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GLOBAL WARMING A SERIOUS ISSUE AND RAPID INDUSTRILISATION

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ABSTRACT

The modern instrumental surface temperature record extends back in time over about one and a half centuries. Since 1850, the number of points at which temperature is observed has increased enormously although even today, there remain many places on Earth where temperature is not routinely observed and reported. Such data gaps do not pose a serious impediment for the reliable estimation of changes in global mean temperature, as has been demonstrated by both empirical and theoretical research. A greater potential concern is that temperature observations are often affected by non-climatic influences including changes in instrumentation, instrument exposure, and instrument location. A great deal of work has been done to remove or avoid those influences wherever possible. Urban heat islands affect some temperature measurements taken over land, but do not substantial affect trends in the global mean record. Estimates of global mean temperature from surface temperature compilations produced by several different research groups are similar, demonstrating robustness to the specific choices that are made in their development. The resulting global record has been studied extensively, and is considered to be reliable.

The record shows an overall warming combined with low- and high-frequency variability. That there is warming is indisputable and is supported by additional lines of evidence (such as cryosphere changes, ocean heat content increases, and sea level rise). Much variability results from internal processes in the climate system and natural external forcing, such as volcanic activity and solar output changes. However, these factors alone do not explain the observed temperature changes well; radiative forcing caused by increases in greenhouse gas concentrations and changes in aerosol loadings provides a more plausible explanation. Statistical comparisons between observed temperature changes and those simulated by climate models that take various external forcing agents into account, as well as analyses of other possible causes, led to the IPCC 2007 conclusion that "most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations".

Keywords- *Global warming, Industrilisation etc.*

I. INTRODUCTION

Many researchers, scientists, and environmentalists are expressing concerns about changes in the overall climate of the earth. Some believe that a dramatically dangerous warming is taking place in the overall global climate, a problem that is referred to as "global warming." This paper will attempt to explore this very issue.

Climate is defined as the analysis of accumulated weather data for long term patterns and trends. The Oxford Reference Dictionary defines *change* as, "To make or become different." *Climate change* is therefore defined as "long-term weather patterns and trends becoming different over an extended period of time." For example, if the average temperature in Kalamazoo, Michigan over the 20th century is significantly higher or lower than the average temperature in Kalamazoo, Michigan over the 19th century, this would be an example of climate change.


Changes in climate can result from both natural events and human activities. Examples of natural causes of climate change are volcanic eruptions, variations in the earth's orbit around the sun, and variations in solar output . Examples of human-induced causes of climate change include industrial pollutants and fossil fuels warming of average annual temperatures due to urbanization and changes in the earth's albedo due to deforestation of tropical rainforests . Climate

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change in the context of this paper refers to changes that result from human activities, especially as these changes relate to the issue of global warming. Of special importance is the "greenhouse gas" effect which is defined as, "The trapping of thermal emissions from the earth's surface by human-induced greenhouse gases" . If global warming is indeed happening, it is the greenhouse gas effect that is believed to be the most responsible.

There are some scientists who do not believe that there is enough evidence to support the idea of global warming. They assert that concerns about global warming have been blown well out of proportion by the media. At the same time, other scientists assert that there is sufficient evidence to suggest that industrial activities, automobile emissions, and technological pollutants may eventually result in dangerous (and even deadly) trends in the overall global climate. This paper will attempt to address this concern by analyzing some of the scientific studies that have been published in major meteorology journals.

Our atmosphere consists of many gases. Some of these gases, such as carbon dioxide and water vapor, naturally absorb long-wave radiation that is emitted from the earth's surface. Short-wave solar radiation enters the earth's atmosphere and is absorbed by the earth's surface. This radiation is then recycled and emitted as long wave terrestrial radiation. Gases such as water vapor and carbon dioxide absorb this radiation, hold it in the atmosphere, and keep the temperature of the earth warmer than it would otherwise be if there wasn't an atmosphere. This is what meteorologists refer to as the "natural greenhouse effect".

Problems could potentially arise, however, when human activities add additional trace gases into the atmosphere that also absorb out-going long-wave radiation. These additional trace gases include methane, chlorofloro carbons, nitrous oxide, aerosols, ozone, and carbon dioxide. The result is an increase in the amount of long-wave radiation that is being trapped by the atmosphere. It is believed that this could eventually increase the average overall global temperature.

Carbon dioxide "...is considered the trace gas of greatest importance because of the substantial increase in its atmospheric concentration as well as its probable continued rise due to global consumption of fossil fuels" . It is clear from looking at the evidence that carbon dioxide concentrations are increasing dramatically in the atmosphere. Observations of carbon dioxide concentrations are available for several locations. Over the period of 1973 to 1982, the atmospheric concentrations of carbon dioxide in Barrow, Alaska rose steadily from 332.6 parts per million (ppm) to 342.8 parts per million.

This is not isolated to Barrow, Alaska. Records from other locations, such as Mauna Loa in Hawaii, are confirming that carbon dioxide concentrations are increasing in the atmosphere at a dramatic rate. Continuous instrument records for atmospheric carbon dioxide concentrations date back to the 1950's at the Mauna Loa observatory . In 1958, the average atmospheric concentration of carbon dioxide was only 316 parts per million (ppm). Preindustrial carbon dioxide concentrations are believed to be 279 parts per millio), and the atmospheric carbon dioxide concentration in 1990 was 353 parts per million . However, as one author points out, the fact that we are dealing with significant changes in carbon dioxide does not automatically mean that we are looking at a serious problem This author points out that carbon dioxide is a " ...minor atmospheric constituent and as such, its variations might not be notably important." He goes on to say that there are a number of things that increasing levels of carbon dioxide could effect and influence, including in ways that are beneficial. For example, " ...at altitudes of 25 km to 90 km, the atmosphere is cooled primarily by thermal radiation emitted to space by carbon dioxide. Increasing carbon dioxide should cool these regions, and this, in turn, should lead to increasing concentrations of ozone at these levels. Increasing carbon dioxide might also stimulate the growth of vegetation...".

While there are indeed some possible benefits to increased atmospheric carbon dioxide concentrations, "...the main concerns have focused on the possibility that increasing carbon dioxide might significantly warm our climate" . One author wrote that there is "...general agreement that increasing carbon dioxide will produce warming due to its ability to absorb in the infrared radiation"
There are studies that have indicated that no significant change in the overall global climate has yet taken place. For example, a study that was done by P. W. Spencer and J. R. Christy, using temperature records from the period of 1979 through 1990, showed a global trend of only +0.04 degrees Celsius per decade . Other studies showed that the Northern Hemisphere has had no significant warming, while the Southern Hemisphere has had a slight temperature increase in the order of 0.2 degrees Celsius since the 1950's . Patrick J. Michaels speculates that the reason that we have not seen a significant increase in temperatures in the Northern Hemisphere is because of the balancing effect of anthropogenerated sulfates going into the atmosphere as a result of industrial pollution. Anthropogenerated sulfates have a cooling effect on the atmosphere because of their ability to reflect incoming solar radiation back to space. Michaels explains this in more detail when he writes, "Because anthropogenerated sulfates are primarily produced and reside in the Northern

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Hemisphere, we may therefore be equaling the current enhanced greenhouse forcing ... with actual negative forcing in the hemisphere that contains most of the world's population".

This lead to the obvious question of whether or not the lack of a significant increase in global temperature should be taken as evidence that we should not be concerned about the issue. William W. Kellog of the National Center for Atmospheric Research in Boulder, Colorado has written an article called "Response to Skeptics of Global Warming" in which he responds to many of the objections that have been raised against global warming. Kellog points out that "...five or so of the most advanced climate models, developed over a period of many years by top notch teams, have all come to essentially the same conclusion: The global average surface temperature would probably rise by about 2 to 5 K if the greenhouse gas concentration were maintained at double the pre-industrial revolution level" . Kellog suggests that the reason that we have not seen a change as of yet in the overall warming is because of a temperature lag of several decades "...due in large part to the large heat capacity of the oceans of the world" . He asserts that the evidence is still in favor of the fact that, sooner or later, a serious warming of the climate will occur.

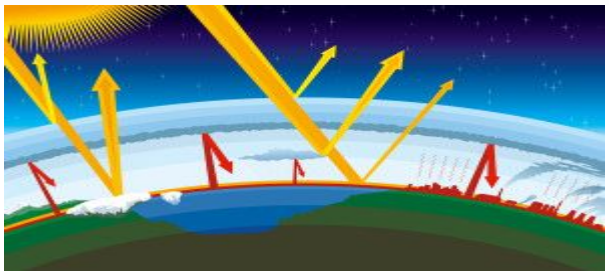
II. CAUSES OF GLOBAL WARMING

Green house gases

The Earth maintains a habitable temperature due to the Greenhouse Effect, which allows heat from the sun to penetrate our atmosphere, where it is absorbed by the Earth's surface or radiated out and reflected back to Earth by greenhouse gases in the atmosphere. Without it, the Earth would be a cold and hostile planet, and would most likely be uninhabitable.

However, maintaining the natural balance necessary to keep the Earth's temperature within a range that is viable for life as we know it is a very fine line that can easily be crossed.

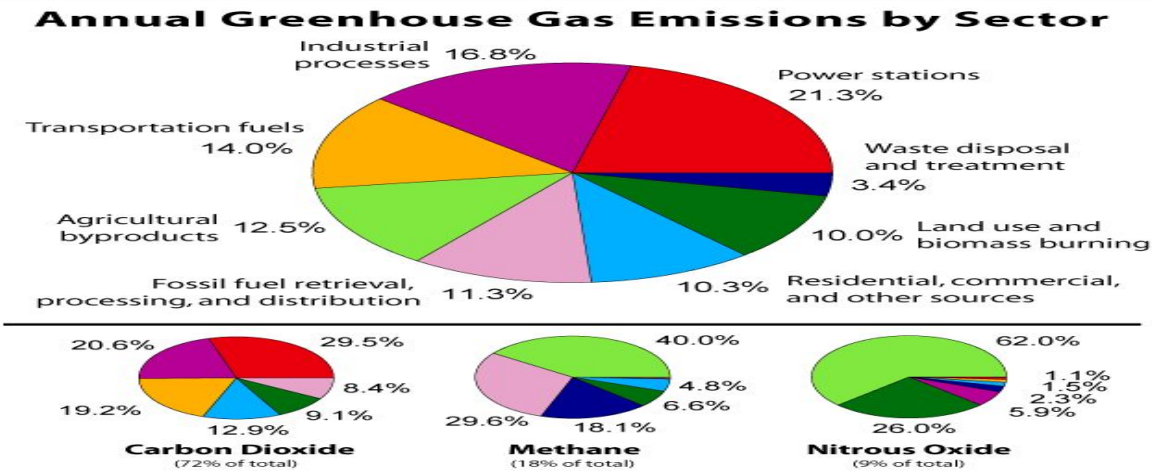
Greenhouse gases are **naturally occurring gases** that pose no harm when they are in balance. However, **when they are present in excess**, the system becomes unbalanced and things start to go awry.



Learn more about the Greenhouse Effect

The most important greenhouse gases are **carbon dioxide, methane, nitrous oxide and water vapor**. While all these gases occur naturally in the atmosphere, emissions from human sources has caused their levels to rise to a point that is no longer sustainable.

Lets take a look at the major human causes of global warming.



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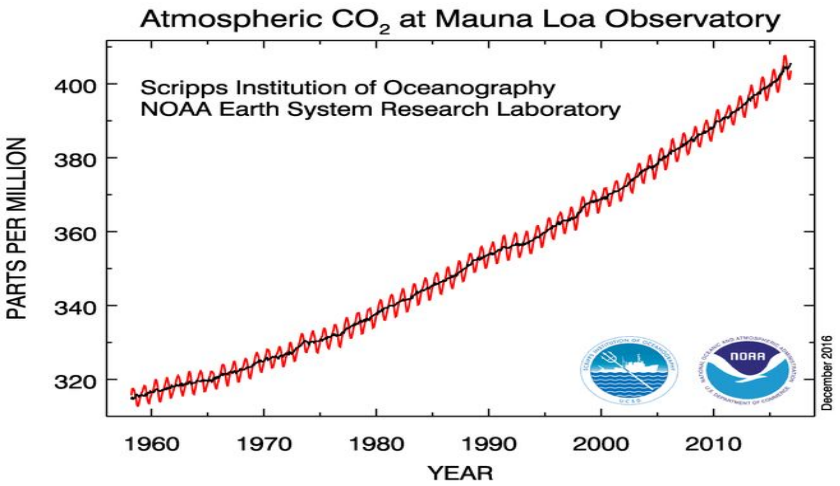
1) Carbon Dioxide

Atmospheric carbon dioxide concentrations have risen by more than 40% since scientists first started recording these levels, from 280 parts per million (ppm) in 1958 to over 400ppm today.

According to NOAA[2], over the past 800,000 years, atmospheric carbon dioxide concentrations have fluctuated between 180 ppm during ice ages to 280 ppm during warm interglacial periods.



Click here for more data on Carbon Dioxide increase

Atmospheric carbon dioxide concentrations are not only higher than they have been in over 800,000 years, the current increase that we are seeing today is more than 100 times faster than that experienced at the end of the last ice age. This is largely due to human activities; primarily the burning of fossil fuels, but also due to deforestation as a result of logging for timber and clearing for agriculture and development.

a) Human sources of carbon dioxide

Human sources of carbon dioxide include:

1) Burning Fossil Fuels: burning coal to generate electricity, burning oil to power vehicles and aircraft (vehicle emissions), or burning wood in fires used for cooking or to provide heat, etc. changes the state of stored organic carbon from a liquid (e.g. oil) or solid (e.g. coal/wood) into a gas (carbon dioxide) which is released into the atmosphere.

2) Deforestation: vegetation absorbs carbon dioxide from the atmosphere during the process of photosynthesis, converting this to carbon which is stored within all plants (i.e it is a carbon sink). When vegetation is burned, this organic carbon is released into the atmosphere in the form of carbon dioxide, and in so doing becomes a carbon source rather than a carbon sink.

2) Methane

Although methane has a shorter lifespan, and consequently, is not as abundant in the atmosphere as carbon dioxide, in terms of it effect as a greenhouse gas, it is much more potent. Methane is produced when organic matter breaks down and also when ruminants digest their food.

a) Human sources of methane

Human sources of methane include:

- Decomposing organic matter: landfills, animal waste, sewerage and dams are all human sources of methane. For example, organic matter is trapped behind dam walls where it sinks to the bottom of the dam and decomposes.

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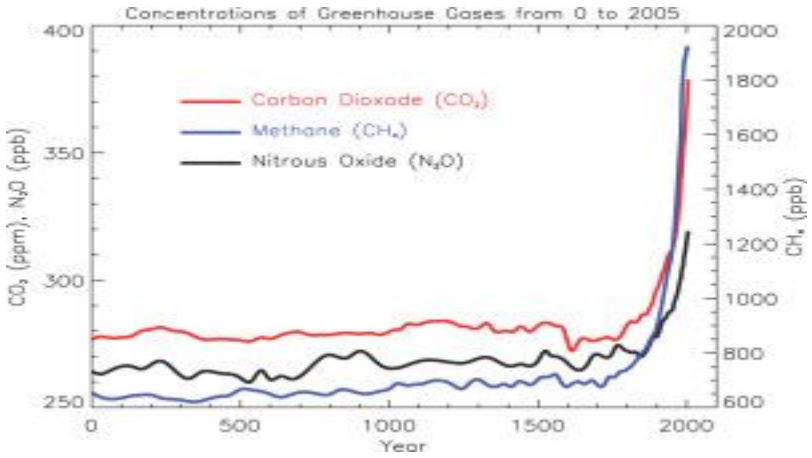
Bacteria produce methane in the decomposition process, which slowly escapes to the surface and is released into the atmosphere. Landfill gas operations and biodigesters provide a method of mitigation, and not only harness methane that would otherwise be released into the atmosphere, but also provide an alternative source of fuel.

- Natural gas extraction: methane escapes during oil and gas extraction (e.g. fracking) operations and is released into the atmosphere.



Atmospheric Greenhouse Gases Level (Source: IPCC, 2007)

3) Nitrous oxide

Nitrous oxide is a potent greenhouse gas that is released primarily by fertilizers used in agriculture and landscaping, but also during the burning of fossil fuels and other organic matter. Atmospheric nitrous oxide levels have risen by roughly 18% since the Industrial Revolution, spiking rapidly towards the end of the 1900's.

4) Water vapour

Water is essential for life, and as it is constantly cycling from one state to another, it is not surprising that it is the most abundant of all the greenhouse gases. However, water vapor not only acts as a greenhouse gas, it also increases as the atmosphere gets warmer and provides climate feedbacks. While humans do not play a large direct role in producing water vapor, other human emissions promote atmospheric warming, which in turn promote evaporation that results in more water vapor in the atmosphere.

5) Chlorofluorocarbons

Chlorofluorocarbons (CFCs) are long-lasting greenhouse gases that also destroy the ozone layer. CFCs do not occur naturally in the atmosphere – they are synthetic compounds that only originate from human sources, including: aerosols, foaming agents, refrigerants, and other industrial applications.

III. EFFECTS

Rising Sea Levels

Climage change impacts rising sea levels. Average sea level around the world rose about 8 inches (20 cm) in the past 100 years; climate scientists expect it to rise more and more rapidly in the next 100 years as part of climate change impacts.

Coastal cities such as New York are already seeing an increased number of flooding events and by 2050 many such cities may require seawalls to survive. Estimates vary, but conservatively sea levels are expected to rise 1 to 4 feet (30 to 100 cm), enough to flood many small Pacific island states (Vanatu), famous beach resorts (Hilton Head) and coastal cities (Bangkok, Boston).

If the Greenland ice cap and/or the Antarctic ice shelf collapses, sea levels could rise by as much as 20 ft (6 m), inundating, for example, large parts of Florida, the Gulf Coast, New Orleans and Houston.

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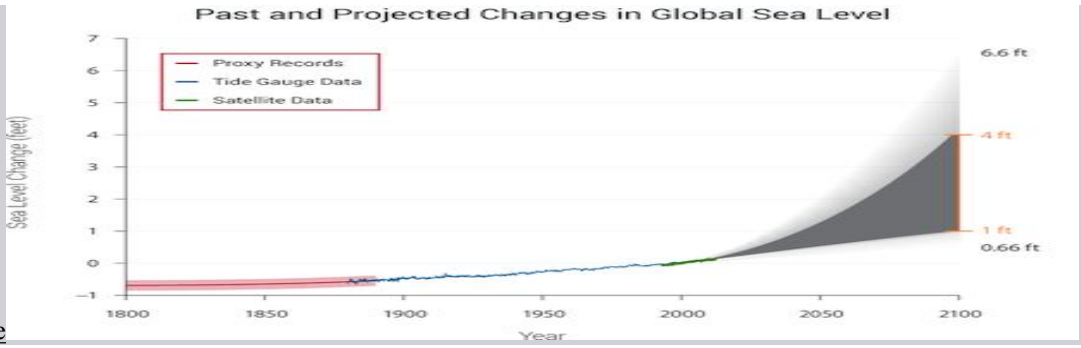
(Source: National Climate Assessment)



Melting Ice

Projections suggest climate change impacts within the next 100 years, if not sooner, the world's glaciers will have disappeared, as will the Polar ice cap, and the huge Antarctic ice shelf, Greenland may be green again, and snow will have become a rare phenomenon at what are now the world's most popular ski resorts.

(Source: National Climate Assessment)

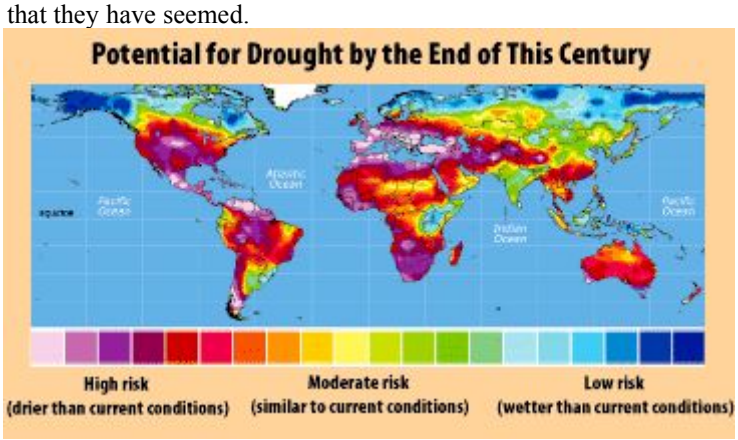
Heatwaves and droughts

Despite downpours in some places, droughts and prolonged heatwaves will become common.

Rising temperatures are hardly surprising, although they do not mean that some parts of the world will not "enjoy" record cold temperatures and terrible winter storms. (Heating disturbs the entire global weather system and can shift cold upper air currents as well as hot dry ones. Single snowballs and snowstorms do not make climate change refutations.)

Increasingly, however, hot, dry places will get hotter and drier, and places that were once temperate and had regular rainfall will become much hotter and much drier.

The string of record high temperature years and the record number of global droughts of the past decade will become the norm, not the surprise that they have seemed.



(Source: EPA adopted from Dai, Drought Under Global Warming)

Changing ecosystems

As the world warms, entire ecosystems will move.

Already rising temperatures at the equator have pushed such staple crops as rice north into once cooler areas, many fish species have migrated long distances to stay in waters that are the proper temperature for the

Changing fisheries
(Source: NOAA Fisheries)

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Farmers in temperate zones are finding drier conditions difficult for crops such as corn and wheat, and once prime growing zones are now threatened.

Some areas may see complete ecological change.

In California and on the East Coast, for example, climate change impacts and warming will soon fundamentally change the forests; in Europe, hundreds of plants species will disappear and hundreds more will move thousands of miles.

European Environment Agency)

Reduced food security

One of the most striking impacts of rising temperatures is felt in global agriculture, although these impacts are felt very differently in the largely temperate developed world and in the more tropical developing world.
Different crops grow best at quite specific temperatures and when those temperatures change, their productivity changes significantly.

mptioIn North America, for example, rising temperatures may reduce corn and wheat productivity in the US mid-west, but expand production and productivity north of the border in Canada.

The productivity of rice, the staple food of more than one third of the world's population, declines 10% with every 1 C increase in temperature.

Past climate induced problems have been offset by major advances in rice technology and ever larger applications of fertilizer; expectations are that in Thailand, the world's largest exporter of rice, however, future increases in temperatures may reduce production 25% by 2050.

At the same time, global population models suggest that developing world will add 3 billion people by 2050 and that developing world food producers must double staple food crop production by then simply to maintain current levels of food consun.

(Source: Slideshare)

Pests and Disease

Rising temperatures favor agricultural pests, diseases and disease vectors.

Pest populations are on the rise and illnesses once found only in limited, tropical areas are now becoming endemic in much wider zones.
In Southeast Asia, for example, where malaria had been reduced to a wet season only disease in most areas, it is again endemic almost everywhere year around.

Likewise, dengue fever, once largely confined to tropical areas, has become endemic to the entire region.

Increased temperatures also increase the reproduction rates of microbes and insects, speeding up the rate at which they develop resistance to control measures and drugs (a problem already observed with malaria in Southeast Asia).

IV. CONCLUSION

Although individual events or phenomena may not always be easy to link to global warming, the increase in frequency and intensity of such phenomena, and their simultaneous occurrence around the world, provides stronger evidence for such a linkage

• Many of the recently observed events have been the worst or unprecedented in 100, 500, 1,000 years or more. This suggests that something highly unusual is happening to our planet.

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Many of the impacts we have seen so far are likely just "the tip of the iceberg"—scientists predict more dramatic, severe and, in some cases, irreversible impacts if we allow warming to continue unabated in the future

• Other effects of human activity, such as the spread of homes and infrastructure into vulnerable locations, sinking of coastal land, and degradation of wildlife habitat, can compound the damage caused by global warming

The facts gathered in this report present society with a choice: We can make no serious effort to combat global warming, and instead try to cope with its increasingly devastating impacts on our livelihoods and the natural world we cherish. Or we can act now to stabilize the climate and mitigate future damages. Progress in combating global warming has already been made at the international, state, and local levels. But national action by the U.S.—the world's most powerful and technologically advanced nation and its biggest emitter of greenhouse gas pollution—is urgently needed as well. National legislation that sets a mandatory cap on emissions, as well as a renewed engagement by the U.S. with the international community, would be transformative steps towards solving the problem of global warming

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