# The Immediate Solution to the Climate Crisis

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During the late 1990's and early 2000's, global warming has crept into the public awareness. We have been told that climate change is occurring, and our future on Earth could be bleak if we continue down our current path.

The purpose of this article is to suggest that if we make simple changes to the way we do things, we can halt (or at least slow) global warming. For many people, it is too difficult to make radical modifications to the way we live our lives. This may be true, but we can still slow climate change without changing our lifestyles. We just need to be a bit more clever about how we do things.

## The Issue

Global warming and subsequent climate change are accepted phenomena. There is no dispute among scientists that this is occurring on Earth. Despite consensus among scientists, however, the theory of climate change is still disputed among popular media and the general public. It seems that everyone has a point of view on the topic, and the people who are least qualified to question the theory happen to have the loudest voice in the media. For this reason, it is worth reiterating the theory behind global warming and relating this theory to current events on Earth.

### *The Greenhouse Effect*

The mechanism that drives global warming is known as the *greenhouse effec*t. To understand how the greenhouse effect works one needs only to look at how a glass greenhouse works. The glass acts as a sort of trap, which lets heat from the Sun in and will not let it all escape. Earth's atmosphere works in much the same way. It contains a range of gases, some of which have a natural heat absorption property. As heat from the Sun (in the form of thermal infrared radiation) arrives at the planet, some of it is reflected back into space while the atmosphere absorbs the rest. As

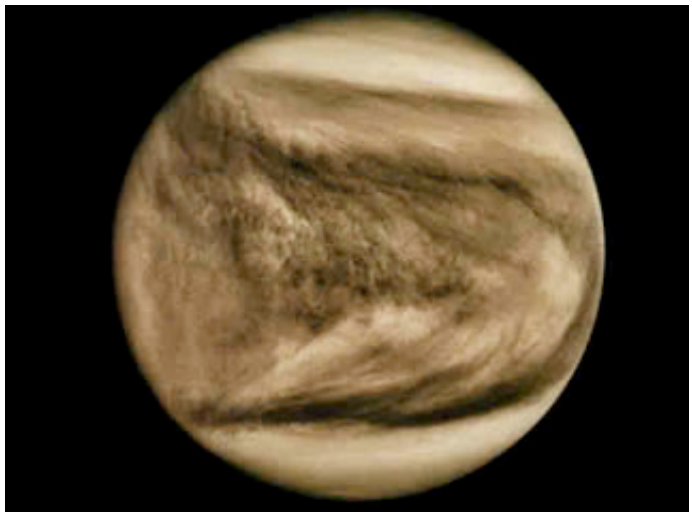
the atmosphere absorbs infrared radiation it becomes gradually warmer, thus making Earth's climate warmer. The key gases involved in this process are Carbon Dioxide (CO2), Carbon Monoxide (CO), Methane, and water vapor.

It turns out that life on Earth relies on the greenhouse effect. If all the heat from the Sun was reflected back out into space, the surface temperature of Earth would be about 20 degrees Celsius below zero. Our atmosphere would be frozen and the planet would be unsuitable for the range of species that it currently hosts. This is not to say that life would be impossible. It is simply to say that life as we have come to know it would not have evolved.

Throughout the history of life on Earth, there has been a good balance between the production of heat trapping gases and mechanisms that remove such gasses. This balance has ensured the average temperature sits in a range comfortable for life. Heat absorbing gases produced through natural processes have been removed through natural processes. When these processes are left to run undisturbed, the atmosphere contains enough heat trapping gas to ensure the protective greenhouse blanket remains intact, and life can continue to flourish. There have, of course, been fluctuations in average levels of heat trapping gas in the atmosphere. And temperature of the Earth have risen and fallen as a result. But these fluctuations are part of the natural cycle of the Earth and the Sun, and are gradual, taking tens of thousands of years to shift the average global temperature by a couple of degrees.

We know that CO2 is a heat trapping gas, and we know that a certain amount of CO2 is required to produce the greenhouse effect, which keeps our environment suitable for life. Now, what happens if we add more CO2 to the atmosphere? Common sense tells us that if CO2 is a heat trapping gas and we add more to the atmosphere, then we will trap more heat. If we add enough CO2 to the atmosphere, we may trap enough heat to significantly alter the environment. Skeptics may complain that there is no evidence to show that adding CO2 to the atmosphere will have a significant impact. Fortunately for us we have evidence relatively close by. The planet Venus contains a dense atmosphere of CO2 and other greenhouse gases. Its surface temperature is about 470 degrees Celsius. Now, given the planet's distance from the Sun, and given the fact that it has a highly reflective cloud layer, scientists calculate that its temperature should actually be lower than the average temperature on Earth. In fact, during the 1950s it was something of a puzzle to discover that Venus was, in fact, high orders of magnitude hotter than previously thought. This discovery was made through the detection of intense microwave radiation emanating from the planet. Several competing theories were developed to account for this radiation. One of the more convincing theories was developed by Carl Sagan, the celebrated astronomer and science popularizer. He proposed that the intense microwave radiation from Venus was evidence that the planet was extremely hot. He subsequently

developed his greenhouse effect theory.



*Venus is covered in thick layers of clouds made up of 98% CO2*

Interestingly, the greenhouse effect theory was not new. As early as 1895 Svante Arrhenius, a Swedish Chemist, calculated that Earth's average temperature would rise by 10 degrees Celsius if we doubled the CO2 in the atmosphere. Then, during the 1950's, scientists (independent to Carl Sagan's work on Venus) began to wonder if the burning of fossil fuels could produce enough CO2 to affect the Earth's temperature. A research facility was set up in Hawaii to monitor atmospheric CO2 and shifts in average air temperature. Hawaii was chosen for this facility because of its distance from industrialization and deforestation. This ensured that the results were not skewed in one direction, as industrialized areas tend to have higher levels of CO2 because of the lack of forestation and industry. Being situated in Hawaii meant that scientists could gather accurate information about global atmosphere without contamination from industrialization.

The results from Hawaii show a clear trend. Since records began in the 1950's, atmospheric concentration of CO2 has increased by over 50 ppm (50 extra CO2 molecules per million air particles). Furthermore, there is a direct co-relation between the increase in CO2 concentration and temperature increase. Now, it is possible to object here and state that *co-relation* does not entail *causation*. But I think such an objection would be naive. Given the fact that CO2 *is* a heat absorbing gas, it is extremely likely that the increase in temperature is a result of the increased CO2 in the atmosphere. Science is in the business of forming theories that *best* explain the evidence. If we were to accept the objection, that would mean we would have to search for another explanation for the rise in temperature, while ignoring the fact that we have more CO2 in the atmosphere. But heat absorption is a *property* of *CO2*. Rationally we should accept that the increase in temperature is brought about by the increase in CO2. And since we know that our activity on Earth significantly increases CO2, we can conclude that our activity is directly related to global warming.

Since the beginning of the industrial revolution we have been pumping billions of tonnes of CO2 into the atmosphere. This CO2 comes from burning of fossil fuels in industry and transportation. It also comes from burning wood. Although it may seem strange in the 21st Century, a surprisingly high number of people still choose to heat their homes by burning wood--despite the fact that burning wood is the least efficient ways to heat a house, and regardless of the fact that it is one of the most expensive forms of heating when all factors are taken in to account.

Another greenhouse gas (methane) is a by-product of our huge meat industry. When cattle eat grass they belch heat-trapping methane in to the environment. Because of our growing demand for meat, forests are being removed to make room for more cows. Forests absorb greenhouse gases, while cows produce greenhouse gases. Anyone can do the math on this one and realize that our meat-eating tendency is also a contributing factor for global warming.

What will happen in the future if global warming is not addressed? The most obvious side effect of global warming is an increase in hotter weather. Already we see this happening. Europe is battling heat wave after heat wave. Every summer people are dying because of excess heat. Australia is suffering the longest continuous drought since records began. Their agricultural industry is entering a state of crisis as an increasing number of farmers are losing the battle against extreme drought conditions.

In addition to increased temperature, global warming brings about severe weather extremes. This means more intense hurricanes, more flooding, and colder winters. We will also see a rise in sea level as the ice caps slowly melt. Already the sea level is over 18 centimeters higher than it was in 1900. Some scientists estimate sea levels rising by up to 50 centimeters over the next 100 years (this is one of the conservative estimates), which would bring devastation to coastal regions across the planet. The impact on the United States alone could cost up to $200 billion.

*This animation from google shows the impact on New York City*

The worst-case scenario would see Earth enter a "runaway greenhouse" period. It works like this: as the temperature rises, there are more forest fires, which increase the CO2 in the atmosphere. Since the trees are burned down, there are fewer trees removing CO2 from the atmosphere. As the climate continues to change, it becomes unsuitable for many plant species. They die out thus further reducing the CO2 removal from the atmosphere. More water evaporates (water vapor is also a greenhouse gas). The planet's temperature increases exponentially until it is unsuitable for life. Skeptics who deny the idea that climate change will harm life need only to look back at two mass extinctions in the past for evidence:

1) The mass extinction of 251 Million years ago destroyed 95% of all species. This event was brought about by a period of intense volcanic activity, which released significant levels of CO2 into the atmosphere. The result was a rise in average temperate of 6 degrees Celsius. This triggered a runaway greenhouse effect, which could have left Earth lifeless were it not for the survival of 5% of species (Benton and Twitchett 2003).

2) The mass extinction of the dinosaurs, which occurred around 65 Million years ago and wiped out most dinosaur species. Their extinction was brought about by a relatively sudden change in the environment caused by an asteroid impact, which resulted in the sun being blocked out by dust and subsequent cooling of Earth.

Evolution can build adaptations to environmental change, but it requires large time frames to do its work. Time frames involved in asteroid impacts and global warming are far too short for the evolutionary process.

There is a school of thought that denies the problem. This school of thought accepts the existence of global warming. It also accepts the truth of human contribution to global warming. But it does not believe global warming poses a serious problem to Earth. Adherents to this line of thought believe that the Earth's environment will somehow "heal" itself and restore "balance". They use as evidence the historical cycle of average temperature change, and conclude that our current situation is the same. The Earth will correct itself.

The main problem with this idea is that it *presupposes* the existence of an *ideal* environment. It also implies that this ideal environment happens to be the environment best suited for human life. Why couldn't it be that the ideal environment on Earth is the environment in which life first evolved 3 billion years ago? That environment was vastly different to Earth's current environment. To suggest that Earth will restore balance to *this current* environment is to commit a crime of anthropocentrism (i.e. suggesting that humans are centrally important to Earth). Besides, there is a problem with suggesting that Earth somehow *wants* to restore balance to some *perfect* state. It implies that nature is goal directed and will adjust itself according to its end goals. This teleological view of nature is incorrect.

Earth's environment is a dynamic and changing system. It does not head towards end goals. Rather, it is a reactionary system. It responds to forces at work from within itself. Ecosystems slowly change over time and life adapts to those changes through evolution. There is no balanced state that Earth is aiming to reach. It does not "self correct". It simply changes. Humans are as much a part of nature as trees, insects, and animals, and as such, our impact on the planet simply contributes to its changing state. This is just another chapter in Earth's history.

**What are we doing to fix the problem?**

There has been much debate about how to combat global climate change. Most solutions revolve around limiting CO2 production from factories and transport systems. The *Kyoto* agreement proposes a system of carbon exchange. The idea is that countries producing low emissions can gain financial credits, which are passed on through tax rebate schemes to industries that have a low CO2 output. Industries with a high CO2 output pay for their environmental impact through taxation. Many countries have signed up to this agreement, which is a sign that governments recognize the importance of the issue. In addition to the Kyoto agreement, governments are setting their own targets for CO2 reduction. Many of these governmental targets involve similar goals, which will see CO2 emissions reduced to 1990 levels by the year 2050.

While it is promising to see governments setting reduction goals, their targets are a problem for two reasons. First, CO2 emissions in 1990 were too high. Reducing output to 1990 levels will still see atmospheric CO2 levels rising. Atmospheric CO2 levels need to be reduced to pre-industrial levels and once that target is reached, our CO2 output needs to be balanced by CO2 removal so that the levels remain static. Second, by the year 2050 it may be too late. If we continue to produce CO2 at current levels we are in danger of severely altering Earth's weather patterns. Changes to global weather are all ready evident, and by 2050 the changes will be extreme by high orders of magnitude. In a worse case scenario the year 2050 will see us entering a "runaway greenhouse effect" period.

Government legislation is not enough. Things move too slowly. It's up to individuals to take responsibility for combating climate change. So, what are individual people currently doing to slow climate change? Well, people are generally doing surprisingly little. There are, of course, exceptions--people who go out of their way to use public transport and reduce their meat consumption. But these exceptions are few and far between. Generally people do not want to change their lives. Some people do not believe that climate change is an issue, so they see no reason to adjust their living. Others (perhaps the majority) agree that climate change is a problem but they are either unwilling or unable to change the way they live.

The truth is that people do not want to change their lives. People want to continue to burn petrol because they view the alternatives as inconvenient. People largely ignore the future side effects of burning petrol. They see climate change as so far away in the future that it is not worth worrying about at this time. A quirk of human psychology means that people tend to focus on the here and now while paying little regard to the way things will be in decades to come. We humans live very much in the present and we solve problems as they present themselves. This is an adaptive trait that evolution has built into us. If our hunter-gatherer ancestors were distracted by thinking too far into the future they might not notice the tiger looking at them in the present. This psychological phenomenon is part of the reason that people happily smoke cigarettes even though they know that the long-term consequence of their habit may be devastating.

So, the future doesn't matter to people. It is more important to continue driving cars now. Besides, many people consider their small petrol consumption to be insignificant in the grand scheme of things. They will not stop using it until supplies dry up. And for many people, this is not something they consider happening in the near future. The language around petrol and oil supply subtly convinces people that supplies are infinite. In the news we hear about oil "production", the implication being that oil is something that companies make. Oil companies never say oil "extraction", which is a far more accurate description of the process.

Interestingly, recent reports from International Energy Agency predict that oil demand will outstrip supply by the year 2012. If this is true, petrol prices will start to rise dramatically. The positive outcome from this scenario will be people's reduced petrol consumption. Psychology may prevent people from looking at the long-term consequence of petrol burning, but that same psychology will certainly ring alarm bells when people realise petrol's short-term effect on their wallets.

**Solutions that work for people**

Because governmental process is too slow, and because people find it extremely difficult to change their lifestyles, we have to find solutions that work for people. There is no point in trying to convince people to drive their cars less frequently, or to stop eating meat because people do not want to make such changes. They may dread the thought of climate change, but they dread more the prospect of changing their lives. So rather than trying to convince people to stop using petrol and thus negatively affect their lives, we need to encourage people to do things that have little impact on their lives.

*A Solution involving Cars*

People should be able to drive cars. But instead of driving large gas-

guzzling four wheel drives, they should be encouraged to drive smaller more fuel efficient cars. Driving a smaller car will not have a negative impact on quality of life. In fact, quality of life might be raised since it is easier to park smaller vehicles.

How do we encourage people to drive smaller cars? For a start, governments could offer tax incentives to people who drive smaller vehicles. Perhaps local governments could provide free parking for small economic cars. For many people money is the key factor in decision making, so if driving smaller cars is financially beneficial, then people may buy in to the idea.

Encouraging people to buy electric cars is another option. It would, of course, be pointless to promote electric cars in countries that produce electricity through coal fired plants (China for example). The increased demand for electricity would result in higher CO2 emissions from the burning of coal. But in countries with environmentally friendly electricity production electric cars have a very small impact on the environment.

So why are there so few electric cars on the road? Well, it's all about perception. Electric cars are perceived as being inferior to their gas-guzzling counterparts. This perception is a hang over from the early days of electric car technology. When electric cars first appeared they were more hassle than they were worth. They were clumsy looking machines, which lacked a certain appeal to the average car buying market. You could only drive about 20-50 kilometers before requiring a recharge and the maximum speed was only 50kph.

But technology has come a long way since those first electric cars were introduced. Electric cars can now travel 300 kilometers at speeds of up to 200kph before requiring a recharge. If we could raise the public perception of electric cars--make them desirable--people may be more willing to give up their petrol drinking monstrosities. We might swing a few opinions with a marketing campaign that clearly shows the internal combustion driven cars as being dependent on an archaic 100-year-old technology compared to the sleek, technological marvel of the modern electric car.

*This technology hasn't changed much in over 100 years. This is the past.*


*Welcome to the clean Electric future*

Despite improvements in electric car technology, many people will continue to drive petrol-fuelled vehicles. This is, in part, because of the cost of electric cars. It will take many years for the cost of these vehicles to come down and become affordable to the general public. So in the meantime, we still need to find a way to remove the CO2 produced by petrol vehicles from the atmosphere because even small, fuel-efficient cars produce CO2.

*A Solution involving Trees*

Let people drive their cars, but if they want to do so they should be asked to plant trees. Now, this seems naive and obvious, but it is worth suggesting. There are many residential properties that are largely grass and concrete. Why not encourage people to plant a few trees? It will improve the look of their property while also absorbing some of their CO2 emissions.

I believe we have to be more clever about how we use our trees. There is a strong belief that trees should be allowed to grow and then be protected from the paper and wood industries. Advocates for protection of trees have very good intentions because, after all, trees absorb CO2 from our atmosphere and use it for growth. However the idea that we should protect trees from industry misses an important point. Trees absorb CO2 at a greater rate *whil*e they are growing than they do after they are fully grown. A 25 year old forest of white and red pine trees will absorb approximately 9,826 lbs of CO2 per acre per year. While a much older forest of 125 years will only absorb 7,516 lbs of CO2 per acre per year (see: www.tufts.edu/tie/tci/sequestration.htm). Therefore, wouldn't it make sense to harvest fully grown trees and replace them with fresh new trees?

If trees are used for timber, the carbon is locked in to the wood and kept out of the atmosphere for at least 30 years (see: www.klimafa.com). Presumably after this time the wood starts to biodegrade through exposure to the atmosphere--the carbon combining with oxygen to result

in CO2. But if there were a way to treat the wood so that the carbon would be locked in for even longer periods, then we would have the means to permanently extract excess CO2 from the atmosphere. Grow large forests of young trees, then after 25 years harvest the forest and plant new trees. Perhaps we need to encourage the building industry to make more use of wood in the construction of new homes. There may also be room for other industries to utilize wood rather than plastics (which are, of course made from oil and as such contribute to climate change).

Similar strategies could be used in the paper industry. Rather than recycling used paper, it may make more sense to harvest trees for the production of new paper, thus making room for the planting of new young trees. Not only would this ensure the continued existence of young forests full of high CO2 absorbing trees, it would also reduce paper recycling which is arguably a greater contributor to climate change than the production of new paper (Collins, L. 1996).

The obvious objection to this suggestion is to question what we do with the millions of tonnes of waste paper each year. Current recycling efforts have drastically reduced the amount of used paper going into landfills. It would be devastating to other environmental systems if we return to the landfill method of disposing of paper. Furthermore, carbon is only locked in to paper for about 2 years (see: www.klimafa.com) so if it is put in to landfill, it will quickly biodegrade and release its carbon back in to the atmosphere thus defeating the purpose of producing paper to make way for more trees.

An answer to this objection is to suggest the development of new methods to deal with waste paper. It is true that paper in a landfill will eventually decompose and release its carbon into the atmosphere. So, to prevent this occurring we need a new type of landfill. Perhaps paper could be separated from other garbage and sent to special treatment centers. These centers could be similar to facilities that deal with other organic waste--perhaps something like giant worm farms. Worms could be used to consume paper (along with anything else organic) and convert it into soil and more worms. While some carbon will be returned to the atmosphere through this process, a significant amount of it will remain locked up in the worms inhabiting the facility.

Finding ways to use wood, paper, and cars more effectively is the type of thinking we need to bring atmospheric CO2 back down to a reasonable level. We cannot rely on governments to implement solutions in a timely fashion, so it is up to us. We should be able to use cars, but while doing so we should be planting trees. We should also be seeking vehicles with smaller engines--or better yet, electric engines. It is fine to use paper and wood, so long as the forests are replaced with young CO2 hungry trees. And as long as we ensure that the CO2 is locked in to the wood and paper. We should not be burning it or letting it decompose.

**The future**

Talk about climate change is often bleak and negative. We are led to believe that climate change is inevitable and that the problem is so big that we can't do much to change it. On the contrary, I believe there is much we can do to curb climate change. In this article I have outlined the cause of global warming, while also providing some historical context to its discovery. I have suggested that people do not want to change their lives significantly because they view climate change as being too far in the future to worry about. With this in mind, I have offered some ways to modify the way we do things that will not have a negative impact on lifestyles. If we take seriously the issue of climate change, and begin to implement simple modifications to our behavior, we have a good chance of halting global warming. But we have to act fast. We are rapidly approaching the point of no return.

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