



A Heretic
Teacher's
Handbook
to
Global Warming

Doesn't really matter who you are. One feature
Is that each of us is an innate teacher.

Ever since you reached that stage
When learning not to act your age
You choose to shock your friends with news
That they counter feebly in ones & twos
The book you read, the morning paper
Watt's dissertation on water vapour
The authority in tone you flaunt
Demands respect, which is what you want
Friends separate you from their herd
Some might title you the nerd.
Its then a wonderful feeling to know
That you have an thousand more seeds to sow.

You might move from teacher to sage
Absorbing knowledge, and turning the page
Not for what it will do to you
But for its impact on the milieu.

A preamble.....

So what keeps the planet stable and cool? Life does. Trillions upon trillions of tiny marine organisms that most of us have never heard of - foraminiferans and coccoliths and calcareous algae - capture atmospheric carbon, in the form of carbon dioxide, when it falls as rain and use it (in combination with other things) to make their tiny shells. By locking the carbon up in their shells, they keep it from being re-evaporated into the atmosphere where it would build up dangerously as a greenhouse gas. Eventually all the tiny foraminiferans and coccoliths and so on die and fall to the bottom of the sea, where they are compressed into limestone. It is remarkable, when you behold an extraordinary natural feature like the White Cliffs of Dover in England, to reflect that it is made up almost entirely of tiny deceased marine organisms, but even more remarkable when you realize how much carbon they cumulatively sequester. A six-inch cube of Dover chalk will contain well over a thousand litres of compressed carbon dioxide that would otherwise be doing us no good at all. Altogether there is about twenty thousand times as much carbon locked away in the Earth's rocks as in the atmosphere. Eventually much of that limestone will end up feeding volcanoes and the carbon will return to the atmosphere and fall to the Earth in rain, which is why the whole is called the long term carbon cycle. The process takes a very long time - about half a million years for a typical carbon atom - but in the absence of any other disturbance it works remarkably well at keeping the climate stable.

Unfortunately, human beings have a careless predilection for disrupting this cycle by putting lots of extra carbon into the atmosphere whether the foraminiferans are ready for it or not. Since 1850, it has been estimated, we have lofted about 100 billion tonnes of extra carbon into the air, a total that increases by about 7 billion tonnes each year. Overall, that's not actually all that much. Nature - mostly through the belchings of volcanoes and the decay of plants - sends about 200 billion tonnes of carbon dioxide into the atmosphere each year, nearly thirty times as much as we do with our cars and factories. But you have only to look at the haze that hangs over our cities to see what a difference our contribution makes.

We know from samples of very old ice that the 'natural' level of carbon dioxide in the atmosphere - that is, before we started inflating it with industrial activity - is about 280 parts per million. By 1958, when people in lab coats started to pay attention to it, it had risen to 315 parts per million. Today, it is over 360 parts per million and rising by roughly one-quarter of 1% every year. By the end of the twenty-first century it is forecast to rise to about 560 parts per million.

So far, the Earth's oceans and forests (which also pack away a lot of carbon) have managed to save us from ourselves, but, as Peter Cox of the British Meteorological Office puts it 'There is a critical threshold where the natural biosphere stops buffering us from the effects of our emissions and actually starts to amplify them.' The fear is that there would be a very rapid increase in the Earth's warming. Unable to adapt, many trees and other plants would die, releasing their stores of carbon and adding to the problem. Such cycles have occasionally happened in the distant past even without a human contribution. The good news is that even here, nature is quite wonderful. It is almost certain that eventually the carbon cycle would reassert itself and return the Earth to a situation of stability and happiness. The last time this happened, it took a mere sixty thousand years.

Excerpted from
A Short History of Nearly Everything
By
Bill Bryson

Ladies & Gentlemen,

Let all ye men know that 2005 was the warmest year on record since the end of the last major ice age nearly 12,000 years ago.

Yet, I am sweating and it's not about the heat. It's about what the heat will do to the Planet.

I was born, and still am, a pessimist at heart. I get worried about things and labour to generate worst-case scenarios and am often derided for this.

Nothing though scares me as much as the outcome of the change in our climate. Yet, in this pessimism, I see an opportunity as well, a fabulous outcome and, to use a much maligned phrase, a paradigm shift in the way we will live our lives in the future, if we recognise the need to change today.

If you need a primer on global warming and climate change, read on.....

The Nobel-winning Intergovernmental Panel on Climate Change (IPCC), in November 2007, issued its starkest warning yet on the subject. The IPCC declared that the impact of global warming would be "abrupt or irreversible" and that no country would be spared. It predicted that, under business-as-usual scenarios, **average surface temperatures worldwide will increase by 1.1 to 6.4 ° C by 2100** as a result of growing greenhouse gas concentrations (about which we will say more later) in the atmosphere.

Doesn't sound like much, does it? After all, on an average day in Bangalore city, temperatures oscillate by 10 degrees.

Well, this rate of warming is without precedent in the last 10,000 years.

Consider the facts:

- ❑ In the past two decades, the average annual temperatures have climbed by nearly 4 ° C in the Arctic.
- ❑as a result of which the sea ice is now 40% thinner and covers 6% less area than in 1980. (source : Time magazine)
- ❑ Average global temperature has risen by 0.6 degree Celsius in the past thirty years to around 14.6 ° C (source : World Watch Institute)
- ❑ By way of comparison, the difference between average global temperatures today and during the last Ice Age is about 4 ° C.

The IPCC didn't quite stop there. Sea levels, it said, will rise by at least 18 centimetres to perhaps a metre, given the uncertainties involved. Heatwaves, rainstorms, tropical cyclones and surges in sea level would become far more frequent later this century.

What could this lead to?

The consequences of this disaster are hard to imagine. Cataclysmic change to ecosystems is a certainty. This would mean, among others,

- ❑ The extinction of hundreds of species of plants, fish, reptiles and other animals that are extremely sensitive to temperature change.
- ❑ Severe and frequent storms, with unpredictable weather patterns. Today, damages caused by storms are estimated to cost around 100 billion dollars annually.
- ❑ Agricultural belts could shift, as many fertile areas turn uncultivable due to drought, while others are drowned under an expanding Ocean
- ❑ Melting of ice sheets. An international team, whose study appeared in the Proceedings of the National Academy of Sciences in early 2008, stated that Arctic sea ice will go into irreversible decline once temperatures rise further between 0.5 degrees to 2 degrees Celsius.....

- ❑ Consequent inundation of coastal areas. Islands such as Mauritius are expected to cease to exist in another 50 years, assuming business-as-usual, so do visit them soon (this part of the story is not sponsored by Mauritius tourism).
- ❑ Food and water shortages to vulnerable parts of the World, displacing millions of people.

What has caused this?

Simply put, greenhouse gases - carbon dioxide (that forms 60% of industrial greenhouse gas production) and five other gases such as methane and sulphur and nitrous oxides. Carbon dioxide concentrations in the atmosphere are hugely over what they were prior to the industrial revolution. Look at the table below:

Pre-industrial revolution	280 parts per million
1970	325
2000	365
2050	560 - projected, with business-as-usual

The surface area of India, along its coastline, may reduce in such a doomsday scenario by about 2-3% - remember that these are among the most heavily populated areas in the country, leaving an estimated **seven million people homeless**.

So do we have your attention?

...and who are the culprits?

- ❑ Industrialized nations: The US emissions of greenhouses gases, per capita, are currently about 20 times those of India.
- ❑and now industrialising nations, such as India, where the emissions are growing sharply and are projected to surpass those of industrialised countries in about two decades.

Fossil fuels are the biggest problem. The more we use of them, the more greenhouse gases enter the atmosphere, never to leave (in our lifetime anyway). According to the World Watch Institute, the use of fossil fuels has almost doubled in the past three decades, from 4,800 MTOE to 8,000 MTOE (MTOE = Million Tons Oil Equivalent). And we don't seem to want to stop - take the aviation industry, for instance.

Aviation is a relatively small source of the emissions blamed for global warming, but its share is growing the fastest. The evidence is strong that emissions from jet engines, including the streaks of cloud (called contrails) they leave behind in the sky, could be especially damaging.

The double decker A380 is a case in point. This is biggest airliner that the World has ever seen, capable of carrying 550 people. Rolls-Royce says the four engines on the A380 are as clean and efficient as any jet engine, and produce "as much power as 3,500 family cars".

Thus, flying a fully laden A380 is, in energy terms, like a **14 km queue of traffic** on the road below. And that is just one aircraft. In 20 years, Airbus reckons, 1,500 such planes will be in the air. By then, the total number of airliners is expected to have doubled, to 22,000. The super-jumbos alone would be pumping out carbon dioxide at the same rate as 5 million cars.

A simple calculation shows that the equivalent of more than six cars is needed to fly each passenger.

Another problem is wood burning from deforestation as a result of land being cleared for agriculture. This is estimated to be responsible for 18% of global greenhouse gas emissions each year, more than is produced by the World's transport fleet. Deforestation to make way for crops and pastures was responsible for more than 7 billion tonnes of such gas emissions in 2000 alone.

So what's the World doing to prevent the change in our climate ?

In 1992, more than 160 nations adopted the United Nations Framework Convention on Climate Change. It acknowledged, fundamentally, that climate change was a problem (which itself was, and is still, debated hotly, particularly by the pro-industry groups in the United States) and mandated the industrialised nations to return their emissions to 1990 levels by the year 2000.

By 1997, it was clear that the targets set would not be achieved; indeed emissions were increasing! Realising that the Framework Convention had failed to realise its objectives, the key parties behind it, 39 of the World's richest nations, in 1997 itself, agreed to what is now called the Kyoto Protocol with a core objective of reducing the emission of greenhouse gases to an average of 5.2% below 1990 levels between 2008 and 2012, a highly ambitious target.

Today, greenhouse gas concentrations are greater than at any time in the last 420,000 years.

These gases have a long atmospheric lifetime and are released as a result of complex industrial effluent interactions, some of which happen long after the reactions begin. What this means is, if I were to wishfully imagine a World in which, from the First Day of Next Year, no greenhouse gas was emitted at all, the atmospheric levels of these gases would continue to rise for a number of years, before levelling off and then reducing.

In our definition of time, it is an excruciatingly slow process, which is why the time to act is NOW.

So, is the Kyoto Protocol working?

No.

There are **three** reasons for this:

Reason 1: the United States

Reason 2: the United States

Reason 3: the United States

As you read earlier, in 1997, 39 of the world's richest countries agreed to curb greenhouse-gas emissions at the Kyoto Climate Change Conference. But President Bush's opposition has hampered the ratification of the resulting Kyoto Protocol. Most environment ministers reached an unexpected deal by

Americans represent 5% of the World's population but drive almost a third of its cars which, in turn, account for nearly half the carbon dioxide pumped out of exhaust pipes into the atmosphere.

the end of 2001, but, the United States, which claims the protocol would cut living standards, remains opposed to Kyoto. Instead, America is considering alternatives like taxes for greenhouse-gas emissions. This is not dissimilar to a hunting licence: kill, but please do pay for the right to do it.

European governments, by and large, say they have the right intentions though. By signing Kyoto, they promised to reduce, by 2012, emissions of greenhouse gases to, on average, 8% below what they were in 1990 (that's a lot!). To meet that goal, each EU country was required to agree to a national emission target, and issue carbon-dioxide allocations to every big industrial facility—in essence, granting them formal rights to emit the leading greenhouse gas, carbon dioxide, a previously uncontrolled “pollutant.” Those firms unable to meet its target would be able to purchase additional carbon credits in the international market. Some people regard the whole carbon exercise as a sham. And, for all their green bluster, most European countries are not on target to meet Kyoto commitments.....

Perhaps the irony of this process of negotiation, delay and display of rabid self interest by the US and other developed nations such as Australia has been the creation of an exchange in trading ‘carbon credits’. Carbon credits are savings in carbon emissions that will be granted to a company that could use them to achieve its own carbon reduction target or, instead, sell them to others. In annexure 3, an article by George Monbiot outlines just why this won't work to save the planet.

‘Carbon credits’ are savings in carbon emissions that will be granted to a company that could use them to achieve its own carbon reduction target or sell them to others.

So, where does India stand in all this?

The answer: with its head in the sand. With a reported GDP growth of 6% in the first decade of the twenty first century, no one in the Government cares a fig about carbon emissions. We want more cars, more power and the right to pollute more, since developed countries have been there, done that. India accounts for 16% of the World's population, but only 3% of global carbon emissions. This will change though, since we hold the fourth largest coal reserves in the World. Coal is the blackest of all polluting fuels, yet the Government has identified it as the source of our future power needs. More core industry activity, more thermal power plants, many more cars, more smelters all mean more greenhouse gases.

India - with our millions of acres of wasteland where we can plant indigenous species of trees that absorb carbon, our CO₂ emitting businesses that can clean up and claim carbon credits and our ability to claim World leadership in clean energy - can become the leader, the innovator, the prima donna in reducing our dependence on carbon and creating rural employment.

Will someone in the Government please wake up ?

If global warming takes its course in India....

- ❑ Agricultural yields in India could decline between 3% and 30%:

- One study estimated that, in the event of a doubling of carbon dioxide in the atmosphere, the resultant 1 metre rise in the sea level would
 - inundate nearly 6,000 sq km of land and 4,000 km of roads in India,
 - displace nearly 7 million people,
 -cause destruction estimated at thousands of crores of rupees

If you are worried, I am genuinely sorry. My intention is not to scare you. It is to terrify you. Global warming is not another person's problem. It is ours to solve.

Humanity needs to respond to this crisis in every way possible. Sir Nicholas Stern, who authored a seminal study on the economics of climate change in 2006, has shown through economic modelling that emissions can be stabilised with an investment of one per cent of Gross Domestic Product by 2050. Many others have demonstrated that for every job lost as a result of the closure of a polluting plant, another job can be created in business that work on energy efficiency and clean generation, mass transportation, water management and in improving environmental standards in manufacturing.

In addition, there is enough of our history to give us hope - recent history at that. During the 1979-86 period, after the second oil shock, **America obtained five times as much new energy from savings** as from all net expansions of supply. While the economy grew by 19%, the total energy required actually declined by 6%.

So what are the five things that India must do?

In every crisis lies an opportunity. Here's what India must do:

1. Take the lead in setting a target for emission reduction.

The bulk of our emissions are from power plants and old economy smokestack businesses. Given an adequate incentive-and-retribution system, Indian industry can, and will, reform. Large international organisations such as Toyota have set emission reduction targets for themselves and will work with Indian companies to transfer technology, because in that process, they (and their country) get, what are called, 'Emission Credits', under the Kyoto Protocol.

Currently, India looks quite the ostrich with its head in the sand. Its stand is that since it missed out on 'development', which generated these gases in the first place, it must now have the right to pollute to 'catch up' (see Annexure 1: Say NO to Coal). The world has changed since the process of early industrialisation, away from manufacturing towards services and, amazingly enough, India has been a important part of this change with the information technology industry and other services now exceeding manufacturing as a percentage of GDP. Yet the men who drive our negotiation process, know little (other than the yoga of an ostrich-in-sand), do less and hardly ever think beyond the obvious. India can prove that we, along with many European nations, are the Green leaders of the World.

We must set ourselves a target of greenhouse gas reduction and see this as an opportunity to leapfrog into latest energy efficient technologies. An excellent example where we can begin is with street lighting. Emulate London. It is striving to become the first city in the World with streets illuminated fully by light emitting diodes (LEDs) by 2012. Mumbai and Delhi can be

early movers as they are part of the Clinton Climate Initiative, which is promoting high performance technologies for lighting.

2. Create a Rs.10,000 crore corpus to provide low-cost loans to corporations to help them adopt eco-friendly industrial alternatives to existing global warming technologies. This capital could fund, for instance, the modernisation of air effluent treatment equipment such as scrubbers, flue-chimneys and the like. The Government must focus on the following industries:

1. Cement
2. Fertilisers
3. Mining & metal production

.....because they are the heaviest consumers of coal and fossil fuels.

3. Rethink transportation, to reduce the consumption of non-renewable fuels, including

- ❑ Better public transport
- ❑ Increase blending of ethanol (derived from sugarcane) in fuels
- ❑ Regulate the aviation industry to reduce the quantum of wasted air miles
- ❑ Increase taxation on vehicles, particularly on large fuel-guzzling luxury cars
- ❑ Provide extraordinary incentives to producers of clean vehicles - companies such as Toyota and Honda - to research, pilot and produce their vehicles in India

4. Protect forests and bring additional land under forest cover

...and not only because more trees mean more carbon credits. The Government of India must increase the land under forest cover by planting trees and by buying forest lands up for sale. Alongwith the need to reduce carbon dioxide is the need to increase oxygen, as the population grows to a possible stable level of about 1.6 billion people. Indeed urgent financial incentives to stop land being cleared for farming are the most cost-effective way of soaking up greenhouse gases.

5. Transition to eco-friendly power generation to meet the needs of twenty first century India.

These include

- ❑ solar power in rural electrification,
- ❑ micro-hydel power in the hilly and mountainous zones of the country, where a mere 8-10 feet head of water can generate enough power for a couple of homes,
- ❑ LED based lighting that consumes a mere fraction of an incandescent bulb
- ❑ biomass based energy generation (biogas) for cooking in rural households; and
- ❑ **remove** the 100% subsidy on power to farmers. Simple economics - free resources are used carelessly.

...and what are the five things that you can do?

1. For starters, use solar water heaters in your homes.

Solar water heaters can operate in any climate. Performance varies depending, in part, on how much solar energy is available at the site, and on how cold the water coming into the system

is. Bangaloreans note: the colder the water, the more efficiently the system operates though it is preferable, in almost all climates, to have some backup system. Wider use of solar water heaters not only saves substantial amount of electricity but also reduces the peak load demand significantly and, consequently, load shedding in the colder months of the year. Solar water heaters are very cost competitive when you account for the total energy costs over the life of the system. Although the initial cost of solar water heaters is higher than that of conventional water heaters (cost of a 100 litres capacity solar water heater would be about Rs 15,000 - 20,000), the fuel (sunshine) is free - the recovery of your investment takes just four years! Electrical heating, by the way, is heavily subsidised because you don't pay for the pollution that coal generates when it burns or for the forests that are destroyed in a hydro electric project. The cumulative installed collector area in the country is about 700,000 m², which is less than 1% of the potential.

Use of 1000 solar domestic water heaters (2000 m² of collector area) can contribute to a peak load shaving of 1 MW - your contribution to solving India's power problem.

If 3 million consumers moved from electric to solar, India could save itself a costly, polluting, soul-destroying, water-consuming power plant.

II. Don't curse the darkness, light a compact fluorescent lamp or an LED

Compact fluorescent lamps (CFLs) are mini-tubelights, consisting of two parts, a gas filled tube and a magnetic or electronic ballast. The gas in the tube glows with ultraviolet light when electricity from the ballast flows through it, which, in turn, excites a white phosphorous coating on the inside of the tube, emitting visible light throughout the surface of the tube. Note that incandescent lamps work differently - most of the electricity they use heats a tungsten filament until it glows white hot. The result - incandescent lamps generate far more heat than a CFL, which is your cool collected customer. They consume between 5 and 40 watts, and have a brightness and colour rendition that is comparable to incandescent lights, which means that

- they can replace standard incandescent bulbs
- they use 20-25% of the energy used by incandescents
- they could be a key to our future energy consumption pattern.

The production of six million CFLs every year in India would eliminate the need for 3700 megawatts of power

In India, there are 300 million general lighting service points and if 10% converted to CFL, 4400 million kilowatt per annum of electricity

would be saved, reducing the country's electricity bills by Rs.1,320 crores. The imagination boggles....

CFLs, when used properly, last upto 10 times longer and produce more light per watt (for example, a 27 watt CFL provides about 1800 lumens, a 100 watt incandescent stops at 1750). CFLs are most effective in areas where lighting is needed for long periods of time. Divide your incandescent's wattage by four (approx) to get the desired wattage for the CFL you want.

Then watt's the hitch?

CFLs are expensive to buy, costing upwards of Rs.150. The 25 watt ones may cost as much as Rs.350. Yet, after the one time cost, the savings begin - these could be as high as 60% on your lighting bills.

Convinced? Well, here's the clincher - a single CF lamp can save enough electricity (coal-fired, as in India) in its lifetime to keep half a ton of carbon dioxide out of the atmosphere.

Caveat :

- Dispose CFLs carefully - they contain microscopic amounts of mercury, much less in quantity than the good ol' tubelights that we know, yet mercury is dangerous, very dangerous.

What can you do: Target to convert your most commonly used light points at home and office to CFLs over the next one year.

LED technology, while in its infancy and hence costly, is even better, since it consumes lesser energy and has no mercury. There is considerable research now to make it better; the best is yet to come. Like Moore's Law for computer chips, there is Haitz's Law for LEDs which states that every ten years, the amount of light generated by an LED increases by a factor of 20, while the cost per lumen (unit of useful light emitted) falls by a factor of 10.

III. How do you commute?

1. Use a bicycle, when you travel short distances (upto 4-5 kms) within the city and, whenever possible, use public transport for longer journeys.
2. Look to pool cars, when you drive to work.
3. Use trains when you holiday.

IV. Plant a tree a month - its least you can do for your planet.

A tree is a carbon sink. As it grows, it absorbs carbon dioxide from the atmosphere to grow and stocks the carbon within its wood. The more trees, the more carbon dioxide absorbed. The converse is also true - when a tree is cut and burnt, say for firewood, carbon stocked in the wood is now released, so when a forest burns, carbon dioxide is released in huge amounts contributing to global warming.

It is estimated that an acre of trees absorbs enough carbon dioxide in a year to equal the amount produced when you drive a car 26,000 miles. The American Forestry Association estimates that 100 million new trees would absorb 18 million tons of carbon dioxide and cut US air conditioning costs by \$4 billion annually.

V.....and finally, relook at your own consumption.

The more we consume, the more, it seems to be, the Earth warms up. More of electronic gizmos, furniture, housing, vehicles and clothing results in more transportation, use of non-renewable fuels and wastage, all increasing greenhouse gas concentrations in the atmosphere. Look at your own consumption pattern and find ways to save.

Recycling and re-using help minimally.

Reducing your needs really helps.

Remember, this is your planet.

Annexure 1: Say NO to Coal

The Ministry for Power is clear about their agenda for meeting India's power needs - when the entire World is moving away from generating electricity using coal and towards cleaner power sources, India will have more coal-based power plants, driving us back into the smoke stack era - all because India has large reserves of coal.

Nearly 73% of India's total installed power generation capacity is thermal, of which coal-based generation is 90% - the remaining comprising diesel, wind, gas, and steam.

Total capacity of the coal energy sector in India: about 69,000 megawatt. The current requirement of coal: 336 million tonnes. Projects in the pipeline in India, using coal = 40,000 megawatt.

So, what's the problem with 'conventional' coal projects ?

Problem 1:

The generation of electric power produces more pollution than any other single industry in the United States. Recent (2002) data shows the U.S. electricity industry was responsible for:

- * 63% of sulphur dioxide emissions that contribute to acid rain
- * 22% of NOx emissions that contribute to urban smog
- * 39% of carbon emissions that contribute to global climate change
- * 33% of mercury emissions that pose significant health risks

And, of course, burning coal creates ash, more precisely, fly ash. Perhaps you haven't met it before - so an introduction may be in order.

This Ash has won no beauty pageants: an introduction to fly ash

The 85 utility thermal power stations in India, besides the several captive power plants, use bituminous and sub-bituminous coal and produce large quantities of fly ash. High ash content (30%-50%) contributes to these large volumes of fly ash. The World Bank has cautioned India that by 2015, disposal of coal ash would require 1000 square kilometres or one square metre of land per citizen. The problem with fly ash lies in the fact that not only does its disposal require large quantities of land, water, and energy, its fine particles, if not managed well, by virtue of their weightlessness, can become airborne, creating dangerous air pollution. Pollution caused by the 860 MW Tau Devi Lal Thermal Power Station, for instance, has forced over 10,000 residents of the five villages in the vicinity of the plant to look for new homes. The release of the huge quantity of flyash waste by the thermal plant has been polluting groundwater, agricultural land and atmosphere. Consequently, most of the villagers suffer from ailments like asthma, skin and eye diseases. Today, after 20 years of the plant's functioning, hundreds of tonnes of ash waste up to 30 feet high has collected in the dumping ground. Though industry and R&D establishments have, in recent years,

Currently, 90 million tonnes of fly ash is generated annually in India, with 65 000 acres of land being occupied by ash ponds.
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looked at alternate uses of fly ash, particularly in construction (part of the Delhi Metro is constructed using fly ash), this is still a miniscule fraction of the total fly ash generated, which

will exceed usage for our life time at least. So we cannot afford any more coal-based power plants.

Problem 2:

Thermal power plants use a huge quantity of fresh water for cooling (nuclear reactors need more, by the way). The need varies by each specific power plant's electricity generating technology and size.

Waste water from thermal power plants in India
in 2000-01 = 323,000,000,000 litres.

Withdrawal of large volumes of surface water for either power plant cooling or hydropower generation can kill fish, larvae and other organisms trapped against intake structures, or swept up in the flow through the different sections of a power plant.

Most renewable energy technologies require little or no water for cooling.

Problem 3:

Coal projects need a lot of land to store raw material (particularly if the coal is imported as is the case with most new plants), build conveyor belts, locate the plant itself, put up transmission systems to take the power, treat effluent and store huge quantities of water for cooling the plant. Take the mega 4,000 mw imported coal-based Girye project in Maharashtra, for instance - it will take 3,500 acres of land, about 15 square kilometres! This project will need 15 million tonnes of coal a year.

Another example. The Government of Karnataka has proposed a new project at Tadari, near the beautiful town of Gokarna in Uttara Kannada.

Project size: 400 MW

Land allotted to project : 2000 acres of acquired agricultural land

Threats to the radius of 25 km around the plant: effluent into the sea, forests doused in fly ash, river water diversion and pollution, health of local residents at risk.

Here's what you can do.

1. Write to the Power Minister & the Minister for Non-Renewables Energy Sources, politely requesting a shift to renewable power in Governmental policy. Mention that the potential for non-conventional energy generation in India: 71,000 megawatt, while the actual generation is only 9% of potential.
2. Spread the word about coal and learn about the clearly viable alternatives that are emerging in a technology-centric society.

Say NO to coal - it's the least you can do for the planet.

Annexure 2

Earth at the tipping point

Robin McKie
Science Editor
The Guardian

STRANGE DAYS have reached Ny-Alesund, Europe's northernmost research station. Located in Svalbard, Norway, a mere 1,000 km from the North Pole, the centre's scientists have been experiencing increasingly unpredictable weather.

The archipelago should still be gripped by ice and screaming winds. But the conditions on Svalbard are balmy. In May, Vigdis Tverberg of the Norwegian Polar Institute, reported that waters in the Kongsfjorden – the long strip of water that pokes eastwards into mainland Svalbard at Ny-Alesund – were 2 degrees centigrade warmer than a few years ago.

The inference is clear, say researchers. Global warming, driven by increasing levels of carbon dioxide in the atmosphere, is not only increasing air temperatures, it is causing the oceans to warm alarmingly.

Neither is Kongsfjorden unique. According to Mr. Tverberg's colleague, Sebastian Gerland, all the other fjords on this normally ice-locked coastline have remained open, thanks to the startling warming of their waters. Polar ice is not so much dwindling, as scientists once suggested might happen; it is disappearing before our eyes.

For years, scientists have stressed that the Arctic and the Antarctic are the most climatically sensitive parts of our planet. Global warming was always going to hit the poles with disproportionate severity, they said. Now those predictions are being proved correct, not just in the warming waters off Svalbard but also in Greenland and in the disappearing ice sheets of west Antarctica. In the case of Greenland, scientists reported this year that previous estimates of the rate of melting of Greenland's glaciers had been too low and too optimistic in assuming it would take centuries to heat and melt its massive ice shield.

Instead, a study of Greenland's glaciers, uncovered an unexpected effect. As air temperatures have risen – roughly 3 degrees centigrade in the Arctic over the past two decades – the resulting meltwater has poured to the bases of glaciers and acted as a lubricant. Thus the marches to the sea of these great rivers of ice are being accelerated, raising the amount of ice dumped in the Atlantic each year from 100 cubic kilometres in 1996 to 220 cubic kilometres last year.

This will have several profound consequences, say scientists.

Worrying prospect

For countries such as Holland, a quarter of which currently lies below sea level, for low-lying Bangladesh, and for coral island nations such as the Maldives, Tuvalu, and Vanuatu, it is a deeply worrying prospect. All these places will become increasingly vulnerable to massive sea surges sweeping over their strained ocean defences.

It is a grim prospect. Yet there may be even more worrying, more serious effects triggered by the disappearance of the polar ice caps. Those vast sheets of bright, white ice make near-perfect mirrors that shine back 80 per cent of the sunlight that falls on them. Thus they help to keep our planet cool. This measure of reflectivity is known as albedo (from the Latin word for whiteness). A perfect reflector would have an albedo of 1.0, The albedo for polar ice is around 0.8. By contrast, the albedo for seawater is around 0.07.

The difference between these two figures is stark. Ice has one of the highest albedos of any substance on earth, seawater has one of the lowest, so we are replacing our planet's best reflector with one of the worst. The bad news does not stop here, however. There is the issue of the melting of the planet's permafrost, the thick layer of frozen soil covering much of the ground in the high latitudes of the northern hemisphere.

The trouble is that the permafrost acts as a repository for greenhouse gases. One estimate suggests there are 450 billion tonnes of the stuff locked up in the world's permafrost.

These two effects, loss of albedo, and the release of permafrost gases, are known as tipping points. Once passed, reversal becomes nigh impossible. The climate is like a rowing boat. You can tip it and it will return to an even keel. You can tip it again, and once more it will return to its original state. But if you tip just a little too far, it will capsize.

That is the danger the earth now faces: the overturning of our climate system, from its relatively stable, moderate status to one in which we have recreated the climate of the Cretaceous era, when there were crocodiles at the poles and the planet cooked.

The question is: how did the planet reach its current status? More importantly, what can be done to halt our seemingly relentless passage towards the Cretaceous? The answer to the first question is, of course, the easier. It can be traced to the moment, in 1765, when James Watt – wandering across Glasgow Green – conceived of the idea of a separate condenser for the steam engine. Patented in 1769, his invention made steam power feasible and economic. It unleashed the Industrial Age – the burning of the earth's fossil reserves of coal, oil and gas, and the injecting of much carbon dioxide into the atmosphere.

Carbon dioxide – like all other greenhouse gases – absorbs the solar energy that perpetually beats down on our world, holds it, then radiates some back to the earth. The effect is to heat up the atmosphere.

This is not necessarily a bad thing. If there were no greenhouse gases, our world would be a decidedly chilly one, as the pioneering British physicist John Tyndall realised almost 150 years ago. Were it not for heat-trapping gases such as carbon dioxide, solar radiation would be reflected straight back into space. On the other hand, if you get too much of the stuff, problems arise, as is revealed through the example of our sister planet Venus. Although its orbit is relatively close to the earth's, and its size is almost identical, conditions there are as near to hell as you could envisage because its atmosphere is mostly carbon dioxide. The greenhouse effect there generates surface temperatures of 450 degrees centigrade, hot enough to melt lead.

No one is predicting such a fate for the earth, of course. Nevertheless, our world cannot avoid disruption even if it could limit global warming to an increase of only a few degrees. The issue is: how can we mitigate the changes we have unleashed? More importantly, have we the political will to carry out the industrial makeover needed to flatten out that curve of rising carbon emissions before our viability as a species is threatened?

There are many eminent scientists and experts who remain optimistic. Equally, there are those who feel the prospects for our planet are hopeless. Both are united on one issue, however: no matter how bleak our position, there can be no excuse for inaction.

It is a point stressed by U.S. anthropologist Jared Diamond. In his recent book, *Collapse: How Societies Choose to Fail or Succeed*, he outlines examples of societies – such as the Vikings in Greenland – who refused to change their ways and perished as climate change swept their Arctic colonies. By contrast, the people of Tikopia, in the Pacific, who when faced with environmental devastation caused by pigs, their favourite source of protein, that were rooting up and destroying their farmlands, acted with commendable decisiveness. They slaughtered every pig on the island.

Our prospects and our choices may not be quite as stark as that – at least not yet. Indeed, we have many courses of action. We are still in control of our own fates.

(Article from the Guardian Online, published on June 15th, 2006)

Annexure 3

Self-delusion of carbon-trading

George Monbiot

Offsetting makes us feel better, allows us to consume more to the benefit of the polluters, deflects attention away from the real and present danger that is climate change and does little good.

REJOICE! WE have a way out. Our guilty consciences appeased, we can continue to fill up our SUVs and fly around the world without the least concern about our impact on the planet. How has this magic been arranged? By something called "carbon offsets." You buy yourself a clean conscience by paying someone else to undo the harm you are causing.

This week in the United Kingdom, the Co-op's holiday firm Travelcare started selling offsets to its customers. If they want to fly to Spain, they pay an extra £3. Then they can forget about their contribution to climate change.

The money will be spent on projects in the developing world, such as building wind farms and more efficient cooking stoves. In August, British Petroleum launched its "target neutral" scheme, enabling customers to "neutralise the carbon dioxide emissions caused by their driving." The consequences of an entire year's motoring can be discharged for just \$40.

Again, your money will be invested in the developing world — "a biomass energy plant in Himachal Pradesh; a wind farm in Karnataka, India, and an animal waste management and methane capture programme in Mexico" — and you need have no further worries about what you and BP are doing to the atmosphere (or, for that matter to the tundra in Alaska).

It sounds great. Without requiring any social or political change, and at a tiny cost to the consumer, the problem of climate change is solved. Having handed over a few quid, we can all sleep easy again.

This is not the first time such schemes have been sold. In his book *The Rise of the Dutch Republic*, published in 1855, John Lothrop Motley describes the means by which the people of the Netherlands in the 15th and 16th centuries could redeem their sins. "The sale of absolutions was the source of large fortunes to the priests ... God's pardon for crimes already committed, or about to be committed, was advertised according to a graduated tariff. Thus, poisoning, for example, was absolved for 11 ducats, six livres tournois. Absolution for incest was afforded at 36 livres, three ducats. Perjury came to seven livres and three carlines. Pardon for murder, if not by poison, was cheaper. Even a parricide could buy forgiveness at God's tribunal at one ducat; four livres, eight carlines."

Just as in the 15th and 16th centuries you could kill and lie without fear of eternal damnation, today you can live exactly as you please as long as you give your ducats to one of the companies selling indulgences. It is pernicious and destructive nonsense.

Irreversible melting

The problem is this. If climate change is not to trigger the irreversible melting of the Greenland and West Antarctic ice sheets and drive millions of people from their homes, the global temperature rise must be confined to 2 degrees C above pre-industrial levels.

As the figures I have published in my book *Heat show*, this requires a 60 per cent cut in global climate emissions by 2030, which means a 90 per cent cut in the rich world. Even if, through carbon offset schemes carried out in developing countries, every poor nation on the planet became carbon-free, we would still have to cut most of the carbon we produce at home. Buying and selling carbon offsets is like pushing the food around on your plate to create the impression that you have eaten it.

Any scheme that persuades us we can carry on polluting delays the point at which we grasp the nettle of climate change and accept that our lives have to change. But we cannot afford to delay. The big cuts have to be made now, and the longer we leave it, the harder it will be to prevent runaway climate change from taking place.

By selling us a clean conscience, the offset companies are undermining the necessary political battle to tackle climate change at home. They are telling us we don't need to be citizens; we need only to be better consumers.

BP and Travelcare, like other companies, want to keep expanding their business. Offset schemes allow them to do so while asserting they have gone green.

Yet aviation emissions, to give one example, are rising so fast in the U.K. that before 2020 they will account for the country's entire sustainable carbon allocation. A couple of decades after that, global aircraft emissions will match the sustainable carbon level for all economic sectors, across the entire planet. Perhaps the carbon offset companies will then start schemes on Mars, as we will soon need several planets to absorb the carbon dioxide we release. Offsets, then, are being used as an excuse for the unsustainable growth of carbon-intensive activities.

But these are not the only problems. A tonne of carbon saved today is far more valuable in terms of preventing climate change than a tonne of carbon saved in three years' time. Almost all the carbon offset schemes take time to recoup the emissions we release today. As far as I can discover, none of the companies that sell them uses discount rates for its carbon savings (which would reflect the difference in value between the present and the future). This means they could all be accused of unintentional but systemic false accounting.

Less attestable plan

And while the carbon we release by flying or driving is certain and verifiable, the carbon absorbed by offset projects is less attestable. Many will succeed, and continue to function over the necessary period. Others will fail, especially the disastrous forays into tree planting that some companies have made. To claim a carbon saving, you also need to demonstrate that these projects would not have happened without you – that Mexico would not have decided to capture the methane from its pig farms, or that people in India would not have bought new stoves of their own accord.

In other words, you must look into a counterfactual future. I have yet to meet someone from a carbon offset company who possesses supernatural powers. At the offices of Travelcare and the forecourts owned by BP, you can now buy complacency, political apathy, and self-satisfaction. But you cannot buy the survival of the planet.