Gain maximization for a few Vs risk minimization for all: *Choice that society will have to make to survive this century*

By Sagar Dhara

Introduction

Four recent events, seemingly very different from one another—

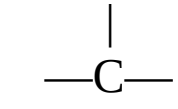
- **Habitat shifts of certain species:** Himachal Pradesh apples no longer growing at the same altitudes, but at higher ones, and butterflies in Northern America have migrated several hundred kilometers northwards.

- **Oil price shock:** Oil prices soaring to an unprecedented US$ 147/barrel in April 2008 and then dropped to a third of that price 6 months later.

- **Global financial meltdown:** The current global financial meltdown has led to a global recession, an ongoing job loss running into in the hundreds of thousands of jobs, stock prices nose diving and destroying trillions of dollars of market created capital.

- **Human relationships mediated by inanimate things:** I was recently told by a lawyer, with whom I had a 20 year acquaintance, that he has come to know me through papers filed in court that made false allegations against me. I asked him why he did not call me directly to find out the truth. The lawyer kept mum.

—are all related to the carbon cycle in some way or the other. And human interference with this cycle is now making it go wonky. But before explaining how these events are linked to the carbon cycle, we need understand a bit about carbon cycle.



The name carbon is derived from the Latin word *carbo,* which means coal. It is the fourth most abundant element in the universe, and humans have known about it since antiquity. As the carbon atom has a valence of four, it forms very complex molecules, unlike and very many more compounds than atoms that have a lesser valence. There are an estimated 10 million known organic carbon compounds.

Carbon is Bramha, Vishnu and Shiva, all rolled into one——the creator, sustainer and taker of life. Creator—Life on earth exists because of the complex organic compounds that are a part of every life form. Sustainer—The food that we eat and the fuels we consume have carbon as a major element. Taker—The use of fossil fuels, basically carbon, is the main cause of air pollution—global, regional and local. The buildup of atmospheric carbon dioxide in recent decades is life threatening.

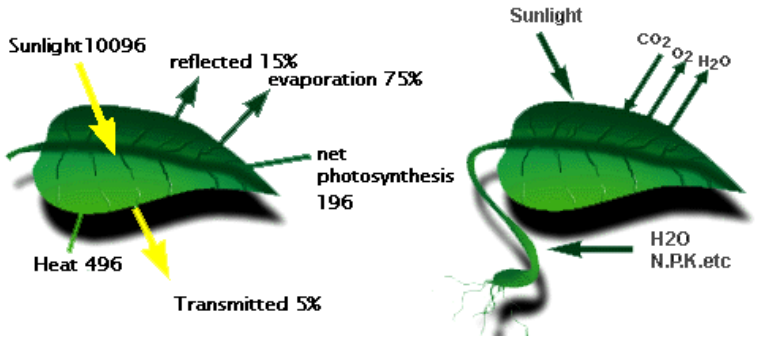
Carbon cycle

Humans exist because of carbon, and their survival is owes itself to the carbon cycle.

Four billion years ago, when life was still to form, the earth's atmosphere was constituted predominantly by carbon dioxide and the average temperature was a sizzling 290^{o}C. The first life forms—micro flora—developed the ability to make high energy organic compounds through photosynthesis, removing carbon from the atmosphere and releasing oxygen to it. This process along with silicate rock weathering, cooled earth to its current average temperature of 13^{o}C, making it habitable for other life forms. This did not happen on Venus or Mars as they did not develop carbon scavenging life forms.

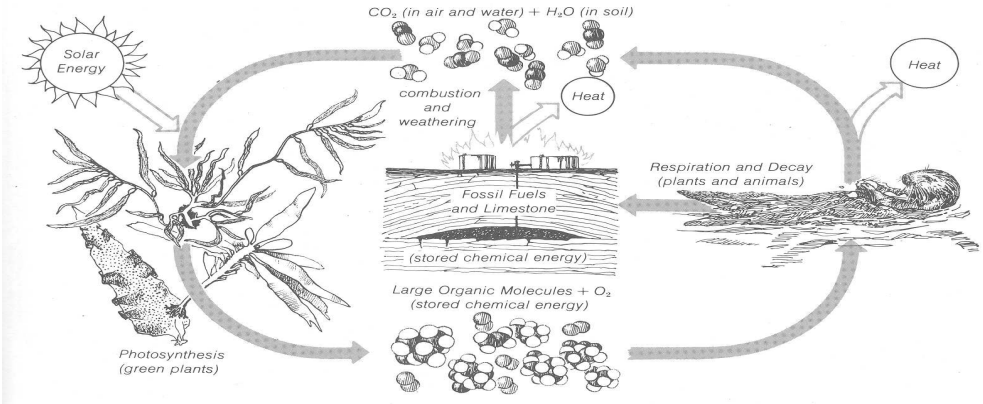
	CO_2 (%)	N (%)	O_2 (%)	Temperature (^{o}C)
Venus	96	3.5	<0.01	477
Mars	96.5	<1.8	<0.01	-53
Earth without life	98.0	1.9	Trace	290
Earth with life	0.03	78	21	13

Atmospheric constituents and temperature on selected planets



Photosynthesis

Heterotrophic creatures (eg, mammals that developed later than photosynthetic organisms) burnt organic compounds made by photosynthetic organisms with the help of oxygen thus producing carbon dioxide that was released to the atmosphere. Both photosynthetic and heterotrophic organisms die, and decomposers break down dead organic matter to release carbon dioxide, which eventually re-circulates its way back into the food web.

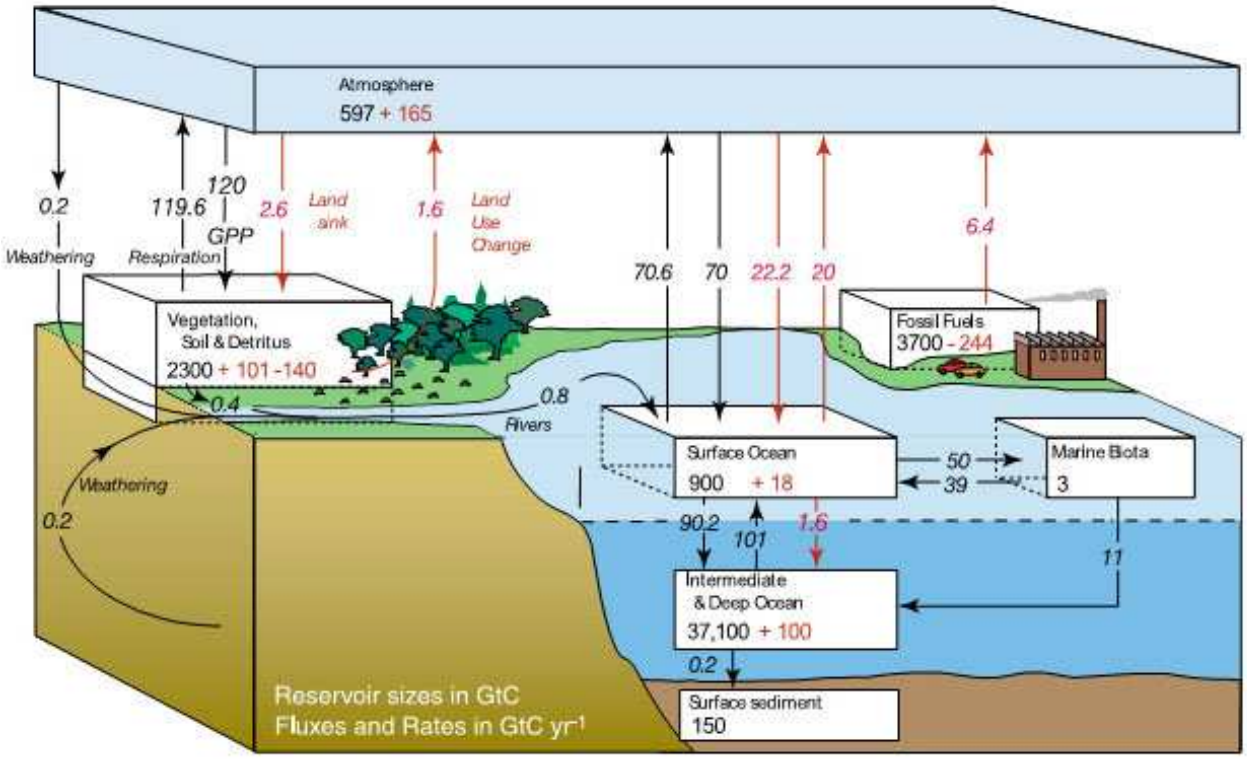


But the carbon cycle is not quite as simple as described above. Over the millennia, carbon from the atmosphere has been locked down in various carbon reservoirs or pools: land—rocks, soil, vegetation; water—as calcium carbonate in shells, corals; and fossil fuels.

Location	Carbon pool {in Giga (10^9) tons of carbon}
Rocks	65,000,000
Oceans	39,000
Soils	1,580
Atmosphere	750
Land plants	610

Carbon accounting

Carbon from land and water carbon pools enters and exits the basic carbon cycle described above. The complete traverse of carbon through all land, water, plants and fossil fuels constitutes the carbon cycle.



The global carbon cycle for the 1990s in GtC/yr

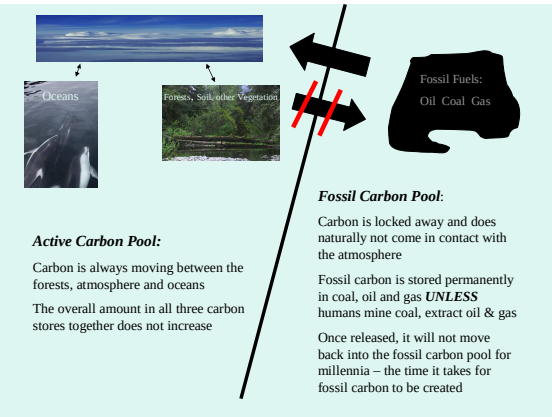
Pre-industrial fluxes are shown in black and 'anthropogenic fluxes in red. The net terrestrial loss of -39 GtC is inferred from cumulative fossil fuel emissions minus the atmospheric increase minus ocean storage. The loss of -140 GtC from the 'vegetation, soil and detritus compartment represents the cumulative emissions from land use change and requires a terrestrial biosphere sink of 101GtC. 'GPP' is the annual gross (terrestrial) primary production. Atmospheric carbon content and all cumulative fluxes since 1950 are as of end 1994. *Source: Working Group I contribution to the IPCC's Fourth Assessment Report*

In its Fourth assessment report (AR4), the Intergovernmental panel on climate change (IPCC) estimates carbon fluxes for the periods 1990s and 2000-05:

	Carbon fluxes 1990s	Carbon fluxes 2000-05
Net land to atmosphere carbon flux (GtC/Yr)	-1.0 ± 0.6	-0.9 ± 0.6
Net ocean to atmosphere C flux (GtC/Yr)	-2.2 ± 0.4	-2.2 ± 0.5
Emissions—fossil fuels + cement (GtC/Yr)	6.4 ± 0.4	7.2 ± 0.3

The estimates indicate that in the last decade, the earth's positive carbon flux to the atmosphere due to emissions has increased by 0.8 GtC/Yr, the negative flux, ie, earth's carbon absorbing capacity has decreased by 0.1 GtC/Yr. We are now dumping (7.2 GtC/Yr) almost 2.5 times more carbon into the atmosphere than can be absorbed back (3.1 GtC/Yr) from it. This excess carbon dumping has interfered with the carbon cycle, which remained stable till the time that earth's carbon absorption capacity exceeded our carbon dumping quantity.

The total carbon on earth being constant, the additional carbon, often termed as anthropogenic carbon, being pumped into the carbon cycle (active carbon pool) comes largely from fossil fuels where carbon was locked away (fossil carbon pool) hundreds of millions of years. A smaller fraction comes from deforestation and agricultural development, where it has been stored for decades to centuries.



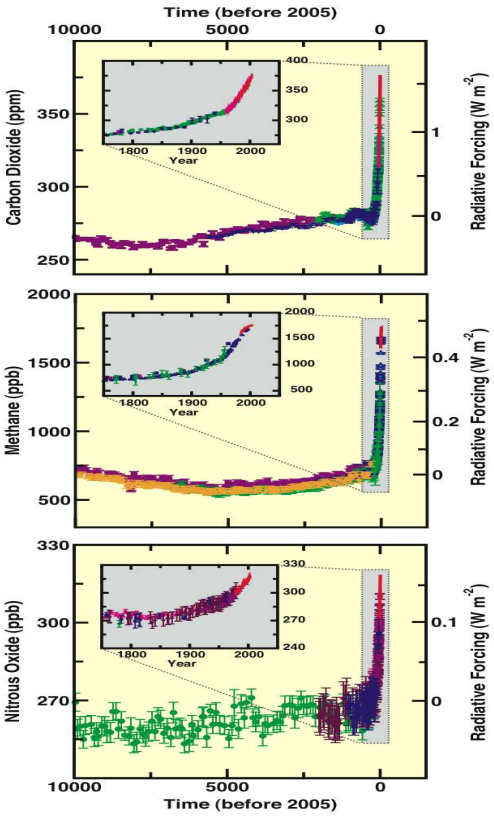
Three tipping points

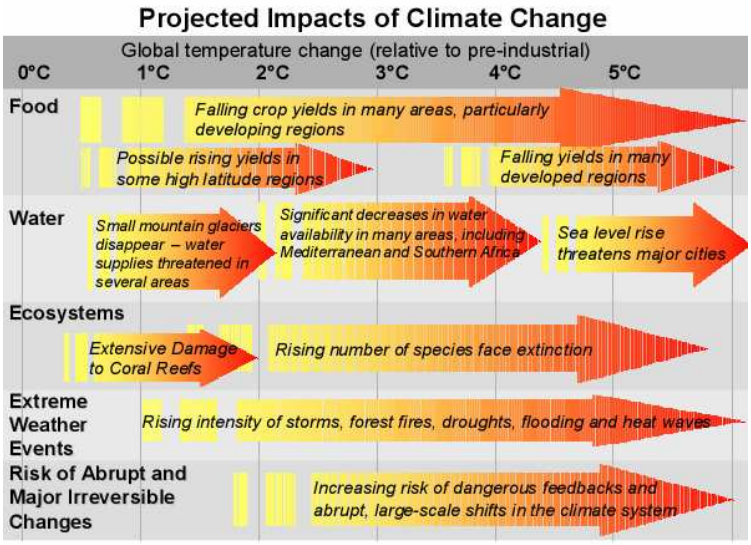
We are poised on an abyss. Three tipping stare us in the face—global warming, energy crisis, and rapid deterioration of the environment and life support systems on earth. All three tipping points are intimately related to human interference with the carbon cycle. Any one of the tipping points has the potential to wreak havoc to human society as we know it today.

Global warming

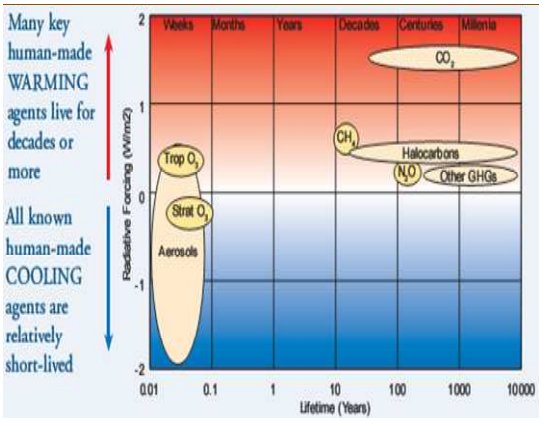
Two thirds of the 244 GtC of fossil carbon mined since industrialization began has deposited itself in the atmosphere, increasing its carbon repository by 27% (see carbon cycle above). The balance has lodged itself in land and water. The additional carbon in the atmosphere has increased carbon dioxide concentration from 280 ppm in the pre-industrial times to the current level of 382 ppm. Prior to 1750, carbon dioxide concentrations remained stable at 260-280 ppm for 10,000 years.

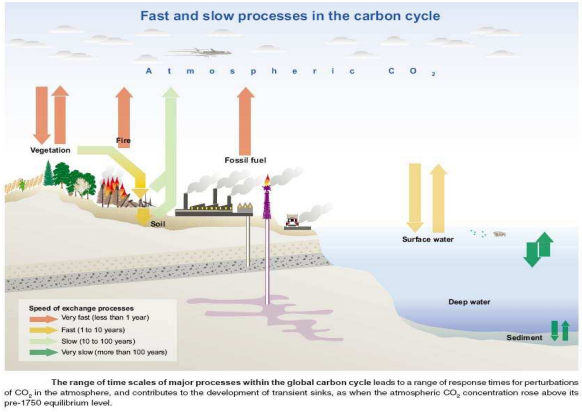
Concentrations of other important greenhouse gases—methane, nitrous oxide and tropospheric ozone—have also risen in the last 250 years. ***These gases together and carbon dioxide will contribute in equal measure to global warming, the predicted impacts of which are expected to ravage the earth and human society.*** As other pieces in this compendium deal with this issue in greater detail, only a brief summary of some of the main impacts are presented below.





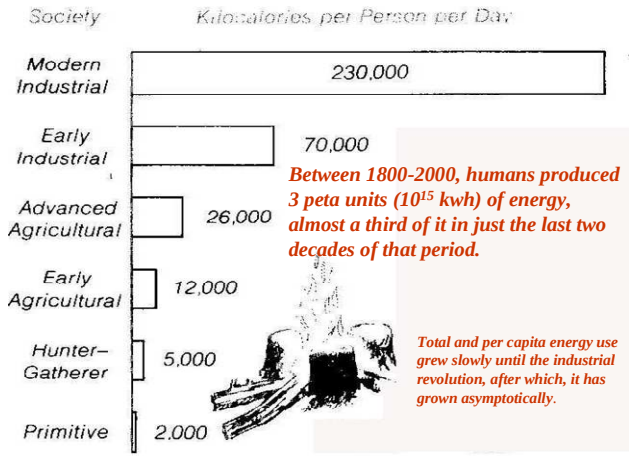
And the problem is not going to blow away quickly even if emissions were reduced immediately as greenhouse gases have long persistence times in the atmosphere. Only 50% of atmospheric carbon dioxide will be removed within 30 years, the balance will remain for centuries as the time to add CO_2 from fossil fuel burning and forest removal is short, but the time for its removal is long.





Development drivers

Energy: All life forms as we know them are energy converters. They seek and use energy for their survival. Living beings other than humans take only that much energy from nature as they require for survival and reproduction, and this has remained constant through time. Humans use more energy than is required for bare survival and reproduction, and their per capita energy consumption today is more than a hundred times that of primitive man.



Energy is one of two prime development drivers that helped human society to reach where it has.

Knowledge: Humans learnt how to tap energy available in nature for their benefit. Knowledge of energy conversion is the second driver of human development. This knowledge was continuously upgraded to tap even greater quantities of energy from nature.

Colonization of the environment: Throughout history, humans migrated and colonized new environments to tap energy sources when their old environments no longer yielded enough energy. They were able to do this because they continuously created new knowledge of energy conversion. Animals could not do this. They merely adapted to their environments, survived if the environment was favourable and provided them with their energy needs, else perished if the environment turned hostile and no longer provided them with energy.

Energy crisis

The second tipping point is the impending energy crisis which will end of the cheap energy period, or peak oil as it is popularly called.

Until the fourteenth century, the main energy source for human society was human and animal power and wood. Coal first began to be used in Britain over 500 years ago. Its widespread use in London in fact made John Evelyn remark in 1661 that, “London resembled the suburb of hell.” Coal became the first fossil fuel to be widely used after the industrial revolution began. Several 18^{th} and 19^{th} century inventions—the steam engine, the railway locomotive—used coal to power them.

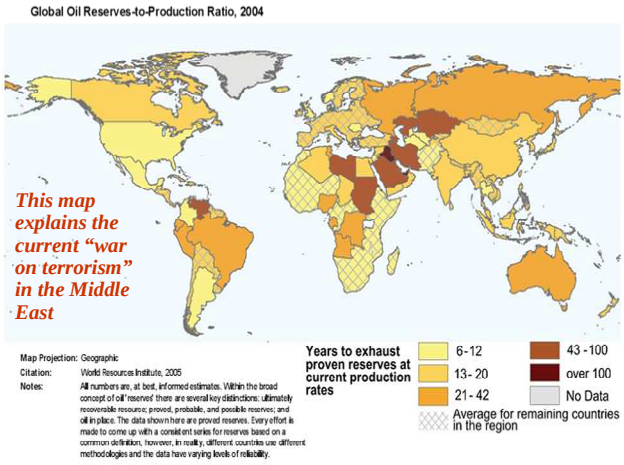
Oil was first extensively drilled in Pennsylvania, USA in 1860. The oil rush over the next 30 years paralleled the earlier gold rush in "wild west" America. Oil was first used as a lighting fuel by refining it to make kerosene. Oil became the route to quick fortune for the enterprising. Many also lost their fortunes as quickly as they made them. It took ruthless business tactics of the likes of John D Rockefeller, who made his millions in the latter half of the 19th century by integrating oil production with refining and marketing and edging out competition, to retain his fortune.

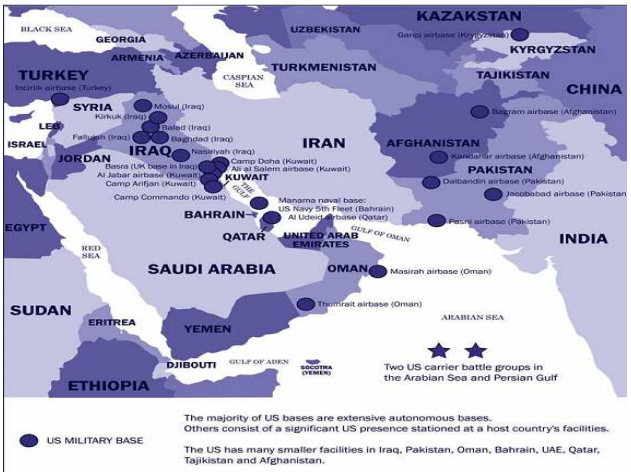
At the turn of the 20th century, Winston Churchill, the then British Defence Secretary, ordered that Royal Navy warships replace their coal fired boilers with oil fired ones. This would give them greater speed, and hence an edge over warships of rival navies. He also secured assured oil supplies from Persia. This allowed the Royal Navy to maintain superiority at sea in World War 1.

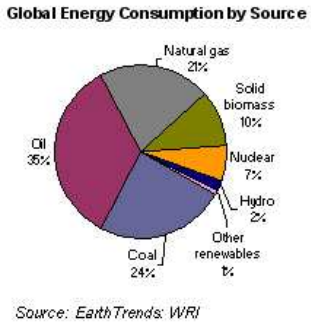
It was between the two world wars that the automobile and aircraft industries grew rapidly, and with them so did the demand for oil products, in particular for gasoline.

World War 2 was again a war fought over energy resources. Japan had no coal or oil. To get coal, Japan invaded Manchuria in the early thirties. After attacking Pearl Harbour, Japan invaded Indonesia for oil. Germany invaded Russia not for real estate but for the Baku oil wells. Finally, Japan and Germany ran out of oil, and this contributed in no small measure to their losing the war.

The more recent interest in the Middle East and the armed conflicts there are all related to control over oil. The last 150 years of global politics has been dominated by the need for access and control over oil.



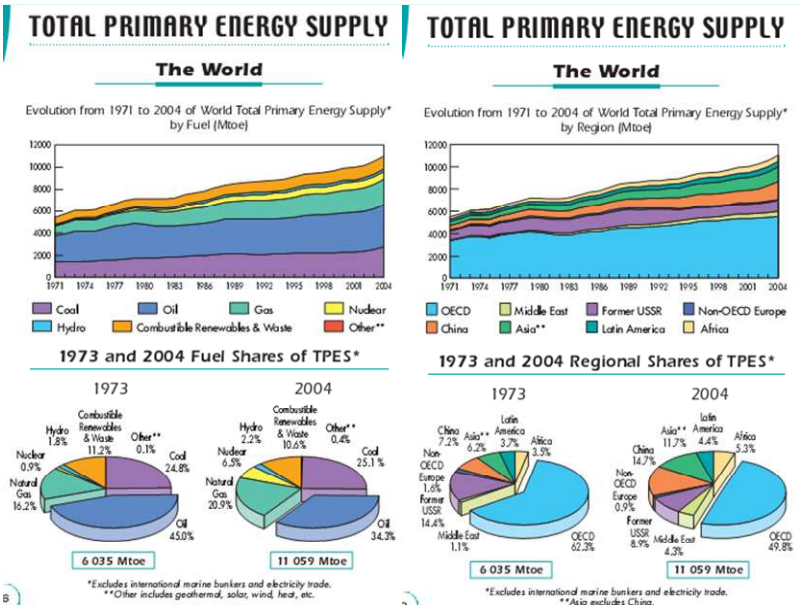




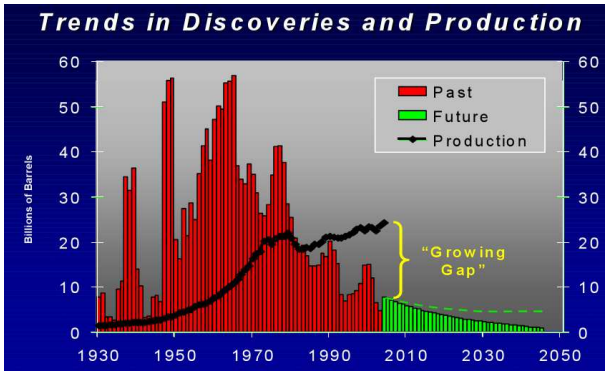
Gas is a more recent fossil fuel that has come into use. While gas meets

21% of human primary energy requirements, it has not quite influenced global politics to the same extent as oil has done.

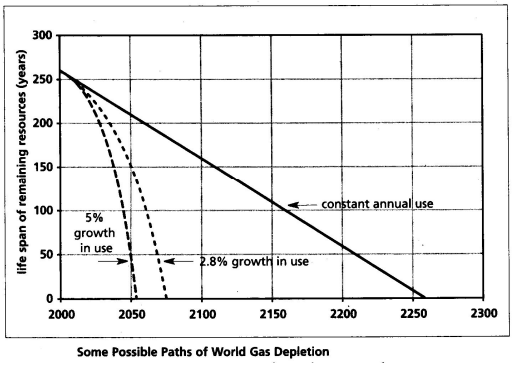
The world's appetite is voracious. We are now consuming more than 12,000 Mtoe, double the amount that we were consuming just 35 years ago. Energy demand is projected to grow at 3% per annum.



The open secret is that oil production has either peaked or will peak shortly, after which it will decline. US and the North Sea oil production has already peaked. Gas production is expected to peak about two decades after oil production.



Peak oil—Red bars indicate discovery, black line indicates production

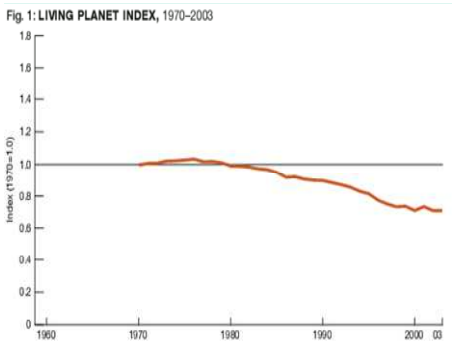


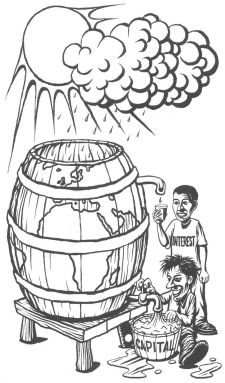
In the recent past oil prices had risen to almost US$ 150 before dropping to less than a third that price because of a demand slump. These price levels are unsustainable and prices will go up again after the global economy recovers. There is speculation that oil prices will hit the US$ 200-250 band. ***That will trigger a demand destruction of a magnitude that would far exceed that modern society has seen hitherto, and a possible complete collapse of the global economy.*** And if that happens a social collapse will follow with lawlessness becoming widespread—armed brigands

controlling neighbouhoods, the re-formation of fiefdoms. Human life could then become far less secure.

Rapid environmental and life support system deterioration

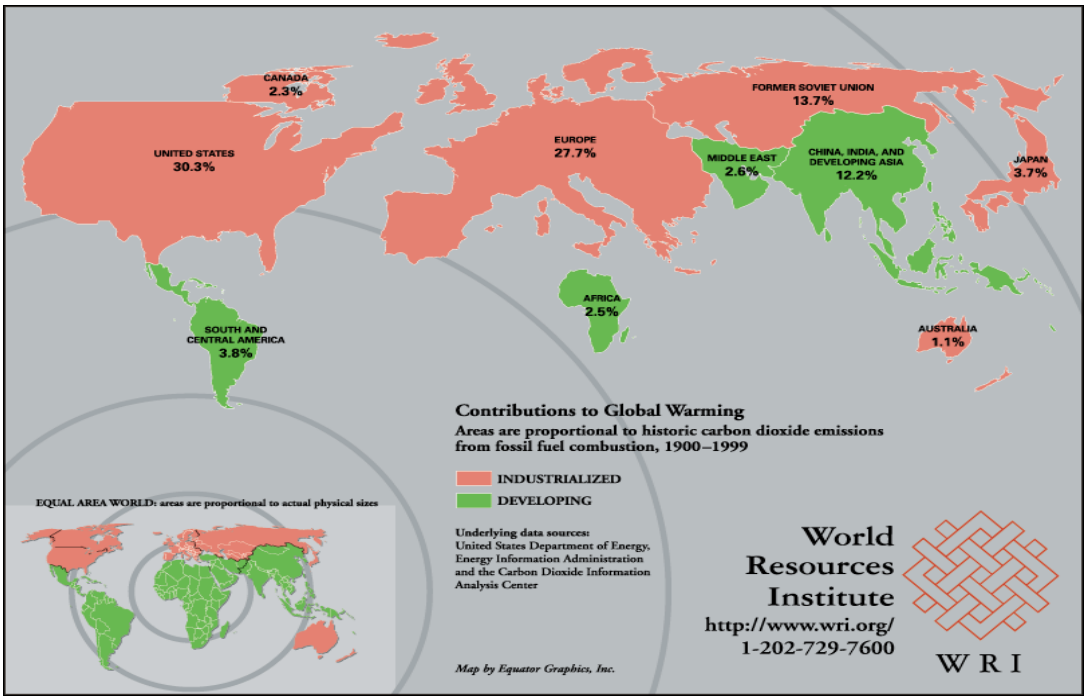
We have become debtors. The amount of raw material that we are extracting from the earth and the wastes that we are discarding require not one earth, but 1.5 earths, and by 2015, we will require 2 earths. A living planet index of 0.75 today as against 1 in 1980 indicates that we have degraded our environment significantly. Clearly, we are well into consuming our natural capital.





Air: Fossil fuels are the common source that has helped poison our air—globally and locally. While the burden of disease that climate change will cause are still to be accurately estimated, local air pollution is causing over 2.5 million excess mortalities and more than 300 million excess morbidities annually. The ozone hole over the Antarctica caused by stratospheric ozone is now the largest. While it is expected to recover about 50 years hence, it is expected to take its toll on human health and the environment.

Developed nations use significantly higher amounts of fossil fuels per capita, and continue to be the main emitter of global pollutants (CO_2) and local pollutants (SO_2, NO_2, PM).



They have the money to clean up their local pollutants. Developing nations, by following the same development paradigm as the developed nations are doing their people a dis-service. For example, in India, it would cost Rs 1000 cr/km^2 to habitat re-design to improve air quality. Bangalore city requires Rs 250,000 cr to do an air quality cleanup. Developing nations do not have this kind of money, hence the problem will be pushed onto people in the form of burden of disease. The solutions in developing have to be radical and the primary strategy should be to prevent emissions, not control them after they have been caused.

Figure 2.6 Amount of space required to transport the same number of passengers by car, bus or bicycle. (Poster in city of Muenster Planning Office, August 2001)

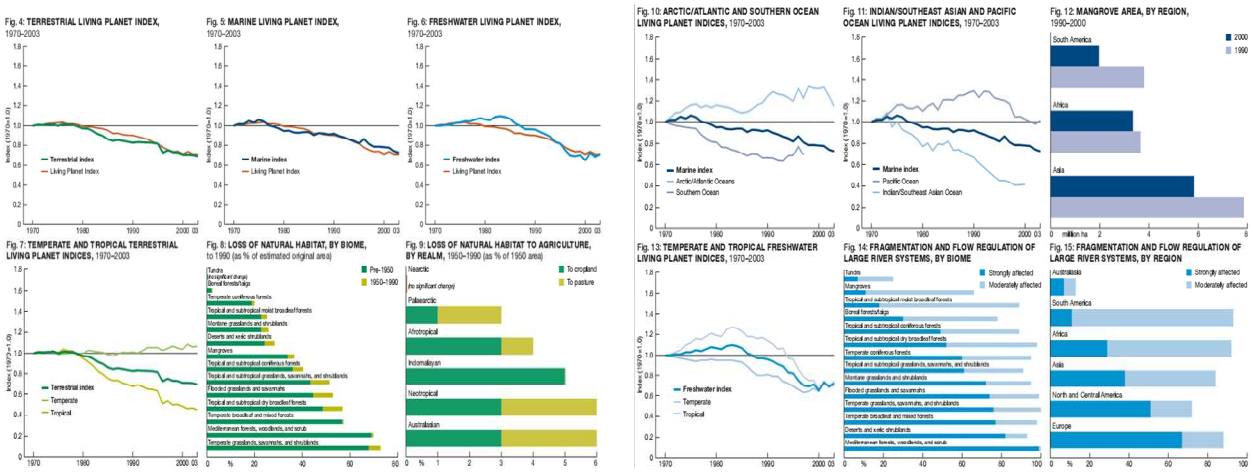
Credit: Press-Office City of Münster, Germany

Water: By 2025, a third of the world's population is expected to face absolute water scarcity and the other two thirds would be water stressed. Contaminated water is a cause for great worry as it causes as high a burden of disease as polluted air. Total marine and freshwater fishcatch have declined due to overfishing, causing 'desertification' of the oceans.

Land: Unsustainable land use are causing unprecedented land degradation—deforestation, desertification, soil erosion, nutrient depletion, soil salinity, soil moisture reduction, chemical contamination and biological cycle disruption. Global forest area shrink is estimated to be 0.2% annually, which is equal to about 7% India's land area. Drylands, that cover 40% of earth's land surface and support a third of its population, are at greatest risk of desertifying. Ninety percent of drylands are located in developing countries.

Biodiversity: Loss of biodiversity and ecosystem services is more rapid than at any other time in human history. Rates of species extinction are increasing and genetic diversity is on the decline. The economic and cultural value due to loss of biodiversity is yet to be understood and computed.

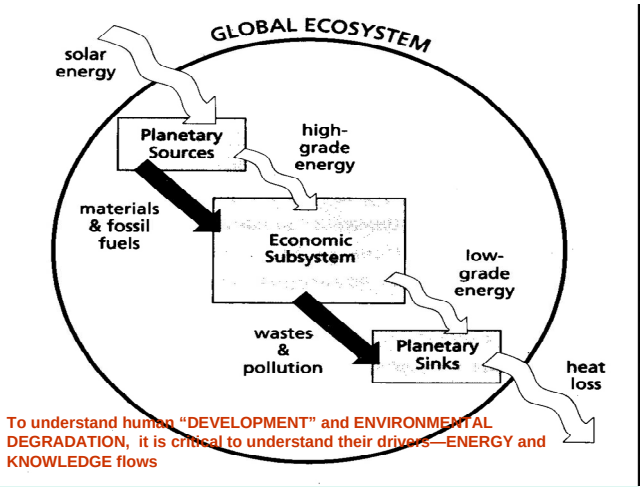
The overuse of fossil fuels has interfered with the carbon cycle and is causing the depletion of fossil fuels and the end of the cheap energy epoch which threatens to cause the collapse of the global economy. Global warming and erosion of the environment and its life support are direct consequences of energy use at unprecedented levels. All three tipping points coming to a head almost at the same time is like a triple whammy for human society. The impact that they will have on the ecosystem and on human society is yet to be comprehended.



Embodied energy

Embodied energy (eMergy) is the sum total of all manner of energy—human, fossil fuel, etc—that has gone in to produce a product or service. A pen, car, human services such as transporting goods and people all have embodied energy. Even humans have embodied energy as right from childhood, we have been cared for by our parents and educated by our teachers. The value of a product or service is directly proportional to the amount of embodied energy it contains.

The concept of eMergy is important to understand how the complex environment-economy systems work.



Solar energy powers the earth's ecosystem—climate, oceanic currents, living beings, etc. Humans have learnt to use energy to fashion natural resources to fulfill their wants. A house, whether a small hut or a steel and cement structure, are examples of embodied energy concentrations. Much of the energy that humans have tapped so far is ultimately derived from the sun, whether it be fossil fuels, wood, hydro-power, or green energies.

Humans use energy and raw materials from the ecosystem to create eMergy-packed products and services in what is termed as the economic system. Waste materials and heat are allowed to flow back into the ecosystem. eMergy-packed products and services are priced while those that do not have eMergy are not. Direct solar energy, wind, air are not priced. Waste products and pollution are not priced as the energy that has gone into their creation is accounted for in the primary product or service that has been produced.

Fossil fuels have helped create a large amount of eMergy within the short period of a couple of centuries. This large amount of eMergy owes itself to the carbon cycle.

eMergy seems have a life of its own. Humans have become obsessed with accumulating eMergy. Instead of eMergy catering to human needs, it is almost as if eMergy is making humans work for it.

Inequity

eMergy created by a person, when appropriated by another, is the basis of class society. For example, a slave is provided with a certain amount of eMergy in the form of food, housing and other wherewithal to take care of his and his family's survival. The grain that he produced by farming his owner's field and other services he performs are appropriated by the slave owner. The energy embodied in the grain exceeds the energy and eMergy input that the slave gets, the excess being appropriated by the slave owner.

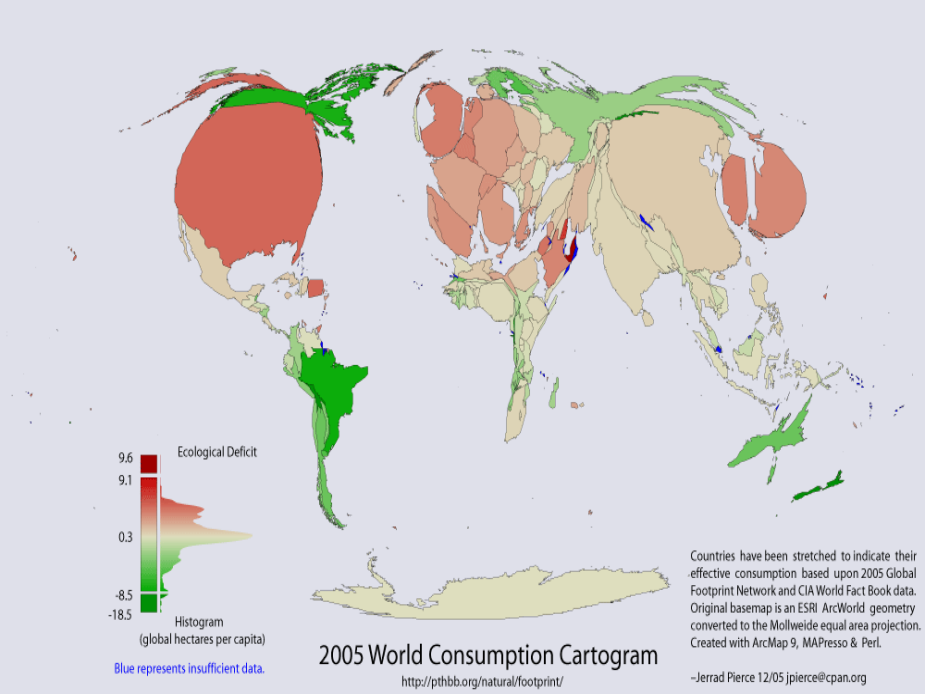
Throughout class society, starting from slave society through capitalism, eMergy has been appropriated by a few from the many. The process of accumulating surplus eMergy is the same in

all class society, ie, energy and eMergy input to the have-not class being less than the output, the excess being appropriated by the class of haves. The forms in which this process happens, however, gets more complicated in feudalism and capitalism. Fossil fuels have hugely accentuated eMergy inequity.

Per capita energy consumption today across regions is highly skewed. A South Asian consumes an average of 0.5 Toe, a European 4 Toe and an American 8 Toe.

Consumption figs in TOE	1971	1981	1991	1999
Central Africa	0.38	0.39	0.37	0.34
Northern Africa	0.28	0.49	0.65	0.69
Southern Africa	1.23	1.30	1.27	1.18
Australia + New Zealand	3.79	4.47	4.91	5.56
Central Asia	2.70	3.17	3.04	3.43
NW Pacific + East Asia	0.70	0.85	1.10	1.28
South Asia	0.31	0.36	0.44	0.49
South East Asia	0.36	0.44	0.58	0.73
Central Europe	1.87	2.30	2.04	1.81
Eastern Europe	3.34	4.55	5.01	3.49
Western Europe	3.03	3.31	3.70	3.86
Caribbean	1.21	1.26	1.06	1.11
Meso America	0.80	1.29	1.28	1.29
South America	0.83	0.97	0.98	1.13
North America	7.41	7.57	7.52	8.08
Arabian Peninsula	1.08	3.31	3.43	3.62
Mashriq	0.48	0.83	0.97	1.23

Energy consumption inequities allow for inequities in consumption. eMergy consumption is an addiction like smoking. It grabs you and seduces you, and is even more difficult to quit than smoking.



Energy/eMergy stealing

Human society has stolen energy from nature by colonizing newer environments throughout history and using newer energy conversion technologies to extract even greater quantities of energy. As greater amounts of energy are squeezed out of nature, there would be less energy for other life and the environment would degrade.

Within human society, the haves have found a way of stealing energy and eMergy from the have-nots. To ensure that have-nots deliver more eMergy than the energy/eMergy input they receive, the haves hold energy converters as private property, ie, land, water, draught animals, energy conversion machines, and during slavery, humans as well, as they too are energy converters.

Amongst all the 'commons' harvesting energy was the easiest from land. It was the first to be privatized, from the times of antiquity. The privatization of water is more recent and can be dated back to a couple of hundred years. Harvesting energy from air is the most difficult. The process of privatization of the atmosphere has just begun with the Kyoto protocol, not to harvest energy, but for dumping wastes. The Kyoto Protocol has created dumping rights for the developed nations, which in any case have the highest per capita greenhouse gas emissions.

Boundaries, nations and state

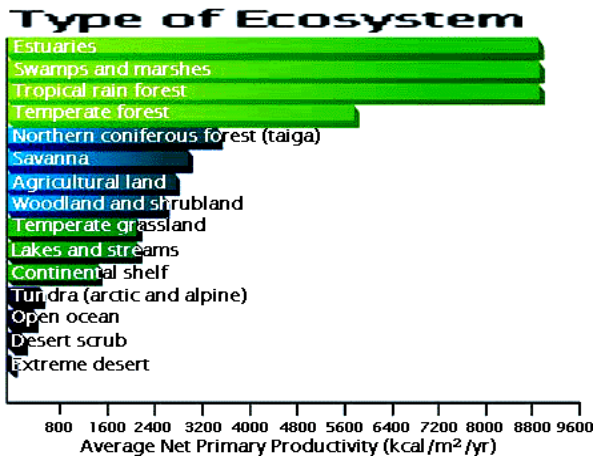
Boundaries have been created by human society from ancient times. It is a way of staking claim and making a public proclamation that a particular society had the right to harvest the energy, and therefore the natural resources, within the bounded area. Boundaries remained fuzzy for a long time. In earlier times, village boundaries were marked by geographical landmarks such as a hill or a stream. The development of the capitalist nation state made boundaries more exact and sacred.

The state is an institution that has potential eMergy which can be converted to kinetic eMergy to facilitate the extraction and accumulation of eMergy by the class of the eMergy haves from within national boundary. It does this by framing a set of laws and creating a mechanism that holds potential eMergy. If the law is transgressed by the hapless, the state acts by imprisoning the person (use of energy). The creation of the police and judiciary that can act against the offender is essentially creating potential eMergy.

Human conflict

All human conflict is fundamentally driven by human perception of the potential difference in the access and control of energy and eMergy between people. The seeds of conflict are sown when one set of people perceive that they have lesser access and control over energy and eMergy resources than another set. This explains class, gender, race, caste, conflicts, as well as conflicts between nations. In the last century, three types of conflicts—interstate, colonial and civil wars were responsible for 100 million deaths.

The energy producing potential of land and water has also determined settling and migration patterns of ancient people. The first agricultural civilizations were found in the Indus, Mesopotamia and Nile valleys, where the soils were rich and produced high energy levels (measured as net primary production). Conflicts between people were largely around the capture of lands that yielded high energy levels. Wars have never been fought over Antarctica.



Fetishism

Human no longer relate to one another directly. Their relationships are mediated by eMergy. The economic and social status of an individual is determined by his eMergy accumulating capacity and eMergy holding. For example, the relationship between a landlord and his tenant is mediated by the landlord's holding, which can be thought of as eMergy. Such mediation of human relationship by eMergy, where it has become more important than humans, tantamount to fetishism and has wreaked havoc in relationships even between siblings, and parents and children.

Some non-solutions

Energy is quite clearly at the centre of our current problems. And it is getting over. The search is on to find alternatives. But such search is basically supply side management, which, given the limited resources on earth, is bound to fail.

Green energies: One possible alternative is green energies. While they look attractive, unfortunately none of the green energies have the energy density that fossil fuels have. A joule invested in fossil fuels yields 30 joules or more. A joule invested in green energies yields 0.5-2.5 joules. Clearly they do not match fossil fuels. For example, 0.75-1 ha of land is required to run 1 vehicle on bio-diesel per year. To run all of Hyderabad 2 million vehicles on bio-diesel would require 15,000-20,000 km^2, ie, 8% of Andhra Pradesh's area.

Wind is fickle and the energy produced by wind turbines has to be stored. Moreover, it requires a lot of land. To produce the total energy requirement of UK with wind farms requires 33% of UK's land area.

Every other green energy has similar problems or they are not techno-economically viable. And the much touted "hydrogen" solution will not work as hydrogen is only an energy carrier. It is not a fuel. It takes a lot more energy to produce hydrogen as compared to the energy that hydrogen will yield.

Nuclear power: Besides being prohibitively expensive and being plagued with safety and hazardous waste disposal issues, conventional nuclear reactors are beset with another problem. Uranium reserves will last 80-100 years for the current operational reactors. If uranium requirement goes up say three-fold, uranium reserves will last barely 25-30. Even if new uranium reserves are discovered, they are not expected to make reactors work for more than 40-50 years. Even though fast breeder reactors were built many years ago, they still have still to produce sufficient power that is commercially viable.

Coal: The world has ample coal reserves to last another 200 years at current consumption rates. As oil and gas deplete, there will be a tendency to replace them with coal. This will only accentuate global warming as coal emits more CO_2 per joule produced than oil or gas.

Other technologies: There are a clutch of other energy technologies, but none of them shows promise of being techno-economically viable at present.

Energy efficiency: Another solution that is often offered for the impending energy crisis is to increase energy efficiency, ie, to reduce the amount of energy used through improvements in technology, materials and market management. Thermodynamic cycles, eg, rankine cycle, have a maximum theoretical efficiency. Power plants that work on these cycles, if worked at maximum efficiency, can at best use only about 38% of the energy stored in coal. Energy efficiency by itself cannot reduce the voracious and growing appetite that society has for energy consumption.

Decreasing individual consumption: An entire school of thought advocates that we should reduce our individual consumption. While this is laudable and necessary to gain moral authority, it cannot solve the problem as the Jevon's paradox will stand in its way. Think of it like this. If I decreased my power consumption, I would put the money saved in my bank account. Banks work

on the principal of borrowing cheap and lending dearly. So, someone else who borrows my money through a bank has to make more profit so that he is able to repay the bank the principal and the interest. If a city street has become clogged with too many vehicles, and air pollution levels have become dangerously high, a city planner's tendency is to widen the road. But within a short time, more vehicles are put on the widened road, and the road is back to square one. As long as the economy is in a growth paradigm, individual effort to reduce consumption will not help except to make a public expression of a sentiment. The question that begs asking is how to get everyone to reduce consumption.

Economies of greed and development

A social system that allows and legitimizes the stealing of energy from nature and stealing of energy/eMergy from other humans will perforce develop an economic outlook that is based on greed. To fulfill their underlying logic, such economies must keep growing continuously. If they stop growing, they go against their logic and must collapse.

Traditionally development is defined as: **Development = growth + equity.**

Trickle down effects are expected to gather the new wealth that has been created and distribute it to the have-nots. Unfortunately, trickle down theory has failed, and inequity has only grown in the last 150 years. In this period, the richest 25% in the world have commandeered a greater share of the total global income, whereas the poorest 25% have lost share.

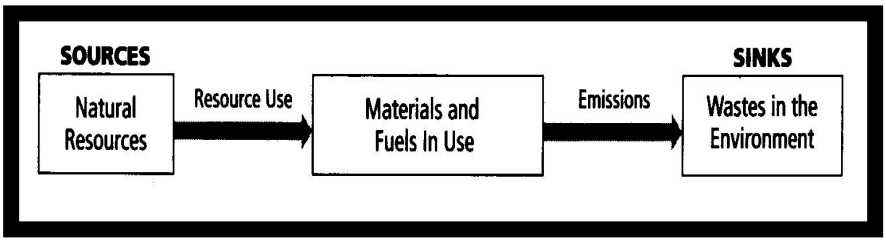
Year	**Percent income**		
	Richest 25%	***Middle 50%***	***Poorest 25%***
1860	58%	30%	12%
1913	69%	25%	6%
1960	72%	25%	3%
	Richest 20%	***Middle 60%***	***Poorest 20%***
2000	74%	24%	2%

Development re-defined

I am offering a broad global agenda for re-defining development acutely conscious that the devil is in the detail, ie, how this broad agenda can be teased out into a workable programme for each region. I am only at the beginning of that long road to re-defining development. By penning my thoughts, I am hoping that others will join the discussion on these very important issues and help in coming up with a programme through collective dialogue.

The core solution for the current situation that we find ourselves is not in trying to find additional resources—energy and other natural resources or find better ways of disposing our wastes, but how

to do with less so that we and nature together survive, and how to distribute whatever we use from nature equitably.



With oil and gas becoming scarcer, and energy prices expected to climb, economic growth is expected to slow down or even become negative. The problem of development than becomes one of achieving equity. But should the equity be only between people of the current generation, or between generations, or even between species? With the three tipping points staring us in the face, this question and another, "What is our relationship to nature" will begin to dominate human discourse and action.

Appropriation and accumulation of eMergy is the cause for the earth to come to the present cross road where it faces three tipping points. Inequity can therefore no longer be divorced from environmental issues.

And conserving the environment cannot be divorced from energy issues. As long as there is expansion of energy use, the tiger cannot be saved, except perhaps in captivity, as forests will perforce disappear.

Environments provide life sustaining energy. Environments are now in private hands, and the energy harvested from them appropriated by their owners. People must now recover their environments in order to control their lives. Else, people will be controlled by those who harvest energy from environments.

If we are to find a way to navigate past the three tipping points with minimum damage, we must begin to believe that the problem does not have technical, legal or economic fixes.

For a start, let me define development as not to mean growth, but to mean equity, ie, how to ensure that *all people have* ***equity*** *in terms of:* 1) ***access to energy*** and other natural resources, 2) ***consumption of energy*** and other natural resources, 3) participation in ***decision making over all issues related to energy and natural resources***, in such a manner that the eco-footprint for earth as a whole, and its various geographic regions, do not exceed their bio-capacities. While it may be easy to talk about energy equities, the roadmap to get people in developed regions to reduce their energy consumption will not be an easy task.

This can only be achieved if global outlooks change from the current "Gain maximization for a few" to ***"Risk minimization for all"***. Animals instinctively follow the latter way of behaving. Only humans follow the former, which is what has brought them to a crossroad.

Changing paradigms is not at all easy as no one will voluntarily give up the eMergy they have already accumulated. How then this can be achieved will be discussed later. Suffice to say that if the risk minimization paradigm is to be implemented, it perforce means powering down, ie, reducing global energy consumption, and living in society that believes and practices equity in whatever it has defined it.

A very quick way to power down is by dismantling all borders. This will get rid of war machines, and save 15-20% of current energy consumption, reduce conflict in this very troubled world and also pave the way for equity as it will allow for people to travel freely anywhere in the world.

It also implies that global energy consumption must be halved within the next 10 years. For some strange reason, those in developed countries who believe in equity are resistant to living with less energy (and comfort).

Ultimately, it is technologies that harvest the sun that we must move towards. Only they are sustainable. The sectors that require immediate technology shifts towards solar technologies are transport and food preparation.

To move towards a sustainable economy: The rate of use of renewable resources should not exceed their regeneration. The rate of use of non-renewable resources should not exceed the rate at which sustainable renewable substitutes are developed. The rate of pollution emission should not exceed the assimilative capacity of the environment.

The ecological footprint of the developed world exceeds bio-capacity. The footprints of all regions must be within their bio-capacities. In a borderless world, this will allow for the migration of populations from regions that is low energy yielding to those that are high energy yielding.

Sustainable development is a commitment to "improving the quality of human life while living within the carrying capacity of supporting ecosystems" (IUCN *et al.*, 1991).

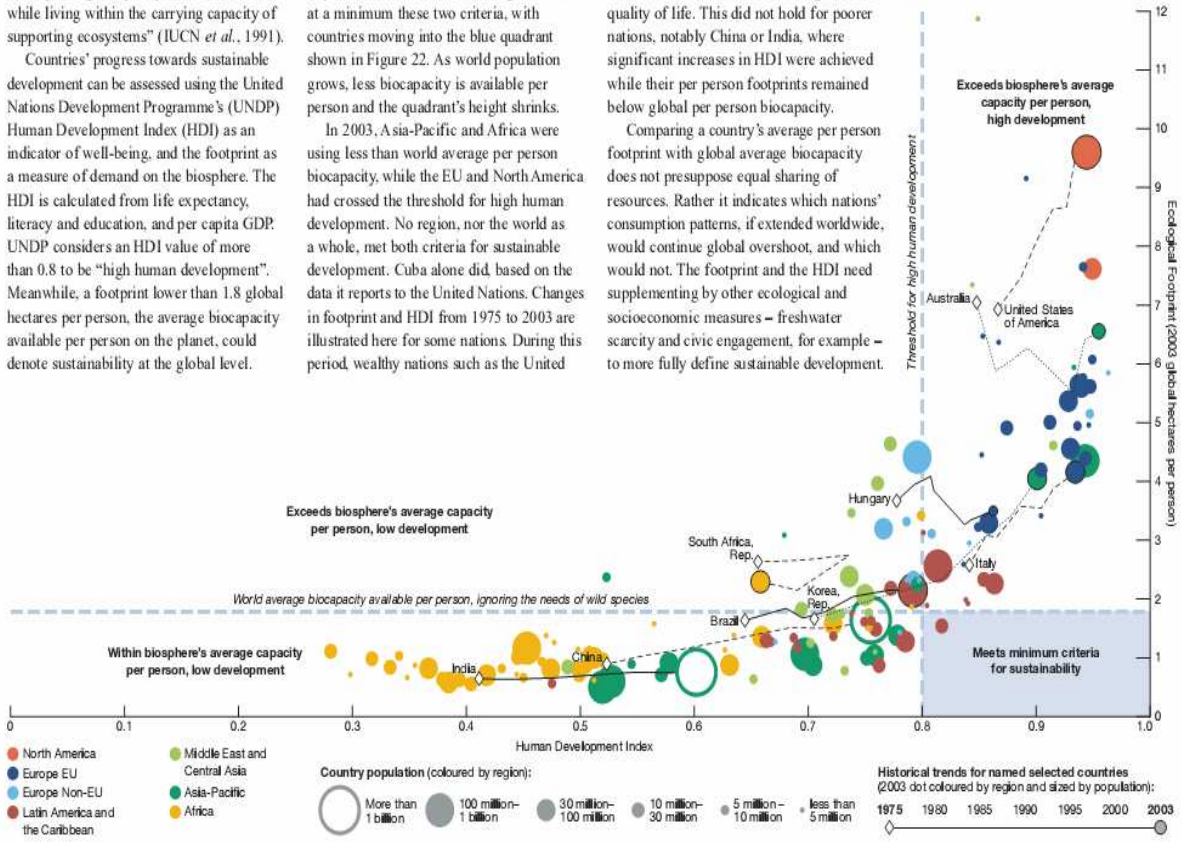
Countries' progress towards sustainable development can be assessed using the United Nations Development Programme's (UNDP) Human Development Index (HDI) as an indicator of well-being, and the footprint as a measure of demand on the biosphere. The HDI is calculated from life expectancy, literacy and education, and per capita GDP. UNDP considers an HDI value of more than 0.8 to be "high human development". Meanwhile, a footprint lower than 1.8 global hectares per person, the average biocapacity available per person on the planet, could denote sustainability at the global level.

Successful sustainable development requires that the world, on average, meets at a minimum these two criteria, with countries moving into the blue quadrant shown in Figure 22. As world population grows, less biocapacity is available per person and the quadrant's height shrinks.

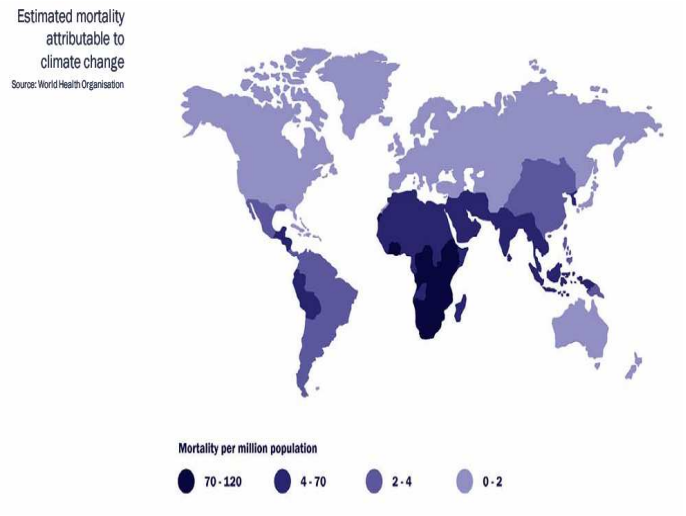
In 2003, Asia-Pacific and Africa were using less than world average per person biocapacity, while the EU and North America had crossed the threshold for high human development. No region, nor the world as a whole, met both criteria for sustainable development. Cuba alone did, based on the data it reports to the United Nations. Changes in footprint and HDI from 1975 to 2003 are illustrated here for some nations. During this period, wealthy nations such as the United States of America significantly increased their resource use while increasing their quality of life. This did not hold for poorer nations, notably China or India, where significant increases in HDI were achieved while their per person footprints remained below global per person biocapacity.

Comparing a country's average per person footprint with global average biocapacity does not presuppose equal sharing of resources. Rather it indicates which nations' consumption patterns, if extended worldwide, would continue global overshoot, and which would not. The footprint and the HDI need supplementing by other ecological and socioeconomic measures – freshwater scarcity and civic engagement, for example – to more fully define sustainable development.

Fig. 22: **HUMAN DEVELOPMENT AND ECOLOGICAL FOOTPRINTS,** 2003



Some of the priority issues that need to worked upon are food, water and physical security, conserving biodiversity and life supporting systems—land, water, air, doing disaster management to save as many people as possible from the ravages of the three tipping points will cause.



One of the most challenging tasks will be to make a society that will have large scale energy converters only in collective ownership. This will ensure that eMergy appropriation and

accumulation does not accrue in the hands of individuals. This will also ensure that fetishism is minimized if not altogether removed.

Humans have already caused an incalculable amount of violence to nature and to other humans. In the past, social transformations have been attempted to be brought about through the use of violence. Any attempt to bring about further social transformations through violence will erode the moral stature of those social change protagonists. Any social change must now be done in an absolutely non-violent manner.

Conclusions

All the four events described in the introductory section are linked to human interference with the carbon cycle.

- **Habitat shifts of certain species:** Himachal Pradesh apples and butterflies require cooler climes, and global warming has made their previous habitats too hot for survival. The additional Carbon pumped into the carbon cycle from fossil fuel burning has remained in the atmosphere as it could not be sequestered back. Carbon dioxide concentrations in the atmosphere have increased by 100 ppm over their pre-industrial concentrations, causing an average rise of 0.74^{o}C in the earth's temperature.

- **Oil price shock:** Fossil fuels are the creation of the carbon cycle of the yesteryear. A resource that took nature millions of years to make is being used up in less than five centuries. The carbon cycle does not have the capacity to create fossil fuels anywhere close to the rate at which they are being used, hence they will deplete. As oil reserves deplete, and carbon is the market will increase oil prices.

- **Global financial meltdown:** In an attempt to maximize profits, low interest housing loans were doled out in the US. Many who took loans were unable to repay them. Piled up bad debts collapsed some financial institutions, shaking investor confidence and causing the financial metdown. The strong desire to maximize profits is driven by the combination of two factors—large eMergy pools that fossil fuels (created by the carbon cycle) have helped create and the fetish that owning a large amount of eMergy (which capital in the form of profits represent) helps relate to other humans from a commanding and respectful position.

- **Human relationships mediated by inanimate things:** The lawyer did what everyone else does. He preferred to learn about me through a piece of paper, rather than talk to me directly. He allowed eMergy to mediate our relationship, rather than have a direct relationship with me because the fetish that eMergy has created is overpowering.

Postscript

I may be a pessimist in believing that human society is on a self-destruct path and that there is not much we can do except to try and save as many people from the ravages of the coming apocalypse that the three tipping points will cause, and to prepare the ground for a brave new post-carbon

society that is based on equity and living in peace with nature and as a part of it. I hope my pessimism is misplaced, and I am proved wrong.

Finally, I would like to end by quoting Albert Einstein: "The significant problems we face cannot be solved at the same level of thinking that we were at when we created them."