CHALLENGING CHANGE IN CLIMATE: CAUSE OF GREAT CONCERN

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ABSTRACT

Global warming is expected to have far-reaching, long-lasting and, in many cases, devastating consequences for planet Earth.For some years, global warming, the gradual heating of Earth's surface, oceans and atmosphere, was a topic of heated debate in the scientific community. Today, the overwhelming consensus of researchers is that global warming is real and is caused by human activity, primarily the burning of fossil fuels that pump carbon dioxide (CO_2), methane and other greenhouse gases into the atmosphere.

If climate change continues unchecked, these impacts are almost certain to get worse. From sea level rise to heat waves, from extreme weather to disease outbreaks, each unique challenge requires locally-suitable solutions to prepare for and respond to the impacts of global warming. Unfortunately, those who will be hit hardest and first by the impacts of a changing climate are likely to be the poor and vulnerable, especially those in the least developed countries. Developed countries must take a leadership role in providing financial and technical help for adaptation.

MEANING OF GLOBAL WARMING

Global Warming is the increase of Earth's average surface temperature due to effect of greenhouse gases, such as carbon dioxide emissions from burning fossil fuels or from deforestation, which trap heat that would otherwise escape from Earth. This is a type of greenhouse effect.

The *Oxford English Dictionary* defines climate change as a change in global or regional climate patterns, in particular a change apparent from the mid to late 20th century onward and attributed largely to the increased levels of atmospheric carbon dioxide produced by the use of fossil fuels. Other dictionary definitions are much more succinct and do not specify cause, direction, or time frame. It is not surprising that there is some disparity in the definitions. With controversial subjects, people often disagree on exactly what the words mean. For the purpose of this chapter, the phrase “climate change” will be used to mean long-term changes in climate (mainly temperature) without implying any cause for, or direction in, the change.

There is good evidence that global temperatures have been slowly climbing for the past four centuries and were slowly declining for many centuries prior to that. But are these temperature changes a serious threat to our way of life or are they just a part of normal variation to which we can readily adjust? Sadly, our lives are going to be affected whether

global warming is a real threat or not. Global warming has been blamed for almost every ill in our society.

In his State of the Union speech in 2013, President Obama said this:

It's true that no single event makes a trend. But the fact is, the 12 hottest years on record have all come in the last 15. Heat waves, droughts, wildfires, floods—all are now more frequent and more intense. We can choose to believe that Superstorm Sandy, and the most severe drought in decades, and the worst wildfires some states have ever seen were all just a freak coincidence. Or we can choose to believe in the overwhelming judgment of science—and act before it's too late.

Within this short quote, many of the common issues related to climate change are raised—recent events that are not necessarily indicative of a long-term trend, a claim that the "science" is settled, and a warning that we must act right now. The president followed these words by vowing that, if legislation were not forthcoming, he would do all he could by executive order.

These new policies will almost certainly raise the cost of energy. Higher energy costs will lower the standard of living for all, particularly the poorest among us. Is a disastrous change in the climate looming? Is man responsible? Let's begin our journey to answer those two questions by defining our terms.

Global warming is caused by human activity. Earth's climate is mostly influenced by the first 6 miles or so of the atmosphere which contains most of the matter making up the atmosphere. This is really a very thin layer if you think about it. In fact, if you were to view Earth from space, the principle part of the atmosphere would only be about as thick as the skin on an onion! Realizing this makes it more plausible to suppose that human beings can change the climate. A look at the amount of greenhouse gases we are spewing into the atmosphere (see below), makes it even more plausible.

What are the Greenhouse Gases?

The most significant greenhouse gas is actually *water vapor*, not something produced directly by humankind in significant amounts. However, even slight increases in atmospheric levels of carbon dioxide (CO_2) can cause a substantial increase in temperature.

Why is this? There are two reasons: First, although the concentrations of these gases are not nearly as large as that of oxygen and nitrogen (the main constituents of the atmosphere), neither oxygen or nitrogen are greenhouse gases. This is because neither has more than two atoms per molecule (i.e. their molecular forms are O_2 and N_2, respectively), and so they lack the *internal vibrational modes* that molecules with *more* than two atoms

have. Both water and CO_2, for example, have these "internal vibrational modes", and these vibrational modes can absorb and reradiate infrared radiation, which causes the greenhouse effect.

Secondly, CO_2 tends to remain in the atmosphere for a very long time (time scales in the hundreds of years). Water vapor, on the other hand, can easily condense or evaporate, depending on local conditions. Water vapor levels therefore tend to adjust quickly to the prevailing conditions, such that the energy flows from the Sun and re-radiation from the Earth achieve a balance. CO_2 tends to remain fairly constant and therefore behave as a *controlling* factor, rather than a *reacting* factor. More CO_2 means that the balance occurs at higher temperatures and water vapor levels.

Human beings have increased the CO_2 concentration in the atmosphere by about thirty percent, which is an extremely significant increase, even on inter-glacial timescales. It is believed that human beings are responsible for this because the increase is almost perfectly correlated with increases in fossil fuel combustion, and also due other evidence, such as changes in the ratios of different carbon isotopes in atmospheric CO_2 that are consistent with "anthropogenic" (human caused) emissions. The simple fact is, that under "business as usual" conditions, we'll soon reach carbon dioxide concentrations that haven't been seen on Earth in the last 50 million years.

Combustion of Fossil Fuels, for electricity generation, transportation, and heating, and also the manufacture of cement, all result in the total worldwide emission of about 22 billion tons of carbon dioxide to the atmosphere each year. About a third of this comes from electricity generation, and another third from transportation, and a third from all other sources.

This enormous input of CO_2 is causing the atmospheric levels of CO_2 to rise dramatically. The following graph shows the CO_2 levels over the past 160 thousand years (the upper curve, with units indicated on the right hand side of the graph). The current level, and projected increase over the next hundred years if we do not curb emissions, are also shown (the part of the curve which goes way up high, to the right of the current level, is the projected CO2 rise). The projected increase in CO_2 is very startling and disturbing. Changes in the Earth's average surface temperature are also shown (the lower curve, with units on the left). Note that it parallels the CO_2 level curve very well.

One of the biggest issues facing us right now is global warming. Its effects on animals and on agriculture are indeed frightening, and the effects on the human population are even scarier. The facts about global warming are often debated in politics and the media, but,

unfortunately, even if we disagree about the causes, global warming effects are real, global, and measurable. The causes are mainly from us, the human race, and the effects on us will be severe.

Global Warming Causes:

Carbon dioxide emissions from fossil fuel burning power plants Our ever increasing addiction to electricity from coal burning power plants releases enormous amounts of carbon dioxide into the atmosphere. 40% of U.S. CO2 emissions come from electricity production, and burning coal accounts for 93% of emissions from the electric utility industry. Every day, more electric gadgets flood the market, and without widespread alternative energy sources, we are highly dependent on burning coal for our personal and commercial electrical supply.

Methane emissions from animals, agriculture such as rice paddies, and from Arctic seabeds Methane is another extremely potent greenhouse gas, ranking right behind CO2. When organic matter is broken down by bacteria under oxygen-starved conditions (anaerobic decomposition) as in rice paddies, methane is produced. The process also takes place in the intestines of herbivorous animals, and with the increase in the amount of concentrated livestock production, the levels of methane released into the atmosphere is increasing. Another source of methane is methane clathrate, a compound containing large amounts of methane trapped in the crystal structure of ice. As methane escapes from the Arctic seabed, the rate of global warming will increase significantly.

Increase in usage of chemical fertilizers on croplands In the last half of the 20th century, the use of chemical fertilizers (as opposed to the historical use of animal manure) has risen dramatically. The high rate of application of nitrogen-rich fertilizers has effects on the heat storage of cropland (nitrogen oxides have 300 times more heat-trapping capacity per unit of volume than carbon dioxide) and the run-off of excess fertilizers creates ‘dead-zones’ in our oceans. In addition to these effects, high nitrate levels in groundwater due to over-fertilization are cause for concern for human health.

Global Warming Effects:

*** Deforestation, especially tropical forests for wood, pulp, and farmland**

The use of forests for fuel (both wood and for charcoal) is one cause of deforestation, but in the first world, our appetite for wood and paper products, our consumption of livestock grazed on former forest land, and the use of tropical forest lands for commodities like palm oil plantations contributes to the mass deforestation of our world. Forests remove and store

carbon dioxide from the atmosphere, and this deforestation releases large amounts of carbon, as well as reducing the amount of carbon capture on the planet.

*** Rise in sea levels worldwide**

Scientists predict an increase in sea levels worldwide due to the melting of two massive ice sheets in Antarctica and Greenland, especially on the East coast of the U.S. However, many nations around the world will experience the effects of rising sea levels, which could displace millions of people. One nation, the Maldives, is already looking for a new home, thanks to rising sea levels.

*** Widespread extinction of species**

According to research published in *Nature*, by 2050, rising temperatures could lead to the extinction of more than a million species. And because we can't exist without a diverse population of species on Earth, this is scary news for humans.

This 6th mass extinction is really just a continuation of the extinction which began at the end of the last ice age and has resulted in the extinction of nearly all of the Earth's mega fauna animals, largely as a result of human-expansion. *"Climate change now represents at least as great a threat to the number of species surviving on Earth as habitat-destruction and modification." Chris Thomas, conservation biologist at the University of Leeds*

Widespread species loss and lists of endangered species just keep growing. This is a concerning matter on many fronts.

Solutions to Global Warming

There is no single solution to global warming, which is primarily a problem of too much heat-trapping carbon dioxide (CO2), methane and nitrous oxide in the atmosphere. The technologies and approaches outlined below are all needed to bring down the emissions of these gases by at least 80 percent by mid-century. To see how they are best deployed in each region of the world, use the menu at left.

- **Boosting energy efficiency**: The energy used to power, heat, and cool our homes, businesses, and industries is the single largest contributor to global warming. Energy efficiency technologies allow us to use less energy to get the same—or higher—level of production, service, and comfort. This approach has vast potential to save both energy and money, and can be deployed quickly.
- **Greening transportation**: The transportation sector's emissions have increased at a faster rate than any other energy-using sector over the past decade. A variety of solutions are at hand, including improving efficiency (miles per gallon) in all modes

of transport, switching to low-carbon fuels, and reducing vehicle miles traveled through smart growth and more efficient mass transportation systems.

- **Reviving up renewables**: Renewable energy sources such as solar, wind, geothermal and bioenergy are available around the world. Multiple studies have shown that renewable energy has the technical potential to meet the vast majority of our energy needs. Renewable technologies can be deployed quickly, are increasingly cost-effective, and create jobs while reducing pollution.
- **Phasing out fossil fuel electricity**: Dramatically reducing our use of fossil fuels—especially carbon-intensive coal—is essential to tackle climate change. There are many ways to begin this process. Key action steps include: not building any new coal-burning power plants, initiating a phased shutdown of coal plants starting with the oldest and dirtiest, and capturing and storing carbon emissions from power plants. While it may sound like science fiction, the technology exists to store carbon emissions underground. The technology has not been deployed on a large scale or proven to be safe and permanent, but it has been demonstrated in other contexts such as oil and natural gas recovery. Demonstration projects to test the viability and costs of this technology for power plant emissions are worth pursuing.
- **Managing forests and agriculture**: Taken together, tropical deforestation and emissions from agriculture represent nearly 30 percent of the world's heat-trapping emissions. We can fight global warming by reducing emissions from deforestation and forest degradation and by making our food production practices more sustainable.
- **Exploring nuclear**: Because nuclear power results in few global warming emissions, an increased share of nuclear power in the energy mix could help reduce global warming—but nuclear technology poses serious threats to our security and, as the accident at the Fukushima Diaichi plant in Japan illustrates to our health and the environment as well. The question remains: can the safety, proliferation, waste disposal, and cost barriers of nuclear power be overcome?
- **Developing and deploying new low-carbon and zero-carbon technologies**: Research into and development of the next generation of low-carbon technologies will be critical to deep mid-century reductions in global emissions. Current research on battery technology, new materials for solar cells, harnessing energy from novel sources like bacteria and algae, and other innovative areas could provide important breakthroughs.

- **Ensuring sustainable development**: The countries of the world—from the most to the least developed—vary dramatically in their contributions to the problem of climate change and in their responsibilities and capacities to confront it. A successful global compact on climate change must include financial assistance from richer countries to poorer countries to help make the transition to low-carbon development pathways and to help adapt to the impacts of climate change.

The future of the humankind can get in danger if the emission of carbon- dioxide and other poisonous gases go on in the same manner. These gases deplete the ozone layer and allow the ultra-violet rays of the sun to enter the earth's environment. This causes the rise in temperature of the earth and giving rise to the phenomenon called global warming. Increased temperature can melt the ice of the Antarctica, and cause other environmental problems, thus jeopardizing the future of human kind.

Climate change is the greatest humanitarian crisis of our time, responsible for rising seas, raging storms, searing heat, ferocious fires, severe drought, and punishing floods. It threatens our health, communities, economy, and national security.

Worldwide, nations have begun taking steps to combat this growing threat, working toward an international agreement in which every country on earth plays its part. Many of the world's largest polluters have stepped up with significant commitments, amplified by efforts from cities, businesses, sports leagues, churches, and many other individuals and groups that have responded to the urgent need for climate action.

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