reliance on energy efficiency offers countries worldwide a means of maintaining economic growth and environmental quality. For example, the U.S. Climate Change Action Plan will both reduce greenhouse gases by 108 million tons and save Americans $260 billion.

Renewables?

Ideally a green building should not just get its daylight and heat, but also its electricity from the sun or other renewable energy sources.

Renewable energy sources include:

- solar power
- wind power
- hydro
- biomass
- geothermal power

Solar Power:

The energy derived from the sun is very versatile and can be used either by *passive* or *active* means.

Passive solar often uses direct gain, in combination with thermal mass storage to allow the heat to be stored and re-radiated into the building.

Solar power can be used on tube collectors to heat water.

Solar radiation can be processed through photo-voltaic cells to create electricity.

The sun can be used to daylight buildings and thereby avoid the use of electric lighting.

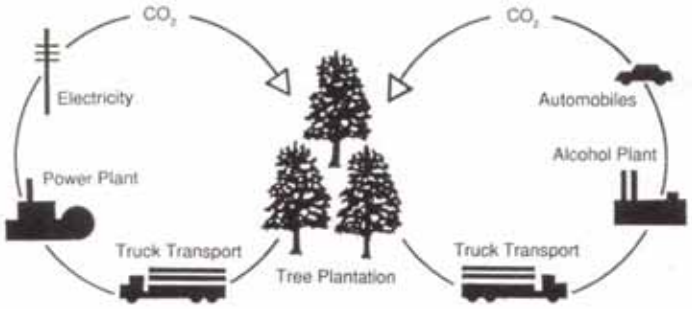
Wind Power:

The terms "wind energy" or "wind power" describe the process by which the wind is used to generate mechanical power or electricity. Wind turbines convert the kinetic energy in the wind into mechanical power. This mechanical power can be used for specific tasks (such as grinding grain or pumping water) or a generator can convert this mechanical power into electricity to power homes, businesses, schools, and the like.

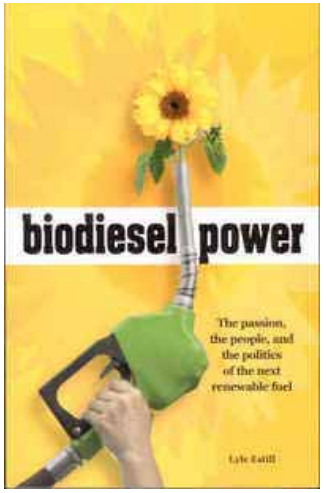
Biomass:

The term "biomass" means any plant derived organic matter available on a renewable basis, including dedicated energy crops and trees, agricultural food and feed crops, agricultural crop wastes and residues, wood wastes and residues, aquatic plants, animal wastes, municipal wastes, and other waste materials. Handling technologies, collection logistics and infrastructure are important aspects of the biomass resource supply chain.

Biopower technologies are proven electricity generation options in the United States, with 10 gigawatts of installed capacity.

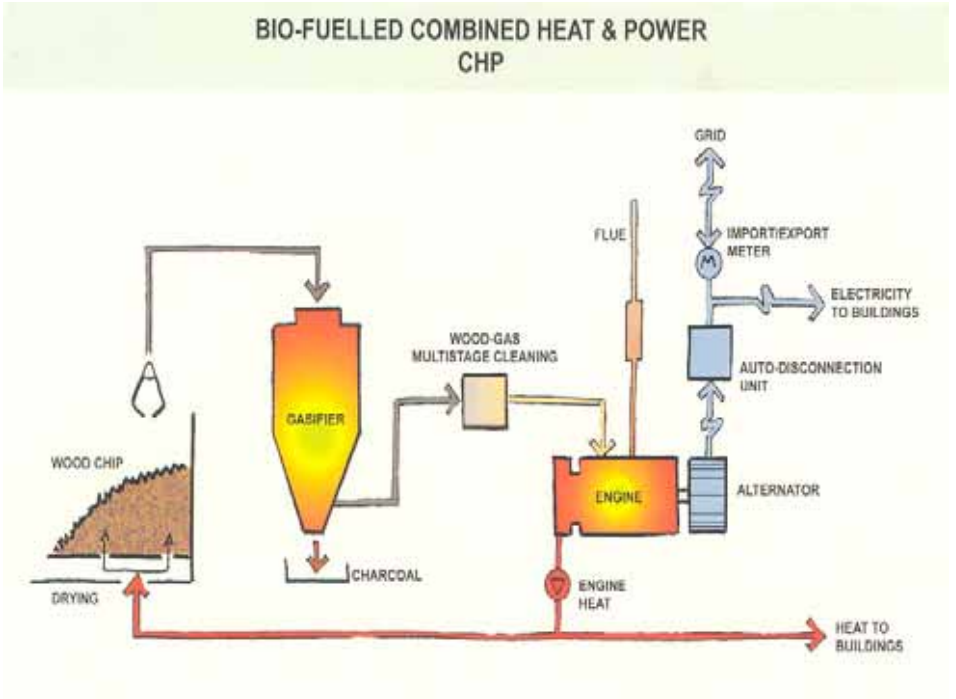


Growth-burn cycle of Biomass

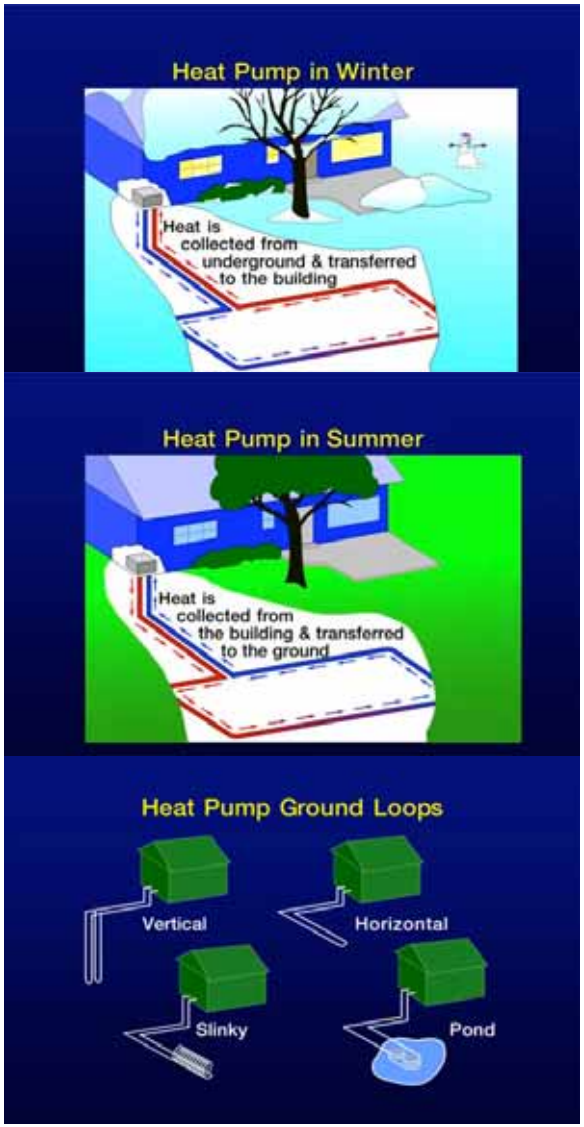


Biomass:

A variety of *Biofuels* can be made from biomass resources, including the liquid fuels ethanol, methanol, biodiesel, and gaseous fuels such as hydrogen and methane. Biofuels research and development is composed of three main areas: producing the fuels, finding applications and uses of the fuels, and creating a distribution infrastructure.



Geothermal Energy:



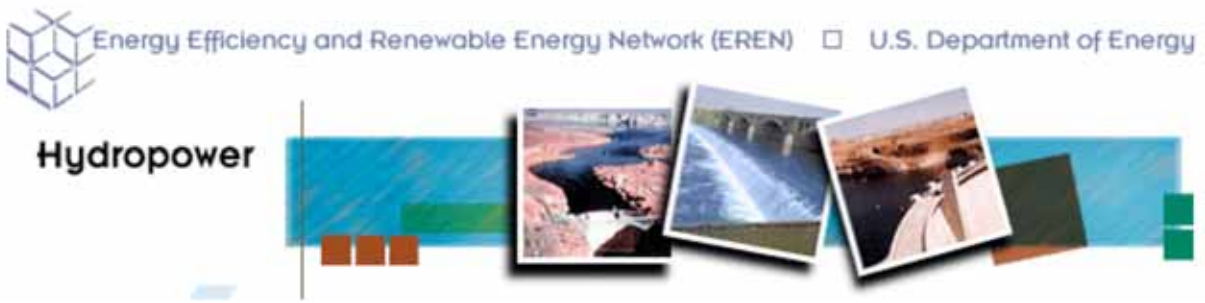
Geothermal energy technologies use the heat of the earth for direct-use applications, geothermal heat pumps, and electrical power production. Research in all areas of geothermal development is helping to lower costs and expand its use. In the United States, most geothermal resources are concentrated in the West, but geothermal heat pumps can be used nearly anywhere.

Geothermal hot water near the Earth's surface can be used directly for heating buildings and as a heat supply for a variety of commercial and industrial uses. Geothermal direct use is particularly favored for greenhouses and aquaculture.

Hydro Power:

Flowing water creates energy that can be captured and turned into electricity. This is called hydropower . Hydropower is currently the largest source of renewable power, generating nearly 10% of the electricity used in the United States.

The most common type of hydropower plant uses a dam on a river to store water in a reservoir. Water released from the reservoir flows through a turbine, spinning it, which, in turn, activates a generator to produce electricity. But hydropower doesn't necessarily require a large dam. Some hydropower plants just use a small canal to channel the river water through a turbine.



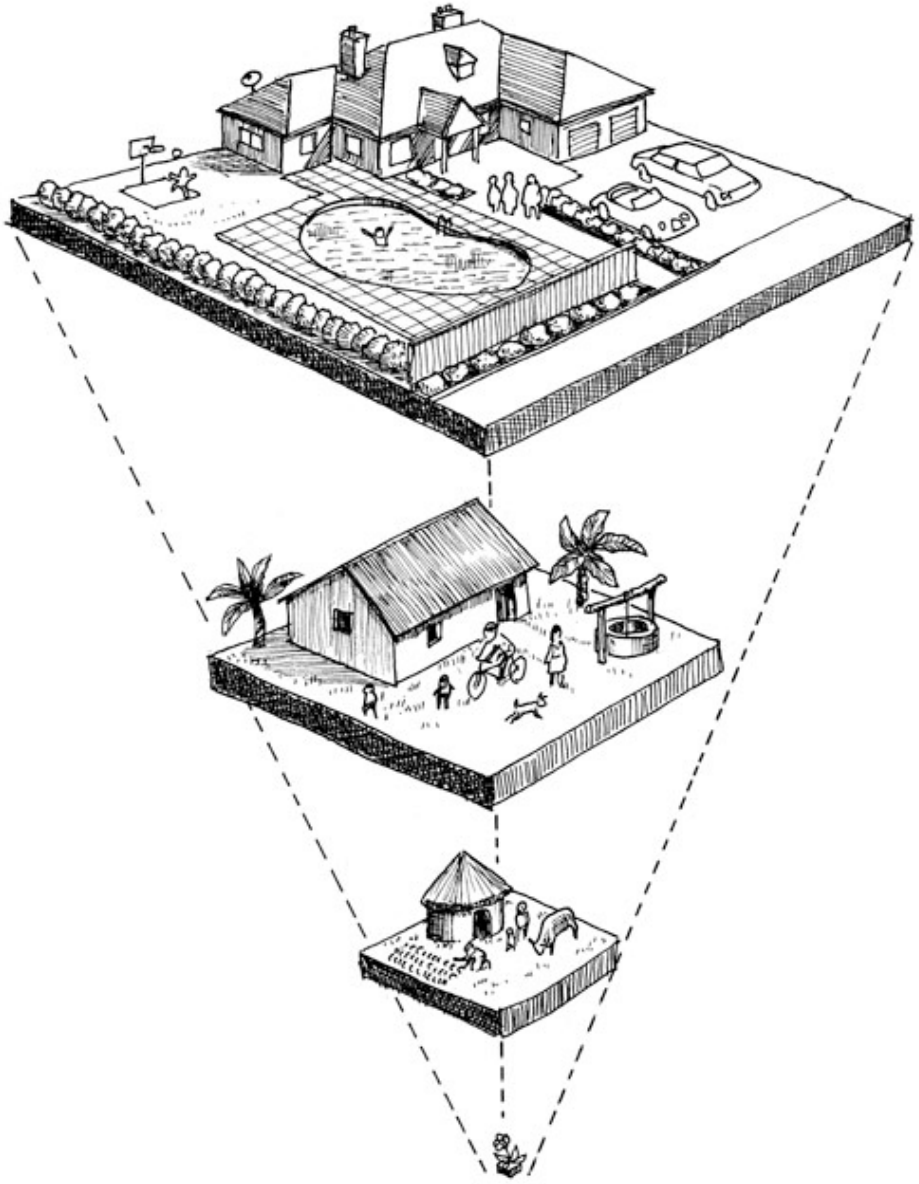
Your ecological footprint...

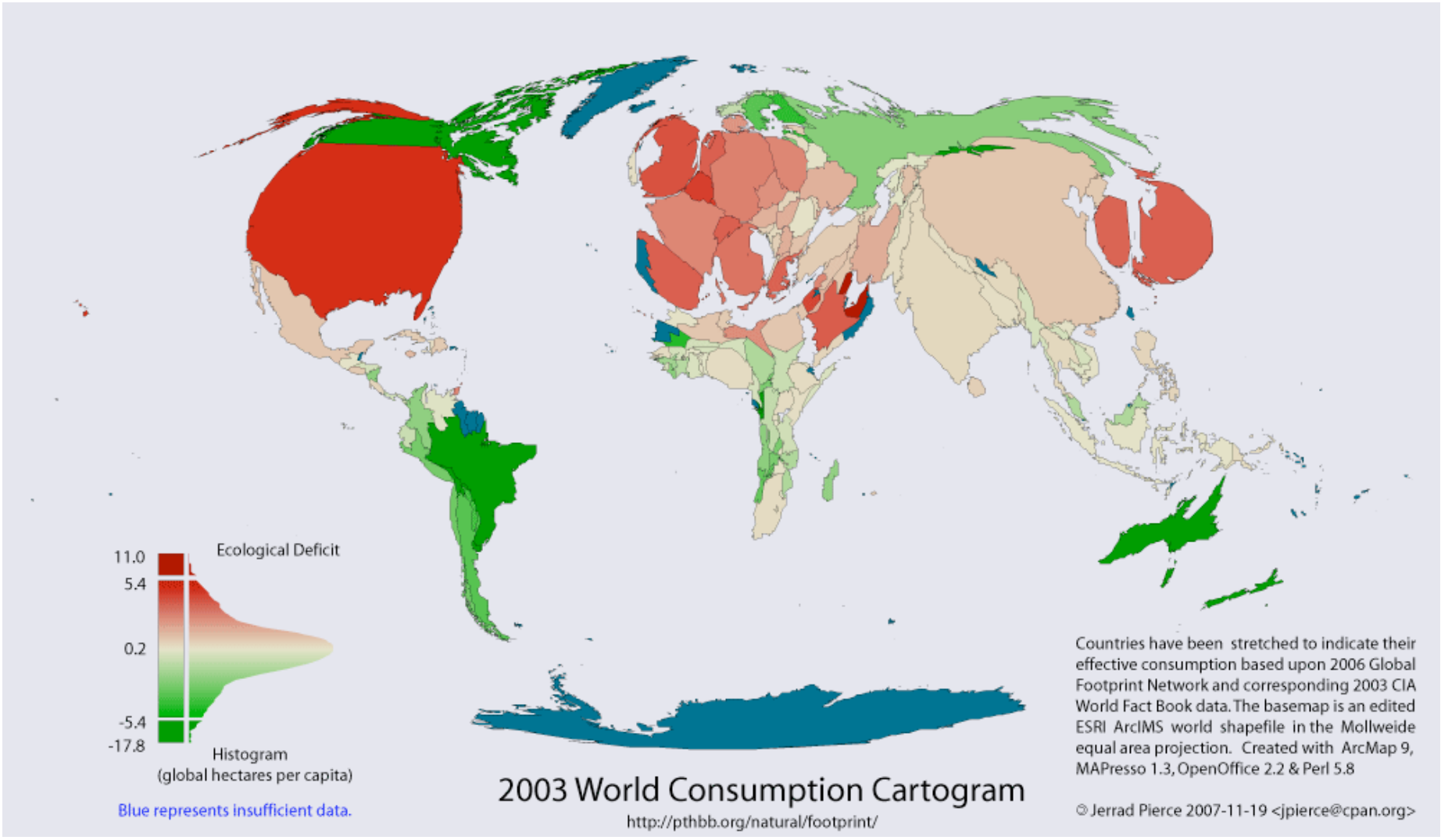
If we are not going to be part of the PROBLEM.

We are going to learn how to be part of the SOLUTION!

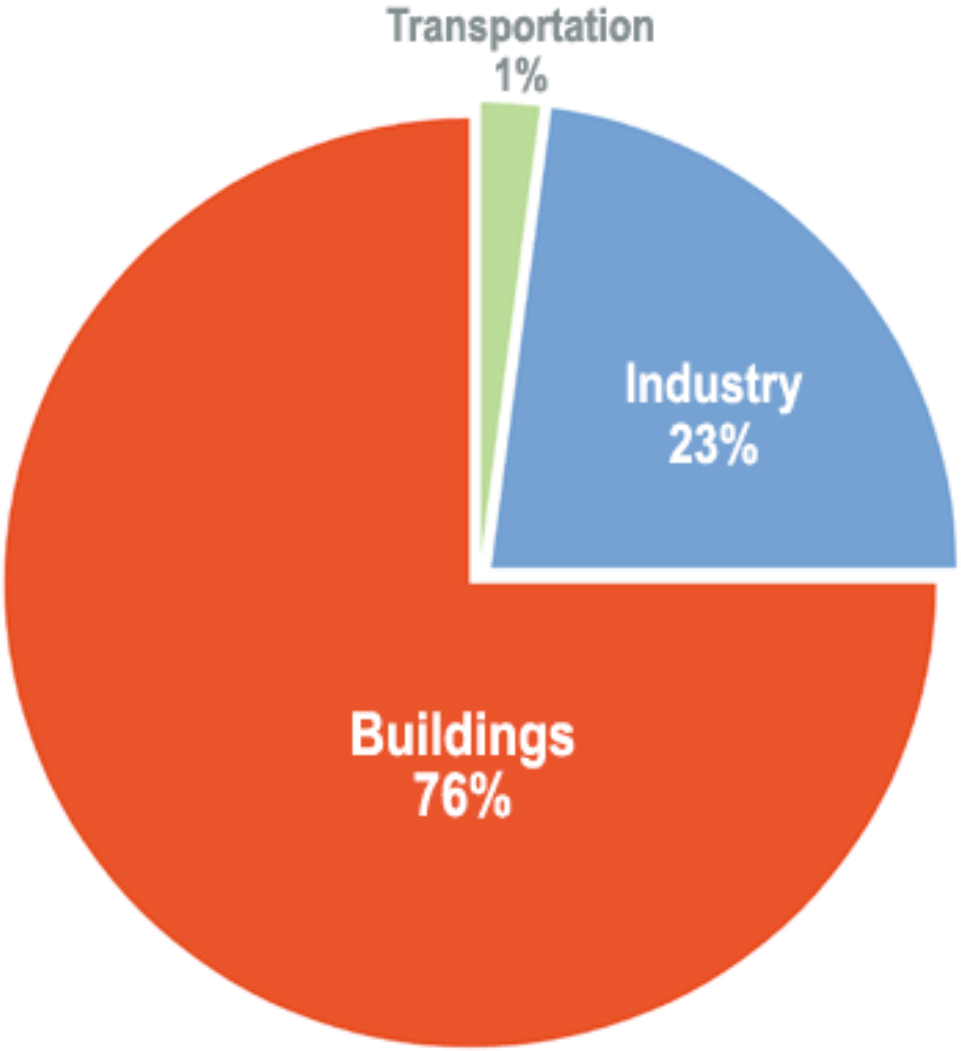
Project #1: Calculate your ecological footprint. How many **planets** are YOU using now....

What is an ecological footprint?




11.0
5.4
0.2
-5.4
-17.8
Ecological Deficit
Histogram
(global hectares per capita)
Blue represents insufficient data.
2003 World Consumption Cartogram
http://pthbb.org/natural/footprint/
Countries have been stretched to indicate their effective consumption based upon 2006 Global Footprint Network and corresponding 2003 CIA World Fact Book data. The basemap is an edited ESRI ArcIMS world shapefile in the Mollweide equal area projection. Created with ArcMap 9, MAPresso 1.3, OpenOffice 2.2 & Perl 5.8
© Jerrad Pierce 2007-11-19 <jpierce@cpan.org>

Arch 125: Introduction to Environmental Design



Consider the percentage of energy used as a direct result of “buildings”...

Who designs buildings?

So, who should be held responsible for them?

US figures

Consider the following:

- 10 billion square meters of buildings exist in Canada
- 6 million square meters of space are added each year
- 10 million square meters of space are renovated each year

- It is a know fact that construction, operation and maintenance of buildings accounts for approximately 40% of total global energy consumption

- In Canada, Buildings contribute 10% of GHGs through direct operating energy consumption

- the construction industry contributes another 30% GHGs indirectly through the production, transportation and waste of materials (through embodied energy)

- In Canada, 8,000 architects and 20,000 engineers control most of these processes

「無後為大」－ 孔子

"Future generation is the most important"
--- Confucius.

"It's not easy being green." --
Kermit the Frog, 1972.