GLOBAL WARMING, GLOBAL DISRUPTION

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Presented at Tulsa, Oklahoma
Sponsored by Oklahoma Academy of Sciences (http://oas.uco.edu)
Sponsored by Oklahomans for Excellence in Science Education (www.oklascience.org)
May 17, 2012
*Not sponsored by Southeastern Oklahoma State University

Introduction

[Slide 2] Global warming (which will cause global climate change) is not the end of the world. We won't have thousands of people falling over dead from the heat or running away from great walls of water pouring in from the ocean like Godzilla. It will not be like the movie *The Day after Tomorrow.* But it does not have to be.

[Slide 3] Our national and world economy is precariously based on the assumption that climatic conditions will remain the same in the future as they have been in the past. Global warming is going to negate that assumption. Even a little bit of climate change can cause disruption to our economy and to the natural world.

[Slide 4] Global warming is not the only process that threatens to disrupt our economy in the future. Population growth is also a threat. For example, the rapid population growth in the American southwest is already putting strain on water supplies. Global climate change may reduce snowpack in the Rockies and Sierra Nevada and encourage the spread of deserts. The intersection of rapid population growth and global-climate-change-induced water shortages may prove disastrous for the American economy. A similar situation is developing in the Himalayas, Andes, and Africa.

[Slide 5] We cannot ignore the effects of global climate change on the natural world. There are both environmentalists and anti-environmentalists who depict global warming as being a disaster for polar bears. But as environmentalist and businessman Paul Gilding indicates, the polar bears can take care of themselves. Nature can take care of itself. We need to worry about ourselves.

[Slide 6] The more important point is that human civilization depends upon ecosystem

services. Ecosystem services are all of the things that the natural world (especially trees and other plants) do for us, for free. Of course, they aren't really doing it for us. Trees are just trying to make a living by removing carbon dioxide from the air and by putting roots down into the soil. But, as it happens, those processes are greatly beneficial to us. Ecosystem services include oxygen production, carbon dioxide removal, soil-building, biodiversity (which benefits medical research), and pest control (wild birds and bats eat pests), and many other things. How could anyone put a dollar figure on ecosystem services? But economist Robert Costanza and colleagues tried to do just that. The number they came up with: $33 trillion a year. And that was in 1997 dollars. To my knowledge, nobody has attempted a revised estimate. You could think of it as the amount of money we would have to spend to compensate for those services if they were lost. If you cut down a forest, you may profit from the lumber or from development of the land, but you have lost the water regulation, carbon storage, and oxygen production that the forest was previously providing for free. Global climate change will damage natural ecosystems and reduce their ability to provide these free services for us—especially since we are chopping down trees and paving over prairies at the very same time that we need their help in preventing global climate change.

[Slide 7] I would like to begin by identifying my connection to the topic. When I was in graduate school, my advisor studied the effects of atmospheric carbon dioxide enrichment on plant growth and was one of the first scientists to consider the possibility that carbon dioxide enrichment would affect different species in different ways (for example, flowers and pollinators). Later he explored the idea that global warming would greatly enhance the natural production of allergens. Since that time, I have written about global warming in two of my books, *Green Planet* and *Encyclopedia of Biodiversity*. My *Encyclopedia of Global Warming* was under contract but the New York publisher has stopped publishing books and the project is in limbo. Some of my current research involves the study of spring budburst times in deciduous trees as an indicator of biological response to climate change.

[Slide 8] I would also like to identify my biases. We all have biases, and we should get them out in the open. I am a botanist. So I love trees. You might think that this makes me side with extreme environmentalism, with declaring global warming to be the end of the world. But this is actually not the case. My bias would be to agree with the organization represented by the denialist website www.co2science.org. They say, don't worry about carbon dioxide; plants absorb it from the air and make food out of it; and the more carbon dioxide there is in the air, the more the plants will grow. As a botanist who studied photosynthesis in graduate school, as the author of *Green Planet: How Plants Keep the*

Earth Alive, this viewpoint appeals to me greatly. *Hooray! Plants will save the world!* It is with a heavy heart that I report to you that this viewpoint is wrong. (1) Carbon dioxide levels are increasing in the atmosphere every year, and have been doing so for decades at least; plants have not prevented this. Furthermore, in order for plants to cleanse the air of carbon dioxide, they need good soil and plenty of water. If drought accompanies warming, plants can't cleanse the air of carbon. (2) Field experiments have shown that higher levels of carbon dioxide in the air sometimes causes greater plant growth, and sometimes does not; and it may stimulate plant growth only temporarily. The slogan of www.co2science.org is, "CO_2—We call it life!" Well, so do I. Without the help of plants, carbon dioxide levels would be rising a lot faster—but it is still rising.

[Slide 9] I would also like to identify my bias regarding the type of solution we should pursue. I have a strong preference for what are sometimes called "no regrets" solutions. These are solutions—such as energy efficiency—that we would benefit from doing anyway, even if they did not help to reduce carbon emissions. Back about 1978 I used to drive a car that got 14 miles a gallon. It wasn't big, or sexy, but just inefficient. I produced a lot of emissions. I drive a Toyota now, which has almost three times the fuel efficiency. Reduced emissions are not the only reason I prefer the car I now drive. No regrets. National fuel efficiency standards are not something that we increased *solely* to reduce carbon emissions or global warming. We also did it to reduce dependence on Middle East oil, for example. Just in case we are wrong—that global warming turns out to be maybe worse than we thought, or not as bad as we thought—we should, I think, choose solutions that are good to do anyway.

[Slide 10] Humans have biases. I have them. So do the thousands of petroleum engineers who have signed petitions saying that they do not believe global warming is happening. At least in my case my job would be unaffected by whichever opinion I had. As a competent professor of biology, I could emphasize in my teaching the role that plants have in cleaning the air of carbon dioxide. I could join with the co2science.org folks. But can a petroleum engineer really have no bias whatsoever in favor of burning petroleum? I was born in Cushing, Oklahoma. If I still lived there, I suspect I would be all excited about the southern portion of the Keystone Pipeline. I'm happy that our state, including the state university system, benefits from tax revenues made possible by natural gas. You see, I have biases both ways. I think it is unfair to paint anyone who talks about global warming as being an environmental extremist. I wrote a letter to Senator Tom Coburn once, and his response (or the response of his staff) was, in effect, why do you hate oil so much? Look at all the wonderful things oil has done. Well, of course, I had never said that I hated oil. That was

not a conversation that I chose to continue.

Global warming: Too much of a good thing

Global warming can be caused either by increased sunlight intensity or by the buildup of greenhouse gases.

(1) [Slide 11] Sunlight intensity can increase either when more light comes from the sun, as sometimes happens, or when sunlight hits the Earth more directly. About every 100,000 years, the movement of the Earth relative to the Sun causes the sunlight to strike the Northern Hemisphere (where most of the land is) at a lower angle. The Northern Hemisphere cools, and ice builds up. During the last two million years there have been about twenty ice ages as a result. Ice ages alternate with interglacial periods in which sunlight strikes the Earth more vertically and warms it back up. This is known as the Milanković cycles and they caused the ice ages. Ice ages did not occur before two million years ago because there was a strong tropical current—the powerful ancestor of the modern Gulf Stream—that kept the Arctic Ocean warm. Back in dinosaur days there was no Arctic Ocean, and ocean currents kept the Earth mild. Dinosaurs, and the trees that they ate, lived almost up to the North Pole.

[Slide 12] Calculations performed by climate scientists (using powerful computers) indicate that modern global warming is partly due to an increase in sunlight intensity—but sunlight accounts for only about 8 percent of modern global warming. The best place to find scientific information about global warming is the Intergovernmental Panel on Climate Change (IPCC) (www.ipcc.ch). This panel publishes consensus documents approved by scientists and government representatives from countries all over the world, including America.

(2) [Slide 13] Greenhouse gases, principally carbon dioxide, are invisible, which means that visible light from the Sun can pass right through them. However, carbon

> dioxide absorbs infra-red light, which is an invisible type of light that you can feel (as heat) but not see. Visible light passes right through the atmosphere and warms up the Earth. Some of this warmth radiates outward in the form of infra-red light. Carbon dioxide absorbs some of this infra-red light on its way out into outer space. This warms up the carbon dioxide, which warms up the atmosphere, which warms up the Earth. In this way, carbon dioxide is sort of like a sweater; it does not produce heat, but holds it in. Also like a sweater, there is a lag time effect. The sweater does not make you warm right away. Similarly, an increase in carbon dioxide does not make the Earth become warmer right away.

Carbon dioxide is not the only greenhouse gas. But the reason we talk about carbon dioxide so much is for three reasons. First, it is the most abundant conventional greenhouse gas. Second, another important greenhouse gas, methane, reacts with oxygen and turns into carbon dioxide within about ten years. (The problem is that, meanwhile, methane is a much more potent greenhouse gas than carbon dioxide.) Third, water vapor is also a greenhouse gas; in fact, it holds in more heat than does carbon dioxide. But water vapor does not accumulate in the air the way carbon dioxide does. It keeps condensing and falling as rain and snow.

[Slide 14] Global warming, like alcohol, is a good thing in moderation. The atmosphere contains about 400 parts per million (ppm) carbon dioxide. Before the modern industrial period, it contained about 300 ppm. This doesn't sound like much, but it is enough to keep the Earth warm enough for life. Without carbon dioxide, the Earth would be more like Mars. The problem is that we are getting too much of a good thing for our economy to tolerate. If the Earth were very warm, and we all lived in the Garden of Eden, eating fruits hanging from trees, there would be no problem. The Earth was downright hot back in the dinosaur days, and they loved it. But we do not live in the Garden of Eden. We have to grow enough food to feed billions of people, and the weather has to be just right for us to do that.

How We Know Global Warming Is Occurring

[Slide 15] Weather is not climate. You can't just stick your head out the window and determine what is happening with the climate. Some people don't realize that. Whenever it snows in Washington D.C. the family of Senator Jim Inhofe builds snowmen to prove that there is no global warming. Well, right at that moment and right at that place the weather was not warm. In case you haven't noticed, winter is colder than summer. Global warming

does not mean that there will be no winter. Inhofe recently quoted Genesis 8 to "prove" that God promised that summer and winter would always occur. But this passage—just read it yourself—does not say the climate cannot get a little bit warmer, just enough to cause trouble. Inhofe played fast and loose with the Bible right then, and I think religious people should be a little bothered by that. Of course, it is equally wrong to say, "It's hot outside this summer—must be global warming!"

We have both short-range and long-range ways to know global warming is occurring.

(1) [Slide 16] Short-range. Direct measurements with thermometers indicate that the Earth has been warming up since the late nineteenth century. Of course, there were thermometers before then; Thomas Jefferson had one at the Continental Congress in 1776. But the thermometers were mostly in the cities of Europe and North America. You cannot generalize about the whole Earth from those few thermometers. But starting about 1856 both the American and British navies began keeping temperature records from all over the world (almost). The average of these global temperature readings indicates that global temperature has increased. Global temperature goes up and down and up and down, but it has gone up more than it has gone down. Sometimes it seems to level off, while at other times it increases rapidly.

The data are very clear. The hottest years on record, in terms of global temperature, are, in descending order, 2010, 2005, 1998, 2003, and 2006. Notice that 2010 was the year when Moscow had weeks of 100+ degree weather. In Oklahoma, it was 2011, but for most of the world 2011 was not as hot as 2010.

[Slide 17] Some anti-global-warming sites present graphs to show that no global warming is occurring. They like to choose short time periods during which global temperatures have leveled off, and ignore the longer time periods when they have increased.

(2) [Slide 18] Long-range. The best long-range temperature indicator is the record from the ice cores. For about a half million years, snow has piled up and become ice in Greenland and Antarctica. Scientists drill great distances down into the ice in these two places, and pull up cores of ice. In these cores you can see the layers of ice, each of which represents one year's worth of snow. You can count down from the top and know exactly how old the layer of ice is. There are two things you can learn

from each layer of ice. First, by analyzing the oxygen isotope ratio, you can estimate global temperature. Second, there are bubbles of air trapped in the layers. These are actual air samples from hundreds of thousands of years ago. You can actually measure how much carbon dioxide these bubbles contain.

[Slide 19] Since about 1957, scientists have been measuring atmospheric carbon dioxide levels out in the middle of the Pacific Ocean. Every year, there is more carbon dioxide than the previous year. Every year. It has increased from about 315 to about 390 ppm. Given the potency of carbon dioxide for holding in heat, this is a major increase.

[Slide 20] Intermediate-range estimates are possible also, using such information sources as tree rings and sediment layers. The most famous intermediate-range global temperature reconstruction was made by Michael Mann, and has been called the "hockey-stick" graph. This graph has been more than a little controversial. The National Academy of Sciences has validated it. However, we cannot be absolutely sure when modern global warming began. Most climatologists say it began with the Industrial Revolution, in which lots of machines have spewed out lots of carbon dioxide. But scientists such as William Ruddiman say it began back when humans first began to farm—in other words, thousands of years before the upswing of Mann's hockey stick. Farmlands and terraces release a lot of carbon into the atmosphere. Because of these uncertainties, I prefer to focus on the short- and long-range temperature reconstructions.

[Slide 21] First, over the last 400,000 years, there have been four ice ages. Right now, global temperatures are as warm as they have ever been during any previous interglacial period. If Michael Mann is right, even warmer. Second, global temperature and atmospheric carbon dioxide are pretty precisely correlated: it is hot when the air has more carbon dioxide in it. Third, the current levels of carbon dioxide far exceed the carbon dioxide levels of any time in the last half million years. What this may mean is that we have yet to see most of the global warming that all of that extra carbon dioxide will cause. The Earth has just put its sweater on during the last century—watch out!

Now, you may have noticed something else. A half million years ago, even a few thousand years ago, there were no farms or factories or cars. So what accounts for the correlation of carbon dioxide and temperature? Who's in charge—does carbon dioxide cause global warming, or does global warming cause carbon dioxide?

I put this question to Maureen Raymo, a climatologist who spoke at the AAAS meeting

here in Tulsa in 2009. And she said each one caused the other. It works both ways. Carbon dioxide holds in the heat, but the heat then enhances carbon dioxide production, mainly through the decomposition of dead stuff in the soil.

This helps to explain a long-standing mystery about the ice ages. The change in sunlight intensity caused by the movement of the Earth relative to the Sun is very slight—how could such a slight change cause the huge temperature changes of the ice ages? Well, what happened was that a slight increase in sunlight warmed the Earth just enough that vegetation started rotting faster, the carbon dioxide from which enhanced global warming. That's what happened 20,000 years ago. Today, it appears to be carbon dioxide from human activity that is enhancing global warming, twenty times as much as sunlight is.

[Slide 22] One of the aspects of global disruption is the disruption of temperature patterns. Global warming does not mean that the climate will get steadily warmer. We are experiencing erratic swings of weather.

[Slide 23] And this brings us to one of the biggest dangers of global warming. Global warming makes itself worse through what are called positive feedback loops. The above example is one of them. Global warming causes more decomposition which causes more greenhouse gases which cause more global warming. This is especially calamitous in the arctic, where there are thick layers of tundra ooze that are, at this moment, decomposing and releasing methane into the air. Some Siberian lakes no longer freeze in the winter because of methane bubbling up from decomposition.

[Slide 24] Another example is the role of arctic ice. Ice reflects visible light back into outer space. This light never gets a chance to warm the Earth. Ice cools the Earth not just because it is ice but because it is white. As a matter of fact, there were three periods of time in Earth history when the ice spread across the globe so much that it very nearly turned Earth into an ice planet. Scientists call these periods Snowball Earth. The most recent one ended just 600 million years ago. Earth was mighty lucky to emerge from those periods. Ice reflects light which makes the Earth cooler which allows more ice to form which reflects more light and so on. On the other hand, as ice melts, the dark ocean water absorbs more light and becomes warmer, making more ice melt, which allows the ocean to absorb more light, and so on.

With global climate change, we are not dealing with direct linear processes that are easily predictable. We are working with positive feedback loops that can catch us by surprise.

There are negative feedback loops also. I mentioned one a while back: more carbon dioxide means more plant growth, which reduces, not increases, the carbon dioxide. Unfortunately, it is the helpful negative loops that we are interfering with and the harmful positive loops that we are exacerbating.

What is already happening?

[Slide 25] There are some things that are already happening. Global temperatures are already increasing. Ocean levels are already rising—not much, but enough that GPS satellites can measure it. Rainfall is already heavier in coastal areas, and droughts are already more common in continental interiors. Warm winters are already allowing insect pests to spread and kill millions of conifers in western North America. This is not speculation. It is news.

[Slide 26] Not all of this is bad, but most of it is. The melting of arctic ice means that ships can sail through the Arctic Ocean for the first time in human history. They are already doing this. For them, it is good. But insurance companies are worried, as are the re-insurers that insure them. They are already losing money to storm damage. And the U. S. military is already worried about the possibility of international conflict. If the ocean covers large parts of Bangladesh, where will those people go? Many of them will try to go into India. India doesn't want them, and is building a wall to keep them out. The U. S. military thinks it has to be involved in every international conflict, so a Bangladesh-India conflict over environmental refugees would involve us too. For this reason, I suspect that those national leaders who deny the reality of global warming and climate change are impairing our nation's military preparedness to respond to these conflicts.

So you think global warming isn't happening? Just ask the shipping companies who are investing in a golden opportunity in the Arctic, ask the insurance companies, ask the government of India, ask the U. S. military. The U. S. military is not primarily an environmentalist organization.

Adaptation

It is too late for us to totally prevent global warming, which has already started. So we will have to adapt our way of life to it.

[Slide 27] Consider, for example, rising ocean levels. We could adapt by either building

dikes to keep out the ocean, or moving our seacoast cities inland. Will we build sea walls around Boston, New York, Washington, Miami, San Francisco, and Seattle? Or will we relocate the people and businesses and agencies located there? We'd better start making plans. Whatever we do will cost a lot of money.

[Slide 28] Consider the effects of heat and drought on agriculture. We could adapt by breeding new kinds of plants that can tolerate those conditions. Plant breeders have already started producing drought- and heat-resistant crop varieties, which may allow our agriculture to adapt to climate change. Despite this, it doesn't look good for American agriculture. Canada might come out better, so long as it doesn't get drier at the same time it gets warmer. The American southwest is already promoting desert gardens in place of green lawns to adapt to water shortage.

No-regrets Solutions: Good Ideas

[Slide 29] There is nothing we can do to prevent global warming, but we can prevent it from being as bad as it might otherwise be. How can we do this? As I said back at the beginning, we should seek no-regrets solutions. We can in fact reduce our carbon emissions in ways that will make our lives better. I already mentioned that fuel efficient cars are actually better cars. Buildings that incorporate natural lighting and recycle their water to grow rooftop plants (which help to cool the building and to reduce storm runoff) are better places to work.

[Slide 30] Replanting forests (as www.americanforests.org does) not only helps reduce carbon emissions but helps to prevent floods and mudslides caused by deforestation. The late Wangari Maathai won the 2004 Nobel Peace Prize not only because she replanted thousands of trees in Kenya but because this work empowered and improved the lives of women in Kenya. We can grow more food *and* remove carbon from the air if we enhance soil organic matter by growing perennial crops (which www.landinstitute.org is working on).

[Slide 31] Amory Lovins and the Rocky Mountain Institute (www.rmi.org) have proposed many no-regrets solutions, which can make our economy stronger even while reducing carbon emissions. Lovins, like Paul Gilding whom I mentioned earlier, makes the current crisis seem like an opportunity. We can drive less and walk more, saving fuel costs, reducing emissions, and enhancing our health—that is, unless there are no sidewalks or you have to breathe other people's fumes, which is the case in much of Tulsa. Lovins

writes extensively about new kinds of energy production that do not release carbon dioxide. An example is microscopic algae that can produce organic fuels. One form of emission-free energy production is wind power. You can see windmills all over Oklahoma, especially around Weatherford and Fort Supply. This sort of energy production has the added advantage that it is decentralized. It can be produced locally, without reliance on the stability of Middle East politics. Energy independence is a good idea anyway, whether it is American independence from Middle East oil or community independence from powerful companies who control coal, oil, and gas. While we are going to depend on coal, oil, and gas for a long time, we can continue our transition to emission-free energy production. The closer we come to it, the better off we will be.

We can also take partial steps, not as good as big steps but better than none. Coal is the biggest producer of carbon dioxide relative to the energy that you get from it. Natural gas is the smallest producer of carbon emissions in the fossil fuel world. Natural gas companies tout it as the "bridge fuel" toward a carbon-free energy world.

Increasing energy efficiency is, however, the proverbial low-hanging fruit. It is something we can do right now. You can buy a small car right now—and it doesn't have to be an expensive hybrid. My Scion cost about $16,000 new, with a full warranty. It has wonderful fuel efficiency and is almost the cheapest car you can buy. When you remodel a house, you can add insulation, or use light-colored roofing tiles (at the same cost as any other tiles), or install geothermal energy.

[Slide 32] Or do something as simple as being frugal with your thermostat. The inside of your house does not need to be as cool in summer as in winter, or as warm in winter as in summer. Because my house has ceiling fans, I do not need to use the air conditioner as much. And as Johnny Cash told us back in the 1970s, if a 68-degree winter house seems chilly, "Put on one o' these!" (referring to a sweater).

Do these things seem trivial? They are not. Americans have the largest "carbon footprint" in the world. A carbon footprint is the amount of carbon emissions that is necessary to support everything we do, whether it is our direct energy use or the energy used to produce the things we buy. The average American produces about 30 times as much carbon dioxide as the average person in Bangladesh by such measurements. So what Americans do with our energy and resources has a much larger impact on the world than what anybody else does with theirs—even more so than most European nations.

Bad Ideas

[Slides 33,34] Some proposed solutions aren't very good ideas. And the main reason is that they are not "no-regrets" solutions. One example is biofuels from maize. It is touted as an environmental alternative. But it seems a little bit like agricultural propaganda. It takes a lot of conventional fossil fuel to raise and process the maize. You do come out about 20 percent ahead (you produce about 20 percent more fuel than you use). Not too impressive. Above all, corn ethanol creates a market for corn that directly competes with food production. In effect, fuel ethanol production drives up the price of food for poor people around the world, because rich Americans can pay more for ethanol (especially with taxpayer help) than poor people can pay for food. You can produce corn ethanol as a fuel or fuel additive, but in the back of your mind there lingers the regret that you may have helped somebody starve.

[Slide 35] In contrast, producing cellulosic ethanol would not have this problem. Take switchgrass, for example. In his 2006 state of the union address, George W. Bush mentioned switchgrass as a fuel source. The next morning, every botanist in the country including me got phone calls from the media asking, where is this switchgrass and how do we use it? Well, it's scattered around mixed up with lots of other grasses and weeds, and it's not easy to use. But it does have the advantage that nobody eats switchgrass. Furthermore, it can grow in poor soil; it doesn't need the rich soil of Iowa cornfields. The problem is that cellulosic ethanol production is still not very efficient. It is worth working on, however.

[Slide 36] Another example of a "solution" that is very costly is CSS (carbon sequestration and storage), a.k.a. CCS (carbon capture and storage). In this approach, we go ahead and burn all the coal we want, but then use machinery to remove the carbon dioxide from the effluent stream and store it underground. Sounds great, until you find out that it takes almost one-third of the energy from the power plant just to do this. You are wasting about one-third of your coal. The only people to whom this might make sense are the coal companies, who can sell one-third more coal for the same amount of energy. CSS has no purpose other than to prevent carbon from coal from getting into the air and is thus not a no-regrets solution.

[Slide 37] Some of the worst proposed solutions fall under the category of geoengineering. These imaginative proposals have been put forth by several scientists and engineers. Some say that we should build big towers that will chemically remove carbon dioxide from the air

and stick it away at some unspecified location. Some say that we should launch thousands of mirrors into outer space to reflect sunlight. Others say we should spew sulfuric acid droplets up into the stratosphere, creating a permanent haze. One problem with geoengineering, "engineering the Earth," is that we'd better get it right or we're in trouble. What if the permanent haze turns out to cause more harm than good? How are we going to undo it? Another problem is that they have no other purpose than to counteract global warming. What if global warming turns out to be not as bad as we thought, and we've already spent billions of dollars to launch mirrors into outer space? Why not choose no-regrets solutions that provide other benefits than just the partial prevention of global warming?

The no-regrets solutions are the ones that most people can embrace—whether you think global warming is the major threat to human survival, as Bill McKibben (www.350.org) does, or whether you are a little skeptical of it. We all know oil is going to run out. The recently retired chairman of Shell Oil recently said this. Amory Lovins has said for decades that oil companies should rethink themselves as energy companies. You don't need government telling you to do it. Just do it in your own creative way.

In many cases regulations are needed in order to "level the playing field." I believe that most energy companies want to do the right thing, so long as they can be sure the other companies are doing it also. A parallel example is the use of catalytic converters to reduce carbon monoxide emissions. You can build a cheaper car if you leave off the catalytic converter, especially with that expensive palladium in it. But we, as a society, decided that carbon monoxide emissions were a public health threat. The automakers are happy to put converters on their cars (maybe they weren't at first but they are now) since all automakers are doing it. We can make the same decision regarding carbon dioxide as a public health threat via its effects on global climate. This is a decision the EPA has recently made. We can do it. We have done it before, and profitably.

[Slide 38] Not everything that Al Gore has said makes sense. But this does: "We're borrowing money from China to buy oil from the Persian Gulf to burn it in ways that destroy the future of human civilization. And every bit of that has to change." To work against global warming is practical and sensible.

Environmental Justice and Altruism

But it is not just practicality and sense. There is a moral dimension to this topic. We could

call it environmental justice. For example, is it right for Americans to produce prodigious amounts of carbon dioxide, if this carbon dioxide results in climatic disasters such as floods in Bangladesh and droughts in Africa? The people who contribute least to the problems are the ones who suffer most from them.

Altruism is a set of instincts and behavior patterns found throughout the animal kingdom in which one animal is nice to another animal of the same species, and derives some benefit from it. Examples are too numerous to review (see the "Altruism for Fun and Profit" document posted at my website). Economist Yochai Benkler has called for altruism as an alternative to both socialism and capitalism. In socialism, the government feels that in order for something to be done right, the government has to do it. In capitalism, companies feel that the right thing will ultimately get done if each company pursues its maximum profit. Both of these approaches have the problem that they assume that human nature is evil. However, as Benkler points out, altruism is a fundamental instinct. Most people really want to do what is right most of the time. Government regulations, producing a level playing field for companies, can allow good companies (which, after all, consist of human beings) to do the right thing without the risk of an evil company outcompeting them. With altruism as its model, the government does not have to do the work itself, but just enable it. It is possible that altruism of rich industrialized countries toward poor developing countries is the biggest altruism challenge we have ever faced.

And when government enables rather than forces solutions, the result is often much more satisfying. I heard a story of a big utility in California. The California government wanted it to reduce its particulate emissions. This would have cost them billions of dollars. They made a counter-proposal. They said that hoopdies (old cars) driven by poor people produced more volatile emissions than did the power plants. The utility claimed that it could achieve the same reduction in pollution by buying fuel-efficient cars for poor people more cheaply than it could by retrofitting its smokestacks. It worked, as I recall. It sounds like a cash-for-clunkers program, but without government funding. In this case, the government set the standards and let the utility figure out how to meet them.

Set those fuel economy standards, and we'll get there. Set those carbon emission standards, and we'll get there. Most of us know we need to do these things. A government of the people, by the people, and for the people can enable altruism, rather than expensively and inefficiently forcing solutions to problems, and rather than leaving the future of the world to chance.

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