Design for A Sustainable Future

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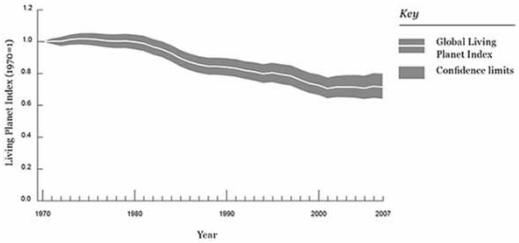
Geographies of Inequality

- Is it possible to ever have a geography of *equality*?
  - Physical geography: may be impossible with different sizes
  - Human geography: very difficult if not impossible (at least not in the foreseeable future)
- Different resources endowment
- Different levels and paces of development
- Different populations
- Good vs bad development
- Sustainable development policies and governance

Since 1970, the global Living Planet Index has fallen by **30%**

The Living Planet Index of global biodiversity was measured by populations of over 2,500 vertebrate species across all regions of the world over 1970-2007.



http://wwf.panda.org/about_our_earth/all_publications/living_planet_report/health_of_our_planet/

This decline is seen in all biomes. And is highest in freshwater habitats.

35% fall for freshwater species

25% fall for marine species

24% fall for terrestrial species

http://wwf.panda.org/about_our_earth/all_publications/living_planet_report/health_of_our_planet

But the trend is not the same all over the world. Tropical and temperate regions show starkly divergent trends.

60% fall
for tropical species

29% rise
for temperate species

http://wwf.panda.org/about_our_earth/all_publications/living_planet_report/health_of_our_planet

As do high-income and low- and middle-income countries.

58% fall
for low-income countries

25% fall
for middle-income countries

5% rise
for high-income countries

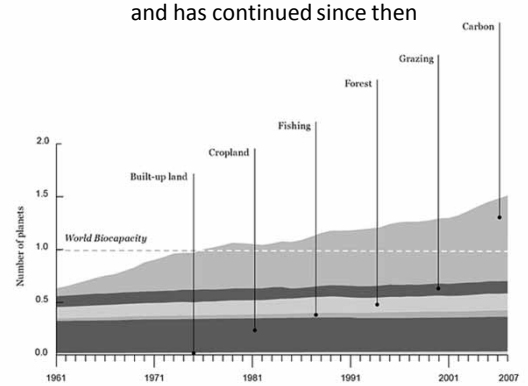
http://wwf.panda.org/about_our_earth/all_publications/living_planet_report/health_of_our_planet

What will be the trends if the period of analysis dates back to much earlier, e.g., 1870, 1770, or 1670?

Costing Nature

- What is the cost of damaging nature?
- Just ask a Chinese fruit farmer who now has to pay people to pollinate apple trees because there are no longer enough bees to do the job for free.
- A recent 2-year study for the United Nations Environment Programme, entitled *The Economics of Ecosystems and Biodiversity* (TEEB), estimated the damage done to the natural world by human activity in 2008 at between US$2 tn and US$4.5 tn (the lower estimate is roughly equivalent to the entire annual economic output of the UK or Italy).
- A second study, for the UN-backed Principles for Responsible Investment (PRI), estimated the cost at US$6.6 tn, or 11% of global economic output.
- These are only indicative figures

During the 1970s, humanity as a whole passed the point at which the annual Ecological Footprint matched the Earth's annual biocapacity. This situation is called "ecological overshoot", and has continued since then



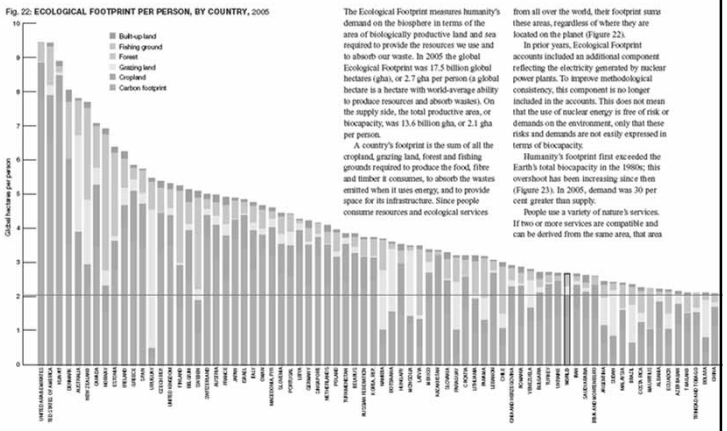
http://wwf.panda.org/about_our_earth/all_publications/living_planet_report/demands_on_our_planet/

In 2007, humanity's Footprint exceeded the Earth's biocapacity by **50%**

Under a "business as usual" scenario, even with modest UN projections for population growth, consumption and climate change, by 2030 humanity will need the capacity of *two Earths* to absorb CO_2 waste and keep up with natural resource consumption; and just 2.8 Earths by 2050 (WWF's *Living Planet Report 2010*).

http://wwf.panda.org/about_our_earth/all_publications/living_planet_report/demands_on_our_planet/

Inequality of resources consumption?



The Ecological Footprint measures humanity's demand on the biosphere in terms of the area of biologically productive land and sea required to provide the resources we use and to absorb our waste. In 2005 the global Ecological Footprint was 17.5 billion global hectares (gha), or 2.7 gha per person (a global hectare is a hectare with world-average ability to produce resources and absorb wastes). On the supply side, the total productive area, or biocapacity, was 13.6 billion gha, or 2.1 gha per person.

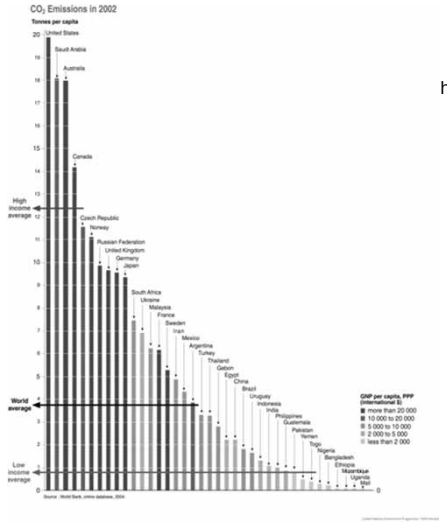
A country's footprint is the sum of all the cropland, grazing land, forest and fishing grounds required to produce the food, fibre and timber it consumes, to absorb the wastes emitted when it uses energy, and to provide space for its infrastructure. Since people consume resources and ecological services from all over the world, their footprint sums these areas, regardless of where they are located on the planet (Figure 22).

In prior years, Ecological Footprint accounts included an additional component reflecting the electricity generated by nuclear power plants. To improve methodological consistency, this component is no longer included in the accounts. This does not mean that the use of nuclear energy is free of risk or demands on the environment, only that these risks and demands are not easily expressed in terms of biocapacity.

Humanity's footprint first exceeded the Earth's total biocapacity in the 1980s; this overshoot has been increasing since then (Figure 23). In 2005, demand was 30 per cent greater than supply.

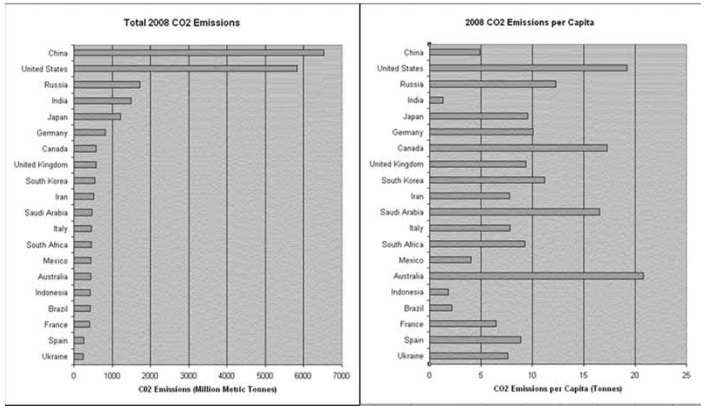
People use a variety of nature's services. If two or more services are compatible and can be derived from the same area, that area

Source: WWF Living Planet Report 2008



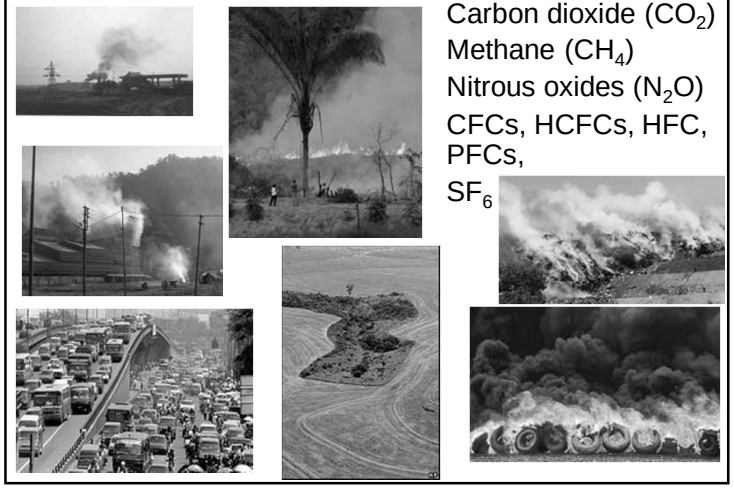
(Source: World Bank, online database, 2004)
http://www.vitalgraphics.net/climate2.cfm?pageID=8

Total CO_2 emissions and CO_2 emissions per capita



http://www.ucsusa.org/global_warming/science_and_impacts/science/graph-showing-each-countrys.html

Emission of greenhouse gases (GHGs), which cause global warming and induce climate change

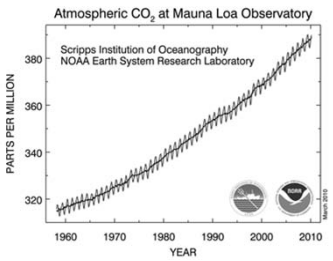


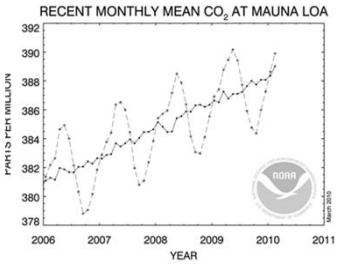
Carbon dioxide (CO_2)
Methane (CH_4)
Nitrous oxides (N_2O)
CFCs, HCFCs, HFC, PFCs,
SF_6

Records at Mauna Loa, Hawaii, shows an increase in the mean annual CO_2 concentrations from 315.98± 0.12 ppm of dry air in 1959 to 385.57 ± 0.12 ppm in 2008, to 387.35 ± 0.12 ppm in 2009.

Atmospheric mixing ratio of CO_2 : 275-285 ppm in the pre-industrial era (AD 1000–1750)

http://www.esrl.noaa.gov/gmd/ccgg/trends/co2 data mlo.html



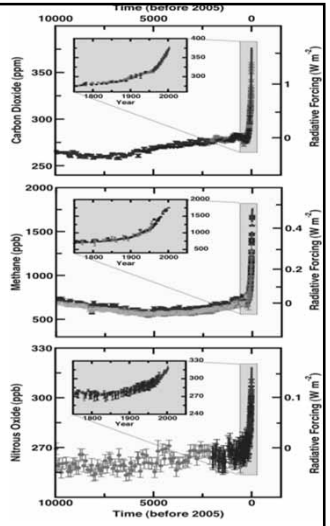


Human and Natural Drivers of Climate Change

CO_2, CH_4 and N_2O Concentrations

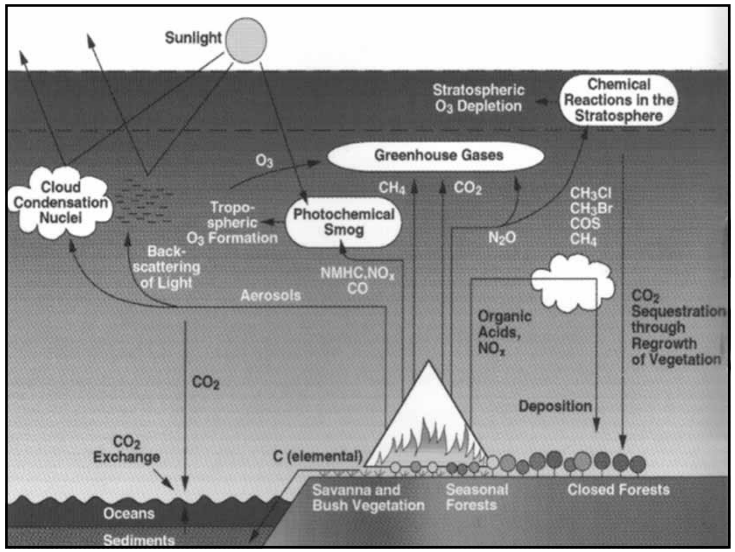
- far exceed pre-industrial values
- increased markedly since 1750 due to human activities

Relatively little variation before the industrial era



Atmospheric lifetime for several greenhouse gases

CO_2	: ~ 200-450 years for small perturbations to tens of thousands of years for large input from burning fossil fuels
CH_4	**: 12 ± 3 years**
N_2O	**: 120 years**
CFC-12	**:100 years**
HCFC-22	**: 12.1 years**
HFC-23	**: 270 years**
SF_6	**: 3200 years**
CO	**: A few months**



Comparison of 100-Year GWP Estimates from the IPCC's Second (1996) and Third (2001) Assessment Reports

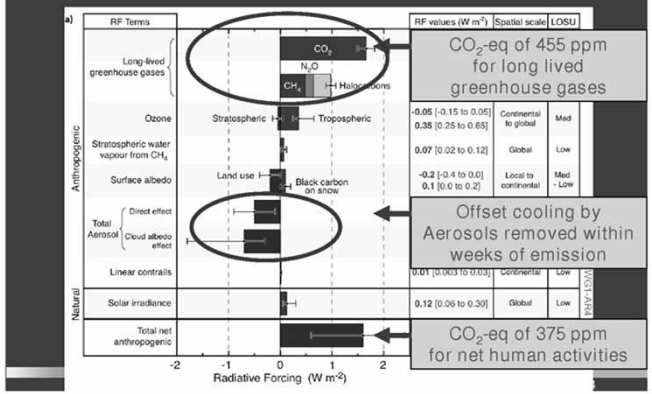
Gas	2001 IPCC GWP[b]
Carbon Dioxide	1
Methane	23
Nitrous Oxide	296
HFC-23	12,000
HFC-125	3,400
HFC-134a	1,300
HFC-143a	4,300
HFC-152a	120
HFC-227ea	3,500
HFC-236fa	9,400
Perfluoromethane (CF_4)	5,700
Perfluoroethane (C_2F_6)	11,900
Sulfur Hexafluoride (SF_6)	22,200

Carbon dioxide equivalent

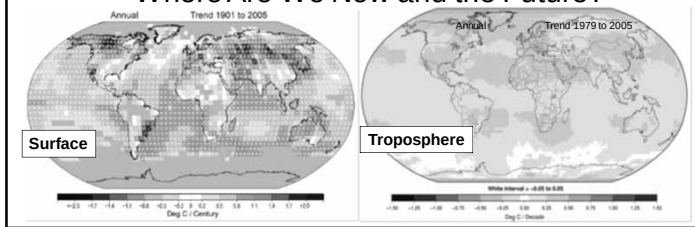
1 tonne of +CO_2 + 1 tonne of CH_4
+ 1 tonne of N_2O
=
1 tonne of +CO_2 + (1 tonne of CH_4 x 23) CO_2 - equivalent + (1 tonne of N_2O x 296) CO_2 - equivalent
= 320 tonnes CO_2 - equivalent

Radiative forcing: CO_2 equivalents

Used to compare different drivers of climate change



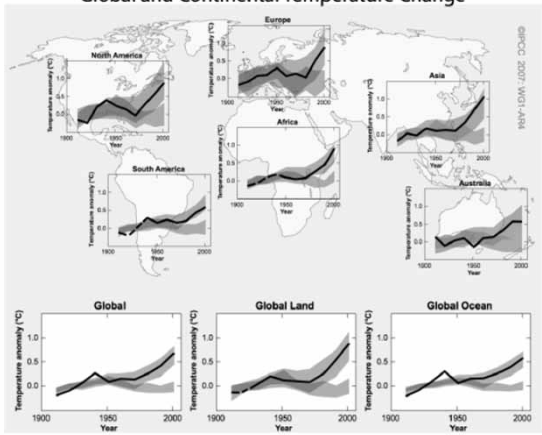
Observed Widespread Warming: Where Are We Now and the Future?



- The global average air temperature has warmed 0.74 [0.56 to 0.92]°C during 1906-2005
- It is projected to increase (best estimate) from 1.8°C (*likely* range 1.1°C - 2.9°C), to and 4.0°C (*likely* range 2.4°C - 6.4°C) by 2100.
- If GHG were kept at current levels, a committed 0.6°C of further warming would be expected by 2100. This means a total of 1.34 [1.16 to 1.52]°C.
- So we are not very far from 2°C.
- More warming would accompany more emissions!

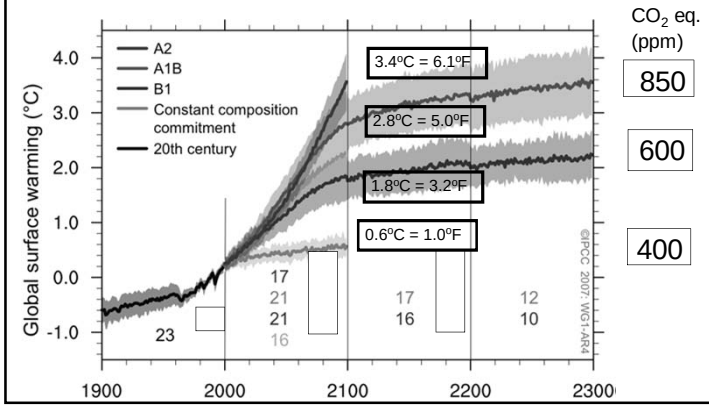
Regional variations in temperature trends. This means that the global 2°C temperature limit as proposed in the Copenhagen Accord has not captured the regional variations

Global and Continental Temperature Change



Projections of Future Temperature Changes

Best estimate for low scenario (B1) is 1.8°C (*likely* range 1.1°C - 2.9°C), and for high scenario (A1FI) is 4.0°C (*likely* range 2.4°C - 6.4°C). If GHG were kept at current levels, a committed 0.6°C of further warming would be expected by 2100. More warming would accompany more emission (IPCC, 2007)



Pathways towards stabilization

Characteristics of stabilization scenarios

Category	CO_2 concentration at stabilization (2005 = 379 ppm) [a]	CO_2-equivalent Concentration at stabilization including GHGs and aerosols (2005 = 375 ppm) [b]	Peaking year for CO_2 emissions [a, c]	Change in global CO_2 emissions in 2050 (% of 2000 emissions) [a, c]	Global average temperature increase above pre-industrial at equilibrium, using "best estimate" climate sensitivity [d], [e]	**Global average sea level rise above pre-industrial at equilibrium from thermal expansion only [f]**	Number of assessed scenarios
	ppm	ppm	Year	Percent	°C	metres	
I	350 – 400	445 – 490	2000 – 2015	-85 to -50	2.0 – 2.4	0.4 – 1.4	6
II	400 – 440	490 – 535	2000 – 2020	-60 to -30	2.4 – 2.8	0.5 – 1.7	18
III	440 – 485	535 – 590	2010 – 2030	-30 to +5	2.8 – 3.2	0.6 – 1.9	21
IV	485 – 570	590 – 710	2020 – 2060	+10 to +60	3.2 – 4.0	0.6 – 2.4	118
V	570 – 660	710 – 855	2050 – 2080	+25 to +85	4.0 – 4.9	0.8 – 2.9	9
VI	660 – 790	855 – 1130	2060 – 2090	+90 to +140	4.9 – 6.1	1.0 – 3.7	5

EU and Copenhagen Accord target at 2ºC (the "dangerous" climate change), approx. 450 ppm CO_2-eq

- Sea level rise under warming is inevitable
- Long time scales of thermal expansion & ice sheet response to warming imply that stabilisation of GHG concentrations at or above present levels will not stabilise sea level for many centuries
- Mitigation efforts over the next two to three decades will have a large impact on opportunities to achieve lower stabilization levels. Annex 1 Parties would require to reduce emissions in a range of 25-40% below 1990 level by 2020

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC)

What is "dangerous" climate change?

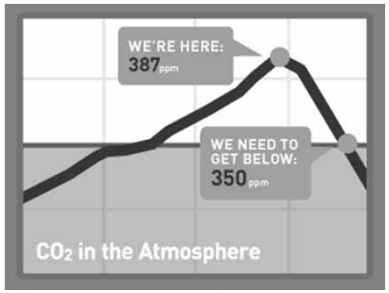
- A warming of 2°C above pre-industrial temperatures is frequently cited as the limit beyond which the world will face "dangerous" climate change
- In January 2007, the European Commission issued a communication stating that "*the European Union's objective is to limit global average temperature increase to less than 2°C compared to pre-industrial levels*".
- Copenhagen Accord adopts this *2°C* temperature limit.
- The Intergovernmental Panel on Climate Change (IPCC) has recommended no specific temperature threshold for dangerous climate changes, and the negative effects are gradually increasing.

Multi-dimensional threshold

- A temperature threshold is an important indicator for "dangerous" climate change
- However, a combination of temperature threshold and other factors (e.g., *changes in precipitation and in large scale atmospheric circulation patterns, socio-economic change, population, settlement patterns, water demands, human choices and behaviour, etc.)* all play roles of equal or greater importance than temperature in determining the final magnitude and timing of adverse impacts in certain areas. The risk can be very low or high depending on how the other factors develop as a consequence of both climate change and socio-economic development paths.
- Thus, other than a certain temperature threshold, it is more important to consider, assess and capture the "**multi-dimensional threshold**" for both climatic and non-climatic factors that will cause the impacts.

New Study Published in *Nature*

- Scientists have used a new probability model to calculate how much CO_2 our atmosphere tolerates under these target specifications.
- A new study published in *Nature* shows that there is a 75% probability that global warming will not exceed *2°C* if a maximum of 1000 billion tonnes of CO_2 are emitted into the atmosphere from 2000 to 2050.
- However, 234 billion tonnes had already been released into the atmosphere between 2000 and 2006. If the emission remain at this high level, or even increase, the budget would be exhausted before 2030.



http://www.350.org/understanding-350

350 ppm is what many scientists, climate experts, and governments of AOSIS and LDCs are proposing as the safe upper limit for CO_2 in our atmosphere, based on the study of Dr. James Hansen of NASA, who first publicly testified before the U.S. Congress in June of 1988 that global warming was real.

BOLIVIA even called for limiting the temperature increase to 1°C and stabilization at as close to 300 ppm as possible.

Publicly Reported Proposals to UNFCCC's COP-15
as Interpreted by Sustainability Institute, April 1, 2010

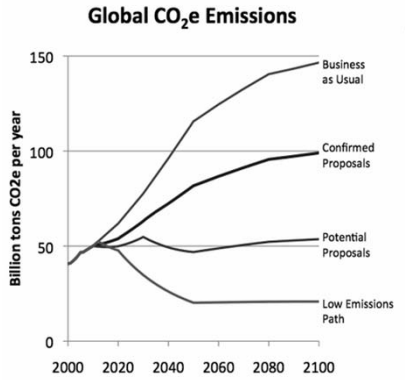
Country/Region	Reduction in Emissions 2020	Reduction in Emissions 2050	Other Proposals
Argentina			*Zero deforestation by 2020*
Australia	5% below 2000 *25% below 2000*	60% below 2000	20% renewable energy by 2020
Belarus	*10% below 1990*		
Brazil	36.1% below BAU *38.9% below BAU*		Amazon deforestation rate 70% below 2009 levels by 2017 *Zero deforestation by 2020*
Canada	17% below 2005	60% below 2006 *70% below 2006*	
China	carbon intensity 45% below 2005		Increase forest coverage by 40 million hectares by 2020; increase proportion of non-fossil fuels to 15% by 2020 *Emissions Peak in 2030 and fall to 2005 levels by 2050*
Costa Rica			0 emissions by 2021
Croatia	5% below 1990		
EU-27	20% below 1990 *30% below 1990*	80% below 1990 *95% below 1990*	
Finland*		80% below 1990	
Germany*	40% below 1990		
Great Britain*	34% below 1990	80% below 1990	
Iceland	15% below 1990 *30% below 1990*	50% below 1990 *75% below 1990*	
India	carbon intensity 20% below 2005		Keep emissions per capita below those of developed countries *20% of electricity from renewable energy by 2020*
Indonesia	26% below BAU		*40% below 2005 by 2030; Change forest to net sink by 2030*
Israel	20% below BAU		
Japan	*25% below 1990*	*80% below 2005*	
Jordan			10% renewable energy by 2020
Kazakhstan	15% of 1992		
Liechtenstein	20% below 1990 *30% below 1990*		
Malaysia	carbon intensity 40% below 2005		
Maldives	carbon neutral		
Marshall Islands	*40% below 2009*		
Mexico	*30% below BAU*	*50% below 2002*	8% below 2009 by 2012
Moldova	25% below 1990		
Monaco	30% below 1990	carbon neutral	
Morocco			600% increase in wind power and 15% reduction in building, industry, and transport energy use by 2020
New Zealand	*20% below 1990*	50% below 1990	
Norway	30% below 1990 *40% below 1990*		*carbon neutral by 2030*
Papua New Guinea		*carbon neutral*	*50% below BAU by 2030*
Paraguay			*Zero deforestation by 2020*
Russia	15% below 1990 *25% below 1990*	50% below 1990	
Scotland*	42% below 1990	80% below 1990	
Singapore	*16% below BAU*		
South Africa	*34% below BAU*		Emissions peak in 2025, stabilize for 10 years and decline *42% below BAU by 2025*
South Korea	*30% below BAU*		
Switzerland	20% below 1990 *30% below 1990*		*carbon neutral by 2030*
Ukraine	*20% below 1990*	*50% below 1990*	
US	17% below 2005 *28% below 2005*	*75% below 2005*	

* Countries are part of EU-27

Black text indicates a confirmed proposal; *green italic* text indicates a potential proposal. Confirmed proposals include official gov't statements, adopted legislation, and UNFCC submissions. Potential proposals include conditional proposals, legislation under consideration, and unofficial government statements.

Climate Scoreboard ©Sustainability Institute April 1, 2010 www.ClimateScoreboard.org

Emission Reduction Proposals Associated With Copenhagen Accord



	2100 Values: Atmospheric CO_2	Atmospheric CO_2e	Temp. Increase Over Preindustrial (90% C.I.)
Business as Usual	965 ppm	1410 ppm	4.8°C (2.9°-7.7°) 8.7°F (5.2°-13.9°)
Confirmed Proposals	770 ppm	1015 ppm	3.9°C (2.3°-6.2°) 7°F (4.2°-11.1°)
Potential Proposals	585 ppm	715 ppm	2.9°C (1.7°-4.6°) 5.2°F (3.1°-8.3°)
Low Emissions Path	470 ppm	520 ppm	2°C (1.2°-3.1°) 3.5°F (2.1°-5.7°)

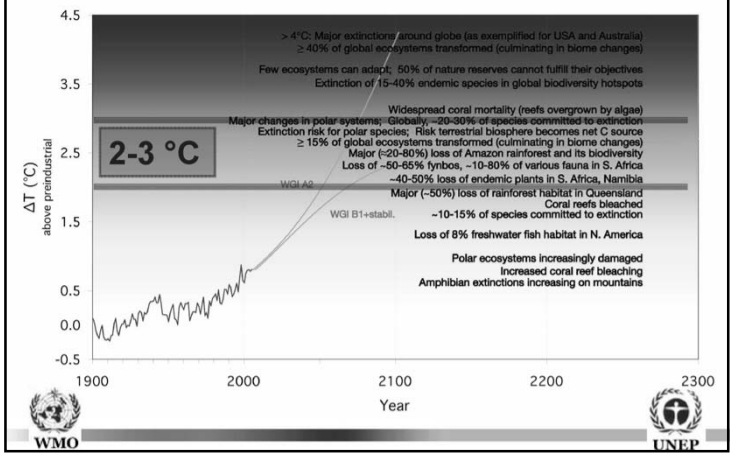
CLIMATE INTERACTIVE

Climate Scoreboard ©Sustainability Institute April 1, 2010 www.ClimateScoreboard.org

Projected impacts of climate change (Stern, 2007)

	Global temperature change (relative to pre-industrial)					
	0°C	1°C	2°C	3°C	4°C	5°C
Food	*Falling crop yields in many areas, particularly developing regions*					
		Possible rising yields in some high latitude regions			*Falling yields in many developed regions*	
Water	*Small mountain glaciers disappear – water supplies threatened in several areas*		*Significant decreases in water availability in many areas, including Mediterranean and Southern Africa*		*Sea level rise threatens major cities*	
Ecosystems	*Extensive Damage to Coral Reefs*		*Rising number of species face extinction*			
Extreme Weather Events	*Rising intensity of storms, forest fires, droughts, flooding and heat waves*					
Risk of Abrupt and Major Irreversible Changes			*Increasing risk of dangerous feedbacks and abrupt, large-scale shifts in the climate system*			

Summary - Ecosystem impacts

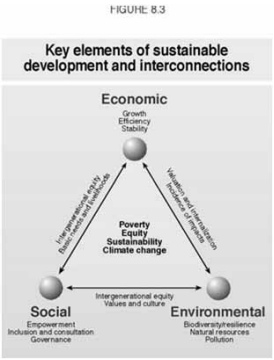


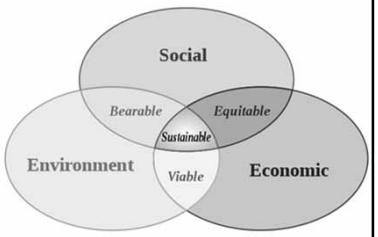
- *In order to reduce our ecological footprint, and to reduce GHG emissions, we must promote sustainable development (i.e., **good** development, NOT **bad** development).*

Sustainable Development Policy

- Need to *develop sustainable development policy* in all environmental, social and economic sectors and *effectively implement* these policies to reduce poverty, improve the quality of life, and enhance the capacity to adapt and mitigate:
  - Industry (sustainable industry)
  - Energy (sustainable energy development and use; energy conservation and efficiency – it is cheaper to save one kWh of electricity than to supply the same kWh of electricity!)
  - Land (sustainable land management; combat desertification)
  - Water (sustainable water resources management)
  - Forestry (sustainable forest management)
  - Agriculture (sustainable agriculture)
  - Mining (least-impact option)
  - Transport (sustainable transportation; promotion of efficient public transport)
  - Technologies (promotion of environmentally sound technologies)
  - Human health (public and environmental health)
  - Social services

What we need is not the “balancing” or “trade-offs” of the three pillars of sustainability but to integrate them into one entity and create synergies





Sustainability

A sustainable society reflects the following three interdependent principles:

- The planet has a limited carrying capacity and we are all dependent on a healthy, functioning biosphere (*environmental sustainability*)
- Individuals can best meet their needs in caring and vibrant communities (*social sustainability*).
- A just economy is dependent on an equitable society and a healthy planet (*economic sustainability*).

Three nested spheres of sustainability — interdependent and integrated into coherent decision-making, planning and implementation processes at all levels of governance

- *This also means we must use our natural resources more efficiently, and hence we must be more eco-efficient!!*

Eco-Efficiency
Economic
Ecological (Environment)

An important tool to achieve sustainable development

Quantity of goods or services produced or provided to customers; Net sales

$$\text{Eco-Efficiency} = \frac{\text{Product or Service value}}{\text{Environmental impacts}}$$

Energy consumption
Materials consumption
Water consumption
Greenhouse gas emissions (CO_2…)
Ozone depletion substance emissions
……

(Modified after Culaba *et al.*, 2005)

WBSCD, 1992

Eco-efficiency

- In simplest terms, eco-efficiency means creating more goods and services with ever less use of resources, waste and pollution.
- It makes good economic, ecological and environmental sense!
- First practised by large manufacturers in North America and Europe in the 1980s, eco-efficiency is now widely endorsed by business, government, community and academia alike.

Vietnamese people are very eco-efficient; but safety is a concern




But Vietnam may hold the record for having eight people on a motor cycle!

Afghanistan people are also very eco-efficient

This is even more eco-efficient!

You have to admire the creativity of the people

Public transport in Bagan, Myanmar

Public transport in Africa, with first class passengers sitting at the top!

(Kindly provided by Chow Kok Kee)

Train transport in India

A unique school bus in New Delhi, India

(Kindly provided by Chow Kok Kee)

(Source: Chow Kok Kee)

Brisbane, Australia

A different world!

Honolulu Airport taxi, Hawaii

Vertical Car Parks in Germany

Is this the solution for sustainability?

Seven Elements to Eco-efficiency

1. Reducing the material requirements for goods and services
2. Reducing the energy intensity of goods and services
3. Reducing toxic dispersion
4. Enhancing material recyclability
5. Maximizing sustainable use of renewable resources
6. Extending product durability
7. Increasing the service intensity of goods and services

Eco-efficiency is linked to…

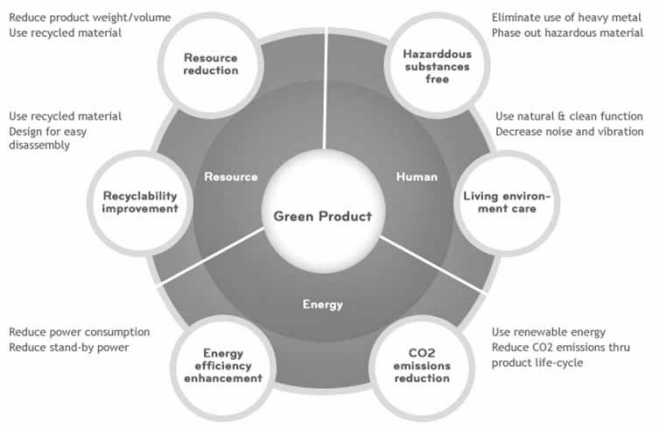
- Cleaner production (Reduce, reuse, recycle, recovery)
- ISO 14,000 Series, including Environmental Management System (ISO 14,001) and Life Cycle Assessment (ISO 14040/41/42/43 and TR 14048/49)
- Various economic and legal instruments
- Green productivity
- Cleaner energy
- Sustainable production and consumption
- Corporate sustainability

Eco-efficiency: Redesign, Reuse, Rethink and Reshape.

- Re-design processes to reduce the consumption of resources, reduce pollution and avoid risks, while reducing costs.
- Re-design products so that they will have less impact on the environment, while still providing the functionality to consumers.
- Reuse by-products and waste – this may be done by cooperating with other companies in creative way, as one company's trash is another company's treasure.
- Rethink your markets and reshape supply and demand completely - find innovative ways of meeting customer needs.

Design for the Environment (DFE) (or Eco-design)

- The most common DFE practices used include:
  - design for recycling;
  - design for disassembly;
  - design for energy efficiency;
  - design for remanufacture;
  - design for disposability;
  - hazardous material minimization



http://www.lg.com/id/about-lg/sustainability/environment/green-products/eco-design.jsp

Weakness of Eco-efficiency

- Eco-efficiency: Using less resources per unit of production may fail to deliver progress toward sustainability if the number of units continues to increase faster than the gains in resource productivity.
- Eco-efficiency: What happens if a bad product has been produced? Then the more eco-efficient you are, the more the bad products are produced!
- Eco-efficiency does not include the social dimension, though an improved environment would bring social and economic benefits.
- At best eco-efficiency improves or delays environmental degradation – it does not eliminate the degradation!!

- So William McDonough and Michael Braungart introduced the concept of *eco-effectiveness*!

McDonough and Braungart

William McDonough (architect and industrial designer)

- Innovative ecological design, such as interior trees, daylight illumination, roofs made of grass, and raised floors that allow for cool air to pass underneath

Michael Braungart (chemist)

- Use oxygen instead of chlorine to bleach paper, thus eliminating the release of carcinogenic dioxins in the atmosphere
- Non-chlorofluorocarbon (CFC) refrigerator

They are the authors of *The Next Industrial Revolution,*1998)

William McDonough's city hall roof garden in Chicago

"The Stone Age did not end because humans ran out of stones. It ended because it was time for a re-think about how we live."

- His ideas for the *Next City* are being played out in China where his company has been charged with building seven entirely new cities.
- His book has been adopted as government policy in China, which needs to house 400 million more people in the next 12 years.

McDonough's Next City in China

- Waste is energy; methane is used to cook food. A quarter of the city's cooking will be done with gas from sewerage.
- "We lay the city out so everyone can move in parks without crossing traffic, the buildings have daylight lighting, the university is at the centre, and with hi-tech connectivity."
- "The energy systems will be solar energy. China will be largest solar manufacturer in the world," says McDonough.
- The soil will be moved onto the roofs. The city will be inhabited by species and the top of the city will be green.

Eco-efficiency vs Eco-effectiveness

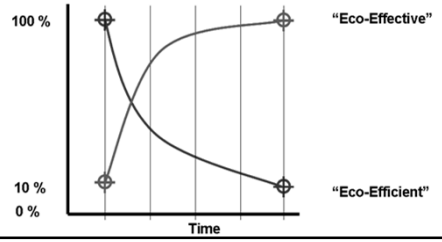
- Eco-efficiency is *depletive*: cradle to grave
- Thus, McDonough and Braungart have proposed a human industry that is *regenerative* and NOT *depletive* – i.e., a system that is *eco-effective*
- Not "cradle-to-grave", but "cradle-to-cradle"!

Eco-efficiency vs Eco-effectiveness

Eco-efficiency
- "Cradle to grave"
  - Linear, One-way model

Eco-effectiveness
- "Cradle to cradle"
  - Nature's Model

To achieve a sustainable system of consumption and production is not a matter of reducing the footprint of our activities on this planet, but transforming this footprint into a source of replenishment for those systems that depend on it.



Back to nature

- *In Nature, waste does not exist at all!*
- For example, the “waste” produced by trees and animals are part of sustainable systems that can be reused composed in soils and become nutrients – very eco-effective!
- Likewise, a product can be *eco-effective* if it produces materials that can be converted to other uses.

Follow Nature’s Design – No waste is generated, and hence it is eco-effective!

Becoming Eco-Effective

- Instead of designing “cradle-to-grave” products, dumped in landfills at the end of their 'life,' we design
  - Products composed either of materials that are biodegrade and become food for biological cycles (biological nutrients)
  - Or of technical materials that stay in a closed-loop technical cycle, continually circulating as valuable nutrients (technical nutrients)
- Maintaining materials in closed loops maximizes material value without damaging ecosystems and the environment.

Becoming Eco-effective

- Thus, there is no need for shampoo bottles, toothpaste tubes, yoghurt cartons, juice containers and other packaging to last decades (or even centuries) longer than what came inside them
- Packaging that lasts much longer than the product it contains would no longer be manufactured

Not waste management, but waste minimization or reduction

- Waste management means "after waste is generated, and so you need to manage it".
- If you keep on generating waste, you will keep on managing it – This is not a sustainable solution
- Waste minimization or zero waste production is the key to solve the "waste management" issue once and for all

But our consumer products have not yet been designed for "*zero waste generation*"!
What is the cost of waste and waste disposal after a A$10 dinner at the Brisbane Airport?

The ice cream cone can be eaten after ice cream is finished. No waste! Very eco-effective!

Plastic bottle or coconut – Which is more eco-effective?

- Can we design a mineral water bottle that can also be eaten or biodegradable when the water is finished?
- How about inventing a coconut bottle?

Up-cycled design

- Recycling could be more expensive for communities than it needs to be, partly because traditional recycling tries to force materials into more lifetimes than they were designed for.
- Down-cycled – As very few objects of modern consumption were designed with recycling in mind, many products after recycled have poorer quality.
- Up-cycled – If products are designed from the very beginning to be recycled or even 'up-cycled' - a term used to describe the return to industrial systems of materials with improved, rather than degraded, quality.

Environmental Performance

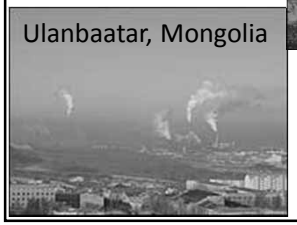
Two options for enhancing environmental performance:

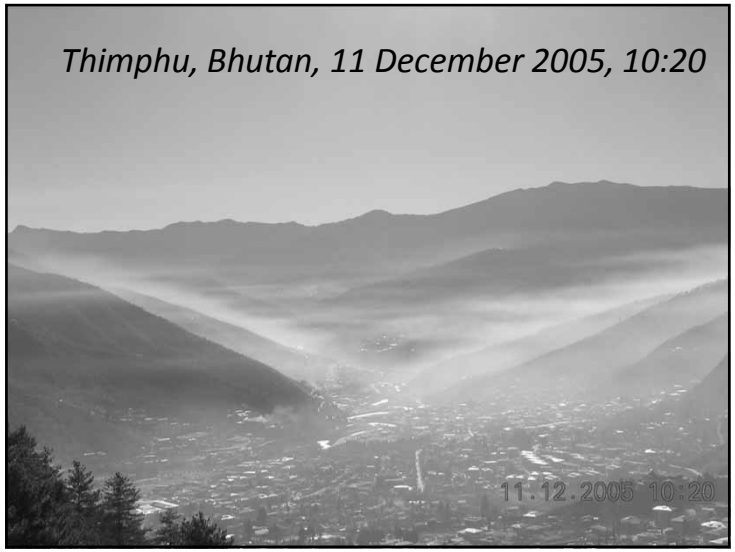
1. Install pollution control equipment, which could be costly (end-of-the-pipe treatment); or
2. Redesign the industrial process to minimize pollution or produce zero pollution – a more eco-efficient option!

Not pollution control, but pollution prevention!

- Pollution and environmental legislation are signals of industrial process design failure!
- Zero emission – no need for pollution control, hence no need for environmental legislation!

The tall stack that I used to design as a chemical engineering student did not actually solve any air pollution problem but to pass the problem further downwind!





Design Challenges

- Can we design our products like nature (no waste and hence no need for waste management)?
- Can you design a house that will generate energy rather than consuming energy?
  - For example, the roof or the top part can be rotated so as to catch the wind or solar energy from any direction? Recently in China, a building has been designed to rotate according to the direction of sunlight!
- Can you design a factory that produce effluents that are drinking water?
  - If the water coming out of the factory is as clean as the water going in, then there is no need for wastewater treatment, and no need for pollution control!!

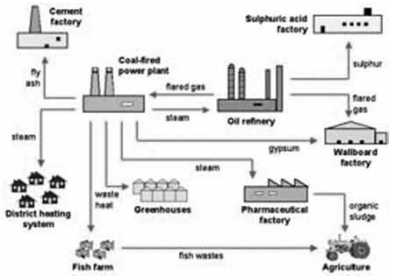
How can we plan our urban development to avoid traffic congestion, which significantly affect air quality and hence public health, productivity (also due to due to congestion time) and economy?

Innovative Ideas

- Two Chinese high school students from a science camp held in Muar, Malaysia, that I attended about three years ago have suggested the following very innovative ideas:
- 1. Design a system to tap the energy generated by moving vehicles on the road, so that the energy can be used for at least street lightings
- 2. Design a system to tap the energy generated by people's walking movement

Some innovative systems and designs

The Industrial Symbiosis of Kalundborg, Denmark



Industrial Symbiosis is a collaborative enterprise in which the by-products or wastes of one industry become valuable resources for one or several other industries. The overall result is of direct economic benefit to the companies involved and widespread environmental benefit to the surrounding region. By 1998, Kalundborg could already boast that internal collaboration between industries had amounted to savings of 160 million dollars since the project's outset.

http://www.cgf-georgia.org/c.jpg
http://sustainablecities.dk/en/city-projects/cases/kalundborg-industrial-symbiosis-waste-makes-resource

Vietnam Airlines seats.
The location of the video controller under the video screen at the back of each seat is more easily accessible than the one located on the side of each seat as designed in some airplanes.




A good use of recycled bottles


http://ecodesigner.wordpress.com/bob-collection/

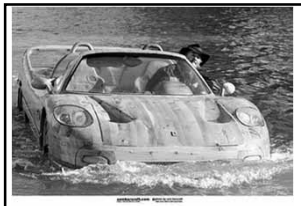
Taga - a multifunctional vehicle that is a baby stroller and carrier bike all rolled into one


http://design345.com/2010/06/11/taga-bike-and-stroller/
http://www.tagabikes.com/Conversions.asp?lang=eng

Bamboo bikes from Ghana

http://springwise.com/transportation/bamboosero/

http://www.calfeedesign.com/BambooOverview.htm



Wooden cars made by Livio De Marchi, a Venetian artist who makes wooden cars. His cars do float, enabling him to drive through the canals of Venice,

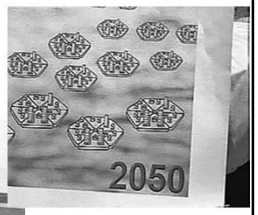
http://www.myunusual.com/downloads/Unusual_Cars6C.html

Rollit Homes

Students at the University of Karlsruhe in Germany designed these chic modular homes, which are built to incorporate multiple uses inside one small living space. The home functions like a mouse on a wheel; the homeowner can change the structure of the house by walking in the center to rotate it. With just a little bit of daily exercise, the unit can be turned to reveal a bed, lounge chair, table, shower, toilet, or a kitchen sink — all in the same space!

Floating Houses in the Netherlands

- The Dutch people have designed houses that can float on the water to mitigate sea-level rise under climate change



Floating village in Chong Kneas, Tonle Sap Lake, Cambodia

Floating gardens, Inle Lake, Myanmar

Urban forest reduces the need to travel to forests in rural areas

Wuppertal Hanging Train in Germany

The railway is called Schwebebahn, which means "floating railway", but in English it is generally called the "hanging railway" or the "suspension railway". The length of the track is just 13.3 km, it is more of a tram than a railway.

http://www.shareordie.in/wuppertal-hanging-train-in-germany/

Solar-powered aircraft Solar Impulse HB-SIA prototype airplane during a flight over Payerne on April 7, 2010. Aeronautical authorities have confirmed world records for the aircraft that flew around the clock in July, including those for the longest and highest flight by such an aircraft.
(AFP/File/Christian Hartmann)

INNOWATTECH

- has developed a new alternative energy system that harvests mechanical energy imparted to roadways, railways and runways from passing vehicles, trains and pedestrian traffic and converts it into green electricity. The system, based on a new breed of piezoelectric generators, harvests energy that ordinarily goes to waste and can be installed without changing the habitat.

Please see video at:
http://www.innowattech.co.il/

China straddling bus

A hollowed out bus to allow cars to drive right on through/under it – the "3D Express Coach" project was created by Shenzhen Huashi Future Car-Parking Equipment.

Please see video at:
http://www.youtube.com/watch?v=Hv8_W2PA0rQ&NR=1

Sustainable Buildings

First Modular Sustainable Construction Timelapse

Please see video at:
http://www.youtube.com/watch?v=OSwUGts_Huc&feature=BF&list=UL1wnT0dN20k4&index=3

2010 Shanghai World Expo, construction timelapse of Broad Pavilion (Built in one day)

Please see video at:
http://www.youtube.com/watch?v=RnexQyMtaQU&feature=BF&list=UL1wnT0dN20k4&index=4

Ark Hotel Construction time lapse building 15 storeys in 6 days

Please see video at:
http://www.youtube.com/watch?v=RnexQyMtaQU&feature=BF&list=UL1wnT0dN20k4&index=5

A construction crew in the south-central Chinese city of Changsha has completed a 15-storey hotel in just six days.

http://news.yahoo.com/s/yblog_upshot/20101112/bs_yblog_upshot/chinese-workers-build-15-story-hotel-in-just-six-days

- Are you eco-efficient?
- Are you eco-effective?

Thank you for your kind attention!

Wind-powered lights, China Olympics 2008

Solar-powered lights, China Olympics 2008